ORGANIZATIONAL GOVERNANCE AND VALUE CREATION: AN EMPIRICAL STUDY IN MEGAPROJECT CONTEXTS

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ABSTRACT

Megaprojects are interorganizational contexts set up by humans to develop capital-intensive, durable, and shareable technology such as transport and energy infrastructure. These enterprises enable the creation of social value by producing goods that serve as input into a wide range of economic and social activities. Extant empirical and theoretical studies have been valuable in furthering our understanding of megaprojects as an interorganizational context where organizational governance (and thus the processes and structures that enable and constrain collective action) evolves over time. However, we still know little, empirically and theoretically, as to why megaproject organizations almost invariably suffer from systematic delays, cost overruns, and scope creep. It also remains unclear how the slack resources controlled by the systems architect of a megaproject organization impact the creation and capture of social value. Further, we also know little about how megaproject organizational governance adapts to heterogeneity in the organization's institutional environment and cross-border conflicts.

By focusing on these phenomenologically–driven research questions, this doctoral thesis seeks to advance our understanding of two contemporaneous conversations in the fields of organizational theory and strategic management: theory on the relationship between organizational governance and the co-creation and distribution of value; and the contingency perspective of mirroring that establishes a relationship between organizational ties and the structure of the task network. Specifically, this three-paper thesis seeks to make three contributions. The first contribution is pre-theory and revolves around discovery of an association between megaproject organizational performance and organizational governance evolution. This phenomenological discovery has, however, important implications to theory development on how megaprojects can create social value. The second contribution exploits megaproject contexts to reveal a curvilinear relationship between an organization's slack resources and the co-creation and capture of social value with enfranchised sovereign stakeholders. And finally, the third contribution hypothesizes a contingency perspective of mirroring which posits that mirroring is actually the exception when a task network with dense technical interdependence needs to cross highly interdependent institutional and historic borders.

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CHAPTER 1

INTRODUCTION

Megaprojects: What are They and Why They Matter?

A *megaproject* is an interorganizational form of organizing that is set up to produce capital-intensive technology that is durable and shareable in use. Examples include transport infrastructure (e.g. railways, highways, bridges, and airports), utility networks (e.g. oil/gas pipelines, electricity grids, and wind farms), and social and science infrastructure (e.g. schools, science parks, and hospitals). Megaprojects aim to equip societies with resources to enable economic competitiveness and tackle grand challenges from climate change to rapid urbanization, population growth, and social inequality. Put differently, megaprojects are strategic instruments by which governments and private firms seek to create *social value*, which is defined as about creating new and appropriable benefits which society as a whole is able and prepared to pay (Cabral, Mahoney, McGahan, & Potoski, 2019; Kivleniece & Quelin, 2012; Lepak, Smith, & Taylor, 2007).

Frequently associated with the provision of infrastructure resources, the importance of megaprojects goes beyond a direct capital-based contribution to economic growth and productivity. Rather, megaproject outputs are factors of production that can yield substantial social gains (positive externalities) in the form of spillover effects, technology and innovation-driven economic growth, as well as third-party effects associated with incomplete and missing markets (Frischmann, 2012). So, societal demand for capital-intensive technologies is largely derived demand (Frischmann, 2012; Samuelson, 1954). In other words, the technologies produced by megaprojects are not exhausted through direct consumption, but rather

input into a wide range of economic and social activities that produce private, public and nonmarket goods (Frischmann, 2005). Hence, megaprojects and their outputs are *means* rather than ends.

Given the enabling role of megaproject outputs in social value creation, there is a great need for investment in megaprojects worldwide, especially in emerging economies. Just the infrastructure sector alone is a recipient of circa $2.5 trillion global investment a year (Woetzel, Garemo, Mischke, Hjerpe, & Palter, 2016). And spending on megaprojects has been estimated to amount to roughly 8% of the global GDP (Flyvbjerg, 2014). Further, the OECD estimates that $70 trillion in megaprojects will be needed by 2030 in order to support the world's growth and development,[1] a forecast which almost doubles a recent forecast by McKinsey.[2] Elsewhere, it has been projected that the global need for infrastructure investment will reach $94 trillion by 2040.[3] Megaprojects are therefore clearly an important setting for management studies.

Notwithstanding the world's need for megaprojects, their organizational performance remains a long-standing puzzle both in scholarly management literature (Gil & Pinto, 2018; Miller & Lessard, 2001; Morris & Hough, 1987; Pitsis, Clegg, Marosszeky, & Rura-Polley, 2003; Ross & Staw, 1986, 1993; Stinchcombe, 1979) and practitioner-oriented literature (Flyvbjerg, 2014; Merrow, 1988, 2011). Megaprojects have become notorious for missing their targets, with performance slippages leading to massive cost overruns and schedule delays. Examples are galore from Boston's Big Dig to Sydney's Olympic Park and high-speed rails in California

[1] Mirabile, M, Marchal, V, & Baron, R. 2016. Technical note on estimates of infrastructure investment needs. Background note to the report *Investing in Climate, Investing in Growth*, July, OECD.

[2] McKinsey Global Institute. 2016. *Bridging Global Infrastructure Gaps*. New York, NY: McKinsey Global Institute, McKinsey & Company.

[3] Global Infrastructure Hub. 2017. *Global Infrastructure Outlook: Infrastructure Investment Needs 50 Countries, 7 Sectors to 2040*. Sydney, Australia: Oxford Economics.

and UK. Statistical analyses corroborate empirical accounts, suggesting that nine out of ten transport infrastructure projects go over budget (Flyvbjerg, Bruzelius, & Rothengatter, 2003). Overruns fuel perceptions of organizational underperformance because they violate the commitments which megaproject managers made upfront in order to reduce ambiguity in the value proposition and gain legitimacy to acquire the necessary resources from the environment towards the system-level goal (Denis, Dompierre, Langley, & Rouleau, 2011; Flyvbjerg, Holm, & Buhl, 2002; Stone & Brush, 1996). Further, slippages in performance targets fuel a perception that the megaproject organization 'failed' because they go against professional norms that equate a 'successful' project to achieving the targets on time and within budget (Cleland & King, 1968; Dvir & Lechler, 2004).

More theoretically, megaprojects constitute useful settings that can be leveraged by management scholars in order to advance our understanding of interorganizational forms of organizing (Puranam, 2018). For example, megaprojects can be leveraged to further our understanding as to why performance slippages seem endemic to interorganizational contexts set up to produce durable and shareable technology. We can also use megaprojects to advance our understanding as to how a strategic choice by an organization to enfranchise sovereign stakeholders can allow for value co-creation and appropriation by a wide range of beneficiaries. Related to this, we can also use megaprojects as a context to learn more about governance mechanisms available to enable competing interest groups to reconcile their subgoals and co-create social value.

Another research question that lends itself to be addressed through empirical studies on megaprojects pertains to the best way to organize task networks that are highly interdependent with the surrounding context. Extant mirroring theory posits

that the structure of the task networks tends to mirror the organizational ties between the actors who carry on those tasks (Colfer & Baldwin, 2016; MacCormack, Baldwin, & Rusnak, 2012; Sosa, Eppinger, & Rowles, 2004; Tee, 2019). However, mirroring literature has assumed limited interdependences between the task network and the organization's environment. Megaproject activity, however, is highly interdependent with the environment (García-Canal & Guillén, 2008; Henisz, 2002; Khanna & Palepu, 1997, 2010; North, 1990). Further, many megaprojects cross borders between nations and thus are interdependent with multiple and differing institutional environments, including developed and emerging economies, and occasionally even with a history of nation-dyadic conflicts. Thus studies on megaprojects create opportunity also to add to a theoretical conversation on the contingency factors affecting the mirroring hypothesis.

In sum, it is the goal of this thesis to use megaprojects to advance our understanding of the relationship between organizational governance and design and value creation in interorganizational contexts set up to develop new, shareable, and integral technology.

Terminology in the Thesis

To avoid confusion, I start with definitions of key constructs in the thesis drawing mainly from literature in organizational governance which adopts an institutional economics (property rights) perspective (Klein, Mahoney, McGahan, & Pitelis, 2019) – the theoretical lenses that informs the first two papers in the thesis. I also draw, however, from a research stream within organizational design literature in the third paper that revolves around the so-called mirroring hypothesis, and I include key terminology here too from that research stream.

Organizational governance. Organizational governance is defined as the rules and procedures that control the accumulation, development, and allocation of resources; the distribution of the organization's production; and the resolution of disputes (Blair and Stout, 1999; Chandler, 1962; Williamson, 1985). So, governance is associated with the rules that establish the organizational boundaries ('who is in and who is out') and how those organizational participants distribute value (claimancy rights, 'who gets what') (Klein et al., 2019).

Polycentric governance. Polycentric governance is a form of governing by which an otherwise hierarchical organization agrees to lodge multiple inner consensus-oriented groups of decision making within its own organizational boundaries (Ostrom, 1990). As such, under polycentric governance, a hierarchical structure vested with unified authority agrees to share decision rights on some organizational resources with inner egalitarian groups. In some polycentric structures, the inner groups of consensus-oriented decision-making can have substantive autonomy to make decisions as long as they stay within a constitution designed by a higher-level authority – see for example Ostrom (1990)'s analysis of polycentric governance in the police forces of Indianapolis. In other polycentric structures, the higher-level authority sits at the negotiation table together with other enfranchised actors as in the case of polycentric structures set up to plan public infrastructure goods (Gil & Pinto, 2018)

Property rights. Property rights are generally understood as a bundle of rights that goes beyond the right to sell the resources one owns, and includes rights of access, withdrawal, management, exclusion and alienation of those resources (Ostrom, 2010). The ownership of a resource is an extreme case of property rights in that it gives the owner of the resource all the rights mentioned (Demsetz, 1967).

Property rights can be well defined when they are clearly demarcated and thus each actor knows exactly what rights she has. But property rights can be ill-defined in that multiple autonomous actors can share the right. For example, jurisdictional overlaps give rise to shared or ill-defined property rights between autonomous public agencies (Bozeman, 1987; Nutt, 1999).

Stakeholders. Stakeholders are generally defined in management literature as organizational actors or individuals that can affect tor are affected by the organization's actions, objectives, and policies; and thus, they have a stake in the organization (Freeman & Reed, 1983). This is a broad definition that includes actors as diverse and ranging from employees and shareholders to suppliers, regulators and local communities affected by the organization's actions. The focus of the first two papers is on the relationship of the organization with actors that lie outside the organization's boundaries but are impacted by the organization's actions including local communities, local authorities, and suppliers. In the third paper, as we move into mirroring theory, the research shift away from stakeholder governance. ***Sovereign stakeholders*** are defined as legal entities with property rights which cannot be brought into the organization's hierarchical structures such as local communities and local authorities and regulators (Dorobantu, Henisz & Nartey, 2017a; Dorobantu & Odziemkowska, 2017).

Performance. The notion of organizational performance in the context of large-scale infrastructure developments is rooted in project management norms and refers to the extent to which targets that are set up ex-ante are perceived to be achieved – the so-called projects golden triangle (schedule, budget, scope). Project promoters are under pressure to announce numeric targets (budgets, deadlines) in order to reduce ambiguity and gain legitimacy to acquire resources from the environment in

the pursuit of the goal (Denis et al., 2011; Denis, Langley, & Rouleau, 2006). Projects literature thus tends to equate organizational underperformance to cost and time overruns and scope creep (Flyvbjerg et al., 2002; Merrow, 2011). This thesis provides extensive evidence however that missing the targets is not necessarily value-destroying in that the slippages of targets can allow for an increase in benefits that outweighs the costs.

Social value. In management literature, social value is close to the notion of total public value in terms of economic and social welfare. Therefore, the social value in this thesis is the sum of value to be captured by all the parties to a resource exchange, where value is the benefits accrued minus the costs incurred (Cabral et al., 2019; Kivleniece & Quelin, 2012; Lepak et al., 2007).

Theoretical Positioning

The first two working papers of this thesis draw on recent theoretical advances that establish a link between organizational governance and value creation and capture (Klein et al., 2019). This research stream integrates insights from organizational theory (Scott, 1995) with insights from new institutional economics literature (Libecap, 1989; North, 1990; Ostrom, 1990; Williamson, 1993). *Organizational governance* is defined as the rules and procedures that control resource accumulation, development, and allocation; the distribution of the organization's production; and the resolution of disputes (Chandler, 1962; Williamson, 1985). So, organizational governance is associated with the rules that establish the organizational boundaries ('who is in and who is out') and how the participants in the organization distribute value or claimancy rights ('who gets what') (Klein et al., 2019).

This literature has sought to advance our understanding of the interplay between organizations and the institutional environment, which refers to the formal and informal legal, political, and social structures and processes that shape organizational governance structures (Klein et al., 2019; North, 1990; Williamson, 2000). The institutional environment is the source of the 'meaning', legitimation, or higher-level support which makes the implementation of the organizational goals possible (Thompson, 1967). The institutional environment is known to directly influence the easiness or difficulty by which organizations can build a bundle of co-specialized resources including property rights,[4] materials, capital, information, and skills in order to realize their own goals (Doh, Rodrigues, Saka-Helmhout, & Makhija, 2017). Put differently, organizational activities are enabled and constrained by the presence or absence of particular institutions in the environment (Dorobantu, Kaul, & Zelner, 2017b; Henisz, 2000). Hence organizations have to develop strategies to adapt to different institutional environments (Delios & Henisz, 2000; Peng, 2003) or to proactively influence those environments (Bonardi, Holburn, & Vanden Bergh, 2006; Oliver & Holzinger, 2008). For instance, the shortfall of institutions in emerging economics is known to directly influence the entry strategies of foreign investors (Henisz, 2000; Meyer, Estrin, Bhaumik, & Peng, 2009). Facing weak or absent institutions, organizations can seek to create and appropriate value by either adapting to, augmenting, or transforming the existing environment (Dorobantu et al., 2017b).

In this thesis, we are interested in organizational choice contingent on the robustness of the institutions in the environment. Hence, the first two studies are grounded in the UK, an institutionally developed context where efficient institutions and well-defined property rights are in place to facilitate market transactions. The

[4] Property rights are understood here as a bundle of rights that goes beyond the right to sell the resources one owns, and includes rights of access, withdrawal, management, exclusion and alienation (Demsetz, 1967; Ostrom, 2010).

third study is grounded on megaproject organizations set up to develop cross-border oil and gas pipelines which are highly interdependent with both advanced *and* emerging economies. The latter are institutional contexts where the transactions are hampered by *institutional voids*, which relate to the lack of efficient markets, well-developed property rights, specialized intermediaries, robust regulatory systems, independent and impartial judiciary, and contract-enforcing mechanisms (Khanna & Palepu, 1997, 2010). Institutional voids also relate to the absence of the non-executive institutions of accountability including the ombudsman, democratically-elected parliaments, and a system of checks and balances (World Bank, 2012).

Importantly, in the third paper, we shift away from organizational governance literature, and draw instead from a stream of organization and design literature that seeks to advance our understanding of the relationship between organizational ties and technological structure (Colfer & Baldwin, 2016; Sanchez & Mahoney, 1996; Sosa et al., 2004). This research stream centers around the so-called *mirroring hypothesis*, which posits that managers will (or should) leverage technological knowledge in order to reduce management complexity by aligning the architecture of the products that the organization develops with the organizational ties between the agents carrying on the tasks (Colfer & Baldwin, 2016; MacCormack et al., 2012; Sosa et al., 2004; Tee, 2019). In this thesis, we are particularly interested in developing a perspective of mirroring that is contingent on two attributes of the organization's environment that is interdependent with the task network – the heterogeneity in the institutional environment and the level of cross-border conflicts.

I now turn on to discuss what megaprojects are from an organizational perspective before outlining the three contributions of the thesis.

Megaprojects as an Evolving Interorganizational Context

Recent empirical studies conceptualize megaprojects as networks of autonomous public and private organizational actors that agree to collaborate under an identifiable system-level goal (Gil & Pinto, 2018; Gulati, Puranam, & Tushman, 2012; Lundrigan, Gil, & Puranam, 2015); put simply, megaprojects are 'meta-organizations' (Gulati et al., 2012). The defining attribute of this form of organizing is the absence of employment relationships and ownership stakes as sources of authority between participants. Yet, megaprojects are not self-organizing systems. Rather, they are guided by an entrepreneurial architect, the megaproject promoter, who formulates the system-level goal and leads the organizational system in the pursuit of that goal. To exert influence, the promoter relies on contracts, resource dependencies, expertise, regulation, and reputation.

Importantly, the membership of a megaproject organization grows over time as its designated leader, the promoter, strives to acquire all the complementary resources. So the promoter acts as the 'gatekeeper' (Rothaermel & Boeker, 2008) that selects new participants based upon the resources that they can bring into the organization such as know-how of local needs, capabilities, capital, property, political influence, or legal powers. Some resource exchanges can be decomposed into contractible transactions if the resources are definable and measurable and do not involve a high degree of reciprocal interdependency (Baldwin, 2007). For example, managerial and technical capabilities can be acquired on the specialized markets using price mechanisms.

However, some complementary resources may be difficult to decompose in contractible transactions. This is the case with some of the resources controlled by *sovereign stakeholders*, which are defined as autonomous actors who have property

rights but lie outside the organization's value chain of customers, suppliers, employees, and alliance partners (Dorobantu et al., 2017a; Dorobantu & Odziemkowska, 2017). Some resources controlled by sovereign stakeholders can be acquired by leveraging regulation or markets; for instance, to acquire land from property owners, the promoter of a megaproject can use imminent domain laws and price mechanisms. So, these stakeholders can be excluded from the organizational boundaries of the megaproject.

Yet, some sovereign stakeholders may control complementary resources that are costly and time-consuming, if not impossible, to acquire by using markets or regulations. To economize on the transaction costs and encourage those stakeholders to volunteer their resources (as well as forestall opposition to the goal), the promoter can enfranchise them. To enfranchise a stakeholder means to bring that stakeholder into the organization's boundaries (Klein et al., 2019). As such, a choice to enfranchise stakeholders grants them residual control rights, this grants them decision rights on the allocation of the organization's resources (Hart, 1995; Klein, Mahoney, McGahan, & Pitelis, 2012). If the institutions in the environment are robust, once the organizations choose to enfranchise sovereign stakeholders, it can be prohibitively costly and time-consuming (although not impossible) to violate this bargain (North & Weingast, 1989). In other words, once enfranchised, the costs of excluding an enfranchised stakeholder from the decision-making process become very high. Yet, a choice to enfranchise a does not mean that the interests and subgoals of the stakeholder and of the organization are aligned. Often, high rivalry can be anticipated between the stakeholder's preferences to allocate the organization's resources and the organization's preferences to allocate its own resources. Still, if the costs of excluding an enfranchised stakeholder are high and the

organizations' resources are finite, then stakeholder enfranchisement transforms some of the organization's *de jure* resources into a *de facto* common-pool resources. Stakeholder enfranchisement transforms some of the organization's resources into an excludable resource that is rivalrous in consumption (Hardin, 1968; Olson, 1965; Ostrom, 1990).

A last major adaptation in the organization governance of a megaproject pertains to the arrival of a vast supply chain governed by contracts. Buyer-supplier contractual governance is effective to simulate an authority hierarchy (Stinchcombe, 1984). However, there is a risk of the suppliers behaving opportunistically ex-post contract award. First, protracted disputes within the core alliance and with stakeholders are a major source of uncertainty; second, some transactions with suppliers may involve high asset specificity, which puts them in a monopolistic position ex-post contract award; and third, the low frequency of transactions can make it hard for the promoter to rely on the contractible shadows of the future, this is, on the expectation of future gains from exchange and the ability to trust and coordinate based on past experiences (Dyer & Nobeoka, 2000; Gulati, 1995). So there is a risk of the suppliers defecting from the spirit of the contract and reverting to self-interest bargaining if the requirements change (Williamson, 1975).

In sum, as a form of organizing, megaprojects can be thought of as an evolving nexus of organizational governance structures. These structures may include a core alliance of legally independent actors that constitutes the megaproject promoter; a polycentric governance structure that lodges decision-making groups of enfranchised stakeholders; and a vast hierarchically-managed supply chain; further, many sovereign stakeholders stay outside the megaproject organizational boundaries.

Importantly, megaprojects, as a form of organizing set up to produce technology, fall under the scope of mirroring literature. This research stream in organizational design theory has evolved independently from organization governance theory but the interests overlap in that both research streams are interested in the study of organizational structures and processes. The mirroring theory is important to the scope of this thesis in that it predicts an alignment between organizational structure and technological structure by which organizational designers seek efficiencies and reduced coordination and cooperation costs (Colfer & Baldwin, 2016; MacCormack et al., 2012; Sosa et al., 2004; Tee, 2019). Megaprojects are forms of organizing to produce technology. As such, the third paper uses them as an empirical setting to further our theoretical understating of mirroring both as a descriptive prediction and a normative recommendation. With this backdrop of what megaprojects are and how they evolve over time, I turn now to introduce the overarching underlying philosophy that glues the three papers together before outlining the three main contributions of this thesis.

Thesis Outline

Figure 1-1 illustrates the outline of this thesis. The introduction chapter presents the empirical setting and draws on recent theoretical advances to illuminate megaprojects as an interorganizational form of organizing and raise new research questions. Chapters 2, 3, and 4 are stand-alone working papers that seek to address the research questions raised in the introduction. The concluding chapter summarizes the theoretical and practical implications of the thesis and suggests directions for future research. The first technical appendix includes the analytical presentation and proofs of the game theory model used in the second paper. The remaining appendices all relate to the third paper and include, first, a list of 52 cross-border gas

pipelines (the database assembled for the third paper); second, a case study that was developed in order to sharpen our intuition for the focal phenomena in the third paper; and third, a Harvard-style teaching case study on the same case produced in order to motivate a class discussion. Specifically, the three papers are:

- 1st paper – "*Is Missing Targets a 'Good' Thing? Linking Organizational Governance Evolution with Social Value Creation in Megaprojects*", co-authored with Nuno Gil. This pre-theory paper has been submitted to *Academy of Management Discoveries* for review. This paper draws upon an extensive empirical dataset for three megaprojects which was previously assembled by my main doctoral supervisor.
- 2nd paper – "*Cut some Slack? Effects of an Organization's Contingency Budget on the Co-Creation and Capture of Social Value*", co-authored with Nuno Gil and David Watling. A slightly revised version of this paper has been submitted to *Organization Science.* This paper draws in part upon an extensive empirical dataset on the High-speed 2 project which was assembled together with my main doctoral supervisor.
- 3rd paper – "*When Mirroring is the Exception: Non-decomposability and the Impact of Institutional and Historic Borders"*, co-authored with Nuno Gil. This paper requires further work to test the theoretical claims developed in the paper before it is ready to be submitted to a management journal; the working paper includes nonetheless a discussion of the data collection strategy and methods by which we plan to take the paper to the next level of development.

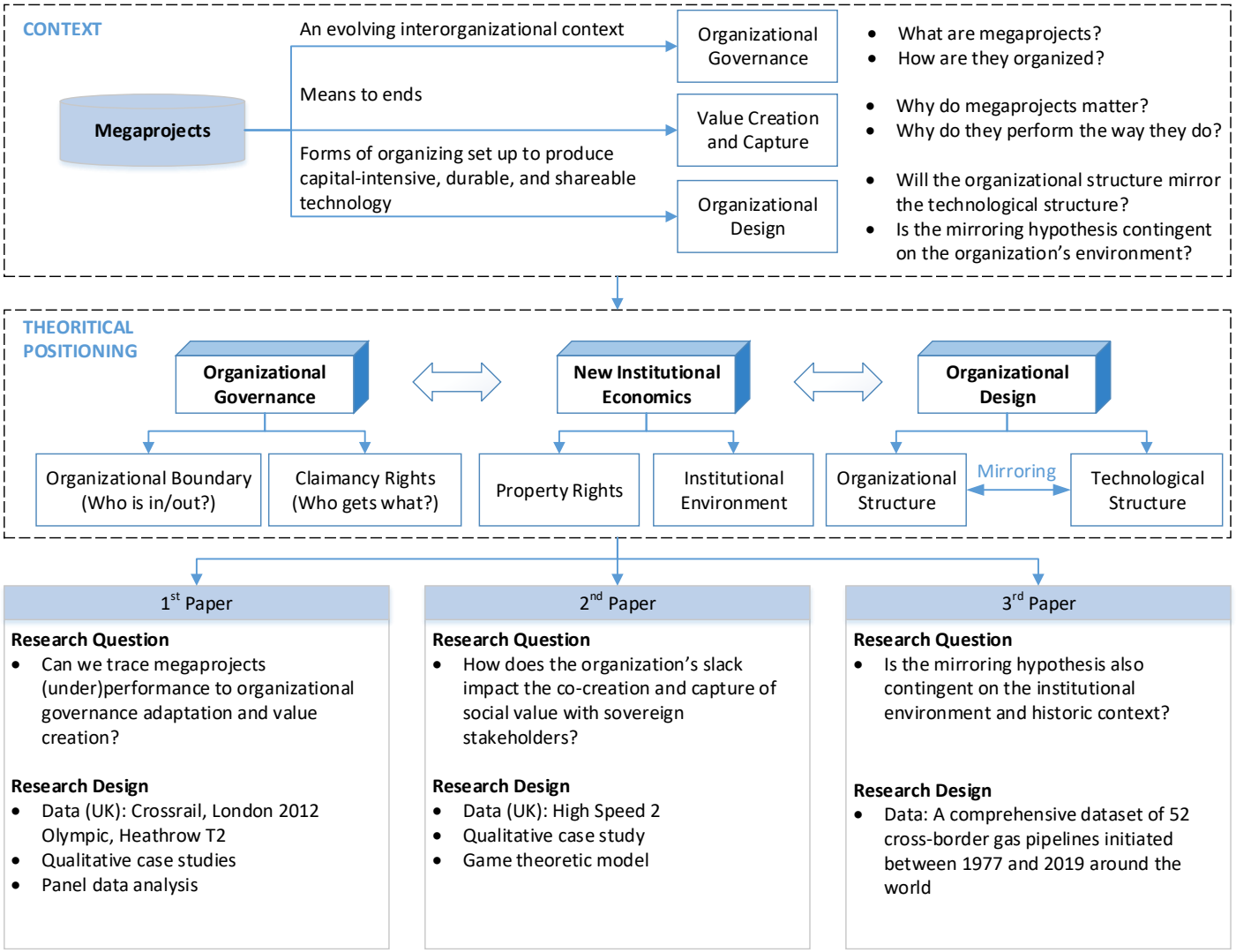


Figure 1- 1 Thesis Outline

The three papers constitute a coherent body of work and relate to each other. Empirically, the three papers are all grounded in megaproject contexts. Theoretically, they draw on complementary research strands of organizational theory and new institutional economics literature in order to further our understanding, empirical and theoretical, of the relationship between organizing and value creation.

Underlying Philosophy of the Thesis

The philosophy of science is about the nature of phenomenon under study (ontology) and the methods for understanding it (epistemology) (Van de Ven, 2007).

From an ontological perspective, it is fair to say that the approach adopted is close to what Van de Ven defines as objective ontology. In other words, we believe that there is a real world out there, but that our individual understanding of it is limited. From an epistemological perspective, we share the assumption that to a degree all facts, observations and data are implicitly or explicitly theory-laden (Van de Ven, 2007). Therefore, in order to develop a better empirical understanding of reality in its full complexity, there is a need to employ multiple and divergent theoretical perspectives and research methodologies. Therefore, given the complexity of our focal phenomena – megaprojects – this thesis adopts mixed theoretical lenses and methodologies, which are depicted in Figure 1-2. That said, we are aware that is difficult to combine multiple cognitive lenses within a paper because often assumptions between different theories may be incompatible, or the same terms have fundamentally different meanings, and teasing out these inconsistencies would require a lot of space not compatible with the length limitations of journal papers. Thus, we try to be theoretically consistent with each paper, although as we move into the third paper we shift the main theoretical lens from organizational governance to organization design.

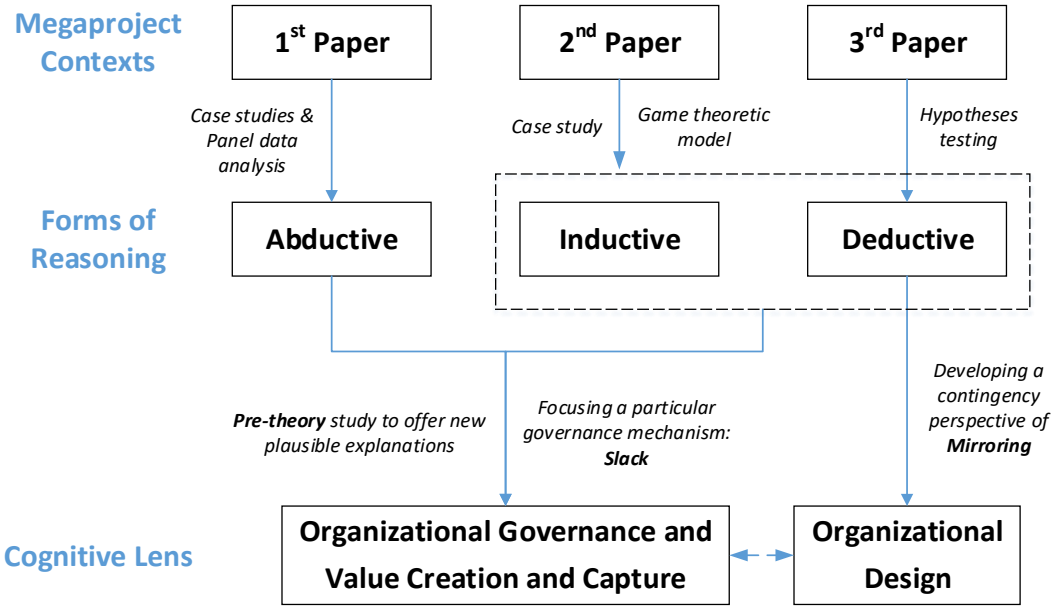


Figure 1- 2 Underlying Philosophy of the Thesis

The first study was motivated by generalized perceptions in the world of practice and policy that megaprojects tend to underperform because of systematic delays, cost overruns, and scope creeps (Flyvbjerg et al., 2002; Gil & Pinto, 2018; Miller & Lessard 2001; Morris & Hough, 1987). The debate over the causes driving this empirical regularity has been stuck for decades (Pinto & Winch, 2016). But recent advances were made by deploying an organizational governance lens (Gil & Pinto, 2018). In the first paper, we follow Gil and Pinto (2018)'s lead and mobilize an organizational governance lens to further our empirical understanding of the megaproject phenomena. We thus follow a tradition of abductive research in that we depart from a phenomenon that literature struggles to explain and develop a new plausible explanation by adopting a different cognitive lens (Charles, 1931; Peirce, 1997; Van de Ven, 2007). The ultimate aim of abductive research is to generate plausible, conjecturable explanations for the status quo explanation of a given phenomenon in question (Van de Ven, 2007). Specifically, we draw on recent theoretical advances that establish a link between organizational governance adaptation and value creation and capture (Klein et al., 2019). To provide nuanced

empirical discoveries for theory development, the research design combines qualitative case study research with quantitative panel data analysis. The case studies of three contemporary megaprojects are suitable to explore novel ideas by incorporating contextual and temporal dimensions (Eisenhardt & Graebner, 2007). Through case analysis, we uncovered a qualitative association between organizational governance, budgetary performance, and value creation and capture. To verify and qualify the associations, we then conducted a panel data analysis. Admittedly, our panel data is limited in size, which limits the generalizability of our claims in that makes it difficult to control for multiple alternative explanations such as for example level of public support or levels of financial slack (contingency funds). And yet, our dataset is the first to our knowledge to offer a quantitative characterization of the structure of participation of a megaproject. Indeed, for more than 30 years of research, megaprojects have remained a black box because of difficulties to access inner data on this form of organizing (Pinto & Winch, 2016). Whilst some progress has been made to characterize the phenomenon using qualitative data (Gil & Pinto, 2018), we are the first to offer a quantitative analysis on the evolution of the organizational structure of a megaproject and to try to link that evolution to organizational performance. The fact we explain how we assembled our data offers guidance as to how similar datasets can be assembled and extended to further this line of research.

Hence, this mixed methods research design enabled us to offer novel conceptual framing that contributes to reconcile competing explanations by revealing an overlooked association between slippages in performance targets and the evolution of organizational governance in megaprojects. It is worth noting that our findings and analysis provide a new plausible explanation for empirical regularities, but do

not refute competing claims for missing targets in megaprojects. However, our explanation suggests a different interpretation for empirical regularities that allows reconciling what otherwise appears to be competing claims as discussed in the paper. A major limitation to the generalizability of our explanation is the fact our observations were grounded in the UK context, and thus our focal organizations evolved surrounded by an institutional environment in which the institutions are robust. Robust institutional environment exists outside the UK, but cannot be taken for granted everywhere.

The second study mobilizes the same cognitive lens (organizational governance) to further our understanding of financial slack, which itself is a particular governance mechanism to enable value co-creation in public-public relations. Importantly, slack in our context differs from financial slack typically research in the literature of the firm. In the latter, slack is normally an exogenous variable that derives from a surplus in the profits, which leads to slack if the firm does not give the surplus to shareholders in the form of dividends. In our case, slack is an endogenous variable that results from a political decision at the onset of development to create a buffer to cope with the anticipated need for compromises with other stakeholders. This notion of slack is nonetheless compatible with the idea of slack in organizational literature which defines slack resources as an inducement to encourage cooperation and reconcile incompatible goals within a dominant coalition (Bourgeois, 1981; Bourgeois & Singh, 1983; Cyert & March, 1963).

The research design follows Gulati and Puranam (2009) by which a case study precedes the presentation of a game-theoretic model. The idea of the case study here is not, however, to induce theoretical insights, but rather illustrate an empirical phenomenon of theoretical relevance. In other words, we use the case analysis to

preview the logic of our arguments. After we develop our argument by mobilizing organization governance literature, we then follow a tradition of using game-theoretic models to formalize boundary conditions for theoretical claims that are derived from observing empirical regularities (Baldwin & Clark, 2006; Gans & Ryall, 2017; Gulati & Puranam, 2009; Van der Meulen, 1998). As a study of "mathematical models of conflict and cooperation between intelligent, rational decision-makers" (Myerson, 1991: 1), game theory provides a set of rules and assumptions to model how rational actors choose the best strategy in a bargaining structure (Bacharach & Lawler, 1981). Game-theoretic models have the advantages of stating the boundary conditions and consequences with a high degree of precision and exposing our underlying assumptions for critique and further refinement by other scholars (Gulati & Puranam, 2009; Lave & March, 1993).

In the third paper, we shift the focus away from organizational governance literature to a stream of organization design literature looking to advance our understanding of the relationship between organizational ties and technological structure (Colfer & Baldwin, 2016; Henderson & Clark, 1990; Sanchez & Mahoney, 1996). Though a separate research stream, the organizational design literature looks into organizational structures and choices which are also key elements in organizational governance research. Unlike the other two papers, the research design in the third paper follows a deductive reasoning by building upon the theoretical notions of mirroring (Colfer & Baldwin, 2016; Sosa et al., 2004; Tee, 2019), institutional voids (Doh et al., 2017; Dutt, Hawn, Vidal, Chatterji, McGahan, & Mitchell, 2016; Khanna & Palepu, 1997, 2010), and cross-border conflicts (Arikan et al., In-press; Arikan & Shenkar, 2013) to develop a contingency perspective of mirroring. Hypotheses are developed but yet to be statistically tested. We ground the

study on the cross-border oil and gas pipeline industry, which are megaprojects set up to deliver a quintessential example of an integral technology. Hart and Moore (1990) list pipelines as examples of assets that ordinarily are owned or controlled together. The development activities and production stages of pipelines are highly interdependent with the physical and institutional environment. During operations too, there is a need to carefully coordinate activities upstream and downstream of the pipeline to ensure the pressure does not build up, stay vigilant on potential leakages, and align supply and demand. The mirroring theory, which is not restricted to any empirical setting neither to a range of technologies, would thus predict that pipelines should be owned or controlled by a single firm. Mirroring theory however also recognizes that there are many exceptions that violate the theory, but the theory still lacks the power to explain why those exceptions exist (Colfer & Baldwin, 2016). In agreement with the idea that there are exceptions to mirroring theory, based on the preliminary descriptive analysis of all the 52 cross-border gas pipelines in the last 40 years, we find extensive evidence that mirroring is the exception in this sector. So, data on cross-border oil and gas pipelines give us an exciting opportunity to add to a conversation as to why there are empirically observed exceptions to mirroring.

Interestingly, our intuition that mirroring is broken in the pipeline industry derives from an initial case study on a cross-border pipeline, which we developed in a Harvard-style presentation and included as an appendix to the thesis. This case study had limitations in that we only had access to a restricted group of actors (from the Chinese organizations) and limited access to archival documentation, which prevented us from triangulating the data. Because we could therefore not verify our data, we were not in a position to pursue an inductive approach to develop our claims. Thus, we chose to develop the case in a Harvard-style to sharpen our intuition for the

findings, but then we shifted to a deductive approach for which we could leverage extensive public information on the form of organizing cross-border pipelines.

In sum, from a phenomenological perspective, the thesis is fully informed by the megaprojects. Methodologically, the three studies individually follow different research strategies: abduction in the first to sharpen our empirical understanding of the phenomenon and uncover directions for theory development; a mix of induction, and deduction by which we further our empirical and conceptual understanding of slack – one particular governance mechanism in megaprojects; and deduction in the third to circumvent difficulties in data collection. Theoretically, the thesis is primarily positioned in the organizational governance literature using an institutional economics perspective. But in the third paper, we shift to a body of literature (organization design) which also interestingly also studies organizational structures and processes, but theoretically that is a different conversation that is rooted in institutional economics and less on sociology. But as Van de Ven (2007) said, it is by mobilizing different cognitive lenses that we can truly advance our understanding of the complex phenomenon.

Linking Organizational Governance with Value Creation and Capture

The first contribution is a pre-theory (but not a theoretical) paper that was motivated by a long-standing puzzle about the performance of megaprojects in the management literature. This puzzle asks: are cost overruns rooted in strategic misrepresentation and incompetence of the project promoter and systems architect, or instead, are cost overruns due to the interests of powerful stakeholders in the environment and to suppliers' opportunistic behavior? In this study we suggest an alternative explanation for empirical regularities in the tradition of abductive research (Charles, 1931; Van de Ven, 2007). Thus, we depart from a phenomenon

that literature struggles to explain and develop a new plausible explanation by adopting a different cognitive lens. Specifically, we draw on recent theoretical advances that establish a link between organizational governance adaptation and value creation and capture (Klein et al., 2019). Hence, this paper seeks to move the debate over the root causes of missing targets by asking: ***can we trace megaproject perceived (under)performance to organizational governance adaptation and value creation?***

We ground the paper on an original dataset by which we pieced together data on organizational governance, budgetary performance, and value creation and capture for three contemporaneous megaprojects: the London 2012 Olympic park; Crossrail, a high-capacity railway linking the East and West of London; and the Heathrow airport Terminal 2 (T2). Our sample is diverse to increase external validity: i) the developments belong to different sectors; ii) the first two are publicly financed whereas T2 is financed by a regulated private firm; and iii) only the Olympic park had an immovable end date.

Using qualitative and quantitative methods, this paper discovers an overlooked association between the longitudinal evolution of the megaproject organizational governance and budgetary slippages. Specifically, we associate major cost hikes to consensus-oriented negotiations for agreeing and redistributing the value to be co-produced as, first, a restricted group of autonomous actors forms an alliance to lead the megaproject; and then, as this alliance enfranchises key sovereign stakeholders in order to get them to commit specialized resources towards the system-level goal. We also find positive, but marginal, associations between costs hikes and contractual governance. These findings suggest less ability to predict reliably the final costs of

collective action than the final costs of contracting for resources with the suppliers and with the stakeholders that were excluded from the megaproject organization.

These empirical discoveries have important implications to our understanding of the megaproject phenomena. Crucially, these discoveries also point to a direction towards the development of a theory of megaprojects and value creation, and thus a direction by which this work can contribute to an emerging conversation as to how value is created and appropriated in interorganizational forms of organizing (Gulati et al., 2012; Jacobides, Cennamo, & Gawer, 2018). Specifically, the findings reveal that organizational governance in a megaproject goes through substantive adaptation over time in order to build a bundle of co-specialized assets towards an evolving goal. This contrasts to the account of Klein et al. (2019) as to how organizational governance adapts to changes in the institutional external environment. Rather, in our focal phenomena, the trigger for organizational governance adaptation is not changes in the organization's environment, but the organization's need to acquire complementary resources.

Importantly, our empirical insights do not refute competing theoretical explanations for cost overruns, ranging from optimism bias and strategic misrepresentation (Flyvbjerg et al., 2002) to escalation of commitment to a failing course of action (Staw, 1981), the power of stakeholders external to the organization (Gil & Tether, 2011; Miller & Lessard, 2001) and suppliers' opportunistic behavior (Stinchcombe & Heimer, 1985). However, our empirical findings do offer novel conceptual framing that contributes to reconcile these competing explanations. Hence, by linking evolution in organizational governance with value co-creation and capture, we show that regular cost overruns are not necessarily a 'bad thing'. Rather, we argue that cost overruns that can be traced to negotiations to redistribute the value

to be co-produced with stakeholders. In other words, cost overruns can actually be an indicator of the creation of social value.

Effects of Organizational Slack on Social Value Creation and Capture

The theoretical focus of the second working paper is on the relationship between the slack carried on by an organization and value co-creation and capture. Slack is a *visible* buffer of actual or potentially utilizable resources in excess of the minimum necessary to produce a specified level of output. As an organizational governance mechanism, slack allows the organization to respond successfully to pressures for adjustment to changes in the internal and external environment (Bourgeois, 1981; Bourgeois & Singh, 1983; Cyert & March, 1963; Thompson, 1967). The study is empirically grounded on the contingency budget owned by the capital provider in a megaproject. A contingency budget is a form of high-discretionary *slack resource* in that the contingency funds are visible and measurable, but have yet to be committed to a specific purpose. The focus of the study is on the way the capital provider may draw from the contingency funds in order to enable consensus-building with enfranchised stakeholders. So, it is a study about the impact of slack in the co-creation and appropriation of value.

Importantly, when an organization chooses to enfranchise sovereign stakeholders, these stakeholders gain residual rights of control: these are defined as the rights to directly influence the use of the organization's resources in conditions not specified by prior agreements (Hart, 1995; Klein et al., 2012). By enfranchising stakeholders, the organization gains access to resources controlled by these stakeholders and which may be costly, if not impossible, to acquire through markets or by leveraging regulation (Asher, Mahoney, & Mahoney, 2005; Brandenburger & Stuart, 1996; Coff, 1999; Dorobantu & Odziemkowska, 2017; Klein et al., 2012).

Yet, this choice creates a risk of conflict as enfranchised stakeholders seek to leverage their bargaining power and the strength of their property rights to appropriate a greater share of the value to be co-produced.

Since slack resources are known to help reconcile incompatible subgoals between the members of a dominant coalition (Cyert & March, 1963; Moch & Pondy, 1977), it is conceivable to anticipate that slack can equally be expected to help resolve interorganizational fights for shared resources. In other words, slack can potentially work as an 'inducement' to encourage enfranchised stakeholders to cooperate and co-create social value. Hence, we ask: ***how does an organization's slack impact the co-creation and capture of social value with enfranchised sovereign stakeholders?***

To sharpen our intuition as to how an organization's slack can impact value co-creation and capture, we undertake a detailed case analysis of High-Speed 2 (HS2) – a multi-billion project to build the first railway network in the UK in 120 years. This case is relevant in that the UK government, the capital provider, built a vast contingency budget ahead of the choice to enfranchise the local authorities (LAs) of the cities on the route. Then, after granting decision rights to the LAs on the planning decision-making process for the city stations, the UK government mobilized vast contingency funds in order to design the stations by consensus. As a surplus that was ready to be mobilized to resolve disputes, the case shows that a contingency budget can potentially enable the co-creation of social value by impacting the 'play of the game'. However, the case also shows there are opportunity costs since a contingency budget is an idle cash that cannot be mobilized for pursuing other goals. Further, building a contingency budget carries a political cost in that third parties can perceive the organization is inefficient because it carries too much slack. Hence, the

findings on HS2 suggest a curvilinear relationship between an organization's (financial) slack and the co-creation and capture of social value. These findings are in agreement with literature on slack, which claims a curvilinear relationship of slack with other organizational variables, for example, innovation (Agrawal, Catalini, Goldfarb, & Luo, 2018; Mishina, Pollock, & Porac, 2004; Nohria & Gulati, 1996; Voss, Sirdeshmukh, & Voss, 2008), or growth and performance (Bentley & Kehoe, In-press; Fama, 1980; George, 2005; Love & Nohria, 2005; Penrose, 1959).

To sharpen our argument on the curvilinear relationship between slack and value creation we build upon a tradition of building theory on value creation and capture by using a game-theoretic model (Ross, 2018). The presentation of the argument follows the presentation adopted in Gulati and Puranam (2009) by which a detailed case study precedes the presentation of the game-theoretic model, and both are leveraged to develop the theoretical claims. Our basic contention is that the point up to which additional investment in an organization's slack positively impacts social value creation is contingent on the private benefits that are accrued to the claimants from the compromise which is made possible by mobilizing slack. Thus, if the benefits are low, social value is maximized by increasing slack up to the point that maximizes the value to be captured by the capital provider; if the benefits are high, social value is maximized by increasing slack up to the point when the value to be captured by the stakeholders is maximized. In this last situation, however, the capital provider must be prepared to trade off a loss in private returns against gains in social value. Further, we also posit that as the cost of building *actual* slack goes up, the positive impact of slack on social value creation decreases. However, we find that the organization can undercut this negative impact by mobilizing *potential* slack

instead of building more actual slack, and thus by credibly committing today to mobilize more resources tomorrow.

We believe these insights add to two topics that are central to the field of strategic management: theory on the creation and distribution of value (Coff, 1999; Dorobantu et al., 2017a; Freeman, 1984; Henisz, Dorobantu, & Nartey, 2014); and research adopting a property rights perspective on organizational governance (Asher et al., 2005; Klein et al., 2012; Klein et al., 2019). This literature recognizes that institutional regimes of shared property are amenable to value co-creation, but also to common losses, free-riding problems, and resource underutilization (Hardin, 1968; Olson, 1965; Ostrom, 1990). We add to this conversation a study of the relationship between an organization's slack and social value creation in situations where the property is de facto shared after the organization chooses to enfranchise key sovereign stakeholders.

Our study also responds to calls to extend strategic management studies on the relationship between value creation and novel forms of organizing to empirical settings that are less germane to that literature (Gulati et al., 2012; Puranam, 2018). A great deal of this literature has focused on new forms of organizing that leverage technological modularity to avoid the costs of cooperation (Adner, 2017; Ceccagnoli, Forman, Huang, & Wu, 2012; Cennamo & Santalo, 2013; Jacobides et al., 2018; McIntyre & Srinivasan, 2017). Here, we add to this literature a study of the relationship of value creation and polycentric forms of organizing – organizational systems whose survival and performance is very much dependent on the ability of their participants to find ways to cooperate across organizational boundaries. Within the universe of polycentric forms of organizing, we add to nascent strategy literature on value creation and capture in public-public partnerships (Cabral et al., 2019;

Kivleniece & Quelin, 2012; van den Oever & Martin, 2019). Finally, our insights also add to the theory of managers as core resources who not only generate rent in conjunction with the organization's other assets but also use bargaining power to capture a substantial portion of that rent, and demand compensation to share resources (Castanias & Helfat, 1991; Coff, 1999).

A Contingent Perspective of the Mirroring Hypothesis

In the third working paper, we relax the assumption (implicit in the other two studies) that the context surrounding the megaproject organization is characterized by robust institutions. Instead, we now focus our research on organizational choice when the institutional environment is heterogeneous and includes advanced and emerging economies, and crucially, when there might be a fresh history of conflict across institutional borders. Specifically, we ground our research in the global cross-border gas pipeline industry, which relies on technology that frequently must cut across emerging economies because those are the countries that hold the world's largest proven oil and gas reserves. For example, the Nord Stream gas pipeline crosses the territories of Russia, Denmark, Sweden, Finland, and Germany. Likewise, the Trans Adriatic Pipeline crosses Greece, Albania, and Italy.

Theoretically, in this working paper, we shift away from an organization governance lens and instead aim to contribute to a conversation in organization design. Specifically, we aim to add to a contingency perspective of mirroring theory, a debate that has also made it into strategic management literature (Colfer & Baldwin, 2016; Furlan, Cabigiosu, & Camuffo, 2014; Sorkun & Furlan, 2017; Sosa et al., 2004; Tee, 2019). The central precept of mirroring theory posits that managers will (or should) leverage technological knowledge in order to reduce management complexity by aligning the organizational structure with the architecture of the

products that the organization develops (Colfer & Baldwin, 2016; MacCormack et al., 2012; Sosa et al., 2004; Tee, 2019). From a descriptive standpoint, the mirroring hypothesis predicts a correlation between organizational ties and the structure of the task network. However, the hypothesis can also be interpreted as a normative recommendation in that it claims that organizations that break the mirror increase coordination costs and inefficiencies.

The roots of mirroring theory in modularity literature have put the emphasis of the debate on the contingency factors that lead organizations to break the mirror for modular technologies. We thus know, for example, that rapid technological change is a driver for loosely-coupled organizations to partially break the mirror. Change creates coordination and cooperation needs that either demand extensive information sharing across firm boundaries (Ernst, 2005) or the use of all-round knowledgeable firms, so-called system integrators, (Brusoni, 2005; Brusoni & Prencipe, 2006). Loosely coupled organizations are also known to break the mirror to keep tight control over a supply network of modules (Sorkun & Furlan, 2017); or to pursue competitive advantage (Colfer & Baldwin, 2016). In contrast, we still know little about the contingencies that drive organizations to break the mirror for integral products – the gap addressed in this paper.

Specifically, we address this gap by looking into the contingency impact of the organization's environment to the choice to mirror organizational and product structures. We focus our study on integral technologies whose task structure is highly interdependent with the institutions in the environment and the quality of cross-border relations between nations. Implicit in the mirroring literature is the assumption that the organization's environment is homogeneous. So, homogeneity is assumed in the formal and informal legal, political, and social structures and

processes that surround the organization (North, 1990; Williamson, 2000) and influence the strategic choices that are available (Dorobantu et al., 2017b; García-Canal & Guillén, 2008; Henisz, 2002; Khanna & Palepu, 1997, 2010). Put differently, in mirroring literature, there is an implicit assumption of homogeneity in the institutions that enable and constrain the production, exchange, and distribution of goods and services, and thus that firms have to adhere to (North, 1990). In addition, mirroring literature assumes away the historic context surrounding organizations. However, national sentiments, cultural aspects, and collective memories are known to directly impact the firm-level decisions made by individuals (Arikan, Arikan, & Shenkar; Arikan & Shenkar, 2013). However, the organization's task structure is not always interdependent with a homogeneous environment without cross-border conflicts. This raises the question in the paper: ***to what extent is the mirroring hypothesis contingent on the institutional and historic environment****?*

We tackle this question with an ongoing study of the cross-border oil and gas pipeline industry. Pipelines are highly integral technologies that require intense coordination across the task structure for development and production stages. The task structure is also highly interdependent with the organization's environment, and indeed the cross-border pipeline industry has a history of vulnerability to disruption and conflict (ESMAP, 2003; Stevens, 2009). Coordination and cooperation problems with local actors from the territories crossed by the pipeline frequently arise because of ideological, political, and legal differences. Complicating matters, cross-border pipelines frequently must pass through emerging economies characterized by institutional voids, which correspond to the absence, or under-development, of the institutions supporting economic activity in advanced economies, e.g. efficient markets, strong regulation, independent judiciary, property rights and contractual

enforcement mechanisms (Khanna & Palepu, 1997, 2010). Thus, to develop a cross-border pipeline, an organization must be capable of navigating differing sets of institutional voids. In many cases, cross-border pipelines also need to cut across neighboring territories with a history of conflict if not war.

If the technology is integral, as it is in the case of pipelines, by definition the network of technical interdependences is dense and thus non-mirroring is not an option (Puranam, Raveendran, & Knudsen, 2012). Hence, the organization set up to develop a cross-border pipeline faces a strategic choice: either it remains centralized (single firm), or instead it chooses to partially break the mirror by entering into alliances with local intermediaries or buyer-supplier relations. To enact partial mirroring to develop an integral technology, there needs to be extensive information sharing and communication across firm boundaries. Further, the organization needs to build organizational ties that are analogous to those found within the boundaries of the firm, e.g. colocation, intensive information sharing and communication (Colfer & Baldwin, 2016; Puranam et al., 2012).

In the working paper, we start to explore the conditions under which the mirror is partially broken for integral technologies contingent on the organization's environment. We do so through by first developing propositions. To this purpose, we draw on mirroring theory and literature on institutional voids and cross-border deals (Arikan et al., In-press; Dutt, Hawn, Vidal, Chatterji, McGahan, & Mitchell, 2016; Shenkar & Arikan, 2009) to develop a contingency perspective of mirroring for integral products on the institutional environment and cross-border conflicts. We conjecture that the more the organization must navigate differing sets of institutional voids and an undamped history cross-border conflict, the more the organization

needs to adapt its structure to the institutional and historical boundaries instead of aligning it with the technological structure.

We then check the plausibility of our induced conjectures through a descriptive analysis of the organizational structure of the cross-border gas pipeline sector. The descriptive analysis examines the entire population of 52 cross-border gas pipelines initiated since 1977, the first year for which we could find records available. By triangulating multiple sources of archival data, we uncover significant variation in the extent to which the mirroring hypothesis holds. Our findings unexpectedly reveal that mirroring is the exception. Rather, we offer extensive evidence of organizations that partially break the mirror by either setting up a single alliance (e.g. consortium, JV) in order to develop the entire cross-border technology; or, by setting up multiple legal entities in the form of alliances with intermediaries and/or buyer-supplier relations for each institutional and historic border that needs to be crossed. So, the membership of the legal entities overlaps, which allows the leading firm to take on the role of the systems integrator.

To sharpen our intuition as to why and how organizations would want to partially break the mirror, we complement the descriptive analysis with a case study on the Turkmenistan-China Gas Pipeline. This case illustrates an organization that chose to partially break the mirror by setting up four legal entities to deliver a single cross-border pipeline that crossed three institutional and historic borders. We finish this working paper with a discussion as to the dataset requirements and statistical methods that can be mobilized in future research in order to test our theoretical propositions.

In sum, this thesis offers a collection of three papers all of which are empirically informed by megaprojects. We start with a pre-theory paper by which we deploy a

cognitive lens – organizational governance and value creation – which has not been previously mobilized to illuminate megaproject phenomena. In this paper, we propose to move forward the debate as to why megaprojects perform the way they do by positing a relationship between the evolution of organizational governance and value creation and capture. We then further this idea in the second paper by focusing specifically on the way the capital provider's slack can influence the co-creation and capture of value with enfranchised stakeholders. In the third paper, we shift the theoretical angle towards organizational design, a body of literature distinct from organizational governance but which also draws from organization theory and new institutional economics literature. In so doing, we then leverage an original dataset on cross-border megaprojects to sketch the rudiments of a theory of mirroring contingent on the organization's environment. In the concluding chapter, we summarize the contributions to theory and practice, and discuss how the insights can be leveraged towards a theory of megaprojects and value creation.

CHAPTER 2

IS MISSING TARGETS A 'GOOD THING'? ORGANIZATIONAL GOVERNANCE EVOLUTION AND SOCIAL VALUE CREATION IN MEGAPROJECTS

This study addresses a long-standing puzzle about the performance of the organizations set up to develop capital-intensive technology, so-called megaprojects: are cost overruns rooted in strategic misrepresentation and incompetence, or instead, are they due to the interests of powerful stakeholders in the environment and suppliers' opportunistic behavior? Our findings are grounded on three megaprojects in the sectors of railways, airports, and Olympic parks. Using qualitative and quantitative methods, we link budgetary slippages to evolution in the organizational governance and social value co-creation and capture. Specifically, we associate major cost hikes to consensus-oriented negotiations for agreeing and redistributing the value to be co-produced as, first, a restricted group of autonomous actors forms an alliance to lead the enterprise; and then, as this alliance enfranchises key sovereign stakeholders. We also find positive, but marginal, associations between cost hikes and contractual governance. These findings suggest less ability to predict reliably the costs of collective action than the costs of contracting for resources with suppliers and stakeholders excluded from the organization. Taken together, these discoveries contribute to reconciling competing explanations for the perceived underperformance of megaprojects. Further, they suggest a pathway towards a theory of value creation and capture in megaproject contexts.

The performance of 'megaprojects' is a long-standing puzzle in management literature (Gil & Pinto, 2018; Miller & Lessard, 2001; Morris & Hough, 1987; Pitsis, Clegg, Marosszeky, & Rura-Polley, 2003; Ross & Staw, 1986, 1993; Stinchcombe, 1979). A megaproject is an interorganizational form of organizing set up to produce capital-intensive technology that is durable and shareable in use, e.g. transport and utility networks or social and science infrastructure. Megaprojects equip societies with resources to enable economic competitiveness and tackle grand challenges from climate change to rapid urbanization, population growth, and social inequality. Spending on megaprojects is estimated to amount to roughly 8% of the global GDP (Flyvbjerg, 2014). Yet, these enterprises are notorious for missing cost and schedule targets (Flyvbjerg, 2014; Merrow, 1988, 2011). Examples are galore from Boston's

Big Dig to Sydney's Olympic Park and high-speed rail in California. Overruns fuel perceptions of organizational underperformance because they violate the commitments made upfront to reduce ambiguity in the value proposition and gain legitimacy to acquire much-needed resources from the environment towards the goal (Denis, Dompierre, Langley, & Rouleau, 2011; Flyvbjerg, Holm, & Buhl, 2002; Stone & Brush, 1996).

Offering competing explanations for these empirical regularities are two research strands that are premised on antagonistic behavioral assumptions about the promoter – the organizational actor (or alliance of actors) which acts as the systems architect and is in charge of resource orchestration. One research strand claims that cost overruns occur because the promoter, at best, is incompetent – so, either the promoter lacks capabilities to set reliable targets and control for optimism bias (Morris, 1994; Ross & Staw, 1993) or, as organizational psychologists argue, the promoter has a tendency to escalate the commitment to failing courses of action and throw good money after bad or persist beyond an economically rational point (Staw, 1981); at worst, as claimed by some planning and projects scholars, the promoter strategically misrepresents the performance targets because of incentives in the budgeting process and agency problems (Flyvbjerg et al., 2002; Jones & Euske, 1991; Wachs, 1989).

A competing research strand assumes the promoter is honest and competent but acts constrained by bounded rationality. So, the promoter succumbs to environmental pressure to announce performance targets when it lacks information-processing capacities and complete knowledge to do so reliably (Gil & Tether, 2011; Miller & Lessard, 2001; Rittel & Webber, 1973). This research stream also draws from transaction cost economics literature to attribute late cost hikes to opportunistic

behavior of the suppliers ex-post contract award (Pitsis et al., 2003; Stinchcombe & Heimer, 1985). Further, this work sees the promoter hostage to interrelationships and obligations to constituent groups which makes it hard to revert a course of action (Ross & Staw, 1986); as well as hostage to the interests of powerful stakeholders in the environment (Gil & Tether, 2011; Miller & Lessard, 2001; Rittel & Webber, 1973).

In this study, we suggest an alternative explanation for observed regularities in the tradition of abductive research (Charles, 1931; Van de Ven, 2007). Thus, we depart from a phenomenon that literature struggles to explain and develop a new plausible explanation by adopting a different cognitive lens. Specifically, we draw on recent theoretical advances that establish a link between organizational governance adaptation and value creation and capture (Klein, Mahoney, McGahan, & Pitelis, 2019). This novel work integrates insights from organizational theory (Scott, 1995) with insights from new institutional economics literature (Libecap, 1989; Ostrom, 1990; Williamson, 1993). *Organizational governance* is defined as the rules and procedures that control the accumulation, development, and allocation; the distribution of the organization's resources; and the resolution of disputes (Chandler, 1962; Williamson, 1985). So, organizational governance is associated with the formal and informal rules that establish the organizational boundaries ('who is in and who is out'), and with how the organizational participants distribute value ('who gets what') (Klein et al., 2019).

We ground our study on an original dataset by which we pieced together data on organizational governance, budgetary performance, and value creation and capture for three contemporaneous megaprojects: the London 2012 Olympic Park; Crossrail, a high-capacity railway linking outer East and West of London; and the Heathrow

airport Terminal 2 (T2). Our sample is diverse in order to increase external validity: i) the megaproject developments belong to different sectors; ii) the first two are publicly financed whereas T2 is financed by a regulated private firm; and iii) only the Olympic park had an immovable end date.

Our study discovers an overlooked association between the longitudinal evolution of the megaproject organizational governance and budgetary slippages – in agreement with a tradition in organizational theory of linking structure and performance (March & Sutton, 1997). Specifically, our analysis traces, qualitatively *and* quantitatively, cost hikes to four governance adaptations: first, to the formation of a core alliance between autonomous actors to promote the project and corresponding negotiations to agree and distribute the value to be co-produced; second, to a choice of this alliance (the 'promoter') to enfranchise key sovereign stakeholders – these are defined as autonomous organizational actors with property rights, but who lie outside the organization's value chain of suppliers, operators, and employees; for example, regulators, local authorities and communities (Dorobantu, Henisz, & Nartey, 2017a; Dorobantu & Odziemkowska, 2017). Stakeholders which are enfranchised by an organization gain residual rights of control, which are rights to make claims about how to use the resources of that organization in conditions not specified by prior agreements (Hart, 1995; Klein, Mahoney, McGahan, & Pitelis, 2012). In a megaproject context, enfranchised stakeholders demand renegotiation of the claimancy rules that govern the promoter's resources. That is, to renegotiate the rules that govern the distribution of the value to be co-produced towards a distribution that is perceived to be more equitable. Third, we link marginal cost hikes to the costs of contracting for resources with stakeholders that were excluded and thus left outside the megaproject organizational boundaries. And fourth, we also find

a positive but marginal link between cost hikes and contractual governance with the supply chain.

These discoveries have important implications for our understanding of the megaproject phenomena. They show that organizational governance goes through substantive adaptation over time to build a bundle of co-specialized assets towards an evolving goal. Our findings do not refute competing explanations for cost overruns, but offer novel conceptual framing that reconciles these explanations. Further, by linking organizational governance evolution with value creation and capture, we show missing targets is not necessarily a 'bad thing' and can instead be an enabler of social value creation. We conclude by discussing how these discoveries can be leveraged towards a theory of value creation and capture in megaprojects.

Megaproject Organizations: What are they?

Megaproject is a popular term referring to any development of a capital-intensive technology that is durable and shareable in use for some appreciable range of demand. Frequently associated with the provision of infrastructure resources, their importance to society goes beyond a direct capital-based contribution to growth and productivity. Rather, megaproject outputs are factors of production that can yield substantial social gains (positive externalities) in the form of spillover effects, technology and innovation-driven economic growth, as well as third-party effects associated with incomplete and missing markets (Frischmann, 2012). So, societal demand for capital-intensive technologies is largely derived demand (Samuelson, 1954). In other words, these technologies are not exhausted through direct consumption, but rather input into a wide range of economic and social activities that produce private, public and nonmarket goods (Frischmann, 2005). The relationship between megaprojects and social surplus (the amount by which the social value

created exceeds the private value captured by project participants and end-users) is context-sensitive and tempered by who the winners and losers are from any capital investment (Aschauer, 2000). Still, the OECD estimates that $70 trillion in megaprojects will be needed by 2030 in order to support the world's growth and development,[5] a forecast which almost doubles a recent forecast by McKinsey.[6] Thus, megaprojects and their outputs are means rather than ends. But more theoretically, what is a megaproject from an organizational perspective?

Megaprojects: An Evolving Interorganizational Context

Recent empirical studies conceptualize megaprojects as networks of autonomous public and private organizational actors that agree to collaborate under an identifiable goal (Gil & Pinto, 2018; Lundrigan, Gil, & Puranam, 2015). Put simply, megaprojects are 'meta-organizations' (Gulati, Puranam, & Tushman, 2012). The defining attribute of this form of organizing is the absence of employment relationships and ownership stakes as sources of authority between key participants. Yet, megaprojects are not self-organizing systems. Rather, they are guided by an entrepreneurial architect, the promoter, who formulates the system-level goal and leads the organizational system in its pursuit. To exert influence, the promoter relies on contracts, resource dependencies, expertise, regulation, and reputation.

The membership of a megaproject organization grows over time as its designated leader, the promoter, strives to acquire complementary resources. So the promoter acts as the 'gatekeeper' (Rothaermel & Boeker, 2008) that selects new participants based upon the resources they can bring in such as know-how of local

[5] Mirabile, M, Marchal, V, & Baron, R. 2016. Technical note on estimates of infrastructure investment needs. Background note to the report *Investing in Climate, Investing in Growth*, July, OECD.

[6] McKinsey Global Institute. 2016. *Bridging Global Infrastructure Gaps*. New York, NY: McKinsey Global Institute, McKinsey & Company.

needs, capital, land, or legal powers. Some resource exchanges can be decomposed into contractible transactions. This occurs for resources that are definable and measurable and do not involve a high degree of reciprocal interdependency (Baldwin, 2007). For example, managerial and technical capabilities can be acquired in specialized markets. Likewise, some resources controlled by sovereign stakeholders can be acquired by leveraging regulations or markets. To acquire land for example promoters can use imminent domain laws and price mechanisms. So, these stakeholders can be excluded from the megaproject organizational boundaries at a limited cost.

Yet, other sovereign stakeholders control complementary resources that are costly and time-consuming to acquire through markets or regulations. To economize on the transaction costs and encourage the stakeholders to volunteer resources (as well as forestall opposition to the system-level goal), the promoter can enfranchise them. For example, Selznick's (1949) account of the Tennessee Valley Authority shows how autonomous actors were brought into its leadership structure to avert threats to its existence. Likewise, many accounts show the membership of the megaproject promoter evolves into an alliance of a few actors who agree to share resources and decision-making authority (Gil & Pinto, 2018; Pitsis et al., 2003). For example, the London 2012 Olympic park was jointly promoted by the UK government (capital provider), London government (land regulator), and the International Olympic Committee and British Olympic Association (brand owners and sport representatives).

The choice of a megaproject promoter to enfranchise key sovereign stakeholders has also been observed when these stakeholders exist within an ill-defined regime of property rights. Property rights are a bundle of rights that goes beyond the right to

sell the resources that one owns to include rights of access, withdrawal, management, exclusion and alienation (Demsetz, 1967; Ostrom, 2010). Changing regimes of property rights is costly and time-consuming, and thus in order to economize on transaction costs, organizations can opt to share property (Libecap, 1989). For example, BAA, as the monopolistic private owner of Heathrow airport, operates under a regime of ill-defined property rights. Hence, when BAA was planning T5, a new terminal to consolidate all the British Airways (BA) operations, the airport operator chose to share decision rights to encourage the airline to cooperate and share knowledge (Gil & Tether, 2011). Likewise, the UK government committed to design by consensus the city stations for HS2, a new national railway, with the local authorities. This choice reflects the fact it would be time-consuming and costly (financially, politically) to take legal planning powers away from the local authorities. Further, if the local authorities were excluded from the decision-making process, the UK government would struggle to encourage them to cooperate and share knowledge of how stations can create value (Gil & Pinto, 2018).

Taken together, this literature suggests that theoretically megaprojects can be thought of as a nexus of organizational governance structures. This includes the alliance that constitutes the promoter; a polycentric structure that includes decision-making groups of enfranchised stakeholders; and a vast hierarchically-managed supply chain; further, many sovereign stakeholders stay outside the megaproject organizational boundaries. This understanding is instructive of what form of organizing a megaproject is, but leaves unanswered why they perform the way they do. It also remains unclear how changes in organizational governance allow for value creation and appropriation by a wide range of beneficiaries, not all of which want to pay for their claims on the allocation of the resources which de jure are

controlled by the promoter. We turn now to explain our methods to investigate these research questions.

Research Design

The aim of this abductive study is to offer a new plausible explanation to empirical regularities that are commonly observed in the megaproject domain. To this purpose, this study supplements comparative case studies (which draws on quantitative and qualitative data) with panel data analysis. Case study is a suitable approach to explore novel ideas by incorporating contextual and temporal dimensions (Eisenhardt & Graebner, 2007). Case studies are particularly appropriate for contextual research (Yin, 1984) and suit well studies of process and change (Pettigrew, 1990). Multiple case analysis has the advantage of enabling to increase the generalizability of our claims. This first paper is pre-theory, however, and thus no geared towards developing inductive claims. Rather, we are trying to further our empirical understanding of a phenomenon which currently literature has struggled to explain, but stay short of developing new propositions or causal relationships. Rather the idea is to mobilize a new cognitive lens to propose a new research agenda.

Hence, to advance our understanding of why megaprojects frequently struggle to stay within the targets, we mobilize organizational governance literature to make sense of empirical regularities across three case studies. To further verify and quantify the associations derived from the case analysis, we then conducted panel data analysis, a widely used statistical method for analyzing two-dimensional (cross-sectional and longitudinal) panel data. To this purpose, we pieced together longitudinal data of cost forecast (obtained after signing non-disclosure agreements by my supervisor) and governance structure across the three projects. With observations over a long time span across a sample of nine sub-projects, we managed

to assemble a reasonable sample for panel data analysis. Admittedly, the size of the sample limits how many control variables we can use as discussed in the introduction, but we managed to control for unobserved or unmeasurable sources of individual heterogeneity that vary across projects but do no vary over time (Baltagi, 2005). Further, our effort needs to be put in perspective. In more than three decades on research in megaprojects, we are the first study to the best of our knowledge that has succeeded to negotiate access to the inner workings of megaprojects and gain access to actual cost forecast data. As Pinto and Winch (2016) stated, megaprojects have for too long remained a black box and that had hindered research progress. Whilst our panel data is limited therefore, it also is nonetheless a new dawn in megaproject research.

Research Sample

Our sample includes three megaprojects for which we gained unprecedented access to first-hand and archival data. In all cases, there was major evolution of the value proposition early on: in London 2012, this evolved from building an Olympic park into also building wider facilities to catalyze urban regeneration; Crossrail evolved from an inner London's train towards a commuters' railway; and T2 evolved from a new terminal building into a terminal campus to co-locate all STAR airlines. The proximity of the cases enabled the first author to conduct the bulk of the fieldwork through regular trips to London between 2011 and 2015. However, the fieldwork lasted till 2019 in order to acquire supplementary quantitative data for the panel analysis and continued to follow the latest developments of the Crossrail case.

We built this sample to vary three attributes of megaprojects, thereby increasing the generalizability of our findings (Siggelkow, 2007). First, the cases differ by the source of finance. We expected decisions to be more politicized in the publicly-

funded cases (Olympics, Crossrail) since the ultimate decision-making power rested with politicians – voters' agents expected to provide public goods and information about benefits and costs, but also leaders seeking re-election and thus incentivized to provide transfers to key constituents and shift costs to others (Johnson & Libecap, 2001). Yet, we were unclear of the significance of this attribute since BAA[7] was a regulated firm as it is often the case in the private provision of public infrastructure. Second, the cases differ in terms of the potential for prior and future relationships between the core participants. The Olympic park was a one-off venture; in contrast, the key T2 participants (BAA, regulator, STAR) had a long history of cooperation in day-to-day business dealings. On this dimension, Crossrail was a hybrid. It was the first commuter rail jointly promoted by the UK and London governments, but there were talks to recreate the arrangement for a second scheme. We expected more difficulty to renegotiate the distribution of the value in one-off ventures, but we were not certain of the impact on organizational performance. And third, our sample varies in the flexibility allowed in the schedules. Only London 2012 had an immovable deadline, but again we were unclear of the impacts from having the ability to negotiate more time. We summarize in Table 2-1 the characteristics of each case, the actors that we interviewed, and the archival database.

Table 2- 1 Summary of Characteristics of the Sample, Interviewees, and Archival Data

Cases	London 2012	Crossrail	Heathrow T2
Value proposition	Evolved *From an Olympic park to a park plus wide facilities to catalyze urban regeneration*	Evolved *From an inner-city London train to an East-West outer London commuters' train*	Evolved *From a new airport terminal building to a much larger airport terminal campus*
Membership of the core alliance	#4 organizational actors *UK and London*	#3 organizational actors *UK and London*	#2 organizational actors *BAA (airport owner),*

[7] In 2012, BAA changed its name to Heathrow Ltd; for simplicity, we keep to the BAA name in our account.

Cases	London 2012	Crossrail	Heathrow T2
('promoter')	*Govt's; BOA(§); IOC/LOCOG(§)*	*Govt's; Network Rail*	*CAA (*) (airport regulator)*
Distribution of the control over complementary resources within the core alliance	IOC controlled the Olympic park requirements; UK Govt controlled finance; London Govt regulated land use; BOA represented the sport bodies	UK and London Govt's controlled finance and regulated land use; Network Rail controlled the national railway infrastructure	BAA controlled the land the finance; CCA (airport regulator) controlled BAA's return on capital investment
Other sovereign stakeholders	> 500 including: *368 property owners; 35 sport bodies; 16 funders; 15 venue owners; 9 transport bodies; 8 interest groups; 5 local governments; 6 utility companies; UK Parliament*	> 600 including: *452 property owners; 37 local governments; 25 community groups; 7 utility companies; 4 transport agencies; UK Parliament*	~ 300 including *120 local residents; 39 retailers; 21 STAR airlines; 68 airlines outside STAR; 25 public agencies, local politicians; 4 utility companies; 4 local Govt's*
Supply chain size (1st, 2nd tier)	~ 1,700 suppliers	~ 2,700 suppliers	~ 650 suppliers
Timescale of the planning stage and main outcomes	~ 10 years (1999-2008/09) Outcome: Formal documents setting the scope, cost & schedule targets: *2005 Bid book;* 2007 *Yellow book; 2009 Blue book*	~12 years (1998-2010) Outcome: Laws safeguarding land for the route and setting undertakings and assurances: *Safeguarding directions (2004); Crossrail Act (2008)*	~ 7 years (2002-2008/9) Outcome: Agreement setting the scope, cost, and schedule targets: *BAA 5-year Capital Investment Plan (2008)*
Timescale of the implementation	~ 7 years (2006/7-2014) *including conversion of Olympic park in public park*	~ 12/13 years (2008/ 09-2020/21) (forecast as of Spring 2019)	~ 5 years (2009-2014)
Escalation of the cost forecast (anticipated final cost)	597%, *relative to the very first announcement* 64%, *relative to the arrival of capital-intensive supply chain*	479%, *relative to the very first announcement* 83%, *relative to the arrival of capital-intensive supply chain*	80%, *relative to the very first announcement* 25%, *relative to the arrival of capital-intensive supply chain*
No. of Interviews	#36	#33	#19
No. and description of the organizational actors interviewed	#8: *London2012 (bid company) ODA (promoters' agent); LOCOG (IOC watchdog); OPLC*	#8 *CLRL (promoters' agent for planning);Crossrail, (promoters' agent for implementation);*	#5*: STAR Alliance, Air Canada, BAA, HETCo and Balfour Beatty (two main project suppliers)*

Cases	London 2012	Crossrail	Heathrow T2
	(future park operator); Transport for London; CLM (program manager); Land Lease (private developer); Network Rail (owner of the UK rail infrastructure)	*Network Rail; UK Treasury; Transport for London (TfL); Canary Wharf (landowner); Bechtel (program manager) Transcend (supplier)*	
Archival data organized by categories (excludes news articles in the press, cost files, design change logs)	Total No. Documents # 134 *Strategy & planning documents: #84* *Financial reports: #6* *Formal communication: #5* *Newsletters & PR docs#17* *Design documents: #7* *Meeting minutes: #15*	Total No. Documents: #124 *Strategy & planning documents: #80* *Financial reports: #2* *Formal communication: #6* *Newsletters & PR docs: #23* *Design documents: #9* *Meeting minutes: #8*	Total No. Documents: #114 *Strategy & planning documents: #74* *Financial reports: #6* *Formal communication: #19* *Newsletters & PR docs: #8* *Design documents: #4* *Meeting minutes: #3*

(§)BOA - British Olympic Association; LOCOG, London Organizing Committee of the Olympic and Paralympic Games and International Olympic Committee (IOC)'s watchdog; (*) CAA – Civil Aviation Authority.

Data Collection

We built our datasets by triangulating data obtained through semi-structured interviews, analysis of public and confidential documents, and on-site visits. Triangulation is critical in performance studies because the accuracy in people's recollections is vulnerable to revisionism and self-aggrandizement (March & Sutton, 1997); further, settings with diffused authority are rich in discrepancies between what people say and factual performance (Denis et al., 2011). To guard against account bias (Eisenhardt, 1989; Jick, 1979; Miles & Huberman, 1984), for each case, we interviewed top managers and technical staff working for the promoter, sovereign stakeholders, and key suppliers.

The fieldwork began in the summer of 2011 after we gained access to the top management of the Olympic Delivery Authority (ODA), the public agency set up by the UK government to develop the Olympic Park. Armed with the ODA's endorsement and a list of interviewees, we then managed to line up comparable

groups of interviewees at Crossrail and T2. All in all, we conducted 88 interviews, one to two-hours long, which we organized in a database. We also invited eight top managers to give talks, and took verbatim notes of the presentations and lunch chats. We always offered to make the quotes anonymous to avoid potential bias (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). The interviews, presentations, and lunch chats were complemented by analyses of a vast database of archival documents (see Table 2-1).

Faced with critical gaps in our dataset, in 2015, we succeed to negotiate access to cost forecast data and design change logs for the three cases. Whilst promoters have no issues in sharing budget information, they are much coy to disclose how the budget splits between the cost forecast and contingency funds; the latter are a form of slack resources in that they give the promoter a buffer of utilizable resources in excess of the minimum necessary to produce a specified level of output (Bourgeois, 1981; Bourgeois & Singh, 1983; Cyert & March, 1963; Thompson, 1967). Budget data alone reveals little of the inner workings of a megaproject because until running out of slack, the promoter can draw down from the contingency funds to finance cost hikes whilst claiming to be ‘on budget’. We first gained access to Crossrail cost forecast data after we formally committed not share any data file. We signed a similar agreement with BAA to gain access to T2 cost data, and used a Freedom of Information request to access a similar dataset for London 2012. These datasets enabled us to verify the cost data we had gleaned from public sources and build accurate charts for all cases depicting the concomitant evolutions in the structures of organizational participation and cost forecasts.

Analysis

We structure the analysis by conceptualizing two development stages in a megaproject: planning and implementation (see Figure 2-1). We define the start of planning with the first announcement of the grand idea. It is more complicated to define when planning ends. Planning is a deliberative and political decision-making process to acquire critical resources and capabilities that are controlled individually by multiple autonomous actors – a process rife in negotiations that last many years. Yet, there is a point when enough progress has been made in acquiring critical resources to enable implementation to start – this is when a vast, capital-intensive supply chain is mobilized to transform the plan into usable technology. The start of the supplier selection does not mean, however, the end of planning activities. Rather, the implementation activity is likely to overlap with late planning talks to resolve any remaining differences. Figures 2-2a, b, and c summarize the evolution of the structure of participation and cost forecast for the three sampled cases and illustrate the analysis.[8]

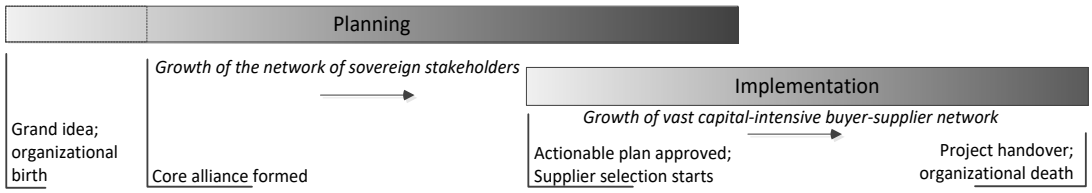


Figure 2- 1 Stylized Model of the Megaproject Organization Lifecycle

[8] All cost figures have been converted to cash (final) prices unless stated otherwise in the paper. We used Treasury guidance on long-term discount rates (Lowe, 2008) to convert the cost figures that were published in constant prices.

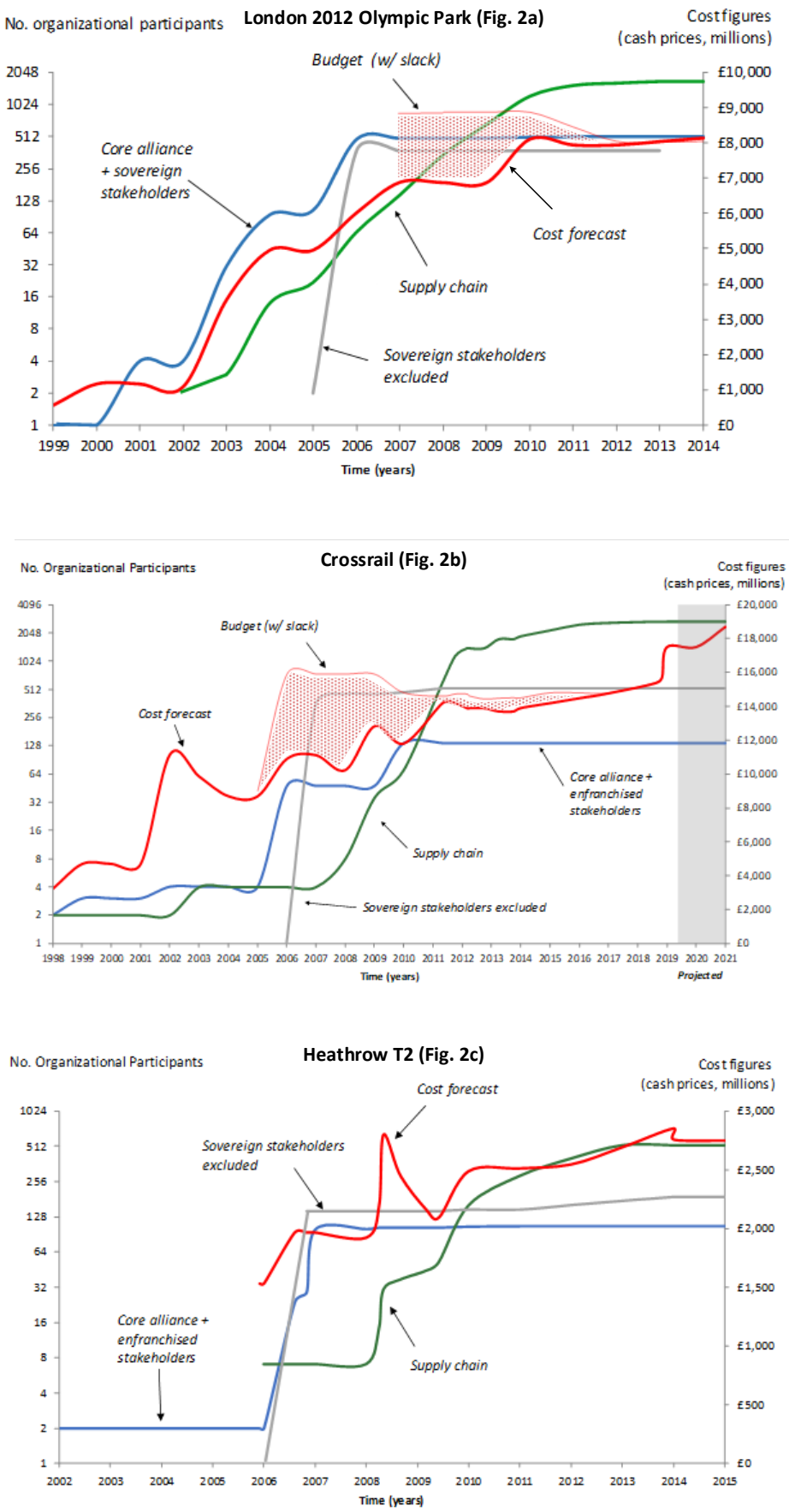


Figure 2- 2a,b,c Evolution of the Structure of Participation and Cost Forecast

From a Grand Idea to a Core Alliance and Shared Goal

The first organizational governance step in the megaproject's lifecycle is to form a core alliance of autonomous actors, the promoter. An alliance is a voluntary arrangement that involves exchange, sharing, or co-development of products, technologies, or services (Powell, 2003; Williamson, 1985). In a megaproject, the alliance brings together a restricted number of actors committed to pool and exchange resources towards a shared goal. To this purpose, the actors must negotiate distribution of the value they can all live up with. The alliance puts its members in control of a bundle of co-specialized resources, which they can then leverage to enter into negotiations with multiple stakeholders and a network of suppliers.

The London 2012 case in Figure 2-2a is telling. The idea to host the 2012 Olympic Games dates back to the mid-1990s. Promoting the idea was the British Olympic Association (BOA), the only actor that could nominate London as a host city. BOA lacked other complementary resources to pursue this goal, and yet, it still used historical data to set a cost target around £1.5bn to build an Olympic park. A few years later the idea gained traction in central government after strong lobbying by BOA– "there is an urgent need for greater ministerial involvement", said a 1999 Parliamentary report.[9] And in 2001, a 'Key Stakeholders Group' was set up to study the economic case for a London bid, which settled the membership of the core alliance. So, other members were the Greater London Authority which regulated land use and the UK government, the capital provider; further, the International Olympic Committee, whilst not a *de jure* member, was a *de facto* participant because it controlled the requirements. After winning the bid in 2005, the four actors shared veto power in a governing body, so-called 'Olympic Board'. As the unifying goal

[9] House of Commons. 1999. Culture, Media and Sports Fourth Report. Culture, Media and Sports Committee Publications. 15 May, London.

evolved to also add facilities to catalyze regeneration of over 100ha in East London, the costs grew commensurately. But the wider economic benefits were used to justify support for the investment; one report said:

The Olympic Games is an opportunity to bring substantial investment into one of the most deprived areas in London... to radically reshape East London's image for the 21st century.[10]

The Crossrail case in Figure 2-2b provides a second example. All political decision-making processes involve negotiations, but in political processes the structure of participation in the negotiations changes (March & Simon, 1958). And this is exactly what happened. In the early 90s, the goal championed by the UK government was to build a 9km-long high-capacity train in central London. But with a cost forecast of £3.3bn, the benefits did not outweigh the costs. The idea was to gain a major boost after the Greater London Authority was set up, and the two parties set up a 50-50 JV to pool resources. During the talks, the goal evolved towards a 118km commuters' railway and Network Rail, the owner of the UK railways, joined the alliance in 2002. As the cost forecast rose to £5bn, the benefits rose too to the extent Crossrail was estimated to add £42bn to the UK economy and considered 'high value for money'.[11]

One could argue the need for a core alliance was rooted in the publicly-financed nature of first two cases. Yet the privately-financed T2 case, illustrated in Figure 2-2c, shows a similar pattern. The idea here dated back to 2002 when the UK government authorized BAA to build a new terminal (T5) for the One World Alliance.[12] As a regulated monopolist, BAA had to treat all the airlines the same.

[10] ARUP. 2002. London Olympics 2012 Cost and Benefits. ARUP in association with Insignia Richard Ellis, May.

[11] The Crossrail Benefit Cost Ratio (BCR) with wider economic impacts was estimated between 2.7 and 3.5. Crossrail Ltd. 2010. Crossrail business case. Summary report, July.

[12] British Airways was the leader of the One World Alliance, the STAR Alliance's main rival at Heathrow airport.

BAA then proposed to rebuild the old T2 building to co-locate the airlines that were part of STAR, a rival alliance. Yet, since BAA had a guaranteed return on capital investment, the budget needed to be approved by the Civil Aviation Authority. It then took three years for the BAA and the regulator to agree a value distribution. Unlike the other two cases, there was less environmental pressure to announce cost targets, and thus only in 2005 the two parties announced plans for a £1.5 billion T2 campus to open around 2012.

Adapting Organizational Governance towards Polycentricity

Once the core alliance settles on a shared value proposition, the emphasis shifts to acquire complementary resources. This raises the question of which sovereign stakeholders to enfranchise. An enfranchised stakeholder gains access to a working group that is committed to a deliberative, decision-making process, and thus governance becomes polycentric. An enfranchised stakeholder has an incentive to volunteer resources, e.g. know-how, networks of trust, even finance. But in exchange, that stakeholder wants to renegotiate the rules governing the allocation of the promoter's resources. Sharing decision rights is a promoter's strategic choice. But once made, it is costly for the promoter (politically, financially) to violate this bargain. Hence, a decision to enfranchise stakeholders transforms the promoter's capital resources into a *de facto* common-pool resource, this is a resource shared by many claimants which is rivalrous in consumption (Gil & Pinto, 2018; Klein et al., 2019; Ostrom, 1990).

This governance choice brings a risk of common losses, under-utilization of shared resources, and organizational failure (Hardin, 1968). There is also an Olson's (1965) risk of the promoter being exploited if the stakeholders perceive any threat of the promoter to defect is not credible because the promoter has a greater stake. Still,

our findings suggest the choice to enfranchise stakeholders reflects a calculation the anticipated costs of collective action are lower than the transaction costs that would be incurred otherwise to contract for the resources controlled by the stakeholders. This is, the costs of exclusion would be higher than the costs of enfranchising. Further, until running out of contingency funds, slack can be mobilized to reconcile differences on capital allocation. Thus, the budget committed to the megaproject becomes a partially (non) rival good with finite and potentially shareable capacity.

The Olympics case is a good example. After the core alliance was set up, around 100 sovereign stakeholders were enfranchised (out of a group of over 500, see Table 2-1 and Figure 2-2a) including local governments, transport bodies, venue owners, and sporting bodies. During the talks to renegotiate claimancy rules, the cost forecast kept growing as Figure 2-2a illustrates – "they are just sort of saying, this is what we need for perfect games...[but] they aren't paying the bill", explained one official. To strike a consensus for the value proposition for each sports venue, the promoter set up an agent, the Olympic Delivery Authority (ODA). But with no structure in place to arbitrate the disputes, the talks put major pressure on the ODA to relax local budgets. For example, whilst one group of stakeholders argued that the Olympics stadium should be planned to become an athletics venue in legacy, others wanted it to fold into a football stadium. The differences divided the members of the core alliance themselves, and the two views were only reconciled after a major cost hike (detailed later on).

The Crossrail case suggests similar organizational governance changes towards polycentricity. For each station, a working group brought to the negotiating table local governments, transport agencies, and firms pledging finance if the stations were built on their land. The difference with the Olympics case was that any dispute

could be deferred for arbitration to the UK Parliament. Still, this dispute-resolution structure did not alter the political nature of the decision-making process – "it's all politics at this stage…you do the design, then the politics, then back to the design", said one official. During the negotiations, the project scope changed multiple times as the stakeholders asked Crossrail to be better integrated with the environment. The talks caused major cost forecast swings (see Figure 2-2b), but cost escalation prevailed – "[Crossrail] it's a very difficult beast to make economies…a bit like a Pandora box, you squeeze it here and pops up over there", said one official.

The T2 case shows a similar pattern. Regulation obliged BAA to 'constructively engage' with all the airlines in the Heathrow's community (over 80) and other stakeholders. This put BAA under pressure to make its capital resources accessible to all within this community irrespectively of their identity or end-use – what legal scholars call a 'semi-commons' property regime (Smith, 2000). And so, the promoter chose to enfranchise all the airlines – "I got called Mr. Masterplan", joked a STAR representative of his insistence for T2 to be a full-fledged campus. Yet, since any cost hike would lead to a rise in the airport fees, all claimants had an incentive to keep the cost stable (see Figure 2-2c). Still, the negotiations were rife in conflict to the extent STAR wrote to the regulator – "BAA and BA are indirectly conspiring not to allow a competitor equal ability to see the realization of facilities that match the T5 campus". It took then four years for a compromise to be reached with a moderate cost hike.

Adding Contractual Governance with Sovereign Stakeholders

Our analysis so far shows large numbers of enfranchised stakeholders across the cases. Still, these numbers pale in comparison with the numbers of stakeholders excluded from the megaprojects. The choice *not* to enfranchise reflects a calculation

well known to institutional economics scholars: when it is anticipated the transaction costs to contract for resources are lower than the costs of collective action, then using regulation or markets is attractive to acquire those resources (Libecap, 1978). This calculation corroborates the idea that economizing on transaction costs is a major driver for the choice of one form of governance over another (Williamson, 1979, 1985). However, our findings suggest not always a choice for contractual governance leads to resource exchanges with predictable transaction costs.

The London 2012 case is a good example. After winning the bid, there were seven years left to deliver the Olympic Park. Yet, there were also 368 actors controlling the necessary land. Many were not keen to part ways with the land, and thus any attempt to build a consensus would take a long time. So, the promoter got the UK Parliament to approve the Olympics Act 2005, which gave the promoter legal powers to expropriate private property – as one official said, "a very important leverage because there were all sorts of shenanigans that thought could hold the government to ransom". Still, even after leveraging regulation, the costs to acquire land escalated significantly from an initial figure of £325m to £766m.

The Crossrail case is also telling. Since the railway crossed central London, the promoter again chose to leverage imminent domain laws to expropriate private property. But in order to attenuate the political cost, the promoter agreed that every stakeholder which was materially impacted could oppose to the Crossrail plans in Parliament – which turned out to be almost 500 actors ("people come out of the woodwork with concerns", said one official, see Figure 2-2b). To save time and transaction costs, the promoter then engaged in private negotiations and leveraged price mechanisms to settle all but 113 disputes. The negotiations lasted over 40

months during which the transaction costs still increased significantly, which forced the promoter to draw down from the contingency budget to finance the shortfalls.

The T2 case is different in that since BAA owned the land, fewer sovereign stakeholders were impacted by the T2 plans and excluded from the megaproject organization (see Figure 2-2c). Still, BAA had to invest in construction mitigation measures to assuage the concerns of over 120 local residents; further, contracting for resource exchanges with the retailers proved challenging as they demanded better facilities – "BAA's mantra is no design change, but what we had didn't match our aspirations...we pushed back", said one respondent. And so, in T2 too, the budget constraint had to be relaxed, this time to account for higher transaction costs.

Adding a Vast Hierarchically-managed Value Chain

The arrival of a vast value chain marks the last organizational governance adaptation. This change occurs when the bundle of resources that are already acquired gives enough certainty in requirements to bring down the transaction costs with suppliers. The exchanges of technical and managerial resources and capabilities do not involve high degrees of reciprocal interdependence, and so they can be decomposed into contractible transactions (Baldwin, 2007). These exchanges are also not difficult to define in terms of amount, purpose, timescale and monitoring rules, which makes them amenable to contractual governance (Williamson, 1985). Still, it is impossible to write complete contracts because of the uncertainty associated with unresolved disputes between the members of the core alliance and with stakeholders. Potentially though, through political negotiations with reasonable costs, the parties to a contract can reach sufficient alignment of interests *ex-ante* of the contract agreement, and devise safeguards to deter opportunistic behavior *ex-post* (Williamson, 1985). However, the high specificity of the buyer-supplier transactions

can leave the suppliers with a monopolistic position ex-post contract award, which they can then leverage to increase their profits (Clegg, Pitsis, Rura-Polley, & Marosszeky, 2002; Stinchcombe & Heimer, 1985). Our findings do not refute these theoretical predictions but suggest two nuances. First, the cost hikes that occur after the growth of the supply chain are moderate relative to previous cost hikes (Figures 2-2a,b,c). And second, although suppliers may acting opportunistically, we cannot categorically attribute the late cost hikes to suppliers' self-interest with guile because the requirements stay in flux well after the suppliers join in.

For example, in the London 2012 case, by 2006, the promoter went in force to the market to select the main suppliers. And yet, many requirements remained in flux until 2010 in order to incorporate lessons from the 2008 Beijing games. Knowing this, many suppliers were reluctant to bid to the extent that only one contractor qualified to build the Olympics stadium. To encourage more suppliers to bid, the promoter adopted flexible forms of contract by which it committed to pay for the costs of late changes.[13] In the Olympics stadium, for example, the requirements were only resolved in 2014, seven years after selecting the main contractor; unsurprisingly, the costs escalated substantially.[14] Still, by drawing funds from the £2bn contingency (Figure 2-2a), the promoter sustained a narrative the project was on budget.

Likewise, in the Crossrail case, the supply chain grew quickly after the promoter gained powers to expropriate land in 2008. Because of the financial crisis, the market was perceived to be efficient ("the industry is on its knees", said one official). The

[13] The public promoters used mostly the so-called New Engineering Contract (NEC) Option C, a target cost contract with a schedule by which the financial risks were shared between the buyer and the supplier in an agreed proportion.

[14] In the Olympics stadium case, the cost forecast evolved from £166m in 2001 (forecasted by BOA) to circa £468 million (in the bid submitted in 2004) to over £700 million by the time conversion ended in 2015.

specificity and uncertainty characterizing the main supplier contracts were clearly high. For example, contractors had to invest in eight bespoken tunnel boring machines, each one costing tens of millions of pounds, to build two 21km tunnels 40m under London. The forms of contract adopted were again flexible in order to encourage suppliers to cooperate. Still, by December 2018, Crossrail had to ask for £2.8bn of emergency funds after depleting a £5bn contingency (Figure 2-2b). In the blame game that ensued, top managers accused 'difficult' contractors for delays and cost overruns.[15] But two independent reports traced the overruns to delays as to when the promoter started to procure trains, communication, and control systems, as well as started to run dynamic tests.[16] Our findings too suggest that differences between the three core alliance members pushed back significantly these procurement decisions – "it's a nightmare…as if we've three maniacs at the wheel", said one Crossrail official back in 2015.

The T2 case offers a third example. As with the other cases, late cost hikes were observed (Figure 2-2c). Our findings show that again the promoter selected the suppliers when uncertainty was high because the STAR membership was in flux. Unlike the other cases, the contingency funds in T2 were limited. So, the cost overruns got visible quickly. Yet, the suppliers refuted accusations they acted opportunistically, pointing instead to late changes in requirements and the BAA's choice to use more rigid forms of contract; one supplier said:

We've an obligation to be receptive to change and an obligation to tell the client [BAA] what the impact of change will be. Sometimes we're being accused of being inflexible; I think that sometimes BAA is guilty of not listening.

[15] Ibbetson. 2019. Ex-Crossrail chair blames 'difficult' contractors for delays. New Civil Engineer. 16 May.

[16] KPMG. 2019. Independent review of Crossrail – Financial and Commercial. Prepared for TfL and DfT, 23 January; London Assembly (2019) Derailed: Getting Crossrail back on track. Transport Committee. April.

Taken together, our findings suggest a link between organizational governance evolution, budgetary slippages, and negotiations to agree the value to be produced and who gets what. We find strong associations of cost overruns with setting up the core alliance and polycentric governance and less with contractual governance. For example, the overall cost escalation for Crossrail and Olympics was 597% and 479% respectively, but cost hikes after the growth of the supply chain were 64% and 83% (Table 2-1). Yet, case research leaves it unclear the impact of the choice to enfranchise stakeholders, or the extent cost hikes can be explained by time-invariant characteristics, e.g., private vs public finance, flexible vs. rigid deadline, or contracting choices. We turn now to panel data analysis to verify and qualify these insights.

Panel Data Analysis

To verify and qualify the budgetary impact of organizational governance evolution we used panel data analysis. To regress with robustness cost escalation, the dependent variable, on measures of change in organizational governance we built a time-series dataset. Our sample leveraged the varying degree of architectural decomposability that characterizes infrastructure, and the one-to-one mapping between function and large-scale components (Gil & Pinto, 2018). Specifically, our sample includes three Olympic park venues; two Crossrail stations and the tunnels package; and for T2, two building concourses and the car park.

To assemble the cost-governance time-series, we combed various data sources. For the very early negotiations, we conducted an exhaustive examination of feasibility studies and parliamentary reports for the two public projects; and in the T2 case, we examined capital investment plans and investor reports. We also looked at minutes of board meetings, financial memorandums, and public presentations. To

learn about which stakeholders were enfranchised (or excluded) for each component, we examined governance maps, formal communications, and minutes of board meetings. In addition, for Crossrail, we studied the petitions lodged by stakeholders in Parliament and corresponding responses; for T2, we checked the responses to the public consultation; and for the Olympic park, we checked the compulsory purchase orders. We supplemented this information with data from the monthly subproject (component level) status reports. A typical report includes information on the cost forecast and contingency funds as well as on the procurement status and major purchases, which indicate the growth of the supply chain. Another data source that we used to double-check the cost and governance figures were the change order logs and the risk registers.

Dependent variables

We measured budgetary performance using the magnitude of the escalation in the anticipated final cost. The cost forecast reflects the capital committed to foreseeable needs (base cost) plus an allowance for known risks, and so predicts the final cost at any point in time. Contingency funds represent capital committed but yet to be allocated; or as UK Treasury guidelines note, capital readily available to tackle 'unpredictable responses and requirements of stakeholders'.[17] Once the contingency funds run out, further cost hikes require emergency funds. So, budgetary performance compares the cost forecast at period t ($Cost\ forecast_{\ t}$) with the cost forecast at a reference point ($Cost\ forecast_{\ r}$), i.e.

$$Cost\ escalation_{\ t} = \frac{Cost\ forecast_{\ t} - Cost\ forecast_{\ r}}{Cost\ forecast_{\ r}} * 100\%$$

[17] UK Government. 2015. Early financial cost estimates of infrastructure programmes and projects and the treatment of uncertainty and risk, 26 March, Open Government Licence, Crown Copyright.

We qualify the relationship between budgetary performance and organizational governance evolution against three reference points: the very first cost forecast that was announced (*Cost_E1*); the cost forecast as it stood after the core alliance was about to start talks with sovereign stakeholders (irrespectively if they were or not enfranchised) (*Cost_E2*); and the cost forecast just before the growth of the capital-intensive value chain (*Cost_E3*).

Independent variables

We measure organizational governance changes using four indicators at each time period: number of core alliance members; number of enfranchised stakeholders; number of excluded stakeholders; and number of first and second tier suppliers. To control for the risk of correlation between independent variables, we checked tolerance statics to determine if the results might be influenced by multicollinearity. We report the highest and mean-variance inflation factor (VIF) in the Tables 2-3 that summarize the regression results. We found no single independent variable with a VIF greater than 10, the generally accepted threshold indicator of multicollinearity (Gujarati & Porter, 2009).

Control variables

Our qualitative analysis revealed differing characteristics across the sample. For example, the public projects adopted flexible buyer-supplier contracts, whereas BAA used more rigid contracts, which could encourage suppliers to behave opportunistically. There were also differences in the scale and visibility of the sampled components, and thus in the number of sovereign stakeholders who were to be impacted by each component. For example, the Crossrail tunnels or the T2 car park were to impact fewer stakeholders than the Olympic venues, Crossrail stations, or the T2 concourses. Further, the analysis suggested the nature of finance affected

budgetary performance differently in that the cost hikes were much greater for the two publicly financed developments than for the privately financed case.

Importantly, these control variables are time-invariant, i.e. their values do not change across time. To decide as to whether we needed to include time-invariant variables as explanatory variables in our regression model, we conducted a Hausman test to compare two alternative models (Greene, 2000; Hausman, 1978). A fixed-effects (FE) model assumes a correlation between time-invariant control variables and independent variables. Thus, time-invariant variables can be omitted because whatever effects these variables have on the dependent variable at one time, they will also have those same effects on a later time; in other words, the effects are 'fixed'. And so, any changes in the dependent variable must be due to influences other than the omitted time-invariant variables and the FE estimated coefficients cannot be biased (Allison, 2009; Bartels, 2008; Stock & Watson, 2007). Alternatively, we could explicitly include the control variables as explanatory variables by using a random-effects (RE) model, which assumes the omitted variables are uncorrelated with independent variables in the model. In the Hausman test, the null hypothesis posits that omitted variables are uncorrelated with other explanatory variables, which implies that the preferred model is the RE model. After running the test, we found that significant levels in all our models are less than 0.05,[18] rejecting the null hypothesis. Therefore, the FE model was preferred. The FE model implicitly captures the individual heterogeneities through the constant in the model.

[18] When *Cost_E1* is the dependent variable, $\chi^2(4) = 20.56$, p = 0.0004; when *Cost_E2* is the dependent variable, $\chi^2(4) = 12.76$, p = 0.0258; when *Cost_E3* is the dependent variable, $\chi^2(4) = 27.28$, p = 0.0001.

Statistical method

We expressed the relationship between budgetary performance and organizational governance evolution using the following generalized equation:

$$Cost\ escalation_{\ it} = \propto_i + \beta' x_{it} + u_{it}$$

in which $Cost\ escalation_{\ it}$ is the magnitude of the escalation in the cost forecast for entity i at time t; $\propto_i$s is the unknown intercept for each entity that captures time-invariant individual heterogeneity; β is a vector of parameters estimates; x_{it} is a vector of independent variables for entity i at time t; and u_{it} is an error term. The coefficient β is interpreted as follows: as the independent variable varies by one unit, the magnitude of the cost forecast escalation increases or decreases by β units. We have also run regression diagnostics by conducting unit roots and heteroscedasticity tests, all suggesting an appropriate use of the regression model.

Panel data analysis results

Table 2-2 summarizes the descriptive statistics and correlations for the variables of interest. In agreement with the qualitative analysis, the formation of the core alliance has a positive correlation (0.33, $p < 0.001$) with cost hikes. This implies a need to relax the budget constraint to agree a unifying value proposition. The choice to add polycentric governance is also positively correlated (0.46, $p < 0.001$) with the cost hikes. This implies an association between budgetary slippages and renegotiations of the claimancy rules with the enfranchised stakeholders. In contrast, cost hikes are negatively correlated (-0.31, $p < 0.01$) with the choice to exclude many other stakeholders and have no significant correlation with the growth of a supply chain (0.10, $p > 0.05$). This suggests a much higher capacity to predict reliably the costs of contracting for resource exchanges. It also corroborates the qualitative findings, which suggest that the claims of suppliers' opportunism ex-post contract

award may be hyperbolic. To control for possible impacts of individual heterogeneity and account for dynamics in the panel data we ran a panel analysis.

Table 2- 2 Descriptive Statistics and Correlations

	Mean	**SD**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1 – *Cost_E1*	1.04	1.14	1.00						
2 – *Cost_E2*	0.56	0.65	0.21*	1.00					
3 – *Cost_E3*	0.27	0.35	0.17	0.83***	1.00				
4 - Core alliance	3.24	0.98	0.33***	-0.25*	-0.15	1.00			
5 – Enfranchised sovereign stakeholders	27.21	36.20	0.01	0.46***	0.25*	-0.33***	1.00		
6 – Sovereign stakeholders outside	41.90	57.84	0.63***	-0.31**	-0.40***	0.21**	0.20*	1.00	
7 - Suppliers	60.22	82.31	0.29***	0.04	0.10	0.30***	0.23**	0.47***	1.00

Note: n = 9 components and 157 component-year observations
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2-3 presents the regression outcomes. We recall that in Model 1, cost forecast escalation is compared to the first cost forecast announcement; in Model 2, it is compared against the cost forecast announced before starting the talks with sovereign stakeholders; and in Model 3, against the cost forecasted just before adding a capital-intensive value supply chain. The F test value is significant in all models, which suggests a good fit with the data.[19]

Table 2- 3 Regression Results for Cost Forecast Escalation

	Model 1 (*Cost_E1*)	**Model 2 (*Cost_E2*)**	**Model 3 (*Cost_E3*)**
Core alliance	0.3279***	-0.1395	-0.1635
Enfranchised sovereign stakeholders	0.0079*	0.0114***	0.0181
Excluded sovereign stakeholders	0.0033*	-0.0019	-0.0049
Suppliers	0.0014	0.0018**	0.0017**
No. of observations	130	95	82
No. of entities	8	8	9
VIF: Highest (Mean)	2.10 (1.86)	2.62 (2.11)	3.53 (2.62)
F test	16.65***	9.09***	8.87***
Adjusted R_squared	0.6981	0.6566	0.5449

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[19] We do not include time-fixed effects because the null hypothesis that the coefficients for all periods are jointly equal to zero was not rejected (Prob>*F* is > 0.05).

In Model 1, we find the negotiations within the core alliance cause the largest proportion of cost hikes. Specifically, as the membership of the core alliance increases by one, the cost goes up by 32.79% on average. We also find a statistically significant association between cost hikes with polycentric governance. Enfranchising one stakeholder increases cost by 0.79% on average, which suggests major difficulties to predict the costs of consensus building. However, contracting for resources with a stakeholder increases the cost just by 0.33% on average, which suggests a greater ability to predict costs of contractual governance. Further, the growth of the supply chain has no significant impact on cost escalation. So, in the grand scheme of things, buyer-supplier relations have limited impact on budgetary performance.

In Model 2, we find the adaptation towards polycentric governance stays positively associated with cost hikes. So, enfranchising one sovereign stakeholder causes 1.14% cost hike on average. However, there is no significant association with contracting for resources with sovereign stakeholders; and there is also only a marginal positive impact from the growth of the value chain (0.18%, $p < 0.05$). These findings reinforce the idea that collective-action costs are much harder to predict reliably than the contractual governance costs.

In Model 3, we find that neither enfranchised stakeholders nor those who were excluded impact late cost escalation. But the addition of a vast hierarchically-managed value chain is positively associated with late costs hikes, although the effect is moderate: when the number of suppliers increases by one, the magnitude of cost escalation increases by 0.17%. This suggests the capacity to predict, somewhat reliably, the costs of buyer-supplier relations. Still, there is a marginal impact on cost hikes. But we cannot tell if this association is rooted in suppliers' opportunistic

behavior ex-post contract award or not. After all, disputes within the core alliance and with sovereign stakeholders remain a protracted source of uncertainty.

Reflection on the panel data analysis

The relatively small sample size in the panel regression models (130 observations in model 1, 95 observations in model 2, and 82 observations in model 3) might trigger a concern over the validity of our findings. There is no absolute standard on the minimum sample size to derive statistically valid results. It is generally acknowledged that the more observations the better (Van Overwalle & Van Rooy, 2001). Nonetheless, we believe that our findings, when reading in conjunction with the qualitative analysis, are representative of the form of organizing megaprojects in institutional environment that are not dissimilar to the UK. Further, we ran regression diagnostics to make sure that our data meets the requirement of the method. The regression diagnostic suggested that our data is not too small to generate statistically meaningful results.

It can be argued nonetheless that a limitation in our panel data analysis is that it omitted other variables that can have a potential impact too on the relationship between performance slippages and evolution of governance structure. For those variables whose value change over time (i.e. time-variant variable), our fixed-effects model (FE) cannot indeed control for their impacts. For instance, public support for a project could change over time as a result of endogenous change in the country's economic environment, and this could, in turn, affect the pressure confronting the promoter to stick to the original performance targets. There could also be discrete change in the political environment, e.g. elections, that again could have an impact on the behavior of the project promoter. With a sample of three megaprojects, we are not in a position to control for these other exogenous factors, which suggests a

direction for further research assuming similar levels of access can be negotiated to a larger sample of projects.

Importantly, however, for time-invariant variables (e.g. source of finance, scale, public visibility), they can be omitted from our fixed-effects regression model because whatever effects these variables have on the dependent variable at one time, they will also have those same effects on a later time. Any changes in the dependent variable must be due to influences other than the omitted time-invariant variables and the estimated coefficients cannot be biased (Allison, 2009; Stock & Watson, 2007).

Discussion

Why do megaprojects struggle to stay on budget? Is it possible to trace this empirical regularity to organizational governance and value creation? We find it is. Governance relates to the rules that enable and constrain organizational action (Blair & Stout, 1999; Chandler, 1962; Williamson, 1985). In this study, we trace major cost hikes to the negotiations by which a restricted group of actors forms an alliance to assemble an initial bundle of co-specialized resources towards a shared higher-order goal. Further, we associate major cost hikes to the choice to enfranchise sovereign stakeholders in order to encourage them to commit specialized resources towards that same goal. In contrast, we find marginal positive associations between cost hikes and contractual governance. These findings agree with Scott's (1987: 23) view of organizations as "coalitions of shifting interest groups that develop goals by negotiation". They also resonate with the notion that organizational governance adaptation requires difficult negotiations (Klein et al., 2019). We turn now to discuss the four pathways that we find driving the evolution of organizational governance, which Figure 2-3 represents.

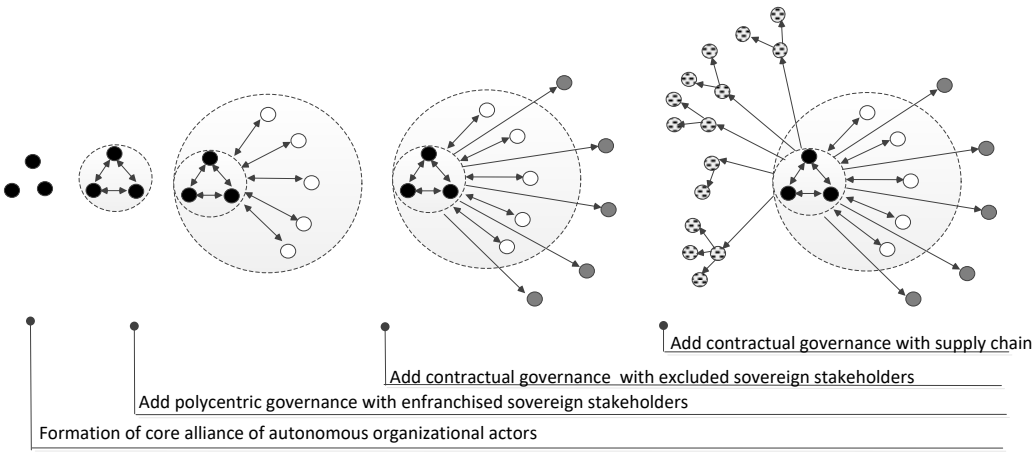


Figure 2- 3 The Evolution of Organizational Governance in Megaproject Contexts

Pathways towards Organizational Governance Evolution

Forming a core alliance

An alliance is a voluntary arrangement between autonomous actors. The key precursors vary from cost minimization to strategic behavior and value maximization drivers (Williamson, 1985). We too observe variation in the drivers of the alliances at the heart of megaprojects: cost minimization drove BAA and the regulator to join forces in the T2 case, whereas enhancing a competitive position for appropriating resources from the environment drove the London 2012 and Crossrail alliances. Irrespectively of the drivers, self-interested actors will not join an alliance and pool their resources unless they agree on what value will be co-produced and who is going to capture what. And as more actors are 'co-opted' (Selznick, 1949) and leverage their bargaining power in the alliance, the more the negotiations will lead to changes to the initial value proposition and major cost hikes.

We should not rush, however, to suggest that incompetence or dishonesty fuels early announcements of the cost targets. In settings with diffused decision-making authority, commitments to numeric targets are necessary to reduce ambiguity and gain legitimacy to acquire and allocate resources in the pursuit of the goal (Denis et al., 2011; Denis, Langley, & Rouleau, 2006). Further, building consensus with

public actors is costly. Public actors are led by politicians who have incentives to provide transfers to key constituents and shift costs to others (Johnson & Libecap, 2001). Public actors also need to cater to competing parochial interests of organized actors (Cabral, Mahoney, McGahan, & Potoski, 2019; Kivleniece & Quelin, 2012; van den Oever & Martin, 2019). Thus, relaxing the budget is an enabler for the core alliance members to coalesce around a shared value proposition.

Adding polycentric governance

Once a core alliance is formed, it is up to its members to choose how to pursue the goal from an organizational governance perspective: either they can enfranchise sovereign stakeholders to encourage them to volunteer specialized resources; or alternatively, regulation and market mechanisms can be leveraged to acquire those resources. Stakeholder enfranchisement economizes on the transaction costs that would have to be otherwise incurred to contract for those resources. The promoter thus adopts polycentric governance when it recognizes that it cannot afford the costs of excluding key sovereign stakeholders neither can it afford the costs of contracting for their resources. Our findings suggest that stakeholder enfranchising is particularly attractive when there is an overlap of jurisdictions as it is in the case of interdependencies with public agencies, local governments, and in regulated businesses. This is in agreement with the idea that changing any regime of property rights is costly when property rights are ill-defined, the number of claimants is high, the interests are competing, and information asymmetries are sharp due to equity concerns and people's perceptions of being better off with the status quo (Libecap, 1989).

The evolution towards polycentric governance gives enfranchised stakeholders residual rights of control (Hart, 1995; Klein et al., 2012). So, they gain rights to

directly influence decisions about how to use the promoter's resources. This gives stakeholders an incentive to volunteer time and effort to attend meetings, commission studies, and cooperate by sharing knowledge of local needs and lobbying for the enterprise. Yet, the stakeholders commit their resources in exchange for renegotiating the distribution of the value to be co-produced so they can maximize the value they can appropriate. So these stakeholders leverage their bargaining power and strength of their property rights to renegotiate the claimancy rules. This does not mean the promoter is hostage to the interests of powerful stakeholders (Miller & Lessard, 2001) and constituent groups (Ross & Staw, 1986). But because the promoter's capital resources are finite, they become rivalrous in consumption. In addition, if the institutions in the environment are robust, as it is the UK case, even as conflict erupts, it is costly (although not impossible) for the promoter to renege on its commitment to share decision rights (Aghion & Tirole, 1995; North & Weingast, 1989). Further, the whole point of enfranchising is precisely to economize on the costs of exclusion. So, the promoter's capital resources become a de facto common-pool resource (Ostrom, 2000). This organizational governance choice creates a risk of free-riding, underutilization of shared resources, and even organizational collapse. Yet, if there is slack to finance shortfalls, the shared resources can be transformed into partially (non) rival goods.[20] So, cost hikes become a mechanism by which the promoter's capital can be consumed non-rivalrously. This is illustrated by the depletion of the contingency funds and even mobilization of emergency funds (a form of potential slack).

[20] Partially (non) rival resources are also called "impure" public goods to emphasize that the degree of (non) rivalry of consumption varies over time, with the number of users, and is often manageable (Frischmann, 2012: 12).

Adding contractual governance with sovereign stakeholders

Adding contractual governance is attractive when the costs of excluding sovereign stakeholders are anticipated to be lower than the costs of contracting for their resources. This is the case, for example, when property rights are well-defined. In the Crossrail and the Olympic cases, the promoter needed to acquire private property (from landowners) and to interface with private property (owned by utilities). Where the markets were efficient, price mechanisms were used to resolve resource exchanges; and if there was no well-functioning market, the promoter used regulation. These transactions had costs, but they were perceived to be manageable and lower than the costs of collective action.

Importantly, we uncover a much greater capacity to reliably predict the final costs of contractual governance than to predict the final costs of polycentric governance. This discovery matters. Our analysis does not refute claims of incompetence and misrepresentation behind major cost hikes (Flyvbjerg et al., 2002; Morris, 1994). Indeed, independent reports on the Crossrail cost overruns do point to bad decisions and unrealistic budgets. Still, our analysis suggests a need to moderate these claims since it is hard to predict reliably collective-action costs. This, in turn, raises the issue if budgetary slippages are an appropriate measure of organizational performance – a point to which we return later in the discussion.

Adding a vast hierarchically-managed value chain

The last pathway to organizational governance adaptation is the arrival of a vast capital-intensive value chain. Buyer-supplier contractual governance is effective to simulate an authority hierarchy (Stinchcombe, 1984). However, there is a risk of the suppliers behaving opportunistically ex-post contract award. First, protracted disputes within the core alliance and with stakeholders are a major source of

uncertainty. The disruption caused to the work of the supply chain by difficulties to 'knit' Crossrail with the national railway (which was controlled by Network Rail, a member of Crossrail's core alliance) is but a case in point. Second, some transactions with suppliers may involve high asset specificity, which puts them in a monopolistic position ex-post contract award. And third, the low frequency of buyer-supplier transactions in megaprojects can make it hard for the promoter to rely on the contractible shadow of the future, this is, on the expectation of future gains from exchange and ability to trust and coordinate based on past experiences (Dyer & Nobeoka, 2000; Gulati, 1995). So there is a real risk of the suppliers defecting from the spirit of the contract and reverting to self-interest bargaining if requirements change (Williamson, 1975). We discuss later if this risk can lead to value destruction.

Social Value Creation and Capture

How does the evolution in organization governance allow for social value creation? Social value is defined as about creating new and appropriable benefits that society as a whole is able and prepared to pay (Kivleniece & Quelin, 2012). Put differently, social value is the sum of the private value captured by each party (Cabral et al., 2019; Cuypers, Cuypers, & Martin, 2017; Garcia-Castro & Aguilera, 2015; Lazzarini, In-press; van den Oever & Martin, 2019). In a megaproject context, the promoter uses procedural rationality in the form of cost-benefit analysis (CBA) to gain support for the decision to forge ahead with the capital investment. A robust benefit-to-cost ratio ensures probity in the use of capital funds. Further, procedural rationality is a strategy of impersonality in response to environmental pressures for accountability and distrust of decision-makers (Porter, 1995). But CBA has a bias towards endorsing capital investments that will generate appropriable value, which

leads to a focus on a narrow range of observable uses and creates valuation problems (Frischmann, 2012).

This is where the evolution towards polycentric governance matters to understand how megaprojects can create social value. Procedural rationality cannot accurately represent societal demand, but cannot also eliminate political and social pressures for compromise with the stakeholders in the environment (Dean & Sharfman, 1993; Dunleavy, 2014; van den Oever & Martin, 2019). Indeed, some economists argue that the provision of public goods is a 'second-best world' in that it needs to attend to missing and incomplete markets (Frischmann, 2012). In other words, were the megaproject promoter to act slavishly to the initial cost-benefit analysis, the output would fail to take into account positive externalities for the non-paying beneficiaries. So, the enfranchisement of sovereign stakeholders creates an opportunity to fix the limitations of procedural rationality. This choice leads to difficult negotiations to redistribute value due to inconsistent payoff structures and conflicts of interest. As Dietz, Ostrom, & Stern (2003) put it, governing common resources is a struggle. Non-paying beneficiaries may want to appropriate more value than the promoter is prepared to accept or can afford. So there is a risk of free riding. The fact the richest football clubs in the world ruled out a financial contribution to the London Olympics stadium is one example.

However, if we accept that cost-benefit analysis distorts by omission, the cost hikes associated with alliance formation and polycentric governance may be more about renegotiating the value to be co-produced in order to capture social benefits and less about free riding. Freeriding itself is a normative and rhetorical expression in that a stakeholder can be deemed a free-rider not because the claims are illegitimate but because they are made in a manner that displeases other claimants or

exceeds the scope of what the others intended to authorize (Frischmann, 2012). Further, by responding to basic human cravings for inclusivity and equitability, consensus-oriented negotiations do encourage voluntary contributions of specialized resources towards a shared higher-order goal (Fehr & Gintis, 2007; Ostrom, Walker, & Gardner, 1992). Norms of cooperation, in particular, are more likely to flourish if the groups are small (Camerer & Knez, 1997) and robust institutions give claimants incentives not to shirk commitments (Williamson, 1996). Indeed, our study shows polycentricity enabled the promoters to acquire critical resources from the enfranchised stakeholders, which would be costly and time-consuming if not impossible to acquire through contracts and consultation. So, stakeholder enfranchisement arguably creates a social surplus.

However, as our findings also show, promoters and capital providers do not want to enfranchise *all* the sovereign stakeholders. Collective action is costly and does bring a risk of free riding. The final costs of collective action are also difficult to predict reliably, which complicates the management of the interdependences with the environment. Further, the costs of exclusion can be lessened by well-defined property rights and well-functioning markets. So, the excludability of sovereign stakeholders, and thus the use of contractual governance, remains a suitable choice to avoid congestion in the use of the promoters' capital resources.

Organizational Performance

Our findings suggest that equating high organizational performance in a megaproject context to 'on budget' is a problematic institutionalized bias. Our work does not refute that promoters may introduce biases when setting budgets, whether deliberative to support a particular point of view, or as an expression of cognitive bias rooted in human's reliance on judgmental heuristics (Feldman & March, 1981;

Tversky & Kahneman, 1974). Further, if the system rewards biased choices, moral handwringing will not lessen the practice and agency problems (Jones & Euske, 1991). Still, our findings also suggest budgetary slippages appear to be – at least in part – a governance mechanism to first enable a group of autonomous actors to set up an alliance and coalesce around an initial value distribution; and then to enable the alliance to renegotiate the value distribution with stakeholders to allow for larger social gains.

Furthermore, our findings raise the question if the budgetary slippages associated with the growth of the value chain are value-destroying. High uncertainty and asset specificity plus low frequency do create a risk of suppliers' acting opportunistically to increase profit. Since the capital resources are finite, this behavior would leave fewer resources left to allow others to create value, which undermines social gains. And yet, the low redeployability of the asset-specific investments in a megaproject gives suppliers an incentive to perform to avoid the costs of writing them off. Further, we find extensive evidence of flexible contracts being used to encourage suppliers to cooperate and act flexibly. So we lack evidence to categorically link cost hikes to excessive value appropriation by suppliers. If anything, we find the association between buyer-supplier relations and cost hikes to have marginal impacts on the grand scheme of things. This resonates with Williamson's (1990) idea of feasible foresight, which posits parties to a contract have the capacity to look ahead, uncover salient hazards, ascertain mechanisms by which they work, and design the contracts accordingly.

Taken together, our findings suggest we need new measures to evaluate how megaprojects create value. Setting budgets has been central to accountability and control within an organization's management process (Pfeffer & Salancik, 1978;

Thompson & Jones, 1986). Yet, because the value captured by non-paying beneficiaries is difficult to observe and measure, megaproject budgets tend to assume away positive externalities. Stakeholder enfranchisement seems to compensate this bias and gives visibility to potential social surplus. However, this governance choice also leads to budget overruns that can be leveraged to fuel hyperbolic claims of value destruction. Opponents can then seize these claims to influence the court of public opinion and make the organization collapse to further their own interests.

On the Role of Slack

We complete this discussion with a note on the role of slack resources. The relationships between slack and social value creation merit further research. Our study shows that contingency funds play two important roles. First, they enable to sustain a rhetoric discourse that the megaproject is on budget. This is an enabler of organizational survival since the organizations that do not conform to the norms of the environment lose legitimacy to operate (Scott, 1995). Indeed, our evidence suggests that contingency and emergency funds (a form of potential slack) were instrumental to sustain Crossrail and London 2012. And second, slack works as a governance instrument to enable compromises, or in Cyert and March's (1963) words, the "quasi-resolution of conflict". By mobilizing contingency funds and emergency funds to resolve conflicts, the promoters' capital is transformed into a partially (non) rival good. This reduces the risks of congestion, even if the capital remains congestible. Further, by mobilizing slack to finance shortfalls, the promoter attenuates the distortions that derive from a rationalistic cost-benefit analysis. So slack can potentially enable redistributing value towards increasing social surplus. Still, many beneficiaries could mobilize finance too. So a question remains if slack does not amplify the risk of free riding and value destruction.

Reflection on Alternative Explanations

The interdependence of organizations with the environment is a major source of uncertainty that threatens the survival of those organizations, and this also the case in megaproject forms of organizing (Gil, Ludrigan, Pinto, & Puranam, 2017; Gulati et al., 2012; Thompson, 1967). Uncertainty in organizational literature refers to the information gap between the information required for a decision and the information available (Galbraith, 1977; Tushman & Nadler, 1978). This perspective is consistent with the idea that organizations as open social systems that must cope with uncertainty (Tushman & Nadler, 1978). Organizations are known to attenuate uncertainty by co-opting resourceful and powerful actors in the environment (Lawrence & Lorsch, 1967; March & Simon, 1958), engaging in alliances (Gulati & Singh, 1998), or decomposing the organization into less interdependent subsystems (Colfer & Baldwin, 2016; MacCormack et al., 2012; Simon, 1962). These ideas are consistent with our findings from an organizational governance perspective, but do not provide an alternative explanation as to why megaproject tend to miss their targets.

Alternative explanations as to why our focal projects performed the way they did could be hypothetically associated to changes in the external environment which we did not control for. That said, our analysis did not reveal any major link between a one-off exogenous event and project performance. Nonetheless, this link merits further investigation. Related to this, it also merits investigating also how slack affects project performance. In our sample, slack was high in the public projects and limited in the project sponsored by a regulated firm. Our research is agnostic as to the effects of reducing slack in public projects or increasing slack in private projects. Finally, we were not able to control for the impact of the level of public support or

for the accuracy of the initial targets. Still, project promoters are boundedly rational actors, so it is conceivable to expect that they can accurately anticipate how the interdependences with the environment will affect project performance. Further, the fact we observed correlations between slippages in targets and consensus-oriented negotiations, but no significant correlations between slippages in targets and contractual governance suggests the idea targets are misrepresented due to political considerations (Flyvbjerg et al., 2012) or incompetent (Morris, 1994; Ross & Staw, 1993) may have been overplayed.

Limitations

There are two main limitations in this pre-theory study. The first limitation is that the revealed association between slippages in performance targets and evolution of governance structure does not necessarily mean causation. That said, the case analysis suggests indeed that consensus-oriented negotiations are a major source of slippages in the targets, and the negotiations are the outcome of an organizational governance choice. A second limitation pertains to the fact that as our observations were grounded in the UK context, an environment in which the institutions are robust. Robust institutional environment, however, cannot be taken for granted in other contexts. In particular, when institutions are robust, it is costly for the organizational actors to renege on their commitments. The fact the institutional environment gave credibility to the promises of the project promoters was essential to ensure the sustainability of the consensus-oriented working groups at the heart of the observed organizational governance structures. If the institutions were fragile, and thus there were institutional voids in the environment such as poor enforceability of contracts or weak systems of checks and balances (Khanna & Palepu, 1997, 2010), it would not be costly for the capital provider to break its promises. This, in turn,

could encourage the other stakeholders to cooperate less. So, caution is needed before extending our insights to fundamentally different institutional environments, such as those observed in emerging economies.

Conclusion

This study reveals the organizational governance of megaprojects evolves over time by juxtaposing different pathways of governance change in the pursuit of the ultimate goal. This discovery suggests important directions for theory development. Let us reiterate three directions. First, we need theories that illuminate the choice between enfranchising sovereign stakeholders versus contracting for their resources. The former incurs the costs of collective action and difficulties to anticipate those costs (which has political costs); the latter incurs the costs of exclusion (which are a function of social norms in the context) but also allows for more predictable transaction costs. Second, we need to examine the extent to which supplier opportunism is indeed a significant risk of value destruction in light of the high uncertainty and asset specificity and low frequency of supplier contracts. And third, it merits further research on the extent to which slack is an enabler of value creation or rather makes the capital provider more vulnerable to exploitation. In recent years, significant theoretical progress has been made in understanding value creation and capture in novel forms of organizing enabled by technological progress (Jacobides, Cennamo, & Gawer, 2018). Megaprojects are not a novel form of organizing per se. But given their immense importance to society, a theory of value creation and capture in megaproject contexts urges. Our work here is but a start.

CHAPTER 3

CUT SOME SLACK? EFFECTS OF AN ORGANIZATION'S CONTINGENCY BUDGET ON THE CREATION AND CAPTURE OF SOCIAL VALUE

This study develops a theoretical perspective on the relationship between the slack resources of an organization and value creation and capture. We argue that increases in slack, but only up to a certain amount, increase social value: the value that is captured by the capital provider plus the value that is captured by the sovereign stakeholders that are enfranchised by the organization. We illustrate this curvilinear relationship by analyzing how the UK Government mobilized vast contingency funds after enfranchising the local authorities to plan a new national railway. We then derive formal boundary conditions using a game-theoretic model. We show that the amount of slack that maximizes social value is contingent on the private benefits that are accrued from a compromise: if these benefits are low, the social value is maximized by the slack that maximizes the value captured by the capital provider; if they are high, the social value is maximized by increasing slack up to maximizing the stakeholder's value – but the capital provider must then trade off a loss in private returns against gains in social value. Further, as the costs of slack go up, its positive impact on value creation reduces – an effect which the organization can undercut by mobilizing instead *potential* slack and thus by credibly committing today to mobilize more resources tomorrow.

A contingency budget is a measure of *visible* cash that is available but has yet to be committed to a specific purpose (Bourgeois, 1981; Singh, 1986). UK Treasury policy, for example, defines a contingency budget as the *excess* beyond the capital committed to foreseeable needs (base cost) plus an allowance for known risks.[21] For transport projects, the policy recommends to uplift early cost forecasts up to 66% to tackle "unpredictable responses and requirements of stakeholders", and to "counteract a tendency for project appraisers to be overly optimistic".[22] Building a contingency is an endogenous decision made by the public organization's elected leaders on the advice of appointed officials. This decision affects the context

[21] UK Government. 2015. Early financial cost estimates of infrastructure programmes and projects and the treatment of uncertainty and risk, 26 March, Open Government Licence, Crown Copyright.

[22] UK Treasury. 2013. Supplementary Green Book Guidance. HMT Green Book Appraisal and Evaluation in Central Government: Supplementary Guidance. HM Treasury, 21 April, London: TSO.

surrounding the talks between public actors since slack is common knowledge. Interestingly, this policy conundrum is in agreement with management literature on slack, which is rooted however in the private firm. This literature defines slack as a *visible* buffer of 'actual' resources or 'potentially' utilizable resources in excess of the minimum necessary to produce a specified level of output, allowing the firm to respond successfully to pressures for adjustment (Bourgeois, 1981; Bourgeois & Singh, 1983; Cyert & March, 1963). Therefore, in this study, we recognize contingency budget as a form of 'actual' slack. Importantly, this slack is endogenous in that it is the outcome of a political consideration at the onset of a development. In contrast, in slack literature, financial slack is an exogenous variable that derives from the surplus of the firm.

Irrespectively if slack is endogenous or exogenous, however, slack has been known to allow the organization to respond successfully to pressures for adjustments (Bourgeois, 1981; Bourgeois & Singh, 1983; Cyert & March, 1963; Thompson, 1967). As the theory goes, the relationship of slack with other organizational variables is curvilinear (inverse U-shaped). Increases of slack – but only up to a certain point – have a positive impact not only on growth and performance (Bentley & Kehoe, In-press; Fama, 1980; George, 2005; Love & Nohria, 2005; Penrose, 1959), but also on innovation and risk-taking opportunities (Agrawal, Catalini, Goldfarb, & Luo, 2018; Mishina, Pollock, & Porac, 2004; Nohria & Gulati, 1996; Voss, Sirdeshmukh, & Voss, 2008). The limits on the benefits of slack are rooted in opportunity costs (leaving resources idle) and agency costs (less efficient deliberating) (Jensen & Meckling, 1976; Williamson, 1964); costly political behavior (Bourgeois, 1981; Cyert & March, 1963); and the form of slack itself and

the institutional environment that surrounds the organization (Greve, 2003; Katila & Shane, 2005; Tan & Peng, 2003).

This study advances this contingency perspective within the slack literature with insights on the relationship between slack and the co-creation of value with sovereign stakeholders. The latter are autonomous actors who have property rights, but lay outside the organization's value chain of customers, suppliers, employees, and alliance partners (Dorobantu, Henisz, & Nartey, 2017a; Dorobantu & Odziemkowska, 2017). Property rights are understood as a bundle of rights that goes beyond the right to sell the resources one owns, and includes rights of access, withdrawal, management, exclusion, and alienation (Demsetz, 1967; Ostrom, 2010). So, local communities and local authorities are examples of sovereign stakeholders.

When an organization chooses to enfranchise sovereign stakeholders, stakeholders gain residual rights of control: the rights to directly influence the use of the organization's resources in conditions not specified by prior agreements (Hart, 1995; Klein, Mahoney, McGahan, & Pitelis, 2012). Strategy literature claims that the choice to bring sovereign stakeholders into the organizational boundaries responds to increasing environmental pressure on organizations to act more collaboratively (Cabral, Mahoney, McGahan, & Potoski, 2019; Dorobantu et al., 2017a; Lazzarini, In-press; Puranam, Alexy, & Reitzig, 2014). By enfranchising stakeholders, the organization also gains access to resources which may be costly, if not impossible, to acquire through markets or by leveraging regulation (Asher, Mahoney, & Mahoney, 2005; Brandenburger & Stuart, 1996; Coff, 1999; Dorobantu & Odziemkowska, 2017; Klein et al., 2012). Yet, this choice creates a risk of conflict as enfranchised stakeholders seek to leverage their bargaining power and the strength of their

property rights in order to try to appropriate a greater share of the value to be co-produced.

Since slack resources are known to help reconcile incompatible subgoals between the members of a dominant coalition (Cyert & March, 1963; Moch & Pondy, 1977), slack can equally be expected to help resolve interorganizational fights for shared resources. In other words, slack can potentially work as an 'inducement' to encourage enfranchised stakeholders to cooperate and co-create social value; this is, to create new and appropriable benefits for which society as a whole is able and prepared to pay (Cabral et al., 2019; Cuypers, Cuypers, & Martin, 2017; Garcia-Castro & Aguilera, 2015; Kivleniece & Quelin, 2012; Lazzarini, In-press; van den Oever & Martin, 2019). Hence, we ask: *how does an organization's slack impact the co-creation and capture of social value with enfranchised sovereign stakeholders?*

Our focus is on the contingency budget, which is widely used by organizations when setting targets and in measuring the organization's performance. However, the debate on whether contingency funds add or destroy value in relationships with stakeholders is far from being settled. As one top manager said to us, "if anyone walks into my door and asks me for more than 10% contingency, they need to be very brave…even 4% is generous for me". More theoretically, contingency funds are high-discretionary slack resources in that they are visible and measurable, but have yet to be committed to a specific purpose (Greenley & Oktemgil, 1998; Singh, 1986). As a surplus that is ready to be mobilized to resolve disputes, contingency funds can potentially enable the co-creation of social value by impacting the 'play of the game' with the enfranchised stakeholders. However, there are opportunity costs too since a contingency budget is an idle cash that cannot be mobilized for pursuing other goals.

We illustrate the curvilinear relationship between an organization's financial slack and the co-creation and capture of social value through a detailed case analysis of how the UK government, the capital provider, mobilized vast contingency funds after awarding local authorities decision rights to plan High-Speed 2 (HS2) – a project to build the first railway network in the country in 120 years. Whilst the contingency was insufficient to finance all the local claims, our evidence suggests it enabled many compromises that produced social gains.

To further our understanding of the relationship between slack and social value creation, we build on a tradition of using game theory to develop formal strategy theories of value creation and capture (Gans & Ryall, 2017; Ross, 2018). Our argument is that the point up to which additional investment in slack positively impacts social value is contingent on the private benefits accrued to the claimants by the compromise which was made possible by mobilizing slack. Thus, if the benefits are low, social value is maximized by increasing slack up to the point that maximizes the value captured by the capital provider; if the benefits are high, social value is maximized by increasing slack up to the point when the value captured by the stakeholders is maximized – but the capital provider must then trade off a loss in private returns against gains in social value. Further, as the cost of building *actual* slack goes up, its positive impact decreases – an effect that the organization can undercut by mobilizing *potential* slack, and thus by credibly committing today to mobilize more resources tomorrow.

These insights add to two topics central to the field of strategic management: theory on the creation and distribution of value (Coff, 1999; Dorobantu et al., 2017a; Freeman, 1984; Henisz, Dorobantu, & Nartey, 2014); and research adopting a property rights perspective on governance (Asher et al., 2005; Klein, Mahoney,

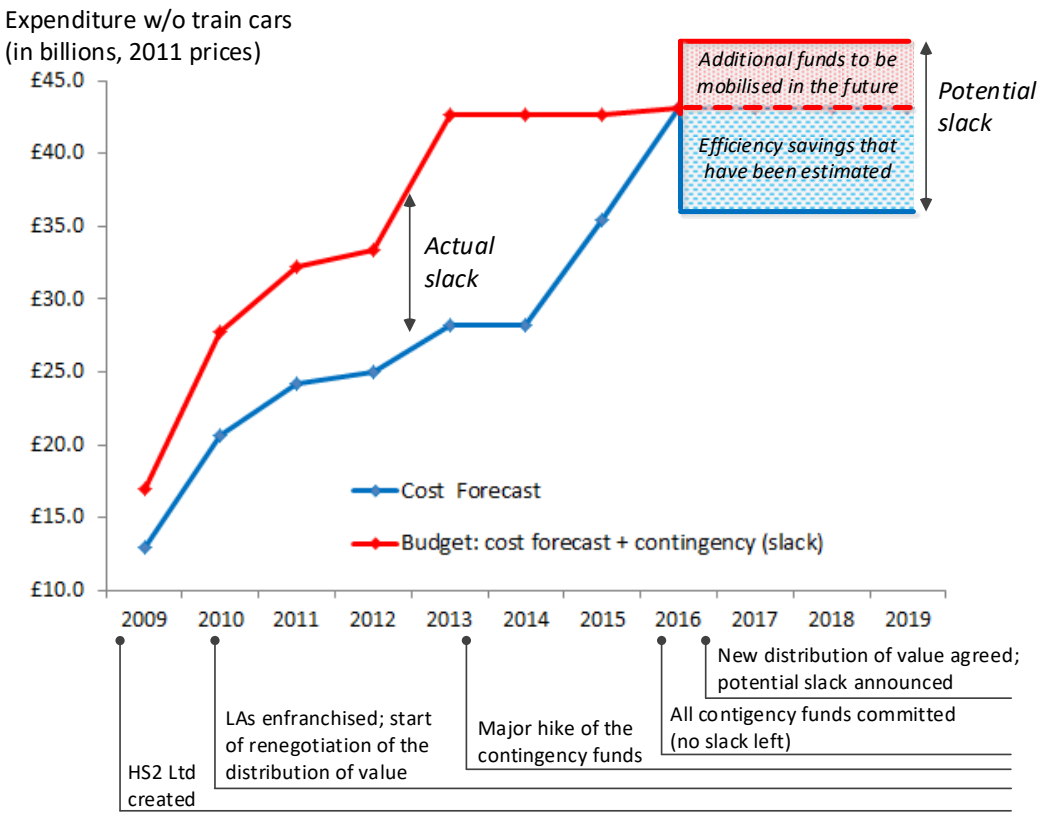
McGahan, & Pitelis, 2019; Klein et al., 2012). This literature recognizes that shared property is amenable to value co-creation, but also to common losses, free-riding problems, and resource underutilization (Hardin, 1968; Olson, 1965; Ostrom, 1990). Regimes of shared property persist as organizations seek either to avoid the high transaction costs to contract for property rights (Libecap, 1978); build bundles of co-specialized resources (Barney, 2018); or create contexts of shared property in order to preserve or increase their wealth (Alexy & Reitzig, 2013; Blair & Stout, 1999; Schelling, 1960). We add to this line of work a study of the relationship between slack and social value creation in situations where the property is shared. We also respond to calls to extend literature on novel forms of organizing to settings less germane to that literature (Gulati, Puranam, & Tushman, 2012; Puranam, 2018). We do so with a study on polycentric forms of organizing whose survival and performance is very much dependent on cooperation across organizational boundaries. Within this universe of forms of organizing, we add to nascent strategy literature on value creation and capture in public-public partnerships (Cabral et al., 2019; Kivleniece & Quelin, 2012; van den Oever & Martin, 2019).

Finally, our insights also add to the theory of managers as core resources who not only generate rent in conjunction with the organization's other assets but also use bargaining power to capture a substantial portion of that rent, and demand compensation to share resources (Castanias & Helfat, 1991; Coff, 1999). We propose slack enables bargaining towards value creation. But only up to a certain point, which is contingent on the benefits to be accrued, the costs of slack, and the willingness to sacrifice private value for social value.

Slack and Social Value Creation and Capture in Planning High Speed 2

In the tradition of research which uses game theory to sharpen empirical insights on organizing and strategy (Gulati & Puranam, 2009), we preview the logic of our arguments with an in-depth analysis of the relationship between financial slack and value creation in the planning of High Speed 2 (HS2). As an instance of 'government strategizing' (Lazzarini, 2015), the railway network was a horizontal policy promoted by the UK government (Govt) to *increase transport capacity and* improve the UK's business environment in a generalized way. The idea gained traction after the 2008 financial crisis and Govt set up a public agency, HS2 Ltd, to develop the plans for gaining legal powers from Parliament to expropriate land. By 2010, to maximize the Benefit-to-Cost Ratio (BCR), Govt settled on a route connecting the largest markets for train services: London to Birmingham, to be planned by 2015 and operational by 2026, and two branch lines, one connecting Birmingham to Manchester and another to Leeds to be planned by 2020 and operational by 2033; concomitantly, Govt announced a £30bn (2009 prices) budget[23] – see Figure 3-1 for key events and BCR evolution.

[23] Wynne, A. 2010. Government reveals £30bn high speed rail plans. New Civil Engineer, 11 March.



Benefit-cost Ratio (BCR) with and without Wider Economic Impacts (WEIs)

	2009	2010	2011	2012	2013	2015	2016	2017
wo/ WEIs	2.4	2.3	2.2-2.3	1.6-1.9	1.8	2.0	2.1	1.9
w/ WEICs	2.5-2.9	2.7	2.0-3.4	1.8-2.5	2.2 -2.3	2.5	2.7	2.3

The Benefit-cost ratio (BCR) summarises the value for money (VfM); VfM is ´high if BCR >2

Figure 3- 1 Indicative Timeline of Key Events in the HS2 Planning Process

Enfranchising the Local Authorities

Around a third of the cost forecast for HS2 was committed for the city stations, which were hard to plan without cooperation from the Local Authorities (LAs) – sovereign stakeholders with statutory planning powers and know-how of the cities' growth potential and needs. Strategically, Govt chose not to leverage regulation to formally exclude the LAs from the planning process as it had done, for example, for the 2012 Olympic park.[24] Instead, Govt asked Parliament for *outline* planning powers for HS2. This move enfranchised the LAs in that they would need to approve

[24] For the London 2012 Olympic park, Govt asked Parliament for full planning powers. But Govt calculated the costs of excluding the LAs, if it used a similar strategy, would be unaffordable since the HS2 city stations would impact a much greater number of LAs and a lot more valuable land needed to be expropriated.

the *detailed* plans for the stations ("they get a second bite on the cherry", one HS2 official said). So, a regime of shared property rights was created.

Yet, cooperation with the LAs would not be trivial. Outrightly, the LAs claimed the Govt's cost-benefit analysis was too narrow since it failed to account for the social gains that would arise from the impetus provided by the stations for urban regeneration and growth. This claim is aligned with new economic growth theory which sees infrastructure as a factor of production in that it yields positive externalities that benefit society such as spillover effects, technology-driven growth, and third-party effects associated with incomplete and missing markets (Aschauer, 2000). To support their claims and maximize the value to be captured, the LAs produced their own masterplans and economic appraisals. One local official said:

They [Govt] proposed a [Manchester] city center station that sits on its own...we don't want that, this is a once-in-a-century opportunity to have a major transport interchange…a fantastic station, iconic in design... we understand their position and they understand ours.

However, cash-strapped by years of austerity, the LAs asked Govt to finance their claims. This created complications because Govt was constrained by promises on the budget – "credibility depends on those numbers do not go up every time the public hears them", said one official. Yet, were Govt to renege on the commitment to enfranchise the LAs, the costs of exclusion would be high – "if you take promises back away, it's difficult to deal with the opposition you may get", said one official. The LAs could then ask Parliament to arbitrate disputes, go to public courts, and even oppose HS2 – joining a chorus of 'voices' (Hirschman, 1970) claiming HS2 was a waste of money and should be canceled. So Govt ruled out excluding the LAs, and the HS2 budget became a de facto common-pool resource; this is, a non-excludable resource that was rivalrous in consumption. Enfranchised by Govt, the LAs had an incentive to cooperate. But the LAs were also determined to renegotiate

the claimancy rules on the HS2 budget in order to increase the value that they could appropriate.

Building Slack in the Form of a Contingency Budget

A contingency budget is a measure of *visible* cash that is available but not yet committed, and thus a form of slack. UK Treasury policy defined it as the *excess* beyond the capital committed to foreseeable needs (base cost) plus an allowance for known risks; policy recommended to build a contingency to tackle "unpredictable responses and requirements of stakeholders".[25] Uplifting early cost forecasts required balancing historical data and political jockeying by internal stakeholder groups with the costs (financial, political) of building a contingency budget, mobilizing it to enable compromises, and eventually running out of contingency. One Govt official explained:

As soon as … the project has been accepted, there's an incentive to talk the budget up to give yourself the headroom to deliver … But there's a bandwidth …if we push it too far, we won't get the project at all. So there's that game to try and find what Treasury's real limits are.

In trying to mitigate perceptions of an 'over-egged budget', as one official put it, the 2010 £30bn HS2 budget limited the contingency to £8bn, less than half of the uplift suggested by the policy. As pressure to adapt the scope of HS2 mounted, Govt started by letting the budget rise up to £33.4bn,[26] thereby protecting the contingency. But as the talks with the LAs gained force (see next section), Govt got alarmed that it lacked enough slack and, by June 2013, the contingency was hiked to £14.4bn.[27] This caused a ruckus with watchdogs ("one heck of a lot of public money, why?"[28])

[25] UK Government. 2015. Early financial cost estimates of infrastructure programmes and projects and the treatment of uncertainty and risk, 26 March, Open Government Licence, Crown Copyright.

[26] DfT. 2012. Economic Case for HS2. A report to Government by HS2 Ltd, January; NEC (2012). HS2 Engineer aims at lower £25bn budget. New Civil Engineer, 28 June; 2011 cost figures unless stated otherwise.

[27] DfT. 2013. The Economic Case of HS2. Cost and Risk Status Report.

[28] House of Commons. 2013. Evidence Taken before the Committee of Public Accounts HC 478, 1 July.

and with political opponents.[29] Still, by promising a chance of a budget overrun of no more than 1 in 20 and a BCR higher than 2 – which policy-wise meant HS2 was "high value for money"[30] – Govt saw off the attacks.

Slack and the Creation and Distribution of Social Value

By 2019, after 6 years of planning talks, Govt had kept to the promise to plan the stations by consensus, and crucially, to keep the HS2 budget stable. Struggling to extract concessions from Govt, the LAs threatened to ask Parliament to arbitrate the disputes. Yet, even in cases where Parliament started to listen to the disputants (e.g. London), private negotiations led to late compromises that avoided arbitration. Knowing that there was slack in the system, the LAs asked Govt to finance their claims. As early as 2015, the contingency had all been committed. Still, the LAs and Govt insisted that the compromises, which were monitored by watchdogs, added value, and the BCR remained above 2 once accounting for the wider economic impacts (WEI).[31] But wary of starting to build HS2 with no slack, in 2016 Govt committed to finding £9bn of savings. Concerns that the benefits would be compromised urged the Infrastructure Planning Commission to ask Govt instead to double the HS2 budget.[32] But wary of the political costs if it let the budget slip again, Govt pledged instead to finance shortfalls with resources to be generated from the

[29] Mandelson, P. 2013. Why I no longer support a high-speed line for Britain. Financial Times, 2 July.

[30] Before the 2013 hike of the contingency budget, the BCR was estimated at 2.2 (2.6 w/ wider economic benefits -WEIs); by 2013, the BCR decreased to 1.8 (2.3); Dft 2013. The Economic Case for HS2, October.

[31] DfT. 2015. HS2 Phase 2a Strategic Outline Business Case. November; also DfT 2017 HS2 Phase 2 Economic Case, July; and National Audit Office 2016. Progress with preparations for High Speed 2, 24 June.

[32] Armitt, J. 2018. When people reach the end of their HS2 journey they will in many cases face inadequate public transport links. The Telegraph, 4 August.

commercial upside of the compromises. Potential slack was cheap, but it failed nonetheless to stop numerous calls to cancel HS2.[33]

The Leeds case is telling. Around 2011, Govt proposed a £250m plan which, to keep the costs down, would locate the Leeds HS2 station a quarter of mile away from the existing central station. Outrightly, the LAs claimed that the plan failed to create enough value ("HS2 is about this regeneration potential...to maximize the benefits", said one local official). After four years of talks, Govt caved in and committed £250m of the contingency budget – "We need to find not just the right transport solution, but also one that goes with the grain of the city's vision", said the HS2 Ltd chairman.[34]

The case of the HS2 London terminus at Euston offers a second example. Trying to keep the base cost under £1.5bn, Govt restricted the scope of the plans to the HS2 platforms, ruling out modernizing the old Euston station. Outrightly, the LAs pushed back – "the plans… amount to a shed being bolted on to an existing lean-to", said one elected leader.[35] Failing to extract concessions from Govt, the LAs asked Parliament to arbitrate the dispute whilst continuing with private talks. Three years later, in 2016, Govt reached a compromise: Euston would be fully remodeled in exchange for the LAs dropping opposition to the new agreed-upon plans, which the Transport Minister characterized as "ambitious and bold".[36] Yet, under pressure to keep the HS2 budget stable, Govt only committed £1bn of contingency funds to enable the compromise. Facing a £2bn shortfall, the parties pledged to work together in order to leverage the revenue opportunities that the new solution was believed to hold.

[33] Plimmer, G, Pickard, J. 2019. Former HS2 boss says 'nobody knows' its final price tag. Financial Times, 22 January.
[34] DfT. 2014. Rebalancing Britain. From HS2 towards a national transport strategy. HS2 Ltd.
[35] HS2 scraps Euston station rebuild plans. BBC News, 19 April 2013.
[36] House of Commons. 2015. Railways: HS2 Phase 1. Standard Note 316, 19 February.

The Manchester case provides a final example of how slack enabled social value creation. Like Leeds, Govt used contingency funds to finance the claim to co-locate the HS2 station with the city's main station, which doubled the base cost. But complicating matters, the LAs asked for an HS2 station by Manchester airport – "another £350m, but the business case doesn't stack up", said initially one Govt official. After five years of talks, Govt acquiesced to move the HS2 route so it would pass by the airport, which required drawing down again from the contingency budget. But with hardly any slack left, Govt was yet to commit finance to build the station – "a matter for Ministers and Greater Manchester to agree in the future", said the HS2 Ltd chairman.[37] Still, this move encouraged the LAs to cooperate – by committing to finance the shortfall *if* Govt would allow the Manchester LAs to earn back the extra tax they claimed the airport station would generate. As the Manchester council leader said, "getting the funding is actually pretty easy, but we don't need to do it now".

The Curvilinear Relationship between Slack and Social Value Creation

The HS2 case suggests the presence of slack induced the enfranchised stakeholders to cooperate towards a common goal. But building slack is not free, neither is using it. So the slack built-in was less than that advised by policy to contain the political costs. Yet, as slack ran out, the survival of HS2 has become under threat. These findings suggest a curvilinear relationship between slack and social value, but important questions remain unanswered: how much slack maximizes social value? How is this amount affected by the benefits of compromising? How is it impacted by the costs of slack? And how does slack affect

[37] DfT. 2014. Rebalancing Britain. From HS2 towards a national transport strategy.

value capture? Following Gulati and Puranam (2009) we answer these questions in two steps. First, we draw on recent theoretical advances to link sovereign stakeholder enfranchisement to the transformation of an organization's resources into a de facto common-pool resource. We then draw on slack literature to argue that the relationship between slack and social value creation is curvilinear. Finally, we use game theory to derive formal boundary conditions.

Enfranchised Sovereign Stakeholders and Common-pool resources

The choice to enfranchise sovereign stakeholders resonates with the need for organizations to attenuate environmental uncertainty to increase the chances of survival (Galbraith, 1977; Lawrence & Lorsch, 1967; Thompson, 1967). This choice determines who is inside and who is outside the organization – a foundational element of the governance structure (Klein et al., 2019; Williamson, 2005). Once enfranchised, the stakeholders gain residual control rights over the organization's resources in conditions yet to be specified.

An institutional economics (property rights) perspective brings further nuance to this conceptualization of the boundaries of the organization. This perspective illuminates the reasons that drive an organization to share decision rights with stakeholder groups (Asher et al., 2005; Dorobantu & Odziemkowska, 2017; Klein et al., 2012). This is a choice that enables the organization to avoid the high transaction costs of contracting for resources when property rights are ill-defined – costs that are rooted in distributional concerns and people's perceptions that they are better off with the status quo (Libecap, 1978); further, organizations also share property to preserve or increase their wealth even if it is costly to disenfranchise the stakeholders later on (Alexy & Reitzig, 2013; Blair & Stout, 1999; Schelling, 1960).

By enfranchising external stakeholders which cannot be managed by contracts or fiat, neither excluded, but whose interests are also not fully aligned, elements of collective action are added to the organization's governance structure. These elements are akin to the collective-action structures that govern internal stakeholder groups given the restrictions on the use of authority by senior management inside organizations (Klein et al., 2019). Hence, by enfranchising sovereign stakeholders, some of the resources that are de jure controlled by the organization become a de facto common-pool resource. And this leads to bargaining to renegotiate the rules which determine who gets what of the value to be co-produced.

Can Slack Encourage Enfranchised Sovereign Stakeholders to Cooperate?

Renegotiating claimancy rules with enfranchised stakeholders involves difficult bargaining (Klein et al., 2019). This bargaining can lead to free-riding problems, social dilemmas, and organizational collapse as stakeholders compete to capture a greater share of value – and the more so if they perceive that the organization is 'privileged' enough to bear all the costs of cooperation (Hardin, 1968; Olson, 1965). So, if the organization's slack is common knowledge, stakeholders can feel tempted to act more competitively to capture even more value. Since slack is not free, there might be a point when the benefits the organization accrues from building slack fail to outweigh the costs of carrying that very same slack.

However, slack can also give stakeholders an incentive to cooperate by volunteering resources such as time, networks of trust, and even finance. If the stakeholders cooperate, the organization can be encouraged to reciprocate by mobilizing slack to enable compromises. So, the social value can be created beyond that which could be produced from the resources that the organization had committed. Asymmetries of information and perceptions of value complicate the

bargaining process (Libecap, 1978). But, they do not negate this fundamental tension between cooperation and competition (Hoffmann, Lavie, Reuer, & Shipilov, 2018).

Still, a relationship with sovereign stakeholders lacks the selective pressure and information-generating capabilities of a competitive market to ensure the utility is maximized. Hence, to ensure the compromises lead to value creation, there is a need for the institutions in the environment to scrutinize the compromises. If the institutions are fragile, compromises can be due to goal distortions, inadequate adaptation, and even interests to 'purchase' votes or frustrate the efforts of potential successors to renege on prior commitments (Zald, 1970). In contrast, robust institutions guarantee the negotiations do not lead to loss of social value. In other words, robust institutions ensure the value distribution does not impair value creation (Ross, 2018). In collective action, utility is transferable when independent monitors ensure cost-benefit proportionality, graduated sanctions punish free-riders, organizational boundaries are clear, and dispute-resolution structures are affordable (Ostrom, 1990, 2005). These institutions cannot be taken for granted, but they have been observed in many settings.

Is There an Optimal Amount of Slack in Sovereign Collaboration?

A choice to enfranchise sovereign stakeholders gives relevance to Scott's (1987) view of organizations as 'coalitions of shifting interest groups that develop goals by negotiation'. From organization theory, we know that slack is a governance mechanism that enables interest groups to reconcile incompatible subgoals (Cyert & March, 1963). Hence, we can expect slack to be of value too to enable cooperation with enfranchised sovereign stakeholders. First, slack allows room for more deliberative processes using rational criteria, which creates less need for inefficient power struggles and political bargaining (Bourgeois, 1981; Cyert & March, 1963;

Moch & Pondy, 1977); and second, slack arms the organization with uncommitted resources, which creates opportunity for growth and innovation (Nohria & Gulati, 1996; Penrose, 1959). But here is the rub. Too much slack can breed inefficiencies (Love & Nohria, 2005) and impair organizational performance (Chiu & Liaw, 2009; George, 2005; Lin, Cheng, & Liu, 2009); further, excessive slack can inhibit entrepreneurship, cause agency problems, and lead managers into suboptimal behavior (Antle & Fellingham, 1990; Jensen, 1986, 1993), indiscipline and irrational optimism (Lin et al., 2009).

In sum, if slack is visible across organizational boundaries *and* the institutions are robust, we can assume a point up to which investing in more slack positively impacts social value beyond the social value that could be created with the resources already committed. We turn now to game theory to develop this argument further and formalize boundary conditions.

Research Methodology

The research design follows Gulati and Puranam (2009) by which a detailed case study precedes the presentation of a game-theoretic model. The aim of the case study is not to build theory, but rather provide intuition for theoretical claims at the heart of the study. Thus, we use the HS2 case to provide evidence for our claim that slack can be expected to help resolve interorganizational fights for shared resources, but slack is not free and thus we can expect a curvilinear relationship between slack and value co-creation.

We then build on organization governance literature to theorize this claim. Interestingly, our claims are consistent with extant literature on slack rooted in the private firm. That literature too suggests that too much slack can potentially breed inefficiencies, cause suboptimal behavior and agency problems (Antle & Fellingham,

1990; Jensen & Meckling, 1976; John et al., 2017). Therefore, our idea that the relationship between slack and value creation is inverse U-shaped is in line with studies between slack and other organizational variables (e.g. innovation, firm growth, and risk-taking activities) in regards to private firms (Agrawal, Catalini, Goldfarb, & Luo, 2018; Bentley & Kehoe, In-press; George, 2005; Love & Nohria, 2005; Nohria & Gulati, 1996; Penrose, 1959).

Our formulation of the main argument, illustrated by our HS2 case, leaves unanswered important question related to the boundary conditions of the impacts of slack on the co-creation of social value. To address this purpose, we build on a tradition of using game-theoretic models to formalize boundary conditions for theoretical claims grounded in empirical regularities (Baldwin & Clar, 2006; Gans & Ryall, 2017; Gulati & Puranam, 2009; Van der Meulen, 1998). As a study of "mathematical models of conflict and cooperation between intelligent, rational decision-makers" (Myerson, 1991: 1), game theory provides a set of rules and assumptions to model how rational actors choose the best strategy in a bargaining structure (Bacharach and Lawler, 1981). Game-theoretic models enable the crafting of theory based on strategy and organization design dynamics by stating the consequences of strategic choice, whilst exposing the assumptions that underlie the theoretical claims to debate (Gulati & Puranam, 2009). In particular, game-theoretic models offer a precise language to further our understanding of the bargaining processes for co-creating value and appropriating value (Ross, 2018).

Slack and the Co-creation of Social Value: Boundary Conditions

Investing in slack is a strategic choice. It creates a governance mechanism to enable value to be redistributed towards a distribution that is perceived to be more equitable without changing stakeholder enfranchisement. To further our

understanding of this choice we built a simple model of the bargaining process by which claimancy rights are redistributed. Our goal is to state boundary conditions under which slack maximizes the creation of social value. We simulate a situation, as in HS2, where the capital provider and an enfranchised stakeholder haggle over using slack under a set of rules that make it costly for both parties to walk away from the negotiations; further, independent monitors ensure both parties accrue benefits from striking a compromise, and incur costly arbitration if they fail to settle the differences. Specifically, we explore how social value is co-created and captured contingent on: i) the private benefits that the parties accrue from the compromises that are enabled by mobilizing slack; and ii) the costs of building and mobilizing slack. We proceed by presenting a verbal and graphic account of the model to explain how the results lead to our formal propositions. In the appendix, we include the analytical details of the game-theoretic model and proofs.

We draw on noncooperative game theory – an approach that is suitable to simulate bargaining processes when the institutions specify who the claimants are, the competitive moves, and restrict cooperation to a well-defined set of actions (Ross, 2018). We conceptualize a bargaining process between the capital provider (A) who invested in slack, S, and de jure controls it, and an enfranchised sovereign stakeholder (B). Table 3-1 summarizes the key variables and relationships by which we model how slack enables social value to be co-created and distributed. We assume that the capital provider prefers value distribution D_A, for which it does not need to mobilize slack and only incurs costs K_A; so D_A leads to private value F_a for the capital provider and private value F_b to the stakeholder. Unhappy with D_A, and aware of the slack that there is in the system, the stakeholder proposes a different

value distribution, D_B, which costs more to realize, K_B. So, the stakeholder demands slack to be mobilized to fill the difference, $K = K_B - K_A$.

Table 3- 1 Value Creation and Distribution: Key Variables and Relationships

	Benefits	Costs	Value
Capital provider	$F_a + \alpha x$	Costs of building slack: rS Costs of mobilizing slack: $\begin{cases} lx & \text{if } x \le S \\ lS & \text{if } x > S \end{cases}$ Costs of running out of slack $\begin{cases} 0 & \text{if } x \le S \\ c(x-S) & \text{if } x > S \end{cases}$	If $x \le S$, $V_A(x) = F_a - (l-\alpha)x - rS$ If $x > S$, $V_A(x) = F_a - (c-\alpha)x + (c-r-l)S$
Stakeholder	$F_b + \beta x$	*Costs assumed to be negligible*	$V_B(x) = F_b + \beta x$
Social Value to be co-created			$\begin{cases} F_a + F_b - (l-\alpha-\beta)x - rS & \text{if } x \le S \\ F_a + F_b - (c-\alpha-\beta)x + (c-r-l)S & \text{if } x > S \end{cases}$

F_a and F_b are benefits accrued by the capital provider and the stakeholder respectively from the capital provider's preferred value distribution D_A. α and β are the unit benefit accrued respectively by the capital provider and stakeholder from the compromise x which is enabled by mobilizing (some of) slack S. The capital provider incurs costs for mobilizing slack as follows: r is the unit cost of building slack (sunk cost); l is the unit cost of mobilizing slack; and c is the unit penalty for running out of slack. It is assumed the stakeholder has no slack and the costs incurred by the claimants in the bargaining process are negligible relative to the potential private gains.

We define value as the benefits accrued minus the costs incurred (Lazzarini, In-press). Hence, the capital provider's value equals the private benefits accrued by entering into a compromise minus the costs of building slack and mobilizing slack.[38] The capital provider can also incur a cost of running out of slack if slack is less than the shortfall associated with a compromise, which leads to a budget overrun. We draw on the idea that bargaining for a greater share of value is a central task of managers (Castanias & Helfat, 1991; Coff, 1999). So the managerial costs the parties incur in bargaining are negligible relative to the gains.

[38] The cost of building financial slack is a sunk cost that cannot be recovered; still, it represents a cost that is incurred by the capital provider and which is proportional to the slack; so this cost needs to be accounted for.

If the organization's slack is visible to the stakeholders and arbitrators, as it was in the HS2 case, the capital provider is under pressure to mobilize slack to induce cooperation. Assuming the institutions are robust, utility is transferable in that the distribution of value does not affect total social value (Ostrom, 1990). Further, if the institutions are robust, the parties seek to maximize private value but do not rule out a compromise that brings positive private benefits. Thus, we model social value as the sum of the value that is captured by each party (Cabral et al., 2019; Cuypers et al., 2017; Garcia-Castro & Aguilera, 2015; Lazzarini, In-press; van den Oever & Martin, 2019). Still, there is an Olson's (1965) risk of exploitation of the capital provider since the stakeholders compete to maximize their share of that value. Additional investment in slack can lead to a loss of social value if the extra costs incurred to build more slack outweigh the extra gains from the compromise enabled by using more slack.

We depict the above arguments in Figure 3-2 (for a technical version of the model described above, see Appendix §A1). The horizontal axis shows the difference in the costs of the preferred distributions of value. The capital provider prefers a value distribution that does not require mobilizing slack, S . The stakeholder prefers to mobilize all the slack, and more if need be, to enable a differing value distribution. Intermediate points represent a compromise by which a solution is agreed upon which costs more than the capital provider's preference but less than the stakeholder's claim. To enable a compromise, the capital provider must mobilize slack, and eventually incur a cost overrun if slack cannot fill the shortfall, x.

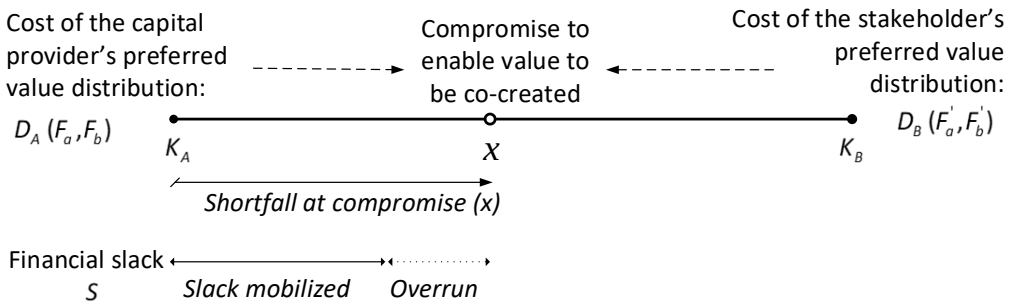


Figure 3- 2 Financial Slack and the Co-creation and Distribution of Social Value

Since neither building nor using slack is free, and too much slack can be counterproductive, the organization wants to optimize the investment (Bourgeois, 1981; Bourgeois & Singh, 1983; Cyert & March, 1963; Thompson, 1967). This leads to two fundamental tensions in the relationship between slack and value creation that inform our model. The first tension revolves around how much slack to build. To address this question we need to untangle the costs of *actual* slack and *potential* slack. Contingency budgets are actual slack in that the resource has been materially created. But as the HS2 case shows, the capital provider faces pressure to reduce the contingency budget to economize on its costs (financial, political). Yet, budget overruns too are costly. So, less actual slack yields savings upfront, but can lead to more cost in the bargaining process. That said, the costs of running out of actual slack can be attenuated (but not eliminated) through a credible commitment today that more resources will be generated tomorrow – a form of *potential* slack (Bourgeois & Singh, 1983). Potential slack is 'cheap', even if not as effective. With no contingency funds left, this is exactly what Govt did in the HS2 case. So, we model the cost of slack as a variable that can be manipulated by building less *actual* slack and more *potential* slack.

The second tension revolves around how much of the built-in slack the organization should mobilize to induce cooperation. As our findings show, once the

contingency funds are mobilized, this slack is costly (if not impossible) to recover. Hence, the capital provider tends to perceive that the costs it incurs from mobilizing slack do not outweigh the benefits. This incentivizes the capital provider to protect the slack and to bargain before deploying it. We use this insight to model the capital provider's value function as the next sections explain.

The Tension between Cooperating and Competing

Built-in slack gives parties an incentive to cooperate to co-create value. But slack also gives them an incentive to compete for a greater share of the value that slack enables the actors to co-create. The tension between cooperation and competition, so-called 'coopetition' (Brandenburger & Nalebuff, 1996), is germane to strategy literature in contexts where value capture is about how much profit each party obtains from a transaction (Hoffmann et al., 2018). Transacting parties often have the flexibility to change the rules of the game (Ross, 2018). In contrast, our findings reveal a bargaining process that is constrained by a clear set of rules, which restrict strategic interaction. Still, cooperation and competition are not orthogonal. Rather, each party incurs costly delays in haggling that impair value creation. And yet, the participants perceive it would be more costly to them to defect from the bargaining process.

Indeed, as the HS2 case showed, the claimants engaged in bargaining for many years, but did not succumb to arbitration, as this would have been a more costly way to settle differences. For Govt, resorting to arbitration could have meant breaking promises on deadlines, which would put the HS2 organization's survival at risk; delays would also have punished the LAs since it would have taken longer to benefit from redistributing value. This suggests that the claimants perceived that the benefits of cooperating towards a common goal outweighed those of competing – in

agreement with the theory on rugged design landscapes (Levinthal & Warglien, 1999) and public choice more generally (Arrow, 1951; Sen, 1970).

To simulate this dynamic we adopted an alternating-offer bargaining model (Cross, 1965; Rubinstein, 1982) in which the two parties take turns to offer alternative value distributions. Hence the capital provider proposes an initial value distribution at time 0. The stakeholder may agree or reject it. Acceptance of the offer ends the bargaining. If the stakeholder rejects, a counteroffer must be made at time $\Delta > 0$, which the capital provider must accept or instead reply to with a counteroffer at time 2Δ. If both claimants keep rejecting each other's offer, the bargaining process fails, rendering futile the effort to create value. We reflect the cost of competition by discounting the value to be captured with discount factors, δ_A for the capital provider and δ_B for the stakeholder. So, both claimants prefer a value today to the same value tomorrow, but not necessarily have the same level of patience. The more impatient the claimant is, the smaller the discount factor. Appendix§A2 presents the technical proof for the existence of an equilibrium offer that is unique, which guarantees that the bargaining process as modeled yields a value distribution that neither claimant would deviate from.

The Effects of Slack on the Creation and Capture of Social Value

Given this representation, we can now ask how additional investment in slack impacts the creation and capture of social value. We also ask how the slack-value relationship varies for differing costs of building slack and differing levels of benefits to be accrued from compromising. We outline the intuition for addressing these questions here and offer a technical presentation in Appendix §A3. We start by explaining the relationship between slack and value creation. The X-axis in Figures 3-3a, b is the organization's slack; the Y-axis shows, at equilibrium and for any

given amount of slack, the social value to be co-produced and how it is appropriated. Figure 3a (on the left) assumes the benefits to be derived from a compromise are low – so, the unit benefit β accrued by the stakeholder from the compromise is lower than a threshold M ($\beta < M$); Figure 3b assumes high benefits ($\beta > M$). M itself is a function of the costs of building slack, using slack, and running out of slack; the discount factors; and the benefits to be accrued from a compromise – see Appendix §A3.1. In agreement with the slack literature, and with the HS2 managers' intuition, we see a curvilinear relationship between slack and social value creation.[39]

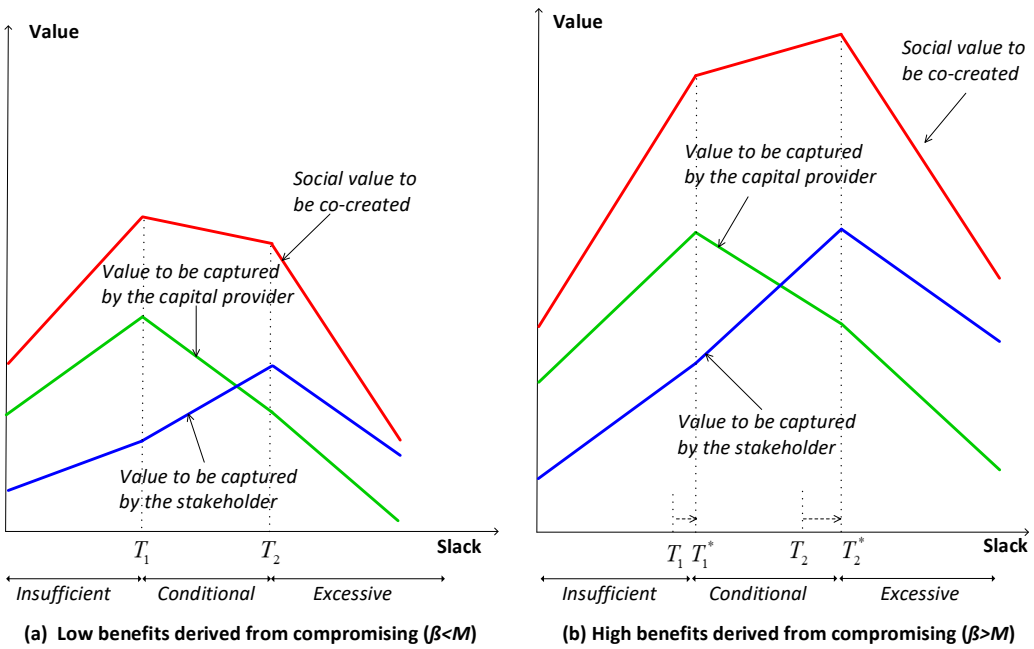


Figure 3- 3a, b The Effects of Financial Slack on Social Value Co-creation and Capture

Maximizing the co-creation of social value

We find the point at which slack maximizes social value is a function of the level of benefits accrued by the parties from reaching a compromise. This is because the amount of slack that maximizes the value captured by the capital provider is less than the one that maximizes the value captured by the enfranchised stakeholder – a

[39] The insights hold whether the last offer to be accepted is made by the capital provider (as illustrated in Figures 3a, b) or by the stakeholder; see Appendix §A3.1 for details.

finding in agreement with the lack of opposition by the enfranchised stakeholders to the HS2 contingency budget. However, it is not in the interest of the stakeholders either to lobby for unlimited slack. As Figures 3-3a, b show, there is a range (up to T_1 / T_1^*) when slack is 'insufficient' in that any additional investment of slack within that range, irrespectively of the benefits to be derived, yields more private value to both claimants and thus adds social value. Above this point (but only up to T_2 / T_2^*), more slack allows the stakeholder to capture even more private value but not the capital provider. As a result, in this 'conditional' range, two scenarios ensue.

First, if compromise leads to low benefits for the stakeholder ($\beta < M$), then investment in slack above T_1 leads to further gains in the stakeholder's value, but these gains cannot offset losses in the capital provider's value. Thus, social value declines. Yet, if a compromise yields high benefits for the stakeholder ($\beta > M$), social value increases as slack exceeds T_1^* because the stakeholder's gains outweigh the capital provider's losses. This pattern applies as the benefits accrued by the capital provider vary too since, as Appendix §A3.1 shows, an increase in the capital provider's benefits (α) reduces the threshold (M) for 'high' stakeholder's benefits. So, the more benefits a compromise yields, the more the slack that maximizes social value shifts from the point at which the capital provider captures more value to the point when the stakeholder captures more value. But this requires the capital provider to sacrifice private gains for social value – we return to this point in the discussion.

Above T_2 / T_2^*, slack becomes 'excessive' as, irrespectively of the benefits accrued from compromising, additional investment in slack leads to decreasing returns in social value; put simply, more slack destroys value. It is worth noting that

the higher the benefits accrued from a compromise, the higher the point at which slack maximizes the value that is captured by the capital provider ($T_1^* > T_1$) and the value that is captured by the stakeholder ($T_2^* > T_2$).

Figure 3-4 sheds further light on this dynamic by untangling the effects of additional investment in slack on the benefits accrued and the costs incurred by the capital provider.[40] Let us recall that we assume the cost of building slack grows linearly with additional investment in slack. As Figure 3-4 shows, slack up to maximizing the capital provider's value (T_1 / T_1^*) cannot fill the shortfall. So, in this range, additional investment in slack pays off because it leads to greater benefits whilst reducing the costs of running out of slack.[41] Beyond T_1 / T_1^*, the value curve inflects: although more slack adds more benefits, this effect is undercut by the higher costs incurred. Further investment in slack above T_2 / T_2^*, gets us into the excessive range because the extra costs of carrying more slack force the capital provider to economize on the costs of mobilizing slack, which leads to a decrease in the benefits. We state these results as our first proposition (see Appendix §A3 for details).

[40] Figure 3-4 illustrates the case when the private benefits that the parties accrue from a compromise are high; but the logic extends to the case when the benefits accrued from a compromise are low.

[41] Whilst marginal, the costs of running out of slack vary with who made the accepted offer, see Appendix §A3.2 for details.

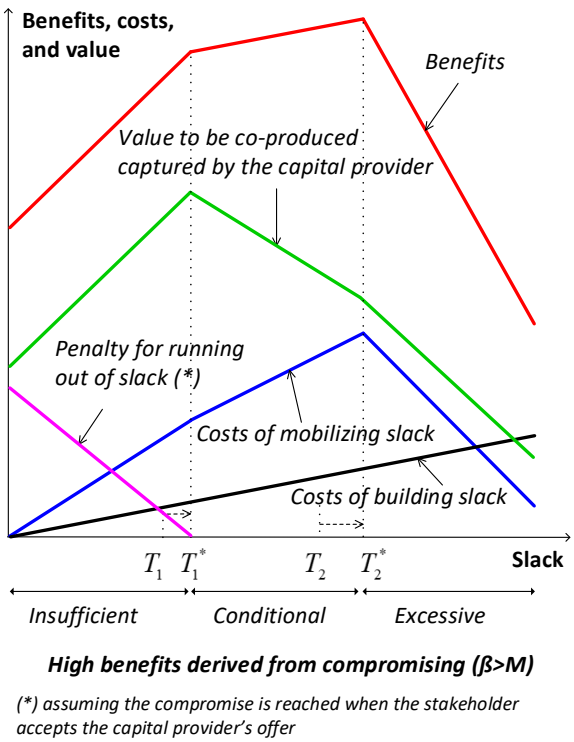


Figure 3- 4 Value Captured, Benefits Accrued, and Costs Incurred by the Capital Provider

PROPOSITION 1a (P1a) *The point at which an organization's slack resources maximize the social value to be co-produced is contingent on the private benefits which the parties accrue from striking a compromise: (i) if the benefits are low, the social value is maximized by the slack that maximizes the value to be captured by the capital provider; (ii) if the benefits are high, the social value is maximized when the stakeholder's value is maximized.*

PROPOSITION 1b (P1b) *When the private benefits the parties accrue from compromising are high, in order to maximize the social value which slack enables the claimants to co-produce, the capital provider must accept a loss in the value that it captures in return for gains in the value to be captured by the stakeholders and thus gains in social value.*

The effects of variation in the costs of slack

As a buffer of actual *or* potentially utilizable resources (Bourgeois, 1981; Cyert & March, 1963) the cost of slack can be manipulated. And this is exactly what Govt did in the HS2 case: facing shortfalls with potential compromises that would exceed the contingency funds, the gap was filled with promises to generate more funds in the future. When the promises occur under the shadow of robust institutions, the

promises are credible (North & Weingast, 1989). Thus, by supplementing actual slack with potential slack, the costs of slack can be brought down. Figure 3-5(a, b) shows the effects of this action: the relationship between slack and value remains curvilinear irrespective of the costs. But as slack gets 'cheaper', the points at which slack maximizes social value increase, and the more so the higher the private benefits from compromising. Further, as slack gets cheaper, there is an upswing in social value creation (see Appendix §A4 for details). We state this result as our second proposition.

PROPOSITION 2 (P2) *If investing in potential slack reduces the costs of the slack resources, for any given amount of slack, the lower the cost of the slack that is available, the greater the social value to be co-produced by mobilizing that slack. Further, as the overall cost of slack reduces, the amount of slack that maximizes the social value to be co-produced increases, and more so the greater the benefits to be derived from compromising.*

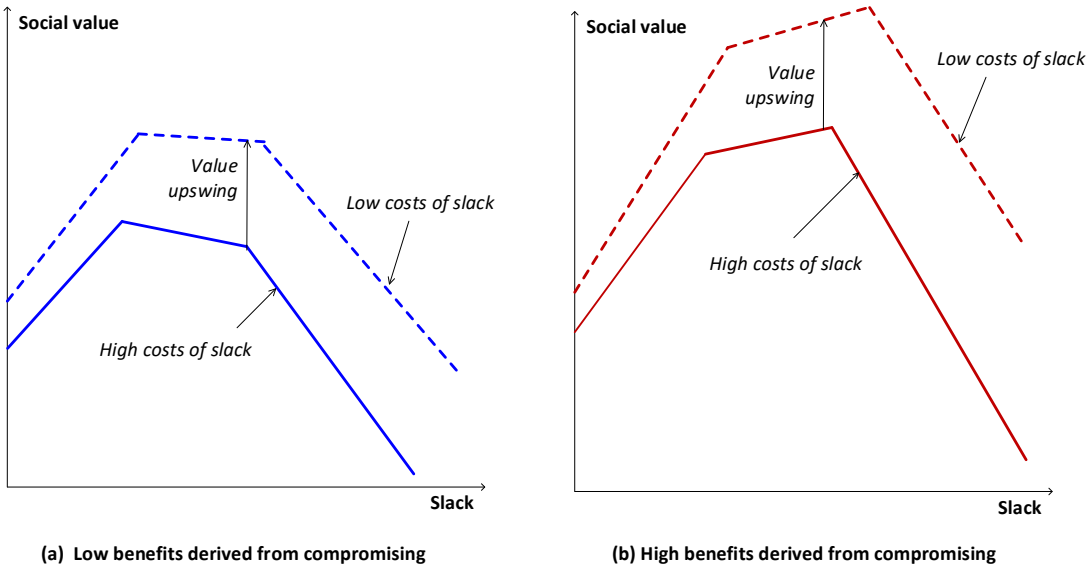


Figure 3- 5a, b The Effects of Variation in the Costs of Building Slack to Social Value Co-creation

Making concessions towards a compromise

Organizational theory posits that slack enables the subunits of an organization to bridge differences without resolving conflict, what Cyert and March (1963) call the 'quasi-resolution of conflict'. In contrast, our study focuses on strategic interactions

across organizational boundaries. Yet, enfranchised stakeholders are not opponents. Rather, they can be seen as self-interested members of a dominant coalition. As the HS2 case shows, the LAs competed to capture more value but stayed supportive of the higher-order goal. Still, this raises the question of whether more investment in slack facilitates the haggling towards a compromise.

Our findings reveal also a curvilinear relationship between slack and the size of the space for cutting a deal. In Figure 3-6a, the Y-axis shows, for any amount of slack, the capital provider's concession that goes with a compromise (x); Figure 6b shows the corresponding stakeholder's concession. In Figure 3-6a (left), the top line represents the capital provider's concession when the stakeholder's offer is accepted, whereas the bottom line represents the concession when the capital provider's offer is accepted (the lines flip in Figure 3-6b). So, the area between the two lines is the zone of permissible concessions – any party that accepts an offer within that area captures more value than it would capture were it to reject that offer. A compromise reached via a stakeholder's offer leads to a higher concession by the capital provider than if the offer had come from the latter because the stakeholder concedes less. Further, up to the point as to when slack maximizes the capital provider's value (T_1), and thus until slack fills the shortfall, more investment in slack widens the area for compromise. This pattern continues for a compromise up to the point of maximizing the stakeholder's value (T_2). But in this range, a compromise can be reached with or without running out of slack, with any compromise from a stakeholder's offer being more likely to lead to an overrun. Above this point, more investment in slack makes it harder to strike a compromise. This is to the extent that after (T_3), the increasing costs of slack rule out the possibility of a compromise (see Appendix §A5). We formally summarize these insights as follows:

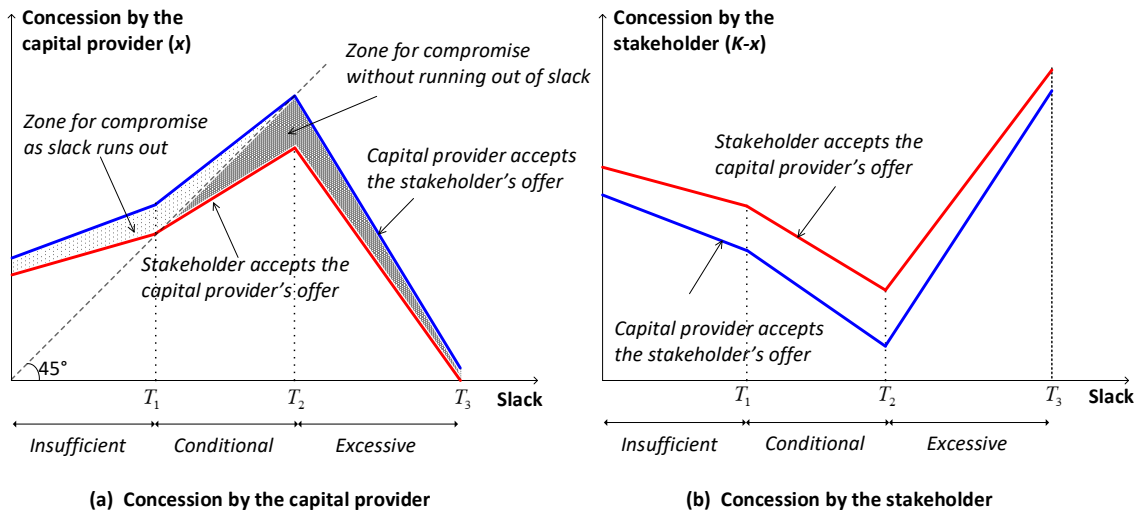


Figure 3- 6a, b The Relationship between Slack and the Zone for Compromise

PROPOSITION *3 (P3) An increase in the slack up to the point when the value captured by the stakeholder is maximized has a positive effect to collaboration by widening the zone for compromise. After this point, an additional investment in slack has a detrimental impact to collaboration in that it shrinks the zone for compromise. This negative effect deepens if the amount of slack gets excessive, which will eventually rule out a compromise at all.*

Discussion

The idea that slack helps to reconcile competing subgoals is well established in management scholarship (Bourgeois, 1981; Cyert & March, 1963; Thompson, 1967). The curvilinear relationship of slack with other variables, e.g. innovation, growth, and performance is also well established (Agrawal et al., 2018; Nohria & Gulati, 1996). Our study extends this contingency perspective in the slack literature to collaboration with enfranchised sovereign stakeholders. Our main argument links the point up to which additional investment in slack increases social value to the benefits accrued as the parties strike a compromise; we also link investment in slack to value appropriation. Further, we reveal how slack – but only up to a certain point – widens the zone of acceptable concessions towards a common goal. We turn now to discuss the contributions of our insights to strategic management scholarship.

Slack and the Creation of Social Value

Our study adds to the literature that seeks to advance a property perspective on organizational governance and value creation (Dorobantu et al., 2017a; Dorobantu & Odziemkowska, 2017; Klein et al., 2019; Klein et al., 2012; Luo & Kaul, 2019). Once sovereign stakeholders are enfranchised, they gain rights and responsibilities over some of the organization's resources (Hart, 1995; Klein et al., 2012). Whilst this governance choice aims to encourage cooperation, once enfranchised, the very same stakeholders will compete to renegotiate the rules that establish 'who gets what' (Klein et al., 2019). In other words, they want to adapt the governance structure that controls the accumulation, development, and allocation of the organization's resources (Blair & Stout, 1999; Chandler, 1962; Williamson, 1985). This raises the question of how much slack resource, which is a strategic margin of reserve capacity, should the organization build ex-ante to enable governance adaptation.

In this study, we find that too little or too much slack impacts negatively social value creation. We also show that after a certain point, the extent to which additional investment in slack adds social value is contingent on whether the organization accepts to sacrifice private returns to pursue pro-social goals, i.e. 'do the greatest good for the greatest number' (Jones et al., 2016). This trade-off is central to the purpose of an organization and of its reason to exist (Battilana & Dorado, 2010; Henderson, Gulati, & Tushman, 2015). Here we illuminate the role that slack plays in this trade-off after a choice to enfranchise sovereign stakeholders.

This issue is given greater importance since collective action theory posits that when one claimant is more resourceful than the others, there is a risk of exploitation of the 'greater' by the 'smaller' (Olson, 1965). Ostrom (1990) too cautions against the presence of resourceful central authorities in collective-action structures. From

this perspective, we could infer that the slack carried by one claimant makes that claimant vulnerable to free riding. Yet, collective action that leads to a perception of a skewed distribution of wealth is not sustainable (Ostrom, 1990). A similar point is made by stakeholder resource-based models of value appropriation (Barney, 2018; Castanias & Helfat, 1991; Helfat & Peteraf, 2003). Our own empirical findings and insights from the game-theoretic model suggest four aspects that appear to neutralize the risks of a moderate amount of slack leading to destruction of social value.

First, if groups are small, norms of cooperation are likely to flourish in spite of the claimants' threats to withdraw completely from the bargaining process or at least withdraw resources (Libecap, 1989) – let us not forget that in the HS2 case, the LAs volunteered resources whilst simultaneously threatening to defer disputes to arbitration. Second, whilst the mobilization of slack can be perceived as exploitation of the more resourceful actor by the enfranchised stakeholders, our findings suggest slack enables the reconciliation of private returns in ways that increase social value. Admittedly, the way value is distributed is influenced by the negotiation skills and the value of the resources (Castanias & Helfat, 1991). But this does not turn enfranchised stakeholders into free-riders.[42] Indeed, monitors, sanctions, and conflict-resolution structures can ensure there is proportionality between the costs and benefits associated with the compromises that are enabled by the mobilization of slack (Ostrom, 1990). Third, low information asymmetry, as we observed in the case of slack, makes bargaining less complicated (Olson, 1982). And fourth, if we accept organizational actors are bounded-rational actors (Simon, 1947), the capital provider would struggle to anticipate the needs of the sovereign stakeholders before

[42] Free riding itself is a normative and rhetorical expression in that a stakeholder can be deemed a free rider not because the claims are illegitimate at all but simply because they are made in a manner that displeases other claimants or observers, or exceed the scope of what the others intended to authorize (Frischmann, 2012: 179).

enfranchising them. So it is useful to have some slack to facilitate the alignment of private interests towards a common end.

Slack and Novel Forms of Organizing

This study also adds to strategic management research on novel forms of organizing. A great deal of this literature has been focused on addressing how new forms of organizing build and sustain a bundle of co-specialized resources by leveraging technological modularity (Gulati et al., 2012; Jacobides, Cennamo, & Gawer, 2018). Yet, modularity is not available to all forms of organizing to reduce the burdens of cooperation. Further, growing pressures for organizations to act more collaboratively is forcing organizations to add consensus-oriented structures to which stakeholders can voluntarily join (Dorobantu et al., 2017a; Dorobantu & Odziemkowska, 2017; Gil & Pinto, 2018). Recent strategy studies on polycentric forms of organizing have revealed the value of contractual arrangements to sustain collaboration with sovereign stakeholders (Dorobantu et al., 2017a). Yet if the institutions are robust, even if the claimants to a shared resource are not governed by contracts and have misaligned interests, they have an incentive not to shirk commitments (North & Weingast, 1989). So a choice to grant sovereign stakeholders residual control rights transforms some of the organization's resources into a de facto non-excludable resource that is rivalrous in consumption. Under these circumstances, the choice to build slack matters. Slack provides the organization with capacity to mobilize resources to reconcile competing claims. This is exactly what Govt did in the HS2 case. So slack transforms a de facto common-pool resource in what Frischmann (2012) calls a partially (non) rival good (or 'impure' public good), which can be managed in a way that avoids rivalrous consumption; as Moch and

Pondy (1977) has long put it, with sufficient slack, there is a solution for every problem.

The question that ensues is whether slack is a value creating or value destroying mechanism. Let us recall why an organization may choose to enfranchise sovereign stakeholders: It is, first, the recognition that the costs of exclusion would be unaffordable; and second, the recognition those stakeholders control resources complementary and co-specialized towards value creation, and thus more productive if bundled together with the organization's own resources than if they were to be used separately (Adner & Helfat, 2003; Barney, 2018; Grossman & Hart, 1986). Stakeholders themselves also have a strong incentive to cooperate in that they can try to manage the exchange of resources to increase their share of the value. So, the concessions that are enabled by slack are instrumental to sustain a bundle of co-specialized resources towards a shared goal. These concessions redistribute the value to be co-produced. If the institutions are robust, they are not value-destroying.

Slack and the Collective Action Problem in Public–Public Partnerships

Our third contribution is to nascent strategic management literature on value creation and capture in the public sector (Cabral et al., 2019; Lazzarini, In-press; van den Oever & Martin, 2019). Public actors are under growing pressure to create valuable public goods by entering into partnerships with other public actors (Goes & Park, 1997; Hennart, 1988). Public-public partnerships are voluntary arrangements to share resources and capabilities (van den Oever & Martin, 2019). Yet, public value is a complex construct in that the measurement of public gains and losses is difficult and the objectives are complex and ill-specified (Klein, Mahoney, McGahan, & Pitelis, 2010). The production of public goods is further complicated by the need to cater to competing parochial interests of organized actors and ambiguity in the

definition of organizational performance (Jones et al., 2016; Klein et al., 2012; Luo & Kaul, 2019; Williamson, 1999). Still, there is pressure on public actors to create public goods that yield net benefits whilst attending to fiscal and austerity pressures (Afonso, Schuknecht, & Tanzi, 2005; Pollitt & Bouckaert, 2017). This raises the question of how slack influences public-public partnerships, since the hierarchical governance of the public actors and the proximity to centers of political power make them pursue excess private returns.

Our contribution to this debate is informed by the provision of infrastructure resources. These public goods are known to generate broad social value because they are inputs into a wide range of downstream productive processes – this is, they are means rather than ends (Frischmann, 2012). However, probity concerns put pressure on public actors to optimize the design of public infrastructure goods for a narrow range of uses than would be socially optimal. Cost-benefit analysis in particular makes it hard for the initial value proposition to take into account the positive externalities that are difficult to observe and measure.

However, procedural rationality cannot allay the political and social pressures for addressing the claims of potential beneficiaries on the provision of public goods (Dean & Sharfman, 1993; Dunleavy, 2014). Stakeholder enfranchisement is a strategic response to this environmental pressure for compromise. Still, this governance choice cannot resolve the problem of how to create a social surplus (i.e. the amount by which the social value exceeds the organization's private value) when the enfranchised stakeholders do not want to pay for it. This is where slack can add value by buffering a network of public actors from political considerations that otherwise will get in the way of endogenous creation of social value (van den Oever & Martin, 2019). But this dynamic, we show, is valid only up to a certain amount of

slack, which is contingent on the benefits to be accrued from the compromises that slack enables to strike, and the costs to be incurred with building and mobilizing that slack.

Limitations

Our study is not without limitations, which arise from features of the research design we employ. We use the case study analysis to preview our central argument, which we formulate by deploying organizational governance literature using an institutional economics perspective. We then derive boundary conditions using a game-theoretic model whose set-up is informed by our empirical finding and theoretical formulation. Of course, single case analysis enjoys the benefits of detailed observation but suffers from limits of generalization (Yin, 1994). This is where we believe our game theoretical model adds value in that it allows for a degree of theoretical generalization in addition to revealing boundary conditions that the case analysis could not reveal. However game-theoretic models also involve strict assumptions, and these limit the generalizability of our findings (Lave & March, 1993). Put simply, we cannot escape the trade-off between realism and rigor that applies to all formal models in social science (Gulati & Puranam, 2009).

Some important assumptions informing our model are worth noting. First, our study was informed by the UK context. So, implicit in our claims is the idea that an organization's slack is common knowledge. However, we can conceive situations where this assumption not always holds. Even in the UK context, it is debatable the extent to which the organization's slack is common knowledge. In the case illustrating our claims, enfranchised stakeholders know the capital provider has vast amounts of actual slack and can mobilize potential slack too. However, the governance structure is polycentric, which means different enfranchised stakeholders

join different groups of collective action to make decisions by consensus. So whilst there is common knowledge of the capital provider's slack as a whole, the capital provider does not communicate the exact among of slack available for each working group. It would be interesting to explore the dynamics of the relationship between slack and value creation when the capital provider's slack is hidden information.

Research in private firms shows that corporate governance matters more for high financial slack firms to ensure these firms do not engage in wasteful spending (John et al., 2017). However, our study does not look into the impact of governance within public actors on the management of slack. It would be interesting to understand, for example, how the distribution of the ownership of slack between political appointees and appointed officials impacts the way slack can be mobilized to create value. Further, our findings suggest some enfranchised stakeholders also have the capacity to mobilize slack, although our model assumes they lack slack. Relaxing this boundary condition also merits further research. Finally, implicitly in our model is the idea that promises to mobilize slack in the future are credible. These promises in our model are the mechanism by the capital provider can bring down the costs of slack. However, as discussed before, not all institutional environment penalize public organizations for breaking their word, which is thus another limitation of the model.

Conclusion

In this study, we claim that slack, but only up to a point, enables the harmonization of the conflicting interests between the organization and enfranchised stakeholders that control resources that are part of a co-specialized bundle for co-creating social value. We verify this argument using a game-theoretic model which reveals the boundary conditions. In particular, we propose the curvilinear

relationship of slack and social value is intertwined with how the organization balances the pursuit of private returns with prosocial goals. The fact that slack is central to such a tradeoff, which is at the heart of the purpose of the organization, makes it crucial to sustaining a collaborative structure of economic exchanges between public actors.

Our game-theoretic model sharpens the empirical insights, but the generalization is restricted by strict assumptions in our model (Lave & March, 1993) and limitations of case research. Still, between realism and rigor, we believe this study provides a novel and precise way of thinking about slack in sovereign collaboration. We hope our claims will encourage further research. As organizational actors find themselves in a bind between competing pressures to act collaboratively and the pursuit of private returns, they must think of slack strategically. We believe this study contributes to helping organizations decide the relevant amount of slack to build; and also, to appreciate that there are social gains to be derived from building slack.

CHAPTER 4

WHEN MIRRORING IS THE EXCEPTION: NON-DECOMPOSABILITY AND THE IMPACT OF INSTITUTIONAL AND HISTORIC BORDERS

This study aims to develop a contingency view of the relationship between technological structure and organizational structure on the organization's environment. Studying the cross-border oil and gas pipeline industry, we investigate the organizational implications of developing integral technology that is highly interdependent with multiple and differing surrounding contexts. An analysis of a comprehensive dataset of cross-border gas pipelines reveals significant variation in the extent to which the mirroring hypothesis holds within and across institutional and historic borders. We find strict mirroring to be the exception. Further, we find a spectrum of strategic choices by which the mirror is partially broken. Partial mirroring ranges from setting up an alliance for developing the entire cross-border technology to setting up, for each section within borders, a distinct alliance with an intermediary or a buyer-supplier relation. We argue that partially breaking the mirror is advantageous to help the organization navigate through differing sets of institutional voids and/or cope with an undamped history of cross-border conflict.

Mirroring theory rests on the hypothesis that managers will (or should) leverage technological knowledge in order to reduce management complexity by aligning the architecture of the products that the firm develops with the organizational ties between the agents carrying on the tasks (Colfer & Baldwin, 2016; Henderson & Clark, 1990; Langlois, 2002; MacCormack, Baldwin, & Rusnak, 2012; Sanchez & Mahoney, 1996). So, loosely coupled organizations (i.e. separate firms) fit better to develop (modular) products made up of many discrete modules, and (integral) products with dense technical interdependencies require tighter coupling as found within a single firm. Nonmirroring, the theory predicts, is a source of coordination problems and inefficiency. Yet, there are contingent factors known to drive firms to break the mirror such as rapid technological change (Furlan, Cabigiosu, & Camuffo, 2014); the pursuit of a competitive advantage (Sorkun & Furlan, 2017; Tee, 2019);

and indirect team interactions (Sosa, Eppinger, & Rowles, 2004; Tee, Davies, & Whyte, 2019).

This study adds to this contingency perspective on mirroring by investigating attributes of the organization's environment that may drive organizations to break the mirror. Mirroring theory assumes homogeneity in the institutions in the environment that influence the strategic choices available to the organization, and which the organization is under pressure to adhere (Davis & North, 1971; North, 1990). Here, we recognize instead heterogeneity in the formal and informal legal, political, and social structures and processes that enable and constrain the development and production of technology (García-Canal & Guillén, 2008; Henisz, 2002; Khanna & Palepu, 1997, 2010; North, 1990). We also see the history of hostility between nations and societies as an environmental attribute that can directly impact strategic choice (Burton & Obel, 1998). This is, we recognize that national sentiments, cultural aspects, and collective memories directly impact firm-level choices unless the influence of these environmental attributes on decision-makers is damped by generational distance and by the presence of a higher ratio of graduates with higher-education degrees in business, law, and social sciences (Arikan, Arikan, & Shenkar, In-press; Arikan & Shenkar, 2013; Shenkar, Luo, & Yeheskel, 2008). Thus, we ask: *is the mirroring hypothesis also contingent on the institutional environment and historic context?*

We tackle this question with a study of the cross-border oil and gas pipeline industry. Pipelines are highly integral technologies that establish physical and durable links among neighboring countries in order to support energy trade. The technology basically consists of a continuous pipe laid on land and/or seabed, and multiple compressor stations to move the oil or gas from the source to the final market. The development and operations of a cross-border pipeline are highly interdependent with the surrounding context, and the industry has a history of vulnerability to disruption and conflict because of ideological, political, economic,

and legal differences between the participating countries. Yet, the industry remains in steady expansion not only because the reserves that are close to traditional markets are being depleted, but also because of the insufficiency of ocean-going tankers to meet increasing global demand for oil, and particularly gas, the cleanest among fossil fuels.

Importantly, cross-border pipelines frequently must pass through multiple emerging economies because those are the areas of the globe that hold the worlds' largest proven oil and gas reserves.[43] Each emerging economy is characterized by a set of institutional voids, which correspond to the absence, or under-development, of the institutions supporting economic activity in advanced economies, e.g. efficient markets, strong regulation, rule-of-law, independent and impartial judiciary to arbitrate conflict, property rights, and contract enforcement mechanisms (Khanna & Palepu, 1997, 2010). In many cases, cross-border pipelines also need to cross neighboring territories with a history of conflict when not war, for example, the much delayed Iran-India-Pakistan gas pipeline, or the controversial Russia-Germany Nord Stream pipelines. Hence, the firm developing a pipeline faces a choice: either it upholds strict mirroring to save cognitive resources and leverage the organization ties within the firm to integrate effort including co-location, ease of communication and information sharing, and cooperation rewards (Puranam, 2018; Puranam, Alexy, & Reitzig, 2014; Thompson, 1967). Alternatively, the mirror can be partially broken by building analogous organizational ties with firms that can act as local intermediaries and facilitate the crossing of institutional and historic borders.

The ultimate aim of this research is to test a perspective of mirroring contingency on the organization's environment. This working paper, however, falls short of this aim in that we develop propositions but have yet to test them. What we do instead is first, develop our

[43] In 2018, the total proved oil and gas reserves in the Middle East accounted respectively 48.3% and 38.4% of the global reserves; and the total proved oil and gas reserves of the 10 post-Soviet republics in Eurasia accounted respectively 8.4% and 31.9% of the global reserves. Data source: BP. 2019. BP Statistical Review of World Energy 2019. London: BP.

theory and corresponding hypothesis by combining mirroring literature with management literature on how organizational choice is impacted by the need to navigate institutional voids (Doh, Rodrigues, Saka-Helmhout, & Makhija, 2017; Khanna & Palepu, 1997, 2010; Luo & Chung, 2013) and cross-border conflicts (Arikan et al., In-press; Arikan & Shenkar, 2013). In order to sharpen the intuition for our propositions, we offer a descriptive analysis of the organizational structures in the cross-border gas pipeline industry. The analysis examines the entire population of cross-border gas pipelines initiated since 1977, the first year for which we could find records available. By triangulating multiple sources of archival data, we uncover significant variation in the extent to which the mirroring hypothesis holds. Unexpectedly, we find strict mirroring to be the exception. Rather, our evidence reveals a spectrum of choices by which the mirror is partially broken within and across institutional and historic borders. This ranges from setting up a single alliance (e.g. consortium, JV)[44] to develop the entire cross-border technology to setting up a set of alliances and/or buyer-supplier relations, with one legal entity per border that is crossed. To further sharpen our intuition, we illustrate the choice to partially break the mirror with a case study on the Turkmenistan-Uzbekistan-Kazakhstan-China Gas Pipeline – a pipeline organization which was decomposed in four legal entities including two alliances with local intermediaries for the transit countries. By choosing to partially break the mirror, our findings suggest that the leading Chinese firm and capital provider managed to overcome cross-border cooperation hazards at the expenses of incurring additional coordination costs in order to integrate the different technical parts into a functioning system.

Taken together, our findings suggest there is an opportunity to develop a contingency perspective on the mirroring hypothesis that conditions on the institutional environment and

[44] We use "alliance" in broad terms to refer to any form of voluntary arrangement that involves exchange, sharing, or co-development of products, technologies or services (Powell, 2003; Williamson, 1985). This includes legal entities such as consortium (partnership), a project joint-venture, and alliance with equitable risk and opportunity share.

historic context. We offer systematic evidence of partial misalignment of organizational ties and technical interdependences. We argue that this contingency view needs to take into account the quality of the environmental institutions and the history of cross-border conflicts and war. We conjecture the more institutional voids and cross-border conflicts in the surrounding environment, the more the organization must adapt its structure to the institutional and historic borders instead of aligning it with the technical interdependences. This choice suggests a calculation that the additional costs of problem-solving incurred by misaligning the technical architecture and the organizational ties do not outweigh the benefits of cross-border firm collaboration. This insight is consistent with studies documenting that dense technical interdependences can be tackled by extensive levels of communication and information sharing in buyer-supplier relations (Cabigiosu & Camuffo, 2012; Furlan et al., 2014; Monteverde & Teece, 1982; Novak & Eppinger, 2001). It is also in agreement with studies documenting the development of highly integral systems by alliances (Argyres, 1999; Snow, Fjeldstad, Lettl, & Miles, 2011; Tuertscher, Garud, & Kumaraswamy, 2014). Finally, we conjecture that partially breaking the mirror through buyer-supplier relations is preferable to doing so through alliances when there is a fresh history of cross-border conflict given this history is an impediment to cross-border corporate deals (Arikan et al., In-press).

We organize the rest of this paper as follows. First, we develop our hypotheses by extending the mirroring literature to contexts where the technology development activity and production stages must cross institutional and historic borders. Next, we describe the research method. The analysis sheds light on the conditions under which organizations partially break the mirror. We conclude with a discussion on how to leverage our data to further our theoretical claims.

Before looking into the cross-border oil and gas pipeline industry, this study was first motivated by an exploratory case of one cross-border pipeline – the Turkmenistan-China Gas

Pipeline. In analyzing the case, we developed an intuition for the case that there we were facing a patent violation of the mirroring hypothesis. Pipelines are the quintessential integral technology (Hart & Moore, 1990), and yet, there were multiple firms involved in the development of the pipeline. The fact we had limited access to the research site prevented inductive analysis. In particular, we are unable to triangulate our dataset with interviews with actors who were not Chinese participants and had restricted access to archival data. This led us to develop the case into a Harvard-style case presentation, which is valuable for pedagogical purposes.

Yet, the idea that we had found a violation of mirroring that extent theory could not predict led us to think of alternative ways to extend mirroring theory using pipelines as a context. After all, mirroring theory acknowledges many instances where mirroring is broken, but the theory still lacks power to explain why that happens. To this purpose, we chose to investigate the whole pipeline industry, and build a comprehensive dataset of cross-border oil and gas pipelines. By looking into the industry landscape, we found extensive evidence that the mirroring is broken as the technology crosses institutional and historic borders. This led us to go back to the theory to develop a contingency perspective of mirroring according to these two attributes of the institutional environment. Appendix B includes the list of 52 cross-border gas pipelines in our dataset; Appendix C includes an analysis of the organizational choices for the Turkmenistan-China Gas Pipeline; and Appendix D includes the Harvard-style teaching case study on the same case produced in order to motivate a class discussion on how the organization's environment impacts mirroring.

Theory and Hypotheses

Background

Mirroring literature predicts a correlation between organizational structure and product architecture, but does not impose a direction of causality (Colfer & Baldwin, 2016). Thus, the

theory posits the organizational ties within a project, firm, or group of firms will, or should, correspond to the technical dependencies in the work being performed (Colfer & Baldwin, 2016; Sosa et al., 2004; Tee, 2019). Organizational ties relate both to the mechanisms facilitating coordination including information sharing, colocation, communication and team interactions (Allen, 1984; Brusoni, Prencipe, & Pavitt, 2001; Gokpinar, Hopp, & Iravani, 2010; Sosa et al., 2004) as well as those rewarding cooperation and settling disputes (Gulati, Wohlgezogen, & Zhelyazkov, 2012; Jacobides, Knudsen, & Augier, 2006; Williamson, 1975, 1991). In turn, technical dependencies are relationships of the form "if something in component 1 changes, then component 2 may need to change as well" (Baldwin & Clark, 2000).

A comprehensive analysis across multiple economic sectors reveals mirroring is a prevalent pattern, but exceptions have been observed when mirroring is less effective or desirable (Colfer & Baldwin, 2016). For example, rapid technological change is a driver for loosely-coupled organizations to partially break the mirror in that it creates coordination and cooperation needs that either demand extensive information sharing across firm boundaries (Ernst, 2005) or the use of all-round knowledgeable firms, so-called *system integrators*, whose knowledge extends beyond the tasks that they perform in-house (Brusoni, 2005; Brusoni & Prencipe, 2006). Loosely coupled organizations also break the mirror to keep tight control over a supply network of modules (Sorkun & Furlan, 2017); or to pursue competitive advantage (Colfer & Baldwin, 2016).

Because of the roots of mirroring literature in the modularity ideas (Baldwin & Clark, 2000; Henderson & Clark, 1990; Langlois, 2002; Sanchez & Mahoney, 1996; Simon, 1962), we know much less, theoretically and empirically, on the contingencies that drive organizations to break the mirror for integral products. Traditionally, integral technologies are associated with single firms and high-powered mechanisms because these technologies

lack the market-supporting mechanisms provided by modules (Langlois, 2002; Sabel & Zeitlin, 2004). This is, integral products lack the technical design rules and standard interfaces between the components or stages of the production process that enable firm specialization and market-based coordination (Langlois, 2002; Sabel & Zeitlin, 2004). Rather, the development of products with dense technical dependencies requires intensive managerial coordination and cooperation since a change in the design of one part tends to impact the design of other parts (Sanchez & Mahoney, 1996). This in turn makes it complicated to encapsulate the task networks for integral products within the buyer and suppliers' boundaries (Baldwin, 2007). Still, performance losses from product modularization can make it desirable for a firm not to try to decompose integral products (Fixson & Park, 2008). Relatedly, physical constraints and path dependencies can make it prohibitively costly, if not impossible, for a firm to even try to break apart technical dependencies (Gil & Pinto, 2018).

Hart and Moore (1990: 1135) formally propose that "if two (or more) assets are (strictly) complementary, they should be owned or controlled together". They gave pipelines as examples of assets that ordinarily are owned or controlled together. Therefore, following the mirroring theory, the null hypothesis (H_0) before taking contingencies into account is listed as follows:

Hypothesis 0 *A single organization (firm) develops an integral technology*.

A contingency view of the mirroring hypothesis offers, however, arguments for misaligning the structure of an integral task network (derived from the product architecture) from the organizational structure (defined by the thickness of the relationships between agents). Thus, technical expertise can be embedded in inter-firm relationships (e.g. buyer-supplier, alliance partners) and substitute for the ability of a firm to integrate effort (Brusoni & Prencipe, 2001; Cabigiosu & Camuffo, 2012; Furlan et al., 2014; Tuertscher et al., 2014; Wolter & Veloso, 2008). This idea is consistent with theoretical efforts to endogenize the

influence of technology in explanations about the origins of transactions (Baldwin, 2007). This perspective sees transactions occurring at locations where the task networks are divided into sets of task subnetworks. Some of these 'crossing points' are thin and require low interaction and information exchange. However, other crossing points can be thick with much dependence to manage and requiring extensive information exchange and coordination via formal and/or relational contracts (Gibbons & Henderson, 2012) or system integrators (Brusoni & Prencipe, 2001; Brusoni et al., 2001).

The idea that not all transactions involve mundane coordination costs is also advocated by organizational design scholars, which for this purpose distinguish interdependencies between tasks and interdependencies between the agents performing the tasks (Puranam, Raveendran, & Knudsen, 2012). This conceptual distinction recognizes that there can be substantial needs for information sharing and coordination between agents even when the crossing points between task subnetworks (thus technical dependencies) are thin because of product modularity. Epistemic interdependence arises when, before choosing an optimal course of action, an agent has broad incentives to predict what another agent will do (Puranam et al., 2012). By definition, integral architectures involve many technical interdependences that challenge humans' bounded rationality. So integral products are expected to require high levels of task coordination and broad incentives and rewards to encourage cooperation.[45] These high levels of technical and epistemic interdependences make single firms economically advantageous to produce integral products; they also suggest that nonmirroring is *not* feasible for an integral product. But, partial mirroring *is* – as long as the firms resort to extensive information sharing, communication, and formal and/or relational contracts to tackle thick crossing points and form predictive knowledge.

[45] The strucutres of the task and epistemic interdepences are not necessarily isomorphic, though (Puranam et al., 2012).

Hypotheses

Partial mirroring, institutional voids, and alliances

The notion of partial mirroring for integral technology gains relevance when the development and production stages are highly interdependent with multiple and differing surrounding contexts. For example, the Nord Stream gas pipeline crosses the territories of Russia, Denmark, Sweden, Finland, and Germany. Likewise, the Trans Adriatic pipeline crosses Greece, Albania, and Italy. If the task subnetworks are interdependent with differing institutional environments, including advanced and emerging economies, it is conceivable that border crossing needs may drive the organization to partially break the mirror. For each emerging economy, the firm needs to navigate through a differing set of institutional voids. These voids relate to the prevailing lack of developed prescriptions to organize exchanges between agents (Delios & Henisz, 2000; Eesley, 2016; George, McGahan, & Prabhu, 2012; Khanna & Palepu, 1997, 2010). They also relate to the absence or weakness of the non-executive institutions of accountability (e.g. ombudsmen, parliaments, systems of checks and balances) that constrain arbitrary action by the political leaders and public bureaucracy (World Bank, 2012). Institutional voids thus hinder the mechanisms that allow efficient transactions and prevent corruption or favoritism in public contracts. Put simply, they create a political risk (Delios & Henisz, 2003; Henisz & Williamson, 1999).

To navigate through the institutional voids, organizations are known to resort to intermediaries – local agents that have the capability to broker resource exchanges between two or more parties that otherwise could not occur, and which help to create and develop local institutions (Dutt, Hawn, Vidal, Chatterji, McGahan, & Mitchell, 2016). Some intermediaries help organizations fill the institutional voids to attenuate uncertainty and mitigate perceived risks (McDermott, Corredoira, & Kruse, 2009; Meyer, Estrin, Bhaumik, & Peng, 2009; Regnér & Edman, 2014). Other intermediaries help organizations overcome (or

exploit) institutional voids in order to create value (Khanna & Palepu, 2010; Wood & Frynas, 2006). Important to our point is the fact that intermediation is local. So, it is unlikely that the intermediary that can help an organization succeed in one emerging economy is the same that can help the organization succeed in another economy.

If an integral technology is interdependent with an emerging economy, we argue it can be advantageous and effective for the leading firm to set up an alliance to distribute the task network with an intermediary. An alliance is a voluntary arrangement that involves exchange, sharing, or co-development of products, technologies or services (Powell, 2003; Williamson, 1985). Firms ally with other firms when their interests are complementary or at least compatible (Kogut, 1988). Alliances are also a way to build a bundle of co-specialized resources that can then be leveraged and exploited towards shared goals (Cabral & Pacheco-de-Almeida, 2018). As such, alliances are cost-effective choices for minimizing the threats and hazards of contracting such as opportunism, hold up, and the difficulty to write complete contracts.

However, an alliance impedes the use of the hierarchical mechanisms of the firm to coordinate work and resolve disputes. Conflict can arise in alliances when partners have divergent subgoals and may act opportunistically given an opportunity (Doz, 1996; Dyer & Singh, 1998; Williamson, 1985). Alliances are particularly difficult to set up and operate in emerging economies because the signatories to an alliance, even if it is underwritten by contract, often have to forfeit legal action given the weakness of the contract enforcement structures (Nee, 1992). Cultural differences also present considerable operational and performance problems for alliances (Zeira & Shenkar, 1990). Further, state-owned firms in emerging economies have less difficult to renege on commitments made to partners than publicly-traded firms (Shenkar & Arikan, 2009).

Still, in emerging economies, alliances with local intermediaries can be critical for business survival (Nee, 1992). Becoming allied with local intermediaries helps to broker resource exchanges, build legitimacy, and overcome institutions barriers (Ang & Michailova, 2008; Webb, Kistruck, Ireland, & Ketchen, 2010). Having a local partner also allows access to knowledge about host country rules and regulations and hence mitigates the liability of foreignness (Zaheer, 1995). In other words, allying with a local intermediary is an effective way of filling institutional voids by supplementing competency (Dacin, Oliver, & Roy, 2007; Henisz, 2000). So, if the task network to develop the technology is highly interdependent with an emerging economy, we conjecture the benefits of an alliance may outweigh the costs in setting up and running it. Further, by entering into multiple alliances with as many intermediaries as the number of emerging economies interdependent with the technology, the firm is only *partially* breaking the mirror. As a member of all the alliances, the firm can act as a systems integrator (Brusoni et al., 2001). This is, the firm can deploy business knowledge and engage in extensive sharing of information and resource across firm boundaries to influence the crossing points between the subtask networks that were distributed across the partners of the different alliances.

Indeed, the literature on alliances is rich in cases of multiple firms participating in the development of a new, tightly integrated technology that is technically challenging, and which none could build alone (Appleyard, Wang, Liddle, & Carruthers, 2008; Argyres, 1999; Gil & Tether, 2011; Staudenmayer, Tripsas, & Tucci, 2005; Tuertscher et al., 2014). This is the case of cross-firm collaborations that involve both repeated interactions and relation-specific investments which will benefit all participants. Facing numerous epistemic and technical interdependences across firm boundaries, firms invest in real-time coordination by reproducing analogs of traditional organizational ties such as co-location and intensive communication (Allen, 1984; Colfer & Baldwin, 2016). These ties enable firms to develop a

shared understanding of the underlying technical system and capability to anticipate when, where and how to look for information from their counterparts. Thus, we expect that alliances, even if not economical, are feasible to develop new, technically integrated products that cross institutional borders. We therefore argue the following:

Hypothesis 1 *Mirroring is partly broken when the institutional environment interdependent with an integral technology is heterogeneous. So, a single firm uses alliances with local intermediaries in order to cross institutional borders.*

Partial mirroring, historic cross-border conflict, and alliances

Theory on the impact of cross-border historic conflict on economic activity matters for developing a perspective of mirroring contingent on the organization's environment. As Zald (1993: 517) observes, "organizations are not only instruments for creating products and profits. They are instruments of power and domination". Yet, the mirroring literature has been very much about the creation of products and the pursuit of efficiencies. But if the task network is interdependent with the context and must cross historic borders, then the history of cross-border conflict cannot be assumed away when investigating the choice to organize the task network.

In effect, the history of conflict between nations and societies is known to have a negative effect on cross-border corporate deals (i.e. joint ventures, alliances, acquisitions) (Arikan et al., In-press). This relationship results from biased individuals' decision-making based on preferences, prejudices, and stereotypes, which reflect the way the history of events such as conflicts and wars is absorbed and enacted in national identities (Smith, 1991) and in the collective and social memories that permeate societies (Olick & Robbins, 1998). The impact of historical context on cross-border deals is such that Arikan et al. (In-press) argue against aggregating historic context with the institutional environment when analyzing firm-level cross-border choices. This is because the animosity between nations and the competition of national identities (e.g. claims over land, common myths, historical memories)

fuel negative sentiments that precondition or bias the firm-level decisions made by individuals (Arikan & Shenkar, 2013).

National identities reflect collective memories and stronger sentiments rooted in cross-border conflicts and wars. If historic events are recent, decision-makers feel safer basing their decisions on negative perceptions (Hamilton & Trolier, 1986). In contrast, the existence of multiple generations between events and decision-makers leads to a decay of initial sentiments of prior historical realities, which makes decision-makers diverge from the widely accepted prejudices of the historical context (Mannheim, 1997). So, Arikan et al. (In-press) find that the negative impact of national identities on cross-border deals is dampened by generational distance from historic conflicts to the extent the impact of animosity is negligible with one generation. A higher ratio of graduates with higher-education degrees in business, law, and social sciences also dampens the negative impact of historic cross-border conflict. This is because learning in professional education is less emotional, more formal, and less influenced by national identity, which attenuates the imprinting of an individual's national identity through the primary socialization that an individual undergoes in childhood (Arikan & Shenkar, 2013; Berger & Luckmann, 1967). A higher ratio of graduates in these fields also enables the formation of professional communities that transcend national boundaries and emphasize gains from economic activities.[46]

So, fresh history of cross-border conflict and antagonism, in the absence of robust market mechanisms, generational distance, and an educated workforce affects individual perceptions of the extent to which partners across borders can work together, and if they can collaborate at all. As Arikan et al. (In-press) argue, connotations such as being 'defeated or lost' could be so strong to the point of inhibiting strategic choices that otherwise would fit the neoclassical

[46] This effect is less likely to apply for the arts and humanities because of their relative remoteness to the business context; and also for science and technology fields because of greater government involvement in these fields, which augments the role of nationalistic concerns such as security, military power, and prosperity (Arikan et al., In-press).

rational doctrine. This inhibition applies even to managers that strive to eliminate seeking-only confirmatory pre-choice information, because the very same managers are often unaware of preference-supporting prejudice and bias in information evaluation (Russo, 2013). In other words, the prejudices and biases rooted in national identities may lead decision-makers to abandon the pursuit of technical efficiency, economic value maximization, or improve performance – the socially acceptable characteristics which are assumed to inform strategic firm-level choice (Greve, 1995), and which are also at the very basis of the mirroring hypothesis itself.

The alliance literature also suggests that firms are likely to refrain to form alliances with partners who come from a nation that is perceived as less friendly to their home country (Shenkar & Arikan, 2009). This claim recognizes strategic intentions are different from actual formation, and that firms' nesting in alliances among nation-states can lead to "missed opportunities". So, the historic context constrains strategic choice beyond contractual commitments to the extent that it can impact the very decision to cooperate (Argyres & Liebeskind, 1999). If the history between two nations is not good, alliances can be difficult to set up and run because of negative attitudes on the part of key stakeholders, such as government and banks (Shenkar & Arikan, 2009). And the more a firm is close to a perceived national interest, e.g. defense, energy, the more it is viewed as a national symbol or champion, and is thus more dependent on government actions and cross-border history. For these reasons, any alliance in industries that are considered strategic by any government can be expected to be tightly embedded in the geopolitical issues. We thus argue

Hypothesis 2 *Mirroring is partly broken when there is no undamped history of cross-border conflict between heterogeneous institutional environments interdependent with an integral technology. So, a single firm sets up a single alliance with local intermediaries in order to cross institutional borders without an undamped history of cross-border conflict.*

Partial mirroring, historic cross-border conflict, and buyer-supplier relations

A history of cross-border conflict can make a firm refrain from forming an alliance with local actors and engaging in trading more generally. The low levels of trade between India and Pakistan, two neighboring nations with a long history of conflict, is a case in point (Nathan, Kulkarni, & Ahuja, 2013). Further, an undamped history of cross-border conflict is known to also impact negatively any intention for cross-border acquisitions (Arikan et al., In-press). But if an integral technology is interdependent with multiple national environments, as it is the case of cross border pipelines, and there is an undamped history of cross-border conflict, a question remains as to how to structure the organization to develop that technology. After all, to navigate institutional voids, the organization is more likely to succeed if it enters into an arrangement with a local actor (Dutt et al., 2016; Khanna & Palepu, 2010; McDermott et al., 2009; Meyer et al., 2009; Regnér & Edman, 2014; Wood & Frynas, 2006). Thus, if a history of cross-border conflict rules out a cross-border alliance, we argue, the choice left is setting up a buyer-supplier relation.

Unlike the intermediary, the role of the supplier is not to broker a resource exchange, but rather to develop and build a critical part of the technology in exchange for compensation that is agreed upon during the contractual negotiations. It is possible that once the parts of the technology are all connected into a functioning whole, the supplier has an operating role for a period of time as for example in design-build-operate contracts or fixed-cost-per-flying-hour engine contracts. Suppliers can be local state-owned companies, but can also be private companies with established relationships with the local authorities. Since buyer-supplier cooperation hinges on a formal contract, a cross-border arrangement is vulnerable to opportunism, hold up, and other threats and hazards of contracting (Williamson, 1985). These threats and hazards are amplified in a context of emerging markets where the markets are often inefficient (North, 1990). They are also amplified for long-term, one-off contracts that

are executed under conditions of uncertainty since it is hard to anticipate all future contingencies for which adaptations may be required (Williamson, 1979).

Further, if the technology is integral, the crossing points between the task subnetworks undertaken by the buyer and supplier will be thick. Thus, the parties will have to engage in extensive cross-border information sharing and incur significant coordination costs. In a context of fresh cross-border conflict and antagonism, the development of cross-border norms of cooperation can be challenging (but not impossible). Further, there will be difficulties in aligning interests as each party will be expected to follow different regulatory laws, social norms, and cultural cognitions, and even perceive professional roles differently (Delios & Henisz, 2003; Doh et al., 2017; Doh, Rodriguez, Uhlenbruck, Collins, & Eden, 2003; Kotha & Srikanth, 2013). Since buyer-supplier contracts are seldom complete, we can anticipate the need for adjustments in price and scope to trigger disputes which can lead to costly, time-consuming negotiations with a zero-sum quality.

Yet, the idea of setting up a buyer-supplier relation to produce interrelated parts of an integral technology is consistent with contingent views of mirroring. Under technological change, for example, component modularity cannot substitute for high-powered interorganizational mechanisms (Brusoni et al., 2001; Zirpoli & Becker, 2011). Rather, technological change calls for a ‘cognitive overlap’ between buyers and sellers because the standard interfaces between components cannot eliminate technical interdependences between the component and the system as a whole and corresponding performance-based trade-offs (Furlan et al., 2014). Likewise, there is extensive evidence of high levels of communication and cooperation in buyer-supplier relations set up to develop complex systems with novel or one-of-a-kind components (Cabigiosu & Camuffo, 2012; Furlan et al., 2014; Parmigiani & Rivera-Santos, 2011). There is also evidence of early supplier

involvement and collaborative or co-exploratory processes to develop new knowledge across firm boundaries (Parmigiani & Rivera-Santos, 2011; Sako, 2004).

In addition, suppliers doing business on a continuing basis are in a better position to take advantage of scale economies and aggregation of collective demands than an outsider (Williamson, 1991). The choice to set up a cross-border buyer-supplier relation for an integral product leads to high task interdependencies. Yet, we anticipate these thick crossing points can be tackled by keeping in-house knowledge of the parts that are to be developed by other parties or by gaining access to part-specific knowledge via collaborative relationships (Brusoni et al., 2001; Furlan et al., 2014). Further, we can also anticipate cross-border buyer-supplier relations to lead to epistemic interdependences related to exchanges about price information, cooperation rewards, and ways to increase predictive knowledge about each other's actions (Dyer & Singh, 1998). These interdependencies will require periodic communication about each other's progress and mutual observations (Puranam et al., 2012). If adding to this, the buyer-supplier relation needs to span a cross-border conflict, we can expect increased information asymmetries, uncertainty of the transactions, and moral hazard problems. We can also anticipate cross-border conflict to make it harder to forge a clear and credible relational contract (Arikan et al., In-press). Adopting a buyer-supplier relation to circumvent cross-border conflict can thus lead to high transaction costs.

Inefficiencies notwithstanding, if high levels of cross-border conflict rule out an alliance or acquisition, we argue that setting up a buyer-supplier relation is still an attractive proposition to develop an integral technology. This arrangement still holds the promise that if the parties overcome historic rivalry and succeed to share information and communicate periodically, the transaction can be mutually beneficial. Further, once the elements of the technology are connected into a functioning whole, it may well be the technology that enables the parties to engage in frequent transactions with limited idiosyncratic investments

and measurable outputs, attributes that economize on transaction costs (Williamson, 1979). For example, building the pipeline section within borders is an idiosyncratic investment. But once the pipeline sections are all connected to form a whole, energy trade becomes a highly frequent activity that is easy to define and measure and thus pay for; and operational contracts are for a long duration, often 15-25 years. So, future business opportunities may outweigh the cost of inefficiencies from breaking the mirror across borders and circumvent a history of cross-border conflict and eventually war. As literature derived from economics also predicts, buyer-supplier relations that involve specific investments and repeated interactions permit a relational contract to form by which the "shadow of the future" restrains short-run opportunistic behavior (Baker, Gibbons, & Murphy, 2002; Gibbons & Henderson, 2012). Thus, we argue the following

Hypothesis 3 *Mirroring is partially broken when there is an undamped history of cross-border conflict between the institutional environments that are interdependent with an integral technology. So, an integral technology will be developed by a buyer-supplier relation to circumvent cross-border conflict.*

Figure 4-1 summarizes our predictions of what happens when the mirroring hypothesis is impacted by our two contingencies – heterogeneity in the institutional environment and cross-border historic conflict. Mirroring literature has focused on the top, left quadrant in Figure 4-1 by implicitly assuming a task network surrounded by a homogeneous context and no cross-border conflict. Under these circumstances, there is no justification to break the mirror. So a product with an integral architecture fits better to be produced by a single firm in order to economize on the coordination and cooperation costs. Mirroring literature is agnostic as to what we can expect when the task network must cross institutional and historic borders. Our reading of the literature on how firms cope with institutional voids and cross-border conflict, together with insights from contingency theory of mirroring, leads us to hypothesize the two contingencies will drive the firm to partially break the mirror. So, if there is no history of undamped cross-border conflict, but the firm is required to navigate across differing sets of

institutional voids, we expect the mirror to be partially broken through a single cross-border alliance with local intermediaries. If there is an undamped history of cross-border conflict, we predict two situations: a cross-border buyer-supplier relation between firms if institutional heterogeneity is low and a buyer-supplier relation between alliances with a common member in order to allow the leading firm to play a role of systems integrator across the institutional borders.

		Heterogeneity in the institutional environment	
		Low	High
History of Cross-border Conflict	Damped	Single organization (firm) **(Strict mirroring)**	Single alliance (e.g. JV, consortium) **(Partial mirroring)**
	Undamped	Buyer-supplier relation between firms **(Partial mirroring)**	Systems integrator: buyer-supplier relation between alliances with overlapping members **(Partial mirroring)**

Figure 4- 1 Summary of the Joint Effect of Institutional Environment Heterogeneity and Cross-border Historic Conflict on the Alignment between the Organizational and Integral Product Architectures

Data and Methods

The Cross-border Gas Pipeline Industry

Our study is grounded in the cross-border oil and gas pipeline industry. Yet, data collection is yet to be completed for the cross-border oil pipelines, and thus we focus this working paper on the cross-border gas industry. Cross-border gas pipelines are highly integral technologies that transport gas over long distances (frequently more than 1,000 km) under high pressure from source to the final markets. A pipeline is integrated with multiple compressor stations which pump the gas flow, as well as with metering and regulation stations which measure and regulate the flow and gas conditions. Aware of the dense technical interdependences between the constituent elements of a cross-border pipeline, an industry's maxim says that a pipeline is no stronger than its weakest point. Figure 4-2 shows a stylized structure of a cross-border pipeline.

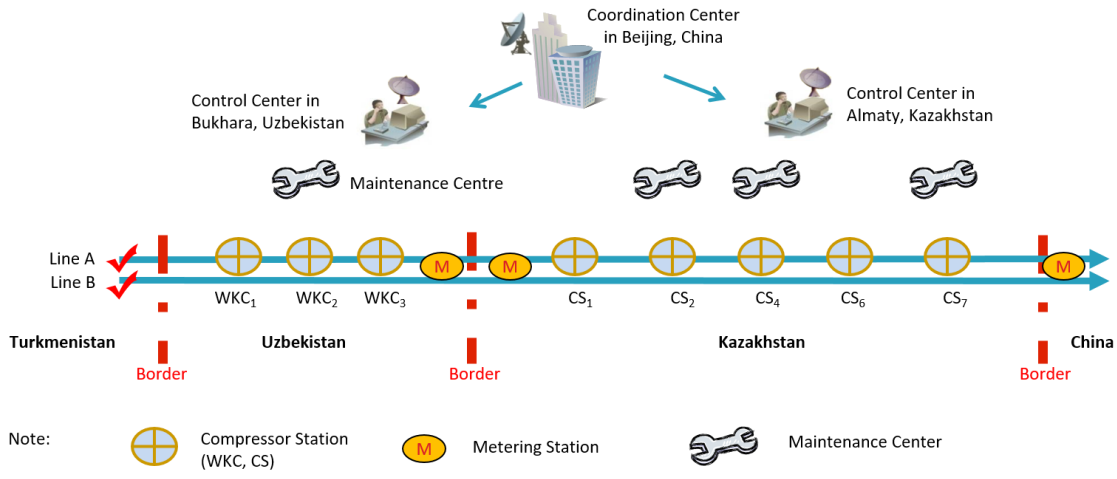


Figure 4- 2 Stylized Representation of the Constituent Elements of a Cross-border Gas Pipeline

The development of a cross-border pipeline requires cooperation among the participants from neighboring countries so as to ensure reasonable uniformity of technical standards across the entire route. Were such uniformity to be absent, the pipeline could collapse. Thus, there needs to be tight coordination between the design and production tasks. For example, the number, capacity, and location of the compressor stations are interdependent with the exact pipeline length and route, pipe diameter, and system capacity. Likewise, the pipeline production tasks need to be tightly coupled in order to ensure consistency in the methods of fabrication and welding and coordination with local agencies such as border defense, security, and customs. Operating a gas pipeline also requires tight coordination between the upstream and downstream activities in order to achieve grid balancing and prevent pressure from building up at any point in time and thus create a risk of explosion. In the event of a gas leak, operations also need to respond swiftly by turning off the compressors and closing the valves so as to avoid a risk of explosion.

Given the highly integral nature of pipeline technology, mirroring literature would predict the development and production would better fit within a single firm. Yet, this prediction assumes homogeneity in the organization's environment, whereas gas pipelines are cross-border technologies, which makes the industry particularly suitable to develop a

contingent perspective of mirroring on the organization's environment. First, most cross-border pipelines pass through emerging economies before reaching the final markets (often advanced economies, but not always) because almost two-thirds of the world's proved gas reserves are in the Middle East and Central Eurasia areas.[47] Thus, pipeline developers must seek inter-governmental agreements and host country agreements, which creates a dense interdependency of the task network with differing environments. And second, there is often a history of conflict between the countries that the pipeline needs to cross. So, the task network also needs to cross historic borders. Challenges notwithstanding, the cross-border pipeline industry is in steady expansion to respond to a decline of the gas reserves close the markets, and a steady increase in global consumption of gas as countries seek to decarbonize the fuel mix.[48]

Data

We used several archival sources to construct a comprehensive dataset of all the cross-border gas pipelines that were built or are in development around the world in approximately the last 40 years (we found no reliable data for cross-border pipelines developed before 1977). The data collection procedure by which we built a dataset of 52 pipelines is depicted in Figure 4-3.

[47] BP. 2019. BP Statistical review of world energy. London: BP.

[48] The global consumption of gas has been increasing at an average annual rate of 2.7% since 2000. Source: IEA. 2018. World Energy Outlook 2018. Paris: IEA.

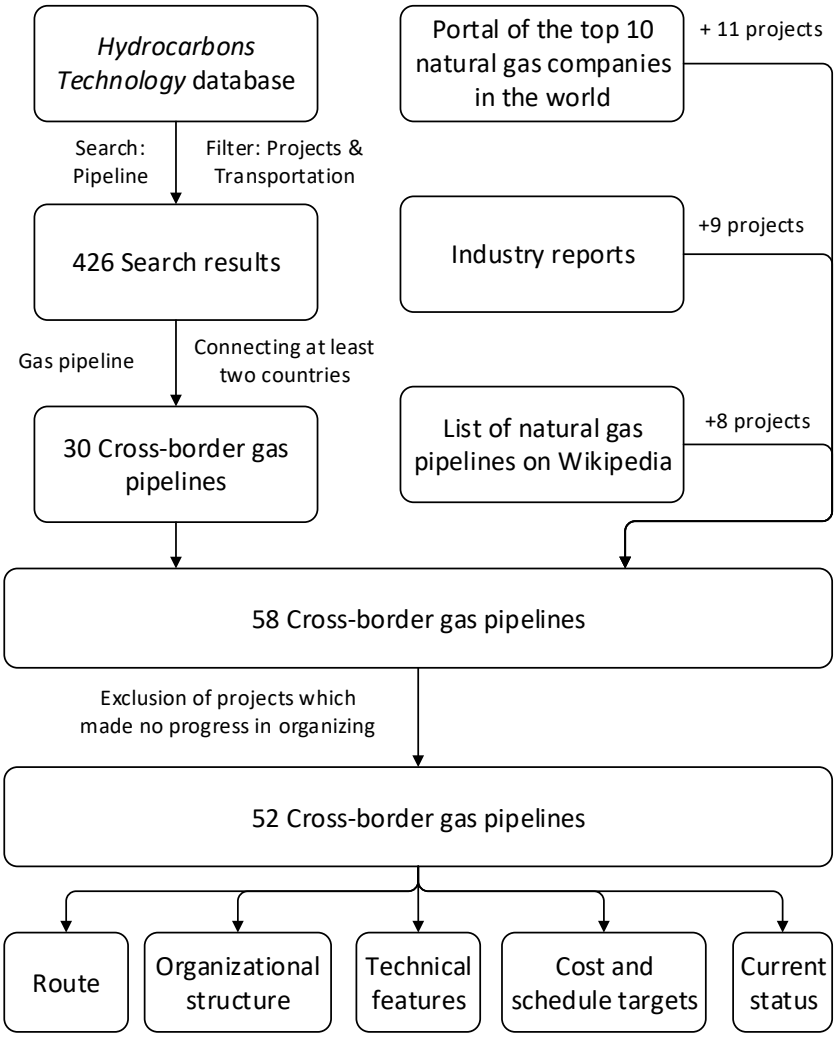


Figure 4- 3 Data Collection Procedure of Cross-border Gas Pipelines

The primary and main data source was the *Hydrocarbons Technology* database, which is the leading site for news and procurement in the hydrocarbons industry.[49] Using "pipeline" as a keyword, we combed through 426 searching results to identify a total of 30 *gas* pipelines connecting *at least two* countries. We then checked the portals of the top 10 global companies in gas production and transport to identify any eventual cross-border gas pipelines missed in the Hydrocarbons Technology database.[50] Further, we cross-checked this information against leading industry reports on the sector and a comprehensive list of natural gas pipelines on

[49] The Hydrocarbons Technology site collects information on the pipeline organizational structure, technical details, financiers, and progress made. The search results are based on data available till 5 June 2019.
[50] Carpenter, J. W. 2019. The top natural gas companies in the world. Investopedia, 29 May.

Wikipedia.[51] We dropped from our dataset a total of 6 pipelines which never made real progress from an organizational perspective. We were left with 52 cross-border gas pipelines initiated between 1977 and 2019 (see Appendix B for a full list). For each case, we pieced together geographical data on the crossing territories, organizational data on the controlling legal entities, technical data (e.g. length, design capacity), development milestones (e.g. signing of intergovernmental agreements/MOU, commencement of construction and operations), and operational status. To sharpen our intuition for the impact of the organization's environment on the task network and organizational structure, we also conducted a case study on the Turkmenistan-China Gas Pipeline which we include in Appendix C.[52]

Methods

The ultimate goal of this study is to test a contingency perspective of mirroring on the organization's environment using both the cross-border oil and the gas pipeline industries. This is work in progress as we have assembled already a comprehensive database for the gas sector, but not yet for the oil sector. So in this working paper, we offer a descriptive analysis of our dataset for the cross-border gas pipeline sector to check the plausibility of the hypotheses that we developed. In the final section, we discuss how we plan to test the hypotheses.

Analysis

Our analysis revealed four fundamentally different structures to organize the development of cross-border gas pipelines as a function of the extent mirroring holds within and across borders. Again the predictions of the mirroring proposition, the situation where a single firm develops the entire cross-border pipeline turned out to be an exception. In contrast,

[51] Source: 1) ESMAP (2003); 2) Stevens (2009); and 3) Wikipedia lists of natural gas pipelines.

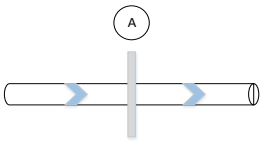
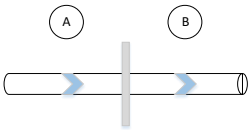
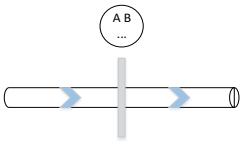
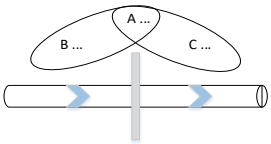
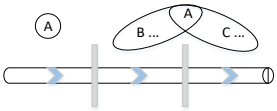
[52] We also leverages the data for the Turkmenistan-China Gas Pipeline to write a Harvard-style teaching case study which allows a classroom discussion on the impact of the organization's environment on mirroring and organizational choice more general, which is included in Appendix D.

we encountered extensive evidence of cases where the mirroring was partially broken through three main configurations. Importantly, it is worth noting that the mirror can be broken within or across borders. We turn now to describe in more detail each main configuration. Table 4-1 and Figure 4-4 summarize our findings and illustrate the analysis that follows.

Strict Mirroring

We only observed tow cases of strict mirroring by which a single firm developed the entire cross-border pipeline. One case is the Minsk-Vilnius-Kaunas-Kaliningrad Gas pipeline, which crosses Russia, Lithuania, and Belarus, and is fully owned and operated by the Russian gas company Gazprom. In this case, all the territories crossed by the pipeline belonged to the former Soviet Union, which is suggestive of a degree of homogeneity in institutional environment and low cross-border conflict, in agreement with the first hypothesis. The second example pertains to TurkStream, a pipeline stretching from Russia to Turkey across the Black Sea, which is fully controlled by South Stream Transport B.V., a Gazprom subsidiary. More research is needed to measure the institutional distance between the two countries and their history of conflict.

Table 4- 1 Main Organizational Structures for Cross-border Pipelines: Cases and Examples

Category	**Description**	**Cases (#52 in total)**	**Illustrative examples**
Single firm 	Strict mirroring within and across borders	**#2 cases (3.9%)**	i) Minsk-Vilnius-Kaunas-Kaliningrad Gas Pipeline; ii) TurkStream *Both pipelines are developed and operated by the Russian gas company Gazprom, the world's largest gas producer which also owns the largest gas transmission system.*
Buyer-supplier relation 	Mirroring within borders, but partial mirroring across borders	**#14 cases *(~26.9%)***	Iran-Pakistan-India Gas Pipeline *The Iranian section is controlled by the National Iranian Gas Company; the Pakistani section by State-owned Pakistan company, Interstate Gas System; and the Indian section by Gail India Limited, a major state-owned gas utility.* *The project has been beset by delays due to disagreements over transit tariffs and other cross-border issues.*
Single Alliance (e.g. JV, consortium) 	Partial mirroring within borders, but mirroring across borders	**#22 cases *(~42.3%)***	Nord Stream AG (Russia to Germany via the Baltic Sea) *International consortium of five major companies established in 2005 for developing and operation of the Nord Stream, including Gazprom (51%), German firms Wintershall and PEG Infrastruktur AG (Uniper) (both 15.5%), Dutch company Gasunie (9%), and French Engie (9%).*
Systems Integrator 	Partial mirroring within and across borders	**#4 cases (*~7.7%*)**	The Paraná–Uruguaiana Pipeline (from Argentina to Brazil) *Developed by two independent consortia. The Argentinian section is developed by Transportadora de Gas de Mercosur, a JV of Techint (Argentina), local actors and international investors. The Brazilian section is developed by Transportadora Sul Brasileira de Gas, a JV of Techint, local actors, and international investors. So Techint plays the role of systems integrator.*
Example of Permutations 	Partial mirroring by recombination of the basic organizational structures	**#10 cases (*~19.2%*)**	Yamal–Europe Natural Gas Pipeline (Russia to Germany via Belarus and Poland) *The Russian and Belarusian sections are developed by Gazprom; the Polish section is developed by EuRoPol Gaz, a JV of Gazprom, the Polish state oil and gas company PGNiG, and Polish Gas-Trading S.A. The German section is developed by WINGAS, a JV of Gazprom and German company Wintershall. So Gazprom plays the role of systems integrator.*

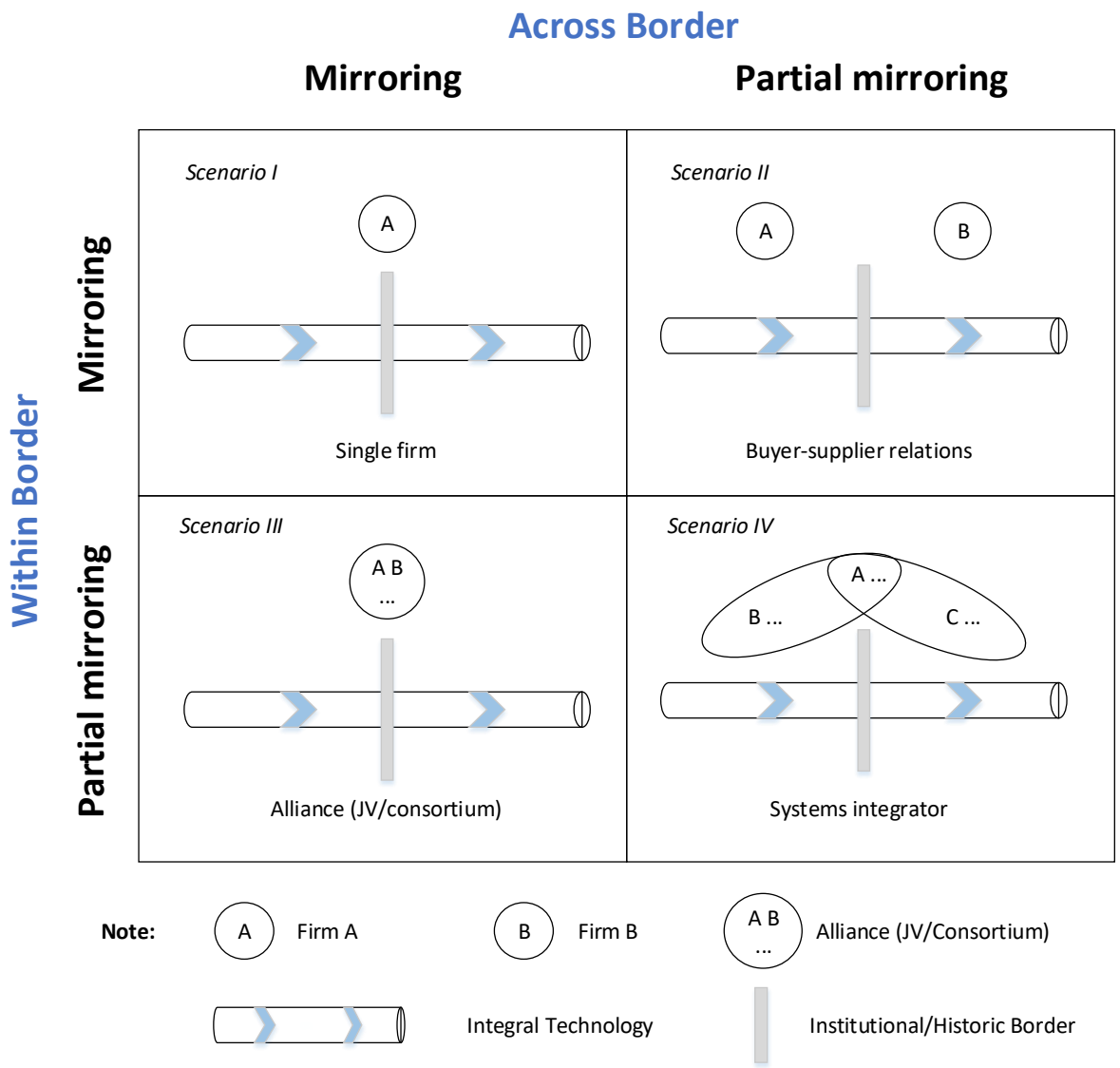


Figure 4- 4 Organizational Structures to Cross Institutional and Historic Borders[(*)]

[(*)] If were to be extremely precise, we could argue in the left bottom quadrant scenario, there is also only partial mirroring across borders because multiple firms are organized into an alliance to develop an integral cross-border technology. But the main point here is that there is only a single consortium for both sides of the border.

Partial Mirroring: Buyer-supplier Relations

Slightly more than a quarter of the cases reveal the mirror was partially broken by establishing cross-border buyer-supplier relations. A market-based contract enables one firm from one side of the border to acquire the necessary capabilities and resources to develop the technology from the other side of the border. Under this structure, independent legal entities are responsible for developing and operating the sections on different sides of the border. If there are multiple borders, perhaps one legal entity is responsible to build the technology to produce gas and transport it to the first border. Then, per each transit country, then there is a legal entity in charge of building and operating the corresponding pipeline section within borders. And then, the buyer of gas has its own legal entity to build the last section of the pipeline in its own territory. So, within borders, the organizational structures mirror the integral product architecture. But across borders, the mirror is partially broken to align with differing institutional environments.

The Iran-Pakistan-India (IPI) pipeline is a good example. In 1993, Pakistan and Iran announced a plan to build a gas pipeline, which was later proposed to extend into India. Despite the history of conflict between Pakistan and India due to an unresolved dispute over the area of Kashmir, the extension was acceptable to Pakistan because of the revenues from transit rights; further, half of the gas transmission capacity would continue to go to Pakistan. Still, the undamped cross-border conflict ruled out setting up a single consortium to develop the entire pipeline. The plan then was for each country to build the sections of the pipeline separately in their own respective territory, but India withdrew from the project in 2009 following US sanctions against Iran. As of mid-2019, the Iranian section of the pipeline has been completed, but the Pakistani section has been subjected to renewed delays in

part related to the US sanctions regime.[53] This case thus suggests that even partial mirroring in the form of a buyer-supplier arrangement can struggle to overcome a fresh history of cross-border conflict.

The Baltic Pipe Project between Denmark and Poland is also telling. Rooted in a feasibility study initiated in March 2016, the project gained the support of Polish and Danish gas transmission operators in November 2018. Energinet, the Danish gas operator will be responsible for developing and operating the section in Denmark and the offshore components in the North Sea. GAZ-SYSTEM, the Polish gas operator, will be responsible for developing and operating the sections in Poland and the offshore pipeline between Denmark and Poland. Construction of the pipeline is expected to start in 2020 and become operational in 2022.

The Russia-China Gas Pipeline to transport gas from Russia to markets in Russia's Far East and China is a third example. The Russian section, so-called the Power of Siberia, is fully owned and developed by Gazprom, the world's largest natural gas company, whereas the Chinese section is owned and developed by China National Petroleum Corporation (CNPC), the world's third-largest natural gas producer. In September 2014, Gazprom commenced the construction of its own section, and construction in the Chinese territory started in April 2017. The two companies entered into an agreement by which Gazprom will supply gas to CNPC for 30 years.

Partial Mirroring: Single Alliance

Our analysis reveals that the prevailing choice (42% of the cases) to organize the development of cross-border pipelines is by setting up a single alliance in the form of a JV or consortium with shared equity. An alliance appears advantageous to

[53] Islamabad Keen to Complete Super-Delayed Iran-Pakistan Gas Pipeline. EurAsian Times, 8 May 2019.

encourage local actors, e.g. state-owned companies, to act as intermediaries and contribute resources (e.g. land, market access, permits) which institutional borders make it hard to acquire for a firm on the other side of the border. Yet, alliance members can also be international companies already established across the border, which can act as an intermediary to navigate the institutional voids across the border.

By establishing a single alliance, members will need to actively coordinate and communicate to develop the entire cross-border pipeline without recource to unitary hierarchy. So, this choice can only be said to partially mirror the integral technology in that we have a group of firms developing an integral technology. At the same time, this choice does not break the mirror just because the integral technology needs to physically cross an institutional and historic border. Arguably, this alignment can therefore reduce the coordination and cooperation costs given that there is clarity across borders in ownership rights, shareholder obligations and alignment of interests. This alignment can also be leveraged in order to agree and write contracts with suppliers. The key aspects for a single alliance to work seem to be to have alliance members which can act as an intermediary for each institutional environment the technology needs to cross. For this organizational structure to work, we anticipate there can be no fresh history of cross-border conflict because of their negative impact on cross-border corporate deals (Arikan et al., In-press; Arikan & Shenkar, 2013).

One example is Nord Stream, a 1,224km-long pipeline that transports gas from Russia to Germany via the Baltic Sea. Its offshore section crosses the Exclusive Economic Zones of Russia, Finland, Sweden, Denmark, and Germany, as well as the territorial waters of Russia, Denmark and Germany. To develop the pipeline, an international consortium of five major companies was established in 2005.

Construction of the pipeline began in April 2010 and was fully completed by October 2012. Given the differences in the Russian institutional environment and advanced economies, a single company alone would struggle to develop the pipeline. But the alliance membership suggests the institutional homogeneity of the advanced economies made it unnecessary to bring one local actor for each advanced economy to be crossed by the pipeline.

The case of the South Caucasus Gas Pipeline (SCP), a 692km-long pipeline to transport gas from Azerbaijan to Georgia (two former Soviet republics) and Turkey is also telling. The entire pipeline was also developed by a single consortium, the South Caucasus Pipeline Company Ltd, thus partially breaking the mirror for each border section whilst the organizational and technology structures aligned across borders. The leading shareholder is BP (28.8%). But the consortium membership suggests an effort to engage with local intermediaries including SOCA (16.7%), owned by the state of Azerbaijan, TPAO (19%), a Turkish firm, and Lukoil (10%), a Russian firm. The pipeline started to transport gas to Georgia in 2006 and to Turkey in 2007.

Not always, however, our evidence suggests that a single consortium can overcome all the institutional borders which the task network needs to cross. The Turkmenistan-Afghanistan-Pakistan-India (TAPI), an 814km-long pipeline to transport natural gas from Turkmenistan through Afghanistan into Pakistan and India, is a case in point. The project was conceived in the 1990s. After tough negotiations, an intergovernmental agreement was signed in 2010 by the heads of the four member nations. However, in 2012, India failed to agree on the transit fee for gas passing through Afghanistan and Pakistan. Difficulties notwithstanding, a consortium known as TAPI was incorporated in November 2014 by four firms, one from each

participating country. By December 2015 construction on the section in Turkmenistan started, and construction on the Afghan side started in February 2018. But unresolved conflicts between Pakistan and India, make it unlikely that the entire pipeline can be operational by the end of 2020 as planned. This finding is in agreement with our conjecture that partially breaking the mirror by setting up an alliance may be insufficient to overcome an undamped history of cross-border conflict.

Partial Mirroring: Systems Integrator

One last significant group of cases suggests an organizational structure by which to develop a technology that crosses multiple borders, the firm chooses to partially break the mirror by setting up as many alliances as the number of borders to be crossed. Because each alliance is a legally independent entity, the relationship between the alliances is de jure a buyer-supplier relation. In this decomposable structure, the firm can be said to play the role of systems integrator (Brusoni & Prencipe, 2001) in that it is a common member of all the alliances that are set up. Variations of this organizational structure occur when the firm chooses not to break the mirror for one section and thus develop that section alone, and then break the mirror within and across borders by entering into alliances for the other sections. By acting as the systems integrator, the firm can effectively coordinate the set of task subnetworks distributed by the alliance members.

One good example is the Trans-Mediterranean Natural Gas Pipeline, a 2,475km-long pipeline built to transport gas from Algeria to Italy via Tunisia. To develop the Algerian and Sicilian Channel sections, ENI, Italy's state-owned energy company, formed a 50-50 consortium with Sonatrach, the Algerian state authority. But at the behest of the Tunisians, the Tunisian section was developed by Sotugat alone, a

state-owned Tunisian company. ENI in turn developed alone the onshore section in Italy. A second example is the Yamal-Europe Gas Pipeline that transports gas from Russia to Germany after crossing Belarus, a former Soviet republic, and Poland. The Russian and Belarusian sections were developed by Gazprom. But to develop the Polish section, Gazprom set up a JV with PGNiG, a Polish state-controlled gas firm and for the German section, Gazprom set up a JV with Wintershall, a German firm.

Not always, however, this organizational structure seems sufficient to overcome all the historic and institutional borders. For example, the South Stream pipeline to transport gas from Russia to South-East Europe shares a similar organizational arrangement, but has yet to come to fruition. The proposed 1,455km-long pipeline starts in Russia and aims to pass through Bulgaria, Serbia, Hungary and Slovenia before reaching Austria. Gazprom controls the Russian section, but has set up six legal entities to develop the other sections: one large consortium to develop the pipeline across the Black Sea.[54] And five JVs with local intermediaries one for each other country to be crossed. Yet, this arrangement fell afoul of the EU legislation so-called *acquis*,[55] and the development is stalled. Arguably, the Ukraine crisis and the Crimean annexation also contributed to putting the development on hold in 2014, in agreement with the idea that fresh cross-border conflicts are an obstacle to cross-border corporate deals (Arikan et al., In-press; Arikan & Shenkar, 2013).

In sum, by examining the organizational structure of the population of cross-border gas pipelines, we find strict mirroring to be the exception. Yet, the analysis reveals substantive variation in the way by which the mirror is partially broken. These range from setting up a single alliance to develop the entire technology to a set

[54] Gronholt-Pedersen, J. 2011. Companies Sign South Stream Deal. The Wall Street Journal, 16 September.

[55] The EU acquis is the accumulated legislation, legal acts, and court decisions which constitute the body of European Union law.

of alliances and/or buyer-supplier relations, with one legal entity per institutional and historic border to be crossed. These findings are at odds with the prevalence of mirroring observed elsewhere (Colfer & Baldwin, 2016). Yet, extant studies have assumed away the interdependency of the task network with the surrounding context. This suggests the opportunity to develop a contingency perspective of mirroring on the organization's environment. Our point is that two contingencies drive organizations to partially break the mirror for integral technologies – borders between heterogeneous institutional environments and borders between nations with an undamped history of conflict and war. We turn now to conclude this working paper with a discussion as to how we plan to test our theory.

Discussion and Research Outlook

Our analysis provides evidence of significant variation in the extent to which mirroring is partially broken contingent on two main attributes of an organization's environment which are interdependent with the task network: heterogeneity in the institutional environment and cross-border historic conflict. This evidence supports the propositions that we induced by combining mirroring literature with literature on how organizations navigate environments with institutional shortcomings and cross-border conflict impacts cross-border corporate deals. The evidence also suggests the cross-border pipeline industry is a suitable setting to test our propositions. To do that, for each pipeline, we need to characterize and measure the two contingency factors and piece together data about the organizational structure.

Measurement of Variables

We anticipate two levels of testing of the extent to which the mirroring hypothesis holds, within the institutional and historic borders and across the institutional and historic borders. Thus, we plan to investigate if the mirror is

partially broken and if so how it occurs both for each section of a pipeline between two borders, and for each entire cross-border pipeline.

Dependent variables: Mirroring and discrete forms of partial mirroring

The descriptive analysis identifies four basic organizational structures for developing an integral technology. We also observed permutations of these structures for pipelines crossing many borders. Our dataset will have an *x* number of cross-border pipeline cases (52 gas pipelines plus a number of oil pipelines to be determined). However, for each case, there are as many cross-border organizational choices as the number of borders to be crossed. For example, if a pipeline crosses three nations/two borders, two cross-border organizational choices have to be made. We illustrate this case in Figure 4-5a,b. Assuming firm A, based in nation I, is leading the technology development, A must resolve two cross-border organizational interfaces, (I, II) and (I, III). These choices may eventually be influenced by the quality of a third-party interface (II, III). Let us suppose there is high institutional heterogeneity across the three nations. If there is no fresh history of conflict between II and III, our theory predicts firm A wants to set up a single consortium with intermediaries for nations II and III in order to develop the entire technology (Figure 4-5a). But if there is an undamped history of conflict between II and III, firm A is predicted to set up two independent alliances, one for each nation, and play the role of systems integrator (Figure 4-5b).

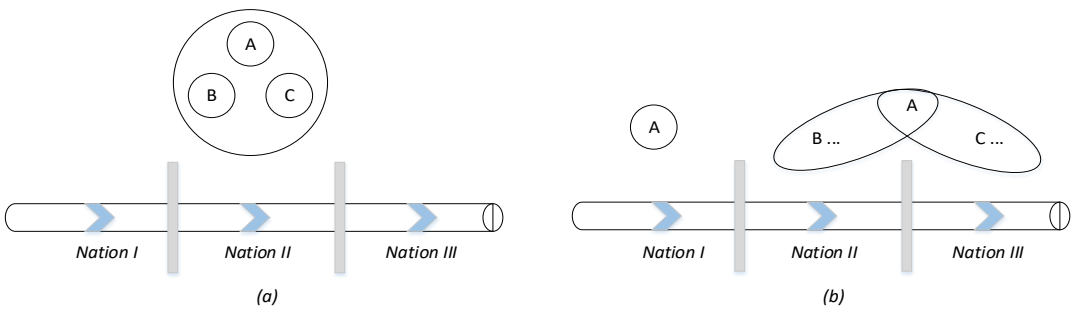


Figure 4- 5a, b Organizational Choices to Cross Two Borders

So we can set up two dummy variables: *Mirroring within-border*, which is "0" if mirroring holds (one firm developing the section within borders) and "1" for partial mirroring (multiple firms developing that section). At the across-border level, we can set up a categorical variable *Mirroring across-border*, which is "0" if there is a single firm developing the technology across borders; "1" if there is a single alliance developing the entire cross-border technology; "2" for partial mirroring in the form of a buyer-supplier relation between two independent entities with no common members; and "3" for partial mirroring in the form of a buyer-supplier relation between two alliances where a systems integrator is a member of both contracting partners.

Independent variables

Heterogeneity of the Organization's Environment. To measure the heterogeneity of the pipeline organization's environment, we need to measure the quality of the institutions on both sides of each border crossed by the technology. We plan to draw on country-level data from the World Bank Worldwide Governance Indicators (WGI) database (Kaufmann, Kraay, & Mastruzzi, 2009). We will follow the lead of Quelin, Cabral, Lazzarini, and Kivleniece (2019), and use three attributes of the institutional environment: rule of law,[56] regulatory quality,[57] and political stability and absence of violence/terrorism.[58] The average value of these three measures after standardization offers an index of institutional quality. We can then use the difference in institutional quality scores to measure the institutional distance characterizing each cross-border interface. Further, we can use the standard deviation

[56] Rule of law captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.

[57] Regulatory quality captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.

[58] Political Stability and Absence of Violence/Terrorism measures perceptions of the likelihood of political instability and/or politically-motivated violence, including terrorism.

of the institutional quality score of all the countries crossed by a single pipeline in order to denote the overall institutional heterogeneity faced by the pipeline organization as a whole.

We also plan to perform a robustness check using an alternative measure of institutional development derived from the World Bank Development Indicators (WBDI) database. We plan to use WGI as the primary database because it covers more countries presented in our cross-border gas pipeline dataset than the WBDI database. But we can also measure the institutional quality by averaging the value of three indicators of the WBDI database: business regulatory environment,[59] property rights and rule-based governance,[60] and enforcing contracts.[61] We can then check if the measurement using data from WGI is correlated with that of WBDI.

Cross-border Historic conflicts. The International Crisis Behavior Project (ICB2) maintains a database of 476 international crisis occurring during the 1918-2015 period (Brecher & Wilkenfeld, 2000; Brecher, Wilkenfeld, Beardsley, James, & Quinn, 2017), which has been used in previous research to measure dyadic conflicts between nations (Arikan et al., In-press). We can thus construct a cumulative count of dyadic conflicts between the country of the leading firm with each country crossed by the pipeline technology (*Dyadic conflicts*). Dyadic conflict is therefore a cumulative count of conflicts since 1918 to *t* per dyad, where *t* is the year when the intergovernmental agreement or MOU for the cross-border pipeline was signed. Further, we can construct a cumulative count of all the conflicts

[59] Business regulatory environment assesses the extent to which the legal, regulatory, and policy environments help or hinder private businesses in investing, creating jobs, and becoming more productive.

[60] Property rights and rule-based governance assess the extent to which private economic activity is facilitated by an effective legal system and rule-based governance structure in which property and contract rights are reliably respected and enforced.

[61] Enforcing contracts indicator measures the time required to enforce a contract is the number of calendar days from the filing of the lawsuit in court until the final determination and, in appropriate cases, payment.

involving all dyads between participating countries in a pipeline (*Total conflict*). Total conflict is thus the sum of all dyadic conflicts that the organization must face to develop the cross-border pipeline. This last independent variable, we conjecture, may have a direct impact on organizing pipelines that cross multiple historic borders. In other words, on the extent to which an organization chooses to set up a single alliance with multiple intermediaries to develop the entire cross-border technology or set up one legal entity for each border to be crossed and then play the role of systems integrator.

Control variables

We can include a range of control variables that are expected to affect the choice to partially misalign organizational ties and the structure of the task network. So, we can control the impacts of technical features, including pipeline length, oil vs. gas, and design capacity. We can also control for the number of borders that the pipeline has to cut across. Given our emphasis on institutional attributes, it is necessary to add a range of country-level controls (Quelin et al., 2019). We thus plan to add supplementary measures from the IMD World Competitiveness Yearbook (WCY): *Competition legislation* which measures the extent to which the country facilitates firm entry and competition and *Financial development* that measures the access to local capital markets. Following Arikan et al. (In-press), we also plan to construct a count variable (*Generation distance*) representing the total number of generations between the final dyadic conflicts and the year before the project was initiated. We use the categories of generations in Straus and Howe (1991).[62] Moreover, we use the Global Education Database[63] to construct a continuous variable (*Professional*) to

[62] There are nine categories of generations. 1=Gilded (1822-1842), 2=Progressive (1843-1959), 3=Missionary (1860-1882), 4=Lost (1883-1900), 5=G.I. (1901-1924), 6=Silent (1925-1942), 7=Boom (1943-1960), 8=Thirteenth (1961-1981), and 9=Millennial (1982-current).

[63] The database is compiled by UNESCO Institute for Statistics.

represent the combined average percentage of graduates from tertiary education graduating from Business, Administration and Law programs in the previous year *t*-1.

Testing the Hypotheses: Logistic and Probit Regression

To statistically test our hypotheses on the impacts of the institutional and historic borders on the choice to align or not organizational and product architectures, we can run a binominal logistic regression and a multinomial probit model. Both statistical methods can be used for analyzing a dataset in which there are multiple independent variables (institutional heterogeneity and historic conflicts in our case) that determine an outcome that has two or more categories. A binominal logistic regression deals with situations in which the dependent variable can only have two possible types, for example, "0" for mirroring and "1" for partial mirroring. In turn, a multinomial probit model is used when the dependent variable can fall into several possible categories, which is the four for mirroring across-borders in our case ("0", "1", "2", or "3").

A binominal logistic regression estimates the coefficient (and its standard errors and significant levels) of a formula to predict a logit transformation of the probability of the presence of the categories of the dependent variable:

$$logit(p) = \beta_0 + \beta_i x_i$$

where p is the probability when a category stands, x_i is a vector of independent variables and control variables, and β_i is the coefficient vector of the explanatory variable x_i.

In a multinomial probit model, the probability that observation (pipeline) k will select organizational structure j ("0", "1", "2", or "3") is:

$$p_{kj} = p(y_k = j) = \emptyset(x_k' \beta_j)$$

in which x'_{ij} is a vector of explanatory variables describing observation k; β_j is a vector of regression coefficients corresponding to organizational structure j; and $\emptyset$ is the cumulative distribution function of the standard normal distribution.

By running the above two types of regression models, we estimate the regression coefficient of each explanatory variable on a certain category of organizational structure. If the regression coefficient is positive (negative), it suggests that increases in the explanatory variable (institutional heterogeneity or historic conflicts) are associated with higher (lower) likelihoods of adopting that category of organizational structure. In other words, we are able to verify the impacts of the organization's environment on the choice to align organizational ties and task network.

Limitations and Future Research Directions

There remain two important areas for future research to refine and expand this study. First, we restrict our analysis to the population of cross-border pipelines that even if they did not move into implementation, they already made substantive progress in planning. As such, our study fails to account for pipeline projects that were not more than ideas floated around by their sponsors. This might cause selection bias towards projects that manage to survive cross-border conflicts or succeed to negotiate differences between institutional environments. Such limitation merits future studies that can, for example, look into the factors and processes that may be behind pipelines that failed to progress from an ideation stage into planning and implementation.

Second, because the development activities of an integral technology such as pipelines are highly interdependent with the institutional environment, we look into two environmental attributes – the heterogeneity in institutional environment and

history of cross-border conflict – to develop a contingency perspective of mirroring. This raises the question as to whether there are other factors that may also contribute to explain observed differences in the form of organizing to develop cross-border pipelines such as capability-based determinants. In management studies, organizational capabilities are of increasing influence in explaining organizational boundary choices (Teece, Pisano & Shuen, 1997; Winter, 2003). In Quelin et al. (2019), the authors find that institutional and capability-based factors jointly determine the private scope in public-private collaborations. This literature tells us that firms may craft and obtain capabilities in cross-border collaboration not only from their prior partnership experience in the host country (experience-based capabilities) but also, from engaging with government and political actors (political capabilities) (Faccio, 2006; Henisz & Delios, 2004; Holburn & Zelner, 2010). Multinational enterprises (MNEs) in particular are known to vary their response to host-country policy as a result of differences in their political capabilities, which refer to organizational capabilities for assessing policy risk and managing the policy-making process (Henisz, 2003; Henisz & Zelner, 2005; Holburn & Zelner, 2010; Siegel, 2007). In emerging economies, one option for MNEs is to ally with politically knowledgeable or connected consultants or employees, who may identify and broker relationships with key local political actors (Holburn & Zelner, 2010). These ideas in international business literature are wholly consistent with our argument that it is advantageous and effective for firms to form alliances with local intermediaries when an integral technology is interdependent with emerging economies; they are also consistent with the idea that if the technology is interdependent with an heterogeneous institutional environment, then it may make sense for the firm to form different alliances for different environments. Our paper

stops short of investigating how capability issues moderate the choices of firms developing integral technology that is interdependent with heterogeneous institutional environments. This line of direction merits further research.

Conclusion

In conclusion, this study aims to contribute to a theoretical conversation on a contingency view of mirroring. We ground our study on the cross-border oil and gas pipeline industry – an industry that revolves around an integral technology, the pipeline, whose task network is highly interdependent with the surrounding context. We develop a yet to be tested set of hypotheses by which we argue the choice to partially break the mirror is contingent on the organization's environment. Specifically, we argue the choice to set up a single alliance, a buyer-supplier relation, or take on the explicit role of systems integrator can be traced to two environmental attributes - the heterogeneity of the institutional environment and the history of cross-border conflicts. To sharpen the intuition for these ideas, we offer a descriptive analysis of the organization of the global population of cross-border gas pipelines over the past 40 years. We find strict mirroring to be the exception. Further, in agreement with our untested propositions, we find a spectrum of choices by which the mirror is partially broken within and across institutional and historic borders. We find that partial mirroring ranges from setting up an alliance for developing the entire cross-border technology to setting up, for each section within borders, a distinct alliance with a local intermediary or a buyer-supplier relation. We also find permutations of these basic organizational structures.

In Appendix C, we illustrate this fundamental trade-off with a detailed analysis of the Turkmenistan-Uzbekistan-Kazakhstan-China Gas Pipeline. The analysis shows a situation of a Chinese-led pipeline organization that needed to cross three

national borders between three emerging economies much less developed than China, and institutionally all very different from one another. A history of cross-border conflicts made it hard to set up a single consortium. So, the Chinese firm chose to ally with local partners, setting up one legal entity for each country to be crossed by the technology, with the Chinese firm taking on the systems integrator role.

In sum, we argue that partially breaking the mirror is advantageous to navigate differing sets of institutional voids and/or cope with an undamped history of cross-border conflicts albeit the costs of integrating effort from misaligning organizational ties and the task network. Our claims are yet to be tested, but we offer an actionable plan as to how we intend to proceed.

CHAPTER 5

CONCLUSION

This thesis was motivated by the very basic idea that megaprojects constitute global empirical phenomena that offer exciting opportunities to help further our theoretical understanding of new forms of organizing in general and organizational governance in particular. From an organizational design perspective, a megaproject is thus conceptualized as an interorganizational form of organizing that is set up to produce capital-intensive, durable, and shareable technology. As strategic instruments to produce technology that serves as an input into a wide range of economic activities, megaprojects are organizational systems that can enable the creation of broad social value. This thesis thus leverages megaprojects as a context to address three core research questions related to organizational choice and value creation.

The first question is a pre-theory (but not a theoretical) question related to why megaprojects invariably are perceived to fail because of systematic delays, cost overruns, and scope creep. By mobilizing organizational governance literature as a cognitive lens, we ask: can we trace the perceived (under)performance of megaproject organizations to evolution in the organizational governance? To this purpose, we analyze extensively qualitative and quantitative evidence from three contemporaneous megaprojects. Our study reveals an overlooked relationship between slippages in performance targets and the evolution in the organizational governance of a megaproject over time. Further, we also link major cost overruns to collective action and corresponding negotiations to agree and redistribute the value to be co-produced. In contrast, we find only marginal associations between cost

overruns and contractual governance with suppliers and stakeholders excluded from the organizational boundaries. These empirical discoveries suggest cost overruns are rooted in difficulties to predict reliably the final costs of social value creation.

Our second research question is more theoretical. Specifically, we investigate how in a polycentric system, the (financial) slack which is carried by its designated leader or system architect impacts the process of value co-creation. Thus we ask: how does the organization's slack impact the co-creation and capture of social value with enfranchised sovereign stakeholders? To further our understanding of slack as a governance mechanism in polycentric systems, we combine a case study analysis of the UK government's use of vast contingency funds to enable compromises with enfranchised stakeholders with insights from a game-theoretic model. This study reveals a curvilinear relationship between slack and value creation, and sheds light on how this relationship can be manipulated by combining actual and potential slack.

To conclude this thesis, our attention is shifted to a fundamental organizational design question that pertains to the strategic choice available to the designers of organizations set up to produce technology. This question builds upon the basic idea that organizational designers seek to align the organizational ties with the structure of the task network, the so-called mirroring hypothesis. In the third paper, we ask: is the mirroring hypothesis also contingent on the institutional and historical context? By investigating the cross-border gas industry, we find – against prevailing wisdom – that mirroring is actually the exception when a task network with dense technical interdependences needs to cross interdependent institutional and historic borders.

In addressing these three research questions, this thesis has important implications for practice and theory development which I turn now to lay down.

Contributions to Practice

Why do Megaprojects Struggle to Stay on Budget?

This thesis traces the empirical regularity of missing cost targets in megaprojects to the strategic choice to build a core alliance first and then enfranchise key stakeholders and the way this choice allows for a redistribution of the value to be co-produced towards a distribution that is perceived more equitable. This insight suggests that equating 'high' or 'positive' performance in a megaproject context to 'on budget' is a problematic institutionalized bias. Specifically, there are four key takeaways from this study. For one, it suggests that although slippages in cost targets are almost inevitable, these slippages have a *raison d'être*. Our findings reveal the control over the resources necessary to achieve the goal is distributed across multiple stakeholders. As a result, there is high ambiguity in the value proposition, which can only be attenuated if the megaproject organization sets numeric targets at the onset, and to do so is important to gain legitimacy to proceed. However, once key sovereign stakeholders are enfranchised, the negotiations to redistribute value put mounting pressure to relax those very same numeric targets. The task of setting reliable targets upfront is further complicated by bounded rationality which makes it hard to predict the outcomes of the consensus-oriented negotiations with key stakeholders. We show this dynamic leads to a systematic failure of performance forecasts. This insight suggests a need to see performance as an 'adaptive' variable in agreement with the idea that projects practice puts excessive emphasis on control systems in detriment of valuing flexibility and adaptability (Dvir & Lechler, 2004).

Second, our analysis suggests that whilst stakeholder enfranchisement can be advantageous to create social value, megaproject promoters do not want to enfranchise *all* sovereign stakeholders. Our findings make clear that collective action

is costly (financially and politically). Further, collective action brings a risk of free-riding in that enfranchised stakeholders may perceive that any threat of the capital provider to walk away from the negotiations is not credible. In other words, enfranchised stakeholders may perceive the capital provider is privileged enough to bear all the costs of collaboration. Complicating matters, our findings show the final costs of collective action are difficult to predict, which complicates the management of the interdependences with the environment. The more the projected costs of collective action derail, the more actors in the environment are likely to perceive that the project is failing and is destroying value even if the cost slippages may be value-creating. Further, our findings show that the costs of contracting for resources can be more reliably predicted if property rights are well-defined and markets are efficient. So, the excludability of sovereign stakeholders remains a suitable strategic choice to avoid congestion in the use of the promoters' capital and scarce resources.

A third implication of our work is that it is unfair to put all the blame for performance slippages on the project promoters. Our analysis suggests promoters act in response to pressures for accountability when they first set targets, and then act in response to pressures to make the decision-making process democratic when they let those very same targets slip. This pressure is rooted in deep-seated norms. Our task here is to produce new managerial insights that can contribute for norms to evolve.

Finally, by shedding light on the inner working of the polycentric governance structures at the heart of megaprojects and the corresponding role of slack, we create an opportunity to change professional norms in project contexts. If promoters are less fearful of being punished for overruns, we argue, more opportunities can arise for megaprojects to create social value. In the current normative environment, the megaproject promoter is under massive pressure to deploy economic rationality early

on to justify the value proposition. To conform, the promoter employs narrow forms of cost-benefit analysis that are known to overlook the wider but more difficult to observe and measure benefits of megaproject outputs. However, this practice also means that were the promoter to act slavishly to the initial cost-benefit analysis, the megaproject output would fail to take into account many positive externalities. So, the enfranchisement of key stakeholders and the concomitant mobilization of slack to build consensus creates an opportunity to fix the limitations of procedural rationality.

Cut some Slack?

Our claim of a curvilinear relationship between slack and value creation also has important implications for projects practice and policy. Public policy often advocates the build-up of a contingency budget upfront, which enables the project promoter to then mobilize contingency funds to finance compromises with key stakeholders and avoid impasse whilst sustaining a narrative that the project is on target. In the UK context, for example, a so-called 'optimism bias' policy from Treasury offers guidance for public sector bodies on how to build contingency budgets.[64] The policy departs from the assumption that project appraisers are overly optimistic and often fail to account for unforeseen events as well as the actual costs of resolving the interfaces with environmental stakeholders. So, the optimism bias policy draws from historical evidence in order to offer decision-makers factors which they should use to uplift the initial cost forecasts and thereby reduce the likelihood of budget overruns. However, optimism bias policy has been criticized to encourage 'lazy' and 'overegged' budgets and reduce the bargaining power of the capital provider (since information of contingency budgets is in the public domain). By showing here that

[64] UK Treasury. 2013. Supplementary Green Book Guidance. HMT Green Book Appraisal and Evaluation in Central Government: Supplementary Guidance. HM Treasury, 21 April, London: TSO.

the optimism bias policy is a mechanism to build financial slack, we show its role in facilitating the negotiations to redistribute the value to be co-produced with enfranchised stakeholders. In other words, we show there is value in building some slack, since up to a point, the compromises that slack enables to strike will increase the social value that can be co-produced. Further, our study offers pointers as to how to determine the right amount of slack taking into account the private benefits to be accrued by the compromises enabled by mobilizing slack, the costs of building actual and potential slack, and ultimately the willingness of the capital provider to sacrifice private value for gains social value. These are important insights for policymakers.

When Mirroring is the Exception!

The mirroring hypothesis posits that managers will (or should) leverage technological knowledge in order to reduce management complexity by aligning the organizational structure with the architecture of the products that the organization develops. It has been suggested that mirroring is a prevailing pattern, but contingency factors are known that motivate firms to break the mirror for modular products. However, we still know very little of the contingencies that may motivate mirror breaking for an integral product. By looking at the cross-border oil and gas pipeline industry, our study suggests that there might be good reasons to partially break the mirror too. Specifically, we claim that when the task network is dense in technical interdependences and highly interdependent with the context, managers have good reasons to partially break the mirror if the tasks need to cross borders between different institutional environments. We also claim that an undamped history of cross-border conflict that is interdependent with an integral task network is another good reason to partially break the mirror. This contingency view of

mirroring makes explicit a trade-off faced by organizational designers: either they align organizational ties and the task network structure in the pursuit of efficiencies and avoidance of management complexity; or instead, they partially break the mirror in order to align the organizational structure with the environmental and historical borders.

Contributions to Theory

This thesis contributes to three conversations in the fields of organizational theory and strategic management: theory on the creation and distribution of value (Dorobantu, Henisz, & Nartey, 2017a; Henisz, Dorobantu, & Nartey, 2014); recent organizational research adopting a property rights perspective on organizational governance (Asher, Mahoney, & Mahoney, 2005; Klein, Mahoney, McGahan, & Pitelis, 2019; Klein, Mahoney, McGahan, & Pitelis, 2012); and strategic choice on the relationship between technological structure and organizational structure (Colfer & Baldwin, 2016; Sosa, Eppinger, & Rowles, 2004).

Linking Organizational Governance with Value Creation and Capture

Whilst the first paper is pre-theory, it still contributes to further a conversation in the more phenomenological management literature that revolves around the reasons for prevailing perceptions of underperformance in megaprojects. We thus discover an overlooked association between the longitudinal evolution of the megaproject organizational governance and budgetary slippages, which is in agreement with a tradition in organizational theory of linking structure and performance (March & Sutton, 1997).

Specifically, we trace major cost hikes to the negotiations by which a restricted group of autonomous actors forms an alliance to assemble an initial bundle of co-specialized resources towards a shared, higher-order goal; further, we associate

major cost hikes to the choice of this alliance to enfranchise stakeholders into a polycentric structure for encouraging them to commit specialized resources towards that goal. In contrast, we trace only a marginal association with cost hikes and the arrival of a vast supply chain governed by formal contracts. We also find only a marginal association between cost hikes and contractual governance with the much larger number of sovereign stakeholders which stay outside the organizational boundaries and thus are also governed by contracts.

These insights do not refute traditional competing explanations for cost overruns which range from strategic misrepresentation and incompetence (Flyvbjerg, Holm, & Buhl, 2002; Morris, 1994) to undue influence of the environment (Gil & Tether, 2011; Miller & Lessard, 2001) and suppliers' opportunistic behavior (Stinchcombe & Heimer, 1985). However, by offering novel conceptual framing as to the reasons for cost overruns, we reconcile these explanations and contribute to moving the debate forward. Forming an alliance and stakeholder enfranchisement are two ways to encourage voluntary contributions of specialized resources towards the goal (Fehr & Gintis, 2007; Ostrom, Walker, & Gardner, 1992). But in exchange, alliance partners and enfranchised stakeholders demand negotiations to redistribute the social value to be co-produced. These findings agree with Scott's (1987: 23) view of organizations as "coalitions of shifting interest groups that develop goals by negotiation". They also resonate with the idea that organizational governance adaptation requires difficult negotiations (Klein et al., 2019). Importantly, we define social value as the sum of the private value captured by each party (Cabral, Mahoney, McGahan, & Potoski, 2019; Cuypers, Cuypers, & Martin, 2017; Garcia-Castro & Aguilera, 2015; Lazzarini, In-press; van den Oever & Martin, 2019). This definition holds when the institutions are robust, and thus utility is transferrable (Ostrom, 1990).

Within this boundary condition, value redistribution does not destroy value, and so relaxing the budget is a governance mechanism towards creating a social surplus.

Organizational Slack and Social Value Creation and Capture

The second study leverages the previous insight between organizational governance and value creation to contribute to a conversation on the curvilinear relationship between slack and other organizational variables, e.g. innovation, growth, and performance (Agrawal, Catalini, Goldfarb, & Luo, 2018; Nohria & Gulati, 1996). It does so by extending this debate to the relationship between an organization's slack and the value of collaborating with enfranchised sovereign stakeholders. Through a mixed-methods study, we find that too little or too much slack impacts negatively social value creation. We also show that after a certain point, the extent to which additional investment in slack adds social value is contingent on whether the organization accepts to sacrifice private returns to pursue pro-social goals, i.e. "do the greatest good for the greatest number" (Jones, Donaldson, Freeman, Harrison, Leana, Mahoney et al., 2016: 217). This trade-off is central to the purpose of an organization and of its reason to exist (Battilana & Dorado, 2010; Henderson, Gulati, & Tushman, 2015).

Because our insights are grounded in a megaproject context, they respond to a recent call to extend literature on novel forms of organizing to settings that are less germane to strategy literature (Gulati, Puranam, & Tushman, 2012; Puranam, 2018). Specifically, we focus our research on polycentric forms of organizing whose survival and performance is very much dependent on cooperation across organizational boundaries. This is an important class of organizations in that growing pressures for organizations to act more collaboratively is forcing organizations to add consensus-oriented structures to which stakeholders can

voluntarily join (Dorobantu et al., 2017a; Dorobantu & Odziemkowska, 2017; Gil & Pinto, 2018). From this perspective, our study can be seen as advancing our understanding of how polycentric forms of organizing build and sustain a bundle of co-specialized resources. We show that once a choice is made to grant sovereign stakeholders residual control rights, then the choice to build slack outrightly matters.

Because our insights are grounded in the public sector, we also add to nascent strategy literature in public-public partnerships (Cabral et al., 2019; Kivleniece & Quelin, 2012; van den Oever & Martin, 2019). Stakeholder enfranchisement is a strategic response to the environmental pressure for compromise on the provision of public goods (Dean & Sharfman, 1993; Dunleavy, 2014). Still, this governance choice cannot resolve the problem of how to create a social surplus (i.e. the amount by which the social value exceeds the organization's private value) when the stakeholders do not want to pay for it. This is where slack can add value by buffering a network of public actors from political considerations that otherwise will get in the way of endogenous creation of social value (van den Oever & Martin, 2019).

A Contingency View of Mirroring on the Organization's Environment

Our third study aims to contribute to a theoretical conversation on a contingency view of mirroring. By drawing extensively on modularity literature (Baldwin & Clark, 2000; Sanchez & Mahoney, 1996), mirroring theory has neglected the study of organizations set up to produce products with integral architectures and thus with dense task networks of technical interdependences. Still, the basic precept of mirroring theory predicts an association between integral products and single firms. Crucially, however, mirroring theory has implicitly assumed that the task network has limited interdependences with the surrounding institutional environment.

In this empirical study, we relax the assumption of independence with the organization's environment to further a contingency perspective of mirroring. We ground our study on the cross-border oil and gas pipeline industry – an industry that revolves around an integral technology, the pipeline, whose development activities and production stages are highly interdependent with the physical and institutional environment. Whilst our ultimate goal is to test a contingency perspective of mirroring on the organization's environment, the current working paper stays short of this goal. Rather, what we do in the paper is to develop a yet to be tested theory of mirroring and corresponding hypotheses contingent on the heterogeneity of the institutional environment and the history of cross-border conflicts. We then offer a descriptive analysis of the organization of the entire population of cross-border gas pipelines initiated since 1977, the first year for which we found reliable data, to sharpen the intuitions for our theoretical propositions. We complement the insights of the descriptive industry-level analysis with a case study.

Hence, by drawing on extant literature on mirroring and theory on how organizations navigate through institutional voids, we hypothesize a contingency perspective of mirroring. Specifically, we conjecture that mirroring only holds if the task structure does not need to cross any significant institutional and/or historic borders. In other words, we propose mirroring is an exception if the organization needs to cross borders between heterogeneous institutional environments, which include advanced economies and environments with a shortfall of robust institutions. If an organization needs to navigate through institutional voids, we argue, it will be advantageous to partially break the mirror by setting up alliances with local actors who can work as 'institutional intermediaries' (Dutt, Hawn, Vidal, Chatterji, McGahan, & Mitchell, 2016). In other words, it will be advantageous to distribute a

dense network of technical interdependences with as many local intermediaries as the number of institutional borders that need to be crossed.

In addition, we claim that if the organization needs to cross a historic border characterized by undamped conflicts between neighboring nations or societies, again, it will be advantageous to partially break the mirror. An undamped cross-border history of conflict occurs when there is no major generational gap between the history of conflict and the time when decision-makers have to make decisions and there is a scarcity of an educated workforce in the fields of business, law, and social science (Arikan, Arikan, & Shenkar, In-press). Because an undamped history of cross-border conflict is also known to impact negatively cross-border corporate deals (Arikan et al., In-press; Arikan & Shenkar, 2013), we propose it is advantageous to partially break the mirror by establishing a buyer-supplier relation with local actors.

A descriptive analysis of the cross-border gas pipeline industry and a case study offer evidence that corroborates our conjectures. Hence, in a population of 52 pipeline initiated over the past 40 years, we find only two cases of strict mirroring. So, mirroring is the exception. In contrast, we find extensive evidence that mirroring is partially broken by setting up cross-border alliances and buyer-supplier relations.

Limitations and Areas for Future Research

This thesis uses megaprojects as an interoganizational context in order to advance our understanding of the relationship between organizational governance and value creation. In addition, in the third paper, this thesis leverages the megaproject context to contribute to a conversation on the reasons as to why not always organizational ties mirror technological architectures. Each paper, however, has a number of limitations which suggest some interesting avenues for future research. I turn now to lay down the limitations of each paper first and then

summarize the overarching limitation of the thesis as a whole. I also offer a reflection on the thesis as a whole in terms of direction for future research.

In the first paper, the association that is uncovered between slippages in performance targets and evolution of governance structure does not necessarily mean causation. Whilst our findings do not refute competing theoretical claims, there might exist alternative explanations that remain underexplored notably differences in level of public support, exogenous events that can change the relationship with the environment, and the levels of financial slack. Constrained by access to hard data, the panel data analysis did not control for impacts of time-variant factors. Moreover, we need more work to understand how the institutional environment affects the choice to include versus exclude stakeholders from the organization. In our study, we show that enfranchising stakeholders is advantageous to encourage voluntary contributions of resources. However, this choice incurs the costs of collective action and difficulties to anticipate those costs (which also have political costs). An alternative is to exclude the stakeholders from the decision-making processes, and contract instead for their resources. This latter choice is advantageous, as our study shows, in that it allows for more predictable transaction costs. However, the choice to exclude stakeholders needs to be weighed against the costs of exclusion which are a function of social norms in the context. Further, as said before, if the institutions in the environment are robust, there is a cost of reneging to commitments such as those of sharing decision rights. But this cost is much less in other environments, which has direct implications too to organizational governance choice. These areas merit further research.

A major limitation of the second study pertains to the trade-off between realism and rigor that applies to all formal models in social science (Gulati & Puranam,

2009). Our study was informed by the UK context, and uses a UK case to illustrate our claims. So, implicit in our claims, is the idea that a public organization's slack is common knowledge. However, we can conceive situations where this assumption not always holds. It would be interesting to explore the dynamics of the relationship between slack and value creation when the capital provider's slack is hidden information. Relatedly, we can conceive situations where stakeholders too have slack that can be mobilized to enable compromise, another situation that merits further research. In addition, our study also does not look into the impacts of governance within public agencies on the management of slack. Yet, it would be interesting to understand how distributing ownership of slack between political appointees and appointed officials could impact the way slack can be mobilized to create value. Finally, our claims assume that because the institutions in the environment are robust, utility is transferrable, and the redistribution of value does not lead to loss of value. But this is not a universal condition. Hence, it remains indeterminate the impact of institutional weakness on the curvilinear relationship between slack and value creation. Related to this, we assume that slack costs can be reduced by making credible promises to generate more revenues and savings. However, the ability to make credible promises is also a function of the robustness of the institutions in the environment, which is another limitation in our research.

The third study is at its early stage. A preliminary descriptive analysis of the population of gas pipelines seems to suggest that our conjectures are valid. But the fact is our hypotheses remain to be statistically tested. To do that using data from cross-border pipelines, we need to characterize and measure the heterogeneity of the institutional environment that is crossed by each pipeline. We also need to characterize and measure the nation-dyadic history of conflicts that are relevant for

each pipeline. This study also stays short of taking other determinants into consideration, for instance, political capabilities of the leading firm. Future research could develop more comprehensive understanding of mirroring by incorporating institutional and capability-based perspectives in our ideas.

However, we sought some degree of generalization in our findings. For example, the first two studies build diversity into the sample in that the cases in the sample differ in the architecture of the product from modular architecture (Olympic Park) to integral architecture (railway systems such as Crossrail and HS2) and Hybrid architecture (Heathrow T2) (Gil & Pinto, 2018). Still, the generalizability of the findings is constrained by the institutional environment. Our observations were grounded in the UK context, an environment where the institutions are robust. Robust institutional environment, however, cannot be taken for granted in other contexts. Future research is encouraged to investigate the governance structure and its implication for value co-creation in emerging economies.

We also note that the second study is very much focused on the public sector where the notion of "collaborative governance" has gained much traction in the last decades (Ansell & Gash, 2008). English institutions of local government are based on minimal functions and simple structures, in which "the great bulk of administrative work was done by the localities, not by the central state authorities" (White, 1939: 18-19). This institutional feature shapes the landscape of interactions in public-public relations and has led to a rise of polycentric governance structures by which the organization deliberately sets up multiple consensus-oriented groups of decision-making with actors that are outsiders to the organization (Gil & Pinto, 2018; Ostrom, 1990). English approach to public sector governance has directly influenced public governance in other parts of the world notably the US and commonwealth

countries and former colonies. Hence, for sure, our insights are not restricted by the UK context.

Further, we claim a study in the public sector can also provide implications for the private sector. Capital projects are not the preserve of the public sector. Overrun in capital projects occur also in private sectors like mining, oil and gas, and utilities. Heathrow T2 is a case in point. Moreover, we know that growing environmental pressures for both private and public organizations to act more collaboratively are forcing organizations to add consensus-oriented structures to which stakeholders can voluntarily join (Dorobantu et al., 2017a; Klein et al., 2019). This suggests that there is value in investigating how bargaining and negotiations – ingredients to make strategic choices and required to find domains of action in the public sector (Nutt, 1999) – can play out in relations between firm and in relations between private firms and public actors. In that sense, the insights from our study of how polycentric governance affects the ability of the organization hit performance targets are relevant too to private firms. Further, although slack literature assumes slack is an exogenous variable for the firm, slack can also be made an endogenous variable as when the private firm sets up a capital budget, for example in the oil and gas industry or in the mining industry and the utility sectors. Given that we show slack can enable to co-create value beyond the value that the organization would be able to capture without slack, our insights too matter to the private firm. Related to this, even in the private sector, we see more and more firms such as Certified B-corporations that are publicly claiming an organizational identity where the requirement to create value for non-shareholder stakeholders is as important as the requirement to maximize shareholder value (Kim, Karlesky, Myers, & Schifeling, 2016). This suggests that the idea that increasing the amount of slack up to the point that allows maximizing

stakeholder value can produce more social value if the capital provider is willing to sacrifice some private value is not be anathema to all private firms. For sure, it is an idea that is uncomfortable with the notion that the purpose of the firms is to maximize shareholder value (Freeman, 1984). But this notion is not a universal belief and there is indeed increasing evidence around the world of firms adopting a triple bottom line in that firms commit to focus on social and environmental concerns just as they do on profits (Battilana & Dorado, 2010; Henderson et al., 2015).

In-pressIn-pressIn sum, this is a thesis about megaprojects – both as empirically underexplored phenomena of major socio-economic importance *and* as an exciting context that offers fresh evidence to further ongoing theoretical debates. Phenomenologically, this thesis illuminates how the organizational governance of megaprojects evolves over time. In so doing, we contribute to moving forward a long-standing debate on why megaprojects perform the way they do. Theoretically, this thesis leverages megaproject contexts to contribute to two conversations: one on the relationship of slack and value creation, and the other on a contingency perspective of mirroring. Clearly, the work here does not exhaust opportunities for further research grounded in megaprojects. This is a vast economic sector that entails technologies with varying degrees of decomposability, and this variation can be expected to directly influence organizational choice. Further, megaprojects are highly interdependent with the organization's environment and we have only started to scratch the surface of the impact of these interdependences on organizational choice. Still, we believe this work is a humble step towards building a theory of megaprojects and value creation.

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APPENDIX A

ANALYTICAL PRESENTATION AND PROOFS IN CHAPTER 3

A1 Model Specification

The bargaining model consists of two players – the capital provider (A) who de jure controls financial slack, S, and an enfranchised sovereign stakeholder (B). The capital provider and the stakeholder bargain over a compromise towards a distribution of value that costs more to implement than the capital provider's preference (D_A) and less than the stakeholder's preference (D_B, see Figure 3-2). Let $V_A(x;S)$ and $V_B(x;S)$ denote the private value that is accrued by the capital provider and the stakeholder respectively.[65] The private value functions are defined as follows:

$$\begin{cases} V_A(x) = f_A(x) - g(S) - m(x) - h(x) \\ V_B(x) = f_B(x) \end{cases} \quad (1)$$

in which $f_A(x)$ expresses the private benefits accrued by the capital provider from compromising and $f_B(x)$ the benefits accrued by the stakeholder. Let us assume $f_A(x) = F_a + \alpha x$ and $f_B(x) = F_b + \beta x$ where F_A and F_b are the initial benefits accrued from D_A. $\alpha\ (\alpha > 0)$ and $\beta\ (\beta > 0)$ are the respective unit benefits to be accrued from a compromise.

We let $g(S) = rS$ denote the costs of building slack, in which r is the unit cost; $m(x)$ is the cost of mobilizing slack in order to finance a shortfall, i.e. $m(x) = \begin{cases} lx & \text{if } x \le S \\ lS & \text{if } x > S \end{cases}$, in which l is the unit cost of mobilizing slack. It is further assumed that $l > \alpha$, since if the benefits outweighed the cost of mobilizing slack, both players could maximize their value by outrightly striking a consensus on D_B with no need to bargain. Yet, slack may not be enough to finance a compromise, which can lead to running out of slack. Thus, the penalty (political cost) of running out of slack is denoted as:

$$h(x,S) = \begin{cases} 0 & \text{if } x \le S \\ c(x-S) & \text{if } x > S \end{cases}$$

[65] For convenience, henceforth we suppress the dependence on S by using $V_A(x)$ and $V_B(x)$ instead.

in which c is the unit penalty of running out of slack. We assume that the penalty for running out of slack is greater than the sum of the costs of building slack and mobilizing slack, i.e. $c > r + l$.[66]

A2 Model Solution

To simulate the bargaining process we adopt the alternating-offer bargaining model (Cross, 1965; Rubinstein, 1982) in which the two parties take turns to offer alternative value distributions until one party accepts an offer that is made by the other party. There are costs of haggling that are incurred by both parties. When reaching compromise on x at time $t\Delta\ (t = 0,1,2,\cdots)$, the discounted value that is captured by the parties are $V_i(x;S)\delta_i^{\ t}\ (i = A,B)$, where δ_i is the party *i*'s discount factor, $0 < \delta_i < 1$. On the other hand, if the parties perpetually disagree, then they cannot co-create value and thus each party captures zero value. The more impatient the claimant is, the smaller the discount factor δ_i is.

We employ the Subgame Perfect Equilibrium (SPE) concept to characterize the bargaining outcome (Osborne, 2004; Selten, 1965, 1973, 1975). The SPE in the alternating-offer bargaining model needs to satisfy the following two properties (Muthoo, 1999). First, whenever a player makes an offer, his equilibrium offer is accepted by the other claimant (*no delay*); and second, in equilibrium, a player makes the same offer whenever it has to make an offer (*stationarity*).

According to the stationarity property, whenever a player needs to make an offer, we use $x_i^*\ (i = A,B)$ to denote the player's equilibrium offer and $V_i^*\ (i = A,B)$ to denote the value captured by the proposer when the offer is accepted by the other player. According to the no-delay and stationarity properties (Muthoo, 1999), the following equations hold:

$$\begin{cases} V_B(x_A^*) = V_B(x_B^*)\delta_B \\ V_A(x_B^*) = V_A(x_A^*)\delta_A \end{cases} \quad (2)$$

By solving out the above equations, we propose the following model solution.

Model Solution For any given amount of slack S, the following strategies are subgame perfect equilibrium: i) the capital provider always offers x_A^* and always accepts an offer x_B if and only if $V_A(x_B) > V_A(x_A^*)\delta_A$, and ii) the stakeholder always offers x_B^* and always accepts an offer x_A if and only if $V_B(x_A) > V_B(x_B^*)\delta_B$, where x_A^*, x_B^*, $V_A(x_A^*)$, and $V_B(x_B^*)$ are listed in Table A-1.

[66] This assumption is informed by empirical regularities. To wit, when Govt faces a choice between incurring a potential budget overrun and investing in slack, the Govt (if it can afford) prefers to invest in slack to mask any potential cost escalation; as one official said, "undershooting almost causes more problems than overshooting".

Proof. We solve the model in two scenarios based on the amount of slack S and the financial shortfall K between the preferences of the two players. When $0 \le S \le K$, let Ω denote the set of instantaneous value pairs that are obtainable through agreement, in which $\Omega = \{(u_A, u_B):$ there exists x such that $V_A(x) = u_A$ and $V_B(x) = u_B\}$. Thus, the set of possible value pairs at time $t\Delta$ is $\Omega^t = \{(u_A\delta_A^t, u_B\delta_B^t): (u_A, u_B) \in \Omega\}$, and $\Omega^0 = \Omega$. Let Ω^ε denote the *Pareto frontier* of the set Ω. A value pair $(u_A, u_B) \in \Omega^\varepsilon$ if and only if $(u_A, u_B) \in \Omega$ and no other value pair $(u_A^{'}, u_B^{'}) \in \Omega$ exists such that $u_A^{'} \ge u_A$, $u_B^{'} \ge u_B$ and for some $i \in \{A, B\}$, $u_i^{'} > u_i$. Furthermore, the Pareto frontier Ω^ε of the set Ω is the graph of a concave function, denoted by $\phi(u_A)$. By the definition of the Pareto frontier, $\phi(u_A)$ is a strictly decreasing function. The inverse of $\phi(u_A)$ is denoted by $\phi^{-1}(u_B)$. $\phi(u_A)$ is the maximum value to be captured by the stakeholder subject to the capital provider capturing a value of at least u_A. Similarly, $\phi^{-1}(u_B)$ is the the maximum value to be captured by the capital provider subject to the stakeholder capturing a value of at least u_B.

According to Muthoo (1999), the SPE is subject to:

$$\begin{cases} V_B^* = \phi(\delta_A V_A^*) \\ V_A^* = \phi^{-1}(\delta_B V_B^*) \end{cases} \quad (3)$$

Because $$V_A(x) = \begin{cases} F_a + \alpha x - rS - lx & \text{if } 0 \le x \le S \\ F_a + \alpha x - rS - lS - c(x - S) & \text{if } S < x \le K \end{cases} \quad (4)$$

the range of $V_A(x)$ is then $V_A(x) \in [F_a - (r + l - \alpha)S, F_a - rS]$ if $x \in [0, S]$, and $V_A(x) \in [F_a + (c - r - l)S - (c - \alpha)K, F_a - (r + l - \alpha)S]$ if $x \in [S, K]$ .The stakeholder's private value remains as $V_B(x) = F_b + \beta x$, $x \in [0, K]$. Thus, the Pareto frontier $\phi(u_A)$ can be expressed as follows:

$$\phi = u_B = \begin{cases} F_b + \dfrac{\beta[F_a + (c - r - l)] - \beta u_A}{c - \alpha} & \text{if } u_A \in [F_a + (c - r - l)S - (c - \alpha)K, F_a - (r + l - \alpha)K] \\ F_b + \dfrac{\beta(F_a - rS) - \beta u_A}{l - \alpha} & \text{if } u_A \in [F_a - (r + l - \alpha)K, F_a - rS] \end{cases}$$

(5)

To address the model solution, it is necessary to differentiate three possible situations.

Situation 1. When $V_A^* \le F_a - (r + l - \alpha)S$, according to Equation (3),

$$\begin{cases} V_B^* = F_b + \dfrac{\beta[F_a + (c-r-l)S] - \beta\delta_A V_A^*}{c-\alpha} \\ V_A^* = F_a + (c-r-l)S + \dfrac{(c-\alpha)F_b - (c-\alpha)\delta_B V_B^*}{\beta} \end{cases}$$

then $$\begin{cases} V_A^* = \dfrac{(1-\delta_B)[F_a + (c-r-l)S + \dfrac{c-\alpha}{\beta}F_b]}{1-\delta_A\delta_B} \\ V_B^* = \dfrac{(1-\delta_A)[\dfrac{\beta}{c-\alpha}[F_a + (c-r-l)S] + F_b]}{1-\delta_A\delta_B} \end{cases}$$

$$\begin{cases} x_A^* = \dfrac{(1-\delta_A)\delta_B\beta[F_a + (c-r-l)S] - (1-\delta_B)(c-\alpha)F_b}{(1-\delta_A\delta_B)(c-\alpha)\beta} \\ x_B^* = \dfrac{(1-\delta_A)\beta[F_a + (c-r-l)S] - \delta_A(1-\delta_B)(c-\alpha)F_b}{(1-\delta_A\delta_B)(c-\alpha)\beta} \end{cases}$$

because $V_A^* \le F_a - (r+l-\alpha)S$, then $S \le \dfrac{(1-\delta_A)\delta_B F_a - \dfrac{(1-\delta_B)(c-\alpha)}{\beta}F_b}{(1-\delta_A)\delta_B(r+l) - (1-\delta_A\delta_B)\alpha + (1-\delta_B)c} \equiv T_1$

Situation 2. When $\delta_A V_A^* \ge F_a - (r+l-\alpha)S$, according to Equation (3)

$$\begin{cases} V_A^* = \dfrac{(1-\delta_B)[F_a - rS + \dfrac{l-\alpha}{\beta}F_b]}{1-\delta_A\delta_B} \\ V_B^* = \dfrac{(1-\delta_A)[\dfrac{\beta}{l-\alpha}(F_a - rS) + F_b]}{1-\delta_A\delta_B} \end{cases}$$

$$\begin{cases} x_A^* = \dfrac{(1-\delta_A)\delta_B\beta(F_a - rS) - (1-\delta_B)(l-\alpha)F_b}{(1-\delta_A\delta_B)(l-\alpha)\beta} \\ x_B^* = \dfrac{(1-\delta_A)\beta(F_a - rS) - \delta_A(1-\delta_B)(l-\alpha)F_b}{(1-\delta_A\delta_B)(l-\alpha)\beta} \end{cases}$$

because $\delta_A V_A^* \ge F_a - (r+l-\alpha)S$, meanwhile $0 \le x_i^* \le K \ (i = A, B)$, then

$$T_2 \equiv \frac{(1-\delta_A)F_a - \dfrac{\delta_A(1-\delta_B)(l-\alpha)}{\beta}F_b}{(1-\delta_A)r + (1-\delta_A\delta_B)(l-\alpha)} \le S \le \frac{F_a}{r} - \frac{(1-\delta_B)(l-\alpha)F_b}{(1-\delta_A)\delta_B\beta r} \equiv T_3$$

Situation 3. When $V_A^* \ge F_a - (r+l-\alpha)S$ and $\delta_A V_A^* \le F_a - (r+l-\alpha)S$, according to Equation (3)

$$\begin{cases} V_A^* = \dfrac{[c-\alpha-\delta_B(l-\alpha)]\beta F_a + (1-\delta_B)(c-\alpha)(l-\alpha)F_b - \beta[r(c-\alpha)+\delta_B(l-\alpha)(c-r-l)]S}{[c-\alpha-\delta_A\delta_B(l-\alpha)]\beta} \\ V_B^* = \dfrac{(1-\delta_A)\beta F_a + [c-\alpha-\delta_A(l-\alpha)]F_b + \beta[c-(1-\delta_A)r-l]S}{c-\alpha-\delta_A\delta_B(l-\alpha)} \end{cases}$$

$$\begin{cases} x_A^* = \dfrac{(1-\delta_A)\delta_B\beta F_a - (1-\delta_B)(c-\alpha)F_b + \delta_B\beta[c-l-(1-\delta_A)r]S}{[c-\alpha-\delta_A\delta_B(l-\alpha)]\beta} \\ x_B^* = \dfrac{(1-\delta_A)\beta F_a - \delta_A(1-\delta_B)(l-\alpha)F_b + \beta[c-l-(1-\delta_A)r]S}{[c-\alpha-\delta_A\delta_B(l-\alpha)]\beta} \end{cases}$$

because $V_A^* \geq F_a - (r+l-\alpha)S$ and $\delta_A V_A^* \leq F_a - (r+l-\alpha)S$, then $T_1 \leq S \leq T_2$

When $S > K$, we find that the bargaining outcomes are identical to those in the situation when $T_2 \leq S \leq T_3$. Thus, the equilibrium offer and the private value that is captured in equilibrium can be integrated into the equations in Table A-1.

Because the Pareto frontier in our model is a concave function, this ensures the existence of a SPE. Further, the set of maximizers of $V_i(x_i)$ subject to $V_j(x_i) = \delta_j V_j^*$ $(j \neq i)$ contains a unique element. Therefore, the pair of strategies proposed in the model solution is the unique SPE of the model (Theorem 3.2 in Muthoo (1999: 63)).

We further verify that,

$$\begin{cases} \lim\limits_{S\to T_1^-} x_A^* = \lim\limits_{S\to T_1^+} x_A^* = T_1 \\ \lim\limits_{S\to T_2^-} x_A^* = \lim\limits_{S\to T_2^+} x_A^* \end{cases}, \begin{cases} \lim\limits_{S\to T_1^-} x_B^* = \lim\limits_{S\to T_1^+} x_B^* \\ \lim\limits_{S\to T_2^-} x_B^* = \lim\limits_{S\to T_2^+} x_B^* = T_2 \end{cases}, \begin{cases} \lim\limits_{S\to T_1^-} V_A^* = \lim\limits_{S\to T_1^+} V_A^* \\ \lim\limits_{S\to T_2^-} V_A^* = \lim\limits_{S\to T_2^+} V_A^* \end{cases}, \begin{cases} \lim\limits_{S\to T_1^-} V_B^* = \lim\limits_{S\to T_1^+} V_B^* \\ \lim\limits_{S\to T_2^-} V_B^* = \lim\limits_{S\to T_2^+} V_B^* \end{cases}$$

Therefore, as a function of the size of the investment in slack, the equilibrium offer and the private value captured by each player in equilibrium are continuous at each point of S .

Table A- 1 Model Solution

Slack	**Equilibrium offer**	**Private value captured by each player in equilibrium**
Insufficient $0 \le S < T_1$	$\begin{cases} x_A^* = \dfrac{(1-\delta_A)\delta_B\beta[F_a+(c-r-l)S]-(1-\delta_B)(c-\alpha)F_b}{(1-\delta_A\delta_B)(c-\alpha)\beta} \\ x_B^* = \dfrac{(1-\delta_A)\beta[F_a+(c-r-l)S]-\delta_A(1-\delta_B)(c-\alpha)F_b}{(1-\delta_A\delta_B)(c-\alpha)\beta} \end{cases}$	$\begin{cases} V_A^* = \dfrac{(1-\delta_B)[F_a+(c-r-l)S+\dfrac{c-\alpha}{\beta}F_b]}{1-\delta_A\delta_B} \\ V_B^* = \dfrac{(1-\delta_A)[\dfrac{\beta}{c-\alpha}(F_a+(c-r-l)S)+F_b]}{1-\delta_A\delta_B} \end{cases}$
Conditional $T_1 \le S \le T_2$	$\begin{cases} x_A^* = \dfrac{(1-\delta_A)\delta_B\beta F_a-(1-\delta_B)(c-\alpha)F_b}{[c-\alpha-\delta_A\delta_B(l-\alpha)]\beta} \\ \quad + \dfrac{\delta_B\beta[c-l-(1-\delta_A)r]S}{[c-\alpha-\delta_A\delta_B(l-\alpha)]\beta} \\ x_B^* = \dfrac{(1-\delta_A)\beta F_a-\delta_A(1-\delta_B)(l-\alpha)F_b}{[c-\alpha-\delta_A\delta_B(l-\alpha)]\beta} \\ \quad + \dfrac{\beta[c-l-(1-\delta_A)r]S}{[c-\alpha-\delta_A\delta_B(l-\alpha)]\beta} \end{cases}$	$\begin{cases} V_A^* = \dfrac{[c-\alpha-\delta_B(l-\alpha)]\beta F_a+(1-\delta_B)(c-\alpha)(l-\alpha)F_b}{[c-\alpha-\delta_A\delta_B(l-\alpha)]\beta} \\ \quad - \dfrac{\beta[r(c-\alpha)+\delta_B(l-\alpha)(c-r-l)]S}{[c-\alpha-\delta_A\delta_B(l-\alpha)]\beta} \\ V_B^* = \dfrac{(1-\delta_A)\beta F_a+[c-\alpha-\delta_A(l-\alpha)]F_b+\beta[c-(1-\delta_A)r-l]S}{c-\alpha-\delta_A\delta_B(l-\alpha)} \end{cases}$
Excessive $T_2 < S \le T_3$	$\begin{cases} x_A^* = \dfrac{(1-\delta_A)\delta_B\beta(F_a-rS)-(1-\delta_B)(l-\alpha)F_b}{(1-\delta_A\delta_B)(l-\alpha)\beta} \\ x_B^* = \dfrac{(1-\delta_A)\beta(F_a-rS)-\delta_A(1-\delta_B)(l-\alpha)F_b}{(1-\delta_A\delta_B)(l-\alpha)\beta} \end{cases}$	$\begin{cases} V_A^* = \dfrac{(1-\delta_B)[F_a-rS+\dfrac{l-\alpha}{\beta}F_b]}{1-\delta_A\delta_B} \\ V_B^* = \dfrac{(1-\delta_A)[\dfrac{\beta}{l-\alpha}(F_a-rS)+F_b]}{1-\delta_A\delta_B} \end{cases}$

Notes: $T_1 = \dfrac{(1-\delta_A)\delta_B F_a - \dfrac{(1-\delta_B)(c-\alpha)}{\beta}F_b}{(1-\delta_A)\delta_B(r+l)-(1-\delta_A\delta_B)\alpha+(1-\delta_B)c}$, $T_2 = \dfrac{(1-\delta_A)F_a - \dfrac{\delta_A(1-\delta_B)(l-\alpha)}{\beta}F_b}{(1-\delta_A)r+(1-\delta_A\delta_B)(l-\alpha)}$, $T_3 = \dfrac{F_a}{r} - \dfrac{(1-\delta_B)(l-\alpha)F_b}{(1-\delta_A)\delta_B\beta r}$

A3 Effects of Slack on the Co-creation and Capture of Social Value

A3.1 Social Value Co-creation

The value that each player captures in equilibrium is piecewise continuous with respect to the amount of slack. Hereby, we reveal the effects of slack on the co-creation and distribution of value by conducting comparative static analysis. We first analyze the effects of slack on each player's private value and then aggregate the impacts on the social value.

When $0 \le S < T_1$, because $c > r + l > \alpha$, $\begin{cases} \dfrac{\partial V_A^*}{\partial S} = \dfrac{(1-\delta_B)(c-r-l)}{1-\delta_A\delta_B} > 0 \\ \dfrac{\partial V_B^*}{\partial S} = \dfrac{(1-\delta_A)\beta(c-r-l)}{(1-\delta_A\delta_B)(c-\alpha)} > 0 \end{cases}$

When $T_1 \le S \le T_2$, $\begin{cases} \dfrac{\partial V_A^*}{\partial S} = -\dfrac{r(c-\alpha)+\delta_B(l-\alpha)(c-r-l)}{c-\alpha-\delta_A\delta_B(l-\alpha)} < 0 \\ \dfrac{\partial V_B^*}{\partial S} = \dfrac{\beta[c-(1-\delta_A)r-l]}{c-\alpha-\delta_A\delta_B(l-\alpha)} > 0 \end{cases}$

When $T_2 < S \le T_3$, $\begin{cases} \dfrac{\partial V_A^*}{\partial S} = -\dfrac{(1-\delta_B)r}{1-\delta_A\delta_B} < 0 \\ \dfrac{\partial V_B^*}{\partial S} = -\dfrac{(1-\delta_A)\beta r}{(1-\delta_A\delta_B)(l-\alpha)} < 0 \end{cases}$

Hence, the private value that is captured by the capital provider increases as slack increases to a lower threshold T_1. But after the inflection point T_1, the costs of building and mobilizing slack that are incurred by the capital provider start to outweigh the benefits that are accrued. For the stakeholder, the value captured after reaching a compromise increases as slack increases up to a higher threshold T_2 after which further increases in slack decrease the stakeholder's value. After T_2, both players have nothing to gain if slack increases further.

These curvilinear relationships hold whether the last offer to be accepted is made by the capital provider or by the stakeholder. When the capital provider accepts the offer made by the stakeholder, the value captured by the capital provider is $V_A(x_B^*)$, which equals to the discounted value when the last offer was made by the capital provider, i.e. $V_A(x_B^*) = \delta_A V_A^*$. Similarly, $V_B(x_A^*) = \delta_B V_B^*$. Discounting the slope of the curves by δ_A or δ_B does not change the curvilinear relationships. Henceforth, we illustrate the exposition with the situation by which the last offer to be accepted was made by the capital provider, but the logic extends if the last offer would have been made by the stakeholder.

Recall that social value is defined as the sum of the value captured by the capital provider plus the value captured by the stakeholder. Other things being equal, when slack increases up to T_1, both players' value increase and social value increases too. Between T_1 and T_2, the capital provider's value starts decreasing while the stakeholder's value continues to increase. Hence, the social value increases if the rate of change of the stakeholder's value is greater than that of the capital provider, otherwise the social value decreases. After T_2, both players' value decrease, so the social value decreases too. Hence, based on the rate of change of the value captured by each player, either T_1 or T_2 maximize the social value.

For T_1 to maximize the social value, the following condition holds,

$$\frac{r(c-\alpha)+\delta_B(l-\alpha)(c-r-l)}{c-\alpha-\delta_A\delta_B(l-\alpha)} > \frac{\beta\delta_B[c-(1-\delta_A)r-l]}{c-\alpha-\delta_A\delta_B(l-\alpha)}$$

This leads to $\beta < \frac{r(c-\alpha)+\delta_B(l-\alpha)(c-r-l)}{[c-(1-\delta_A)r-l]\delta_B} \equiv M$, which means that the decrease in the capital provider's value outweighs the increase of the stakeholder's value. As a result, T_1 maximizes social value. In contrast, when $\beta > M$, the increase of the stakeholder's value outweighs the decrease in the capital provider's value, and so T_2 maximizes social value. Because T_1 maximizes the capital provider's value, it is not in the capital provider's interest to build more slack than T_1, although it benefits the stakeholder. Therefore, to maximize the social value, the capital provider must sacrifice private value against gains in social value.

Because $\frac{\partial M}{\partial \alpha} = -\frac{r+\delta_B(c-r-l)}{[c-(1-\delta_A)r-l]\delta_B} < 0$, increases in the benefits accrued by the capital provider from compromising decrease this threshold, which makes it more likely for β to exceed the threshold.

Obviously $\frac{\partial T_1}{\partial a} > 0$, $\frac{\partial T_1}{\partial \beta} > 0$, $\frac{\partial T_2}{\partial a} > 0$ and $\frac{\partial T_2}{\partial \beta} > 0$. Therefore, the higher the private benefits the higher the point at which slack maximizes the capital provider's private value ($T_1^* > T_1$) and maximizes the stakeholder' s private value ($T_2^* > T_2$).

A3.2 Costs of Running Out of Slack

We show that the costs of running out of slack vary with who made the accepted offer. If the equilibrium offer was made by the capital provider, since $x_A^*\big|_{s=T_1} = T_1$, up to the point T_1 (or T_1^* in the case of high benefits), the cost of running out of slack is $c(x_A^* - S)$. After T_1, slack is able to fill the shortfall, and thus the capital provider incurs no costs for running

out of slack. If the stakeholder made the accepted offer, since $x_B^*\big|_{s=T_2} = T_2$, up to the point T_2 (or T_2^* in the case of high benefits), the cost of running out of slack is $c(x_B^* - S)$. After T_2, a compromise can be reached without running out of slack, and thus the capital provider incurs no costs for running out of slack.

A4 Effects of the Variation in the Cost of Building Slack

The relationship between slack and the creation of social value is contingent on the cost of building slack. By conducting comparative static analysis, we derive the first order partial derivative of the equilibrium offer and value with regards to the cost of building slack.

When $0 \le S < T_1$, $\begin{cases} \dfrac{\partial V_A^*}{\partial r} = -\dfrac{(1-\delta_B)S}{1-\delta_A\delta_B} < 0 \\ \dfrac{\partial V_B^*}{\partial r} = -\dfrac{(1-\delta_A)\dfrac{\beta}{c-\alpha}S}{1-\delta_A\delta_B} < 0 \end{cases}$

When $T_1 \le S < T_2$, $\begin{cases} \dfrac{\partial V_A^*}{\partial r} = -\dfrac{\beta[(c-\alpha)-\delta_B(l-\alpha)]S}{[c-\alpha-\delta_A\delta_B(l-\alpha)]\beta} < 0 \\ \dfrac{\partial V_B^*}{\partial r} = -\dfrac{(1-\delta_A)\beta S}{c-\alpha-\delta_A\delta_B(l-\alpha)} < 0 \end{cases}$

When $T_2 \le S \le T_3$, $\begin{cases} \dfrac{\partial V_A^*}{\partial r} = -\dfrac{(1-\delta_B)S}{1-\delta_A\delta_B} < 0 \\ \dfrac{\partial V_B^*}{\partial r} = -\dfrac{(1-\delta_A)\dfrac{\beta}{l-\alpha}S}{1-\delta_A\delta_B} < 0 \end{cases}$

The negative sign of these derivatives suggests that as the cost of building slack is low, the value captured by each player and the aggregated total value increase. Vice versa, if the cost of building slack is high, the value to be created and captured by each player decreases. Meanwhile,

$$\frac{\partial T_1}{\partial r} = -\frac{(1-\delta_A)\delta_B\left[(1-\delta_A)\delta_B F_a - \dfrac{(1-\delta_B)(c-\alpha)}{\beta}F_b\right]}{\left[(1-\delta_A)\delta_B(r+l)-(1-\delta_A\delta_B)\alpha+(1-\delta_B)c\right]^2} < 0$$

$$\frac{\partial T_2}{\partial r} = -\frac{(1-\delta_A)\left[(1-\delta_A)F_a - \dfrac{\delta_A(1-\delta_B)(l-\alpha)}{\beta}F_b\right]}{\left[(1-\delta_A)r+(1-\delta_A\delta_B)(l-\alpha)\right]^2} < 0$$

Further, the negative sign of the derivative suggests that as slack gets cheaper, the points at which slack maximizes private value and social value increase and more so the higher the private benefits to be derived from compromising.

A5 The Effects of Slack on the Zone for Compromise

For any given amount of slack, the equilibrium offer x_A^* is the lowest concession by the capital provider that the stakeholder could accept, and x_B^* is the highest possible concession from the capital provider. Obviously, $x_B^* > x_A^*$. We denote G as the space between x_A^* and x_B^* for any given amount of slack. The range of the interval (Z) equals to $x_B^* - x_A^*$. A fully rational player would always follow the strategy which is illustrated in the model solution. But a bounded rational player is more likely not to make the equilibrium offer, and instead make an offer x within G ($x_A^* < x < x_B^*$), which would be accepted immediately because this offer distributes more value to the recipient of the offer ($V_A(x) > V_A(x_B^*)$ or $V_B(x) > V_B(x_A^*)$). For the proposer, because $V_A(x) > V_A(x_B^*) > \delta_A V_A(x_B^*)$ and $V_B(x) > V_B(x_A^*) > \delta_B V_B(x_A^*)$, the value captured by the proposer ($V_A(x)$ or $V_B(x)$) is greater than the value that could be captured if entering into the next run of bargaining ($\delta_A V_A(x_B^*)$ or $\delta_B V_B(x_A^*)$). Thus, although the off-equilibrium offer x within G does not maximize the proposer's private value, it is still satisfactory because it is better than entering into another run of counteroffers with the recipient. So, offers with G represent the zone of permissible concessions.

When $0 \le S < T_1$, because $c > r + l > \alpha$, $\begin{cases} \dfrac{\partial x_A^*}{\partial S} = \dfrac{(1-\delta_A)\delta_B(c-r-l)}{(1-\delta_A\delta_B)(c-\alpha)} > 0 \\ \dfrac{\partial x_B^*}{\partial S} = \dfrac{(1-\delta_A)(c-r-l)}{(1-\delta_A\delta_B)(c-\alpha)} > 0 \end{cases}$

$$\frac{\partial Z}{\partial S} = \frac{(1-\delta_A)(1-\delta_B)(c-r-l)}{(1-\delta_A\delta_B)(c-\alpha)} > 0$$

Because $x_A^*\big|_{s=T_1} = T_1$, a compromise can be reached even if slack is insufficient to fill the shortfall, and any additional investment in slack widens the zone for compromise.

When $T_1 \le S \le T_2$, $\begin{cases} \dfrac{\partial x_A^*}{\partial S} = \dfrac{\delta_B[c-l-(1-\delta_A)r]}{[c-\alpha-\delta_A\delta_B(l-\alpha)]} > 0 \\ \dfrac{\partial x_B^*}{\partial S} = \dfrac{c-l-(1-\delta_A)r}{c-\alpha-\delta_A\delta_B(l-\alpha)} > 0 \end{cases}$

$$\frac{\partial Z}{\partial S} = \frac{(1-\delta_B)[c-l-(1-\delta_A)r]}{c-\alpha-\delta_A\delta_B(l-\alpha)} > \frac{(1-\delta_A)(1-\delta_B)(c-r-l)}{(1-\delta_A\delta_B)(c-\alpha)} > 0$$

When the amount of slack is T_2, $x_B^*\big|_{s=T_2} = T_2$. Within this range, a compromise can be reached with or without running out of slack, depending on who made the last offer to be accepted. Moreover, increases in slack would keep widening the zone for compromise.

When $T_2 < S \le T_3$, $\begin{cases} \dfrac{\partial x_A^*}{\partial S} = -\dfrac{(1-\delta_A)\delta_B r}{(1-\delta_A\delta_B)(l-\alpha)} < 0 \\ \dfrac{\partial x_B^*}{\partial S} = -\dfrac{(1-\delta_A)r}{(1-\delta_A\delta_B)(l-\alpha)} < 0 \end{cases}$, $\dfrac{\partial Z}{\partial S} = -\dfrac{(1-\delta_A)(1-\delta_B)r}{(1-\delta_A\delta_B)(l-\alpha)} < 0$

Above the point T_2, more investment in slack leads to a decrease in the equilibrium offer and shrinks the zone for compromise as well, making it more difficult to strike a compromise. Because $x_A^*\big|_{s=T_3} = 0$, above T_3, the presence of slack rules out a compromise.

So, additional investment in slack - up to the point when slack maximizes the stakeholder's private value – widens the zone for compromise. After this point, an additional investment in slack has a detrimental impact to the search for a mutually consensual solution.

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APPENDIX B

Table B- 1 List of Cross-border Gas Pipelines

No.	Gas Pipeline	Crossing territories	Current status	Organizational structure	Category
1	Minsk-Vilnius-Kaunas-Kaliningrad Gas Pipeline	Russia, Lithuania, Belarus	In operation	Single firm	1
2	TurkStream	Russia, The Black Sea, Turkey	In implementation	Single firm	1
3	Iran-Pakistan-India Gas Pipeline[67]	Iran, Pakistan, India	In partial operation	Single firm within each border, buyer-supplier relations across borders	2
4	Korpeje-Kordkuy Pipeline	Turkmenistan, Iran	In operation	Single firm within each border, buyer-supplier relations across borders	2
5	Tabriz-Ankara Pipeline	Iran, Turkey	In operation	Single firm within each border, buyer-supplier relations across borders	2
6	Iran-Armenia Gas Pipeline	Iran, Armenia	In operation	Single firm within each border, buyer-supplier relations across borders	2
7	Arad-Szeged Gas Pipeline	Hungary, Romania	In operation	Single firm within each border, buyer-supplier relations across borders	2
8	The Slovak-Hungarian Gas Interconnector	Slovak, Hungary	In operation	Single firm within each border, buyer-supplier relations across borders	2
9	Iran-Iraq-Syria Pipeline	Iran, Iraq, Syria	In planning, stalled	Single firm within each border, buyer-supplier relations across borders	2
10	Russia-China Gas Pipeline	Russia, China	In implementation	Single firm within each border, buyer-supplier relations across borders	2

[67] After India's withdraw in 2009, the pipeline is later known as Iran-Pakistan Gas Pipeline.

No.	Gas Pipeline	Crossing territories	Current status	Organizational structure	Category
11	Bulgaria-Romania-Hungary-Austria Natural Gas Transmission Corridor	Bulgaria, Romania, Hungary, Austria	Partly in implementation. The Hungarian section is suspended.	Single firm within each border, buyer-supplier relations across borders	2
12	Gas Interconnection Poland-Lithuania	Poland, Lithuania	In implementation	Single firm within each border, buyer-supplier relations across borders	2
13	Baltic Pipe Project	Denmark, Poland	In implementation	Single firm within each border, buyer-supplier relations across borders	2
14	Baltic Connector	Estonia, Finland	In implementation	Single firm within each border, buyer-supplier relations across borders	2
15	Poland-Slovakia Gas Interconnection	Poland, Slovakia	In implementation	Single firm within each border, buyer-supplier relations across borders	2
16	Gas Interconnection Bulgaria-Serbia Pipeline	Bulgaria, Serbia	In planning	Single firm within each border, buyer-supplier relations across borders	2
17	The GasAndes Gas Pipeline	Argentina, Chile	In operation	Alliance (JV/consortium)	3
18	Interconnector (North Sea)	UK, Belgium	In operation	Alliance (JV/consortium)	3
19	Maritimes and Northeast Pipeline	Canada, USA	In operation	Alliance (JV/consortium)	3
20	Dolphin Gas Pipeline	Qatar, The Persian Gulf, UAE	In operation	Alliance (JV/consortium)	3
21	West African Gas Pipeline	Nigeria, Benin, Togo, Ghana	In operation	Alliance (JV/consortium)	3
22	Trans Thailand Malaysia Gas Pipeline	Thailand, Malaysia	In operation	Alliance (JV/consortium)	3
23	Nord Stream	Russia, The Baltic Sea, Germany	In operation	Alliance (JV/consortium)	3
24	Medgaz Pipeline	Algeria, Spain	In operation	Alliance (JV/consortium)	3

No.	Gas Pipeline	Crossing territories	Current status	Organizational structure	Category
25	South Caucasus Pipeline	Azerbaijan, Georgia	In operation	Alliance (JV/consortium)	3
26	Langeled Pipeline	Norway, UK	In operation	Alliance (JV/consortium)	3
27	Arish-Ashkelon Pipeline	Egypt, Israel	Ceased operation since 2012	Alliance (JV/consortium)	3
28	BBL Pipeline	Netherlands, UK	In operation	Alliance (JV/consortium)	3
29	Trans Adriatic Pipeline	Greece, Albania, Italy	In implementation	Alliance (JV/consortium)	3
30	Algeria Sardinia Italy Gas Pipeline	Algeria, Italy	Proposed, but most likely to be canceled	Alliance (JV/consortium)	3
31	Skanled Gas Pipeline	Norway, Sweden, Denmark	Canceled in 2009	Alliance (JV/consortium)	3
32	Trans-Saharan Gas Pipeline	Nigeria, Niger, Algeria	Proposed but delayed	Alliance (JV/consortium)	3
33	White Stream	George, Romania, Ukraine	In planning but with unclear future	Alliance (JV/consortium)	3
34	Nabucco Pipeline	Turkey, Bulgaria, Romania, Hungary, Austria	In implementation but with unclear future	Alliance (JV/consortium)	3
35	Gas Interconnector Greece-Bulgaria	Greece, Bulgaria	In implementation	Alliance (JV/consortium)	3
36	Turkmenistan-Afghanistan-Pakistan-India Pipeline	Turkmenistan, Afghanistan, Pakistan, India	Partly in implementation; long-delayed	Alliance (JV/consortium)	3
37	Tauern Gas Pipeline	Germany, Austria, Italy	In operation	Alliance (JV/consortium)	3
38	Nord Stream 2	Russia, The Baltic Sea, Germany	In planning	Alliance (JV/consortium)	3

No.	Gas Pipeline	Crossing territories	Current status	Organizational structure	Category
40	Bolivia-Brazil Gas Pipeline	Bolivia, Brazil	In operation	Systems integrator. GasPetro and BTB formed multiple strategic alliances with local actors.	4
41	Alliance Pipeline System	Canada, USA	In operation	Systems integrator. Same shareholders across two legally independent consortia.	4
42	Paraná-Uruguaiana Pipeline	Argentina, Brazil	In operation	Systems integrator. Two legally independent consortia, one for each country. Techint is present in both consortia.	4
50	Sino-Myanmar pipelines	Burma, China	In operation	Systems integrator. CNPC formed strategic alliance with local actors in the section outside China. Mirroring within Chinese border.	4
43	Trans-Mediterranean Natural Gas Pipeline	Algeria, Tunisia, Italy	In operation	Permutation. ENI formed multiple strategic alliances with local actors. Mirroring within Algerian and Italian onshore sections.	5
44	Maghreb-Europe Natural Gas Pipeline	Algeria, Morocco, Spain, Portugal	In operation	Permutation. Engas formed multiple strategic alliances with local actors. Mirroring within Algerian border.	5
45	Yamal–Europe Natural Gas Pipeline	Russia, Belarus, Poland, Germany	In operation	Permutation. Gazprom formed multiple strategic alliances with local actors. Mirroring with Russian and Belarusian borders.	5
46	Blue Stream	Russia, The Black Sea, Turkey	In operation	Permutation. Gazprom formed multiple strategic alliances with local actors. Mirroring with	5

No.	Gas Pipeline	Crossing territories	Current status	Organizational structure	Category
				Russian and Turkish borders.	
47	Arab Gas Pipeline	Egypt, Jordan, Syria, Lebanon	Partly in operation. Interruptions in the operation due to military attacks and supply shortage.	Permutation. Two legally independent consortia, one for each country. EGAS, GASCO, ENPPI and PETROJET are present in both consortia.	5
48	Interconnection Turkey Greece Italy Pipeline	Turkey, Greece, Italy	In operation	Permutation. DEPA is present in two consortia.	5
49	South Stream	Russia, Bulgaria, Serbia, Hungary, Slovenia, Austria	Canceled in December 2014	Permutation. Gazprom formed multiple strategic alliances with local actors. Mirroring within Russian border.	5
50	Turkmenistan-China Gas Pipeline (Line A/B)	Turkmenistan, Uzbekistan, Kazakhstan, China	In operation	Permutation. CNPC formed multiple strategic alliances with local actors. Mirroring within Turkmen and Chinese border.	5
51	Turkmenistan-China Gas Pipeline (Line C)	Turkmenistan, Uzbekistan, Kazakhstan, China	In operation	Permutation. CNPC formed multiple strategic alliances with local actors. Mirroring within Turkmen and Chinese border.	5
52	Turkmenistan-China Gas Pipeline (Line D)	Turkmenistan, Uzbekistan, Tajikistan, Kyrgyzstan, China	In implementation	Permutation. CNPC formed multiple strategic alliances with local actors. Mirroring within Turkmen, Kyrgyz, and Chinese border.	5

APPENDIX C

A CASE STUDY OF THE TURKMENISTAN-CHINA GAS PIPELINE

The Turkmenistan-China Gas Pipeline Project (TCGP) is but one illustration as to why and how pipeline organizations partially break the mirror. TCGP was China's first major effort to build an alternative to the maritime supply of LNG to Chinese markets. The 1,833km pipeline transports gas from gas fields in Turkmenistan, and runs across Uzbekistan and Kazakhstan before crossing the border with China where it connects to the China's domestic network. The pipeline development goes back to 2007 when the China National Petroleum Company (CNPC) and Turkmenistan's state-owned energy major Natural Gas Konzern (NGK), signed a Gas Purchase and Sale Agreement and Gas Production Sharing Contract. The two deals committed Turkmenistan to export gas each year to China for 30 years, starting in 2010. With no historical data to serve as a guide, the two parties agreed to deliver the pipeline in two and a half years, and with a forecast cost of $7.31bn (cash prices).[68] One year after the initial agreement, the scope evolved to two slightly narrower pipelines to open respectively by the end of 2009 and 2010. The cost forecast then rose to $9.9bn (cash prices) – $3.6bn for Line A and $6.3bn for Line B.[69] The focus of the analysis is on the choices to organize the cross-border pipeline development made by TAPLINE, a subsidiary of CNPC which was set up in 2007.

Data Collection

Data collection was part of an independent research program to further our understanding of how Chinese firms organize megaprojects in emerging markets. This research program is in collaboration with the Belt and Road Initiative Research Center at Tianjin University, where the author of this Ph.D. thesis did his master study. In May 2012, we gained access to the top management and technical staff of TAPLINE. Between 2012 and 2018, the author of this Ph.D. thesis conducted 18 interviews and 3 focus groups, visited the TAPLINE headquarter (Beijing) 8 times and the pipeline field in Kazakhstan 1 time, and gathered extensive archival information. Specifically, four sources of data were used: 1) semi-structured interviews, 2) focus group, 3) archival documents on TCGP, and 4) information gathered on the specialized press. The respondents were identified by using a 'snowball sampling technique' in which we asked the respondent to suggest other people to

[68] Source: 1) CNPC document, December 2007; 2) CNPC News (news.cnpc.com.cn). 2008. The first batch of equipment of Central Asia Pipeline 'steps' on a new journey, 6 May.

[69] CNPC document, May 2010.

talk to (Biernacki & Waldorf, 1981). Respondents included staff working at different functions and hierarchical levels in TAPLINE, local partners, Chinese government officials, and external consultants hired by TAPLINE. We collected both real-time and retrospective data, a practice useful to mitigate retrospective bias (Langley, 1999). In total, we conducted and tape-recorded 55 interviews. We also had access to verbatim transcripts of 22 focus groups organized by each of which lasted up to two and a half hour long. The focus of each focus group varied significantly, but the transcripts offered extensive complementary opinions and beliefs on the strategic choices for TCGP. Finally, we conducted follow-up interviews to probe deeper into particular issues, double check a verbal account, and bridge gaps in the database. We always offered to make the quotes anonymous to avoid potential bias (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003) and the respondents were anonymously coded.

We also collected thousands of pages of archival documents, including strategy and planning documents, self-evaluation reports, meeting minutes, progress reports, and presentations. In addition, we collected information about TCGP from specialized media such as China Petroleum News and the Hydrocarbon Technology database. We played interview data against the analysis of archival and external documents to verify the accuracy of our findings. Table C-1 summarizes the organizational structure of TCGP and data sources.

Table C- 1 Description of the Units of Analysis, Interviews, and Archival Database

Unit	TAPLINE	ATG	AGP	CNPCI
Organizational role	Systems integrator, coordinating multiple alliances; fully owned by CNPC	Member of 50-50 JV with TAPLINE to develop and operate the 529 km Uzbekistan section	Member of 50-50 JV with TAPLINE to develop and operate the 1,304 km Kazakhstan section	Gas producer fully owned by CNPC under a contract with a Turkmen's state-owned firm NGK
Base country	China	Uzbekistan	Kazakhstan	Turkmenistan
Semi-structured interviews	Executive manager: 5 Department manager: 7 Staff: 2 In total: 14	Executive manager: 7 Department manager: 6 Staff: 2 In total: 15	Executive manager: 4 Department manager:14 Staff: 5 In total: 23	Executive manager: 1 Department manager: 1 Staff: 1 In total: 3
Focus group	9	8	5	0
Archival document (News articles in the press not counted)	Strategy and planning document: 145 Self-evaluation report: 9 Formal communication: 765 Meeting minutes: 49	Strategy and planning document: 73 Self-evaluation report: 4 Formal communication: 465 Meeting minutes: 32	Strategy and planning document: 65 Self-evaluation report: 5 Formal communication: 563 Meeting minutes: 54	Strategy and planning document: 3 Self-evaluation report: 1 Formal communication: 17 Meeting minutes: 12

	Newsletter: 7 Contract document: 45 PowerPoint slides: 12 In total: 1,032	Newsletter: 42 Contract document: 38 PowerPoint slides: 5 In total: 659	Newsletter: 24 Contract document: 42 PowerPoint slides: 8 In total: 761	Newsletter: 3 Contract document: 2 PowerPoint slides: 1 In total: 39

Our aim was to produce a detailed factual and chronological account of the organizational choices made to develop the pipeline. We followed the coding scheme from Khanna, Palepu, and Sinha (2005) on institutional voids to make sense of our data on the institutional environment. We used data from internal and external documents to triangulate interview data. We also developed a detailed account in a Harvard-style teaching case study which we shared with key respondents to get feedback on its accuracy.

Impacts of Institutional and Historical Borders

A distinctive feature of TCGP is that it crosses three emerging markets – Turkmenistan, Uzbekistan, and Kazakhstan – all of which were former Soviet republics, before reaching the border with China. These emerging markets are all characterized by institutional voids which are known to hamper the functioning of markets. The World Bank Group's 'Ease of Doing Business' index is telling.[70] Kazakhstan was ranked 36 in 2018, while Uzbekistan ranked 74. In terms of trading across borders, Kazakhstan was ranked 123, while Uzbekistan ranked 168. Rankings of Turkmenistan were not available due to lack of access to relevant data which is nonetheless an indicator of underdeveloped market in Turkmenistan. Table C-2 summarizes salient institutional shortcomings based on the conceptual framework developed by Khanna et al. (2005).

[70] Economies are ranked on their ease of doing business in ten aspects such as starting a business, dealing with construction permits, getting credit, trading across borders, and enforcing contracts. A high ranking means the institutional environment is more conducive to the starting and operation of a local firm. The World Bank Group. Doing Business.

Table C- 2 Summary of Institutional Voids in the Three Countries Crossed by TCGP and Illustrative Quotes

Environmental Attribute	Institutional Voids	Illustrative Quotes		
		Uzbekistan	**Kazakhstan**	**Turkmenistan**
Political, Social, and Economic System	Highly centralized state Ineffectiveness of the country's bureaucrats Ineffectiveness of legislative, executive, and judiciary systems Poor contract enforcing mechanisms Underdeveloped economic system Restrictions on foreign investment	*The project must apply for the presidential decree after finishing the pre-feasibility study.* *Changes in one influential politician's mind would result into significant changes in the legal system.* *After the dissolution of Soviet Union, Uzbekistan is quite conservative and not open enough. There has been little cooperation with foreign investors, and they are always afraid of being at the short end of the stick.*	*Changes in the legal system of Kazakhstan were frequent. A law can be introduced in just a few days, which creates huge uncertainty for the project.* *It's clearly stated in the law that foreign investors cannot take over 50% of the equity of a JV in the oil and gas sector.* *Kazakhstan is rich in oil resources. After the independence in the 1990s, Kazakhstan was the first Central Asian country that opened to the West and started to cooperate with China.*	*Turkmenistan's economy depends heavily on the production and export of natural gas, oil, petrochemicals.* *Foreign companies were not allowed to participate in the exploration and development of their gas blocks.*
Capital Market	Difficulties in getting credit, project financing Restrictions on foreign exchange	*Uzbekistan was extremely strict about foreign exchange regulation. According to the regulation, 50% of foreign companies' foreign exchange were obliged to be converted to local currency.*	*The estimated cost of the Kazakhstan section was amount to $7.5 billion, and the Uzbekistan section was up to $3.5 billion. Neither the Kazakhstan company or the Uzbekistan company had the financing capability, the financing process was actually driven by CNPC.*	*The inability to convert local money into hard currency for repatriation of profits, dividends, and payment to foreign suppliers.*
Product Market	Difficulties to access to raw materials, components, and equipment of good performance Poor logistics and transportation infrastructures Unreliable supply chain	*They [local contractors] only had manual welding equipment, which was out of date.*	*Most of the pipeline welding equipment was left from the Soviet Union era.*	*We couldn't find many high capacity trucks, only some in the 1920s model.*
Labor Markets	Poor education infrastructure Unqualified workforce Visa constraints on foreign workers	*Local contractor ZM knew nothing about how to do structural calculation of when doing pipeline crossing work.* *Till February 2009, the local contractor had only completed less than 15 km welding work, and even worse, the passing rate of welding work was less than 2% while the passing rate of the Chinese contractors were more than 95%.*	*The joint venture is required to hire 9 local employees for every one Chinese staff member employed in Kazakhstan.* *Kazakhstan was less experienced in delivering megaproject in EPC approach and managing joint ventures with foreign investors. There was no complete project management system there. The management was quite subjective.*	*Turkmen government was unfamiliar with collaboration in the form of a joint venture. Being afraid of in an unfavorable situation, Turkmen government rejected the suggestion of forming a joint venture.*

Heterogeneous Institutional Environment

Prior to independence from the Soviet Union in 1991, the socioeconomic gap between the three former republics was negligible. But after independence, the gap widened because of differences in natural resources, administrative reforms, and politics. Kazakhstan's GDP became higher than the aggregate of the other two.[71] Kazakhstan became a leader in terms of market liberalization. Still in terms of regulation and government effectiveness, the three countries continued to fare poorly on the World Bank's governance indicators which reflect the quality of institutions that govern economic and social interactions (Kaufmann, Kraay, & Mastruzzi, 2009). Still, Kazakhstan had slightly better ratings than the other two countries. For instance, with respect to the regulatory quality indicator which captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit private sector development, Kazakhstan was at 39th percentile in 2007. In turn, Uzbekistan was at the 5th percentile and only 2 countries among over 200 countries ranked worse than Turkmenistan. Again, in terms of the rule of law which captures the quality of contract enforcement and property rights, Kazakhstan was at the 19th percentile in 2007, while Uzbekistan was at the 11th percentile and Turkmenistan at the 3rd percentile. One respondent said of Uzbekistan, for example, "*a highly planned economy, similar to China in the 1980s. It was only in 2005 that the collective farms were dissolved. They are extremely closed*."

Turkmenistan gas reserves accounted for 1.42% of global reserves, ranking them 13th in the world.[72] However, there had been no foreign involvement in the exploration and development of gas field in Turkmenistan before the Petroleum Law (2008) entered into force. The production sharing agreement (PSA) between the Turkmen government and CNPC in the Bagtyyarlyk gas field was the first onshore gas PSA with foreign companies.[73]

In terms of the access to capital markets, none of the three countries had the ability to raise huge amounts of finance, especially in 2008 when the financial crisis swept around the world. The financing department manager of TAPLINE recalled:

Kazakhstan also wanted to lead the project financing by organizing the Kazakh consortium. However, they finally gave up because they didn't have such financing capability. The whole country's foreign exchange reserves were just over $50 billion. The capital markets in Turkmenistan and Uzbekistan were even more underdeveloped.

The product markets too were underdeveloped. In Turkmenistan, construction materials were highly regulated under a planned economy system. As described in Lu and Ji (2015):

[71] Source: World Development Indicators, World Bank.

[72] Source: BP. 2019. BP Statistical review of world energy. London: BP.

[73] Mammadov, O. 2015. Turkmenistan positions itself as Eurasian natural gas power. Oil & Gas Journal, 7 December.

Materials such as bricks, cement, and asphalt were not available in the market, they were only distributed by the government…Local contractors only had old bulldozers with low power. The bulldozers often worked for a couple of hours and then mechanical failure occurred…We couldn't find many high capacity truck, only some 1920s models.

A similar situation occurred Uzbekistan and Kazakhstan as one respondent said:

Local contractors only had manual welding equipment, which was out of date. They didn't even have X-ray examiner which is essential for welding work. Most of the pipeline welding equipment were left from the Soviet Union era.

In addition, the labor markets were underdeveloped across all the three economies. In the eyes of the Chinese managers, there was a severe lack of skilled workforce and management expertise although local partners did not agree. The story of pipeline welding work in Uzbekistan telling. "*The local contractors knew nothing about how to do structural calculation when doing pipeline crossing work*", said one TAPLINE respondent. The situation in Kazakhstan was not much better according to the deputy manager of the technical department:

The engineering industry in Kazakhstan was relatively weak. You might find some qualified worker in electrical engineering, but not in more professional aspects. Occasionally, when they didn't understand how to operate, they would seek help from us [Chinese staff].

Local partners not only lacked skilled workforce but also lacked management skills and norms of cross-firm cooperation. Further, local engineering and construction companies had little experience in international cooperation. Language was another challenge. One respondent said: "*It's hard to find qualified management staff that can speak English fluently, not to mention Chinese.*" Besides the language, local actors lacked understanding of common international project management practices such as Engineering-Procurement-Construction contracts and Project Management Consultancy (PMC). One respondent said: "*Project developers in Uzbekistan had never heard about EPC and PMC. They rejected to hire project management consultants to help better manage the project at the beginning*." Another respondent added: "*At the beginning, we asked the local contractor to introduce their organizational structure, management model, and construction plan, but they basically had no idea what those were*."

The lack of qualified local actors thus made it hard for the TAPLINE to use buyer-supplier relations with local actors to navigate the institutional voids. Still, political leaders and top bureaucrats in Uzbekistan and Kazakhstan favored this structure as they saw more opportunities to develop local capabilities and control assets in their countries. The deputy executive director of Uzbekistan's state oil and gas company argued:

We have the capability to build the whole Uzbekistan section by ourselves. Do you know what's the total length of pipelines with a diameter over 1,000 mm in Uzbekistan? 33,000 km! More than the total length in China. We also built more than 130,000 km pipelines with a diameter between 256 mm and 1,000 mm. We are totally capable of building a 500 km new pipeline.

Yet, executives of TAPLINE were not fully convinced that they could trust their partners to get on with the job. Uzbekistan had a large pipeline network, but it had all been built in the Soviet Union period and did not reflect their current local technical, financial, and managerial capabilities. The managing director said:

It is a fact that Uzbekistan has very intense pipeline network linking to Russia and built more pipeline than China. But those are all very old pipelines built in the Soviet period. It doesn't reflect their current capability. We did research and found out that they still rely on the manual welding technique. They would not be able to deliver the project on schedule.

Given that TCGP was of significant strategic importance for China, TAPLINE did not want to incur any risks of delays were it to enter into buyer-supplier arrangements with local actors, and thus ruled out this organizational choice.

History of Cross-border Conflicts

Whilst there was no significant history of conflict between China and the three emerging economies, there were reasons to expect some level of conflict in that Central Asia was a political zone in its infancy that lacked a regional governance structure to resolve cross-border conflicts. Complicating matters, the three Central Asian countries are multi-ethnic countries with a complex ethnic structure. There was thus a perception among TAPLINE managers that local conflicts for example about natural resources and trade could become an obstacle were TAPLINE to try to set up a single consortium for the whole pipeline. One assessment report said:

The relations among the Central Asian countries were relatively tense for a variety of reasons including ethnic conflicts, territory disputes, conflicts on water resources, etc. Seldom did they cooperate with each other. The historical and cultural differences in Central Asian countries had also led to different ways for all parties to understand and handle related business issues, resulting in various disputes.

One event in the early negotiations illustrates this perception. Initially, as a transit country, Kazakhstan had the intention to get a transit fee in kind so as to lift gas from the pipeline at a lower cost to meet its domestic need for gas in the west region. Further, by using gas from TCGP, Kazakhstan could sell its own gas to the European markets. Turkmenistan outrightly refused this proposal and threatened to withdraw from the project. "*They [Turkmenistan] would terminate the gas sales contract if we [China] allowed Kazakhstan to download gas during transmission… It's basically impossible to persuade them sit around a table to negotiate….*", the managing director said. Therefore, forming an overarching alliance did not seem to be a wise choice given the fixed deadline to complete the project.

Partial Mirroring: Systems Integrator

The choice to organize the project consisted of setting up three legally independent entities with TAPLINE taking the role of systems integrator, and thus being a member of all the entities, as illustrated in Figure C-1.

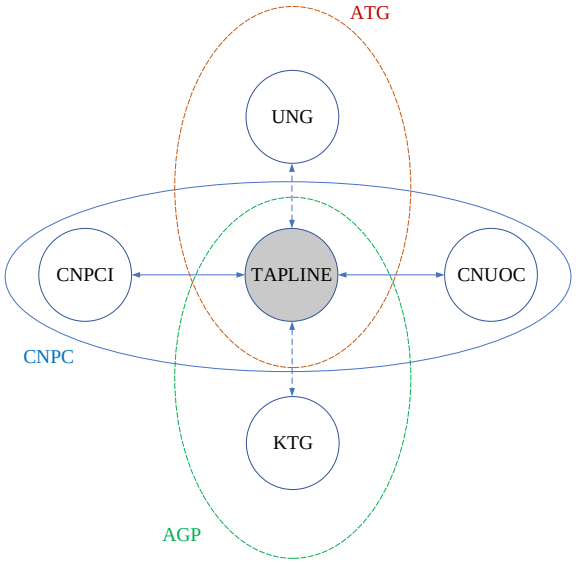

Figure C- 1 A Nearly Decomposable Organizational Structure

Turkmenistan was the first country to buy into this idea. To this purpose, the state passed legislation to allow foreign companies to participate in the exploration and development of gas blocks. But the stated ruled out the idea of entering into an alliance with Turkmenistan's state-owned gas company, letting instead CNPC set up a subsidiary to explore and develop the gas blocks in 2007 – the CNPC International (CNPCI). It became the job of this subsidiary to explore and develop the gas blocks, build a gas processing plant, build the 86km-long Turkmen pipeline and then sell the pre-agreed amount of gas to CNPC.

At the same time, CNPC sought an agreement with the Uzbekistan government for the construction and operation of the pipeline in their territory. This paved the way for CNPC, through TAPLINE, to enter into a JV (incorporated in Uzbekistan in January 2008) with the Uzbekistan state-owned UNG – the Asia Trans Gas JV Ltd. (ATG). TAPLINE and UNG each held 50% equity of ATG, with $1.5 million registered capital from each shareholder. ATG became responsible for the construction and operation of the 529 km Uzbekistan segment of the TCGP. UNG brought into ATG statutory property rights for land acquisition and pipeline operation. In turn TAPLINE brought financing and construction, contracting, and commissioning capabilities. Personnel from UNG took the lead in dealings with local governments and local communities. But TAPLINE staff got the top management roles in construction, commerce, security, human resources, and commissioning. A similar structure

was adopted for the Kazakhstan segment. Hence, in February 2008, TAPLINE and KazTransGas (KMG), the state-owned company of Kazakhstan's oil and gas industry, set up a JV – Asia Gas Pipeline Limited Liability Partnership (AGP). TAPLINE and KMG each held 50% equity of ATG, with $5 million registered capital from each shareholder. AGP became responsible for the construction and operation of the 1,304km Kazakhstan segment of TCGP. As TAPLINE held 50% equity of both ATG and AGP, there was an overlap in the membership of the two alliances. There is also an overlap with the gas supplier CNPCI and gas buyer CNUOC as both legal entities as well as TAPLINE are all subsidiaries of CNPC. Thus, TAPLINE was effectively taking on the role of systems integrator.

Cross-firm Cooperation across Borders

By decomposing the pipeline organization into overlapping alliances, the organization as a whole found it less difficult to cross the historic and institutional borders. For each country, problems could be solved within each alliance, and it was up to the systems integrator to ensure the compatibility of problem-solving across borders. One manager said:

The local firms refused to participate in multilateral negotiations. Therefore, we had to separate them by doing bilateral negations to make it easier to develop the project. As such, for them, it is not about cooperation with other Central Asian countries but rather with China alone…At least Uzbekistan cannot intervene the construction of the segment in Kazakhstan. Likewise, Kazakhstan cannot intervene what happened in Uzbekistan, nor did Turkmenistan.

This organizational structure gave TAPLINE holistic information which the firm leveraged to resolve local problems, consistent with the idea that system integrators need to know more than what is necessary for their production tasks (Brusoni & Prencipe, 2001). For example, in March 2009, Uzbekistan's state-owned company UNG requested to change the pipeline route in Uzbekistan, a change which was resolved with TAPLINE alone. Kazakhstan also benefited from this approach. After the completion of TCGP, Kazakhstan connected their domestic gas pipeline network with the TCGP which enables them to take out the gas for the use of their domestic market. This move would have created complications if there was a single alliance because of objections from Turkmenistan. But under the decomposed structure, Turkmenistan did not have veto rights over the agreements between TAPLINE and Kazakhstan and Uzbekistan.

This organizational structure also turned out advantageous to acquire finance, a context-sensitive transaction. With TAPLINE as a shareholder, ATG (Uzbekistan) succeeded to gain access to a $3.5 billion loan from the China Development Bank (CDB) at the height of the financial crisis – in spite of its meagre registered capital of $3 million, and the fact the project would not generate revenues to pay back the loan for many years. A similar arrangement was leveraged by AGP (Kazakhstan) to mobilize a $7.5 billion loan from CDB, on the condition that CNPC provided a guarantee for the on-time completion of the pipeline.

But unlike the deal with Uzbekistan, in which the pipeline was used as a collateral, Kazakhstan ruled out that approach. "*If the pipelines were mortgaged, we would have nothing left. Our efforts would be in v*ain", said the deputy executive director of KMG, Kazakhstan state-owned gas company). Instead Kazakhstan used the rights in an insurance contract as collateral to the creditor if things went wrong, showing once more the advantages of a decomposed organizational structure to produce an integral technology.

The JV partnerships were not without their challenges, though. TAPLINE was very focused on on-time delivery and got frustrated with the bureaucracy within local partners. Still, the JVs gave TAPLINE an opportunity to influence the local partners through the formal agreement and informal daily interaction. The Chinese deputy manager of the technology department in ATG (Uzbekistan section) said: *"We're all members of ATG and work together for the same goal. Day by day, personnel from UNG (Uzbekistan firm) saw how devoted we're to the project …they've been subtly influenced and started to work more effectively."*

Supplementing Resources and Capabilities

TAPLINE tapped in the local partners to acquire complementary resources. TAPLINE had access to finance and technical and managerial capabilities. But as a foreign company, it would struggle to acquire legal rights for land acquisition, or build and operate pipelines. The division of labor in the JVs was designed to leverage the capabilities of each member whilst attending to the institutional environment. So, the local partners were put in charge of activities such as land acquisition, public engagement, and compliance with local regulations and tax laws. TAPLINE, in turn, mobilize bridge loans to the local partners before the loan from financial institutions become available. Further, TAPILINE was allowed to take on the management roles and provide technical skills although local laws could oblige TAPLINE to subcontract at least half of the work to local contractors. One TAPLINE manager said,

It's acceptable to subcontract work to local contractors as long as Chinese contractors are allowed to do part of the work. Just in case local contractors fail to do their job, we can still rely on Chinese contractors when necessary.

This type of local arrangements turned out handy in Uzbekistan when a local contractor failed to deliver a work package for 50km of on-site welding. Facing a massive delay that could undermine the completion date and a passing rate of welding work of less than 5%, the Chinese contractors were allowed to step in. The Chinese manager of the local JV said, "*Local welding workers had very low productivity, but we helped them learn the latest welding technique and how to do a construction plan*."

Coordination between Cross-border Task Subnetworks

By decomposing the pipeline organization into multiple alliances, TAPLINE had to take on the role of systems integrator. This was so more important in that there were dense technical interdependences, e.g. on distances between compressors and measurement devices, and the task network was also highly interdependent with local laws and regulations, which varied across institutional borders; as a TAPLINE senior manager said, "*Every activity and individual output needed to be organized and coordinated by TAPLINE in a timely manner. It all counted on us.*" Still, however, significant coordination costs were incurred. For example, acquiring permits for work near the borders could take months, causing delays and additional costs. Agreeing the exact location where the pipeline would cross the borders also involved difficult talks to coordinate with the armies from both sides. Cross-firm coordination across borders also turned out complicated when one party lacked incentives to cooperate. The director of Turkmenistan's NGK, the firm responsible for selling the gas, for example, said: *"Once the gas goes beyond Turkmenistan's border, it's no longer our responsibility. We don't want to have anything to do with the pipeline operation in Uzbekistan and Kazakhstan. It's none of our business*." To change the mindset, TAPLINE established a TCGP Operation Coordination Committee (OCC) to bring on board the gas supplier, gas seller, pipeline operators, gas buyer, and the gas distributor. OCC then held coordination meetings twice a year to determine, on an annual, semi-annual, and monthly basis, for the gas supply and pipeline maintenance. OCC also set up a coordination center in Beijing to act as the 'brain' of the pipeline, monitor operations 24 hours, and provide a command center under emergencies.

Conclusion

All in all, our findings suggest that the choice of the Chinese leading firm to partially break the mirror seems to have paid off. Whilst we lack data to know if the cost and schedule targets were conservative or not, the fact is the multi-billion dollar pipeline was reportedly completed on time or with minor delays and within budget.[74,75,76] By setting up multiple alliances, TAPLINE succeeded to navigate through the institutional voids in each context. In other words, the institutional voids placed constraints on organizational choice which ruled our strict mirroring. The fact there was a perception of potential cross-border conflict arguably contributed to rule out the choice to set up a single alliance for the entire pipeline. Taken together, the finding provides evidence the misalignment between technical structure and organizational ties could be attributed to the organization's environment.

[74] Source: CNPC evaluation report, January 2011.
[75] Source: TAPLINE project progress report, October 2010.
[76] Source: CNPC document, July 2017.

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APPENDIX D

BELT AND ROAD INITIATIVE（一带一路）: THE TURKMENISTAN-CHINA GAS PIPELINE

To forge closer economic ties, deepen cooperation and expand development space in the Eurasian region, we should take an innovative approach and jointly build an economic belt along the Silk Road…This will be a great undertaking, benefiting the people of all countries along the route.[77]

President Xi Jinping, September 7, 2013, Kazakhstan

In 2018, five years after hosting China's President Xi Jinping's visit to Kazakhstan, Fang Mason was mulling over what to tell the Leading Group for Advising the Development of the Belt and Road Initiative (BRI). Fang was the managing director of TAPLINE, a subsidiary of China National Petroleum Company (CNPC), which had been set up ten years earlier to build and operate the multi-billion dollar Turkmenistan-China Gas Pipeline (TCGP) **[Exhibit 1]**. This was China's first major effort to build an alternative to the maritime supply of liquefied natural gas to Chinese markets. But in 2018, more than 15 years after the idea first emerged and 10 years after Fang, and his then boss, Bob Song (since deceased, in 2012), jointly designed the project structure, he was no longer sure he'd make the same strategic choices today as they did then.

The 2013 visit was memorable for the public announcement of the BRI: a foreign policy intended to sustain China's breakneck economic pace. Officially, it was about promoting the development of numerous trade-boosting infrastructures along two routes: one linking China to Southeast Asia and Africa by sea – the Road, and another following the ancient Silk Road to Europe through Central Asia and the Middle East – the Belt [**Exhibit 2**]. Since 2013, the BRI had evolved into a trillion-dollar development program ranging from deep-sea ports in Pakistan and Sri Lanka to railways in Africa, gas pipelines across Central Asia and power plants in the Middle East. But the Western world was increasingly suspicious of more sinister motives underpinning the BRI, and so, decided to fight back. In 2018, Europe announced a new Connectivity Strategy, while the USA committed to double down investment in infrastructure in the Indo-Pacific region. While Western policymakers awakened to the global impact of the BRI, China forged ahead with its policy, aiming to solidify its status as the world's largest economic powerhouse and globalization leader. It

[77] Witte M. 2013. Xi Jinping Calls For Regional Cooperation Via New Silk Road. The Astana Times, September 11.

was in this geopolitically charged context that the Turkmenistan – China gas pipeline entered operations, and Beijing was eager to showcase it to other countries.

The idea for an almost 2,000km-long pipeline connecting Turkmenistan to China, crossing Uzbekistan and Kazakhstan, first emerged in 2003, when China and Kazakhstan signed a bilateral cooperation agreement.[78] Mason and Song's involvement had been to figure out a structure to encourage cooperation among four centralized emerging economies, three of which – Turkmenistan, Uzbekistan, and Kazakhstan – only gained independence after the dissolution of the Soviet Union in 1991. If the four countries failed to cooperate, there was a high risk of the project unraveling. At the time, there were two prevailing forms of organizing cross-border pipeline projects: either incorporate the whole project into a single company, or decompose it into as many subprojects as the number of participating countries, and allow each country to figure out the best way to carry out their part. Not convinced by either choice, Mason and Song opted, instead, for each country to form a joint venture (JV) between TAPLINE and a local company. But this was a hasty choice, because in 2007, CNPC had entered into a take-or-pay purchase agreement by which CNPC committed to start to importing gas from Turkmenistan in 2010. Which meant that from 2010 onwards, CNPC was obliged to pay the gas seller regardless of whether the pipeline was completed or not.

By 2017, though, it seemed that Mason and Song had got it right: the pipeline was fully operational and gas imports had reached 100bn cubic meters.[79] But could things have been done quicker and cheaper had they designed a different structure? And would they make the same strategic choices now that China's BRI was provoking the ire of the western world? After accumulating losses forced the Sri Lankan government to hand over control, on a 99-year lease, of a $1.3bn Chinese-built port to the Chinese, international pressure on China was mounting. Its critics insisted that the BRI was a neocolonialist policy to further Chinese interests – even if there were BRI projects creating broad value, such as at Piraeus, a Greek harbor. All these dynamics couldn't be ignored, though, and Beijing was advised to hold the projects to the goal that the BRI had set for itself: to build a better future modeled on an idealized past.[80]

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[78] Sources: i) China, Kazakhstan Discuss Cross-border Gas Pipeline. China Daily, August 25, 2004.

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[79] The Cumulative Amount of Gas Transported through the Turkmenistan-China Gas Pipeline Surmount 100 Billion Cubic Meters. CNPC Press Center, 13 Novermber 2014.

[80] Millward, J. 2018. Is China a Colonial Power? The New York Times, May 4.

The Belt and Road Initiative (BRI)

More than 2,000 years ago, the Silk Road opened up the land trade route from China to Asia, Africa, and Europe, and promoted vast economic, political and cultural exchanges between East and West. A similar ambition lay behind the Belt and Road Initiative (BRI), which aimed at massive capital investment on new infrastructure throughout Asia, the Middle East, and Africa. By building an overland 'belt' and a maritime 'road', China intended to promote the socioeconomic prosperity of the countries along the route, and strengthen exchanges and mutual learning between different civilizations. The BRI scope was vast, including investment in sectors as diverse as transport, energy, education, and healthcare. It would span several decades, making it the largest program of economic diplomacy since the US-led Marshall Plan – although President Xi insisted that the BRI, unlike the Marshall Plan, was just "*an economic co-operation initiative, not a geopolitical or military alliance*".[81] Still, China had plans to reach over 70 countries, which accounted for more than two-thirds of the world's population and half of its GDP.[82] This would certainly give Chinese companies an international opportunity to become global brands, while securing privileged access to natural resources and foreign markets.

Backed by its vast foreign exchange reserves, the Chinese government planned to transfer billions of dollars to state-owned banks to enable hundreds of BRI projects. In addition, through China's sovereign wealth fund, Beijing planned to establish a multi-billion dollar Silk Road Fund. In 2013, they also announced plans to launch the Asian Infrastructure Investment Bank (AIIB) with at least $100bn of initial capital, from which the BRI projects were expected to borrow $20 to $25bn a year.[83] The establishment of the AIIB suggested that China was serious about going beyond infrastructure and into building institutions and developing the capabilities of Chinese and local officials. This change of tack was key to neutralize critiques by Western observers, which framed the BRI as nothing but a neo-colonialist policy, implemented through dodgy and opaque deals with the host-state elites. The critics saw BRI as nothing but a plot to ensnare countries in neo-imperialistic debt traps, create vassal states and force these countries to hand over territory and strategic assets – criticisms that Chinese officials adamantly rejected:

…we have made a lot of contributions to those countries…we also advise host countries [of BRI projects] to act within their means and not to overstretch…some

[81] Mitchell, T. 2018. Beijing insists its initiative is no Marshall plan. Financial Times, 26 September.

[82] Campbell, C. 2017. China Says It's Building the New Silk Road. Here Are Five Things to Know Ahead of a Key Summit. Time, May 12.

[83] Peterson Institute for International Economics. 2016. China's Belt and Road Initiative: Motives, Scope, and Challenges.

countries may face difficulties in repaying the debt...[but] we will not press down hard on them.[84]

It was undeniable the BRI was important to create a sustainable pipeline of business opportunities for Chinese companies as demand at home petered out. It enabled leveraging the management and technical capacity that Chinese contractors and consultants had acquired in the previous decades, and offered a stimulus to forge deeper trade relationships with sovereign nations around the world. Of course, it was also a political instrument for China to craft strategic alliances with other countries. And for this, the BRI needed to pursue cost-effective and economically sound projects supported by foreign governments and populations alike. Otherwise, global perceptions would continue to grow that the initiative was all about neglected accountability and transparency to help Beijing gain control over strategic assets in sovereign counties – a perception that could lead to pushback and derail China's BRI ambition. One example was the case of Malaysia, which, after a change of government, suspended $23bn in China-backed infrastructure projects, including railways and pipelines. To justify this decision, the Malaysian government cited excessive costs, opaque bidding procedures and 'lopsided' contracts. By November 2018, amid a major US – China spat over trade, Mike Pence, the US vice-president, mocked the BRI as a 'constricting belt' and a 'one-way road' in front of China's President Xi Jinping. In response, President Xi insisted the BRI was not a 'trap' and that there was no 'hidden agenda', lashing out at 'America First' trade protectionism.[85]

Geopolitics aside, Western businesses were being increasingly vocal about their interests in becoming active participants in the BRI, both in terms of financing support to BRI projects and in working side by side with Chinese contractors. To the extent that in June 2018, German giant Siemens opened a 'BRI Office' in Beijing, and signed more than 10 agreements with state-owned Chinese groups such as China Railway Construction Company, China Civil Engineering Construction Corporation and others to cooperate in areas such as power generation, building technology and manufacturing. As Joe Kaeser, president and chief executive of Siemens, said:

BRI has proven to be a wise and powerful force for accelerating infrastructure development already in many participating countries…Siemens is uniquely positioned to help ensure sustainable success of the BRI through its vast technology portfolio, in-depth knowledge of local market needs based on a long-standing local footprint in the respective economies as well as the ability to create local value for these societies.[86]

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[84] Anderlini, J. 2018. We say, if you want to get rich, build roads first. Financial Times, 26 September.

[85] Agence France-Presse. 2018. APEC summit fails to agree on statement amid US-China spat. The Guardian, 18 November.

[86] Global Construction Review. 2018. Siemens joins China's Belt and Road Initiative. By GCR Staff. 7 June.

China's Thirst for Energy

The growth of China's economy had been one of the most significant developments for the global economy. After the reform and opening up in 1978, China's economy soared with an average GDP growth rate of 10% between 1978 and 2007 **[Exhibit 3]**.[87] In 2007, China's GDP reached $4.6trn (2010 prices) with 14.2% growth of GDP – the fifth consecutive year of double-digit increases. In 2010, with a total GDP of $6.7trn (2010 prices), China overtook Japan as the world's second-largest economy. With the largest population and fastest economic growth in the world, China's needs for energy were increasing commensurately. Total primary energy consumption had risen by an average annual growth of 11.46% between 2000 and 2007.[88] So access to adequate and secure energy supplies was crucial for enabling China's continued economic growth, industrialization and urbanization.

Meanwhile, the need to cut pollution and develop more sustainable energy drove China's increasing needs for gas and clean energy. From 1990 to 2007, gas consumption in China had also soared, with an average annual growth rate of 9.66%, significantly higher than the global average of 2.48%[89], and all during a period when global gas consumption was also rising. The average annual growth rate of gas consumption was already higher than that of oil usage, showing the importance of gas in the fuel mix **[Exhibit 4]**. Furthermore, the International Energy Agency had projected the gas market in primary energy would keep its fast-growing pace, owing to the continued decarbonization of the fuel mix.[90] This trend gained traction at a time when the gas share in China's primary energy consumption was around 3.5%, far below the global average 23.6%,[91] indicating potential growth. Yet domestic gas production in China was limited, so to fill the gap, China imported gas from abroad, mainly using liquefied natural gas (LNG) tankers. But LNG was a costly option, and raised safety concerns as it required dealing with concentrated energy. And, further constrained by the Strait of Malacca, marine transportation posed a critical risk to China's energy safety from a geopolitical perspective. So China was proactively seeking alternative ways of importing gas from neighboring countries.

Crucially, Central Asian countries controlled a significant bulk of the world's gas reserves.[92] For example, the total proved gas reserve of Turkmenistan in 2007 was 2.3tn

[87] The World Bank Group.

[88] BP Energy Outlook.

[89] Calculation based on BP Statistical Review of World Energy, June 2017.

[90] International Energy Agency. World Energy Outlook 2007, China and India Insights: Executive Summary.

[91] Source: i) National Bureau of Statistics of China, data on energy consumption in China; ii) CNPC Institute of Economics and Technology, presentation slides, 5 December, 2008, Tokyo. Released by The Institute of Energy Economics, Japan, January 2009.

[92] The borders of Central Asia are subject to multiple definitions. In this teaching case, Central Asian countries refer to Kazakhstan, Uzbekistan, Turkmenistan, Tajikistan, and Kyrgyzstan.

cubic meters, which accounted for 1.42% of global reserves, ranking them 13th in the world. Total proved gas reserves of Uzbekistan and Kazakhstan were smaller, but still ranked them as 21st and 22nd in the world **[Exhibit 5]**. In terms of gas production, Turkmenistan's gas production in 2007 reached 65.4 billion cubic meters (bcm), ranking it as 11th in the world, followed by Uzbekistan with 58.2bcm, ranking 15th in the world. And while Turkmenistan had the largest gas reserves and production capability in Central Asia, its domestic gas consumption was small, accounting for less than one-third of its gas production **[Exhibit 6]**.

Historically, Central Asian countries had prioritized gas markets in the West. Their existing gas pipeline systems, built in the Soviet Union era, all crossed Russia before reaching the European market. So, despite the collapse of the Soviet Union, Central Asian countries were still forced to sell gas to Russia at a lower price, which Russia then sold on to European markets with higher margins. This economic dependence on Russia was frustrating for Central Asian countries, and so it was in this geopolitical and economic context, that China raised the idea of building a gas pipeline from Turkmenistan to China.[93] This pipeline would meet both Turkmenistan strategy to diversify gas exports and China's gas import strategy. The idea also suited Uzbekistan and Kazakhstan, as their lower gas production capacities made it unfeasible for them to build separate gas pipelines to export gas to China. A pipeline linking Turkmenistan, Uzbekistan, and Kazakhstan to China was viable. Uzbekistan and Kazakhstan could both become transit countries, while exporting their own gas, too. Additionally, the pipeline's construction and operation could boost tax revenues of all three countries, as well as create job opportunities, drive investment along the pipeline and further attract foreign investment.

The Turkmenistan-China Gas Pipeline Project (TCGP)

When China's President Xi Jinping visited Kazakhstan in 2013, the Turkmenistan – China Gas Pipeline project (TCGP) was fairly advanced. But getting to that point had been a long journey. The idea gained traction in 2003, when China's President Hu Jintao visited Kazakhstan and the two states reached an agreement to undertake a feasibility study.[94] But transforming the ambition into reality had required multiple government-to-government agreements and business-to-business execution agreements between state-owned oil and gas companies.

It was only by 2006, three years later, that China entered into an agreement with Turkmenistan to export gas to China via a pipeline crossing Uzbekistan and Kazakhstan. This pipeline would carry gas from the Bagtyyarlyk gas fields in Turkmenistan, run across

[93] Radio Free Europe, 10 April 2006. Central Asia: Turkmenistan-China Pipeline Project Has Far-Reaching Implications.

[94] Sources: i) Blagov, S. 2003. Hu Makes His Mark in Central Eurasia. Asia Times, June 4. ii) China, Kazakhstan Discuss Cross-border Gas Pipeline. China Daily, August 25, 2004.

Uzbekistan and Kazakhstan, and cross the Kazakhstan-China border at Khorgos, where it would connect to the Chinese West-East Gas Pipeline II. Turkmenistan's President Saparmurat Niyazov saw the pipeline as one of the greatest achievements in his tenure. As a testament to this, both heads of state met in person – the first time in China's history that their president signed a project agreement with a leader of another country.[95] One year later, CNPC signed the China-Turkmenistan Gas Purchase and Sale Agreement (PSA) and the Turkmenistan Amu Darya Right Bank Gas Production Sharing Contract (PSC) with Turkmenistan's Oil and Gas Resources Management and Utilization Department and Turkmenistan's National Gas Konzern (NGK).

The deal committed Turkmenistan to export 30bcm gas to China each year for 30 years, starting in 2010. Of that gas supply, 17bcm would be supplied by commercial purchase according to the PSA, and the other 13bcm from the CNPC's share of gas production according to the PSC. The PSA was a take-or-pay agreement, which meant the buyer committed to pay the pre-agreed sum of money to the supplier even if actual usage was lower than the transported amount of gas. In turn, the supplier was obliged to compensate the buyer if the gas supply did not reach the pre-agreed amount. This take-or-pay contract provided the seller with an assured revenue stream and the buyer with an assured gas supply. But it applied pressure to deliver the pipeline on time since the buyer was obliged to pay the supplier even if the project ran late, unless, of course, the buyer could prove the seller was to blame – a situation both parties wanted to avoid, as it could lead to costly disputes and undermine diplomatic links between the countries. With no historical data to serve as a guide, the two parties agreed to deliver the 1,833km pipeline (pipe diameter 1,219mm) in two and half years, and with a forecast cost of $7.31bn (cash prices).[96]

This was not an easy project. Turkmenistan, Uzbekistan, and Kazakhstan were multi-ethnic countries with differing ethnic structures and development models. Prior to independence from the Soviet Union, the socioeconomic gap between the countries was negligible. But after independence, the gap widened because of differences in natural resources, administrative reforms, and politics. Kazakhstan's GDP became higher than the aggregate of the other two **[Exhibit 7]**, and it also became a leader in terms of market liberalization. In contrast, foreign companies entering into either Uzbekistan or Turkmenistan still needed to get licenses signed by the respective presidents. In terms of regulation and government effectiveness, the three countries fared poorly on the World

[95] China News Services Website, 5 January 2016. Zhang Guobao: The Central Asia-China Gas Pipeline Negotiation and Decision-making Process I Experience.

[96] i) CNPC document, December 2007; ii) The first batch of equipment of Central Asia Pipeline "steps" on a new journey. CNPC News (news.cnpc.com.cn), 6 May 2008.

Bank's governance indicator **[Exhibit 8]**.[97] Still, Kazakhstan had slightly better ratings than the other two countries. Cooperation between the countries also had a long way to go, as one industry insider noted, "Uzbekistan was unwilling to recognize Kazakhstan's leadership in Central Asia and refused to cooperate with Kazakhstan in the process of regional integration."[98]

It was the job of Mason and Song, an industry veteran, to figure out how to deliver the cross-border project. This was an important assignment, as the sub-goals of the participating countries weren't fully aligned. CNPC was keen to start importing gas as soon as possible; Turkmenistan cared about producing gas, but the take-or-pay agreement reduced the pressure on them to complete the pipeline. And while Uzbekistan and Kazakhstan, as transit countries, naturally wanted to see the pipeline completed to increase their tax revenues, they also saw short-term value in construction, e.g. local jobs and local contracts. And complicating matters, the project scope was far from frozen; in 2008, one year after the initial agreement, the scope evolved to two slightly narrower pipelines (1,067mm in diameter) to open respectively by the end of 2009 and 2010. The cost forecast then rose to $9.9bn (cash prices) – $3.6bn for pipeline A and $6.3bn for pipeline B.[99] And the scope changed yet again in 2011, when they agreed to add a $7bn third pipeline to open by 2014.[100]

For a while, Mason and Song toyed with two ideas: either incorporate the whole project in one single company and invite the regional partners to become shareholders; or decompose the project into as many subprojects as the countries involved, and create one regional company per subproject.

A Centralized Approach

A prevailing structure to deliver cross-border pipelines was to bring all the participants together under an overarching legal entity **[Exhibit 9]**. Under this approach, a legal entity would meager with equity shared between the development partners. This structure recognized that one party controlled the production of the gas, while another, the gas buyer, held the access to the end-user market. And others, the transit countries, controlled the land required to build the pipeline. The negotiations to agree the ownership of the unified company could be time-consuming. But once the legal entity was created, the company could work effectively by leveraging centralized authority to resolve coordination problems and reward cooperation. The organizational boundaries would be clear, reducing ambiguity about purpose and facilitating decision making. Furthermore, this centralized structure

[97] Voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, and control of corruption

[98] Zhao, H. 2013. On the Overall Development Process of Central Asian Countries. Journal of Xinjiang Normal University: Philosophy and Social Science Edition, 5: 58-68. (In Chinese)

[99] CNPC document, May 2010.

[100] CNPC document, 2011.

would boost investors' confidence, given the clarity in ownership rights, shareholder obligations and alignment of interests. Such a structure was also advantageous to agree and write contracts with project suppliers. Importantly, the equity shareholders would not necessarily have to be the local state oil and gas companies along the route of a pipeline. With the liberalization of energy markets, more and more international companies seemed eager to get involved in cross-border pipeline projects, despite challenges in aligning interests and reducing transactions costs **[Exhibit 10]**.

But there were good reasons to expect difficulties in aligning the interests of four sovereign states in a single legal entity. Kazakhstan, in particular, was demanding a high gas transit fee that China found unacceptable. Kazakhstan also wanted to take gas from the pipeline to meet its own domestic need for gas, since its gas reserves were located in the west of the country. By using the gas from TCGP, Kazakhstan could not only save the cost of transporting gas from the west to the south, but also sell its own gas in European markets.

Let Free Markets Rule

Another alternative was to make TAPLINE a much leaner company, and let the other countries do their share. Under this structure, each country would be responsible for developing local components of the pipeline and offer corresponding services **[Exhibit 11]**. Such an arrangement would leave it up to the gas supplier to sort out gas production and transmission to the border with the transit country; each transit country would have its own transmission company for building, operating and maintaining the pipeline within its territory. This would leave the buyer to import gas from the border and operate the pipeline on its territory. Such arrangements were not unusual **[Exhibit 12].** And indeed, the political leaders and senior management in Uzbekistan and Kazakhstan favored this structure, as they saw more opportunities to develop local capabilities and control assets in their own countries. Majiduofu, the deputy executive director of UzbekNefteGaz (UNG), the state-owned holding company of Uzbekistan's oil and gas industry, said:

We have the capability to build the whole Uzbekistan section by ourselves. Do you know what's the total length of pipelines with a diameter over 1,000mm in Uzbekistan? 33,000km! More than the total length in China. We also built more than 130,000km pipelines with a diameter between 256mm and 1,000mm. We are totally capable of building a 500km new pipeline.

Yet, Mason and Song were not fully convinced they could trust their partners to get on with the job. Uzbekistan had a large pipeline network, but it dated from the Soviet era and didn't reflect their current local technical, financial and managerial capabilities. It seemed unlikely that Uzbekistan firms could acquire the finance to build a pipeline and modernize their capabilities – they were, for instance, still relying on old manual welding techniques. The situation was somewhat different in Kazakhstan, where the laws of the country

prohibited foreign companies owning and operating gas pipelines, and so local companies seemed better equipped to do the job. Another concern was the extent to which such an arrangement could respond quickly to eventual emergencies. Would such a structure be capable of reacting rapidly by turning off compressors and closing valves in the event of a gas leak or explosion? And how would cross-border disputes be resolved? Could this arrangement leave the pipeline vulnerable to disruption due to political conflicts between the countries? No pipeline is ever stronger than its weakest link.

Form a Group of Strategic Alliances

A third, and unusual alternative in the oil and gas sector, was for TAPLINE to enter into multiple strategic alliances with state-owned enterprises in each participating country **[Exhibit 13]**. Decomposing the whole system by geographical zones would perhaps increase the coordination and cooperation costs; it was also likely to make it more difficult to reap efficiencies from using the local markets of each country. But still, the idea seemed attractive in order to reduce the transaction costs that otherwise would be incurred to form a single project company. Another advantage would be to give TAPLINE flexibility for private agreements with each local partner, suitable development processes and structures. And this arrangement also recognized that the local markets and local capabilities were still underdeveloped.

Turkmenistan was the first to buy into this idea, and so the state passed legislation to allow foreign companies to participate in the exploration and development of gas blocks. But the state ruled out the idea of forming its own company; they opted instead to allow CNPC to set up a subsidiary to explore and develop the gas blocks in 2007 – the CNPC International (Turkmenistan). This subsidiary's mission was to explore and develop the gas blocks, build a gas processing plant and an 86km pipeline in the Turkmenistan segment, and all within less than two years. Meanwhile, Turkmenistan's state-owned gas company separately sold the pre-agreed amount of gas to CNPC.

Simultaneously, CNPC sought an agreement with the Uzbekistan government for the construction and operation of the pipeline in their territory. This paved the way for CNPC, through TAPLINE, to enter into a joint venture (JV) – incorporated in Uzbekistan in January 2008 – with the state-owned UNG – the Asia Trans Gas JV Ltd (ATG). TAPLINE and UNG each held 50% equity of ATG, with $1.5m registered capital from each shareholder. ATG became responsible for the construction and operation of the 529km Uzbekistan segment of the TCGP. UNG brought into ATG statutory property rights for land acquisition and pipeline operation, while TAPLINE brought financing, construction, contracting and commissioning capabilities. Personnel from UNG took the lead in dealings with local governments and local communities, but TAPLINE staff got the senior management roles in

construction, commerce, security, human resources and commissioning. With TAPLINE as a major shareholder, ATG secured a $3.5bn loan from the China Development Bank at the height of the financial crisis – despite its meagre registered capital of $3m, and the fact that the project wouldn't generate enough revenues to pay back the loan for many years.

The TAPLINE and UNG partnership was not without its challenges, though, as TAPLINE was very focused on on-time delivery and became frustrated with the bureaucracy within UNG. Still, the JV gave TAPLINE opportunity to influence the local partner through formal agreement and informal daily interactions. The Chinese deputy manager of the JV's technology department said:

We're all members of ATG and work together for the same goal. Day by day, personnel from UNG saw how devoted we're to the project …they have been subtly influenced and started to work more effectively.

The JV also enabled TAPLINE to influence procurement and relax policies to procure all work locally, which opened up opportunities for Chinese contractors. As part of the deal, any Chinese contractor would have to subcontract at least half the awarded package to local contractors. For TAPLINE, having Chinese contractors on board was important for the project's momentum, as Song said:

It's acceptable to subcontract work to local contractors as long as Chinese contractors are allowed to do part of the work. Just in case local contractors fail to do their job, we can still rely on Chinese contractors when necessary.

This arrangement turned out handy when the work package for 50km of on-site welding awarded to a local contractor ran into problems. By February 2009, a work package that should have been completed by the end of 2008 was just about a quarter done, with the passing rate of welding work at less than 5%. Facing a massive delay, UNG waived the condition that forced Chinese contractors to subcontract work to local contractors.

A similar structure was adopted for the Kazakhstan segment. And in February 2008, TAPLINE and KazTransGas (KMG), the state-owned company of Kazakhstan's oil and gas industry, set up a JV – Asia Gas Pipeline Limited Liability Partnership (AGP). TAPLINE and KMG each held 50% equity of ATG, with $5m registered capital from each shareholder. AGP became responsible for the construction and operation of the 1,304km Kazakhstan segment of TCGP. The arrangement benefited from a $7.5bn loan from the China Development Bank, on the condition that CNPC guaranteed on-time completion of the pipeline. But, unlike the deal with Uzbekistan, in which the pipeline was used as collateral, Kazakhstan ruled out that approach – "If the pipelines were mortgaged, we would have nothing left. Our efforts would be in vain", said the deputy executive director of KMG. Instead, Kazakhstan used the rights in an insurance contract as collateral to the creditor if things went wrong. And because the Kazakhstan owned-KMG had more experience working

with foreign companies, more senior managerial roles in AGP were allocated to KMG personnel. Still, with 50% equity of the JVs with Uzbekistan and Kazakhstan, plus a CNPC subsidiary in charge of production in Turkmenistan, TAPLINE management felt in control of the whole project. Their director of contract management said:

The construction of a pipeline that crosses borders required coordination among government departments, owners, contractors, and project management consultants. Every activity and individual output, e.g. construction plan, schedule arrangement, technical requirement needed to be organized and coordinated by TAPLINE in a timely manner. It all counted on us.

All in all, this arrangement seemed to work well in coordinating cross-border work on the pipeline. Still, TAPLINE struggled to work with multiple national agencies such as border defense, security and customs. For example, requiring permits for works near the borders required a raft of signatures that could take months to assemble, causing delays to the construction schedule and additional costs. Agreeing the exact location where the pipeline would cross the borders also involved difficult talks to coordinate with the armies from both sides.

Another challenge was to ensure the pipeline was operated and maintained as a whole, and thus ensure alignment between the amount of gas supplied upstream and the capacity of the downstream compressors. Initially, the gas seller in Turkmenistan lacked incentives to cooperate. As the director of Turkmenistan's NGK said, "Once the gas goes beyond Turkmenistan's border, it's no longer our responsibility. We don't want to have anything to do with the pipeline operation in Uzbekistan and Kazakhstan. It's none of our business." To change this mindset, TAPLINE established a TCGP Operation Coordination Committee (OCC) that brought on board the gas supplier, gas seller, pipeline operators, gas buyer and gas distributor. OCC held coordination meetings twice a year to determine, on an annual, semi-annual and monthly basis, plans for the gas supply and pipeline maintenance. OCC also set up a coordination center in Beijing to act as the 'brain' of the pipeline, monitoring operations 24- hours a day and providing a command center for emergencies.

In the end, though, the decision to form a nexus of strategic alliances seemed to have paid off. Pipeline A was completed on time and commissioned on December 14, 2009, 17 days ahead of the target set in 2007. The final cost was $3.5bn (cash prices), reportedly $100m less than the expectation in the 2007 feasibility study.[101] Pipeline B opened on October 26, 2010, two months behind schedule, a delay TAPLINE attributed to reorganizing, financial and raw material supply issues of the Uzbekistan contractor.[102] Still, the final cost was $5.8bn, reportedly $500m less than the initial forecast.[103] And finally, Pipeline C

[101] CNPC evaluation report, January 2011.
[102] TAPLINE project progress report, October 2010.
[103] CNPC evaluation report, January 2011.

commenced operations on May 31, 2014, six months behind schedule and reportedly within the original budget.[104]

This delivery, within the initial targets of the Turkmenistan-China Gas Pipeline, of an infrastructure of high strategic importance for China, made the project an attractive setting for Beijing to launch the BRI. The TCGP had also attracted attention in Beijing's top circles for the innovative choice of a set of cross-border strategic alliances, as opposed to traditional organizational solutions. But were these reasons good enough to make it a preferred form of organizing future BRI projects? Given that TCGP was the first of its kind in the region, it was hard to say objectively whether the initial cost and schedule targets had, or hadn't, been set too conservatively. It was also hard to say if a different structure would have produced better results.

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In the 15 years it had taken to negotiate, plan build, and operate the Turkmenistan-China Gas Pipeline, the world had changed a lot. China had massively increased its commitment to foreign investment, and the Western world had become increasingly critical. China insisted the BRI was about enhancing regional connectivity and embracing a brighter future. But many Western observers disagreed, with some calling it a 'domestic policy with geostrategic consequences rather than a foreign policy'.[105] Others expressed concern about future project returns being sufficient to cover the repayments to Chinese creditors, which would have saddle China with more debt to add to its already quickly growing debt burden. Yet another critique was that China was promoting projects, which were hard to justify economically, as a cynical ploy to shift excess construction capacity overseas. Saddled by white elephants, host countries would then struggle to pay the debt and China would gain access to valuable natural and man-made resources that had served as collateral, such as had happened in Sri Lanka. A fatal attack on China's consulate offices in Karachi in 2018 by a separatist group, after a string of attacks by the same group against security personnel guarding projects linked to the China-Pakistan economic corridor, also suggested that the BRI projects, were becoming a target for local militant groups.[106] Even the managing director of the IMF entered the fray in late 2018, after an independent study suggested that the BRI had put 23 countries at risk of debt distress:

Ventures can also lead to a problematic increase in debt, potentially limiting other spending as debt service rises, and creating balance of payments challenges … [it is critical] to

[104] CNPC document, July 2017.

[105] Hancock, T. 2017. China encircles the world with Belt and Road Initiative strategy. Financial Times, May 4.

[106] Assault on Chinese consulate in Karachi as violence flares across region. The Guardian, 23 November 2018.

ensuring that Belt and Road only travels where it is needed.[107]

Still, many developing countries and many Western companies, too, were keen to entertain talks with China, frustrated with the economic orthodoxy imposed by the West and delayed investment in infrastructure. For these countries and companies, the BRI was about China embracing globalization. And some Western observers, too, argued that the BRI shouldn't be judged without prior knowledge of each project, recognizing that though some projects may have been more about promoting Chinese interests, others had been true catalysts of development. But the much more critical view, which framed the BRI as 'a nefarious plot for world domination', was both persistent and pervasive.[108] This wasn't the case in 2007, when Mason and Song designed TCGP. And this gave Fang Mason pause for thought.

List of Abbreviations

ATG	Asia Trans Gas JV Ltd.
BCM	Billion cubic meters
CNPC	China National Petroleum Company
CNPCI	China National Petroleum Company International (Turkmenistan)
CNUOC	China National United Oil Corporation
KMG	KazMunaiGas
KTG	KazTransGas
NGK	National Gas Konzern (Turkmenistan)
OCC	Operation Coordination Committee
PSA	Purchase and sale agreement
PSC	Production sharing contract
UNG	UzbekNefteGaz

[107] Clover, C. 2018. IMF's Lagarde warns China on Belt and Road debt. Financial Times, 12 April.
[108] Bräutigam, D. 2018. U.S. politicians get China in Africa all wrong. The Washington Post, 12 April.

Exhibit 1 Route of Turkmenistan – China Gas Pipeline

Figure source: CNPC presentation slides

Exhibit 2 Proposed Routes of China's Belt and Road Initiative

Figure source: China – Britain Business Council, www.cbbc.org/bri

Exhibit 3 China's GDP Growth and Energy Consumption Growth

Data sources: GDP data (2010 constant price, World Development Indicator, The World Bank Group); Energy consumption data (BP Energy Outlook, June 2017)

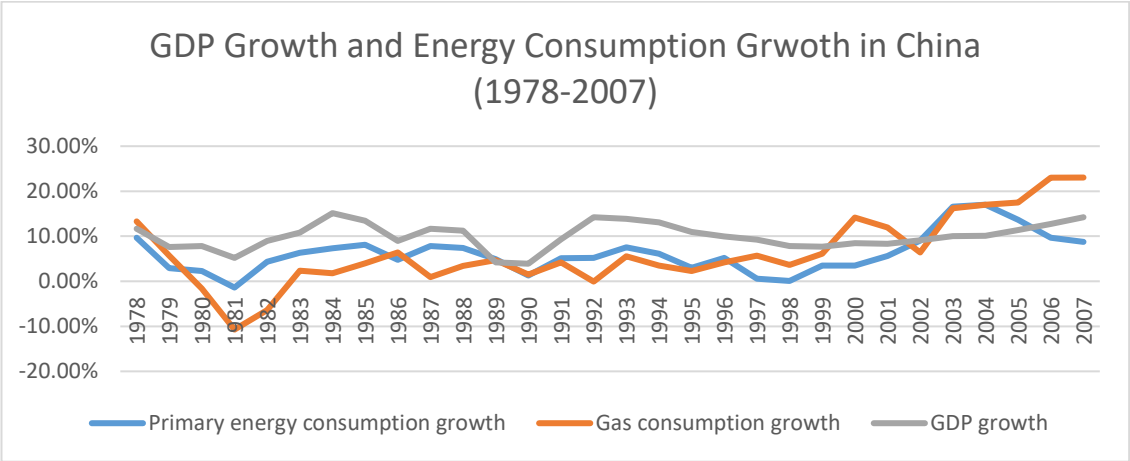
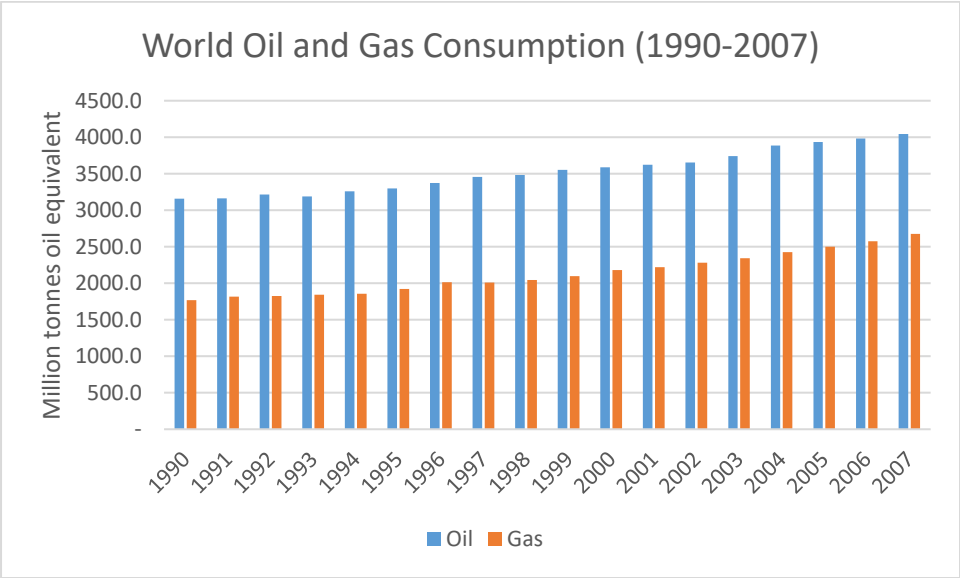


Exhibit 4 Trend of Global Oil and Gas Consumption (1990 – 2007)

Data source: BP Statistical Review of World Energy, June 2017



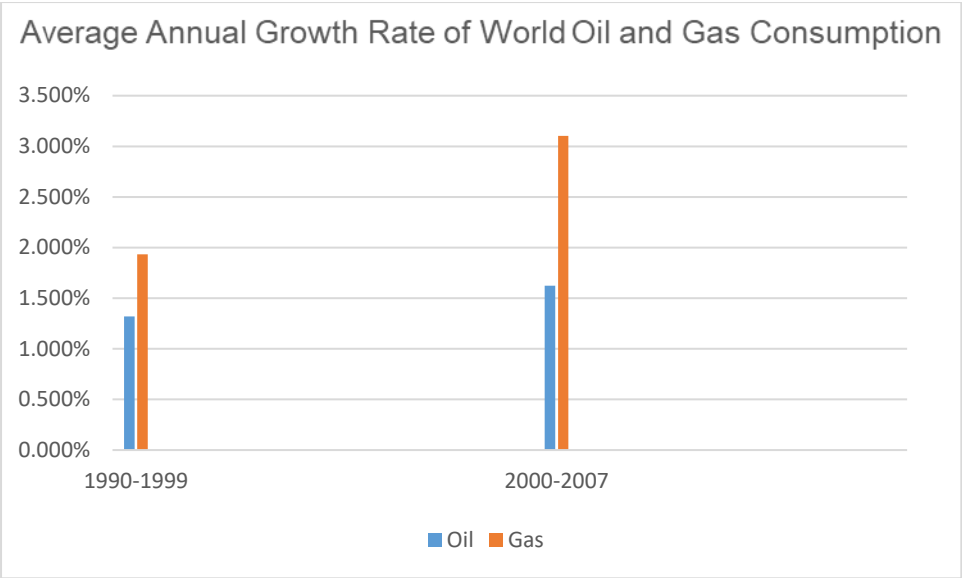


Exhibit 5 Total Proved Natural Gas Reserves and Production of Turkmenistan, Uzbekistan, and Kazakhstan in 2007

Data source: BP Statistical Review of World Energy, June 2017

	Total proved reserves in 2016 (trillion cubic meters)	Share of the world	World ranking	Production in 2016 (billion cubic meters)	Share of the world	World ranking
Turkmenistan	2.3	1.42 %	13	65.4	2.22%	11
Uzbekistan	1.2	0.74 %	22	58.2	1.97%	15
Kazakhstan	1.3	0.80 %	21	13.8	0.47%	32

Exhibit 6 Turkmenistan Gas Production and Consumption

Data source: BP Statistical Review of World Energy, June 2017

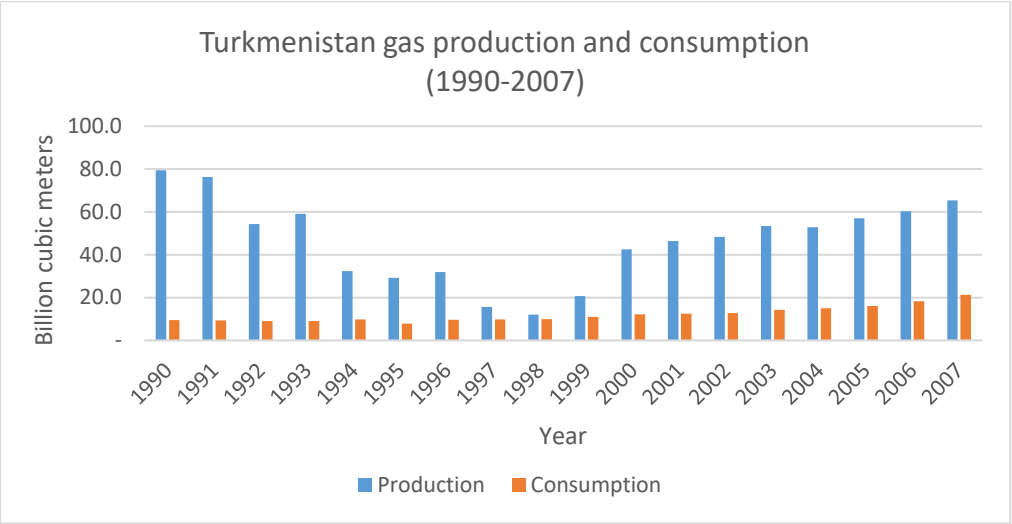


Exhibit 7 GDP of Kazakhstan, Uzbekistan, and Turkmenistan

Data source: World Development Indicators, World Bank

https://data.worldbank.org/indicator/NY.GDP.MKTP.KD

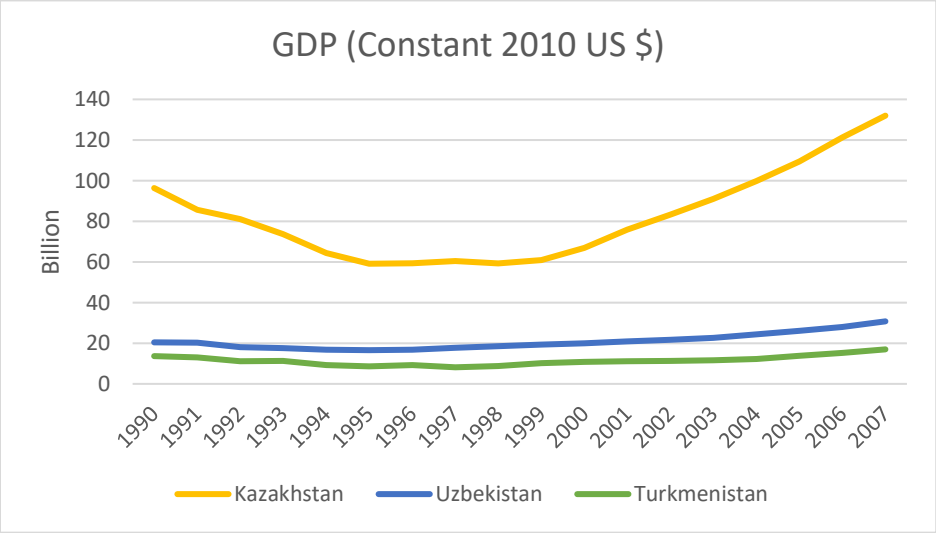


Exhibit 8 World Governance Indicators

Source: Worldwide Governance Indicators, World Bank

http://info.worldbank.org/governance/wgi/index.aspx#reports

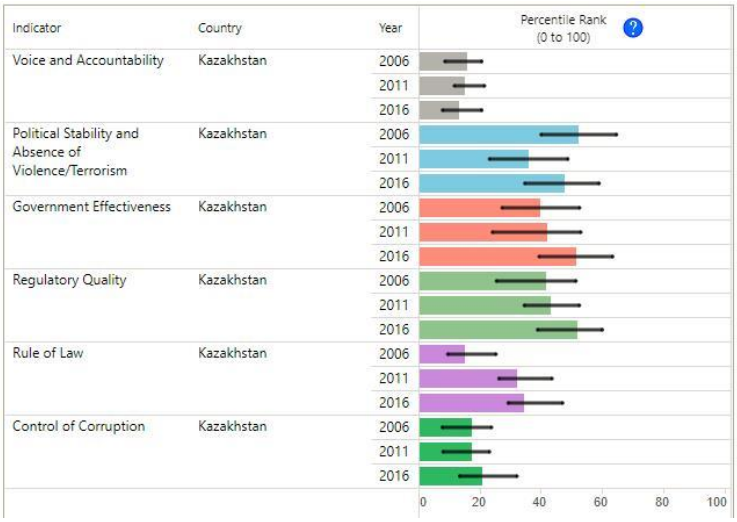


Exhibit 8a: Kazakhstan

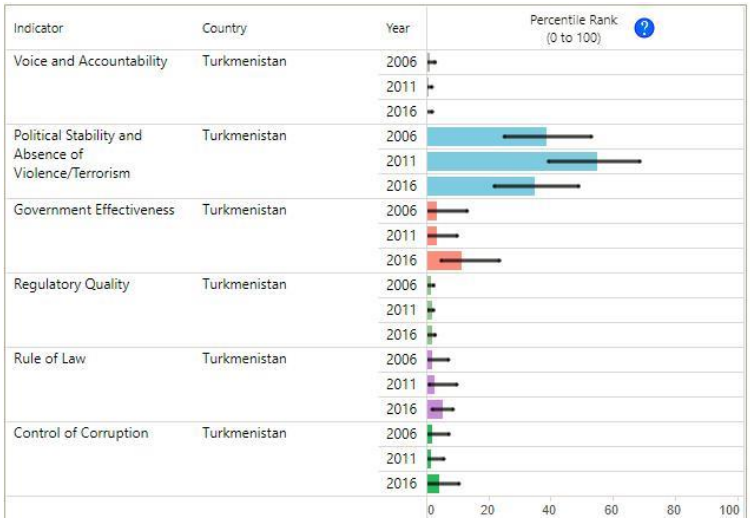


Exhibit 8b: Turkmenistan

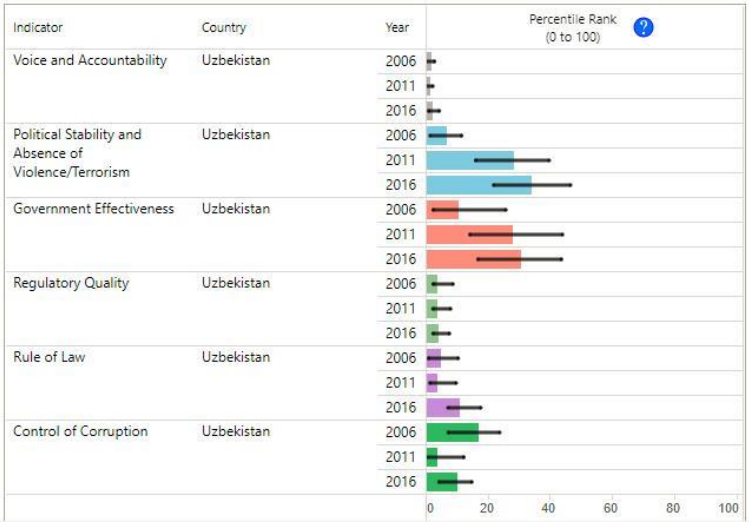
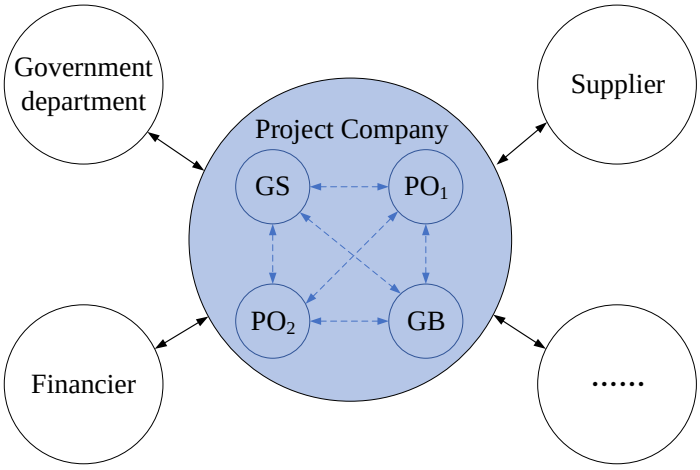


Exhibit 8c: Uzbekistan

The charts show the percentile rank of the country on each governance indicator. Percentile rank indicates the percentage of countries worldwide that rate below the selected country. Higher values indicate better governance ratings. Percentile ranks have been adjusted to account for changes over time in the set of countries covered by the governance indicators. The statistically likely range of the governance indicator is shown as a thin black line. For instance, a bar of length 75% with the thin black lines extending from 60% to 85% has the following interpretation: an estimated 75% of the countries rate worse, and an estimated 25% of the countries rate better than the country of choice.

Exhibit 9 A Traditional Hierarchical Approach



Note:
GS: Gas supplier
PO1: Pipeline operator in country 1
PO2: Pipeline operator in country 2
GB: Gas buyer

Dotted lines: Intra-organizational relationship
Solid lines: Inter-organizational relationship

Exhibit 10 Examples of Project Companies Formed to Build Cross-Border Gas Pipelines

Example 1: Nord Stream Gas Pipeline (NSGP)

The Nord Stream Gas Pipeline (NSGP) is a 2,224km-long pipeline (formerly North European Gas Pipeline), crossing the Exclusive Economic Zones of Russia, Finland, Sweden, Denmark, and Germany, as well as the territorial waters of Russia, Denmark and Germany. The twin-pipeline has a combined transmission capacity of 55bcm a year and transfers gas from the Yuzhno-Russkoye oil and gas deposits within the St Petersburg region of Russia to Germany. The project began in 1997, when the Russian company Gazprom and Finnish company Neste (later known as Fortum) formed a project company, North Transgas Oy, for the construction and operation of a gas pipeline from Russia to northern Germany across the Baltic Sea. The German partner was Ruhrgas (later E.ON). In April 2001, Gazprom, Fortum, Ruhrgas and another German company, Wintershall, commissioned a joint feasibility study for the pipeline. In May 2005, Fortum withdrew and sold its 50% stake in the project to Gazprom. As a result, Gazprom became the 100% owner of North Transgas Oy. In September 2005, Gazprom, BASF, and E.ON signed a basic agreement for the construction of the North European Gas Pipeline. In November 2005, the North European Gas Pipeline Company (later Nord Stream AG) was incorporated in Zug, Switzerland. Shareholders of the company are the Russian gas company Gazprom (51% of shares), German companies Wintershall and PEG Infrastruktur AG (Uniper) (both 15.5%), the Dutch gas company Gasunie (9%), and the French gas company Engie (9%).[109] Construction on the first line of the pipeline commenced in April 2010 and completed in June 2011. Construction of the second line began in May 2011 and completed in April 2012.

Example 2: Turkmenistan-Afghanistan-Pakistan-India Pipeline (TAPI)

The organizational structure of Turkmenistan – Afghanistan – Pakistan – India Pipeline (TAPI) is another example of centralized authority. The 1,800km pipeline aims to transfer gas from the Galkynysh Gas Field in Turkmenistan through Afghanistan and Pakistan, and then on to India. This grand idea dates back to 1995 when the governments of Turkmenistan and Pakistan signed a memorandum of understanding for the project. But forming the company was a protracted process. A consortium for TAPI – TAPI Pipeline Company Ltd (TPCL) – was only incorporated in the Isle of Man after a shareholders' agreement was signed in December 2015. Turkmenistan owns 85% of TPCL, while India, Pakistan, and

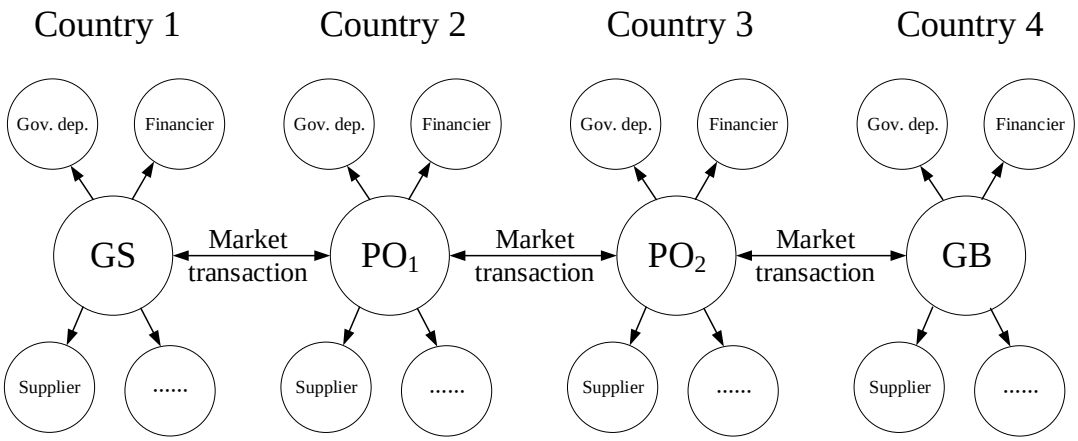
[109] Source: Nord Stream website.

Afghanistan each hold a 5% stake.[110] Construction on the project started in Turkmenistan on 13 December 2015, and is expected to start operations in early 2020.

Example 3: TransAdriatic Pipeline (TAP)

Trans Adriatic Pipeline (TAP) aims to transfer Caspian gas from the Trans Anatolian Pipeline (TANAP) at the Greek – Turkish border. It then crosses Greece, Albania and the Adriatic Sea to Italy and further on to Western Europe. The idea of the 878km pipeline traces back to an early announcement in 2003 by the Swiss energy company EGL Group (now named Axpo). But it took almost a decade to align the interests of the relevant governments. Then, in 2012, Albania, Greece, and Italy confirmed their support for the pipeline by signing a memorandum of understanding. The negotiations to agree on the structure of the company to build the pipeline were equally time-consuming, and construction delayed until 2016. The key shareholders of the overarching project company include BP, a leading oil and gas company (20%); SOCAR, the State Oil Company of the Azerbaijan Republic (20%); Snam, an Italian natural gas infrastructure company (20%); Fluxys, a Belgian-based independent gas infrastructure group (19%); Enagás, Spain's leading natural gas transmission company (16%); and Axpo, an energy utility with its operational headquarters in Switzerland (5%).

Exhibit 11 A Market-Based Approach



Note:
GS: Gas supplier
PO1: Pipeline operator in country 1
PO2: Pipeline operator in country 2
GB: Gas buyer
Gov. dep.: Government department

[110] Source: India should revive IPI pipeline: Parliamentary Panel. The Economic Times, 19 March 2017.

Exhibit 12 An Example of Market-based Approaches to Pipeline Development

Example: Iran-Pakistan-India Gas Pipeline (IPI)

The IPI project illustrates the implementation of a market-based approach to deliver a cross- border pipeline.[111] Iran has the world's second-largest gas reserves after Russia, and the export of gas from Iran to Pakistan was first considered in the early 1990s.[112] During the visit of Pakistan's prime minister to Iran in 2003, the project was revisited and a bilateral joint working group was formed not only to build a pipeline connecting the two countries, but extending it to India, too. The extension was acceptable to Pakistan because the pipeline offered revenues from transit rights. Half of the gas transmission capacity – 22bcm per year – would go to Pakistan and the other half to India. But it took India more than a decade to accept the idea of gas transmission over the territory of Pakistan, with which it has had various armed conflicts and an ongoing, unresolved dispute over the area of Kashmir. While major companies expressed interest in the project through an international holding company, including BHP, Petronas, Total, Shell, British Gas, and Gazprom, the idea floundered after it became clear such a company would struggle to acquire finance due to political reasons – a complication exacerbated by the 2008 financial crisis.

Since then, the plan has been for each country to own and build the portions of the pipeline separately in their respective territory. The IPI pipeline segment in Iran – 1,157km, at an estimated cost of $3bn at 2007 prices – will be owned and operated by National Iranian Gas Company.[113] The Government of Pakistan created its own company, Inter-State Gas System, to build the pipeline on its own territory and handle the import of natural gas into Pakistan – 1,035km at an estimated cost of $2.2bn at 2007 prices. And the Indian segment – 300km, at an estimated cost of $0.65bn at 2007 prices – will be owned and operated by Gail India Limited, a major gas utility in the country. But there has been limited progress because of a lack of political will and disagreement over transit tariffs and feed gas. While Iran has started construction, the work accomplished is limited; Pakistan has only identified a suitable corridor for its territory, and India almost abandoned the project in 2008 following US sanctions against Iran.

[111] Report: The Iran-Pakistan-India Pipeline Project: Cross-border Gas Pipeline Challenges.
[112] BP Statistical Review of World Energy, June 2017.
[113] Data source: The Iran-Pakistan-India Pipeline Project: Cross-border Gas Pipeline Challenges.

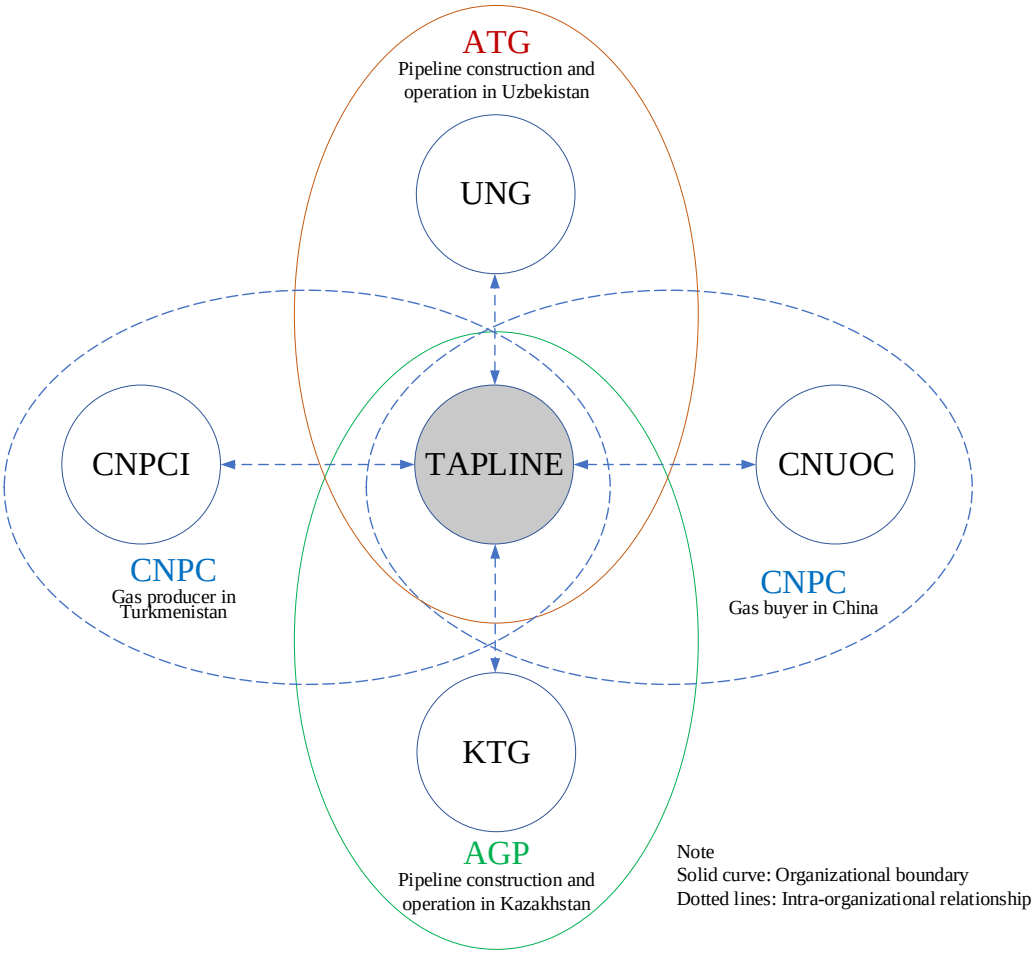



Exhibit 13 A Nearly Decomposable Approach