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Working Paper Series
2015/04/STR

The (Under) Performance of Mega-projects: A Meta-organizational Perspective

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December 2014

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The (under) performance of mega-projects: A meta-organizational perspective

Abstract

This study links evolution in organizational structure to ambiguity in the definition of performance in the context of organizations formed to develop long-lived infrastructure: so-called 'mega-projects'. Based on a longitudinal, inductive analysis of three mega-projects in London, we argue that a mega-project is a meta-organization with two symbiotically-related constituent structures. The core, led by a coalition, is a mutable collective that shares control over the goal of the project and corresponding high-level design choices. The periphery is a supply chain selected to design and build the infrastructure, but lacks the authority to change the high-level choices. As the mega-project structure evolves over time, we show that the founders and new comers renegotiate the high-level choices and slippages in performance targets ensue. The conflation of committals to different baselines, differing preferences for efficiency and effectiveness, and rivalry in high-level choices gives rise to competing performance narratives which cannot be reconciled. Thus, we argue, the disappointing and controversial (under) performance of mega-projects may be a result of how their organizational structure develops, rather than due to any agency or competence related failure per se.

INTRODUCTION

Mega-projects involve vast networks of public and private actors formed to develop capital intensive infrastructure. Their outputs include Olympic parks, airports, railways, power plants and other long-lived assets that play a vital role in the socio-economic development and sustainability of modern societies. They represent an important form of public-private collaboration.[1]

Despite their social significance, mega-projects have a reputation for disappointing performance. The performance of a mega-project is typically evaluated on whether they deliver a useful asset within the cost and schedule targets announced at the onset of planning (Hall 1972; Merrow, McDonnell and Arguden 1988, Morris 1994, Szyliowicz and Goetz 1995). Against the initial baseline, mega-projects frequently suffer schedule and cost overruns. For instance, Merrow et al. (1988) report 88% average cost growth and 17% average schedule slippage from a sample of 52 civilian mega-projects. There is variation across sectors, with 44.7% average cost overrun reported for rail projects and less than half that at 20.4% average cost overrun for roads (Flyvbjerg, Bruzelius and Rothengatter 2003). But the high rates of 'failure' as measured by cost and schedule over-runs are ubiquitous across both the industrial (Merrow 2011) and government sectors (e.g., Major Projects Authority of the U.K. annual

[1] The World Economic Forum's Global Competitiveness Report 2012-2013, for example, ranks infrastructure one of the four pillars of the Basic requirements category in the Global Competitive Index

report for 2013-2104). As the mega-project cost and schedule targets slip, and the form of the designed artefact evolves substantially, critiques also surface that the capital and future maintenance costs are disproportional to the usefulness of the infrastructure asset in use, and thus that mega-projects frequently create 'white elephants' (Flyvbjerg et al. 2003). These critiques are however seldom consensual, and frequently, they are vehemently contested by those that led the enterprise.

A number of explanations have been offered for this (controversial) disappointing performance. They include the idea that the initiators of such projects: a) use inflexible contracts with the suppliers despite high uncertainty in the high-level design requirements (Stinchcombe and Heimer 1985); b) succumb to escalation of commitment, scope creep, and sunk cost fallacies (Ross and Staw 1993; Shapiro and Lorenz 2000); c) under-invest in front-end planning (Morris 1994) and in flexible design structures (Gil and Tether 2011); d) keep shaping the final design in response to unforeseen evolution in the environment (Miller and Lessard 2001); and finally e) are guilty of strategic misrepresentation (at worst) and optimism bias (at best) to get the project initiated (Flyvbjerg et al. 2003; Wachs 1989). Common to all these explanations is the assumption that mega-projects are controlled by a unitary actor whose characterization ranges from outright incompetent to Machiavellian.

In this study, we move beyond this unitary actor approach to treat the mega-project as an organization—and study how the structure of the interaction between its members may explain the organization's outcome. We use the lens of "meta-organizations" to understand a mega-project. Meta-organizations are networks of legally autonomous actors collaborating under an identifiable system-level goal (Gulati, Puranam, and Tushman 2012). The meta-organizing lens addresses the distribution of the resources and appropriation of value central to buyer-supplier networks, distributed communities of production, and managed business ecosystems (Baldwin 2012; Baldwin and von Hippel 2011; Womack Jones, and Roos 1990, O'Mahony and Bechky 2008). The design dimensions of meta-organizations include the openness of the network's boundaries, the degree of stratification in the member's decision rights, and the sources of authority within the system.

Mega-projects exhibit the distinguishing qualitative attribute of a meta-organization—the absence of employment relationships or ownership stakes as a basis for authority relationships between its members (Gulati et al. 2012). Hence a mega-project is formed when a group of legally

independent parties including governments, public agencies, interest groups, communities and firms endorse the venture in the early planning stage (Altshuler and Luberoff 2003; Szyliowicz and Goetz 1995). To explore how the evolution of the mega-project organizational structure may influence performance, we conduct a longitudinal inductive study of three mega-projects. The system-level goals of these mega-projects were to produce an Olympic park, an airport terminal, and a railway network. Surprisingly, a longitudinal analysis of the evolution of the structure of participation in a mega-project has yet to be undertaken in the literature. We believe such an analysis can shed new light on the structure and performance of mega-projects. Specifically, we tackle the following research question*: Can the performance of mega-projects be traced back to their organizational structure?*

We organize the remainder of this paper as follows. In Section 2, we draw on theory on meta-organizations and design to discuss the mega-project form of organizing. After explaining our method and introducing our database in Section 3, Section 4 proceeds with the analysis of development processes for our sample of mega-projects and concomitant evolution in the performance expectations. We conclude by discussing the link between structure and performance in mega-project meta-organizations where a collective perforce shares control over the goal and the plan to achieve it.

Meta-Organizations and Mega-projects

A precept of the emerging theory on meta-organizations is that, despite absence of the sources of authority used in traditional firms, they are not self-organizing systems but rather must be designed and managed (Gulati et al. 2012). At the heart of a meta-organization is a central founding actor, an entrepreneurial architect, who imprints an archetypal structure and ideology during the meta-organization's early stages (Boeker 1989; Eisenhardt and Schoonhoven 1990; Stinchcombe 1965) and shapes the system-level structure. This structure defines the "components, their relationships to each other and to the environment, and the principles guiding its design and evolution" (Maier, Emery and Hilliard 2001). Thus the meta-organization's founder (or founders) play a role in identifying, developing, and promoting a superordinate goal, and in designing the structures to achieve that goal.

In lieu of ownership stakes or employment relations, the meta-organization's founder(s) relies on other mechanisms to exert its influence such as supplier contracts, resource dependencies, technical

expertise, and reputation (Blau 1964; Gulati and Sytch 2007; Raymond 2008). Specifically, the founder influences two structural properties of the meta-organization—member stratification and boundary permeability. In highly stratified meta-organizations, members of the upper tiers have greater decision-making privileges and responsibility, whereas in flatter organizations members are held to be relatively equal. When setting the boundary permeability, the founder influences how external actors become members of the meta-organization. When the boundaries are closed, a single 'gatekeeper' or the community at large select new members from the environment based upon the resources that they can offer, e.g., labor or technology, capital, or less tangible inputs such as branding and reputation (Rothaermel and Boeker 2008). In contrast, open meta-organizations have few, if any, conditions for membership. Their members are self-selected and members volunteer for tasks (Lakhani and Von Hippel 2003). In such open systems, the founder provides a democratic framework and some control mechanisms under which the membership can self-develop (Lee and Cole 2003).

The notion of a meta-organization maps well to empirical accounts of mega-projects (Altshuler and Luberoff 2003; Flyvbjerg et al. 2003; Grun 2004; Hall 1972; Hughes 1998; Merrow et al. 1988; Miller and Lessard 2001; Szyliowicz and Goetz 1995). The development of a large infrastructure requires the acquisition of diverse resources controlled by various parties including land, capital, planning consent rights, political support, and technical and management capabilities. As the founders seek to attract the support of resource-rich actors, decisions about their membership ensue. Potential supporters are unlikely to be altruistic; to court them, the founders must offer some incentive. Empirical accounts suggest that resource holders commit to supplying resources conditionally in exchange for gaining rights to directly influence the final design of the megaproject's assets (Gil and Baldwin 2013; Gil and Tether 2011; Miller and Lessard 2001).

When a collective of heterogeneous actors share the right to directly influence the high-level design choices for a long-lived, monolithic structure that they will share in use, as it is the case of mega-projects, high rivalry between their preferred choices ensues. And when *high rivalry* in design choices juxtaposes with the *low excludability* of the claimants from development because they control critical resources, Gil and Baldwin (2013) argue that collective action problems become endemic to development, i.e., situations wherein different parties share the goal but may lack incentives not to

free-ride or skirt commitments (Axelrod 1984; Hardin 1968; Olson 1965). The more parties involved, the more complicated collective action becomes (Ostrom 1990, Gray 1989). We can thus expect complicated problems of collective action to be endemic to mega-projects.

Yet between this picture of a meta-project as being subject to collective actions problems, and the specifics of how its structure influences outcomes, there remains a substantial gap. We lack a clear sense of why schedule overruns and critiques that mega-projects produce white elephants are so prevalent, and whether these can in any manner be linked to the distribution of decision rights amongst a host of independent actors. This important gap in knowledge motivates this study.

Research Setting and Methods

Comparative case studies, a fruitful approach to building theory (Eisenhardt 1989; Eisenhardt and Graebner 2007), are particularly appropriate for contextual research (Yin 1984) and suit well studies of process and change (Pettigrew 1990). Hence to advance theory, we grounded our study on three mega-project meta-organizations formed to develop three large infrastructures in London: 1. the 2012 Olympic Park; 2. Heathrow airport's Terminal 2 (T2); and 3. Crossrail.

A duality characterized the goal of the publicly financed £7.1bn[2] development of an Olympic park. It aimed to provide the sporting venues and athlete accommodation to host the 2012 Games, whilst catalyzing the urban regeneration of the area surrounding the park. In contrast, the £2.6bn Heathrow T2 development was wholly financed by the airport's private owner and operator, BAA[3]. The goal was to co-locate into a new terminal the airline members of STAR Alliance (STAR), which accounted for approximately 25 per cent of all traffic going through Heathrow airport. Using a mix of public and private finance, the £15.8bn Crossrail development aimed to deliver a high-capacity train to increase the capacity of London's railway network by 10%; it involved building a tunnel and eight stations in central London and upgrading over-ground commuter lines east and west of London.

We chose this sample to vary three key attributes of mega-project organizations and thus build a diverse and polarized sample as recommended for process-focused inductive studies (Siggelkow 2007). First, the cases differ by the sources of finance. We considered finance an important

[2] All prices in anticipated or final outturn (cash) costs, i.e., costs adjusted for inflation unless indicated otherwise
[3] In late 2012, BAA changed its name to Heathrow Ltd; for simplicity, we keep to the BAA name in our account

differentiating factor since we expected more and diverse parties making claims on the design and development of the publicly funded mega-projects than on privately financed ones.

Second, the cases differ in terms of the potential for prior and future relationships between the members of the mega-project organizations. The Olympic park was a sui generis endeavor unlikely to be repeated for decades to come. In contrast, the key parties in Heathrow T2 had a long history of collaboration in both day-to-day business dealings and prior airport expansion schemes. On this dimension, the Crossrail meta-organization again was a hybrid. It was the first major commuter line jointly promoted by the national government and the London government. But talks were ongoing to recreate a similar arrangement to promote a north-south commuter line so-called Crossrail 2.

The existence of prior and potential future relationships creates an environment more amenable for sustaining collaborations (Gibbons and Henderson 2012; Gray 1989; Newcomb 1956, Thompson and Perry 2006). Thus we expected less difficulty in resolving differences amongst members in a mega-project in which people had worked together in the past compared to one-off ventures.

Third, the mega-projects in our sample varied in terms of the flexibility allowed in their schedules. While the Olympic Park had an immovable completion date, the other two projects would (potentially) be able to negotiate additional time to complete their activities. This variation allowed us to observe differences in the collective dynamics under different levels of schedule constraints.

Data Collection

We triangulated several data sources for this study including semi-structured interviews with a range of actors, analysis of archival documents, and on-site visits. Triangulation was important to improve the accuracy of our data and the robustness of the conceptual insights (Jick 1979; Miles and Huberman 1984:234) particularly because when discussing organization performance people's recollections are vulnerable to revisionism and self-aggrandizement (March and Sutton 1997).

Recent developments in the practice of organizing mega-projects in the UK have had the effect that on the surface their governance structures resemble corporate governance structures. Thus, to limit respondent bias (Eisenhardt 1989), for each mega-project, we interviewed executive and non-executive directors, as well as senior management and technical staff of the public agencies (or corporate division in BAA's case) established to plan and later deliver the scheme. We also

interviewed managers of the founders and other public agencies and firms that directly influenced the goal and the plan to achieve it, and staff of the suppliers doing the design and construction works.

The 2-year field work began in the summer 2011 after we negotiated access to the top executive team of the Olympic Delivery Authority (ODA), the public agency set up in January 2006 to deliver the Olympic park. Through its internal Learning Legacy project, the ODA had committed to share knowledge and lessons learned. The ODA executive felt our wholly independent theory building study fit nicely with their initiative, and agreed to contribute in kind. Armed with the ODA's letter of endorsement and a list of interviewees involved with the Olympic park, we then sought to line up comparable groups of interviewees at Crossrail and Heathrow T2. All in all, we conducted 75 formal interviews, one to two hours long, which we transcribed and organized in a digital database. In addition, throughout the research, we regularly invited top managers to give talks to our graduate-standing students which were followed by a Q&A period and lunch. In total, we organized eight events which created opportunities to ask complementary questions and take extra notes.

The interviews, presentations, and lunch discussions were complemented by numerous site visits, including a four week on-site observation at Heathrow T2 carried out by one of the authors. We chose Heathrow T2 for a longer observation on site because it gave opportunities to garner archival documents which were not confidential but would be otherwise difficult to access. For each case, our archival data included documentation internal and external to the mega-project organization

We organized our database of archival documents in seven broad categories (see Table 1). *Strategy and planning documents* include project feasibility studies, records of public consultations, outputs from planning bodies, and reports generated by central or local governments and regulatory investigations (for the publicly financed projects, we also studied parliamentary debates and documents released in response to requests made under the UK's Freedom of Information Act). Together with the interviews, power point presentations, and records of executive and high-level meetings ('*meeting minutes*') this information was crucial to chart the evolution of the structure of participation of the meta-organizations and commensurate evolution in performance expectations. Other sources of data on the evolution of performance expectations were *financial reports* including annual company accounts and budgetary audits, and *news articles* in the national and trade press.

To learn more about salient interorganizational controversies that surfaced during the interviews, we examined *formal communications* including open letters exchanged between members of the mega-project organizations or sent by independent actors native to local communities affected by the mega-project organization; we also studied *newsletters and public relations (PR)* documents including magazines, presentations, and multimedia created to inform the public about the works undertaken, and thus providing an additional source of data on announcements of performance expectations.

Finally, *design documents* were useful to appreciate the quality of the evolving structure of the designed artefacts and include architectural renderings, technical drawings, schematics, and detailed project scope documents. To learn more about the design structures, we also studied detailed technical and managerial accounts and interviews with senior managers in the trade press.

We focused data collection on understanding the evolution of the meta-organization's membership and concomitant evolution of the high-level design choices and cost and schedule targets. The archival documents helped to cross check the informants' accounts. Our theoretical emphasis meant that we were not seeking to share commercially sensitive information, but we offered nonetheless to make the quotes anonymous to avoid potential bias (Podsakoff et al. 2003). Table 1 summarizes the overarching characteristics of each mega-project, the documents in our database organized by the salient categories, and the official roles of the interviewees and their employers.

<insert here: Table 1 Summary of Characteristics of the Case Sample and Interviewees>

Data Analysis

The research followed an inductive, multiple case study approach. Our core question (Eisenhardt 1989) was: can the performance of mega-projects be traced back to their organizational structure? To address this we sought answers to a set of subsidiary questions including: what form of organizing is a mega-project? Which actors influence the system-level goal and the high-level design choices? And how does evolution in organizational structure affect performance expectations? The typology provided by Gulati et al. (2012) was our cognitive frame of reference (Van de Ven 2007) and provided a set of high-level codes (Miles and Huberman 1994). To allow for a more detailed level of inquiry (Yin 1984) we embedded units of analysis that captured high-level decisions in the development of

key functional components. We define a component as a distinct element of the infrastructure asset which performs a relatively well-defined function or set of functions (Ulrich 1995).

Following a snowballing process (Biernacki and Waldorf 1981), we asked the first interviewees to introduce us to respondents who could provide complementary points of view for our core questions. We also worked with interviewees to sample components that could illustrate the concomitant evolution of the organizational structure, high-level choices, and plan to achieve the goal.

Following recommendations for inductive reasoning (Ketokivi and Mantere 2010) and to guard against potential account bias (Miles and Huberman 1994), we first developed detailed chronological accounts for each case.[4] This was important to take a process orientated approach to theorization (Langley 1999; Van de Ven and Poole 2002) and develop reliable theory (Miller, Cardinal, and Glick 1997). As we cycled between empirical data and theory, a theory started to emerge that the organizational structure of mega-projects could be internally differentiated into two constituting elements, a core and a periphery, that the composition of the core was in flux for a significant period after initiation, and that this was linked to ambiguity in performance. As we refined our theory, we proceeded to fill gaps in our understanding through subsequent interviews. By mid-2013, we had reached theoretical saturation as additional data was no longer leading to new conceptual insights.

ANALYSIS

We begin by recounting how the embryo of a new mega-project meta-organization is conceived after a set of independent actors form a coalition to promote a new scheme. We then analyze how the meta-organizations in our sample evolve and the concomitant evolution in performance expectations in terms of high-level design requirements (so-called project scope) and costs and schedule targets.

Our analysis uncovers two approaches that a coalition can use to attract supporters from the environment and negotiate performance expectations that cater to the needs of a wider membership. We also examine the loss of flexibility in development after a vast network of suppliers selected by the core forms a *peripheral* structure to carry out the design and construction works. We identify three

[4] These detailed factual accounts were published with a presentation style similar to a Harvard-style teaching case study and circulated for comments

main development stages, and qualify them by the porosity of the core and peripheral structures and by the quality of the development agreements that hold the organizational members together.

Table 2 and Figures 1-3, compiled from analyzing archival and interview data, illustrate the longitudinal data that underpins our analysis.

<Insert Table 2 here Evolution of the Membership, Scope, and Cost and Schedule Targets >

Embryonic stage: How a mega-project meta-organization is conceived

Our cross-case analysis reveals a recurring pattern characterizing the emergence of a mega-project. A single actor envisages demand for a new infrastructure, but alone cannot mobilize enough resources to achieve the goal, and thus attempts to attract other interested partners. Hence the emergence of a new mega-project is a social matching process (Barnett, Mischke, and Ocasio 2000) in which a new organization is conceived after a few independent parties, the founders, succeed in forming a coalition by agreeing in broad terms a plan to solve a set of interdependent problems.

During this embryonic stage, the founders collectively craft a mutually acceptable system-level goal and a plan to achieve that goal including the project scope, and corresponding budget and schedule targets. Public announcements of high-level expectations are used symbolically to garner commitment and legitimacy (Stone and Brush 1996), but the founders stay short of making legally binding commitments. Eventually, as the founders make strides to bridge their differences, they may sign off a non-binding protocol or Memorandum of Understanding (MoU).

An incipient periphery to which the founders contract out design services may emerge at this stage if the founders lack in-house capabilities. The periphery, made up of suppliers selected through tender, plays a key part in verifying the performance assumptions of the founders. However, the quality of the suppliers' contributions is directly constrained by the information that the founders supply to them about the high-level design requirements and other performance expectations.

Figure 1 outlines the evolution of the two constituent structures of the mega-project meta-organization in this stage for our sample.

<Insert Figure 1 - Mega-project embryo: Conceiving a meta-organization>

The case of London 2012 illustrates the protracted and political nature of this stage. The idea to bid for the Games dates back to the mid-1990s. The British Olympic Association (BOA) contemplated

a London bid in 1994 after the International Olympic Committee (IOC) rejected three prior proposals set in other cities. In 1997, the major political party in opposition pledged to back the BOA's plans. By 1999, with that party in power, pressure mounted for a firm commitment: "there is an urgent need for greater ministerial involvement", said a Parliamentary report. But work only began in earnest in 2001 when the Greater London Authority (GLA), an agency headed by the Mayor of London, joined the BOA and government to form a 'Key Stakeholders Group' to study the viability of a London bid.

Each founder provided critical resources or functions to the embryonic organization. The GLA had powers to acquire land; the UK government could finance the scheme; and only the BOA could nominate potential host cities. As the embryo was conceived, a system-level goal was crafted around using the development of an Olympic park to regenerate a swathe of industrial wasteland in London.

During this stage, the relationship between the founders remained non-binding and flat. As none of them had sufficient skills to develop a bid, they selected firms to compare potential sites and provide feasibility studies—and a symbiotic relationship emerged with an incipient periphery. In 2003, the founders signed a first MoU agreeing to back the bid, and after they settled on an outline master plan for the Olympic park, they signed a second MoU agreeing to a funding package. Still, after 9 years of talks, the founders had yet to acquire a critical resource—the support of the IOC. To chase this resource, the structure of the Games meta-organization needed to evolve substantially.

We witnessed a similar process in the embryonic stage of the Heathrow's T2. In that case BAA saw an opportunity to have two airline alliances using Heathrow as a hub, and after one year of talks, STAR and BAA signed a MoU to collocate STAR's members 'under one roof'. To meet this pledge, BAA sketched a vision for a sixth terminal and a new runway. But after a public outcry, the founders settled on a more modest goal—to rebuild the old T2. To announce a new consensus, BAA and STAR signed a new MoU in late 2005. But as part of its regulated business model, BAA needed to negotiate the scope, budget, and schedule with the regulator and the whole airport's airline community. Accommodating the new members would require a substantial evolution of the T2 meta-organization.

The Crossrail case provides a third example. Crossrail's history, like the Olympics, was peppered with failure; two prior attempts to promote it failed to garner enough support. The meta-organization that we studied reflects the third attempt to promote Crossrail when the City of London Corporation

(City) started lobbying the government to revise the scheme in the mid-nineties. But progress was again hindered by difficulty locating sufficient finance. It was not until the end of the decade that the scheme began to take shape after the City pledged capital—"funding talks breathe life into Crossrail" read one headline (NCE 1998). And after the London Mayor took post in 2000, the founders met another enthusiastic partner ready to contribute financially. Still, many more stakeholders needed to buy into the goal and the plan to achieve it, and thus the organizational structure was poised to evolve.

We analyze next how the embryonic structure evolves in gestation, the next development stage.

Gestation: Expanding the Mega-project Meta-organization's core

We define the start of gestation when the founders formally appoint an agent, who acts on their behalf, to sharpen the system-level goal and further develop the plan to achieve the goal. Throughout gestation, the boundaries of the mega-project organization's core remain porous as its founders must let the membership expand to acquire more resources without which the scheme cannot forge ahead.

New parties are invited to contribute their resources in return for a stake in the development of particular components; uninvited parties may also lobby in an attempt to gain access to the core's high-level decision-making process. Decision-making hierarchy within the core remains mostly flat as the founders, under pressure to move forward and thus with limited time to resolve differences, pragmatically opt to engage in tit-for-tat negotiations with the newer core members, and strike a spate of new deals. As one Crossrail top manager said: "All the way through this [planning] the whole thing is about doing a deal. It is about making promises, getting commitments and satisfying people."

In gestation, the core members select suppliers that operate through formal contracts. The suppliers work to integrate prior high-level design choices and performance expectations with the preferences of the newer core members feeding back potential options for the core members to debate. Importantly, our analysis suggests that the environment creates two distinct paths for the development process that vary in the extent the core members invest time and effort in creating binding agreements in gestation. Figure 2 outlines the evolution of the three mega-project structures throughout gestation.

<Insert Figure 2- Mega-project gestation: widening the meta-organization structure>

As a mega-project evolves in gestation the environment may allow its core members to forgo binding commitments. The Games' case is telling of a gestation where the London2012 bid company, the founders' agent, attracted new members through grandiloquent rhetoric and pledges:

The Olympics is a beauty parade.....frankly, the bid was not much more than a concept, a sales document...it's speculative, [it's] sales, meetings ... persuading people to back them. ... there's a philosophy of winning it and then worry about how we're going to deliver it [Bid advisor]

Throughout gestation the extant members of the Games organization keenly sought the support of one critical actor—the International Olympic Committee (IOC). The IOC controlled an irreplaceable resource—the Olympic brand—the acquisition of which would pave the way to obtain all the remaining resources. To attract the IOC's support, the extant core members of the Games organization tailored the bid to, at the very least, meet the requirements supplied by the IOC and the associated sport federations. Furthermore, to lend credibility to the bid, other important actors were invited to join the Games' core. For example four London boroughs were invited to negotiate a master plan; the lead architect said 'if London can say it's got planning permission … it puts us ahead.' In turn, other parties lobbied to enter into the core. For example, the architectural community lobbied for iconic designs, and representatives joined a panel to select the architect for the aquatics center.

Still, most of the deals brokered between the core members remained conditional on winning the IOC's support. As a bid advisor put it: 'the money doesn't exist in the beginning... but you cannot bid for those resources until you know you're in the game and you win'. Hence the only binding contracts were held between the bid company and the suppliers selected to assist putting together the bid book.

In marked contrast to the Olympics, the Crossrail and Heathrow T2 meta-organizations forged ahead with binding deals. In both cases, the broader institutional environment demanded from the founders and other parties potentially interested in joining the mega-project to take a far more labored approach to incorporating their various preferences for the high-level design requirements.

The Crossrail case illuminates this struggle. For the Crossrail meta-organization to acquire the capital and receive legal powers to compulsory buy land, the UK Parliament needed to approve the system-level goal and the high-level scope based on a fixed budget. From the onset, the London's leading business lobby group and influential politicians demanded a change to the goal; a former transport minister said: "We cannot simply submit the same application that failed last time" (NCE

2002). Aware of changes to the London's economic geography, the founders invited other parties to reshape the goal including the private owners of the Heathrow airport and Canary Wharf (London's second financial center) and Network Rail, the public monopolist that owned the UK railway network.

The boundaries of the Crossrail meta-organization's core remained porous throughout—'it's all politics at this stage...you do the design, then the politics, then back to the design', said a senior official. Owners of interdependent assets lobbied to influence parts of the scheme. For example, London Underground insisted that the Crossrail stations should connect to their stations, and private firms pledged finance in exchange for rights to design a station on their land. After the scheme was introduced to Parliament a new round of deals began with local communities, businesses, councils, and individuals—'people come out of the woodwork with concerns', said an official. All in all, the Crossrail scheme took eight years of negotiations until the core members settled on a legally binding scope and budget. And even then, the core members stayed short of committing to a fixed timescale.

Importantly, the Heathrow T2 case demonstrates that the presence of an established, smaller community does not change the protracted nature of gestation if the institutional environment demands a binding commitment from core members. In this case, the coalition at the helm of the core consisting of BAA, STAR, and the regulator trusted on the BAA's capital projects group to manage the development process. Through years of collaboration in developing airport infrastructure, the core members had worked out a set of protocols which facilitated their interactions. In addition, BAA was the sole financier and owned the land which could presumably facilitate the development process.

Still, coalescing all the heterogeneous interests proved difficult. BAA tabled a design for a small intervention which STAR outrightly rejected because, STAR wrote, it did not "rival the scale and ambience" of their competitors' assets. Aggrieved with BAA, STAR asked the local government to reject BAA's proposal. STAR were disenchanted by BAA allowing the timescale to slip and complained to the industry regulator: "BAA and BA [British Airways] are indirectly conspiring not to allow a competitor equal ability to see the realization of facilities that match the T5 campus."

STAR and BAA's relationship remained fractured throughout gestation. STAR's project director recalled: "I got called Mr. Masterplan because…[I said] 'you cannot design this from the bottom up'". To complicate matters, BAA had to negotiate the scheme with Heathrow's remaining airline

community (approximately 60 airlines), a prerequisite before the regulator could endorse a binding agreement on scope, budget, and timescale. With a widened core, convergence took two years.

In summary, the qualifying property of the gestation of a mega-project meta-organization is the juxtaposition of binding and non-binding development deals amongst a growing core membership. But, as observed, the proportion between the two varies substantially. Hammering out binding deals makes the development process protracted and fraught with conflict at the core. Thus the coalition at the helm may avoid seeking binding deals upfront unless the institutional environment so it demands. We now turn to discuss the final evolution in the mega-project's meta-organizational structure.

Delivery: Expanding and Engaging the Mega-project Meta-organization's Periphery

We define the start of delivery when the mega-project meta-organization has acquired all the critical resources needed to begin detailed design and construction. In delivery, the core members must nail down the remaining development deals before they start hiring the supply chain after which the space for negotiating changes to high-level choices becomes substantially more constrained. The core membership is now relatively stable, but its boundaries stay porous. For instance, new parties may lobby or be invited for a late inclusion or indeed extant members may leave or be replaced.

Figure 3 illustrates the exponential growth of the periphery vis-à-vis a relatively stable core.

<Insert here Figure 3 – Mega-project delivery: consolidating the meta-organization's structure>

To resolve the loose ends, the mega-project meta-organization goes through a last round of substantial structural changes. After London won the bid, for instance, the bid book folded into a legal contract—'they [International Olympic Committee, IOC] certainly learned the trick... you deliver in the spirit of that contract but not in the detail', said one bid advisor. With seven years to deliver, the founders together with an IOC's watchdog, LOCOG,[5] formed an Olympic board to govern the enterprise, and created an agent, the Olympic Delivery Authority (ODA), to buy land, manage the project, and select the suppliers—'we were firmly on the driving seat', recalled one ODA director.

Still, the agent was not awarded voting rights at the Olympic board. Hence the ODA's main task was to recommend how to fold the prior pledges into firm commitments. One ODA director said:

[5] London Organising Committee of the Olympic and Paralympic Games

We spent the first year trying to get to a point where ... we could go back ... and say 'this is the detailed scope, the delivery plan, and this is what it's going to cost' and....they [Olympic board members] all fell off their chairs because it had very little relationship to the bid book.

Faced with an immovable completion date and concerned about legacy, the ODA spent two years negotiating with the now vast collection of core members a new set of high-level design requirements and performance targets for the scheme—'there was a 'disconnect between bid promises and reality', said one ODA director. Concomitantly, the number of suppliers selected to work on the Park started to grow steadily up to 1,600 at peak, and decision-making at the core got more and more constrained.

Substantial changes in structure also happened at the onset of the delivery for Heathrow T2. But in marked contrast with the Games case, the new management team at the helm (redeployed by BAA from the last mega-project at the airport) inherited a rigid set of high-level requirements and a budget. And yet, new management insisted that there was a £600m shortfall in finance. Locked in a binding contract, the new team asked for scope changes, but STAR rejected the new design proposed by BAA:

They [BAA] bring new drawings to this meeting and people, myself included [STAR project director], said 'what's that?' They had changed a whole bunch of stuff....so we then wrote a letter back saying ... that if they didn't rectified the design within the next 3 months, we would be writing to the regulator

To avoid an impasse, the core members rekindled negotiations. BAA soothed STAR by offering some concessions over design provisions aimed at making it less costly to further expand the terminal in phase 2. The core members also agreed to shift to T2 capital that had been committed to smaller schemes, and to delay the T2 opening another year. The number of suppliers joining the organization grew as expected, although BAA chunked the works in large packages to reduce their number.

The interlock between the gestation and delivery for Crossrail suggests a similar pattern. The new agent taking a central role in the meta-organization, CRL, also pointed to a shortfall in financing. But as in the T2 case, the budget was fixed, and thus the alternative left was to renegotiate the scope and the completion date. The boundaries of the core stayed porous, and property developers and operators were invited for talks before freezing the high-level requirements. Discussions to ditch non-binding requirements were also initiated before selecting the vast periphery. One CRL director said:

When I joined, the forecast cost was several billion [pounds] higher than the maximum funds available.... You find pieces of scope that have no justification because nowhere ...it said 'do this piece of work'…we agreed to do something, [but] it was never a legal commitment

In summary, the delivery is qualified by a last round of substantial structural changes in the mega-project meta-organization, starting off with the arrival of new management. This triggers a last round of talks as to how to achieve the goal before action becomes severely constrained by the growth in the periphery. We turn now to analyze how this structural evolution impacts on performance.

Linking Organizational Evolution and Ambiguity in Performance

Our longitudinal analysis reveals a relationship between the evolution of the mega-project meta-organization's membership and the potential for this to be accompanied by episodic re-definition of the goal, and the corresponding high-level design requirements and cost and schedule targets. Indeed our findings suggest that as the meta-organization's core and periphery expand to acquire more resources this directly leads to substantial changes to the performance expectations.

The Olympic park, for example, was floated by the British Olympic Association in 1999 as a £1-2.5bn capital investment to end in a £17bn enterprise when accounting for all expenditure in building the park, regenerating East London, upgrading London's transport network, and hosting the 2012 Olympic Games. Likewise, Crossrail evolved from a £2.1bn privately financed 9km central London train to open by 2008 into a £16bn (mostly publicly financed) 148km commuters' train to fully open by 2019; and T2 evolved from a new £1-1.5bn concourse to open in 2012 into a £2.6bn fully-fledged campus to open by 2019 (although the second phase was ditched later on in delivery).

Importantly, substantial changes to the performance expectations occur under two distinct conditions of membership change. The first pattern of change occurs in gestation when an influx of new resource holders into the core leads to calls for widening the scope. Hence the Olympics saw a significant scope increase coinciding with the founders' attempts to please IOC, appease the Sports federations, and placate public agencies and lobbyists. Similarly, as new members joined in Crossrail in gestation, the goal evolved to resolve broader transport problems across Greater London.

As it requires considerable effort to negotiate these changes, the full effect of a new member's demands may remain inadequately integrated into performance baselines unless the environment prohibits the scheme to forge ahead before the expectations are reconciled—this was the case of Crossrail and T2. In contrast, London2012 dodged the scrutiny from the UK Parliament, and thus the reconciliation of the performance expectations took place only much later on in delivery.

A second equally substantial change to the performance expectations occurs when the founders appoint an agent to manage project delivery. At this interlock, this so-called delivery agent has to recruit the suppliers who will further challenge the core's assumptions through the tendering process and constrain decision-making at the core. To protect perceptions of their own performance, the delivery agent wants to commit to a more robust performance baseline aligned with more recent information, and thus sets off a new round of negotiations for the performance expectations.

Hence after the appointment of the ODA in the Olympics, CRL in Crossrail, and new management at T2, the performance expectations were invariably readjusted. For example, in the Olympics, the scope was reduced and the budget grew after the ODA took the helm of development, but the schedule remained fixed; and in Crossrail, the schedule slipped and scope was removed after the CRL got on board, but the budget remained unaltered. One respondent quipped about this pattern, "they [delivery agent] will immediately say 'it's their [predecessors] fault, they've stuffed up all the estimates'...and they [predecessors] will say 'bloody amateurs, couldn't they build it for that?'".

Admittedly, not all changes in the performance expectations can be attributed to negotiations carried on by founders and newer core members. Crossrail began with a goal around a central London train, but over time London's economic geography altered. Arguably this evolution in the environment contributed to a rethink of the core membership, and to subsequent changes in performance expectations. Furthermore, when development lasts decades unforeseen events occur that directly impact on performance expectations. The financial crisis, for example, required the UK government to bail out the developer of the Olympic village and to ask Crossrail to devolve £1bn of contingency funds; both cases held the founders' feet to the fire and forced them to defend their prior performance expectations. And in the T2 case, during development, BAA changed hands and later the government told the company to end its monopoly control over the London airports. These changes contributed to BAA's decision to shelve plans for the second phase. The airlines were outraged, but a BAA director said—'you created the beast, and this is how the beast is playing out'.

Major changes in the environment were, however, exceptional in contrast to the empirical pattern that links evolution in the mega-project organizational structure to changes in the performance expectations. We now examine three mechanisms that motivate the changes to performance

expectations, and explain how these changes in turn create ambiguity in evaluations of performance, and thus trace the ambiguity in performance back to the evolution in the structure. The scheme in Figure 4 illustrates the logic that emerges from the analysis of our empirical findings.

<Insert Figure 2 – The link between Evolution in Structure and Ambiguity in Performance>

The Influence of Committals to Different Performance Baselines

Our findings suggest that each iteration of the performance baseline reflects the zeitgeist of the new mega-project organizational structure and corresponding high-level preferences. Yet not everyone will agree with the legitimacy of the newer baselines. In particular, the aforementioned announcements of new baselines at the interlocks between development stages are controversial.

If the intent is to slam the mega-project performance, or to craft a narrative of strategic misrepresentation and optimistic bias (Flyvbjerg et al. 2003), our sample suggests that critics can refer back to the original project baseline to support the argument. The comparisons of cost data are not linear because of longitudinal changes in accounting reporting practices. But the three mega-projects in our sample do fare badly when their performance is evaluated in this way.

Despite this, many praise the observed mega-projects for their performance. In the Games case, for example, top management of the delivery stage brazenly stated that their performance was a story of great leadership—"for the ODA all came together", said its Chairman in 2013 proud that the ODA had delivered the Olympic park within the budget it negotiated in 2007. And yet enthusiasm was not universal particularly after the founders and the ODA agreed to sharply increase the budget envelope at the onset of delivery—"we've been treated like imbeciles by those who believe they've a divine right to squander other people's money", said a tabloid (Hardman 2011), and the respected Financial Times concurred "the costs were grossly and persistently underestimated" (Kay 2013).

In summary, as the mega-project structure evolves, performance expectations change irrespectively of whether prior targets were or not scrutinized by the environment. They change because new management chooses to commit to new performance baselines. By renegotiating high-level design choices, and by building in slack in the budget and schedule if possible, new management hedges against the perceived risk that targets have to slip later on to accommodate more demands from new latecomers to the core, supplier bids higher than anticipated, or changes in the environment.

The co-existence of committals to different performance baselines, each one associated to a legitimate organizational structure fuels antagonistic evaluations, and ambiguity in performance ensues.

We examine next how performance can be evaluated differently irrespectively of the baseline.

The Influence of Differing Preferences between Efficiency and Effectiveness

Our analysis shows that the core members of a mega-project will dispute the need to change the high-level choices as development unfolds. Some members show a preference for fixing upfront the project scope and corresponding performance targets; for these members high performance is about efficiently delivering on the upfront commitments. For others notably new latecomers to the core and actors that operate under uncertainty over their needs for the infrastructure in use, high performance is about providing flexibility to adapt the scope as development unfolds, and thus maximize the asset's long-term effectiveness. These different but equally legitimate perspectives about how the mega-project should perform are difficult to reconcile, and as the organization evolves and core members negotiate hard choices between efficiency and effectiveness, ambiguity in performance arises.

The Heathrow T2 case offers a good example. Due to volatility endemic to the airline industry, throughout development STAR kept pushing for changes in the high-level design requirements and asked to delay design commitments. But at the onset of delivery, with a new BAA capital projects team at the helm, the airlines were asked to bed down all the design requirements. The airlines hit back saying that they were not ready to commit. Frustrated, one new BAA director compared the airlines to a child entering a sweetshop: 'they're not quite sure, but know they want something.'

As it turned out, the conflict between the concerns of the new BAA capital management team with efficiency and the STAR's demands for flexibility dragged throughout the delivery stage. STAR successfully pushed for major changes at the onset of delivery—'if you've to make changes, it better damn well be good', threatened the BAA capital projects director—after which BAA froze the design requirements to the dismay of STAR. But two years before the opening, the domestic carrier of STAR left the alliance, which wreaked havoc on the occupancy strategy for the future terminal, and BAA was forced to let the cost target slip again to accommodate a new round of very late changes.

A similar pattern was observed in the other schemes. At the onset of the delivery of Crossrail, for example, new management fired an opening salvo by announcing a controversial freeze of the high-

level design requirements ten years ahead of the opening date. And in London2012, under pressure to get the suppliers on board, the Olympic Delivery Authority sought to freeze the requirements and budget once it got in post into a new baseline so-called the ‘Yellow Book’. The sport federations protested that it was premature to freeze the requirements before the 2008 games, the ‘Beijing effect’ as they put it, and a long list of exclusions had to be co-produced to accompany the Yellow Book.

In the absence of objective data about the socio-economic value of ploughing ahead to keep development on target versus letting the targets slip to accommodate change, different and subjective evaluations of performance arise as a function of the discretionary emphasis put upon efficiency versus effectiveness. Parties that fail to force late change slam the mega-project performance on the basis of lack of flexibility. Those that won the fights hail the performance by stressing the need to be efficient. This leads to different concomitant evaluations, and ambiguity in performance ensues.

The influence of Rivalry in Preferred High-level Choices for the Final Design

A final mechanism that explains changes to performance expectations and how these changes in turn create ambiguity in performance pertains to the rivalry in the preferences for the final design amongst core members, as well as in the preferences between those at the core and outsiders that failed to directly influence the final design. The case of T2, wherein BAA, STAR, and the regulator crafted the system-level goal of the scheme, illustrates how collective development of a single, monolithic, designed artifact for common use is complicated. It was the regulator’s role to ensure that all the airlines were treated equally; to this end the regulator had the power to veto BAA’s plans. Still, STAR never felt wholly enfranchised because, in its view, the regulator did little to force BAA to meet the initial pledges. STAR also never fully accepted BAA’s argument, accepted by the regulator, that physical constraints made it impossible to add a modern baggage handling system in the first phase—‘there’s an inherent weakness in everything that is being supplied’, said the STAR director.

The development of the other schemes was also beset by conflicts over high-level design choices between founders and latecomers to the meta-organization’s core. For example, the Olympics founders were accused of callous indifference to leaving a “white elephant” after a coalition inside the core staved off calls by football aficionados to renege on the bid promise to create an athletics venue

in legacy[6]. Other fights are fueled by the delivery agent's preferences for high-level design choices that allow them to hedge against the risks of schedule and/or budget slippages during project delivery. Hence Crossrail management was accused of paying lip service to their motto for a 'world-class railway' after turning down the EU railway regulator's call to adopt leading edge technology. And Crossrail management's decision to renege upon prior non-binding commitments such as enhancements to the stations outside London infuriated the respective local councils and the architectural lobby who accused management of leaving a 'mediocre legacy'; after a gory fight leaked to the public press, the managers were forced to make a series of embarrassing U-turns.

Finally, other fights were caused purely by antagonistic preferences for the final design. A good example is one that opposed a local council against the Crossrail founders. The founders opposed to the idea of adding toilets to the local station ('we told them to bugger off …they [toilettes] are nothing but a nuisance', said one respondent). But the Councilors could not disagree more; after years of unsuccessful talks, the proponents raised a ruckus in Parliament ('will the Minister [of Transport] join me in urging Crossrail to build some toilets?'). After this well publicized political move[7], the founders appear to have taken fright and caved in to the Council's demands.

In summary, actors that lose fights over the high-level design choices are tempted to shame the performance of the mega-project in the court of public opinion, whereas the winners will proudly stand by their decisions. Given the lack of a universal definition of performance and of time and resources to resolve the emerging controversies through dialogue and using objective evidence, the debate on mega-project performance remains inconclusive and mired forever in political fights.

DISCUSSION

Our analysis suggests that mega-projects are a hybrid form of meta-organization blending properties from both open, pluralistic systems (Garud et al. 2014, Shipilov et al. 2014, Kratz and Block 2008) with closed, hierarchical systems (Simon 1962, March and Simon1993). To make sense of this hybrid we argue that a megaproject consists of two interdependent structures – a core and a

[6] The battle dragged throughout development, and after the Games the stadium was leased to a premier league football team, with the national government footing the bill for the ex-post reconversion of the asset

[7] Arguably because of the use of the word 'piss' in Parliament, Daily Hansard- Debate, Commons Debates, House of Commons, 23 June 2011 and Hoggart, S. (2011). Looking after number one. The Guardian 23 June

periphery (Hannan and Freeman 1984; Siggelkow 2002; Thompson 1967). The core consists of those members that possess resources critical to the achievement of the system-level goal, and which are not easily substituted. In contrast, the periphery consists of those members that hold resources that can be acquired through market transactions. The mega-project's founders hold substantial amount of decision-making power, but lack absolute authority. Over time the founders, out of necessity, invite other stakeholders to join the core, thus core membership evolves over time through entries (and sporadic exits) of other actors. A high degree of interdependency between the core actors operating under time pressure results in bargaining aided by face-to-face interactions and knowledge exchanges to seek consensus. The structure at the periphery, in contrast, is formed by a vast supply chain selected to design and build the infrastructure but not granted direct influence over the high-level choices.

Mega-project meta-organizations are thus not open systems such as open communities of production (Lakhani and Von Hippel 2003; O'Mahony 2003), global communities of scientists (Tuertscher et al. 2014), or managed business ecosystems (Baldwin and von Hippel 2011) since a significant class of members—the project supply chain—cannot self-select or volunteer for tasks. Rather the mega-project suppliers must apply for membership and compete to be selected as typical of a meta-organization with closed boundaries such as OEM-supplier networks or closed consortia. But equally, a mega-project meta-organization is not a wholly closed system because the boundaries of the core are permeable. Throughout development, new parties can gain core status through lobbying or leveraging valuable resources to force their preferences into high-level choices.

Nor do the organizational structures that we observe fit neatly between highly stratified and flat decision-making bodies. In stratified meta-organizations, the higher-tier members have increased decision-making privileges and take additional responsibility for orchestrating the efforts of other members; they also rely on an authority hierarchy built upon employer-employee relationships and legal contracts to resolve emerging controversies (Gulati et al. 2012). This fits with the relationship between the mega-project's core and the supply chain where contracts are used to simulate hierarchical authority (Stinchcombe 1965; Stinchcombe and Heimer 1985). In marked contrast, the decentralized governance structure held between the core members of a mega-project reflects more egalitarian systems in which interdependency of the member's resources creates a relative equality.

We turn now to discuss how these idiosyncratic features of the mega-project meta-organizations suggest theoretical and practical complications relative to other known meta-organizations.

The permeable boundaries of the mega-project meta-organization's core

The inception of a mega-project's core is a 'social matching process' (Barnett et al. 2000) in which the founder and other parties seek out a mutually acceptable goal and plan to achieve it. For the founders, core membership is permanent and gives them system-wide decision rights ex-officio. Other parties that join the core as the development progresses, e.g., a local council, by the nature of their position, may also gain decision rights ex-officio but these will be bound to particular components.

The permeable boundaries of the core are necessary for the founders to attract commitments of resources from powerful actors who could otherwise oppose to the mega-project and prevent it from thriving. Increasing the size of the collaborative brings additional resources that can be drawn upon to provide a benefit enjoyed by all (Gray and Clyman 2003; Ostrom 2005). But the permeability of the core also exacerbates pluralism (Shipilov et al. 2014) and the risks that some actors feel marginalized and leave the enterprise (Pratt and Foreman 2000), and thus the costs of resolving differences.

Importantly, the mega-project's core has no single gatekeeper or 'systems-integrator' (Brusoni et al. 2001) that unilaterally controls core membership and product design architecture. Occasionally parties which hold non-critical resources gain access to the meta-organization's core through effective lobbying and bargaining. This can be problematic as extant core members may disagree on the legitimacy of latecomers who, in their view, seek to benefit disproportionally to their stakes. This in turn undermines efforts to achieve goal congruence, a useful action to encourage unfamiliar parties to collaborate (Beck and Plowman 2014). By the same token, as the core structure evolves, coalitions of members can form which seek to renege on prior pledges and disenfranchise less powerful members.

The mega-project core members therefore operate under a relatively pluralistic structure. They share the goal of getting the infrastructure done. But they belong to different communities of practice (Brown and Duguid 1991), and thus are individually motivated by different interests, knowledge bases, and beliefs. Hence, they may fundamentally disagree over how to achieve the goal, and the epistemic and cognitive differences (Puranam et al. 2012) are complicated to bridge In such pluralistic environment it is hard to rely on a meritocracy-based authority (Hippel and Krogh 2003) to resolve

controversies. To complicate matters, the core members operate under deadlines imposed by rigid electoral or regulatory cycles, which limit the scope of the discussions and undercut collaboration (Susskind and Cruikshank 1987). Thus the core is under pressure to cut deals at the same time it seeks consensus through cycles of knowledge exchange and transformation and production of compelling evidence and superior arguments (O'Mahony and Bechky 2008; Tuertscher et al. 2014). In pluralistic and constrained developments, the parties find it tempting to use mutual gains bargaining and interest-based negotiations to pragmatically bridge differences (Garud et al. 2014; Gil and Baldwin 2013).

Hence the mega-project is rife in controversies amongst core members, some of which turn into political fights; controversies and fights between core members and outsiders wishing to enter into the core are also common. These confrontations can drag for years creating high uncertainty over the high-level design choices until a mutually acceptable solution emerges, the opponents are defeated, a dissenting party defects, or the venture collapses. A degree of self-selected membership together with relatively flat decision-making are thus the qualifying attributes of the mega-project core.

The vast but closed mega-project meta-organization's periphery

Since the core members of a mega-project rarely have the in-house knowledge, skills, and labor necessary to design and build the infrastructure, they acquire these resources by using market mechanisms (Ouchi 1980) to select a complementary supply chain. As the suppliers do not have a monopoly over key resources they must compete for membership. For example, the endorsement of the local councils to the Crossrail scheme was irreplaceable, but a few suppliers were capable of designing and building the railway stations. Hence exchanging one supplier for another with similar capabilities, ceteris paribus, does not require changes to the high-level design requirements.

Potential suppliers are not however all equivalents, and a supplier seeking membership to the mega-project must prove it is the best for the job. Still, the suppliers are selected not to disregard, alter, or veto the high-level choices, but to translate them into drawings, specifications, and physical artifacts. If the design requirements change, the supplier itself may need to be replaced—the architecture firm for T2 was replaced mid-course, for example, after the core dropped their aspiration for T2 to aesthetically match T5. Because a supplier can only become a member if it gets selected by the mega-project's core, the boundaries of the meta-organization's periphery are effectively closed.

Unlike the bargaining and decentralized governance observed at the meta-organization's core, the suppliers carry out their work in accordance with contracts they hold with one or more core members. Suppliers can subcontract work out to other firms, but the actions must remain within the bounds of the contract. Suppliers can also propose changes to the high-level choices, but only the core has the authority to approve such changes. Still, the periphery members play a key role in validating the core's goal and the performance assumptions underpinning the plan to achieve it.

Critically, after the core lets out contracts to the suppliers, the core members lose the flexibility hitherto enjoyed to make development deals (Williamson 1975). Many schemes unravel when either the core forges ahead in gestation without sounding out suppliers if the performance targets are realistic, or the core hammers out late development deals without negotiating first the extra costs and risks with the suppliers already on board (Stinchcombe and Heimer 1985). Core members and suppliers are thus symbiotically related. The core needs the suppliers to get things done for a target price and timescale; the suppliers need the opportunities created by the core to make profit. Market selection together with binding contracts qualify the mega-project organization's periphery.

Linking Evolution in Organizational Structure to Ambiguity in Performance

Prior studies of the relationship between organizational structure and performance illuminate the elusiveness of this relationship. Not only different structures can lead to similar levels of performance (Doty, Glick and Huber 1993; Gresov and Drazin 1997), but also performance is shaped by interactions between high- and lower-level choices (Siggelkow and Rivkin 2009) and environmental factors (Child 1972; Davis, Eisenhardt and Bingham 2009). Our research uncovers another factor: the evolving nature of the definition of performance—a process of constantly shifting goalposts as the core membership remains in flux—independently makes the measurement of the structure-performance link difficult. Our research shows that ambiguity both in the "baseline against which performance is evaluated" and in the "definition of performance" arise through multiple mechanisms.

First, in mega-project meta-organizations, core members do not join all at the same time, and different core members have different preferences, beliefs, and priorities; they also differ in the planning horizons, a major cause of problems in collective action (Ostrom 1990, Ansell and Gash 2007, Gil and Tether 2011). When many autonomous actors are part of a constrained collaborative

development and share the right to design a single non-decomposable asset their preferred choices are mutually exclusive and thus subtractable, i.e., it is one or the other (Gil and Baldwin 2013).

Endemic to mega-project meta-organizations is thus a problem of appropriation characteristic of developments in which organizational and design structures do not mirror one another, and thus are misaligned (Colfer and Baldwin 2010). Mega-projects consist of sets of monolithic components with varying degrees of interdependence. Still, a coalition with system-wide rights to design the whole shares the right to directly influence the design of each component with many heterogeneous actors. Thus the *design in the making* exhibits the qualifying properties of a common-pool resource—many autonomous claimants are entitled to use the resource, but its use by one claimant deprives others from the flow of potential benefits (Ostrom 1990). And indeed, not all core members will see their preferred choices making into the final design. As the core membership grows, and thus the structure changes, the problem of appropriation grows commensurately, and the core faces hard choices.

To bridge the differences within a solution space constrained by announcements of performance targets, the leading coalition and latecomers can opt to bargain and use politics—a pattern of developments that unfold under pressure (Eisenhardt and Bourgeois 1988; Gersick 1994). But this creates winners and losers, which creates risks that some parties defect (Garud et al. 2014; Tuertscher et al. 2014) and thus a failure to harness the benefits of pluralism (Kraatz and Block 2008). Gaps in expectations between the design that some actors craved and what they got fuels different evaluations of performance irrespectively if the mega-project stayed or not within the cost and schedule targets.

Another alternative for resolving controversies that arise during development between core members is to relax the boundaries of the problem, and therefore *if the environment allows,* let the schedule and/or cost targets slip. Slippages in the performance targets allow for different interpretations of the performance, and thus ambiguity in performance on two accounts.

First, even if different parties evaluate performance against the same baseline, slippages are framed (Benford and Snow 2000; Gray and Clyman 2003; Gray et al. 2014) as failures by those actors who put efficiency above adapting development to late requests for design change. In contrast, for others it is more important to flex design to emerging needs than meeting initial performance targets. For the latter, slippages evince that the autonomous parties succeeded to bridge their differences.

And second, slippages in cost and schedule targets create different legitimate baselines against which performance can be evaluated. Our findings show that major slippages in targets are associated with discrete interlocks between development stages, and thus with fundamental changes in the membership of the mega-project. Hence the last actors to announce performance expectations argue it is only legitimate to evaluate mega-project performance against the expectations that their structure announced and committed to. Other actors, in contrast, underplay the significance of changes in scope, and insist it is legitimate to evaluate performance against the baseline committed to by a prior organizational structure. Of course outcomes of evaluations of performance vary according to the adopted baseline, and since it is not easy to rule one out, ambiguity in performance ensues.

The ambiguity in performance that we trace back to the organizational evolution gets further amplified by the interaction between the mega-project and the environment. For one, the inability of some actors in the environment, despite fierce lobbying, to enter the meta-organization's core and change the design requirements contributes to concomitant differences in evaluations of the performance of a mega-project. Other actors in the environment may simply oppose to the whole venture. Excluded or otherwise disenfranchised, these actors may seek to highlighting inconsistencies and pointing to prior expectations against which the scheme will be shown to be doing poorly. Radical discontinuities in the environment such as a financial crisis or the breakup of a monopolist are sporadic, but can change performance expectations and thus amplify ambiguity in performance.

As characteristic of inductive studies, there are important limitations to the generalizability of our insights. To lessen the effect of this our sample was diverse, but all the schemes unfolded in London, a global city in a democratic nation with stringent planning laws and a strong regime of property rights. Organizations like the World Economic Forum argue that infrastructure and institutions are two pillars of what makes societies competitive (WEF 2013). But institutions differ substantially across societies. We thus do not claim as universal our conceptualization of a mega-project as a hybrid meta-organization, neither the link between evolution in structure and ambiguity in performance.

Furthermore, the mega-projects in our sample were also either publicly financed, or financed by a private monopolist operating in a regulated environment. More research is thus needed before extending our insights to infrastructure promoted by firms operating in more competitive markets.

IMPLICATIONS FOR PRACTICE

Managers of mega-projects, we argue, have been denigrated by suggestions of incompetence and Machiavellian guile. By looking to mega-projects as a meta-organization, our study claims that they are not developed by unitary actors but by evolving collectives. Furthermore, we argue that mega-project managers lack the sources of authority found in hierarchies or contracts with respect to co-members of the core structure (though they have this mechanism with respect to handlings with the periphery), and thus managers must negotiate a set of performance expectations that satisfices (Simon 1981) an evolving host of dissenting independent actors and political masters.

Specifically, our study sheds light on the often contradictory pressures that managers of mega-projects are forced to reconcile. In the face of a changing environment, and ongoing growth of meta-organization membership, mega-project managers are encouraged to be adaptable and create new performance baselines to meet incoming challenges. But releasing new performance targets which are inconsistent with previous announcements generates complaints that the scheme is inefficient and is spiraling out of control. Equally, failing to adapt to changing conditions attracts similar levels of disdain of lobbyists for change (from both within the meta-organization and outside) who accuse mega-project managers of being undemocratic and indifferent to risks of producing a ‘white elephant’. In the absence of a clear cut definition of performance, to maintain the legitimacy to manage, mega-project managers are thus constantly struggling to balance their commitment to a prior set of performance expectations against the need to let the performance expectations evolve.

Hence mega-projects suffer from being ‘designed by committee’ (Rosenkopf, Metiu and George 2001) resulting in tumultuous changes to the scope and to cost and schedule targets; unifying all members under a shared goal and plan to achieve it, this is a ‘future perfect’ (Pitsis et al. 2003), that is itself a goal difficult to achieve. That said, we see five areas where managers can reduce the costly impact of conflict and/or avoid the perception of poor performance.

Given that critics frequently attack mega-project performance on two fronts, the gap between early and late expectations and the frequency with which expectations change, managers should do more to persuade the leading coalition of founders to delay the release of time and budget estimates

for as long as possible. We recognize that this is easier said than done, however. Political masters operate under rigid electoral cycles and thus under pressure to make announcements. And without announcing precursory commitments to tangible performance targets, the founders may struggle to build legitimacy for the scheme and thus to acquire critical resources (Stone and Brush 1996).

In this vein, managers may find respite in committing to flexible targets *if the environment allows*. For example, soft openings can be announced instead of rigid opening dates—both T2 and Crossrail did that; and managers may also lobby late claimants for using their own budgets to finance late design changes, which allows keeping stable the budget at the heart of the scheme.

A second method of avoiding the perception of poor performance is building substantial contingencies onto the scheme's critical path and budget envelope before releasing performance targets. This adds organizational slack, i.e., uncommitted resources reserved to satisfy individual and sub-group objectives (Bourgeois 1981). This approach gives managers more room to resolve conflicts under pressure (Cyert and March 1963; Galbraith 1973) and buffers performance expectations from the impacts of discontinuities in the environment (Thompson 1967). It thus masks slippages—as one manager said "undershooting always causes more problems than overshooting", and was applied both in London 2012 and Crossrail. But there are trade-offs. Large contingencies make it harder to sell the scheme in gestation. And they can become a self-fulfilling prophecy and encourage opportunistic members to make even greater claims on the final scope. London2012, for example, depleted practically all its contingency, and Crossrail is 'going down the same way', one respondent said.

A third approach to improve the perception of performance lies in cutting out the source of late changes. Throughout gestation, the growth of the core membership, and thus creating a pluralistic enterprise (Shipilov et al. 2014) is vital to acquire key resources to forge ahead. But the more core members the more complicated collective action becomes (Ostrom 2005) and thus it is tempting to fend off lobbying from other parties to enter the core. Excluding resource-poor claimants brings short-term benefits but undermines legitimacy (Gray 1989), and increases the risk of late conflict if the excluded claimants force a late entry into the core and form a coalition to overturn high-level choices.

Fourth, our study suggests that coalition leadership rather than hierarchy reins within the mega-project core, and this brings governance over high-level choices to the fore. Attempting to simulate a

hierarchy is difficult as the ownership of the critical resources is distributed. Physical constraints and tight budgets in turn impair investment in flexible designs to attenuate rivalry over high-level choices (Gil and Tether 2011). And scarcity of resources, urgency, and large numbers of claimants exacerbate the difficulties to achieve consensus through dialogue, evidence, and knowledge exchanges.

Mega-projects are thus collaborative developments of one-off indivisible structures under pressure. In these constrained environments the design-in-process becomes a shared resource, and thus can be subjected to Ostrom's (1990) commons governance. This nested, polycentric approach decentralizes authority and gives local groups substantial decision-making autonomy insofar they do not violate higher-level rules. When local groups fail to converge, they *defer* the search for satisfying solutions to top governing bodies. If commons governance is robust, collectives self-develop social norms of cooperation, trustworthiness, and reciprocity, and thus avoid tragic outcomes (Ostrom 1990). Recent work suggests commons governance can apply to collaborative developments under pressure (Gil and Baldwin 2013), but remains unclear if it applies to complicated mega-projects.

Fifth, it may be worth exploring the extent to which managers have scope to influence the sequence of entry of members into the core. It can be tempting to allowing the members with the most bargaining power over the design choices with greatest interdependencies enter the core first. But if the inclusion process is too slow, the resources maybe stretched too thin, momentum is lost and legitimation problems arise (Johnston et al. 2010). Thus there is a trade-off. And it remains undetermined here the extent managers have freedom to manipulate the order and pace through which the core grows and thus the sequence and pace of collective action problems that core members face.

CONCLUSION

This study offers an explanation for the prevailing perceptions of poor performance of mega-projects using the lens of meta-organizations. Prior studies on mega-projects have labeled slippages in time, cost, and scope as indicative of poor performance. By relaxing the assumption that mega-projects are unitary organizations, our study has uncovered a hybrid meta-organization. At the core, a porous collective led by a coalition shares the right to directly influence the final design of an indivisible structure for common use. At the periphery, a closed supply chain does the actual design

and build works, but has limited direct influence over the high-level choices. Our task here has been to explore the link between this organizational structure and performance.

We find that the changing nature of the core membership and the bargains and compromises struck among its members imply that the scope of the mega-project: a) will evolve considerably; b) will deviate substantially from initial estimates; c) will be measured on very different dimensions; and d) will always leave some core (and non-core) members dissatisfied. The conflation of committals to different baselines, differing preferences for efficiency and effectiveness, and rivalry in high-level choices gives rise to competing performance narratives which cannot be reconciled. Perceived performance is therefore ambiguous, and frequently described as disappointing by at least some stakeholders. Environment-driven changes to performance expectations exacerbate ambiguity in performance, but are not be the main reason as to why performance is ambiguous. The environment in which a mega-project unfolds creates a public record of initial targets created by de jure structures. These targets allow people to legitimate interpret them as commitments to unmovable milestones, and thus can be used to buttress accusations of underperformance when the expectations change.

In concluding, in the same way that beauty is in the eye of the beholder, when it turns to mega-project meta-organizations, different actors see different things. Their statements of performance are often political and shaped by the expectations that they choose to adopt as the baseline and by the extent to which throughout development and in the end the actors achieve what they crave.

ACKNOWLEDGEMENTS

We acknowledge the time and knowledge of all the professionals who participated in this research. We give special thanks to Don Ward—who helped negotiate access to the vast and busy London mega-project community—and funding from Constructing Excellence (recipient Lundrigan). We are also grateful for insightful discussions and comments by Sérgio Lazzarini, Sam Macaulay, and participants at the 1st and 2nd Megaprojects workshops: Theory meets Practice (London, Perth) and at the SMS workshop Public-private Governance, Social Value and Innovative Organizational Design (Paris). The authors are solely responsible for any errors, omissions, or inaccuracies.

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Table 1 - Summary of Characteristics of the Case Sample and Interviewees

Case	Goal	High-level framework for achieving the shared goal	Archival Database	Actors interviewed	Description of the actor	Informants interviewed by official job roles
London Olympic park	Develop Olympic park to host the 2012 Olympic games and catalyze regeneration of East London	~£7.1bn final public investment (2013) ~8 years of planning talks (1995-03) ~9 years to design and develop (2003-12) Immovable completion date	Total number (except news articles): 469 *Strategy and planning documents: 260* *Financial reports: 6* *Formal communication: 5* *Newsletters and PR documents: 111* *Design documents: 16* *Meeting minutes: 71* *News articles: 219*	Olympic Delivery Authority (ODA)	Public agency created to lead the development and delivery of the Olympic park	Chairman; two chief executives; design managers ('sponsors'); executive directors of: construction/ property/ procurement; finance/ commercial/ design and regeneration/ transport/ infrastructure; head of design; head of program assurance
				London 2012 Ltd.	Agency that produced the bid	regeneration advisor; transport advisor
				Games Organizer (LOCOG)	Private company created to deliver the games	Director of venues and infrastructure; head of venue development
				Olympic park operator (OPLC)	Public agency created to operate the park in legacy	Director of infrastructure
				Transport for London	Public agency in charge of London's transport	Director of games transport
				CLM ; Lend Lease	Private management and development firms	Program supply chain manager; director of infrastructure; program director; deputy head of procurement; assurance officer; commercial director
Heathrow Terminal 2 (T2)	Develop new airport terminal to co-locate the STAR Alliance	~£2.6bn final private investment (2014) ~4 years of planning talks (2002-06) ~9 years to design and develop (2006-14) Financial penalties if BAA unduly lets completion date and/or budget slip	Total number (except news articles): 114 *Strategy and planning documents: 74* *Financial reports: 6* *Formal communication: 19* *Newsletters and PR documents: 8* *Design documents: 4* *Meeting minutes: 3* *News articles: 40*	STAR Alliance	Consortium of airlines	Project director
				Air Canada	Member of STAR Alliance	General manager for commercial operations
				BAA	Private airport operator and owner	Planning and program director; capital director; project director; director of program control and performance; director of integration; director of operations; director of development
				HETCo; Balfour Beatty	Private design and build consortiums	Commercial director; construction director; project director
London Crossrail	Develop new cross-London high-capacity railway	~£15.8bn public-private investment (2014 estimate) ~6 years of planning talks (1995-01) after two previous failed attempts ~18 years to design and develop (2001-19) Flexible completion date	Total number (except news articles): 122 *Strategy and planning documents: 74* *Financial reports: 2* *Formal communication: 6* *Newsletters and PR documents: 23* *Design documents: 9* *Meeting minutes: 8* *News articles: 274*	Crossrail (CRL)	Public agency created to deliver scheme	Program supply chain manager; chairman; chief executive; executive directors of commercial/ procurement /technical/ central area/ infrastructure/ delivery/ program/ financial/ operations; chief engineer; chief of staff; project manager; head of risk management
				Network Rail	Public railway owner	Director of infrastructure; chief executive
				Transport for London (TfL)	Public agency in charge of London's transport	Director of operations
				Canary Wharf	Private funder of a station	Executive director
				Cross London Rail Links(CLRL)	Public agency created to promote the scheme	Executive chairman; acting chief executive/managing director; financial director

Table 2 - Evolution of the Membership, Scope, and Cost and Schedule Targets of the Mega-project meta-organizations in our Sample

Case	Mega-project lifecycle	Membership of the mega-project organization		Evolution of the Public Announcements of Performance Expectations associated to the System-level Goal		
		Core	Periphery	Planned scope	Estimated expenditure	Completion
Olympic Park	Embryo (9 years) 1994 to June 2003	Three Founders *British Olympic Association (BOA); UK Government; London government (Mayor)*	3 firms	Initial scope *1994, Build Olympic park and village* *01.03, Build Olympic park and village, regenerate swathe of derelict land, improve local transport system*	Initial cost estimate *12. 99, £1bn-£2.5bn (1999 prices)* *01.03, £1.98bn (2003 prices) (w/ 90% confidence) for Olympic park and land; private finance for Olympic village*	Immovable *summer 2012*
	Gestation (2 years) July 2003 to June 2005	Growth in membership *+ London 2012 bid company (founders' agent); 4 London boroughs; Architectural lobby; Transport bodies; 16 funders; International Olympic Committee (IOC); 35 Sporting bodies*	10 firms	Scope evolves and grows *11.04, Olympic park framed as catalyst of East London regeneration; Improve London transport network; add 'iconic' venues; athletics' stadium in legacy*	Slippage *11.04, £3.3bn (2004 prices)/£4.2bn (final prices without VAT) for Olympic park and land; private finance for Olympic village; £8.9bn for London transport schemes*	
	Delivery (7 years) July 2005 to July 2012	Growth in membership *+ODA (founders' delivery agent); private developer for Olympic village; Olympic Park operator; local communities; interest groups; late buyer of part of the Olympic village*	1,600 tier-one suppliers at peak	Scope evolves further and shrinks *2007, new master plan for sustainable Park in legacy with smaller permanent venues; fewer temporary venues; relocate and shrink Olympic village*	New slippage *03.07, £9.2bn (final prices w/ VAT): £6.1bn for Olympic park and local transport schemes + £3.0bn contingency + £8-9bn for London wider transport scheme* *12.13, £10.2bn (final prices w/ VAT): £7.1bn Olympic park and local transport schemes + security + others; +£7.2bn for London Transport schemes(§)*	
Heathrow T2	Embryo (4 years) 2002 to 2006	Three Founders *BAA; STAR Alliance; Industry regulator*	N/A	Initial scope *2005, Six terminal and third runway* *2005/6, One main terminal building with one satellite and airfield around*	Initial cost estimate *2005,£1-1.5bn (2005 prices)*	Initial target *2005, Phase 1 open in Summer 2012*
	Gestation (3 years) 2006 to 2009	Growth in membership *+Heathrow airport's broader airline community (over 60 airlines); Local Council; UK Home office; BAA Retail*	20 tier-one firms	Scope evolves and grows *2007, T2 will be a T5-like campus; phase 2 opening around 2016* *2009, Actively safeguard for phase 2 expansion; phase 2 opening in 2019*	Slippage *07.2006, £1.6bn (2006 prices) for phase 1; phase 2 budget unresolved* *05.2009, £2.2bn (2008/09 prices): phase 1 includes ~5% contingency (§); phase 2 budget unresolved*	Slippage *2006, Phase 1 opens 12/2012* *2009, Phase 1 opens 11/2013*
	Delivery (5 years) 2009-2014	Decrease in membership *Loss of critical member (BMI, STAR Alliance's domestic carrier)*	150 tier-one firms	Scope evolves further and shrinks *2010, Phase 1 gets further enhanced* *2013, Phase 2 postponed indefinitely*	New slippage *05.10, £2.6bn (2010/11 prices) for phase 1; phase 2 budget unresolved* *12.13, £2.6bn (final prices) for phase 1; phase 2 budget unresolved*	New slippage 2010, Phase 1 open 14/15 2013, Phase 1 open 2014

Crossrail	Embryo (6 years) 1995 to 2001	Three founders *Central Government; London Government (Mayor); City of London Corporation*	2 tier-one firms	Initial scope *1998-2001, 9km central London rail tunnel; 5 stations in central London*	Initial cost estimate *1998, £2.1bn (1998 prices) railway infrastructure and train cars; assumes scheme wholly privately financed* *2000, £2.3-2.8bn (2000 prices): railway infrastructure and train cars; assumes scheme wholly publicly financed*	Initial target *1998, open in 2008* *2000, open in 2011-12*
	Gestation (7 years) 2001 to 2008	Growth in membership *+CLRLL (founders' development agent); Parliament; 365 Petitioners; 37 local councils; transport agencies; Private funders of stations*	4 tier-one firms	Scope evolves and grows *2002, 118km East-West London railway; 8 stations in central London; new stations at Heathrow airport and London's Financial District*	Slippage *2003, ~£9.8bn (2002 prices): £6.9bn (infrastructure) + £2.9bn (contingency); ~£650m train cars (private finance)* *11.2007, £15.9bn (final prices w/VAT) including contingency (~£5bn) but excluding train cars (¥)*	Slippage *2003, Open in 01.2016* *2007. Open in 12.2017*
	Delivery (planned to last 11 years) 2008 to 2019	Growth in membership *+Crossrail Ltd (founders' delivery Agent); railway operator; property developers; High-speed 2 Ltd*	1,700 tier-one suppliers at peak	Scope evolves, first shrinks, then grows *2009, links to London Tube dropped* *2010, extra London station* *2012, safeguard interchange with HS2* *2014, 30km route extension to Reading*	Stable after initial drop *10.2010, £14.8bn (final prices) incl. contingency (~£3bn); assumes private finance for train cars (£1bn)* *03.2013, £15.8bn (final prices): £14.8bn (railway infrastructure)+£1.0bn train cars*	New slippage *2010, Fully open in 12.2018* *2013, Fully open in 12.2019*

(§) Construction prices inflation at 0% between 2008 and 2011

(¥) £10.3bn at 2002 prices gives a final price of around £13.6.bn using a discount factor of 3.5 % (the rate used in 2005), roughly comparable to Crossrail's £15.9bn final price (£13.28bn plus VAT at 17.5%)

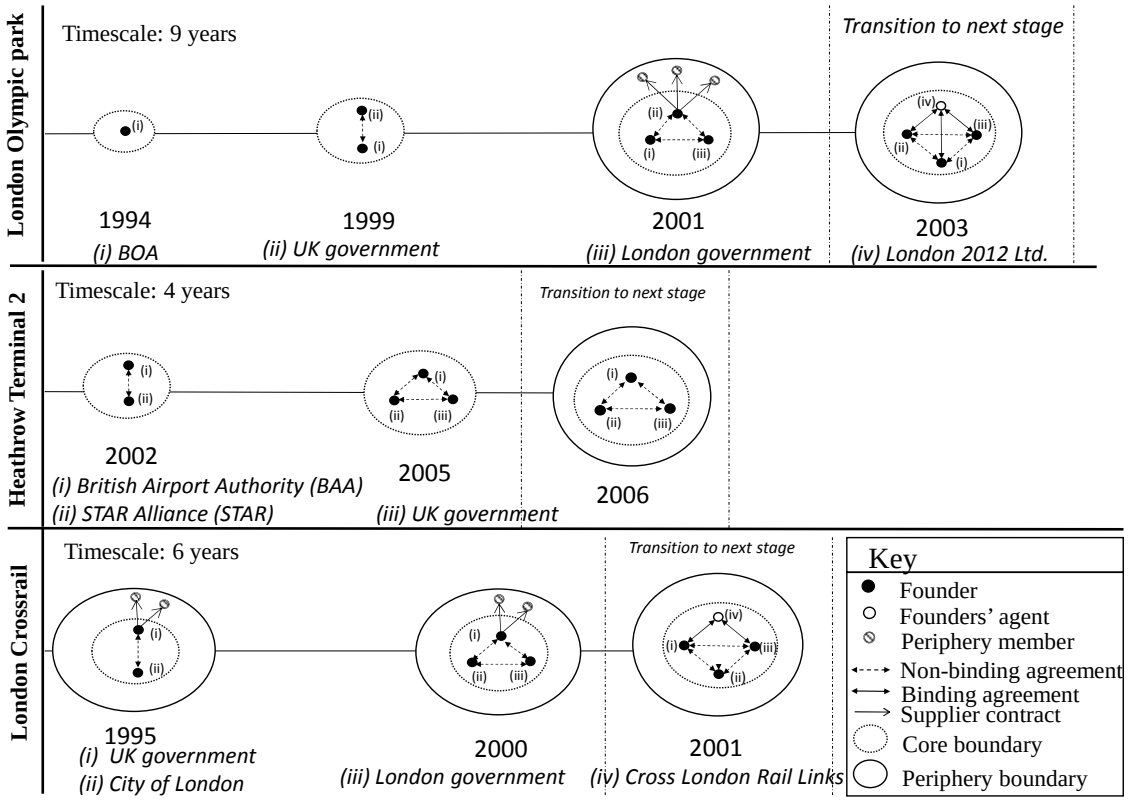

Figure 1 - Mega-project embryo: conceiving a meta-organization

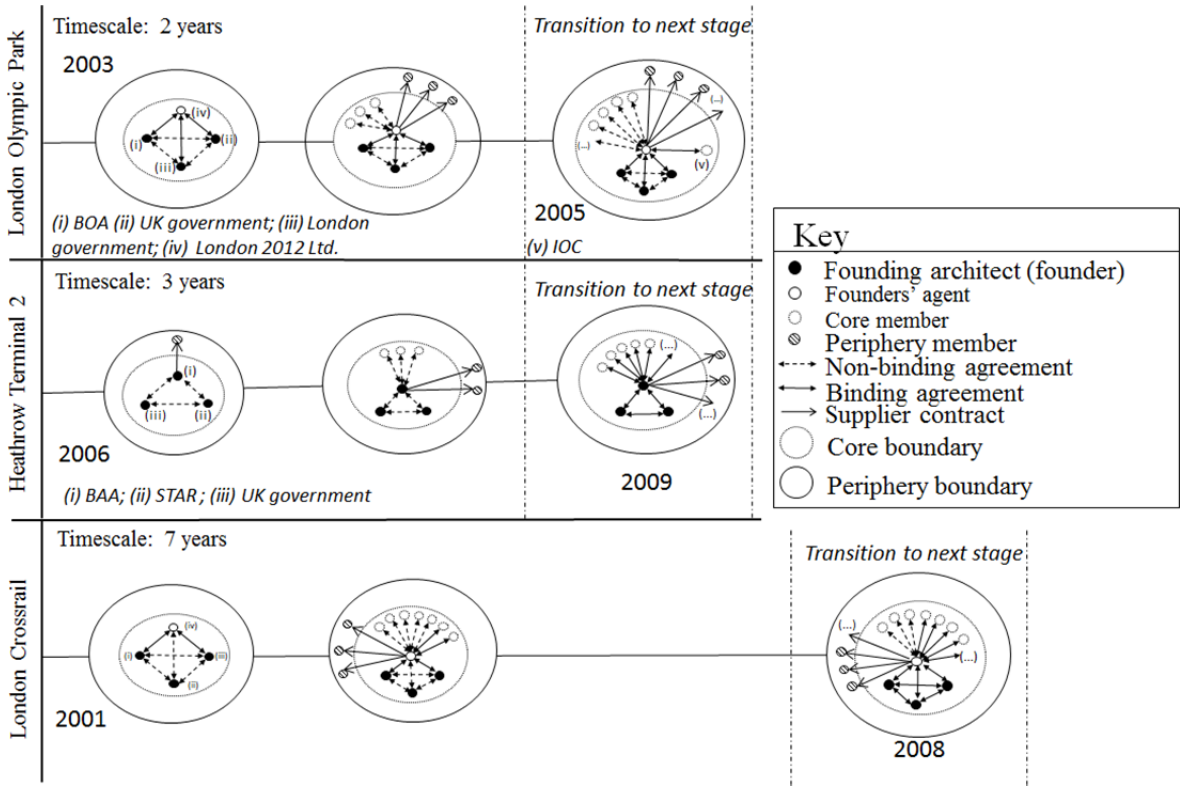

Figure 2- Mega-project gestation: widening the meta-organization structure

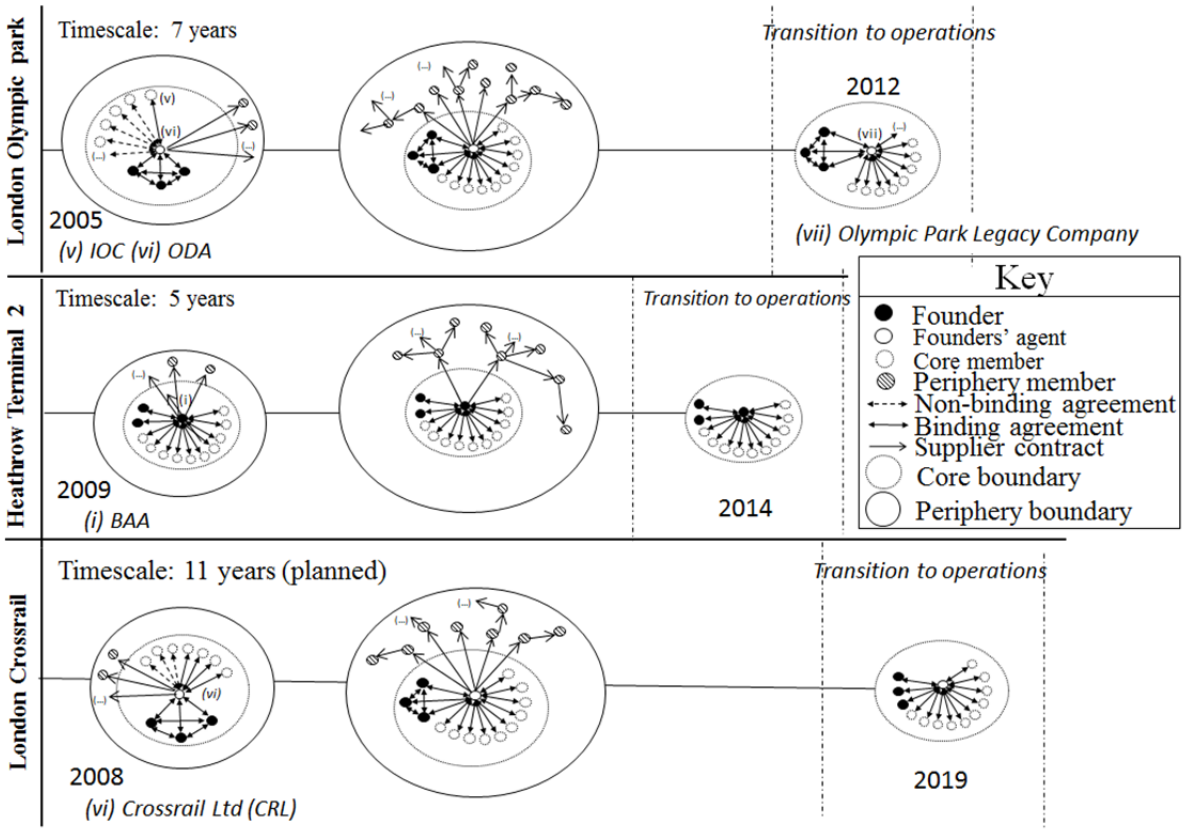

Figure 3 –Mega-project delivery: consolidating the meta-organization's structure

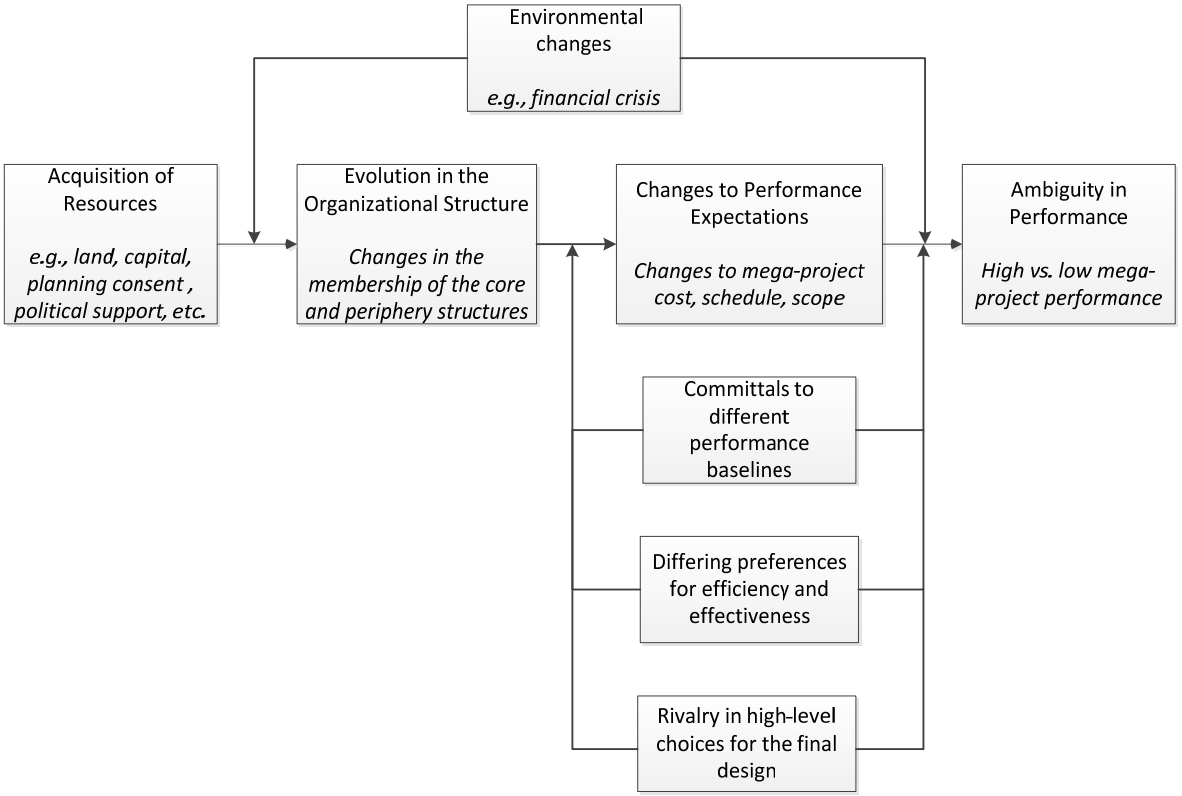

Figure 4 – The link between Evolution in the Organizational Structure and Ambiguity in Performance