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Who Does What? An Organizational Design Perspective on Buyer-Supplier ‘Packaging’ Problems

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WHO DOES WHAT? AN ORGANIZATIONAL DESIGN PERSPECTIVE ON BUYER-SUPPLIER ‘PACKAGING’ PROBLEMS

DREWS F1, GIL N2

ABSTRACT

This study examines the organizational architecture of project organizations formed to deliver one-off, capital-intensive systems. We investigate how the project promoter divides and allocates the scope of the development work across multiple suppliers, and thus sets organizational boundaries around the work of each supplier – the so-called ‘packaging problem’. Our research is informed by the analysis of the procurement choices in the implementation phase of four large infrastructure projects. Our main contribution is a conceptual framework that illuminates how four complementary cognitive perspectives are brought to bear in decision-making for designing organizational architectures. We propose that the organizational boundaries that delineate each supplier’s work are the outcome of an organizational decomposition that balances efficiency concerns with considerations about the actual capabilities of the suppliers in the market. However, we also show that organizational boundary setting is context-sensitive. Hence, the solution space for potential organizational architectures is constrained by the power interdependency between the buyer organization and the environment and by the organizational identity of the buyer organization.

KEYWORDS

Procurement, organization design, organization boundaries, megaprojects.

INTRODUCTION

Organizational architectures exist because the division of labor and integration of effort are essential to any form of organizing work set up to achieve complex goals. The traditional focus of organization design literature has been the structure of the corporation, including both the classic multidivisional form (M-form) and new architectures enabled by technological progress and low coordination costs. In this study, we seek to extend literature in organization design to project organizations formed to develop capital-intensive systems. In these settings, the promoter leading the project organization needs to assemble a network of suppliers to transform an approved concept design into a physical asset. Put differently, the promoter needs to

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‘buy’ capabilities in order to get things done. To this purpose, the promoter must divide the ‘scope’ of the works into packages, and decide which packages stay ‘in-house’ and which ones are outsourced.

Since each supplier package sets an organizational boundary, this so-called ‘packaging problem’ is a problem of designing organization architecture in order to achieve an identifiable system-goal. More supplier packages mean a greater decomposability of the project organization, creating opportunities to create differentiated groups with the knowledge necessary to carry out the tasks. However, a greater decomposability potentially leads to more needs to integrate work across organizational boundaries, unless the work can be modularized to limit needs for interaction. In contrast, larger packages lead to fewer buyer-supplier and supplier-supplier interfaces. Understanding which rules guide decision-makings when resolving this supplier packaging problem is the motivation for this work. Extant megaproject literature offers limited research outputs with regards their organization architecture or for that matter on the procurement and packaging problem. Existing literature instead is limited to predominantly efficiency concerns and focuses in particular on commercial arrangements and ex-post contract signing governance of suppliers (some examples: Winch 2010, Hartmann et al. 2010, Henisz et al. 2012, Sanderson 2012, Chang 2013).

Hence, we turn to organization design theory, which suggests that four different vast bodies of management literature can be brought to bear to illuminate the logic underlying organizational boundary decisions (Santos and Eisenhardt 2005). We turn next to discuss how the insights from these bodies of literature complement each other.

**BACKGROUND: SETTING ORGANIZATIONAL BOUNDARIES**

**Transaction Cost Economics** (TCE) has substantively contributed to our understanding of organizational boundaries (e.g. Williamson 1985, Shelanski and Klein 1995, Geyskens et al. 2006, Crook et al. 2013). The central question underlying TCE is why firms exist (Coase 1937). The theory posits that with market transactions being inherently more efficient due to competition, organizing activities within the boundaries of a firm only occurs when transaction costs are higher than the cost of internalizing an activity and producing in-house. Building on Coase’ work, Williamson’s (1981, 1985) developed three dimensions to help us predict the boundaries of the firm: (i) asset specificity, (ii) uncertainty, and (iii) transaction frequency. Crucially, the perspective is premised on the assumptions that decision-makers are boundedly rational and opportunistic, this is self-interest seeking with guile. The basic idea is that transaction costs rise with increasing transaction uncertainty (i.e. we cannot foresee everything that might happen) and with increasing asset specificity (we cannot easily replace a contract partner).

Importantly, underlying this body of knowledge is the assumption that although transactions frequency varies, most transactions are recurrent. As Williamson (1979) explains: “Although discrete transactions are intriguing […] few transactions have this totally isolated character. For those that do not, the difference between one-time and occasional transactions is not apparent.” (p.247). This suggests that one-off transactions occurring within a one-off capital program, such as exceptional
transactions involving projects unlikely to occur again in a reasonable future, exist at
the boundaries of transaction cost theory.

In contrast to the efficiency concerns underlying transaction cost economics, the
Capabilities literature focuses on how a (particular) firm can create value as opposed to the firm (in general). In other words, the capabilities literature also seeks to ask why firms and their boundaries exist (Madhok 2002, Barney 1996, Penrose 1959). But rather than seeking answers in efficiency considerations, capabilities literature seeks to understand the boundaries of the firm by looking into how firms can utilize and combine resources effectively and innovatively, in order to create a competitive advantage and earn rents (Mahoney 1995). The basic idea is that firms seek in-house resources and capabilities that should be rare, valuable, inimitable and non-substitutable (Eisenhardt and Martin 2000). Importantly, the capabilities literature recognizes that capabilities evolve over time and so do organizational boundaries. Divergent from this, when we discuss the nature of the packaging problem, we analyze decisions based on the capabilities that firms on the market have at a particular point in time, as opposed to sustainable capabilities that firms have in-house or can develop in the future.

While TCE and capabilities literatures have long dominated the debate in management literature around how organization boundaries are created, other cognitive lenses can be brought to bear to help us make sense of the focal phenomenon. In a literature review Santos and Eisenhardt (2005) propose a theory of where organizational boundaries come from that conflates four explanations rooted in fundamentally different cognitive lenses. Specifically, the authors argue that boundary setting decisions can better be understood by combining what we know from a cost efficiency and capabilities perspectives with insights from literatures on power and organizational identity. Similar findings are uncovered by Zenger, Felin and Bigelow (2011) in their review of extant literature on organization boundaries. Recent efforts to juxtapose cognitive lenses to illuminate organizational boundaries aim to complement, as opposed to blend, individual insights from different theoretical perspectives in order to increase the predictive power of explanations. It is thus worth looking at insights on organizational boundary setting from power and organizational identity literatures.

Power literature sees the organization as interdependent with its environment. This interdependence is rooted both in the organization’s dependence on resources that exist in the surrounding environment (Thompson 1967, Pfeffer and Salancik 1978, Davis and Powell 1992), as well as its political relationship with environmental actors and concerns to build institutional legitimacy in the eyes of actors in the environment (Porter 1980, DiMaggio and Powell 1983, Aldrich 1979). Interdependency with the environment is a source of major uncertainty and thus a threat for organization survival (March and Simon 1958). Hence, the basic idea of the power literature is that the organization will use boundary setting decisions to try to reduce interdependency with the environment. Put differently, organizational boundaries enable the organization to increase the sphere of influence through ownership and non-ownership mechanisms, (D’Aveni 2001, Pfeffer and Salancik 1978). The focus of power literature is less on dimensionalizing power as a concept (Davis and Powell 1992) and more on understanding the mechanisms that can enable the organization to reduce interdependence with the environment, of which ownership
based ones are less likely to occur in complex programs. Similar to regulated firms, capital-intensive project organizations, by the scale of their outputs and by the magnitude of the resources that need to be deployed, tend to be quite enmeshed in their environment (Lundrigan, Gil and Puranam 2015). Amplifying this interdependence is often the fact the promoter is either a public organization operating under the eye of multiple third parties, or a regulated company. This suggests a power perspective can help us better understand how organizational boundaries are set in capital-intensive project organizations.

Furthermore, Santos and Eisenhardt (2005) also suggest that our understanding of where organizational boundaries come from is not complete unless we take into account insights from an organizational identity perspective. Organizational identity is frequently described as attempting to address the question of “Who are we as an organization?” (Weick 1985). Albert and Whetten (1985), for example, define identity as central and enduring to the organization and its character as well distinctive (see also Whetten 2006). Identity thus is a social construct that enables the organization to delineate itself from the environment, and as such contributes to boundary setting decisions (Gioia et al. 2013). However, organizations rarely have full autonomy to set their organizational identity and corresponding boundaries. Rather, organizational identity and the corresponding boundaries are better understood as a construct which the organization needs to negotiate through its relationships with stakeholders (Brickson 2005, Scott and Lane 2000) and external pressures (Elsbach and Kramer 1996, Gioia and Thomas 1996, Dutton and Dukerich 1991). Organization identity is of particular importance to understand organizational boundary decision in uncertain environments or for emergent organizations (Rindova and Fombrun 2001, Weick, Sutcliffe and Obstfeld 2005). This suggests identity can play an important role to understand organizational boundary decision in capital-intensive programs.

In sum, extant theory suggests that the four cognitive lenses matter to understand how organizational boundaries are created, and these ideas individually or in groups have informed studies aimed at advancing our understanding of the evolution of the boundaries on the firms operating long-term in efficient markets. A variety of studies in the past two decades have examined relations between pairs or groups of perspectives in terms of how they come to bear in organizational boundary creation; However, no empirical study has yet investigated all four lenses simultaneously in any setting.

The by far largest amount of research that combines lenses, examines the interdependency of TCE and capabilities in creating organization boundaries. Both are seen as complementary (Jacobides and Winter 2012) and this research, in essence, explains why companies choose different boundaries faced with the same transaction costs (Williamson 1999). Vast amounts of this research (see for example: Argyres et al. 2012, Argyres and Zenger 2012, Jacobides and Billinger 2006, Jacobides and Hitt 2005, Argyres and Liebeskind 1999) investigates both perspectives over the long term, finding particularly an impact of evolving (in-house) capabilities in the longer-term boundary development, and in the shorter-term an impact by transaction costs on organization boundaries. Again, this unfortunately tells us few about how the two perspectives interact where no long-term exists and where capital-intensive projects are unlikely to build up capabilities in-house. However, this literature points to the
importance of governance capabilities particularly for successful outsourcing (Argyres and Mayer 2007, Mayer and Argyres 2004, Madhok 2002), which may very well be of even greater importance in our setting. Mayer and Salomon (2006) find that the more a firm knows about an asset, its value, etc., the more likely will the firm be able to efficiently govern the asset transaction in the market.

Work combining power and TCE suggests that power can act as a shift parameter for the level of transaction costs present (e.g. Williamson 2000, Davis and Powell 1992). Examples in different industries have found regulations and institutional factors, as well a firm’s market position relative to its competitors, to shift make to buy decisions given the same TCE predictors (Sherani, Frazier and Challagalla 2007, Arruñada, Gonzáles-Díaz and Fernández 2004). Further work in recent years expands on these insights by adding a third perspective: capabilities. Fabrizio (2012) finds the importance of capabilities, particularly contracting capabilities, in determining boundaries rises, with higher transaction costs in less certain environments (see also: Brahm and Tarziján 2014). Given again the high likelihood of outsourcing in capital programs, where due to uncertainty and asset specificity high transaction costs are the norm, these findings again indicate a likely importance of governance capabilities in the buyer.

Nevertheless, we still know little as to how the four cognitive lenses contribute to our understanding of the boundaries in capital-intensive project organizations; One-off organizations with a limited life-span rarely operate in efficient markets and are rarely insulated from the surrounding context. We aim to build on this existing organizational design literature and take the juxtaposed four perspectives of organizational boundary creation by Santos and Eisenhardt (2005) to develop a framework that enlightens our understanding of how buyer-supplier and supplier-supplier boundaries are created in large capital programs. In effect, we develop existing theory by making it “more dense by filling in what has been left out – that is by extending and refining its existing categories and relationships” (Locke 2001, p.103).

On the one hand, we aim to explore and fill the gap in literature with regards to how each perspective impacts the design of organizational boundaries in the thus far significantly underexplored setting of capital-intensive projects. On the other hand, we seek to understand how the four perspectives interrelate in this setting. Similarly, this has also been explored only very rudimentarily thus far in our empirical setting. However, contrary to the former aim of this research, the answer to this question has also only been theorized for any other form of organization, but not empirically investigated to include all four perspectives.

METHODS

We built a diversified sample of multiple case studies, as these are particularly valuable for answering How? and Why? questions (Eisenhardt and Graebner 2007, Meredith 1998) and produce accurate and testable insights (Eisenhardt 1989). Case studies are suitable to study phenomena that are enmeshed with the surrounding environment, making this method appropriate to investigate organizational boundary setting in capital-intensive developments. Our four case studies serve as distinct experiments confirming or disconfirming theoretical insights based on replication.
logic (Yin 1994). Hence, they enable more robust and generalizable findings (Herriott and Firestone 1983, Eisenhardt and Graebner 2007).

Specifically, our sample consists of four multi-billion infrastructure projects in London, UK: i) 2012 Olympic Park; ii) Crossrail (a commuter railway line); iii) Heathrow Airport Terminal 2 (T2); and Thames Tideway Tunnel (TTT, a sewerage tunnel); See Table 1 for details. We gained access to the four research sites as part of an independent program to further our understanding of infrastructure development, a grand challenge facing modern society.

We purposely built this sample for this research to vary the context surrounding procurement, and thus increase the generalizability of our insights. First, the cases differ by source of finance. The Olympic park and Crossrail are largely publicly-financed projects; in contrast, T2 and TTT were privately financed, but project activity was regulated because of the associated natural monopolies. We expected efficiency concerns to be more salient in private procurement, but were unclear of the impact of regulation, since both T2 and TTT had a guaranteed return of investment. Second, procurement for the four cases occurred in a close sequence (within a ten-year timeframe from 2006 to 2016). Even so, overall economic conditions varied significantly and we were unclear how this would impact packaging. And third, the value and product design structures across the cases were different: an Olympic park is decomposable into modular venues; TTT and Crossrail are continuums of tunnels and stations; and T2 is a hybrid of connected tunnels and concourses and independent assets like the car park. Organizational design literature suggests that organizations align organizational and product structures to reduce management complexity (Colfer and Baldwin 2016). But it was unclear if the so-called mirroring theory would extend to packaging problems.
Table 1: Case study overview

<table>
<thead>
<tr>
<th>Case Study</th>
<th>London 2012 Olympics</th>
<th>Crossrail</th>
<th>Heathrow Terminal 2</th>
<th>Thames Tideway Tunnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aim of analyzed case study</td>
<td>Olympic Park to host the Olympic Games, incl. for example venues</td>
<td>High capacity commuter rail line connecting East and West London</td>
<td>New airport terminal (T2) to replace old facilities</td>
<td>Sewage tunnel to stop untreated sewage overflow</td>
</tr>
<tr>
<td>Final or estimated outturn costs of entire Program</td>
<td>£6.7bn for Olympic park (per 2013 calculation)</td>
<td>£14.8bn (per 2012 estimated outturn costs)</td>
<td>£2.6bn (per 2014 final budget)</td>
<td>£4.2bn (per 2011 estimated budget)</td>
</tr>
<tr>
<td>Buyer (Design Architect)</td>
<td>Olympic Delivery Authority (ODA)</td>
<td>Crossrail Ltd.</td>
<td>BAA (now named Heathrow Airports Ltd.)</td>
<td>Bazallgette Tunnel Ltd.</td>
</tr>
<tr>
<td>Form of Finance</td>
<td>Public</td>
<td>Mainly public, with private sector contribution</td>
<td>Private from regulated business</td>
<td>Private from regulated business</td>
</tr>
<tr>
<td>Design Structure</td>
<td>Modular Set of loosely coupled functional components (sport venues, facilities)</td>
<td>Integral Railway line including 42km of new tunnels and new underground stations, some partial operation possible</td>
<td>Hybrid Some functional components loosely coupled (e.g. car park), and others tightly coupled (IT &amp; baggage systems)</td>
<td>Highly Integral Tunnel connects to sewerage overflow points and to London sewerage system; partial operation impossible</td>
</tr>
</tbody>
</table>

To ensure validity and reliability, as well as robustness of any emerging theory, we collected and triangulated data from multiple different sources (Yin 1994, Miles and Huberman 1994). A major source of qualitative data for this research were semi-structure interviews (n=66), which were recorded and transcribed verbatim (Table 2). Additionally, we gathered archival documents publicly available on-line, as well as archival documents not in the public domain. Moreover, we included reports produced by watchdogs or government agencies and articles in the specialized press. Lastly, we collected observations and notes from a one month non-participant observation at Crossrail.
Table 2: Overview semi-structured Interviews

<table>
<thead>
<tr>
<th></th>
<th>Number of Interviews per case</th>
<th>Job Roles of Interviewees</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>London Olympic Games</strong></td>
<td>16</td>
<td>Deputy Program Director</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Head of Procurement</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Senior Commercial Managers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Senior Procurement Managers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Senior Supply Chain Manager</td>
</tr>
<tr>
<td><strong>Crossrail</strong></td>
<td>17</td>
<td>Commercial Director</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Deputy Head of Procurement</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Engineers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Head of Procurement</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Legal Director</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Procurement Managers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Senior Commercial Manager</td>
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<td></td>
<td></td>
<td>Senior Procurement Managers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Senior Supply Chain Manager</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strategic Procurement Consultant</td>
</tr>
<tr>
<td><strong>Thames Tideway Tunnel</strong></td>
<td>10</td>
<td>CEO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Commercial Director</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Deputy Program Manager</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Head of Asset Delivery</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Senior Procurement Manager</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strategic Procurement Advisor</td>
</tr>
<tr>
<td><strong>Terminal 2</strong></td>
<td>13</td>
<td>Capital Director BAA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Portfolio Director BAA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Program Director T2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Project Director of a Tier 1 Supplier</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Project Director T2 for Star Alliance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Senior Commercial Managers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Senior Engineer</td>
</tr>
</tbody>
</table>

Guiding data analysis was the question central to this research: How do the project organizations formed to deliver large infrastructure systems get designed? We started data analysis by developing detailed factual accounts of each case, in the form of Harvard Case Studies, to discern the hype surrounding the projects from the actual producing practices determining organizational boundaries (Miles and Huberman 1994). We used Santo’s and Eisenhardt’s (2005) framework on organizational boundary setting as the main cognitive lens to guide data collection and analysis (Van de Ven 2007). Hence, the four perspectives (efficiency, capabilities, power, and identity) provided an initial set of high level codes to test, refine and potentially extent. As we gained confidence as to the interplay of the perspectives in each case, we started to compare and contrast the cases to find patterns and themes that were consistent or inconsistent (Eisenhardt and Graebner 2007); Leading us to develop our conceptual framework of how boundaries are designed.

**RESEARCH FINDINGS**

We will in the following present excerpts of our analysis from one of the four empirical case studies. Crossrail is a London based commuter railway that required 42km of newly bored tunnel, nine new underground stations, as well as new tracks
and railway systems for an estimated outturn cost of £14.8bn (2012 estimate, roughly US$19bn). The project is almost entirely funded by the regional and central government and delivered by the Crossrail Organization, set up specifically for this program (the Crossrail Organization will cease to exist upon completion of the program in 2019).

In analyzing the Crossrail case study procurement decisions, which determined the divisions of labor and the resulting organizational boundaries within the program, we find that a distinction can be made between drivers that constrained the design solution space (constraints) and the available design choices within that space (choices). We interpret the constraints, and compliance in relation to them with reference to the power perspective. In this case however, not all power related constraints were rigid or inflexible and indeed we find instances where the Crossrail Organisation was able to ‘shape’ and, in effect, relax, the constrained solution space. Nascent organizational identity was forged by power, but became active and further influenced the choices made within the residual solution space. Both these perspectives therefore constrain and influence the design solution space within which organizational boundary setting choices can be made. Within this design solution space, our analysis suggests that organizational design choices were primarily related to transaction costs and capability considerations. We now first examine how constraints created the solution space and second, how choices were made within it.

In terms of Power, the Crossrail Organization was constrained by regulatory-political, as well as by bargaining power. With regards to the first, it had to adhere to EU and UK procurement regulations, which require the equal treatment of all bidders, transparency in processes and foregoing the opportunity of judging suppliers based on previous behaviors. Moreover, funders required and political stakeholder interests demanded for the Crossrail Organization to provide ‘value for money’, which included national interests in social and economic sustainability at times of recession (procurement took place following the 2008 financial crisis). With regards to bargaining power, Crossrail had no lack of interested suppliers as the market was in recession and Crossrail being an exceptionally prestigious project. Given this market, potential constraints in organizational boundary design choices due to a potential lack of interest among suppliers as it might arise in a buoyant market and indeed did happen in other cases, were here largely not applicable.

Crossrail was the biggest construction project in Europe at the time and their iconic work and great size also gave them room to ‘shape’ some of the power constraints they were subject to. Examples of these include: (i) their successful lobbying to be classified as a ‘utility’, which allowed for more flexible and favorable constraints in terms of regulatory power and (ii) their negotiation for a railway-track asset standard that carried less uncertainty in delivery. A summary of power constraints found in Crossrail, as well as the three other case studies can be found in Table 3.
Crossrail’s Organizational Identity was partially established at its inception, giving it a clear objective that implied a finite-lifespan. It governed for example its recruitment of senior leaders and their task orientation. This aspect of the Crossrail Organization’s identity can be considered given, and constrained the scale, scope and timing of the activities that it sought to undertake. The organizational identity of the Crossrail Organization is however, not limited to this given, nascent identity, but includes aspects which the Organization actively selected and developed. The Crossrail Organisation decided, based on the power structures detailed above, to ‘work for the public good’, particularly in terms of regenerating the economy during times of recession: “[Crossrail] isn’t about building the railway; It’s about getting the money into the economy … The railway is a by-product, as far as the politicians are concerned.” It also chose to focus on social and environmental sustainability, foremost through the use of exemplary delivery methods. This led them to place emphasis on sustainability in packaging decisions. Examples include a contract dedicated to improving tunneling knowledge or one that transports waste by river, instead of via roads. By placing an emphasis on sustainability in their organizational identity, Crossrail also gave credibility to their claim to be following the example of the London Olympics. The Organisation recognized the success that the London Olympics had had with their procurement strategy and its link to the support of managing powerful stakeholders, as well as attracting suppliers to their packages. Hence, while beneficial, linking Crossrail’s identity to that of the London Olympics, also constrained the Crossrail Organization’s choices. See Table 4 for a summary of the identity lens.
Table 4 – Summary Organizational Identity Perspective

**Given Organisational Identity**

- Aspect of organisational identity that is ‘given’ to the organisation
  - Finite life-span of the organisation with a single goal (Crossrail, TTL, LG12)
  - Pre-existing identity of the entire organisation, delivery of a capital programme is one-off or extremely sporadic (T2)
- This precludes the option of delivering the majority of the work in-house, as it does not fit this ‘given’ identity.

**Actively selected Identity**

- Power forges elements of organisational identity that are used for compliance and to increase power, however, the organisation selects the precise elements of its organisational identity in line with this;
  - ‘Driven by efficiency’ forged by (e.g. owner) power, precise elements selected: few focus on sustainability or non-economic value
  - ‘Working for the public good’ forged by political power, precise elements selected to enact this are for example: STEM-focus, women in construction, sustainable construction processes, SMEs, Britain wide benefits

**Actively selected Identity can shift/change during the packaging and selection phase**

- As power forges identity, changes in power have an impact on the identity, i.e. identity will align with change to higher profit seeking focus in owner power, or a shift in focus from diversity to economic opportunity due to political power

**Contribution:** Organisational identity in this setting aligns with extant literature. We find two sources of identity, which are (i) imprinted at creation and (ii) shaped through interaction internally and with the environment. We further find that identity can develop over time as the project progresses.

Power, and to a lesser extent identity, thus constrained and influenced the ‘solution space’ within which the Crossrail Organisation could realize the railway. While attending to power and identity, the Organisation could then make choices as to packaging, which we interpret as having been shaped by considerations pertaining to transaction costs and capabilities. Essentially, we find the Crossrail Organization could choose to divide the work into horizontal packages by task, or vertical packages by purpose, or a mixture of the two (this aligns March and Simons (1958) work on departmentalization within organizations). The Crossrail Organization chose to use a mixture of both packaging forms, but given the large size of the program and the variety of activities involved, the Crossrail Organisation decided to first create seven horizontal work clusters. Within these clusters, it would then package the discrete contracts, thereby creating the organizational boundaries. These clusters were split according to capability and cost concerns; Whereby each cluster included a limited range of similar capabilities that fit individual supplier markets, which in turn increased the number of potential suppliers and decreased the asset specificity. It also enabled the buyer to follow a similar contracting and monitoring approach for each contract in a cluster, reducing transaction costs. We will provide more details on two exemplary clusters, one of which is packaged horizontally and one vertically (Figure 1 shows the Organization Design Map of Crossrail).
Both transaction costs economics and capabilities are here found to have guided the strategy behind the packaging choices made in the ‘Stations’ and ‘Systems’ cluster. The Station cluster involved the vast majority of work required to build each underground station. Finding the “sweet spot” (as many procurement managers referred to it) of a packaging solution that balances costs and capabilities, turned out to be having a vertical package for each station. Alternatives would have been activity based packages within stations, or packaging multiple stations together. From the capabilities perspective, a good number of potential suppliers had the capabilities and capacity to deliver an entire station, and moreover the Crossrail Organisation saw suppliers to have superior capabilities in managing and integrating the work within a station. A ‘one supplier per station’ approach avoided complex horizontal interfaces within each station site, which would have required monitoring by the Crossrail Organisation and could have given rise to opportunistic behavior by suppliers.

Would packaging multiple stations together have saved costs? Given that the stations were geographically dispersed, this reduced the benefits of scale which would have arisen by including multiple stations per package. Moreover, each station required slightly different capabilities given its particular circumstances (involving various local stakeholders and integration with differing pre-existing infrastructure) and its idiosyncratic design. In turn this would also have meant that each suitable supplier would have needed a wider range of capabilities and bigger capacity, decreasing the number of potential suppliers competing, and hence, raising transaction costs. Taken together these reasons clearly suggested that the packaging “sweet spot” was to create one package per station; that is a ‘vertical’ division of

Figure 1: Organization Design Map Crossrail
work by purpose. The logic of this decision clearly lay in reducing post contract award costs and obtaining supplier capabilities on a competitive basis. It is also worth noting that the ‘one supplier per station’ approach fitted with the Crossrail Organization’s identity. Having one supplier in charge of each station construction site meant clear and consistent rules and processes, which assisted in achieving Health and Safety targets; These were a key part of the Organization’s emphasis on social sustainability.

The Systems cluster involved the majority of the works that make a railway function, such as laying tracks within the built tunnels, installing signaling and other systems and providing different types of power for operations. Crossrail managers compared the work to “something like a nervous system in the body … you can’t break it down unless you’re absolutely clear you can link it all up together again”. This created a need to reduce vertical interfaces and to bundle work together, but at the same to balance the need to align packaging with the available specialist supplier capabilities, as each activity required specialist capabilities. In the end, the Crossrail Organization decided to create seven horizontal packages, whereby five specialist capabilities became discrete contracts, one specialist capability was build in-house and one additional outsourced contract combined several less specialist capabilities. In that last contract, the goal of a horizontal interface reduction and its associated transaction costs outweighed capability concerns. On the contrary, in the six distinct system contracts Crossrail’s ability to select suppliers based on exactly that specialist capability outweighed potential interface concerns. Moreover, a combination of contracts, would have decreased the number of potential suppliers significantly, increasing transaction costs. Lastly, the Crossrail Organization chose to develop one skillset in-house, the integration of Systems. Crossrail’s management considered that it had time to build up these capabilities and that any increase in production costs relative to those of potential suppliers in the market, would be offset by reduced transaction costs.

Overall, given the specialist capabilities required and increased complexity of any vertical interfaces, the Crossrail organization decided to create horizontal Systems packages. However, for Stations, each individual skill needed was not as specialized and complex horizontal interfaces in a small construction site would have increased costs significantly, leading Stations to be packaged vertically. Table 5 and Table 6 provide a summary of the Capability and TCE perspectives as analyzed in this case study.
DISCUSSION

Through the analysis of the four case studies we developed a conceptual framework (Figure 2). It sheds light on to the design of the organizational structure in capital programs through the individual contribution of each of the four perspectives, as well as through the contribution resulting of the interaction between them. We find that the buyer organization in capital programs is constrained (i.e. the funnel boundaries in Figure 2) in its organizational design choices by the power dynamics in its environment, as well as by its own organizational identity. Left with a residual solution space of possible design choices (i.e. the inside of the funnel in Figure 2), the

Table 5: Summary TCE Perspective

- In-house delivery is almost entirely not an option given identity constraints and extreme costs for one-off contracts. Hence, the focus lies on reducing transaction and overall costs in buying works.

**Uncertainty & Asset Specificity**
- Balance the reduction of (technological and behavioural) uncertainty and asset specificity within each package with the same reductions at B-S/S-B organisational boundaries (includes option of reducing the number of org boundaries). This reduces effects of potential supplier opportunism both ex-ante and ex-post contract signing.

**Frequency**
- As the programme is a one-off, the frequency of almost all work is one for the buyer.
- Where possible similar or same processes and contract types can be used for multiple packages (e.g. in a cluster of packages) reducing transaction costs for the buyer.

- TCE literature suggests that the buyer would be better off with in-house delivery when faced with high uncertainty and high specificity, in order to reduce transaction costs.
- Power and identity constraints, as well as low frequency, however, make it impossible to deliver works in house given the needed investment in capital-intensive production capabilities. Hence, the buyer is better off outsourcing the work and applying the above measures to attenuate high transaction costs and the risk of supplier opportunism.

**Contribution:** In this empirical setting, TCE is not a question of make-or-buy, but rather 'how to buy'. Still the key variables remain the same and the focus still lies on reducing costs and particularly transaction costs. We extend the focus beyond the buyer-supplier boundary, to also focus on supplier-supplier boundaries and do so looking at multiple boundary creations at the same time. Lastly, we find clustering to introduce artificial frequency that reduces costs.

Table 6: Summary Capabilities Perspective

**Supplier capabilities**
- Ensure that packages require only capabilities (incl. their capacity) that suppliers have or where they have the capability to build them efficiently.

**Buyer capabilities**
- No construction capabilities present in buyer, limited other capabilities.
- Buyer requires to know more than they do themselves as well as the following capabilities for transacting through the market: contracting capabilities, management capabilities.
- Any other capabilities it has to be questioned if the buyer can build them in-house within the given timeframe or if it is possible to buy them in the market.

- Capabilities literature would suggest focus on sustainable and rent-earning in-house capabilities. However, these are not in focus in this setting given the finite lifespan and organisation purpose. Rather optimal existing supplier capabilities are searched for in the market to create value.

**Contribution:** In this empirical setting, capabilities focus on supplier capabilities rather than on in-house capabilities in decision making on organisational boundaries. In-house capabilities are predominantly limited to contracting capabilities and dynamic capabilities.
buyer is then understood to make organizational structure design choices based on concerns for costs efficiency, as well as capabilities. This conceptual organizational boundary design framework is the outcome of a first empirical investigation in any setting of all four perspectives at the same time. It shows that all four perspectives are relevant to how organization structure is created and how they relate to each other. Hence, we confirm the prediction by Santos and Eisenhardt (2005), as well as Zenger et al. (2011), in their theoretical work that more perspectives matter than TCE and capabilities in the creation of organizational boundaries. We further find that the resulting organizational structure is divided in vertical and horizontal packages, i.e. contracts that are organized in terms of purpose and activity respectively (i.e. see ‘outcome’ in Figure 2). This builds on the work by Simon and March (1958), where the same forms have been suggested for departments within an organization. We will now lastly provide more detail as to the conceptual framework and its individual elements.

Figure 2: Organizational Boundaries Design Funnel

With regards to constraints, the recognition that boundary setting decisions are interdependent with the environment is crucial to make sense of organizational architectures in our focal setting. These constraints exist and are being constructed through two stages (Figure 3).
First, the procurement choices to design capital-intensive project organizations are enmeshed with the environment. Irrespective if the organization is publicly- or privately financed, procurement decision-making is constrained by the power in the organization’s environment (for example regulation, inefficient markets, and the interests of powerful actors). Procurement choices in capital-intensive settings are about allocating capital to long-term goals that are ambiguous and contestable. Hence, procurement choices cannot and should not be indifferent to the scrutiny and interests of multiple actors in the environment, as well as by any project funders. The organization buyer is therefore dependent on the support and resources of these environmental players. At the same time the buyer organization is created with a given purpose to assemble suppliers for delivery, and to disband as the project nears completion; Based on the desires of the powerful actors in its environment calling it into existence. It is important to note that this identity for example precludes the buyer organization from becoming long-term construction company that acquires and builds in-house delivery capabilities. Consequently, power also extends to increase the buyers resource dependency on capabilities offered through profit seeking construction suppliers; Depending on market demand they may have a higher or lower bargaining power in their exchange with capital program buyers.

This does not mean that environmental constraints restrict the solution space to single choices, or that decision-makers cannot push back on the interests of powerful actors. On the contrary, organizational boundaries are to a degree negotiated with the environment. The second stage is in effect a form of self-selection of further constraints and a shaping of those by the buyer organization. Given these set power interdependencies of the program, the buyer needs to decide how exactly it will comply with them and if possible also how it can shape some power constraints to decrease its dependence and increase its own power. We found that buyer organizations use predominantly non-ownership mechanisms to comply with and increase their power, both of which are decidedly linked to how they chose to enact their organizational identity. For example, buyers often decide to focus their identity
on aspects of sustainability, which fosters conformance with political power demands. These interdependencies, both given and self-selected, constrain the space of design solutions, and exclude options that the theories of the firm assume to be available.

The buyer organization can now make organization structure design choices, within the constraints of the design funnel. In these settings, buyers need to know more than they do in order to be competent buyers (Brusoni, Prencipe, and Pavitt 2001) and have contracting and governance capabilities, as the in-house production capabilities of the buyer are limited given the above constraints. Hence, the fundamental problem of organizing here is not about make vs. buy, but how to buy. In effect, how to divide the scope of works, how to buy each divided bit of scope and lastly, how to manage the ensuing inter-organizational interfaces.

In agreement with theory, concerns with cost efficiency are rooted in outsourcing tasks with high asset specificity and uncertainty in requirements—tasks that would be better brought in-house to mitigate risks of supplier opportunism ex-post contract signing, were it not for the one-off frequency created by the nature of the program and the buyer organizations identity. Efforts to reduce costs of these one-off transactions need to be reconciled with the supplier capabilities available in the market. It is no good to divide the work in ways that increase cost efficiency, if suppliers lack capabilities to take on the content of the work packages, or are not interested; This in turn would only raise costs up again through for example a lack in competition or increased uncertainty due to the lack of established bundles of capabilities.

We find that in the end choices are in effect as much a trade-off between costs and capabilities, as they are a trade-off between the complexity of boundaries surrounding a package and the capabilities required within a given package (see Figure 4). First, looking at boundaries (lower left hand corner in Figure 4) or empirically speaking the package interfaces. Boundaries increase in complexity as uncertainty and asset specificity rise. Hence, they can be less or more complex to integrate, as for example a vertical boundary between two physically decoupled station packages is not complex requiring few if any integration, while the same type of vertical boundary would be highly complex within railway signaling system in the east and west of the tunnel. Such an interface in railway signaling would require great amounts of complex integration work, as the system has to work uniformly across the program. Unsurprisingly, TCE would thus suggest a vertical station boundary to carry much fewer transaction costs than the same type of boundary within a system; The later struggling with much greater technical and human uncertainty, as well as asset specificity of the interface works. Stations would therefore, from a boundary perspective, be vertically packaged by purpose, and systems horizontally by activity.
However, optimizing the boundary complexity of a given package is only one side of the coin in designing organization architecture. At the same time, the organization buyer must assure the capabilities to be available in a number of potential suppliers for within the package (upper right hand corner in Figure 4). We found that for horizontal packages by activity, the supplier needs a lower number of different (usually rather specialized) capabilities, but therefore a greater scale of those capabilities that are needed. Imagine again the railway signaling system in Crossrail. If packaged horizontally, the supplier will need capacity to design and install the system for the entire program. At the opposite end, in a vertical package of one station, the supplier will need a greater number of capabilities, but a lower scale of each. Again, in a station the supplier requires many different capabilities, but only to the scale of one, rather than nine stations.

Taking these two dynamics of boundary complexity and package capability, we have found two sweet spots “where all the stars align”, as procurement manager referred to well-designed packages (see the ‘stars’ in Figure 4). For one, we find that packages with less complex vertical boundaries, but more complex horizontal boundaries, require at the same time a high range of capabilities, but not a high scale of each capability. These packages end up split vertically by purpose, such as the stations (star marked ‘V’ in the lower right hand corner Figure 4). For two, we find that packages with more complex vertical boundaries, but less complex horizontal boundaries, require a low range of capabilities, but a high scale of those capabilities that it does need. These packages end up split horizontally by activity, such as systems (star marked ‘H’ in the upper left hand corner Figure 4). We empirically found that the all our packages analyzed in all four case studies aligned with one of these two ‘star’ positions. Where they did not, we found that packaging decision were later on amended; Or where that was not possible, they were regretted in hindsight.
CONCLUSION

In summary, our main contribution is the development of a conceptual framework that establishes a logic as to how different perspectives are brought to bear in the packaging problem, and thus in setting organization boundaries in a one-off, capital-intensive enterprise. We argue that central to procurement choices is a search for solutions that balance cost efficiency concerns with considerations about the capabilities of the suppliers. To understand variance in organizational architectures, we need to recognize that the solution space is constrained by interdependence with regulation and by powerful actors in the environment. Still, the organizational structure of the project delivery organization is best understood as the outcome of a search to balance cost efficiency and capabilities considerations, within a solution space constrained by power and organizational identity.

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