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**Polycentric Organizing and
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Contingency Model and
Evidence from Megaproject
Planning in the UK**

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(Forthcoming in Research Policy)

January, 2018

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Polycentric Organizing and Performance: A Contingency Model and Evidence from Megaproject Planning in the UK

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This study sheds light on polycentric forms of organizing and corresponding performance implications. Organizations with a polycentric architecture supplement their internal hierarchical decision-making structures with egalitarian, local structures to encourage collaboration with independent stakeholders. We ground our study on the planning stage for four large infrastructure projects in the UK. We first establish that project planning is carried on by polycentric organizations. We show that in this form of organizing the promoter has decision-making authority over high-order choices, but shares the authority over local choices with groups of autonomous stakeholders. We also show how this architecture addresses local disputes and pressures to relax performance targets. Our main contribution is a contingency model that proposes four conditions linking performance to polycentric organizing, whether or not: i) the institutional environment empowers an ‘umpire’ to referee disputes; and ii) the system leader can mobilize substantial slack resources to reconcile conflicting interests. We argue that the four conditions reveal different classes of managerial problems, and draw implications for practice and policy including but not limited to megaprojects.

Keywords: megaprojects, architecture, polycentricity, organization design, collective action, performance

1. Introduction

A long-standing puzzle in management and policy literature is why empirical accounts repeatedly show that capital-intensive project organizations (so-called ‘megaprojects’) struggle to meet the initial performance targets. These accounts matter because performance slippages fuel a perception that the megaproject ‘failed’. This perception is rooted in institutionalised norms positing that ‘successful’ project organizations avoid scope creep and achieve the goals on time and within budget (Cleland and King 1968, Dvir and Lechler 2004). The London 2012 Olympics project is a case in point. The cost forecast of the 2002 plan was set at £3.55 billion (cash prices) with 95% confidence¹. By 2006, after four years of planning, the anticipated cost had soared to £7.0 billion (cash prices) with an additional £2.0 billion set aside as

¹ Pricewaterhouse Coopers (2013) Olympics Bid London 2012. Probability Assessment for the Department of Culture, Media and Sport, 13 January,

contingency, leading to public claims that the project leaders were willing “to spend money like water”². By 2012, the leaders came to their own defence, insisting that “Britain delivered” and that the £9.0 billion project was a story of “great leadership”.

Extant theoretical explanations for these empirical regularities fall within two broad groups. One group blames the organization that promotes and finances the projects (the ‘promoter’) for underestimating the performance targets. The explanations range from cognitive optimism bias and strategic misrepresentation (Wachs 1989, Flyvbjerg et al. 2003) to lack of planning and project management capabilities (Hall 1972, Morris 1994, Merrow et al. 1988, Stinchcombe and Heimer 1985, Ross and Staw 1986). The second view is equally common—that megaprojects simply cannot be planned reliably because of external events and of the vested private and institutional interests that lie outside the promoter’s control. Hence, in the second view, the promoters are hostage to political bargaining and externalities, which leads to project pathologies including scope creep (Szyliowicz and Goetz 1995, Shapiro and Lorenz 2000) and collective inflationary consensus (Altshuler and Luberoff 2003, Miller and Lessard 2000, Gil and Tether 2011). Neither approach addresses, however, the structures by which the planning process actually happens.

In this empirical study, we adopt an organization design perspective to move forward the debate on the causes of megaproject overruns and scope creep—a debate that has been stuck for more than 20 years (Pinto and Winch 2016). We argue that central to understand megaproject performance is the quality of the architecture of the organizations formed to plan megaprojects—this is, the fundamental organisation of the system in terms of its components, their relationships to each other and to the environment, and the principles guiding its design and evolution (Fjeldstad et al. 2012,

² Kelso, P. 2008. Olympic 2012 Chiefs willing to spend money like water, say MPs. *The Guardian*, 20 April,

Simon 1962). We claim that implicit to the unresolved debate on the causes of megaproject overruns is the assumption that megaprojects are ‘authority hierarchies’ over their life-cycle. In this study, we challenge the assumption that through employer-employee relationships, property rights, regulation, and legal contracts the promoter has complete authority to allocate resources and resolve disputes (Gulati et al. 2012). Admittedly, multiple accounts show that promoters have authority to set the performance targets at the onset of planning—in this regard, it is fair to say that promoters *act* as an authority hierarchy. Planning activities, however, consist of much more than simply setting targets. In planning, the promoter is unlikely to control all the resources necessary to achieve the system-level goal, e.g., finance, regulatory consent, property, political influence. Hence, the promoter needs to collaborate with multiple independent actors to encourage voluntary contributions of complementary resources (Lundrigan et al. 2015, Gil and Baldwin 2013). As such, planning involves designing structures and processes, and occurs *before* the promoter can ‘simulate’ (Stichcombe and Heimer 1985) an authority hierarchy through regulation, property rights, development agreements, and the buyer-supplier contracts needed for execution. That is, planning occurs in a ‘pluralistic’ setting where the authority to make decisions is diffused across multiple independent, heterogeneous actors (Denis et al. 2001). In pluralistic settings, major decisions require extensive communication and negotiations between self-interested organizations to resolve disputes rooted in cognitive differences and in conflicting goals, norms and interests (Pettigrew 1973, Jarzabkowski and Fenton 2006).

This understanding that interorganizational disputes are endemic in a pluralistic setting such as megaproject planning is instructive. However, it leaves outstanding the organizational design choices that managers make to create an interorganizational

context for searching for mutually consensual solutions. We know, however, that managers intuitively design contexts to attenuate the managerial complexity of collective action (Ostrom 1990). We also know that causal relationships between organization design and performance are contingent on the surrounding context (March and Sutton 1997). This reasoning leads to our core research questions: First, how is the planning stage of megaprojects organised from an architectural point of view? Second, how does organizational design impact performance? Finally, to which degree does the project context affect organizational design choices and performance?

In this paper, we address these questions through multiple-case research. This approach is useful to explore new ideas in comprehensive ways as it reveals the complexity in social settings and the longitudinal interconnections between events (Eisenhardt and Graebner 2007). Our sample consists of four large infrastructure projects in the UK: three projects promoted by the central government (two railways, Queen Elizabeth Olympic Park) and one promoted by a private firm (airport terminal). This sample varies in two dimensions with the potential to impact organizational design choices and thus critical to develop generalizable claims (Eisenhardt 1989, Eisenhardt and Graebner 2007). First, the sample varies in the decomposability of the architecture of the product being planned, a factor that design theorists claim to influence organizational design choices (Sosa et al. 2004, MacCormack et al. 2012, Colfer and Baldwin 2016). Second, the project organizations vary in their interdependency with the environment, a source of major uncertainty that again is long known to directly impact organizational design choices (March and Simon 1958).

Two main contributions follow from this multiple case research. First, we suggest that a ‘polycentric’ architecture is central to the design of capital-intensive project organizations in planning, irrespective of the architecture of the product being planned

and of the degree of interdependency with the environment. Polycentric systems are a known approach to decompose large arenas of consensus-oriented collective action (Ostrom 1972, 1990). The basic idea is to create a system of nested interorganizational groups of decision-making to reduce the coordination costs and encourage collaboration. These local structures enable independent actors to share decision rights and search for mutually consensual solutions (Dorobantu et al. 2017). Polycentric architectures are additive and collaborative because they supplement the authoritative decision-making structures within the organization with decentralised decision-making structures to which independent actors commit voluntarily (Ingram and Clay 2000, King et al. 2005). In our focal settings, the megaproject promoter has full authority to set upfront performance targets, to decide which decision rights it wants to share voluntarily and when, and to choose which actors in the environment it wants to bring inside the organizational boundaries. Our polycentric systems are thus a hybrid form of organizing which combines a hierarchy vested with unified authority to make high-level choices with egalitarian groups with shared decision rights over the local choices.

Our second contribution is to develop a contingency model that establishes logic for linking project organizational performance to a polycentric form of organizing. Our model is contingent on two administrative structures that can be deployed to resolve local disputes if the context allows: one structure is external to the polycentric system, and relates to whether the institutional environment empowers an ‘umpire’ or arbitrator to resolve the disputes that the organizational participants struggle to resolve on their own; the second structure is internal, and relates to the latitude of the system leader to mobilise substantial slack resources in order to reconcile conflicting interests.

We organize the rest of this paper as follows. First, we review our understanding about designing organizations in pluralistic settings. Next, we describe the research

design, sample, and methods. We then examine the product and organizational architecture of the sampled projects and variation in the structures deployed to resolve disputes. Based on our analysis we propose a contingency model of polycentric performance. We conclude with boundary conditions and implications to policy.

2. Designing Organizations in Pluralistic Settings

Pluralistic settings are characterized by the diffusion of decision-making authority. In these settings, decisions require lengthy discussion so the participants can understand complex issues and strike a consensus (Susskind and Cruikshank 1987, Thomson and Perry 2006). Diffused authority also makes politics and bargaining part of the decision-making process (Ring and Van de Ven 1992). Furthermore, the risk of inaction is also high if the decision-making participants mistrust one another and keep disputing each other's evidence—what Langley (1995) calls, 'paralysis by analysis'.

Organizations that aim for system-level goals that require pooling resources controlled by multiple autonomous and heterogeneous actors operate in pluralistic settings. This is the case, for example, of organizations in health care, infrastructure, and education—economic sectors where independent actors control interdependent but not necessarily transactional resources (Dennis et al. 2001, Jarzabkowski and Fenton 2006). This interdependency of the organization with 'external' actors is a threat to organizational survival. To attenuate this risk, the organization can manipulate the organizational boundaries; this is share decision rights with key stakeholders although they stay nominally independent. Endemic to such 'collective' strategy (Dorobantu et al. 2017) is a trade-off: less uncertainty in the environment comes at the expense of a loss in decision-making autonomy (March and Simon 1958). This is the trade-off that megaproject promoters face when they open the planning process to key stakeholders.

For example, accounts of planning for Heathrow Airport Terminal 5 show the airport owner involved the airlines in critical choices (Gil and Tether 2011, Gil et al. 2012).

Getting multiple independent, heterogeneous actors to achieve a system-level goal creates a problem of collective action that is prone to failure (Hardin 1968, Olson 1965). First, considerable conflict can be expected because the actors may agree to work together but still disagree over the system-goal since each actor has its own individual incentives and motivations (Ostrom 1990, Rittel and Webber 1973). Second, since the actors are independent, legal contracts cannot be deployed to simulate an authority hierarchy (Stinchcombe and Heiner 1985). Third, since the actors are drawn from different communities of practice, it is hard to set up a ‘meritocracy-based’ authority to resolve disputes (O’Mahoney and Ferraro 2007). Finally diffused decision-making authority across multiple heterogeneous actors makes it hard to use ‘dominant coalitions’ in order to enforce preferences on others against their will (Pettigrew 1973).

Although pluralistic interorganizational settings are so complex that they resemble ‘organised anarchies’ (Cohen et al. 1972), theorists in collective action claim that managers intuitively make organizational design choices to attenuate this complexity (Ostrom 1990, 2010, Dietz et al. 2003). One way is by creating polycentric systems to encourage cooperation and voluntary contributions of resources; that is, decentralising authority by setting up additional centres of decision-making with capacity for mutual adjustment that supplement the hierarchical structures inside the organization. In the archetype of polycentric systems, groups of local actors are granted latitude to manage local resources insofar as they stay within a set of rules devised by the higher-level authorities (Ostrom 1990). One example is the Maine lobster fishery, a polycentric system where state laws to protect the breeding stocks are supplemented by day-to-day fishing regulations organised by harbour gangs (Acheson 2003). Likewise, the Carte di

Regola that self-regulates the use of pastures in the Alps requires approval by the regional governments (Ostrom 2005). Similar polycentric systems have also been observed in the private sector around industry self-regulation (Maitland 1985), trade associations (Barnett and King 2008), and standard-setting (Leiponen 2008).

The concept of polycentricity resonates with the idea that management complexity can be reduced by grouping the participants on the basis of either similarity or complementarity of knowledge (March and Simon 1958, Thompson 1967, Nadler and Tushman 1988, Galbraith 1973). However, we lack empirical studies that explore questions of whether polycentricity can extend to enterprises where the higher-level authorities are unlikely to grant the local actors full decision-making authority. That is, the central authorities are willing to *share* local decision rights, but not to entirely ‘alienate’ (Jensen 1998) those very same decision rights to the local stakeholders.

Related to this issue, we also know little about how an organization working towards a system-level goal in a pluralistic setting can cope with high interdependency with the environment. A polycentric architecture internalises key stakeholders by giving them decision rights which reduces environmental interdependency (Ostrom 1990, Dorobantu et al. 2017). However, even polycentric systems cannot bring all the environmental actors impacted by the system into the organizational boundaries. Hence, the decisions of organizations operating in pluralistic settings are scrutinised by numerous third parties. This scrutiny is a source of controversy for decisions that allocate vast resources and impact property rights and yet are hard to reverse.

Complicating matters, scrutiny by third parties puts pressure on the organization to make commitments early on as illustrated by pressure on megaproject promoters to ‘lock in’ performance targets (Flyvbjerg et al. 2003). Early commitments reduce ambiguity in the value proposition and give the organization ‘pseudo-legitimacy’ to

acquire the resources necessary to achieve the goal (Stone and Brush 1996). However, bounded rationality makes it hard for the organization to make reliable commitments. Furthermore, were the organization to set overly conservative targets, the enterprise could collapse because the idea would be neither convincing nor compelling. As a result, the chances are real (and examples in megaprojects are innumerable) that organizations operating in pluralistic settings struggle to meet their initial commitments. Whilst relaxing the commitments helps to bridge differences, it erodes the legitimacy of the polycentric system to operate in the eyes of third parties (Denis et al. 2011). Still, we know little of how polycentric systems can help the system leader to encourage cooperation whilst responding to pressure to meet commitments.

We turn now to a discussion of how we investigated these questions.

3. RESEARCH DESIGN, SAMPLE, AND METHODS

This study adopted a multiple-case research design with embedded units of analysis (Eisenhardt 1989, Yin 1984). Case studies allow researchers to incorporate contextual and temporal dimensions, and thus are suitable to explore novel ideas (Eisenhardt and Graebner 2007). To advance theory and yield generalizable and robust insights, we built a diverse sample (Siggelkow 2007) consisting of four large infrastructure projects: i) London Crossrail, a high-capacity railway; ii) London 2012 (since renamed Queen Elizabeth) Olympic Park; iii) Heathrow Airport Terminal 2 (T2); and iv) UK's second high-speed railway (HS2). Table 1 summarises for each case the system goal, resource ownership, planning outcome, and data sources; Appendix I summarises the timescale, history, context, and evolution of performance targets.

--Insert here Table 1 --

We built diversity into this sample to increase the generalizability of our insights. The cases differ in the architecture of the product under planning (Figure 1 illustrates this point in a stylised way). An Olympic Park intuitively suggests a decomposable

system comprising a set of sport venues. The only exception is the underground utilities which are ‘slaves’, designed not to constrain the planning choices for the sport venues. In contrast, railways seem less decomposable since all stations connect to the same track and control systems and must accommodate the same train cars. In turn, an airport is suggestive of a hybrid system—some components are physically linked, for example, the tunnels that connect the concourses, but others, e.g., car park, hotel are not. Design scholars claim that managers leverage technological knowledge so as to reduce management complexity by aligning organizational architecture with product architecture (Sosa et al. 2004, MacCormack et al. 2012, Colfer and Baldwin 2016). We could infer from this logic that organizational architecture would vary across our sample, making it important to control for variation in the product architecture.

--Insert Figure 1 about here --

Our sample also varies the degree of interdependency of the project organization with the environment. The T2 project was promoted by BAA³, the regulated private owner of Heathrow Airport. In contrast, the other schemes were financed by central government acting alone (Olympic Park, HS2) or in a coalition with local government (Crossrail). An infrastructure project promoted by a monopolistic firm which owns the land is potentially less interdependent with the environment than one financed by the tax-payers involving compulsory land acquisition. Yet this conjecture is not linear because of the large contingencies observed in the UK public projects (discussed later). Furthermore, even in public projects the degree of interdependency with the environment varies. In the Crossrail and HS2 cases, for example, planning decisions had to be approved by the Parliament, but government had much more autonomy for

³ In 2012 BAA changed its name to Heathrow Ltd; we keep to the BAA name for the sake of simplicity

the Olympic Park. These issues raised the questions as to if and how variation in the interdependency with the environment would impact organizational design choices.

3.1. *Units of Analysis*

Multiple-case studies that embed a unit of analysis are useful to investigate a holistic question without overlooking operational details (Yin 1984). Accordingly, our units of analysis were planning disputes. Disputes are situations in which actors disagree and thus illuminate the conflict process and how people resolve conflict (Coleman and Ferguson 2014). In this study, the analysis of disputes was important to explore, first, how decision rights were shared and thus impacted organizational design; second, the extent to which we could trace performance to organizational architecture. Our focus, however, was not the negotiation processes. We agree that researching connections between organizational design and social networks is critical to further our understanding of organizational performance (Van de Ven et al. 2013). We also agree that dispute resolution hinges on the interplay between formal and informal mechanisms. But we cannot further our understanding of this interplay unless we understand the organizational structure in which it happens- the focus of our study.

3.2. *Data Collection*

Data collection was part of a broad research program to further our understanding of megaprojects from an organization design perspective. In 2011, we first gained access to the top managers of the Olympic Delivery Authority (ODA), the public agency established in 2005 to develop the Olympic Park. This agency reported to the four promoters but had no veto power over planning decisions. Between 2011 and 2014, we leveraged our access to the ODA top managers to, first, independently access top managers of other stakeholders participating in the planning for Olympic Park; and second, acquire similar levels of access to participants in the other three cases.

Data collection involved semi-structured interviews and analysis of archival documents. Appendix II includes the key questions of the research protocol that we used consistently across the four cases. We arranged the interviews by adopting a snowball approach (Biernacki and Waldorf 1981). Hence, for each case, once the top managers cognitively filtered major disputes, we asked for names of other people who had intimate knowledge of those disputes. In total, we conducted and tape-recorded 123 interviews, each up to 2 hours long. Follow-up interviews were conducted to probe deeper into particular issues, double check a verbal account, and bridge gaps in the database. We were not asked to sign non-disclosure agreements for interview data, but always sought permission to use verbatim quotes and offered to keep the source anonymous; some respondents gave us free rein to use the transcripts, whereas others disallowed the use of particular quotes. We committed not to share any reports that were not in the public domain. To gather extra data and allow for member checks (Lincoln and Guba 1985), we shared the findings with the respondents. We also invited 13 respondents to give talks and stay for lunch. For each visit, we produced hand-recorded verbatim notes of the talks and informal conversations at lunch time.

To improve data accuracy and the robustness of the insights (Jick 1979), we triangulated the verbal accounts against archival data (Miles and Huberman 1994). The planning stage of a large infrastructure project in the UK is highly regulated. In public projects, many documents are uploaded online because the promoter either elects or is mandated to do so under the Freedom of Information Act. Key documents included minutes of board meetings, letters exchanged between the promoter and development partners, and reports announcing performance targets and corresponding plans. In the case of BAA, we studied capital programs, master plans, and consultation documents. The disputes between BAA and the main user of T2, STAR (an alliance of over twenty

airlines), were documented in reports produced by the regulator and in exchanges between BAA, STAR, and the regulator. The inclusion of the HS2 case was important because the HS2 planning effort unfolded concurrently with data collection and analysis, which further limited the risk of account bias and created added opportunity to test the emerging insights (Denis et al. 2011, Miles and Huberman 1994). For all cases, we crosschecked information in the project documents against third-party reports. Hence, we combed through reports produced by the National Audits Office, Parliamentary committees, spending watchdogs, and other public agencies. Other sources of archival data were articles and interviews with top managers in professional outlets, e.g., *New Civil Engineering*, *Construction News*, and articles in the mainstream press, particularly for local disputes that had fallen in the public domain.

3.3. Methods

Following recommendations for inductive reasoning (Langley 1999, Ketokivi and Mantere 2010), we started the analysis by producing detailed accounts for each case. Each account provides a contextualised and chronologic understanding to guard against account bias. We then combined the use of Design Structure Matrices (DSMs) with qualitative coding to explore answers to our research questions. The DSM is a modelling tool from design theory that is suitable to investigate the architecture of complex systems (Steward 1981, Eppinger et al. 1994, Eppinger and Browning 2012). Specifically, DSMs enable researchers to represent a complex system into a square matrix by capturing the interdependencies between constituent elements. DSMs have shed light on organizational and product architectures and on logic between the two architectures (Sosa et al. 2004, MacCormack et al. 2012, Colfer and Baldwin 2016).

DSMs have rarely been used, however, to model the architecture of a planning problem, and thus we had to develop an original protocol. Our aim was not to

exhaustively model the planning problem. Rather, we sought to first confirm our intuition that the architecture of the planning problem differed across the sample; and second, we wanted to explore the potential impact of the sources of variation in our sample on the architecture of the project organization. We built the DSMs using data on the disputes identified by the respondents, which invariably revolved around planning for major components (sub-projects), e.g., a sport venue or a railway station. Our dataset includes 35 disputes (see Table 1 for their distribution across the cases, and Appendix III for a comprehensive list). To model planning for a component, the DSMs capture the interdependencies between five constituent decisions: i) local goal (affects interests); ii) cost forecast (affects budget); iii) capacity (affects viability in use); iv) footprint (affects land acquisition); and v) any controversial sub-element. We complemented the DSM analysis with data coding to build companion matrices that reveal, for each decision, which actors had rights to directly influence that decision.

The combination of the product and organizational matrices reveal a critical regularity across *all* cases: polycentric organizational architectures. Furthermore, the analysis reveals a first contingency affecting polycentric performance: the extent to which the institutional environment imposes an umpire, external to the project organization, with legal rights to arbitrate and settle disputes (and thus rights to directly influence the planning decisions represented in the DSMs). This analysis reveals a polycentric system in which local, egalitarian governing units were added to the promoter's authority hierarchy so as to make local choices by consensus. However, this approach cannot reveal how the local disputes impact the overall performance targets. As we sifted through the data to investigate this issue, we uncovered a second contingency affecting polycentric performance: the contingency funds that the promoter could mobilise to reconcile interests without having to relax the initial

targets. Variation in this variable, which was centrally manipulated by the promoter, radically altered the interdependency between the polycentric system and the environment. As we iterated between further analysis and theory development (Miles and Huberman 1994), a contingency model of polycentric organizational performance emerged. We stopped iterating when we reached theoretical saturation.

4. ANALYSIS

We have previously noted that polycentricity is an intuitive organizational design choice to attenuate the complexity of large arenas of collective action (Ostrom 2010). The basic logic consists of creating a nested system of local groups with restricted decision-making authority to facilitate interorganizational cooperation (Dorobantu et al. 2017). In the archetype of polycentric systems, the high-level authorities retain centralised control over the higher-order choices, whilst granting local decision rights to the local actors. The higher-level authorities may retain *de jure* power to enforce their local preferences; however, in robust polycentric systems, the higher-level authorities give autonomy to the local actors to search for local solutions; this is, a robust polycentric system lodges inner, self-organizing units that are committed to search for solutions within a solution space that is constrained by the high-level rules.

For all cases, our analysis reveals a more fragile implementation of polycentricity in that the higher-level authorities *share* local decision rights, and thus continue to participate in local decision-making. Table 2 illustrates the protocol that we used to interrogate the database of disputes and construct the matrices. Figure 2 illustrates the analysis with excerpts of the DSMs and corresponding organizational matrices.

<Insert Table 2 and Figure 2 here>

4.1. Variation in the Product Design Architecture of the Planning Problem

A first point to note is a degree of potential decomposability of the planning problems across all cases. The cells along the diagonals of the DSMs represent the

planning decisions (listed to the left of the rows) and the off-diagonal entries indicate interdependency between the decisions. For example, if the DSM has an entry in row *i*, column *j*, the decision concerning element *i* has an impact on the decision concerning element *j*. Hence, the decisions in the diagonal cells have inputs entering from the top and bottom decisions, and outputs leaving from the left and right sides. Invariably all the DSMs show densely populated clusters of off-diagonals 'x'. Each cluster reflects the reciprocal interdependencies among the constituent decisions needed to plan a functional component (i.e., a sub-project), e.g., sport venue, station, airport concourse.

For example, one component illustrated in Table 2 and Figure 2 is the Olympic Aquatics Centre. The decision to set its local goal as a 'massive iconic venue' was an input for local decisions on cost, footprint, and capacity; these decisions, in turn, were inputs to refine the local goal. Indeed, the initial goal for the Aquatics Centre had to be readjusted because: i) the forecasted cost made it unaffordable; ii) there was not enough land; and iii) a massive venue was unviable in use. As the goal was readjusted, the other local decisions also changed. One level down, the controversial decision to add a costly and 'stylistic' diving board turned out to be interdependent only with the planning decisions to set the local goal and the cost forecast for the Aquatics Centre.

In spite of this decomposability potential, the DSMs differ in the degree of interdependency between the component clusters, and thus in the degree of interdependency between the planning decisions for each subproject. For example, the Olympic Park DSM is sparsely populated off the component clusters. This result reflects the technological independency between sport venues and the modular architecture of the Olympic Park. The exception is the interdependency between local cost decisions since increasing the cost for one venue potentially leaves less money to invest in the other venues. In marked contrast, the Crossrail and HS2 DSMs show high

interdependency between the component clusters, and thus between subproject planning, due to the more integral architecture of the railway systems. For example, in the HS2 DSM, the local goals for each station are interdependent—the goals need to be analogous to respect equitability of investment across cities. Technological constraints in the railway systems, in turn, create interdependency between the decisions on the capacity and footprint of each station, while global budgetary constraints create interdependency across the local cost decisions. Hence, the railway DSMs are densely populated off the component clusters. In turn, the DSM for T2 suggests a planning problem with hybrid architecture: on the one hand, the cluster of planning decisions for the car park subproject is, apart from cost interdependencies, independent from the concourse and baggage system subproject clusters. However, the two latter components are physically connected, showing interdependency among the respective decisions on the local goal, capacity, and footprint.

4.2. The Polycentric Architecture of the Megaproject Planning Organization

Critically, our analysis uncovered limited variation across all cases on the distribution of decision rights and thus on the architecture of the planning organizations. The organizational matrices, at the right of the DSMs in Figure 2, show which actors have decision rights over which local decisions. All four matrices show a top governing body whose membership is restricted to the leading actors promoting the project. The promoter (in coalition or individually) and its agent are embedded in all the local decisions. For example, in the HS2 case, the UK government and its agent, HS2 Ltd., directly influenced all local planning decisions. Likewise, in the Olympic Park case, the four promoters and their agent, the Olympic Delivery Authority (ODA), shared decision rights over all the planning decisions through the Olympic board. One level down, and consistent with a polycentric architecture, the organizational matrices

show a fragmented structure of groups—so-called ‘project boards’. The participants in each board—local resourceful stakeholders and the promoter’s agent—share decision rights over local planning choices. However, the project boards are closed to opponents and to resource-poor stakeholders (although consultation reached all affected parties).

In addition, Table 2 and Figure 2 show that the influence of each group of local stakeholders is restricted to the component to be planned by that group. For example, the UK government and its agent, HS2 Ltd, share decision rights for the HS2 Euston Station plans with the London government, Transport for London (a local transport agency), and Camden Council (local regulator of land use); as one respondent said, “you could make HS2 Ltd its own planning authority, [but] that would flout democratic processes.” Likewise the UK government shares decision rights on the plan for the Manchester station with the Manchester government, Transport for Greater Manchester, and other local stakeholders. Nevertheless, the London stakeholders do not participate in the Manchester planning talks and vice-versa. Likewise, in the Olympic Park case, for each sport venue, a different group of sport bodies and other local stakeholders shared decision rights with the promoter. Last but not least, the analysis of the railway cases shows that the UK parliament also directly influences the local decision-making process. We will later consider the ‘umpire’ role of Parliament.

In sum, our analysis establishes the following insights. First, we consistently find a degree of decomposability of the planning problem. As expected, this decomposability is high for modular systems like an Olympic Park, but low for more integral systems like a railway. Second, we find no evidence of strict modular problems because the local cost forecasts are interdependent. Third, we uncover a fragile polycentric architecture irrespective of the product architecture or of the presence of an external referee. In this organizational design, the promoter centralises

authority over the higher-level choices, but shares local decision rights with multiple local stakeholders. We turn now to examine dispute resolution in this architecture.

4.3. Dispute Resolution within a Project-based Polycentric Organization

We noted that our focal polycentric organizations seek consensual choices at the local level. Building consensus within a solution space that is constrained by high-level choices, e.g., performance targets, set ex-ante with limited information about the interests of the local stakeholders leads to multiple disputes. Crucially, our findings show important variation in two administrative structures that can be mobilized to resolve disputes. The first relates to whether the institutional environment provides an ‘umpire’—this is an actor external to the polycentric system with a mandate to arbitrate and referee disputes as an alternative to the public courts.⁴ In our sample, the umpire was in evidence only in the railway cases. The second administrative structure relates to the amount of slack resources that the promoter can deploy so as to resolve disputes whilst masking the ensuing cost overruns from the public eye. We observed substantial slack in the public projects, but limited slack in the private project. We turn now to analyse how structural variation affects performance. Table 3 illustrates the analysis with a summary of the evidence for six disputes and Appendix III lists all the disputes.⁵

<insert Table 3 about here>

Variation in the use of an ‘umpire’ to resolve local disputes

Our findings reveal substantive variation as to whether an umpire to arbitrate between contending parties was or not institutionalised in the environment. In the Crossrail and HS2 cases, the Parliament was instructed by law to set up a committee to regulate land use. Hence, any actor who was ‘materially affected’ by the promoter’s

⁴ According to the Oxford English Dictionary *umpire* and *referee* are synonyms to denote the actor in power to exercise the final authority

⁵ Detailed accounts for each case with detailed information on the local disputes are publicly available

plans could lodge a petition in Parliament and refer dispute resolution to that committee. The dispute about the HS2 London Euston station (Table 3, #1) is telling. From the onset of the planning talks in 2010, HS2 Ltd indicated that the UK government preferred a utilitarian, modular station to keep the costs down. On the other hand, the local stakeholders argued that the existing station, which had not been modernized for 50 years, needed to be fully redeveloped. To persuade the central government to expand the subproject scope, the local stakeholders commissioned masterplans in support of their vision. However, under pressure to keep to the original targets, HS2 Ltd refused to cave in. It was then up to the Ministers in the Cabinet⁶, a level above, to decide what to do next, as one top official in HS2 Ltd explained:

HS2 Ltd, if you like, are the infantry out there; actually doing what they're told by [central] government. So HS2 Ltd get all the fights, appear to have all the fights, are the bad boys, but they're really only doing what they're instructed to do.

Consistent with polycentric organizing, our analysis on the Euston station dispute show that the local decision rights were *de facto* shared. The UK government may have had *de jure* power to impose its preferences, but rather than forcing the issue, they opted to compromise. After three years of planning talks, the scope and cost increased commensurately. Still, a number of issues remained outstanding and dispute resolution was deferred to Parliament; as one local official said, "HS2 Ltd. didn't persuade us that our points were wrong nor did they persuade us their points were right....[petitioning] is ultimately about making your case that your vision is superior." The Parliamentary committee was impartial, but also inefficient. It consisted of elected lawmakers who needed significant time to listen to all the arguments before making a judgement. In the Euston case, it took three years of Parliamentary debates and negotiations at closed doors until a consensual solution emerged that further inflated the scope and cost.

⁶ The UK Government Cabinet includes the Prime Minister and the most senior ministers

The Woolwich station dispute (Table 3, #2) shows a similar pattern—linking efforts to build local consensus with slippages in the cost target. In this case, after three years of talks, the promoter refused to add this station to the project scope so as to keep the cost forecast down and to avoid establishing a precedent. Petitioning thus gave the local stakeholders a chance to overturn what in their view was a flawed decision. After 40 months of hearing evidence, the Parliament ruled that the station should be built, and that the petitioners should partially finance the extra costs (over £250m⁷).

In marked contrast, we did not encounter evidence of external umpires to arbitrate disputes in the T2 and Olympics cases. In the T2 case, the more concessions on project scope that the airlines asked BAA to make, the more BAA asked the regulator to increase the airport levies, leading to disputes (‘we’re battling all the time’, according to one BAA respondent). Our findings show that BAA and STAR both routinely asked the airport economic regulator to mediate disputes. However, since it was within the mandate of the regulator to cap the levies requested by BAA, the regulator was not a ‘third party’ to the polycentric system. Furthermore, the regulator lacked legal power to settle disputes.

One example is the dispute about the main concourse (Table 3, #3). The airlines desired a modern campus, whereas BAA planned to simply replace old facilities (in part to avoid umpiring by public inquiry). Consistent with its preferences, BAA announced a modestly-budgeted £700m new concourse to open in 2012. STAR then wrote several letters to the regulator complaining that BAA was ignoring their needs, a claim that BAA found unfair—‘I can never get consensus on almost anything’, said a BAA director. In the end, BAA agreed to safeguard the airlines’ vision but demanded an increase in the levies. The regulator facilitated the negotiations by postponing the

⁷ All cost figures are presented in final (cash) prices for the sake of simplicity

deadline to complete the talks. For minor disputes, however, BAA and STAR agreed to recruit a retired director to arbitrate privately. In the gate dispute (Table 3, #4), for example, the airlines preferred ‘closed’ gates which they deemed more efficient, whereas BAA favoured ‘open’ gates so passengers could move around in the retail area and shop up to the time of boarding. The dispute was resolved after the arbitrator suggested ‘flexible’ gates which added some additional cost.

In the Olympic Park case, the participants in the local groups were also left to their own devices to settle disputes. In this case, because of the rigid deadline (a non-moveable date for the start of the Games), the Parliament rushed to give planning powers to the ODA, the promoter’s agent, right after the UK won the bid. Still, mindful that making unilateral decisions could cause a political backlash, the ODA appointed a ‘design sponsor’ for each project board and gave them a mandate to search for local consensual designs. The Olympics Aquatics Centre (Table 3, #5) offers a good example of how the planning talks led to substantive slippages in the cost targets. The promoter had pledged a massive venue designed by a famous architect but as the cost forecast started to climb, the goal became unviable. However, backing down from the public pledge was tricky—as one official said, ‘if you challenge them [the architect] they will just walk away’. Complicating matters was a constraint imposed by the International Olympic Committee on the minimum capacity of the venue and preferences of the local government, the future operator. Unable to defer the resolution of the dispute to an umpire, the parties resolved the issues by keeping the aesthetics, shrinking the venue size, and safeguarding a capacity increase just for the games. This negotiated solution doubled the cost forecast and a public outcry ensued—‘the history of the aquatics centre shows a risible approach to cost control’, said a watchdog⁸.

⁸ Kelso, P. 2008. Olympics 2012 chiefs willing to spend money like water, say MPs. *Guardian*, 30 April

Even more complex was agreeing a plan for the Olympic stadium (Table 3, #6). In this case, two claimants to the planning choices – the London Mayor and professional football clubs – opposed the bid pledge to fold the stadium into an athletics venue after the games. After two years of talks, the ODA suggested increasing the budget by 20% (~£100m) to build retractable seating and allow for dual use. Unmoved, football aficionados ruled out what they called a ‘jack-of-all-trades’ design. With time running out for the Games, the Olympic board went ahead with a technical design for the stadium that left both options open, incurring an increase in cost by some fifty percent. Still, the tussles between the disputants dragged on until 2014 when the dual-use idea was finally accepted by all the participants. By 2016, the conversion cost had reached £323m, more than doubling the initial cost forecast for the Olympic stadium.

In sum, resolving disputes consistently required throwing more resources (money, time) into the pot. This finding resonates with claims in the projects literature that promoters regularly underestimate the initial targets, leading to huge overruns downstream. Crucially, these results show that performance slippages are often rooted in local searches for consensus, but since the targets are set by the promoter, third parties find it tempting to blame the slippages on the promoter. We turn now to analyse how promoters can mobilise slack resources to mask slippages from the public eye.

4.4.Variation in the Use of Slack Resources to Resolve Disputes

A second source of variation across the sample of polycentric systems was the amount of slack resources that the central actor could mobilise to resolve the disputes. We focused our analysis on the contingency funds because they enable the promoter to internalise the cost of local concessions and sustain a public narrative that the project is ‘on budget’. In the sampled public projects, UK Treasury policy recommended promoters to set aside a substantial percentage of the initial cost forecast into a

contingency fund to neutralise ‘optimism bias’⁹. The elected leaders adhered to this policy unreservedly since they had no appetite to let the budget enveloped (defined as the cost forecast plus the contingency funds) publically slip multiple times. As one civil servant explained: ‘There’s a bandwidth there...if we push it [budget] too far we won’t get the project...so there’s that game that goes on to try and find what the [UK] Treasury’s real limits are...it’s a political decision.’”

The Olympic Park case is a good example of this phenomenon at work. The 2004 bid cost forecast (~£4.9bn¹⁰) turned out to be insufficient to meet the bid pledges and the multiple local disputes that were likely to ensue—‘it’s like the Olympics will solve all the world’s problems’, said one official. To get a grip on a chaotic situation, in late 2005, the promoter set a 2-4-1 target: two years to plan, four to build, and one to test. However, by 2007, numerous planning disputes remained unresolved and facing an immovable deadline, the promoter chose to set aside a large contingency (£2.0bn) on top of what was by then a much higher cost forecast (~£6.1bn); one official said:

Treasury were really, really clear...big envelope and never knock on our door for money...actually they were right...we were then able to make decisions...rather than being petrified because we didn’t have enough money to do what we needed to do.

Appendix A shows a similar pattern for HS2 and Crossrail. In both cases, the promoters faced a public outcry at the planning onset related to cost slippages. To mitigate the risks of further overruns the promoters set large contingencies. The use of the contingency funds was scrutinised by watchdogs to reduce moral hazard—‘[contingencies] are there for known risks, not for somebody’s betterment’, said one official. Similarly to London 2012, however, both Crossrail (NAO 2014) and HS2 (Butcher 2015) depleted their contingencies; still, in the public discourse, all projects were ‘on target’. In marked contrast, in the privately-financed T2, this procedure was

⁹ *Supplementary Green Book guidance-Optimism bias*, a recommendation issued by the UK Treasury

¹⁰ Includes £971m (venues); £89m (conversion costs); £640m (Olympic infrastructure); £1040m (non-Olympic infrastructure); £700m (local transport schemes); £766m (land) plus VAT (NAO 2007)

ruled out for two reasons. First, BAA seemed confident of its ability to parry any backlash caused by cost slippages since there was less public scrutiny. Second, since BAA had a guaranteed return on capital investment, the airlines and regulator were against large contingencies to keep the construction costs down. Hence the T2 planning unfolded with a single-digit risk provision that was insufficient to mask cost overruns.

In sum, our cross-case analysis reveals two consistent patterns: i) megaproject organizations are polycentric; and ii) slippages in the performance targets are necessary to resolve the local disputes that are endemic to these polycentric systems. Within this broad relationship between organization design and performance, we observe within-set variation on: 1) whether an external umpire exists to arbitrate disputes; and 2) the amount of slack that can be mobilised to resolve disputes. We turn now to discuss how these insights further our understanding of polycentric organizing and performance.

5. DISCUSSION

We noted at the outset that the debate on the causes of poor performance of megaprojects has been stuck for some two decades: one explanation traces performance slippages to agency and competence problems with the promoter (Wachs 1989, Flyvbjerg et al. 2003, Morris 1994, Merrow et al. 1988, Stinchcombe and Heimer 1985, Ross and Staw 1986; the other suggests that the promoter has limited agency in the face of externalities and resourceful stakeholders (Altshuler and Luberoff 2003, Miller and Lessard 2000, Gil and Tether 2011, Gil et al. 2012, Szyliowicz and Goetz 1995, Shapiro and Lorenz 2000). Here, we sought to move the debate forward by challenging the assumption that these organizations are authority hierarchies with centralised capacity to allocate resources and resolve disputes.

Our analysis first established that megaprojects evolve towards a polycentric architecture at the planning stage—a finding that is consistent with predictions of

theorists in collective action (Ostrom 1972, Ostrom 2010). Specifically, we show that the decision rights over the high-level choices remain centralised, whilst the local decision rights are gradually shared. Decision rights determine organizational boundaries—as Pfeffer and Salancik (1978: 32) argue, an organization ends where its discretion ends and another’s begins. Hence, the local stakeholders that are granted decision rights become *de facto* members of the project organization and yet, these actors remain nominally independent. An organizational system with these characteristics is inherently fragile and vulnerable to collapse—the active presence of the central actor across the decision-making hierarchy creates sharp heterogeneity in interests and resources in the local governance units (Ostrom 1990). This heterogeneity can lead to impasse if some participants choose to free ride; that is, demand concessions from the others without giving anything in return. The risk of free riding is particularly high in collective-action arenas formed to produce public and regulated goods given that the central actor is under pressure by the institutional environment to produce outcomes that are socially optimal (Hardin 1968, Olson 1965).

Still, the ability to evolve an authority hierarchy towards a polycentric architecture brings five advantages to the megaproject’s promoter—the designated leader of the polycentric system. First, the evolution towards polycentricity encourages interorganizational collaboration. If the system’s leader would withhold local decision rights, the affected stakeholders would be less willing to volunteer their own resources. By establishing multiple ‘negotiated environments’ (Cyert and March 1963), polycentricity creates conditions for the leading organization to remove bottlenecks on the path towards the system goal. For example, in the Crossrail and HS2 cases, we conjecture that the local governments would be much less likely to volunteer time, effort, and money if the central government ignored or just paid lip service to their

views. Second, the promoter retains centralised authority to announce global budgets and deadlines before and after it opens the organizational boundaries. Numeric targets fill the void created by the goal ambiguity that is endemic to organizations operating in pluralistic settings, and give these organizations legitimacy to operate (Denis et al. 2001, 2006, Stone and Brush 1996). For example, it is hard to conceive how the Olympics megaproject could forge ahead without a budget for bidding purposes.

Third, a polycentric architecture restricts the membership of each local working group to the actors with a direct stake on the local problem and with knowledge and other resources that are valuable to formulate a local solution. This ‘mirroring’ (Colfer and Baldwin 2016) at system level between the product and organizational architecture reduces the size of the local groups. However, the groups are heterogeneous to leverage resource interdependences and thus, locally, product choice is not aligned with a single organization. Still, the local groups are small, which facilitates norms of cooperation to flourish (Cemerer and Knez 1996, Heath and Staudenmayer 2000).

Finally, by negating the potential for promoter dominance in local choice, polycentricity allows for ambiguous projections of resource allocation without having to incur in strategic misrepresentation. This ambiguity creates space for conflicting goals and helps to avoid defections (Jarzabkowski and Fenton 2006, Denis et al 2001). Indeed, our findings suggest that the announcement of the initial performance targets—that reflect the promoters’ individual preferences and knowledge at the time of setting the targets—consistently enabled the boundedly-rational promoters to gain momentum for their plans. The target slippages that then ensued due to the political negotiations imbued in in the planning process were critical to keep the polycentric system afloat.

The main disadvantage of a polycentric organization lies in its inadequacy for meeting the normative expectations on delivering outcomes to target. A polycentric

system gives local actors decision rights within a constrained solution space. However, because self-interest encourages each participant in a joint search to try to optimize the solution from their individual perspective (Knudsen and Levinthal 2007), the local actors demand concessions; as March and Simon (1993 p.312) put it, ‘we create our wants, in part, by experiencing our choices’. The search for compromises puts pressure on the leader of the polycentric system to relax the targets. This pressure is exacerbated if the shared choices are hard to reverse and are long-lived, the case of megaproject planning, because people find it harder to give ground (Gil and Tether 2011).

However, the system leader lacks incentives to make concessions because those very same targets have created interdependency with the environment, and third parties expect the targets to stay stable. Hence, the leader of a polycentric system is in a Catch-22: if it governs by diktat, the local actors defect; if it abandons the targets, the project ‘fails’ in the eyes of third parties. It is thus reasonable to say that a polycentric system operates under the risk of imminent collapse if the participants in the local collective action arenas choose to free ride and refuse to compromise. The history of our cases is telling: two failed attempts to promote Crossrail, three failed attempts to host the Olympics; and an airport terminal awaiting replacement for 20 years. This evidence is consistent with agent-based simulations that show decentralized searches of solutions for interdependent problems can quickly bog down (Mihm et al. 2010).

Importantly, the fact that we saw polycentric architectures across our diversified sample suggests that megaprojects are a ‘population of organizations’ that share a common form of organizing and face similar environmental vulnerabilities (Hannah and Freeman 1989). Our analysis, however, reveals variation in the organizations’ blueprint for action, this is the structures and patterns of activity that can be mobilised to resolve the disputes that are endemic to polycentric systems. This variation

invalidates indiscriminate comparisons within this population of organizations, and informs the contingency model of organizational performance that we discuss next.

Polycentric Organizational Performance: Context Matters

Our analysis suggests that two key administrative structures can be deployed to resolve local disputes contingent on the project context: umpires and slack resources.

The Role of Umpiring

The umpire is external to the polycentric system and is institutionalised in the environment for giving an agent authoritative judgement over disputes. In other words, the umpire is a safeguard against the risk of self-interested actors failing to achieve a common interest (Olson 1965). Importantly, the umpire is different from private arbitration (Heine and Kerk 2017). Private arbitrators are members of the organization tasked to leverage their latitude in decision making and observability power to reward disputants with a greater share of the surplus of the joined activity (Lumineau and Oxley 2012). As such, private arbitrators are third party to the dispute, but not third party to the organization. In contrast, umpires such as the Parliament are similar to a public court and thus operate under strict procedural rules but lack expert knowledge.

The main benefit of an umpire is to avoid hold-ups by individual parties. This external referee cannot be co-opted, has no property rights, and is impartial. As a dispute-resolution structure, an umpire is more efficient than a public court. However, umpires lack knowledge and arguably a sense of urgency. Furthermore, the presence of an umpire encourages disputants, even if they support the system goal, to defer dispute resolution to the umpire. Hence, an umpire creates a negative precondition for cooperation, an insight in agreement with collective-action theory (Frey 1994, Ostrom 1990). Our findings also show that the intervention of the umpire repeatedly led to late cost overruns and delays. Umpires thus are effective to adjudicate disagreements.

However, they exacerbate the interdependency of the polycentric system with the environment by offering disputants a last-resort, delaying mechanism that makes it harder to meet normative expectations of the environment actors of high performance.

The Role of Slack Resources

Unlike umpires, slack resources, such as contingency funds, are controlled by the leader of the polycentric system, and represent a structure internal to the polycentric organization. The main advantage of slack resources is that they help disputants reconcile their interests without having to resolve the dispute, what Cyert and March (1963) call ‘quasi-resolution’ of disputes; as Moch and Pondy (1977: 356) contend, “with sufficient slack, there will be a solution for every problem”. However, as literature on slack in organizations also shows, there is a real risk of slack encouraging inefficient behaviour (see Dolmans et al. 2014 for a recent review). It is outside the scope of this study to resolve this trade-off in the context of polycentric megaproject organizations. Our purpose is to show that the amount of slack resources that can be mobilised to resolve disputes also fundamentally changes the management problem.

In our setting, public policy encouraged the promoters to establish large contingencies to accommodate cost hikes over time. In all public projects, the promoter took advantage of the policy and set conservative budgets; our analysis also shows that over time, the contingency funds were depleted to finance local concessions. This pattern merits two observations. On the one hand, by masking cost hikes, slack enables the promoter to claim publicly that the projects are on ‘target’. This finding does not mean that slack can decouple the polycentric system from the environment—“no project is an island,” as Engwall (2003) puts it. Still, if slack resources are substantial, they provide the promoter with the ability to make local concessions without violating the norms used by third parties to evaluate project performance. This circumstance

reduces the interdependency between the project organization and the surrounding environment, which attenuates uncertainty and thus reduces management complexity.

On the other hand, the fact that cost forecasts of the public projects invariably grew asymptotically to the budget envelope resonates with the notion of self-fulfilling prophecy – the idea that people’s behaviour, influenced by false expectations, causes those expectations to come true (Merton 1968). Self-fulfilling prophecies occur when public definitions of a situation become an integral part of the situation, and thus affect subsequent developments. In our case, public policy differentiates ‘cost’ and ‘budget’, but the two words are used interchangeably in lay discourse. Our data is insufficient to determine if policy misconceptions either made the promoter more willing to concede and/or made it easier for local stakeholders to force the promoter’s hand. However, our analysis does suggest that slack resources amplify the propensity for scope creep and corresponding cost escalation up to the threshold set by the slack that is available.

We turn now to summarise how the permutations of these two sources of structural variation give rise to four fundamentally different management problems.

A Contingency Model of Polycentric Organizational Performance

The possibility of alternative permutations of slack resources and umpires informs a contingency model of polycentric project performance. Figure 3 illustrates our main contentions in four quadrants. On the horizontal axis, we differentiate polycentric organizations with or without external umpires. On the vertical axis, we show internal availability of slack resources; slack is a continuous dimension, but for the sake of the argument we assess its availability categorically as either “limited” or “substantial.”

<Insert Figure 3 about here>

Our model proposes four classes of management problems. The top left quadrant—the ‘*robust*’ context—conflates limited slack with the absence of external umpires.

We propose that this context, the closest to meeting Ostrom (1990)'s design principles of a robust polycentric system, helps to create the most robust polycentric organization. Limited slack allows the participants to internalise moderate slippages in the performance targets, but makes visible to the environment major slippages. The lack of umpires, in turn, puts dispute resolution solely in the hands of the participants, making them fully accountable for any slippages that the public may see. The conflation of these two structures does not eliminate disputes given the heterogeneous membership of the local governance units—a source of organizational fragility. Still our evidence shows that the two structures combine encourage norms of cooperation to flourish. The T2 project is a good example. From the onset of planning, BAA and the airlines ruled out the use of excessive slack, denouncing the government's use of, in their view, 'over-egged budgets'. With a limited risk provision and no umpire to blame for eventual slippages in the performance targets, the participants worked hard to find compromises that could help them bridge their differences without major violations of the initial targets; in addition, they agreed to defer some disputes to a private arbitrator.

A different problem arises in the lower left quadrant—the '*challenging*' context—which conflates substantive slack with the absence of an umpire. Substantive slack is useful to resolve disputes and mask slippages in the performance targets from the public eye. The lack of umpiring, in turn, avoids the risk of late overruns due to external arbitration and encourages the participants to build consensus on their own. This context is nonetheless challenging because substantial slack undercuts the benefits of the lack of umpire to encourage collaboration to flourish, thereby creating a real risk that the participants will succumb to free riding (Dolmans et al. 2014). This is, slack disincentives self-interested participants in a collective-action arena from searching for a compromise within the initial solution space, encouraging them instead to ask the

system leader to mobilize slack to bridge differences. The Olympics Park project is a good example. Knowing that time was not a luxury for the participants, the Parliament immediately absented itself from serving as an arbitrator. A subsequent decision was made to build a hugely conservative budget. Whilst the contingency funds enabled the promoter to sustain a late narrative of high performance, their depletion to finance the resolution of numerous planning disputes created a perception of performance failure in the public eye. Hence, even if there are good reasons to mobilize slack, a challenge remains to convince third parties that the slack was not a source of inefficiency.

The problem in the lower right quadrant—the '*fragile*' context—conflates substantial slack with the presence of an umpire. Unlike grand coalitions formed to change the laws in the environment, polycentric systems only change the environment locally by creating local structures (Dorobantu et al. 2017). Hence, the presence of an external arbitrator, a structure which discourages cooperation, undermines the purpose of a polycentric system (Ostrom 1990). However, this source of fragility is attenuated by the fact that slack allows parties to internalise uncooperative behaviour. Furthermore, the umpires play a useful role to avoid impasse given the heterogeneity in the local governance units. In both railway cases, for example, the Parliamentary committee took years to assimilate the arguments and the cost forecasts slipped considerably. In both cases, the juxtaposition of contingency funds together with arbitration by the umpire enabled the promoter to avoid disputes from evolving into legal action and to sustain a rhetorical discourse that the projects were 'on target'.

Finally, we refer to the top left quadrant as the '*dangerous*' context because it conflates limited slack resources with the presence of an umpire. Significantly, our sample does not include a case under this quadrant. However, our analysis allows us to conjecture that this context creates a high risk of major performance slippages in the

public eye that erode the legitimacy of the project promoter and at the limit can trigger the collapse of the polycentric system. Indeed it was megaproject “failures” from a normative perspective in the UK, notably after dramatics cost escalation with the London Underground Jubilee line extension (Mitchell 2003), that triggered policy changes to discourage this situation, a point that we return to in the conclusion.

In sum, our contingency model recognizes that overruns are rooted in local disputes endemic to polycentric organizing, yet simply noting that performance slippages are endemic is not a satisfactory theoretical approach. Here we show how different permutations of two structures – one internal and another external to the polycentric system – create very different classes of management problems. Our model is therefore a first step toward a more general theoretical synthesis that addresses the question of why megaproject organizations perform the way they do.

6. CONCLUSION

In this study we demonstrate how polycentric systems contribute to achieve system goals in pluralistic settings and propose a contingency model of organizational performance that accounts for structural variation in the context. Polycentric architectures are an organizational design choice that determines the governance system. We do not claim that polycentric systems are universal in megaprojects, nor do we argue that they are superior to more stratified or egalitarian approaches. However, we show that polycentric systems are a viable approach to organize capital-intensive collective action. Instrumental in yielding these insights was an innovative use of Design Structure Matrices—a design tool that is appropriate to model complex systems. This is in agreement with the idea that major breakthroughs in scholarly debates are often triggered by innovation in methodology (Greenwald 2012).

Our insights are useful to reconcile two strands of conflicting explanations on megaproject performance. In agreement with claims that trace underperformance to externalities (Miller and Lessard 2000, Gil and Tether 2011), we found that major performance slippages are rooted in the interaction with resourceful stakeholders. However, we argue that these stakeholders are routinely internalised and are *de facto* organizational participants because they share local decision rights. In agreement with claims that trace underperformance to promoter's behaviour (Flyvbjerg et al. 2003, Morris 1994, Stinchcombe and Heimer 1985, Ross and Staw 1986), we confirm that the initial targets are set unilaterally and invariably optimistically. However, we propose that it is wholly inadequate to attribute empirical regularities to strategic misrepresentation and incompetence, especially considering that our study is grounded in the London's megaproject ecology—a very robust institutional environment and a setting excelling in project capabilities (Davies 2017, Lobo and Whyte 2017). Rather, we claim the performance slippages are rooted in a benign form of optimism—that striking multiple local consensuses will not be as costly as it actually is. Yet, building consensus is always a struggle (Dietz et al. 2003), and more so in fragile polycentric system where the central actor participates in local choice Under these circumstances, a good dose of optimism is a precondition to believing that ambitious goals are achievable; that is, the promoter's optimism bias is both a blessing and a curse.

Importantly, this study only illuminates the performance impact of the organizational design choices that mandate interactions for exchanging and mobilizing resources in pursuit of collective goals (Gulati and Puranam 2009). As such, this study is agnostic about how informal social structure affects the relationship between organization and performance; we also cannot shed light on the influence of emergent interactions, negotiation tactics, and patterns of individual behaviour and the norms,

beliefs, and values underlying such interactions, tactics, and behaviours. Still, we agree that explanations of performance should aim at combining formal and informal elements since underlying designed structures are actions carried on by individuals (Van de Ven et al. 2013, Simon 1947). Hence, our work is one step forward towards the development of a more holistic understanding of polycentric performance.

Reflecting on our findings, three boundary conditions are in order when assessing how far our insights might be generalizable. First, large infrastructure projects are socially complex but not so technologically complex that planning choices cannot be comprehended by multiple heterogeneous stakeholders. The fact that many actors can grasp what the issues are and what is at stake exacerbates the interdependency with the environment. Hence, a choice to set up a polycentric system responds to calls in the environment for more collaborative and inclusive decision-making processes. In contrast, in technologically complex settings such as aeronautical product development (Brusoni et al. 2001) and science (Tuertscher et al. 2014), the understanding of what is at stake is usually restricted to subject-matter experts. In these settings, even if a polycentric architecture is implemented to encourage collaboration, meritocracy-based authority can be used to resolve disputes, which creates a different class of problems.

Second, planning choices for large infrastructure projects are hard to reverse once approved, and impact the property rights of multiple actors who are often ill-defined due to overlaps of jurisdictions. Hence, planning choices are, perforce, controversial. However, not all capital-intensive projects impact property rights or unfold under contentious system goals. In the response to the Columbia space shuttle disaster (Beck and Plowman 2014), for example, a benign system goal enabled cooperation and a sense of collective identity to flourish rapidly between dissimilar actors who had never

worked together. This circumstance suggests that the quality of the system goal is another boundary condition that merits further investigation.

Finally, our study is grounded in the UK context, an institutional environment that encouraged polycentric organizing; umpires and slack resources are also designed arrangements rooted in UK policy. These structures, however, are not universal. Likewise, the UK emphasis on formal cost-benefit analysis to resolve disputes is also not universal. As Porter (1995) notes, intimate social networks among elites in some countries allow for much more informal decision-making processes. Hence, caution is needed before extending our insights to very different institutional environments.

Limitations notwithstanding, our study offers some important implications for policy. The regular occurrence of scope creep and overruns has dogged the reputation of megaprojects and their promoters. Implicitly at work here is the assumption that promoters have centralised authority throughout the megaproject lifecycle. This misconception has fuelled ideas that promoters are not to be trusted, maintain secret agendas, and are loath to divulge “real” cost data, all of which influence policy including optimism bias and the use of umpires. Recognizing that planning choices occur within a polycentric system suggests a different direction for policy. If organization design allows for shared decision rights, then policy ought to encourage shared accountability for outcomes. This implication suggests, for example, that policy could require the resourceful stakeholders who support the system goal to accept private arbitration to resolve disputes, freeing the time of umpires to resolve the disputes with stakeholders that remain outside the polycentric system. Private arbitration would reduce the interdependency of the polycentric system with the environment. This, in turn, would enable to reduce the reliance of the polycentric system on slack and mitigate the risk of inefficient and opportunistic use of resources.

In conclusion, polycentric organizing is an organizational design choice to create collaborative local structures to achieve system goals in a pluralistic setting. Structural variation creates fundamentally different classes of problems within a polycentric form of organizing. These insights do not make polycentric organizations less complex to manage or suggests simple solutions. However they illuminate the underlying structure of the problems and help us to move forward the megaproject performance debate.

Acknowledgements

We acknowledge the time and knowledge of all professionals who agreed to participate in this study. We give special thanks to Don Ward who introduced us to top management of the London megaprojects. We are also grateful to Carliss Baldwin who first saw value in deploying collective-action theory to illuminate this complex form of organizing work. Finally we appreciate the thoughtful comments from Graham Winch, our editor Paul Nightingale, and the anonymous reviewers who helped us sharpen our arguments. We also thank the support of the Alliance Manchester Business School research fund. We are solely responsible for any errors, omissions, and inaccuracies.

APPENDIX I–Summary of Sampled Projects: History, Context and Performance

History of the Project Organization and Surrounding Context	Summary of Evolution in the
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	Global Performance Targets (cash prices unless stated)
<p>Crossrail: <u>Main Planning Effort:</u> occurs between 2001 and 2008. <u>Prior History:</u> The idea of building a cross-London railway first gained momentum in the seventies but the UK government dropped the plan after a few years because of cost concerns; the idea was reignited in the nineties but planning again unravelled after five years due to cost-benefit concerns. The start of the third attempt happened in 2001 when the UK and London governments formed a coalition to promote the scheme. <u>Performance baseline:</u> during planning talks, the goal evolved from a 9km central London train to open by 2012 into a 118km high-capacity commuters' train to open by 2017; the cost and schedule targets evolved commensurately. <u>Context:</u> Construction could not start before the promoter acquired from the Parliament the power to force land sales. Planning unfolded under pressure to submit a proposal to Parliament before the 2005 elections; in 2008 Parliament gave the UK government authorization to proceed.</p>	<p>Actual cost forecast evolution 2001, ~£4.7bn 2003, ~ £9.8bn 2007/8, ~ £10.9bn Final (as of 2016) ~£14.0bn</p>
	<p>Contingency funds 2006/7, ~£5.0bn 2010, ~£4.0bn (~ £1.0bn removed after financial crisis) 2016/7, no contingency left</p>
	<p>Completion date evolution 2000, fully open in 2012 2003, fully open in 2016 2008, fully open in 2017 2016: fully open in 2019/20</p>
<p>Olympic park: <u>Main planning effort:</u> occurs between 2001 and 2007. <u>Prior history:</u> The idea of hosting the 2012 Olympics in London emerged in 1995 after the third loss for the UK loss of the Olympics contest. In 2001 the UK government formed a coalition to promote the scheme with the London government and the British Olympic Association. <u>Performance baseline:</u> In 2002, the International Olympic Committee (IOC) opened the contest; the UK was given two years to develop an intermediate bid and six more months to submit the final bid; the scope and cost forecasts evolved during the bidding process and afterwards. Facing an immovable deadline, the promoter spent 18 months after winning the contest to refine the plan and produce a performance baseline ('Yellow book'), which was updated in 2009 ('Blue Book'). <u>Context:</u> after London gained the contest, Parliament rushed to give government the power necessary to force land sales; and LOCOG, a IOC's watchdog, joined the promoter organization and gained veto power on the top governing board.</p>	<p>Actual cost forecast evolution 2002, ~ £1.1bn 2004, ~ £4.9bn 2006/7, ~ £6.1bn Final, ~£8.1bn (<i>includes post-games conversion</i>)</p>
	<p>Contingency funds 2006/7, ~£2.0bn 2013, no contingency left</p>
	<p>Completion date immovable <i>But some major planning disputes were only temporarily resolved for the Games in 2012, e.g., dispute around the design of the Olympic stadium</i></p>
<p>Heathrow Airport T2. <u>Main planning effort:</u> occurs between 2005 and 2009. <u>Prior History:</u> The goal of consolidating all operations by Star Alliance, a network of over 20 airlines, in a new terminal was announced in 2005; in that same year BAA, the private airport owner, started building Terminal 5 to consolidate the operations of One World, a rival alliance; <u>Performance baseline:</u> The initial goal was to replace the old T2 building with a new building so-called 'Heathrow East'; BAA also aimed to complete planning by 2008 to coincide with the end of the regulatory cycle, but the end of planning was later delayed to 2009. During planning, the T2 goal evolved into a modern T5-like campus to develop in two stages; the first stage would open by 2013 and the second by 2018. The first phase opened in 2014; as of 2017, no plan exists to start the second phase. <u>Context:</u> Construction could not start before the performance baseline was approved by the regulator. By regulation BAA had to treat all airlines the same way; the opening of T5 put BAA under pressure to open T2</p>	<p>Actual cost forecast evolution 2005, ~ £1.3-1.8bn 2006, ~ £2.0bn 2008, ~ £2.4bn Final (2015): ~£2.8bn</p>
	<p>Overall contingency funds 2008, ~£200m</p>
	<p>Completion date evolution 2005, open in 2012 2008, open in 2013 Actual completion (1st phase): 2014; 2nd phase put on hold</p>
<p>High-speed 2 <u>Main planning effort</u> occurs between 2009 and 2017 (first phase) and 2009-2020 (second phase) (<i>as of 2017</i>). <u>Prior history:</u> The idea to develop a new national railway gained momentum in 2008 after the financial crisis. In 2009 the UK government created HS2 Ltd, a public agency tasked to plan the scheme. <u>Performance baseline:</u> The initial goal was to open the first phase connecting London and Birmingham (225km) by 2026 and</p>	<p>Actual cost forecast evolution (10/11 prices) 2010, ~ £22.7bn 2012, ~ £22.7-27.6bn +£5.8bn (train cars) 2014, ~£28.2bn+£6.0bn(train cars) 2017, ~£37-40bn+£6.5bn(train cars)</p>

<p>open a second phase connecting Birmingham to various Northern cities (248km) by 2032/3; in 2015, scope shifted between the two phases and pledges were made to develop more railway lines. <u>Context:</u> Construction could not start before government acquired from the UK Parliament the power to force land sales. Planning unfolded under pledges that the plans for the first phase would be approved by Parliament before the 2015 general elections; the plans for the first phase were finally approved two years late in March 2017.</p>	<p>Contingency funds (10/11 prices) 2010, ~£7bn 2013, ~ £14.4bn 2017, ~£ 5.0-8.0bn</p>
	<p>Completion date evolution 2010, planning (1st phase) done by 03/2015 2015, planning (1st phase) in 2016 2017, planning (1st phase) ends Opening dates unremoved</p>

APPENDIX II – Research Protocol for the Semi-structured Interviews

- What was your role in the project development process?
- Which were the major planning disputes to emerge in the development process?
- What were the main causes of these disputes? Who were the disputants?
- Who had ultimate decision rights to make the final planning choice?
- Could monies from the contingency funds be withdrawn to resolve the disputes?
- To what extent could the disputes be anticipated at the onset of planning?
- Were their external/internal arbitrators in place to help resolve the disputes?
- Who set the initial project performance targets (time, money, scope)?
- How much leeway did you have to change the performance targets over time?
- Where did the meetings to resolve the disputes occur? who attended the meetings?
- How long did it take to resolve a major planning dispute?
- Why was it difficult to reconcile the conflicting interests?
- Were the disputants framed as stakeholders or as development partners?

APPENDIX III – Comprehensive List of the Dispute Dataset

Case	Brief Description	Illustrative quote
Olympics Park	Olympics Stadium: Conflicting goals for the venue in legacy	We went back to the Olympics Board three times because there were strong tensions [ODA official]
	Olympics Stadium: Uncertainty around the design requirements	Broadcasters came to the party quite late ...once they arrive they start to say 'we want' ..it's continuous negotiation [ODA official]
	Aquatics centre: Initial goal for the venue turned out unrealistic	The architects wouldn't compromise an inch.....they threatened to walk away...everything was on the table [ODA official]
	Aquatics centre: Conflicting design requirements	The federation [FINA] wanted us to do a complete redesign of the diving boards...we held the line [ODA official]
	Aquatics centre: Conflicting design requirements	We assumed that we didn't need to heat the wings...LOCOG quite late said, 'it's not fit for purpose' [ODA director]
	Aquatics centre: Conflicting goals for the venue in legacy	The priority must be to achieve a facility that meets the long-term need of the community [Newham council]
	Olympic village: Dispute with the London Mayor interests	The Mayor didn't like the design of the village, thought it was a soviet-style blocks. ..he made good points that led to changes [ODA official]
	Olympic village: Dispute with LOCOG, the games operator	When you are talking about 2,800 apartments, keys are a pretty expensive proposition...we don't agree who should pay for it [ODA manager]
	Olympic village: Dispute with the building regulator	The fact we're not putting kitchens created a problem with the organisation that needs to say the building is fit for occupation [ODA top manager]
	Olympic village: Conflicting interests with the future landlord	In the stairwells design', there was exposed concrete finish...They decided that's not the way a professional development should work [ODA manager]
HS2	Euston station: Conflicting interests with local government	We oppose HS2 Euston station because it will devastate our borough [Local Council leader]
	Manchester station: Conflicting goals with local stakeholders	They [HS2] came up with the option that it was one station next to another, and we don't want that; this is a once-in-a century opportunity [Council official]
	Manchester airport station: conflicting business cases	It is not our gift to give it [station] to them ...If they want it, they have to pay, or prove that the business case is better [HS2 top manager]
	East Midlands route: conflict with private interests	Where the route came out, it would have been allocated to a major freight hub which a private developer was investing in [HS2 official]
	Euston station: conflicting goals with London agencies	What they [HS2 Ltd] said was, 'we don't think that what you're asking for is absolutely necessary' or 'what you're asking, you could do it yourself ' [TfL official]
	Sheffield Station: conflicting preferences for location	They will be disappointed because they feel they are not getting a city centre station... we said 'there is just no viable way you can do this [HS2 Director]

	HS2-HS2 link: conflicting assessment of disbenefits	The current proposed HS2-HS1 link is, I believe, sub-optimal and should be reconsidered [HS2 Chairman]
	Leeds Station: dispute over the location with local stakeholders	They couldn't understand why we felt that our station [south of central station] worked better than the one that they wanted [HS2 director]
	Birmingham station: dispute with local stakeholders	I can't offer them everything that they want... they want to be assured, for example, that the station is world-class, but what is world-class? [HS2 official]
	Chilterns route: dispute with local stakeholders	If the constituents want a tunnel and put sufficient pressure on their councillors, the Council will petition. It's the way that politics works [HS2 official]
	Crewe station: conflicting goals with local stakeholders	The Crewe station is £200m ..it wasn't part of the original remit; no. But we've looked at it, and the business case pays for itself [HS2 official]
Heathrow T2	Masterplan: conflicting goals with the STAR airlines	There was a view in 2005... to demolish T2 and to replace it with a building.. we weren't going to build a campus [BAA director]
	Concourse layout: dispute with the STAR airlines	We wanted retail on the way, not in the way [Star director]...there were a number of changes as a result of revising the drawings [T2 Project leader]
	Terminal gates: dispute with some STAR airlines	We[BAA] like open gates...there are significant capital savings, [but] a couple of airlines were very much against open gates [BAA Top manager]
	Concourse: conflicting design preferences	We will leave them [fountains] where they are... Some of the people get a bit blasé it only costs a quarter of £1m. OK, you write the cheque [BAA leader]
	Aircraft stand design: conflicting design preferences	Operations are quite keen to change the precondition air units and we have pushbacked very hard on that ... it stays where it is [BAA project leader]
Crossrail	Kensington station: conflicting assessment of business case	They [Council] lobbied very hard for and felt very upset that they weren't going to get that [London government official]
	Farringdon station: dispute with the local stakeholders	Will the Minister join me in urging Crossrail to build some toilettes ? ... At the end of the day, men piss (sic) against everything around here [Politician]
	Woolwich station: dispute with local stakeholders	Treasury was saying, 'you can't have any more money' and Parliament was saying, 'we'll refuse to report the bill unless there's a station [Crossrail director]
	Canary Wharf station: dispute with the private developer	They [Crossrail Ltd] were basically asking us to comply with a standard for escalators that wasn't relevant [Private Developer manager]
	Outer London stations: dispute with the local governments	What is disturbing about this [decision to descope outer London stations] is that it creates an outer- versus inner-London discrimination [Politician]
	Farringdon station: dispute with the local government	The London council protested quite heavily because we were actually going to take quite valuable playing fields [Crossrail manager]
	Paddington station: dispute with the London Underground	We tried to delete an underground link to Bakerloo line but that didn't work because LU still believe they need to link ... it's a shame [Crossrail manager]
	Systems technology: dispute with the EU railway regulator	We said, this technology won't be developed in time; and their argument is, 'can't you pay to get it developed to the market in time? [Crossrail manager]
Seating arrangements: conflicting design preferences	Some people are saying we should get rid of the cross seats, but is that a train people are going to accept, a train that looks like a big tub? [TfL official]	

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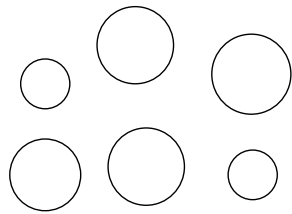
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Table 1 - Description of the Sample of Cases, Interviewees, and Archival Database

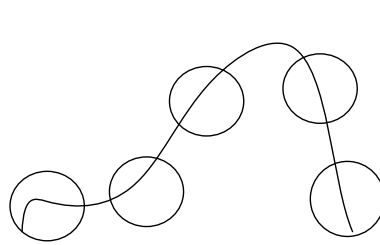
Cases	London 2012	Heathrow T2	London Crossrail	UK High-speed 2
System-level goal	Build an Olympic park to host Games and catalyse urban regeneration	Build a new terminal campus to create a dual-hub at Heathrow airport	Connect the East and West outer London with a new high-capacity train system	Build a cross-country railway to increase transport capacity and trigger economic growth
Membership of the project promoter	Coalition: <i>UK and London governments; BOA(§); LOCOG(§)</i>	Coalition: <i>BAA, STAR airline, Airport regulator</i>	Coalition: <i>UK and London Governments</i>	Solo: <i>UK Government</i>
Distribution of the ownership/ direct control of key resources to achieve the system-goal	LOCOG/IOC controlled the Olympic brand; UK government controlled finance; London government controlled the land; sport bodies controlled design requirements	BAA controlled the land; central government and local authorities controlled planning consent; airlines controlled knowledge of needs in use	UK & London governments controlled finance; UK Parliament controlled legal power to compulsory buy land; local authorities regulated local construction works	UK government controlled finance; UK Parliament controlled the power to compulsory buy land; local authorities on the HS2 route had knowledge of operational needs for local stations
Outcome of the planning effort	Formal performance baseline <i>Yellow book (2007)</i> <i>Blue book (2009)</i>	Legal contract setting performance targets <i>5-year capital investment plan</i>	Legal contract setting scope and assurances <i>Parliamentary bill</i>	Legal contract setting scope and assurances <i>Parliamentary bill</i>
Interviews	36 (10 disputes)	19 (5 disputes)	33 (9 disputes)	35 (11 disputes)
Number and description of organizations interviewed	8: <i>London2012 (bid company) ODA (promoters' agent); LOCOG (games operator); OPLC (park operator); Transport for London ; CLM (programme manager); Land Lease (private developer); Network Rail (owner of rail infrastructure)</i>	5: <i>STAR Alliance, Air Canada, BAA, HETCo and Balfour Beatty (private design and build companies)</i>	8: <i>CLRL (promoters' planning agent); Crossrail, (promoters' delivery agent); Network Rail; UK Treasury; Transport for London (TfL); Canary Wharf (private funder); Bechtel, Transcend (consultants)</i>	11: <i>HS2 Ltd (promoter's agent); Manchester City Council (MCC); Greater London Authority (GLA); Transport for London (TfL); Borough of Camden; Transport for Greater Manchester (TfGM); Network Rail; UK Treasury; Manchester Airport; CH2MHill, AECOM (consultants)</i>
Archival data	Total number of documents: 134	Total number of documents: 114	Total number of documents: 122	Total number of documents: 101
Documents on the planning effort organised by categories: (news articles in the press not included)	<i>Strategy and planning documents: 84</i> <i>Financial reports: 6</i> <i>Formal communication: 5</i> <i>Newsletters and PR documents: 17</i> <i>Design documents: 7</i> <i>Meeting minutes: 15</i>	<i>Strategy and planning documents: 74</i> <i>Financial reports: 6</i> <i>Formal communication: 19</i> <i>Newsletters and PR documents: 8</i> <i>Design documents: 4</i> <i>Meeting minutes: 3</i>	<i>Strategy and planning documents: 74</i> <i>Financial reports: 2</i> <i>Formal communication: 6</i> <i>Newsletters and PR documents: 23</i> <i>Design documents: 9</i> <i>Meeting minutes: 8</i>	<i>Strategy and planning documents: 46</i> <i>Financial reports: 6</i> <i>Formal communication: 20</i> <i>Newsletters and PR documents: 12</i> <i>Design documents: 12</i> <i>Meeting minutes: 5</i>

(§)BOA - British Olympic Association; LOCOG, London Organising Committee of the Olympic and Paralympic Games and International Olympic Committee (IOC)'s watchdog;

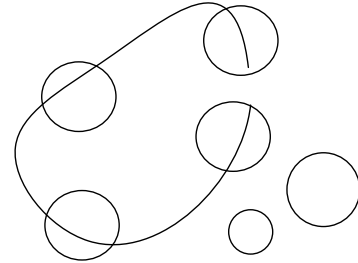
Figure 1 – Stylised representation of different infrastructure architectures



Modular architecture
(e.g., Olympic park)



Integral architecture
(e.g., railway system)



Hybrid architecture
(e.g., airport terminal)

Table 2- Research Protocol to Uncover the Architecture of the Planning Problems and the Distribution of Decision Rights

Case	Local Dispute	Selected quotations on the interdependencies between planning decisions and coding for the Design Structure Matrix	Interdependencies (→ represents input in decision)	Independent actors with decision rights	Selected quotations on the distribution of decision rights over the planning choices [<i>claimants in italic</i>]
London Olympic c Park	Goal of the Olympics stadium	The football clubs weren't coming forward with money [COST]...so we [Olympic board] decided to invest into an athletics legacy venue [GOAL] and all facilities on top would be temporary so they could be demountable [CAPACITY]	COST→GOAL→CAPACITY	#>10 4 promoters; 2 football clubs; promoter's agent; athletics body; 4 local governments; others	<i>I [promoter's agent-ODA] said to [Olympics board] what's wrong with leaving an athletics centre ...why do we have to publicly subsidise the richest clubs in the world? why? It's public land ...don't renege on your responsibility to public sport</i>
	Goal of the Aquatics centre	The bid needed an iconic building [GOAL]...it wasn't just a pool for a community facility [GOAL]...this was grand, ostentatious [FOOTPRINT/CAPACITY]. ..costs a lot of money [COST] to build ... so the reasons were about predominantly making a statement [GOAL] about the London's bid	GOAL→FOOTPRINT/ CAPACITY → COST → GOAL	#>10 4 promoters; IOC; promoter's agent; architect, local governments; others	<i>It's difficult to anticipate willingness of an architect like Zaha to compromise... the roof was everything, if you lose that flow, there would be no way she would continue. ...London boroughs, accessibility interest groups, equality groups, etc.... each one wanted the utopian solution</i>
	Diving boards of the Aquatics centre	I always saw it [aquatics centre] as a sculpture [GOAL] really and that's why we [ODA] put the diving boards [SUB-ELEMENT]... one afternoon... a guy says 'there's this very stylistic design for the boards [GOAL] but we cannot afford it' [COST]... and I said 'give us a price ... at least £0.5m extra [COST], you're authorised'	GOAL→SUB-ELEMENT →COST→GOAL →COST	#>10 4 promoters; International Olympic Committee; promoter's agent; award-winning architect; user groups; local government	<i>They [Swimming federation/Fina] didn't like our [ODA] diving boards, and they wanted them to be changed, and we said we weren't going to change.....LOCOG [IOC's watchdog] was playing a political game telling Fina that we can still change them when...we [ODA] weren't going to change</i>
High-speed 2	Goal of the London Euston Station	The complexity comes, really, because ...you need quite a bit of land [FOOTPRINT], and there's nowhere in central London [GOAL] just sitting vacant to receive... against our requirement, which is ... a target of £1.7bn or so [COST], we can't... afford a station with a double-deck scenario [CAPACITY/FOOTPRINT]	FOOTPRINT→GOAL→COST→CAPACITY/FOOTPRINT	#>7 UK Government, Agent (HS2 Ltd); Local borough; Mayor of London; TfL; Station manager (NR); multiple train operators	<i>This is all the art of the possible isn't it?...HS2 Ltd is a government agent being oppressed...Mayor of London, Camden Council, Transport for London, Network Rail, they all need to give a bit ... we [London First] absolutely could referee...it's just not one of our priorities...it's very resource-intensive...like doing UN peace negotiations</i>
	Goal of the Manchester Station	HS2 have proposed a station that ..sits on its own [GOAL]...so its own concourse, access[FOOTPRINT/CAPACITY] all that... in our design [GOAL] we see one integrated station with everything open so you can walk, different levels [CAPACITY] because land is at different levels [FOOTPRINT]	GOAL→CAPACITY/FOOTPRINT→GOAL→CAPACITY→FOOTPRINT	#>6 UK Government, Agent (HS2 Ltd); Local government; local transport agency; station manager; train operators	<i>The design process has been collaborative ...we [Manchester City Council] are engaged with the work they [HS2 Ltd] might be doing around station design; they're engaged with us on the wider regeneration program...our objective is always to try get consensus</i>
HeathrowT2	Goal of the new terminal	We [BAA] got some more money [COST] to deliver safeguarding of structures which will be needed for later [GOAL]. So we are building tunnels under taxiway [FOOTPRINT/CAPACITY] at the moment and those weren't included [GOAL]	COST→GOAL→CAPACITY/FOOTPRINT→GOAL	#>80 Airport operator (BAA); regulator; Star Alliance (>20 airlines); other airlines; local council	<i>I [Star Alliance director] wrote to the planning authority, 'I don't think you should approve this [Heathrow East building proposal] because it's only a terminal building; it does not have from a campus perspective all of the elements which is going to make this work'</i>
Crossrail	Toilets at the Farringdon station	Whilst we have no legal obligation to provide toilets [SUB-ELEMENT], one or two councils have demanded them...can you really accept that one of the major interchange hubs in London [GOAL] doesn't have any public toilets? So the board accepted that ... about £1 m extra [COST]	SUB-ELEMENT → GOAL →COST	#>7 2 promoters, promoter's agent; 2 local governments; London underground; politicians	<i>The London Assembly Committee Chair described the failure to provide toilets at Crossrail stations as "a missed opportunity" and said the rail scheme offered "an ideal and cost-effective chance to increase the numbers of toilets in the capital"</i>

Table 3 – Excerpt of the Evidence on the Resolution of Planning Disputes: Outcomes and Implications to Performance Targets

Case	Embedded dispute	Dispute resolution mechanism	Outcome	Implications to the Local Performance Targets			
				Extra scope	Completion date	Cost (final prices unless stated)	
High-speed	Euston St #1, Low local goal congruence <i>Utilitarian vs. 'world-class' station</i>	Umpire <i>UK Parliament (Land use regulator)</i>	Mutual compromise facilitated by umpire (after 4 major design cycles) <i>The principle...that all the works...are on the HS2 credit card has been accepted [TfL official]</i>	Yes <i>Formal commitment to fully redevelop Euston station</i>	Relaxed <i>Dispute was resolved in 2017; completion of works delayed from 2026 to 2033</i>	Major slippage 2010, ~£2.0bn (09 prices) 2011, ~£1.1bn (11 prices) 2014, ~£2.2 bn (11 prices) 2015, ~£4.5bn (TfL forecast)	
Crossrail	Woolwich St #2 Low local goal congruence <i>Divergences over the business case</i>	Umpire <i>UK Parliament (Land use regulator)</i>	Mutual compromise facilitated by umpire (after 2 major design cycles) <i>Parliament rules that station should be built, but asks locals to partly finance</i>	Yes <i>Construction of the station agreed</i>	Relaxed <i>Dispute only fully resolved in 2013 after 7 years of planning talks</i>	Major slippage 2005, £0m (no station) 2008, £150m (local claimant pays) 2013, £166m (£16m from promoter)	
Heathrow T2	Main Concourse	#3, Low goal congruence <i>Modern campus vs. facility replacement</i>	Planning talks <i>Airport economic regulator mediated planning talks</i>	Mutual compromise (after 3 major design cycles) <i>Future expansion of main concourse building is actively safeguarded</i>	Yes <i>Extra capacity for future expansion (tunnels, basements)</i>	Relaxed <i>Dispute pushed back in one year the end of the planning stage</i>	Major slippage 2005, ~£666m (final prices) 2008, ~ £1bn (£200m in safeguards) 2015, £1.2bn
		#4 Rilyary over local planning choice <i>Open versus closed gates</i>	Planning talks <i>Independent director arbitrated planning talks</i>	Mutual compromise (2 major design cycles) <i>Gates can be open, but only if new boarding technology is adopted</i>	Yes <i>Flexible building grid in order to leave both options open</i>	Stable <i>Dispute resolved during the planning process</i>	Additional cost 2008, ~£5m extra
London Olympic c Park	quatics centr	#5, Low goal congruence <i>Small vs. massive aesthetically sophisticated venue</i>	Planning talks <i>Long series of meetings between project participants</i>	Mutual compromise (after 3 major design cycles) <i>Sophisticated roof stays, but venue shrinks to a third of its original size</i>	Yes <i>Temporary 15,000-seats added just for the games</i>	Stable <i>Dispute resolved during the first two years allotted for planning talks after bid</i>	Major slippage 2004, ~£128m 2007, ~ £236m Final (2010): ~£262m
	Stadium	#6, Low goal congruence <i>Football vs. athletics venue in legacy</i>	Planning talks <i>Long series of meetings between project participants</i>	Mutual compromise (after 4 major design cycles) <i>2007, potentially demountable venue 2013, dual-use venue</i>	Yes <i>Retractable seating added in 2013</i>	Relaxed <i>Goal dispute resolved in 2013 after 6 years of talks</i>	Major slippage 2004, ~ £468m 2008, ~£541m Final (2015): ~£706m

Figure 2- Excerpts of the Design Structure Matrices of the Planning Problems and Corresponding Organizational Matrices

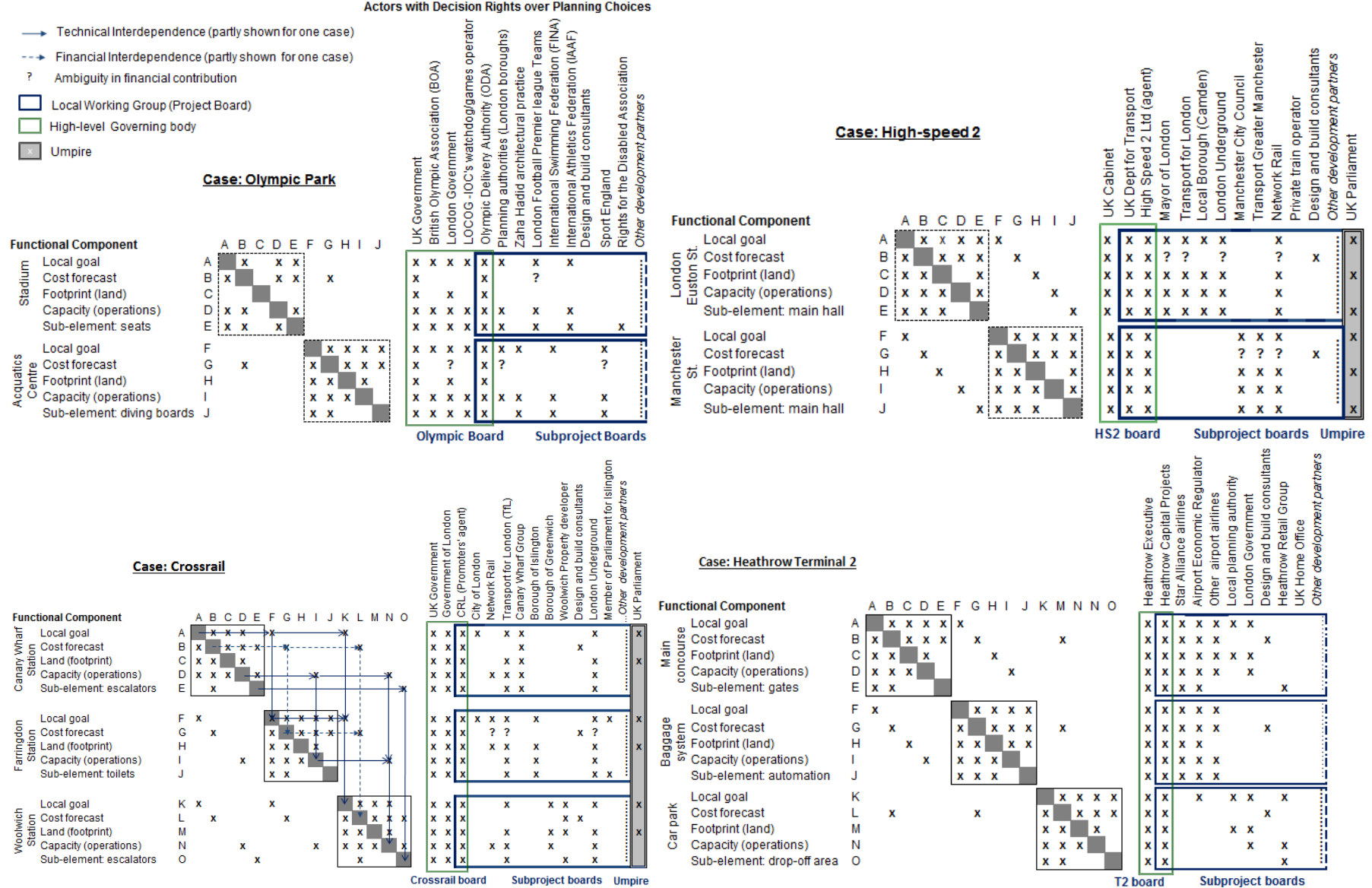


Figure 3- Contingency Model of Polycentric Project Performance

Internal Slack Resources for Reconciling Interests	External Umpire for Arbitrating Local Disputes	
	Not available	Institutionalised
Limited	<p>ROBUST CONTEXT</p> <p>Risk of moderate slippages in the performance targets</p> <p>Limited slack deters major slippages in the performance targets</p> <p>Absence of umpiring encourages norms of collaboration to flourish</p> <p><i>Example: Heathrow T2</i></p>	<p>DANGEROUS CONTEXT</p> <p>High risk of major slippages of performance targets <i>in the public eye</i></p> <p>High risk of collapse of the project organization if slippages of the performance targets are ruled out</p> <p>Umpiring <i>can</i> make it hard for norms of collaboration to flourish</p> <p><i>No Example: Scenario discouraged by current UK public policy</i></p>
	Substantial	<p>CHALLENGING CONTEXT</p> <p>High risk that performance targets will slip until no more slack is left</p> <p>Slack “masks” performance slippages</p> <p>Slack can make it hard for norms of collaboration to flourish</p> <p><i>Example: Olympic Park (after 2006)</i></p>