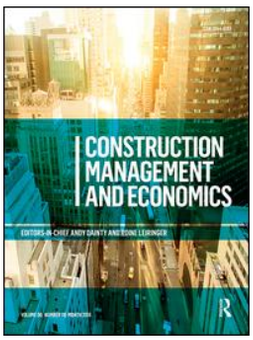

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Megaprojects: a meandering journey towards a theory of purpose, value creation and value distribution

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ABSTRACT

This paper departs from a reflection of how my time as a doctoral student in the late nineties with the lean construction group at U.C. Berkeley influenced my (ongoing) research journey. I first recall how those early years led to my core empirical and theoretical interests on the management of 'megaprojects' - the project-based, multi-party contexts that are set up by one or more organisational actors with the aim of developing capital-intensive, long-lived infrastructure resources. I also analyse the challenges that I faced in the pursuit of a theoretical perspective with power to predict and explain empirical regularities on megaproject behaviour, and thus capable of illuminating the pervasiveness of major cost and schedule slippages as well as scope creep. As well as this, I discuss how the discovery of Elinor Ostrom's commons governance theory was a watershed in my research journey. Then, drawing from organisational governance literature, I introduce and illustrate a model of the evolution of the governance structure of a megaproject over the project life cycle. I harness this model to draw inferences on megaproject organisational boundaries, on megaproject behaviour, and on how megaprojects create both economic *and* social value. Further, after conceptualising a megaproject as a purposeful interorganizational form of organising capital production, I discuss feedback loops and contingency variables that affect the gap between intended and realised project behaviour. I conclude with a discussion on how to leverage an organisational perspective of megaprojects to realise the potential of capital investment in new infrastructure to create value, as well as to engender trust in megaprojects, and thus mend their fractured relationship with society.

Each era's theories and prevailing arguments, in part, reflect the preoccupations of the times and coevolve with them[1]

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Introduction

I must admit that I hesitated to contribute to this Festschrift honouring Glenn Ballard. Of course, I am forever indebted to Glenn for co-supervising my PhD at U.C. Berkeley. Jointly with Iris Tommelein, my main supervisor, they equipped me with a set of constructs in 'lean thinking' and relationships between constructs that worked as a first compass to guide my empirical and theoretical interests on 'megaprojects': the capital-intensive projects to develop long-lived infrastructure resources that are shareable in use for an appreciable range of demand such as transport, energy and IT systems, social assets like hospitals and Olympic parks, and commercial assets like high-tech factories or oil and gaz pipelines.[2] Yet, although I do respect lean construction scholarship, after the PhD I chose to pursue a different identity as a design scholar operating at the interface between technology and organization studies. Since I have not followed the literature on lean construction for almost two decades, I lack the authority and credentials to join that conversation. Yet, if my narrow self-interest was telling me that a contribution to this Festschrift was a distraction, my heart was telling me otherwise. Glenn once told me, "some things seem important, others are important". As I recalled those words of wisdom, I realised I had to do this, come hell or high water.

Once determined to chip in, I asked: what can I say? Glenn's lasting influence on me was not in the realm of theory, but rather in terms of intellectual posture around asking important questions and pursuing answers for those with integrity and rigour as well as curiosity and passion. And indeed, since the PhD, my empirical discoveries and conceptual insights on the megaproject management problem have fuelled a research journey away from lean thinking (as well as away from project management (PM) literature for that matter) towards the pursuit of a theoretical perspective with greater power to predict and explain empirical regularities on megaproject behaviour. Unsurprisingly, these regularities relate to

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the intriguing pervasiveness of major cost and schedule slippages and scope creep, irrespectively of the surrounding context and form of finance. Indeed, slippages in megaproject targets are as common in advanced economies as they are in emerging markets, and slippages occur in both the public and private sectors (Gil *et al*. 2019, Gil and Yongcheng 2021).

Unlike many scholars, my research journey was not a straight one but rather meandering. But ultimately, I landed on organisational governance literature, which draws from new institutional economics (Ostrom 1990, 2005, Libecap 1989a, 1989b, Williamson 1975, 1985, Klein *et al*. 2019) and organisational science (Simon 1957, Scott 1995). To share where I am on this journey, as well as reveal the process through which I got to where I am today, is thus the core contribution of this paper. Specifically, I shed light on how insights derived from a series of empirical studies yielded a conceptualisation of a megaproject as an inter-organisational form of organising capital production. From this framework, I infer implications to our understanding of megaproject organisational boundaries and behaviour. Further, I discuss how megaprojects create both social *and* economic value, and how the distribution of value reflects the ultimate purpose of the megaproject.

Mindful this is a contribution to a Festschrift, I structure this paper as follows. I first reflect on the days at Berkeley, and the ways in which key ideas from lean thinking and new product development both influenced my doctoral research. I also examine early research work that I did right after leaving Berkeley where I mobilised ideas from design theory to make sense of the challenges that megaproject managers face. Further, I discuss how the discovery of Ostrom's (1990, 2005) theory on the governance of common-pool resources was a watershed in my research journey. Then I share a recent conceptual model of the evolution of a megaproject from an organisational governance perspective (Gil and Yongcheng 2021), and discuss how this model can be a stepping-stone towards the development of an organizational theory of megaproject purpose, value creation, and value distribution. I conclude by introducing a novel conceptualisation of megaprojects as a purposeful form of organising capital production, and discuss how it can be harnessed by scholars from differing research traditions, practitioners, and policymakers to create actionable knowledge and tackle the trust deficit between megaprojects and society.

Formative years at berkeley

When I arrived at U.C. Berkeley in the late 1990s, I needed to choose a team of PhD supervisors within the construction management group of the Department of Civil Engineering and Environment. The size of the group was small, which limited my choices. But after a round of talks, I quickly got convinced that I wanted to work with Iris Tommelein and Glenn Ballard who were spearheading a research agenda around the application of lean thinking to the delivery of capital projects (Tommelein 1998, Koskela 1992, Ballard *et al*. 2002). I was impressed by their methodological rigour and the novelty of the intellectual underpinnings as laid out in Womack *et al*. (1991), *The Machine that Changed the Word*. Further, there was excitement in the air around a shared idea that we were seeing a Kuhnian (1962) paradigm shift.[3] This is, that lean construction ideas and applications were about to dislodge the methods and professional norms that were espoused by Project Management (PM) professional bodies and scholars at the time. As Koskela (1992, p. 6) said, the "adoption of the new production philosophy will be a fundamental paradigm shift for the construction industry".

To complement the guidance of Iris and Glenn, I chose as a second co-supervisor Sara Beckman, an award-winning lecturer at the Haas Business School, who introduced me to management literature on new product development (Clark and Fujimoto 1991, Wheelwright and Clark 1992, ; Iansiti 1995, Ward and Liker 1995, Sobek *et al*. 1999). Outrightly, I related to the efforts to theorise the relationships between the goals of the firms, the task structures by which the firms pursue those goals, and the efforts of the firms to seek efficiencies and create valuable products and services that customers want to buy at a profit for the firm. There were also interesting overlaps between new product development and lean thinking literatures. For example, Womack *et al*. (1991) theorised the lean philosophy of production by observing the Toyota production system. Likewise, Clark and Fujimoto's (1991) comparative study of product development practices revealed how by drawing more engineering resources from parts suppliers than their competitors, the Japanese auto manufacturers gained direct access to the suppliers' know-how, allowing them to align their designs with the supplier production capabilities and to leverage supplier capabilities throughout the development process.

New infrastructure development

Influenced by the new product development literature, I chose to focus my doctoral research on the relationships between the "grand idea" motivating a new

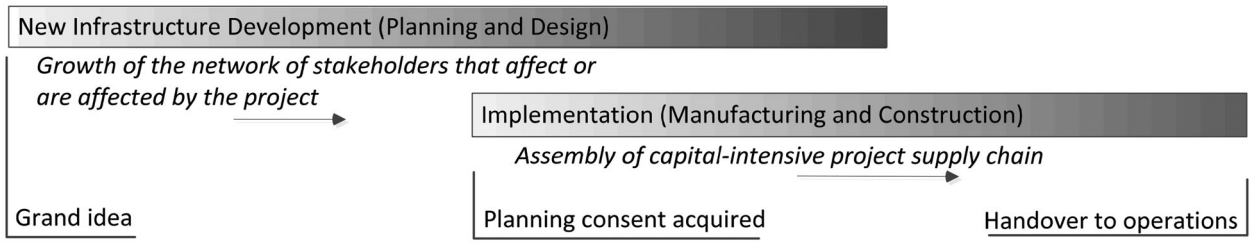


Figure 1. The Lifecycle of a New Infrastructure Development Project.

infrastructure project, the planning and design task structure, and the final design and technology choices – what I call the new infrastructure development process (Gil and Beckman 2009 ; Gil and Tether 2011, Gil, Miozzo and Massini 2012). A fundamental difference between new infrastructure development and new product development, which has major theoretical and practical implications as discussed later, is the fact that new infrastructure development tends to affect materially many organisations and individuals who are non-users of the project output. For example, building a railway may require expropriating private land and disrupting protected natural habitats. Likewise, a new offshore wind farm may ruin the views and create other nuisances for local communities. So a new infrastructure project cannot go ahead unless its promoter (the entity responsible for managing the project and mustering finance) acquires complementary resources such as land and consents, resources that are essential to realise the project and thus create value. This interdependence of the project with the environment constrains the space of design and construction solutions. Further, it leads to protracted negotiations with non-market stakeholders such as regulators, activists, interest groups, and local communities that have (or claim to have) legitimate rights over those essential resources. In other words, the negotiations to acquire non-market stakeholder resources impact, first, the infrastructure design that is possible to realise, and which encapsulates the instructions to carry on the construction and manufacturing tasks. And second, the negotiations with non-market stakeholders impact the market-based transactions with suppliers. Complicating matters, the tasks to develop a new infrastructure and implement it (e.g., transform the design into a usable artefact) overlap (Figure 1). This overlap occurs, sometimes extensively, because rarely the planning and design tasks are completed by the time when a sufficient bundle of resources (technology, capital, property rights, consents, know-how of user needs) has been assembled in order to enable to start the project implementation tasks.

This conceptualisation of the life cycle of a mega (infrastructure) project suggests important differences with manufacturing from an organisational perspective. New product development tends to precede mass production. For example, firms develop new designs for cars, Covid tests, vaccines and computers, and the designs hold the instructions for mass production. When consumers value bespoken products, consumers are given a choice to mix and match predesigned components. Still, it is up for the firm to develop the menu of choices based on which each consumer can tailor a product to her needs. Only in niche markets, one-off products may be engineered and manufactured to order such as a cruise ship. In contrast, new infrastructure development is about developing a site-specific prototype based on the (evolving) needs and claims of many autonomous organisations and individuals, many of which are non-users of the future asset. Of course, in some situations, the project promoter is also the user, for example a power plant to be built by an electric company. And even if promoter and future users are autonomous actors, the promoter may still capture the economic value to be created by charging user fees, e.g., a toll road. But in other cases, a project promoter may operate under a mandate to distribute the value to be created with non-users, for example, a railway financed by a public agency but to be developed jointly with the local authorities of the cities on the route.

Organisational differences notwithstanding, my PhD was directly influenced by the seminal claim that the early involvement of parts suppliers in product development was central to the performance advantage of Japanese manufacturers (Womack *et al.* 1991, Clark and Fujimoto 1991). Specifically, I explored the idea if it would be worth involving specialty contractors early on in new infrastructure development (Gil *et al.* 2001). Specialty contractors, for example roofers, pipefitters and electricians, often called second-tier contractors because they tend to be appointed by the main contractor, rarely get involved early on in new infrastructure development. So, I asked: *can the early*

involvement of specialty contractors lead to extra efficiencies and outputs that are more valuable?

Early supplier involvement in new infrastructure development

I am an empiricist at heart. And I was lucky that for my doctoral studies, our industrial partner was IDC, a consultant specialised in the design of semiconductor fabrication facilities ('fabs'). Fabs are the high-tech facilities that house the manufacturing tools necessary for the production of semiconductors (chips). To collect data for the core research question, I spent two summers in Portland, Oregon. A main client of IDC was Intel, the chipmaker, which had an industrial campus outside Portland and a long history of working with IDC. Working for Intel was challenging. Because of the fast-paced nature of the semiconductor industry, fabs need to be delivered quickly since the earlier a chipmaker arrives to the market with a new chip that has no rival at the time, the more it can benefit from higher-priced sales until the competitors catch up.[4] Further, due to increased competition from Asian chipmakers, Intel was under pressure to bring the fab construction costs down (which in the early 2000s were reaching $2billion). Increasing the attractiveness of the research setting was Intel's Copy Exactly Technology Transfer policy, by which the chipmaker instructed IDC to reuse the blue prints of the Technology Development (TD) fab when developing the High-Volume Manufacturing (HVM) fabs. The Intel's policy asked the consultants to "exactly copy everything about equipment and its installation down to diameters of piping and number of bends" (McDonald 1998). By reusing the design of the TD fab when developing the HVM fabs, Intel was seeking to shorten the elapsed time that would take to transfer technology across the fabs without compromising the chip production yields (Gil *et al.* 2005). Further, Copy Exactly made it easy to move Intel staff between fabs, building resilience in the Intel global production facility network to cope with local disruptions.

As I started to collect data about Intel fab projects, I encountered a fab development process that was beset by requests for late design changes. These changes complicated the relation between Intel with the fab project suppliers in that they caused not only rework cycles and delays, but also difficult negotiations to adjust the prices ex-post contract award. And so I asked: where do late changes come from? Would involving the specialty contractors early on make a difference? Were fab designers and contractors behaving opportunistically? As I sought answers for these questions, I realised that I needed to talk to Intel. Getting to Intel was not a walk in the park. Understandably, IDC was nervous that I would talk to their client. Luckily, after toying with possible e-mail addresses for Intel vice presidents, one e-mail did not bounce back, and I was introduced to Art Stout, the director of the Intel Capital Development group. This then led to a memorable meeting at the Intel campus that brought together top managers from IDC and Intel and the research team (myself, Iris and Glenn).

Unexpectedly, the access to Intel revealed that most design change requests could be traced, not to lack of coordination between Intel and fab designers like IDC, but to late evolution of the fab requirements. This evolution was rooted in the extreme levels of concurrency and interdependency between the development of the chip technology (and corresponding development of manufacturing tools and assembly processes) and the development of the R&D and HVM fabs themselves. As a result, any late change in the chip technology had a direct impact on the fab projects that were progressing concomitantly. Both development processes were crucial to the Intel business.[5] Still, the scientists developing the chips wanted flexibility to change the fab requirements as late as possible. Reconciling their calls for adaptability – a classic problem of organisation (Barnard 1938) - with pressure to shorten the fab delivery time and to bring the construction costs down was a tall order. It also meant that high uncertainty in requirements was a key attribute of the tasks to be carried out by the fab project suppliers. Given this uncertainty, gaining direct access to the specialty contractor's know-how early on in the fab development process was surely advantageous from a production perspective. But writing a contract to govern the buyer-supplier relationship under high uncertainty was not trivial. This governance problem spoke to transaction cost economics (TCE), a vast body of literature that could thus not be ignored to further our understanding of the organisation of capital production.

Supplier opportunism and the hold-up problem

As an institutional economics theory rooted in the question of why firms exist, transaction cost economics (TCE) seeks to illuminate when an organisation is better off keeping production inside its organisational boundaries as opposed to engage in market transactions or relational forms of contract with other parties (Coase 1937, Williamson 1985). Briefly, TCE claims that

when uncertainty is high, the suppliers have incentives to behave opportunistically to increase profit (Williamson 1985, Williamson 1993). This is because uncertainty forces the buyer to sign an incomplete contract to be completed through negotiations during the contract period. And so, ex-post contract award, if conditions change, the supplier may refuse to continue to supply, or to supply at a pre-set level of performance, unless its increased demands are met (Williamson 2003). The propensity for suppliers to act opportunistically increases if the frequency of the buyer-supplier exchange is low, and thus reputation concerns are unlikely to constrain the suppliers' behaviour. The incentives for suppliers to behave opportunistically augment too under conditions of high asset specificity (Williamson 1985, 1990). Asset specificity is a measure of non-redeployability of the supplier investment in a buyer-supplier relationship and can take a variety of forms, e.g., physical, human, or site-location. If asset specificity is low, competition works well after contract award. But as asset specificity builds up, bilateral dependency between the buyer and supplier sets in after contract award, and complications emerge since the buyer's ability to switch suppliers is constrained by time or site-specific investments (Williamson 2003).

Because in megaprojects the contractors that are selected to deliver the main work packages tend to make one-off, site-specific investments that are not easy to redeploy to other projects or substitute by the buyer, e.g., acquiring heavy machinery or setting up a construction yard, the promoter-contractor transactional relationship tends to show high asset specificity (Winch 2006, Drews 2017). And so, from a TCE perspective, there is a real risk of these contractors behaving opportunistically ex-ante contract award (by deliberately bidding low) and then seeking to hold up the promoter ex-post contract award (by requiring compensation for change orders, litigated to the maximum).

To deter suppliers from behaving opportunistically, TCE suggests that a buyer can adopt a cautious approach, employing extensive contractual and control mechanisms (Williamson 1985).[6] This was the Intel approach, in alignment with prevailing PM practices at the time (Stinchcombe and Heimer 1985, Lenfle and Loch 2010). Yet, things have changed in the last two decade in many parts of the world (but not everywhere). And as more evidence accumulated that rigid contracts and control systems cannot avoid cost hikes in supplier contracts, many megaproject promoters have shifted towards the use of forms of contract that are more flexible with safeguards built in (Pitsis *et al.* 2003, Gil 2009a). Of course, the use of flexible contracts is not free in that it incurs transaction costs, which are the costs of organising a transaction using price mechanisms, including the costs of competitive bidding, of bargaining over the terms of trade, of writing the contract, and of enforcing and monitoring the behaviour of the contracting parties (Williamson 2003). To reduce transaction costs, alternatively, a buyer can invest in relational contracts, which refers to collaboration sustained by the contractible shadow of the future or past as opposed to contracts enforced by courts (Gibbons and Henderson 2012). Building a relational contract is difficult, however, because it requires resolving the problems of credibility and clarity. And if credibility might in principle be instantly acquired, clarity tends to take time to develop (Gibbons and Henderson 2012).

In TCE theory, the assumption of supplier opportunism (defined as 'self-interest seeking with guile') is rooted in the frailties in human nature (Williamson 1975 pp. 26-37) and self-interest.[7] Yet, this behavioural assumption has been disputed (Ostrom 1990). And in fairness to efforts to develop relational forms of buyer-supplier contracts in construction (e.g., Gil 2009a, Pitsis *et al.* 2003), some empirical studies suggest it is possible to create an expectation that suppliers will not exploit commercial vulnerabilities even when there is an incentive to do so (Conner and Prahalad 1996, Kogut and Zander 1996, Noteboom 2002). Still, by the end of my PhD, I could not see how lean thinking could help managers deliver megaprojects within ambitious cost targets and completion dates, whilst under increasing environmental pressure to act more collaborative with nonmarket stakeholders and suppliers.[8] As I was about to leave Berkeley, I met Glenn to say farewell. Knowing that I would stop at Boston first, Glenn told me, "read this book", *Design Rules,* from two Professors at the Harvard Business School (Baldwin and Clark 2000). And this set me off in a search for an alternative cognitive lens to make sense of the world as I was seeing it on the field. Further, since I was moving to the UK for a lectureship at the University of Manchester, generous as usual, Glenn gave me access to top managers at Terminal 5 (T5), a £4.5 billion project to build a new terminal campus at Heathrow airport.

From lean thinking to design modularity

The T5 project, from a case study perspective, was "unique and extreme" (Yin 2003) because lean practices were being adopted in an experimental way with the help of consultants[9], making T5 a good setting to further our empirical and theoretical understanding of

megaproject behaviour. The promoter was British Airports Authority (BAA), a private firm that owned the Heathrow airport and had a guaranteed return on the capital investment, together with the Civil Aviation Authority, the industry regulator. Between 1990 and 1999, BAA had been led by Sir John Egan who, as a former executive at Jaguar, believed that T5 could not be "business as usual", but rather should learn from the automotive industry.[10]

When I started the fieldwork on T5, I got intrigued by BAA's Last Responsible Moment (LRM) policy (Gil and Tether 2011). Similar to the Intel fab projects, the LRM policy recognised that uncertainty in the T5 requirements would remain high throughout the construction and manufacturing tasks. The reason was the time it would take to develop T5 was at odds with the short planning horizons for the airline industry: just acquiring consent for the T5 concept design had taken more than ten years, from 1988 to 2001, and the first phase of the T5 campus was not expected to open before 2008. Yet, during this period, the airline industry was going through major changes with the boom of low-cost carriers, e-ticketing, superjumbo aeroplanes, and an overhaul of security measures. Hence, it was impossible for British Airways (BA), the main occupier of T5, to tell BAA their needs years in advance. So, the LRM policy worked as a compromise by which BAA committed to project suppliers to freeze the design as early as possible, whilst giving the airlines as much time as possible to define their user requirements.

When modularity in use *is not within reach*

Because at the core of the T5 project was again a problem of coping with high uncertainty in requirements, to guide data collection and analysis, I had the idea of deploying design literature on the power of modularity to respond to pressure for adaptability (Baldwin and Clark 2000). This literature draws from design theory and specifically from Simon's (1962) notion of near-decomposability: the idea that in systems that exhibit a hierarchy of components, at any level of the hierarchy, the rates of interaction within components at that level tend to be much higher than the rates of interaction between different components. In management literature, the idea of near decomposability has been harnessed to make sense of the ability of some product architectures to cope with uncertainty, where product architecture is defined as the scheme by which the functional elements of a product are arranged in building blocks and by which these blocks interact with one another (Ulrich and Eppinger 1995). The term 'modularity' was subsequently coined to characterise a design architecture by which a product is decomposed into separate functional components (modules) that are loosely coupled to one another (Baldwin and Clark 2000). When a product architecture is modular, not only there is a one-to-one correspondence between modules and functions, but also the rules that govern the interfaces between modules are standardised and verifiable. Hence, in a modular product, a module can be replaced or added to respond to change without affecting the functionality of the system as a whole (Baldwin and Clark 2000). In other words, modular products can adapt economically to changes because local changes require limited need for coordination and cooperation between the developers of the components (Thomke 1997). The opposite of a modular design is an integral design in which no clear division exists between the components and thus the components are tightly coupled to one another.

Design modularity is central to the profitability of the computer industry (Baldwin and Clark 2000) and, more recently, it has been shown to be at the core of the rapid growth rates that are being achieved by new forms of organising including business ecosystems and digital platforms (Jacobides *et al.* 2018). When the main element flowing between modules are electrons, the costs of decomposing a product architecture are outweighed by the benefits (Cusumano 1997, Baldwin and Clark 2000). Further, product modularity is an enabler of set-based design, a practice by which manufacturers consider a broad range of possible product designs and then gradually eliminate weaker solutions in response to a changing environment (Ward and Liker 1995, Sobek *et al.* 1999). To take advantage of set-based design, manufacturers leverage their centralised decision-making authority to instruct the designers to outline sets of possibilities and the implications of choosing one alternative over another, and to leave the options open for as long as possible (Ward and Liker 1995, Sobek *et al.* 1999).

As I deployed modularity literature to guide and interrogate T5 data, it dawned on me another fundamental difference between new infrastructure development and new product development (Gil and Tether 2011). In both settings, the development process would stop not when the participants would reach an optimal solution but when they encountered a 'satisficing' (Simon 1962) solution that all participants would find acceptable. But unlike the world of new product development, in T5 I saw limited ability

to modularise product architectures because of laws of gravity (Gil 2009b, 2009c). Of course, an airport terminal consists of many functional elements such as terminal concourses, airways and control tower. And substantive investment was made in T5 to exploit the advantages of off-site construction, a form of modularity *in production*. But as construction progresses, in T5 as in most (physical) infrastructure projects, the functional elements become tightly coupled to one another, which hinders modularity *in use*. For example, in T5, the concourses became linked to one another by tunnels and baggage systems that run under the airways. So, as construction progressed, it became difficult to make changes to one functional element without having to adapt other elements too.

Further, the fieldwork on T5 revealed that decomposing the inner product architecture of each functional element to enable modularity *in use* was difficult too. The T5 airport concourses required foundations to support the columns, which were designed to hold the slabs and the roof. Whilst the roofs could be decomposed into cassettes to be manufactured off site, once the roofs were assembled on site on top of the steel and concrete superstructures, the structural elements for each concourse became tightly coupled. Physically entwined with the structural systems were the mechanical, electrical and plumbing systems. The design of all these building systems depended on assumptions about the loads, which in turn were a function of the occupancy strategy. Hence, any major change in the occupancy strategy had a direct impact on the design of all the building systems. And yet, what key stakeholders such as airlines, border agencies and retailers wanted was precisely flexibility to change the T5 occupancy strategy as late as possible to meet the late evolution in their user needs.

If modularising a product architecture to enable low adaptation costs is technologically unfeasible, an alternative to increase adaptability is to make conservative design assumptions. This is the idea of 'safeguarding', which I developed through inductive studies of T5 (Gil 2007, 2009b). Safeguarding, also called 'future proofing' in industry parlance, is about designing in allowances for a number of forward-looking scenarios in use. Put simple, safeguarding is about leaving the options open. Safeguarding is passive if the allowances are not implemented to economise on capital costs and active if the allowances are implemented. For example, a bridge can be designed for a scenario in use where a railway will run under the car lanes. Yet, if demand is low during the first operational decades, there is no need to build the railway although the geometry of the deck can be passively safeguarded for that day. But as the foundations of the bridge would be too costly, if not impossible, to reinforce at a later date, these can be actively safeguarded for the ultimate scenario in use.

Design safeguards create adaptability to accommodate late change requests but demand a capital investment that not always is affordable. Further, there is a real risk that the capital investment will not pay off. For example, BAA built a tunnel and extra platforms at the T5 railway station to leave the option open to expand further the airport capacity in the future, whilst mitigating a risk of an unacceptable increase on CO_2 emissions. Still, as the plans to add a third runaway and add a new terminal fail to get consent, it is unclear if the safeguards will ever pay off. Other times, investments in safeguards are designed in early on, but as the project cost starts to escalate, the safeguards are removed in late value engineering exercises. For example, when the T5 budget came under pressure, the safeguards built in the mechanical system by sizing equipment conservatively were designed out (Gil & Tether 2011). Hence, as I looked at megaprojects from the lens of modularity, I realised these settings did not exhibit the product decomposability that was premised in new product development studies.

Relatedly, my findings revealed that infrastructure design choices were directly influenced, invariably, by multiple stakeholders, which was in marked contrast with the centralised authority of the firm premised in product development studies. Some stakeholder groups such as users (e.g., airlines in T5 or scientists in Intel fabs) are part of the megaproject value chain as traditionally understood (Stinchcombe and Heimer 1985, Merrow *et al*. 1988, Morris 1994, Koskela 1992, Winch 2010). Others such as local communities, interest groups and regulators are non-users and thus lie outside the traditional project value chain. Yet, in the same way that users have know-how essential to create value, local communities, regulators and others also control essential resources to value creation such as access to land, land, and consents. And yet, these stakeholder resources rarely can be acquired through market mechanisms in that they often exist in non-market environments, or are hard to decompose into a 'contractible transaction' (Baldwin 2018) that can be defined, counted and monitored. Rather, to foster non-market stakeholders to volunteer resources, it is tempting for a promoter to share with them decision-making authority over the use of the promoter resources. By committing to search for mutually consensual

solutions, non-market stakeholders are encouraged to cooperate (Gil and Baldwin 2013). But as the promoter's managers become stewards accountable to many stakeholders, a problem of collective action arises. This problem had been overlooked by the PM and lean literatures, but not by collective-action scholars notably Elinor Ostrom, an institutional economics scholar who went on to share the Nobel economics prize with Oliver Williamson.

Elinor Ostrom's theory on the governance of common-Pool resources

Collective-action problems arise when autonomous actors face a situation in which there is a tension between self-interest and the collective interest (Olson 1965, Hardin 1968, Ostrom 1990). This tension relates to the use, or consumption, of common-pool resources - resources that are shared by many autonomous claimants (so property rights are shared and ill-defined) and have two attributes: First, the resource is *rivalrous* (or *subtractable*) because the use, or consumption, of the resource by one claimant reduces the flow of benefits to others. For example, if villagers are able to graze their livestock in a common land, the more ruminants are put out to graze, the less fodder is available for the rest of the population. And second, the resource has *low-excludability* because it is costly to limit the access of the legitimate beneficiaries either by physical means or through property rights (Ostrom 1990). In the context of managing natural resources, collective-action problems lead to "take-some" social dilemmas (van Lange *et al.* 2013). These are situations in which an individual action that benefits the self (often in the short-term) leads to long-term losses for all, e.g., overfishing or overgrazing can make someone a short-term winner, but leaves everyone worse off in the long term.

According to Garrett Hardin (1968), who first identified the "tragedy of the commons", managing a common-pool resource would require a hierarchical form of governance, either through government regulation or private ownership. Olson (1965) was similarly pessimistic about the ability of individuals to maintain collective goods. Without some form of compulsion, Olson argued, individuals will not voluntarily pay their proportional share of the cost of maintaining or building a shared good but will instead free ride. Against the backdrop of claims that in collective-action situations, individuals choose to free ride and thus do not to pull their weight in the expectation others will do, Ostrom began to study the actual management of shared resources from community-owning pastures in the Alps and irrigation channels in Sri Lanka to underground water basins in California (Ostrom 1990, 2005). And her research encountered many cases of sustainable commons where the claimants had succeeded to self-organize themselves on a day-to-day basis and adapt to changing circumstances.

Through extensive empirical work and lab experiments, Ostrom (1990, p.91–102) proposed a theory of commons governance, positing a set of eight principles to design a robust commons. These principles include having in place monitors who are accountable to all the claimants and graduated sanctions to punish rule-breakers; organisational boundaries that clearly define who is (not) a claimant; congruence between the rules determining individual benefits and costs; affordable conflict-resolution mechanisms; and respect of higher authorities for local rule. Further, to sustain a large commons, Ostrom argued, the governance structure should be decentralised across multiple centres of decision-making authority and nested levels of collective action and rule making, what she called *polycentric* governance. Meeting all principles is not necessary for commons governance to be robust, but the more they are implemented effectively, the higher the chances the commons is sustainable.

Why is Ostrom's theory of commons governance relevant to megaprojects?

Any megaproject is a problem of production of a man-made resource. In these settings, collective-action problems can take the form of "give-some" social dilemmas (Van Lange *et al.* 2013, Bridoux and Stoelhorst 2020). These are situations in which an action that has negative consequences for the self, if performed by enough of the participants involved, leads to gains for all. For example, if many project participants are unified by a higher-order goal, and yet they have differing legitimate preferences over a one-off design choice, they have more to gain by compromising than by behaving competitively. A compromise may require sacrificing some individual utility but avoids a dispute that could lead to an impasse where all lose. In other words, in a give-some dilemma, one actor may find it tempting to cooperate not because cooperation yields superior outcomes for the self, but because, if cooperation encourages others to cooperate as well, all are better off in the end (Bridoux and Stoelhorst 2020).

Give-some dilemmas happen in megaprojects when non-market stakeholders who control valuable

resources to complete the project gain rights to influence directly governance-related decisions on the use of the promoter resources (Gil and Baldwin 2013). This sharing of decision-rights occurs when, to motivate stakeholders with high reciprocal task and/or outcome interdependence to cooperate, stakeholders are invited to join local structures of decision-making. For example, in a seminal study, Gil & Baldwin (2013) show how a local authority promoting new school buildings to replace the old ones gave teachers decision rights to gain access to their know-how of the needs-in-use and encourage goodwill during decanting from the old buildings to temporary premises and then to the new buildings. So, this governance choice encouraged the teachers to volunteer resources that would be hard to acquire otherwise.[11] But this choice also led to many collective action problems because of high rivalry over the one-off design choices in a context of tight and rigid project budgets.

It is in the gift of a megaproject promoter to choose to decentralise or not the organisational governance of a megaproject. The more the promoter adds local structures of shared decision-making and joint value creation, the more project governance becomes 'polycentric'. By gaining local decision rights, the stakeholders gain incentives to interact with one another and volunteer resources to the local tasks, which gives legitimacy to the value creation process (Bridoux and Stoelhorst 2020). Further, by committing to a fair distribution of the value to be created jointly, the promoter responds to basic human cravings for inclusivity and equitability (Fehr & Gintis 2007, Ostrom, Walker & Gardner 1992). But this governance choice also leads to give-some dilemmas. When the promoter and many autonomous stakeholders have different priorities for a one-off design choice and the project budget is rigid, one actor's preferences preclude another's, diminishing the value of the final design solution for the other. Hence, the enfranchised stakeholders have an incentive to cooperate to create local value jointly, but also to compete to appropriate as much as possible of that value. If the promoter then also acts competitively, an impasse can emerge. If, in the face of an impasse, the institutions make it costly for the promoter to shirk the commitment to create value jointly, the resources that *de jure* are controlled by the promoter become a *de facto* common-pool resource (Gil and Baldwin 2013).

To mitigate the risk of collective-action problems undermining cooperation, empirical accounts suggest that the promoter's managers keep a 'lead-role' (Bridoux and Stoelhorst 2020) within the local groups (Gil and Pinto 2018). Still, at local level, the promoter is one decision-maker among many and its managers are accountable to the stakeholders. Hence, as the decision-making process gets more democratic, collective-action problems become a major source of uncertainty. In the pursuit of mutually consensual solutions, it can be tempting for the promoter to relax the local cost and schedule targets (Gil and Pinto 2018). But this cooperative move is not without political costs in that cost and time slippages undermine the legitimacy of the promoter to use the project resources in the eyes of other third parties (Dennis *et al.* 2011). This is thing: to develop an infrastructure, the promoter needs to acquire vast nonmarket resources to realise a value proposition that is likely to be ambiguous. To reduce this ambiguity and gain legitimacy to acquire those resources, the promoter has to promise to deliver the project on time and within budget. So any decision to relax these targets later on, even if it adds legitimacy to the value creation process from the perspective of the enfranchised stakeholders, compromises the promoter' legitimacy to use its own resources from the perspective of the outsiders.

Recent accounts suggest, however, that megaproject promoters can attenuate collective-action problems by getting the governance structure right (Gil and Baldwin 2013). This speaks to Ostrom (1990)'s principles of collective action, and thus to the promoters' ability to set in place graduated sanctions and independent monitors; to define clear organisational boundaries, and to create affordable conflict-resolution structures in order to reassure enfranchised stakeholders that they will not be the dupe of others if they dispose to cooperate. In other words, to encourage stakeholder cooperation, the promoter needs to be perceived as a neutral party despite its stake in the outcomes and heterogeneity in the subgoals and values that are espoused by the promoter and the enfranchised stakeholders. Still (solving) collective-action problems is a 'struggle' (Dietz, Ostrom and Stern 2003), which leads to high uncertainty in project requirements. Hence, by illuminating the collective-action problem at the heart of megaprojects, new insight is offered as to why they behave the way they do.

Megaprojects: an organizational perspective

Theoretically, my research journey ultimately led me to organisational literature. From this perspective, a megaproject is seen as a project-based

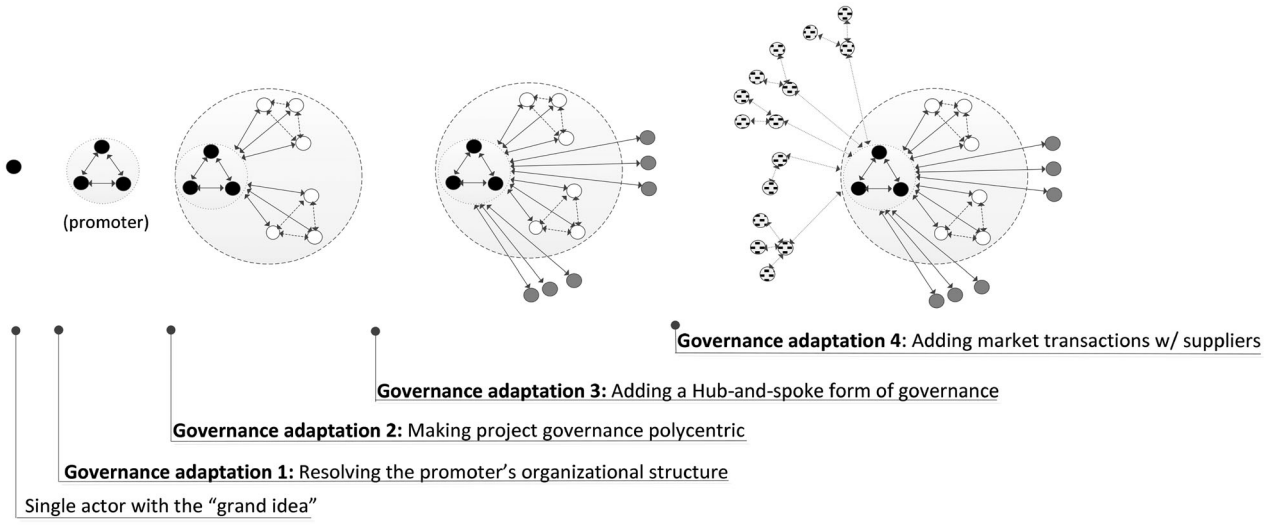


Figure 2. Evolution of the Organisational Governance Structure of a Megaproject (adapted from Gil & Yongcheng 2021).

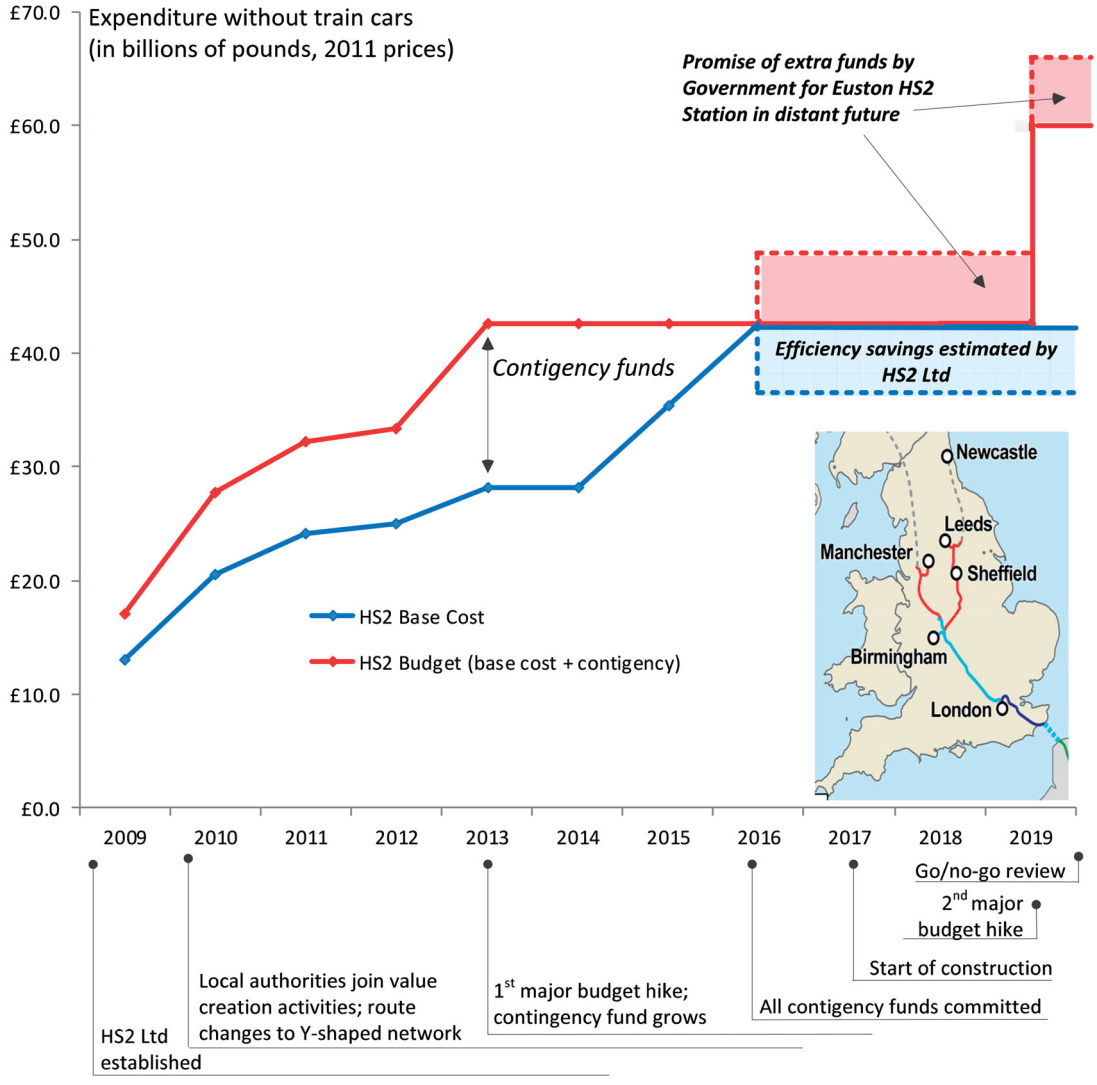
interorganizational context, or 'meta-organisation' that unifies many autonomous actors under a higher-order goal (Lundrigan *et al.* 2015). Looking at a megaproject from this lens offers new insights on why they behave the way they do. Still, it is not my aim to claim a paradigm shift or dislodge extant explanations for delays and cost overruns, but rather contribute to reconcile them. Salient among those are claims that trace target slippages to the lack of managerial capabilities (Morris 1994), optimism bias (Flyvbjerg *et al.* 2002), or failure to prevent escalation of commitment to a losing course of action (Staw 1981). More controversially, Flyvbjerg *et al.* (2002) claim (speculate?) that managers set unrealistic targets because of incentives in the budgeting process. Other scholars trace target slippages to uncooperative behaviour by powerful stakeholders (Miller and Lessard 2000), collective action problems (Gil and Pinto 2018), suppliers' opportunistic behaviour (Winch 2010), and exogenous factors that lay beyond the control of the promoter (Love *et al.*). To move forward the debate, I propose next a conceptual model that illuminates the evolving organisational governance structure of a megaproject.

A model of megaproject organizational governance

Organisational governance relates to the rules and procedures that control resource accumulation, development, and allocation; the distribution of the organisation's production; and the resolution of disputes (Chandler 1962, Williamson 1985). Put simple, the governance structure establishes the boundaries of the organisation ('who is in and who is out') and the value distribution ('who gets what') (Klein *et al.* 2019). In a megaproject, the governance structure is thus responsible for the decisions that set the performance targets and determine the ability to stay or not within those targets. Bringing key stakeholder groups "in" and inviting them to create value jointly is a choice by which the promoter's managers seek to gain access to essential nonmarket stakeholder resources. Alternatively, to acquire those resources, the promoter can adopt a traditional 'hub-and-spoke' form of governance (Bridoux and Stoelhorst 2020), with the promoter's managers as the hub and the stakeholders at the end of spokes that only relate to the hub through independent, bilateral relations (Gil and Yongcheng 2021). To shed light on these governance choices and implications to value creation, I conceptualise the evolution of the megaproject organisational governance structure in terms of four main adaptations, illustrated in Figure 2. The four adaptations are shown sequentially for the sake of exposition, but they can be expected to overlap to a greater or lesser degree according to the surrounding context. To illustrate the discussion, I use the case of High-Speed 2 (HS2), a megaproject to deliver a railway network for the UK in two phases over the first half of the XXI century: first, a 225km (140miles) line connecting London to Birmingham, and then two branch lines totalling 306km (190 miles), one connecting Birmingham to Manchester and another to Leeds (see Figure 3).

Governance adaptation 1: Resolving the promoter's organisational structure

At the very core of a megaproject lies the promoter, a hierarchical structure where the decision-making authority is centralised in the hands of the promoter's



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

	2009	2010	2011	2012	2013	2015	2016	2017	2020
without WEIs	2.4	2.3	2.2-2.3	1.6-1.9	1.8	2	2.1	1.9	1.1-1.2
with WEIs	2.5-2.9	2.7	2.0-3.4	1.8-2.5	2.2-2.3	2.5	2.7	2.3	1.3-1.5

The Benefit-cost ratio (BCR) summarises the value for money (VfM)
VfM is "high" if BCR >2; VfM is "medium" if 2> BCR >1.5, and VfM is "low" if 1.5 >BCR >1

Figure 3. HS2: Evolution of budget, cost forecast, and Benefit-Cost-Ratio (BCR) (Data compiled from numerous public documents.

managers. The governance structure of the promoter varies, however, according to the extent to which a single actor has sufficient resources or not to pursue the 'grand idea'. For example, in 2009, to develop HS2, the UK government set up a public company, HS2 Ltd, and delegated on the HS2 top managers powers to make day-to-day management decisions[12]. HS2 Ltd is an agent of the UK government. Yet, although some governance-related decisions have to be approved by the UK Ministers, the latter rarely go against the advice of HS2 Ltd. Thus, it was very much up to the company's managers to determine the route for HS2 with an aim to maximise the economic value to be created as well as to set up project performance targets.

In contrast, in other cases, a temporary alliance needs to be set up to promote the project, bringing together a group of autonomous actors who are committed to pool resources in the pursuit of a higher-order unifying goal. Since an alliance is a voluntary arrangement that involves a shared form of governance by which all its members have relatively equal say (Powell 2003, Williamson 1985), its members must negotiate a proposition to create value jointly. As the

promoter's structure evolves into a shared form of governance, reconciling different distributional preferences can take years during which the project targets slip considerably (Gil and Yongcheng 2021). But many accounts show that once the promoter members reach a collective agreement, this leads to a strong commitment to create value jointly, which prevents defections. For example, the structure of the promoter of the London Olympics 2012 evolved from a single actor, the British Olympic Association, into an alliance with the UK government, the Greater London Authority (GLA), and the International Olympic Committee (Gil and Lundrigan 2012). And after the UK won the Olympic bid, the four actors formed a project governance board where all shared veto power.[13] Likewise, the promoter of Crossrail, a multi-billion pound commuters train linking the West and East of London, evolved from a single actor, the UK government, into a joint venture with GLA (Gil and Lundrigan 2013, Gil and Pinto 2018).

Governance adaptation 2: Making project governance polycentric

Once a project promoter settles on a higher-level goal and corresponding proposition to create value, the promoter needs to acquire complementary resources to value creation. Many of these resources are controlled by nonmarket stakeholders that, as sovereign entities, cannot be internalised in the promoter's hierarchical structure. Yet, their resources (e.g., consents, know-how) are also not amenable to be acquired through transactions or regulation. To encourage these nonmarket stakeholders to volunteer their resources, the promoter can share local decision rights with them over the use of the promoter's own resources (Gil and Baldwin 2013). As the promoter sets up multiple local groups of shared decision-making, the promoter's managers lose the last word on how local conflicts are resolved, and thus the project governance becomes 'polycentric' (Gil and Pinto 2018). Within each local group, the promoter keeps a 'lead role' in governance matters (Bridoux and Stoelhorst 2020). But the promoter is one decision-maker among many, and thus is accountable to the stakeholders who also interact among themselves. In other words, the promoter's leadership position is only secure if it plays a facilitator role in reaching an agreement on a value distribution that is perceived to be fair by all.

For example, two years after HS2 Ltd was established, its managers had created multiple local working groups, one for each station on the route, in order to agree the location of each station and the design solution with the respective local authorities (Msulwa and Gil 2014, Msulwa 2017). Unified by the higher-order goal, the local authorities agreed to volunteer effort, time, and know-how of local needs and constraints, whilst accepting the lead-role of the HS2 managers. Still, the bargaining was tough and protracted: HS2 Ltd tried to keep to the initial cost targets, whereas the local authorities demanded to renegotiate the rules for creating and distributing value (Yongcheng and Gil 2019, Yongcheng 2019). For example, the local authorities of the cities of Manchester and Leeds asked for the respective stations to be moved to the centres of the cities and to be integrated with the existing stations to stimulate urban regeneration and local job creation. Yet, the changes were difficult to agree because they would add significant capital cost to the project, which could undermine the legitimacy of HS2 Ltd in the eyes of third parties. Yet, the shadow of the state made it costly (but not impossible) for HS2 Ltd to go back on the word to share decision rights with any local authority which had been invited to join in. So, the resources that *de jure* were controlled by HS2 Ltd became *de facto* non-excludable and rivalrous.

Adaptation 3: adding a hub-and-Spoke form of governance

Given that there is a real risk of collective-action problems undermining stakeholder cooperation, empirical studies suggest that the megaproject promoter's managers will exclude many stakeholders from directly participating in governance-related decisions and instead choose to trade independently with each one (Gil and Yongcheng 2021). By adopting a hub-and-spoke form of governance, the promoter's managers gain latitude to align interests by using market mechanisms. Because many stakeholder resources are site-specific, they are 'strong complements' (Hart and Moore 1990, Grossman and Hart 1986) for the promoter in that the value of the promoter's resources is greatly diminished except in the presence of the stakeholder resources. Yet, many stakeholders (but not all) may see limited or no value at all in the promoter's resources. In other words, for many stakeholders, the resource complementary may not operate in 'two-ways' (Baldwin 2018) in that the promoter's resources are not valuable to the stakeholder and thus there is no symmetry in the economic exchange. Because of differences in the quality of the resource complementarity, the quality of the promoter-

stakeholder bilateral relations varies significantly (Gil and Yongcheng 2021). In some cases, the conflicts can be resolved cooperatively by aligning interests through communication and market mechanisms. In other cases, the promoter-stakeholder interactions become competitive and managed on a power differential that involves dominance and confrontation (ibid).

In the HS2 case, for example, once HS2 Ltd optimised the route, over 60,000 nonmarket stakeholders were identified that controlled valuable site-specific resources including land, access to land, and property[14]. Complicating matters, the majority of the stakeholders saw no value in parting ways with their property or having a railway passing nearby, and thus the resource complementarities operated one-way. Yet, historical data suggested that if the HS2Ltd enfranchised the stakeholders through transparent communication, it was possible to align interests using market mechanisms. And thus after a 6-month consultation, and by making concessions that went above and beyond its legal obligations, for the first phase, HS2Ltd managed to align interests with about ninety percent of the stakeholders[15]. To deal with the stakeholders that remained opposed to HS2, HS2 Ltd asked for legal powers to deprive those stakeholders from property rights in exchange for compensation, a move that triggered time-consuming arbitration. A case in point were the disputes with the local authorities of the Chilterns, an area of outstanding beauty. Facing demands to build an end-to-end tunnel, HS2 Ltd sought instead powers to build a shorter tunnel, and deferred dispute resolution over the contractual exchanges to the Parliament.

Adaptation 4: adding market transactions with suppliers

As a megaproject moves into implementation, the promoter's managers need to assemble a vast supply chain. Many suppliers are selected under conditions of high uncertainty because of ongoing disputes with nonmarket stakeholders, which makes it impossible to develop complete buyer-supplier contracts. Under these circumstances, and given that suppliers are also being asked to make one-off site and project-specific investments, the buyers incur a risk of hold up ex-post contract award. Wary of this, promoters tend to build some flexibility in the buyer-supplier contracts, for example, by agreeing to reimbursable contracts and target prices if suppliers commit to share the actual costs (Gil 2009a; Drews 2017). Further, promoters may attempt to add elements of a relational contract to the formal contract to foster cooperation (Pitsis *et al.* 2003, Gil 2009a). Still, because of high uncertainty and specificity, as well as exogenous events, managers struggle to forecast reliably the supplier costs.

This is exactly the case of HS2. For example, early on in 2019, a contractor was awarded a £1.3 billion contract for the HS2 London Euston station after a procurement process that lasted almost two years.[16] Yet, although the development of the station design had started back in 2011, by 2019, HS2 Ltd and the local authorities were still struggling to agree a value distribution that all perceived to be fair (Yongcheng *et al.* 2019). The first 5 years of talks revolved around a major claim from the local authorities – HS2 could not go ahead unless HS2Ltd committed to redevelop the existing station too. In 2016, to fill a £3 billion shortfall after the promoter caved in, the agreed-upon plan was to mobilise extra funding from property developers. But by 2019, many issues remained unresolved that could disrupt project progress. And so, although a contractor had already been selected, an independent review suggested to decouple the governance of the HS2 Euston subproject from HS2 Ltd to bring together all the claimants to the Euston station under a single governing body (Oakervee Review 2019).

Megaproject behaviour, value creation, and value distribution

The debate on megaproject behaviour, both in the projects scholarship as well as in policy, has long revolved around cost escalation, reflecting the centrality of budget setting to accountability and control within an organisation's management process (Pfeffer and Salancik 1978, Thompson and Jones 1986). Yet, the megaproject governance model presented here suggests that managers compensate for this procedural bias by manipulating the project organisational boundaries and relaxing the cost constraint to realise a social surplus, which is the amount by which the total value created exceeds the economic value that is appropriated by the promoter. Hence, when the promoter brings key stakeholders "in" and agrees to share decision rights, the promoter is in effect committing to renegotiate the value distribution towards a new distribution that allows for greater social gains. Likewise, when the promoter seeks to align interests with non-market stakeholders to acquire their resources, the concessions to facilitate the resource exchanges are likely to create social value.

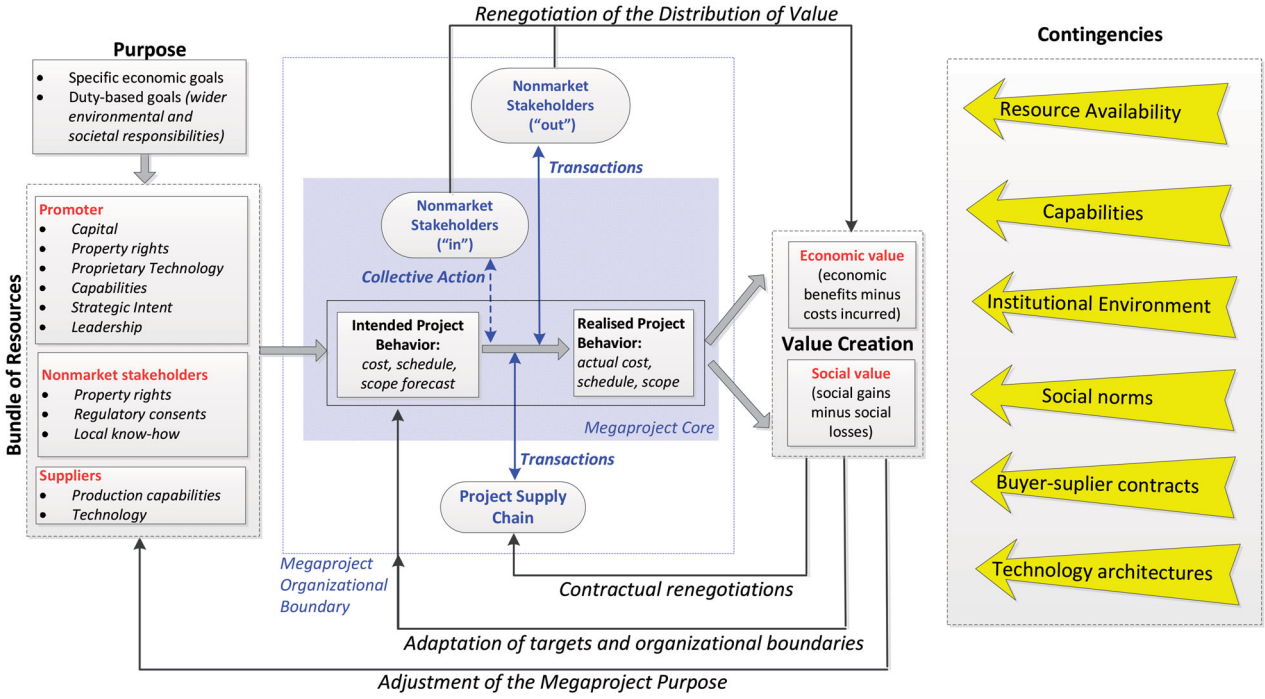


Figure 4. Megaproject: A Purposeful Interorganizational Form of Organising Capital Production.

These mechanisms to acquire nonmarket stakeholder resources agree with Frischmann's (2005) claim that infrastructure resources are 'shared means to many ends'. They are also consistent with inclusive definitions of value in management literature, where value is defined as the sum of economic benefits and social gains to be accrued minus the costs to be incurred (Klein *et al.* 2012, Garcia-Castro and Aguilera 2015, Bacq and Aguilera 2021). In a megaproject, the social gains to be created relate to the nature of the future infrastructure as an intermediate good that inputs into a variety of downstream activities. Thus, those social gains include technological contributions through spill-over effects, the facilitation of productive behaviour by non-users, and the creation of public goods through changes in the environmental conditions and social dependences (Frischmann 2012). Further, megaprojects are under increasing pressure to attend to wider societal concerns and demonstrate how they intend to use resources to contribute to tackle grand challenges such as inequality, poverty, job creation, and do no harm by meeting the net-zero golden standard throughout the whole infrastructure life-cycle.[17]

However, an inclusive definition of value is at odds with conventional cost-benefit analysis, which restricts the evaluation of the benefits to those that can be transformed in monetary units through market prices and the availability of robust evidence and methods.[18] An inclusive definition of value is also at odds with assumptions underlying classic megaprojects literature, which also restrict value to user willingness to pay (Flyvbjerg *et al.* 2002, Merrow *et al.* 1988). The HS2 case is telling. The cost forecast has been steadily increasing since 2009 when HS2 Ltd was set up - see Figure 3. The initial cost hikes can be traced to a major change in the project goal after the scheme evolved from a single London-Birmingham line to a Y-shaped network to improve further connectivity between the north and south. But in the subsequent years, the costs continued to escalate as, first, the value distribution was renegotiated with the local authorities of the cities on the route, which claimed that the goal of HS2 needed to evolve beyond improving railway capacity and connectivity to factor in economic growth and urban regeneration (Msulwa and Gil 2014, Msulwa 2017). And second, as the HS2 managers engaged in independent exchanges with thousands of nonmarket stakeholders along the route. Yet, the evaluation of the HS2 benefits has been restricted to user fees (based on journey timesavings, reduction of crowding, and improved reliability) and wider economic benefits (based on increases in worker productivity and land prices). As a result, the benefit-to-cost ratio (BCR) has declined to a point where, from a policy perspective, HS2 is low 'value-for-money'. In 2019, facing calls to shut down HS2Ltd, the government commissioned a 'go-no go' independent review.[19] The review observed that the HS2 BCR cannot capture all the social gains to be created by the

railway.[20] After the review, the government made a decision to proceed with HS2. Since then, the costs have increased further as safety protocols were implemented to protect workers from Covid-19. Again, the costs are incurred by the promoter, but the social benefits are captured by non-users.

Towards a theory of megaproject purpose, value creation, and value distribution

As said at the onset, the invitation to contribute to this special issue honouring Glenn Ballard's work left me in a tricky position in that I long stopped following the lean construction conversation. Further, both the construction and PM literatures follow different epistemological traditions from the social-science oriented literature where I fit. In lean construction and PM research, the emphasis is on actionable knowledge. This complicates the search for synergies with social-oriented management research, which is geared towards illuminating empirical regularities and developing verifiable theory. Epistemological differences notwithstanding, a reflection as to how lean construction and PM literatures relate to an organisation view of megaprojects is in order. Yet, before doing so, I start by introducing a novel conceptualisation of megaprojects, illustrated in a stylised diagram in Figure 4.

From an organisation perspective, I see megaprojects as a purposeful interorganizational form of organising capital production. Drawing on recent work on purpose-driven firms (Hollensbe *et al.* 2014, George *et al.* 2021) and new stakeholder theory (McGahan 2021), I define the megaproject purpose as a high-order goal that is chosen by the promoter without necessarily recognising the wider role of megaprojects in society as moral actors. In other words, the megaproject purpose is the compass that guides the value distribution, and thus guides the balance between the creation of economic value and social gains. Purpose thus reflects the specific goals of the promoter as formalised in a vision or strategic intent, but also reflects the promoter's understanding and consideration to a wider set of environmental and societal responsibilities and expectations that are linked to moral and ethical obligations.

Defining the project purpose is important because purpose informs the bundle of resources that need to be acquired to move the project forward and create value. Some essential resources are controlled by the promoter (e.g., capital, property rights, technology, capabilities, leadership). Other complementary resources that are also essential to value creation are controlled by market and nonmarket stakeholders (e.g., property rights, know-how of user needs, consents). And then, there are the production capabilities of suppliers and their own technologies too. Crucially, the purpose of the megaproject not only drives the bundle of resources that needs to be assembled to realise the intended distribution of value, but also influences the initial choices on organisational boundaries, and thus inform where the 'responsibility' (McGahan 2018) of the megaproject ends. In other words, together with the characteristics of stakeholder resources and the nature of the resource complementarities (one-way vs. two-way), the project purpose drives the choice to use collective action to govern exchanges with nonmarket stakeholders vs. using bilateral relationships. Put simple, purpose influences the membership of the megaproject organisational core, which becomes "encapsulated" (Baldwin 2019) by transactions. As well as this, purpose informs the intended project behaviour (scope, cost, time) and the form of the legal contracts that will govern promoter-supplier relationships.

Yet, as the project progresses, the more the initial purpose is misaligned with the expectations of the environment concerning the societal contribution of the project and fairness, the more the non-market stakeholders will ask to renegotiate the value distribution and adjust the project purpose. These renegotiations create feedback loops that can force renegotiations of the project organisational boundaries as well as of the promoter-supplier contractual arrangements. Further, the value distribution renegotiations determine the realised project behaviour as well as the ultimate purpose that is realised. Hence, the more the initial purpose is misaligned with the expectations of key nonmarket stakeholders, the more we can see a substantive renegotiation of the value distribution and corresponding adjustment of the project targets.

The instantiation of the relationships that explain why megaprojects behave the way they do is context-sensitive and thus contingent on the institutional external environment and other contingency variables. I turn now to discuss four contingencies that merit further research in order to develop a full-fledged theory of megaproject purpose, value creation and value distribution.

Contingency variables

The model of megaproject governance offered here is not a theory in that more research lies ahead to

further our understanding of how different contingency variables affect the relationships between purpose, organisational boundaries, value creation and value distribution. Hence, I discuss four contingencies that can motivate further research and reflect my proximate research interests.

First, empirical studies suggest that often third parties such as a central government equip megaprojects managers with a large contingency fund from which managers can draw to resolve collective-action problems and align interests with stakeholders and suppliers (Gil and Pinto 2018). In other words, some megaprojects suffer from resource scarcity whereas others benefit from resource abundance, which permits the 'indulgence of higher-order needs' (Klein 1990). In the HS2 case, for example, this contingency is the difference between budget and cost forecast, where the cost forecast is a projection with a 50 percent probability of not being exceeded, including an allowance for foreseeable risks; and the budget has 95 percent probability of not being exceeded.[21] In theoretical terms, this contingency is a buffer of actual or potentially utilisable resources, which creates financial 'slack' (Yongcheng *et al.* 2019). This slack limits the (political) costs of relaxing the cost forecast in that the promoter can do so and still claim publicly that the project is "on budget". But it merits further research how the contingency affects the promoter's bargaining power when trading with nonmarket stakeholders and suppliers since the contingency is public knowledge – as one procurement director said, "we are playing poker with our hand exposed". Further, in collective-action situations, the contingency transforms the promoter's capital resources into a more manageable "partially (non)rival good" (Frischmann 2012) in that it enables the promoter to finance stakeholder claims.[22] Yet, we need more research on whether a large known contingency enables the enfranchised stakeholders to force the promoter to make concessions that are disproportional to the stakeholder contributions – what Olson (1965) calls, the risk of exploitation of the "larger by the smaller". In other words, we need more research to understand how resource availability affects the renegotiation of the distribution of value and the gap between intended and realised project purpose.

Second, a different set of capabilities is required to exercise a lead-role when renegotiating the distribution of the value to be created jointly from the capabilities required to trade independently with stakeholders and suppliers. In collective-action, stakeholder theorists argue that cooperation is usually conditional on trust and on the participants' expectations that others will cooperate too (Balliet and Van Lange 2013, Van Lange *et al.* 2013, Bridoux and Stoelhorst 2020). In other words, trust is an outcome of a belief that impersonal structures have been put in place to enable one party to anticipate another party's behaviour – what Pennington, Wilcox and Grover (2003) call "system trust". This contrasts with hub-and-spoke governance where trust is "interpersonal" and managers are trusted if they have a legitimate basis for their claim to authority (Wood and Gray 1991). Hence, when megaproject scholars trace cost slippages and delays to managerial incompetence, we need first to ask how the alternative organisational governance choices are made and the extent to which those choices are contingent on the managerial capabilities that are available.

Third, we need to investigate how the context surrounding a megaproject affect purpose setting and corresponding governance choices. For one, purpose is not only a function of organisation-specific goals as expressed in a vision and strategic intent, what George *et al.* 2021 call 'goal-based' purpose. Purpose is also a function of context-specific societal values and expectations ('duty-based' purpose). Likewise, a promoter's choice to invite nonmarket stakeholders to create value jointly is sensitive to the institutions and social norms in the context.[23] Further, a choice to adopt an inclusive form of governance can also be a response to changes in the institutional environment (Klein *et al.* 2019). For example, in the high-speed railway project promoted by the California State, unlike the HS2 case, the State first excluded the local authorities from governance-related decisions. As lawsuits piled, the State caved in and stroked agreements by which it committed to 'work collaboratively in good faith' with the local stakeholders.[24] Complicating matters, what is fairness is context-sensitive too. In some contexts, fairness is about equity and thus the principle of rewarding a stakeholder in proportion to their contribution to joint value created (Fortin and Fellenz 2008). In others, fairness can be about equality and thus the principle to give more to stakeholders that have the biggest material needs (Deutsch 1975). How differences in perceptions of fairness impact purpose setting and value distribution also merits further research.

And fourth, more research is needed to further our understanding of supplier behaviour and implications to project behaviour and the realised purpose. Many accounts of megaproject promoter-contractor relationships suggest that it is possible to build a degree of

clarity about the expectation of future gains from an exchange as well as about the ability to trust and coordinate (Pitsis *et al.* 2003, Gil 2009a, Drews 2017). For example, in the UK, recent accounts reveal an increasing use of flexible buyer-supplier contracts with elements of relational governance (Gil 2009a, Davies and Mackenzie 2014, Drews 2017). To create a cooperative environment is also the aim of flexible forms of contract developed by lean construction professionals such as the Integrated Lean Project Delivery in the US and alliance agreements in Australia (Ballard and Howell 2005, Matthews and Howell 2005). Contractual flexibility facilitates renegotiations of the value distribution to align project purpose with environmental expectations. Yet, it has been difficult to produce evidence with statistical significance that supports the argument that the effort to build a flexible and/or relational contract pays off. So, once the suppliers claim compensation for extra production work caused by late change requests, it is tempting to see in the suppliers' claims an opportunistic attempt to hold up the buyer. This calls for research to untangle the root causes of the supplier claims. And the more the claims can be traced to extra production costs that the supplier incurred to adapt the work to a renegotiated value distribution, the less the suppliers can be said to be engaged in profiteering under flexible forms of contract. Until then, the jury is out.

Implications to lean and project management scholarship and practice

Kuhn (1970) suggests that science advances through "normal activity" done within a prevailing framework or paradigm, as well as through paradigm shifts. These shifts occur when the dominant paradigm under which normal science operates is render incompatible with a new way of seeing the world, which facilitates the adoption of that new paradigm. This is true in some fields where science is said, colloquially, to advance 'funeral by funeral'. As in astrophysics, when Copernicus and later Galileo established that the earth revolves around the sun. But in management, a novel cognitive lens can emerge to look at phenomena without dislodging other ways of viewing it. Rather, the different lenses stay in competition for their superior ability to predict, explain, and inform the development of practical tools and methods, a competition fuelled also by people's beliefs and stakes in those lenses.

From this perspective, I would argue that lean construction scholarship is not a paradigm shift. Clearly, after three decades, this body of work continues to make inroads in academia and influence practice (Tommelein 2015). This is good. But there is no evidence that lean ideas are up to dislodge ideas and practices espoused by the PM professional bodies and scholars. So, this stubborn fact should give us pause.[25] Likewise, I do not claim that the megaproject theory of purpose, value creation and value distribution that I proffer in terms of its rudiments will lead to paradigm shift, even if so I wished. Importantly, though, social science also produces actionable knowledge, even if the target audience of who may be interested in putting that knowledge to use is different – as Lewin (1952, p. 169) said, "there is nothing more practical than a good theory." With this caveat in mind, I conclude this essay by offering a set of questions that lean scholars - and PM scholars and policymakers for that matter too - may wish to ask if they want to draw from an organisational view of megaprojects to further their own conversations.

First, I ask: how do lean and PM scholars define and measure value? In megaprojects, and in any new infrastructure project more generally, the decision-making authority over the use of the project promoter's resources is often distributed with key nonmarket stakeholders. Further, promoters tend to use power differentials and market mechanisms to gain access to other valuable nonmarket stakeholder resources. This raises the question of how these literatures (and policymakers too) address the tension between economic and social value creation that is endemic to infrastructure projects. In other words, in which way do these literatures attend to the increasing environmental pressure on megaproject promoters to behave collaboratively and allocate more resources to the creation of social value?

This tension speaks to a discussion on the purpose of a megaproject and the root causes of disputes with nonmarket stakeholders.[26] These disputes are mechanisms to renegotiate the project purpose and the corresponding value distribution. But because the disputes invariably lead to slippages in the project performance targets, the disputes undermine the legitimacy of the promoter to manage the project and fuel a lack of trust of society in megaprojects. This trust deficit is amplified by the orthodoxy around the project iron triangle, and thus the idea that the project manager's job is to keep the 'project on target'. This orthodoxy seems to be shifting as more scholars and project leaders call for a rethink of cost-benefit analysis to account for the role of projects as instruments of social value creation.[27] But way more research is

needed before megaprojects can become "generators of trust" (Hollensbe *et al.* 2014) as opposed to "consumers of trust".

This insight is relevant in particular to PM scholars given the crisis affecting the debate on megaproject performance[28]. For example, it suggests that the line of inquiry that draws on behavioural science to trace cost hikes to promoter's optimism bias (a capability problem) and strategic misrepresentation (an agency problem) lacks nuance (Flyvbjerg *et al.* 2002). If we accept that collective-action problems are central to megaprojects, under these circumstances, behavioural scientists are the first to ask if if there is a point at which unrealistic optimism is productive because forecasts free of optimistic bias can be self-defeating, destructive, and demoralising (Kahneman and Lovallo 1993). In other words, realism can potentially do more harm than good in collective action situations. Hence, optimistic targets may be a necessary condition to enable megaprojects to forge ahead. And cost hikes, delays, and scope creep can then be seen necessary mechanisms to ensure that the project purpose and corresponding value distribution evolve to a point where they are perceived to be fair by all the stakeholders that have legitimate claims. This in turn calls for new methods to measure social gains so promoters can 'responsibly' (Bacq and Aguilera 2021) commit upfront capital investment to realise social gains as well as discuss who else can pay for social gains that society expects the project to realise. If project purpose can be better aligned with wider societal expectations, promoters and other stakeholders will be in a position to engender more trust on megaprojects right from the onset.

As well as this, it merits to investigate where PM and lean scholarship stand in regards to the governance of nonmarket stakeholders. Specifically, how do these literatures propose to tackle the fundamental tension between sharing decision rights to encourage nonmarket stakeholders to cooperate versus excluding them from the resource allocation process? Sharing decision rights is advantageous to encourage voluntary contributions of essential resources. But this governance choice also creates collective action problems that can potentially compromise cooperation. In turn, contracting for nonmarket resources can lead to high transactional costs, and the more so the more powerful the stakeholder is (Miller and Lessard 2000, Gil and Yongcheng 2021, Odziemkowska and Dorobantu 2021). In other words, how do lean and PM scholars address the question of which stakeholders should be "in" and "out"? This is an important question since waste reduction is a central tenet of lean scholarship (Koskela 1992) and controlling change remains a major preoccupation in PM literature (Merrow 2011). Admittedly, lean scholars recognise there are productive and unproductive cycles of rework (Ballard 2000b). And some PM scholars have criticised the obsession of the field with control in detriment of flexibility and novelty (Lenfle and Loch 2010). Still, more research is needed to understand the conditions under which rework can be categorised not as waste or inefficiency but rather as the costs of renegotiating project purpose through a democratic decision-making process.

Further, irrespectively of the governance choices, megaproject buyer-supplier relationships will tend to show high uncertainty, high asset specificity, and low frequency. Inevitably, these attributes will lead to a risk of hold up for the buyer. Under these circumstances, it does merits further investigation how differing forms of contract can foster cooperation. This calls for empirical studies on the sources of cost overruns in supplier contracts. Only by doing so, we can untangle how much cost overruns under flexible or relational forms of contract are associated with legitimate hikes in production costs vs. supplier opportunism. This is a tricky question because it requires gaining access to data that is commercially sensitive; anecdotal evidence is not enough. Sighs – will the day ever arrive as to when suppliers will be willing to let us discern the sources of the profit they make?

Finally, lean and PM scholars want to explore the relevance of Ostrom (1990)'s principles of robust collective action to further their own conversations[29]. Let's take, for example, the case of Ballard's Last Planner System (Ballard 2000a). It may well be possible that the joint production of a reliable construction plan is a collective action problem in the form of a give-some dilemma. If this is the case, a supplier may have an incentive to free ride on the effort of others, even if they all are better off if they commit to cooperate. Yet, from an Ostrom's perspective, we could argue that robust governance can encourage suppliers to cooperate, even if they have to incur a cost for doing so. This claim resonates to Womack *et al.* (1991, p. 155) idea that the basis of Toyota-supplier relations is "mutual interdependence enshrined in the agreed-upon rules of the game". Advancing this line of inquiry would require analysing if a "plan-in-the-making" meets the conditions of low excludability, high rivalry, and shared property rights. If the problem meets these conditions, then it is a collective action problem. Assuming it is, lean scholars could then discuss if Last Planner is a technology or a governance

mechanism, and harness Ostrom's ideas to improve the effectiveness of the Last Planner. There is little technology in collective action research, so that would be an interesting line of work. As well as this, Ostrom's ideas could be leveraged to further our understanding of lean practices like target value design, where mechanisms are built in to safeguard that every claimant benefits from an overall cost reduction and safeguard that every party is making honest cost reduction efforts (Ballard 2009). Yet, whether target-value design transforms a 'design-in-the-making' in a common-pool resource is a function of the extent excludability of legitimate claimants is low even if there is high rivalry in preferences. If the participants in target-value design can exclude legitimate claimants, then target-value design may be instead a problem of managing a club resource. Investigating the conditions under which target-value design is a commons problem vs. a club problem merits further research.

Conclusion

My job here has not been to offer an organisational theory of megaproject purpose, value creation and value distribution to illuminate megaproject behaviour. That is work in progress. Rather, the aim is to shed light on my ongoing journey towards this ultimate goal, revealing, with honesty, the meanderings I went through up to here. Accordingly, I first discuss the challenges that I encountered when deploying lean construction and modularity scholarship to make sense of empirical regularities. Then, drawing from organisational literature, I offer a conceptual model on megaproject governance evolution and discuss the implications to organisational boundaries, behaviour, and value creation. Further, I harness this model to offer a conceptualisation of megaprojects as a purposeful interorganizational form of organising capital production. Finally, I discuss how scholars, practitioners and policy makers can leverage a view of a megaproject as a purposeful organisation to allow these enterprises to realise their full potential to create both economic and social value, and crucially, to mend the fractured relationship between megaprojects and society. In a post-pandemic world where organisations are being called to take on grand societal and environmental challenges, megaprojects can lead the way. Let's not lose sense of this possibility.

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Notes

1. Gulati *et al.* 2012.
2. Whilst megaprojects are often associated with multi-billion dollar enterprises, what is capital-intensive is relative to the resources and capabilities that are available. A project to build a cycle lane through the middle of a city may have relatively 'small' budget. But it may nonetheless feel 'mega' to the local authority's managers
3. In Kuhn's (1962) thesis, a paradigm includes key theories as well as the application of those theories and laws to problem solving along with new techniques employed in those applications. And a shift in paradigm occurs in periods of revolutionary science, which end up leading to a difference in one's experiences of things and a change in one's phenomenal world
4. At the time, chipmakers were seeking to reduce the fab project life-cycle to less than 18 months, and to reduce the time elapsed from the first concrete pour to the first full output of chips to less than 16 months (Gil *et al.* 2005)
5. To the extent that the Intel Director of the Intel Hillsboro campus was asked to adjudicate a tricky case as to which professional group should have priority to park the car, the construction workers or the scientists!
6. As Williamson (1985) famously wrote, "rather than reply to opportunism in kind, the wise [bargaining party] is one who seeks both to give and receive credible commitments"
7. As Adam Smith (1776) said, and gets quoted for again and again, "It is not from the benevolence of the butcher, the brewer, or the baker that we expect our dinner, but from their regard to their own self-interest" in The Wealth of Nations
8. I impart the intuition for this complex managerial problem with my students through a role-playing game I developed, *The Collective Design Project*, where a simple housing renovation project turns out fiendishly complicated due the participants' competing interests. The game draws inspiration from the MIT Delta Design Game, but shifts the focus away from the technical design problem to the multi-party negotiations. The game set is available from the author on request
9. And lean scholars too of course including Glenn Ballard

10. As chair of the UK construction industry, Sir John Egan was also behind two institutional reports that were challenging the construction industry to reinvent itself, *Rethinking Construction* and *Accelerating Change*.
11. In class, I impart the intuition for this dilemma through a teaching case study, Gil, N. 2009. The BSF programme: Teacher Involvement in Design. Alliance Manchester Business School, The University of Manchester, UK
12. Devereux, R. 2009. The role and funding of High Speed Two (HS2) Limited ("the Company"). Letter from the Permanent Secretary, Department for Transport, 14 Jan.
13. In the London Olympics board, the International Olympic Committee (IOC) was represented by its watchdog, the London Organizing Committee of the Olympic and Paralympic Games (LOCOG)
14. NAO 2018. Investigation into land and property acquisition for Phase One (London-West Midlands) of the High Speed 2 Programme. Report by the Comptroller and Auditor General National Audit Office.
15. Hence, for the first phase, only 2,586 petitions were lodged in the House of Commons and 822 in the House of Lords; DfT 2017 Government Overview of Case for Phase One of HS2 and its Environmental Impacts. CM 9398, January
16. Smale, K 2019. Mace and Dragados sign HS2 Euston station contract. New Civil Engineer, 11 March
17. A case in Point is the recent UK Government Procurement Policy Note 06/21: Taking account of Carbon Reduction Plans in the procurement of major government contracts
18. In the UK, the HM Treasury Green book is a good example. See also the Independent Evaluation Group. 2010. Cost-Benefit Analysis in World Bank Projects. Washington, DC: World Bank.
19. Oakervee Review (2019). Oakervee Review of HS2. Department for Transport December, 135 pages.
20. As well as this, reviewers noted that the railway was designed for lasting over 100 years, but the economic appraisal policy only allowed to take into account the economic benefits for the first 60 years, which again negatively affected the BCR
21. The contingency fund, whose figures are calculated based on the difference betweeen cost forecasts with different likelihoods of occurrence based on Monte Carlo simulations, accounts for "stakeholder risks and optimism bias" as defined in the UK Treasury Green book
22. Partially (non) rival resources are also called "impure" public goods to emphasize the degree of (non) rivalry of consumption varies over time, with the number of users, and is often manageable (Frischmann, 2012, p. 12)
23. See for example Gil *et al.* (2019) on the striking differences between the governance of megaprojects in Africa that are financed by Chinese actors and the governance in projects financed by multilaterals like the World Bank
24. California High-Speed Rail Authority 2018. Resolution #18-16
25. Still, lean construction scholarship is closer than PM literature to a social science definition of theory, where theory is understood to be a coherent body of knowledge that is laced with a set of logically interconnected and convincing arguments that make it possible to discern the conditions under which the major hypotheses are most and least likely to hold (Sutton & Staw 1995). In contrast, project scholars like Flyvbjerg (2016) call theory to 'ideas, systems of ideas, and hypotheses'.
26. This also mirrors a fundamental debate about the purpose of the firm that remains unresolved. Is the purpose of the firm to maximize value for shareholders or for all the stakeholders? See, for example, Barney, 2018.
27. A similar shift is happening in the corporate world with the emergence of new accounting measures of firm performance that enable to address to the firm's obligation to attend to wider social and environmental concerns, eg the Global Reporting Initiative (GRI) and the Sustainable Accounting Standards Board (SASB)
28. It is outside the scope of this paper to enter into this exchange. But for those curious, see a nonpartisan account in Foster, A. 2018. *Academics clash on causes of transport cost overruns*. Local Transport Today, 27 April.
29. An anonymous reviewer kindly noted this conversation is occurring already, e.g. Hall & Bonanomi 2021

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