Governance arrangements in complex, temporal supply networks: Delivering megaproject supporting ecosystems through local, small-medium enterprises

Jas Kalra (J.Kalra@bath.ac.uk)
HPC Supply Chain Innovation Lab, School of Management, University of Bath, Bath, UK

Jens K. Roehrich
HPC Supply Chain Innovation Lab, School of Management, University of Bath, Bath, UK

Brian Squire
HPC Supply Chain Innovation Lab, School of Management, University of Bath, Bath, UK

Andrew Davies
The Bartlett Faculty, University College London, London, UK

Abstract
Small and medium-sized enterprises (SMEs) are critical to the growth of UK economy. Therefore, organisations are increasingly under political pressure to contribute to development of SMEs. One way of achieving this is by integrating SMEs into supply networks orchestrated by big organisations. This presents a number of governance challenges for the network orchestrator, one of which is the selection of governance arrangements. This study seeks to examine this issue by conducting a single case study in the context of a megaproject supporting ecosystem. Findings reveal service complexity and supply-base capability to be contributing factors to the selection of governance arrangement.

Keywords: Supply networks, Network Orchestration, Megaprojects

Introduction
Megaprojects, defined as projects worth more than $1bn, are vehicles used by organisations and governments around the world to achieve innovation and value creation, including new infrastructure and services (Flyvbjerg, 2014). While megaprojects are often led by governments or large firms, these large projects are delivered by a myriad of companies from different sectors, countries and of different size. The majority of our understanding of the strategic supply chain/network design has been developed from manufacturing paradigms, leading to development of approaches such as lean and agile. Extant literature, however, does not provide sufficient insights for designing supply networks vital in a megaproject setting with its unique characteristics. For instance, in megaprojects, the scale of demand increases massively over the project phases (from design to build to operate) and there are a range of interfering factors such as political pressures and public visibility to create social and regional value (Kivleniece and Quelin, 2012). While the supply networks linked to delivering these projects are vital, they are of, in contrast to more permanent manufacturing supply networks, a more temporal nature.

Governments and organisations are increasingly seeing the development of supply networks in megaprojects as a means to creating economic and social value by creating employment opportunities and contributing to the prosperity of the region. The problem with this, however, is that the local suppliers often consist of mostly small and medium enterprises (SMEs) who seldom have the expertise, resources and capabilities to deliver on such a large scale (Terziovski, 2010). The focal supply network firm (i.e., the network orchestrator) needs to actively engage with SMEs to deliver ancillary services such as catering, transportation and accommodation. This attempt to integrate SMEs in megaproject supply network, however, is not without its challenges. For example, studies in the construction sector have revealed that there is a high level of mistrust and scepticism between SMEs and network orchestrators, inhibiting collaboration between them (Dainty, Briscoe, et al., 2001; Dainty, Millett, et al., 2001). Such problems inherent in designing bespoke megaproject supply networks have not been given much attention in the supply chain management literature.

In addition to the paucity of focus on the supply chain design in the context of megaprojects, even less attention has been given to the supporting network around these megaprojects, i.e., the indirect, site support services. Thus, we pose the following overarching question:

"How does a network orchestrator choose the adoption of a particular governance mechanism to integrate SMEs in complex, temporal supply network?"

In order to address this research question and dearth of live cases representative of the phenomenon, a single case study design was adopted. In this case, development of the supporting ecosystem for a nuclear plant construction megaproject by a big energy company, *The Energiser*, was examined.

Literature review

Megaproject supporting ecosystem

Following James Moore, a 'business ecosystem' is characterised by a network of organisations and individuals that co-evolve their capabilities and roles and align their investments so as to create additional value and improve efficiency (Moore, 1993). Such a business ecosystem involves companies crossing different industries and individuals crossing different professions to tackle more complex challenges. As Moore (1993: 76) describes, companies in the ecosystem work both cooperatively and competitively to support new products and satisfy customer needs. In contrast to, for instance, mergers and acquisitions where organisations seek to transfer and integrate skills and knowledge into the acquirer's organisation, an ecosystem strategy allows the lead firm to avoid these risks (Williamson and De Meyer, 2012). By leaving key resources, skills and knowledge with the members of the ecosystem, the network orchestrator and the wider ecosystem can draw on the benefits from members' unique abilities.

This form of organisation can be superior to both the classic integrated organisation or to a streamlined supply network based on principal-agent relationships (Williamson and De Meyer, 2012). It is the leadership provided by the network orchestrator which enables all ecosystem members to invest towards a shared future in which they anticipate profiting together (Moore, 1993). Following Moore's (1993) argumentation, business ecosystems condense out of the original swirl or capital, customer interest, and talent generated by, for example, a new innovation or wider social and economic needs. A vibrant and evolving ecosystem may enable activities, assets, and capabilities to be flexibly and constantly reconfigured in response to changes and uncertainties. Thus, it is the network orchestrator (with the help of its key ecosystem partners) who shapes the ecosystem, gradually moving the ecosystem from a more random collection of companies to a more structured community (Williamson and De Meyer, 2012) which can absorb changes and uncertainties in the wider environment.

Network orchestration

The study on inter-organisational relationships have been conducted on two levels of analyses: dyadic and network. While studies on inter-organisational dyads have focused on transactions, processes and actions taken by the interacting parties, network studies have been majorly concerned with structures, relations and outcomes. The studies on network orchestration are attempts to understand the organisational actions that perpetuate the network (Dhanaraj and Parkhe, 2006). While initial network studies have focused on unintentional emergence of networks, where "*actors make choices about who to connect with, what to transact…without guidance from any central network agent*" (Kilduff and Tsai, 2003: p90), this study's focus is on intentional identification, recruitment and engineering of networks by the focal firm (Dhanaraj and Parkhe, 2006; Doz et al., 2000; Human and Provan, 2000).

Network orchestration has been defined "*as the set of deliberate, purposeful actions taken by the hub firm as it seeks to create value (expand the pie) and extract value (gain a larger slide of the pie) from the network*" (Dhanaraj and Parkhe, 2006: p659). Within the context of supply networks, it has been referred to as a meta-competency of the focal firm to connect its core competencies with the competencies of its suppliers without owning them (Wind et al., 2009). Extant studies have referred to focal firms by a variety of names such as network entrepreneurs, hub firms, lead organisations and anchor tenants. Following on Paquin and Howard-Grenville (2013) and keeping in view the process-centric view of our study, we refer to the focal firm as the 'network orchestrator'.

Although extant studies are beginning to address our gap in understanding of network creation (Dyer and Nobeoka, 2000), network orchestration activities and dilemmas (Paquin and Howard-Grenville, 2013) and legitimacy building (Human and Provan, 2000). Extant studies offer very limited insights into the specific activities taken by the network orchestrator to develop and govern the network.

SMEs and governance arrangements

Over 99% of the 5.7 million businesses in the UK fall into the small and medium-size enterprises (SMEs) category (Rhodes, 2017). However, it is well known that the SME category is not homogenous. They are composed of varying levels of strategies, structures, processes and are dispersed across various sectors and locations (Blackburn et al., 2013). Within the construction supply network, SMEs occupy an important place. The varying size, ownership structures, expertise and the sheer number of SMEs involved in a construction supply network create significant challenges with respect to their integration in the supply chain (Dainty, Millett, et al., 2001). For example, studies have reported that the network orchestrator needs to invest efforts in overcoming mistrust and make them see potential learning and improvement benefits in collaborating with a big business. This general mistrust between the network orchestrator and SMEs impedes improvement in project performance (Dainty, Briscoe, et al., 2001).

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"How does a network orchestrator choose the adoption of a particular governance mechanism to integrate SMEs in complex, temporal supply network?"

Methodology

We adopt a single case study design with one of utility firms in the UK, *The Energiser* (i.e., the network orchestrator) and explore how it integrated SMEs into a complex supply network that it created (Siggelkow, 2007). More specifically, we follow the set-up of supporting ecosystem around a megaproject and governance arrangements adopted by The Energiser over five years (Langley, 1999). Data are primarily collected through a series of direct observations, semi-structured interviews (n=20), and analysis of secondary data such as internal reports, presentations and media coverage. The interviews were conducted with the Energiser's supply chain and service managers. In addition to this, the service managers from the suppliers' side were also interviewed. Finally, collection of data from multiple sources allowed for triangulation and addressing of respondent bias.

For analysis, a two-step strategy was adopted. Firstly, three detailed write-ups of the case were developed focusing on the rationale behind involving SMEs in the complex megaproject supply network and the steps taken by both EDF Energy and the SMEs to integrate themselves into the network. These write-ups were validated by the network orchestrator's supply chain managers. Following on this, analysis of interview transcripts were conducted using template analysis (King, 2009). Template analysis is a form of thematic analysis which gives the researcher the flexibility of iterating between extant theory and data by developing a coding sheet based on *a priori* themes and adding additional codes inductively as the analysis progressed. Through inductive codes, themes would then be developed.

Findings

Research context

After a decision was made to involve local SMEs in the megaproject's supporting ecosystem, further decisions need to include key considerations about the best ways of governing these relationships. A megaproject involves a set of different governance arrangements which are set out at the front-end "planning" stage when the network orchestrator defines how the project will meet its strategic objectives.

This planning phase includes key decisions regarding, for instance, regarding governance structures, governance arrangements and governance mechanisms. The decision of which governance arrangement to select when working with SMEs in the supporting ecosystem is vital as the wrong decision can lead to a range of problems such as poor performance and misaligned relationship management later on in the megaproject lifecycle.

Governance arrangements to integrate SMEs in complex supply networks

Based on an analysis of several service contracts and supply arrangements for the supporting ecosystem of megaprojects, five main types of delivery models were identified for incorporating SMEs into complex supply networks: direct contracting, tier-1 led, joint ventures, strategic alliances and consortia. In-depth front-end planning by the network orchestrator is vital to develop new and adjust existing delivery models which includes wider governance considerations of contracts and collaborations to deal with complexities, risks and uncertainties in a megaproject. These models are crucial as they enable or hinder the interactions between ecosystem partners. The selected delivery model needs to provide an appropriate framework to drive value creation for the involved partners, the megaproject as a whole and the wider megaproject environment, while at the same time ensuring flexibility to evolve with the wider ecosystem.

Five types of governance arrangements

1. **Direct Contracting (for security contract):** Under this model, the network orchestrator contracts directly with a number of MNCs with proven capabilities and experience to deliver a range of services. This approach is helpful in terms of receiving an end-to-end, one-stop solution

for a service. A major limitation of this arrangement is an over-reliance on a single, powerful supplier over a long period of time and losing access to potential innovations available in the market.

Even though this model was least favoured by the network orchestrator due to its dissonance with its agenda of setting up a supporting ecosystem which involves local SMEs, there were instances where there was no other alternative. This was mostly due to the nature of the market for a particular contract.

One of the network orchestrator's service manager reflected on his experience of the sourcing process: "*We went out to suppliers and so we went to twelve, we ended up with four, we went to invitation to tender to the four and then when the invitation to come back, when it came to do the interviews with the four, three dropped out and we were left with one. […] We had done the whole process twice, went through it all and then when we had to put everything on hold, we were left with one company then and it was the same company.*"

2. **Tier-1 Lead (for facilities management contract):** This delivery model closely assembles Japanese automotive firms' tiered or '*keiretsu*' form of supply arrangements. Under this model, the suppliers closest to the final industrial customer, also known as tier-1 suppliers, played a strategic role of managing the procurement and production of individual sub-assemblies through subsequent tiers of suppliers (Lamming, 1996). One of the biggest advantages of this model was that it reduced the number of suppliers the focal company was actually dealing with and made supplier relationship management much more pragmatic and manageable. This approach might put risks on the focal company by exposing it to the market place and increasing reliance on fewer and more powerful suppliers.

   The network orchestrator adopted this delivery model for contracts with high levels of complexity and uncertainty. For instance, the network orchestrator contracted with one of the biggest firms in its supply base as its Tier-1 supplier in the facilities management contract. This tier-1 contractor in turn manages a number of tier-two suppliers to set up a tier-1 led arrangement. The choice of this governance arrangement is driven by the complexity of the service, in which the network orchestrator seeks to reduce the risk associated with managing the transaction. This is illustrated by a quote from one of the tier-2 suppliers, *"Our whole view of where we were* (initially) *going was five companies getting together, one being management and then four task streams […] somewhere along the line, [the network orchestrator] moved the goalpost from a risk angle, we want a tier-one and we want people in partnership as tier-twos, so that is where we have ended up"*.

3. **Joint Ventures (for transportation contract):** JVs are equity-based alliances that combine resources from more than one organisation to create a new organisational entity which is distinct from its parent companies. JVs are considered hierarchical because they more closely replicate some of the features associated with organisational hierarchies than do other alliances models. A key benefit of JVs is that the partners in a JV gain access to each other's complementary capabilities, thereby reducing the amount of initial investment needed. This is very common approach taken by global or national organisations when they attempt to penetrate a local market.

   A JV with a local provider reduces the upfront learning costs as the global/national partner is able to access the knowledge and social capital of local partner. The local partner, in turn, is able to gain access to the infrastructure and strategic knowledge of its more mature partner. The limitation with JVs is that in the absence of trust, the partnership essentially becomes a race to learn, with the partner who learns faster seeks to dominate the relationship, often leading to partnership instability, shifts in bargaining power and potential opportunistic behaviour.

   The network orchestrator encouraged the formation of a JV for the provision of bus services. The JV is a partnership between a national transport group and a local bussing company. One of

the managers at the local bussing company reflected on his experience of the partnership journey: "*Initially there were teething problems with the joint venture as we fully expected there would be. Bringing in a very small company and a large company there was always going to be some kind of conflict. Luckily the board members – there are six of us in total, three from either side of the joint venture – and we very quickly got a very good working relationship with each other which has really helped, so the first three months of pain was worth it to get to where we are now.*"

4. **Strategic Alliances (for site infrastructure contract):** SAs are a delivery model by which organisations respond to increasing competitive pressures by entering into a collaborative partnership with other firms to create a 'collaborative advantage' (Das and Teng, 1996). SA can be broadly defined as: (i) equity alliances which involve financial investment by partners; or (ii) non-equity alliances which are relatively more informal forms of partnerships as they do not involve the transfer of equity.

   SAs are often formed in deals involving medium-type risks, where the risk is too high for adopting a pure market mechanism (e.g. direct contracting) and not high enough to completely internalise the transaction (i.e. bring it in-house) (Ring and van de ven, 1994; Williamson, 1981).

   Although this type of alliance leaves room for trust to develop between partners, which is essential for managing a complex contract with ever-evolving specifications, it also exposes partners to potential opportunistic behaviour by partners.

   In some of the more complex (and risk-intensive) contracts**,** such as site infrastructure maintenance, the network orchestrator identified a need for a more mature firm to support local SMEs in the supporting ecosystem. Therefore, the network orchestrator entered into a contract with a global infrastructure company. This global company in turn formed a non-equity partnership with two local SMEs. This was an unusual arrangement for the global organisation, as its project manager notes: *"Normally in our world, we go and find sub-contractors; sub-contractors do not tend to come and find us. […] We then agreed between the four parties that if we held the main contract, we would have a partnering agreement that sat within the contract that stipulated that the SMEs had people on the management board, they had work allocation rights and stuff like that. […] So, we actually bought effectively the agreement brings the two SMEs up to the tier-1 table*". To reduce the risk in the alliance and allow for trust to develop between three partners, the network orchestrator absorbed all the risk itself by entering into a cost-plus contract with the SA.

5. **Consortia (for catering contract):** Consortia are delivery models which are formed by groups of small- to medium-sized enterprises with complementary skills, resources and capabilities. This allowed each consortium to combine individual SMEs' offerings to provide a one-stop solution for the supporting ecosystem. The difference between consortia and other types of arrangements is that in a consortium, other partners retain their corporate identities, while a central managing body is established. This central body does not own, lease, or contract-manage its affiliates.

   This type of delivery model solves some of the coordination challenges that are prevalent in other structures and is more open to innovation and evolution. On the other hand, all partners have equal votes, irrespective of their size and power and in theory, can leave the consortium whenever they want. Thus, the high level of autonomy enjoyed by each member, poses significant risk to its existence.

   The network orchestrator formed consortia for food and beverage solutions as well as accommodation solutions offered as part of the supporting ecosystem. For example, the chairman of the accommodation consortium, illustrated this type of arrangement: "*I was very fortunate with the partners that I had brought in to the consortium. That was really important. There was a key message that came from the network orchestrator as the local consortium pulled together. The network orchestrator was looking for us to ensure that no single party dominated, so there was a*

company by financial scale and business, whatever, by any metric, were by far the largest entity, but they had one vote. We had one vote. So, there was parity around the table. That principle was very important early on and if you were to meet the other members of the consortium board, you would find no egos really to speak of, no-one was trying to dominate."

The network orchestrator worked closely with a local trade organisation and the local SMEs to facilitate the creation of consortia, alliances and joint-ventures of interested SMEs and help them bid for the work packages. By 2016, a majority of the megaproject's supporting ecosystem was composed of local SMEs, with the estimated value of contracts being over £450 million during the construction phase.

To summarise, the network orchestrator holds a significant, but not exclusive, role in shaping, directing, managing and facilitating the ecosystem and its activities. The planning phase is vital and includes key decisions regarding, for instance, governance structure, prepare the contracting approach and devise a procurement strategy to consider alternative ideas and ways of stimulating innovation during the tendering phase. The decision of which governance arrangement to select when working with SMEs in the supporting ecosystem is crucial as the wrong decision can lead to a range of problems such as poor performance and misaligned relationship management later on in the megaproject lifecycle.

Discussion

From the analysis of the findings presented for the five types of governance arrangements observed for integrating SMEs in complex supply networks, a decision matrix was developed, which has been provided in figure-1. Further analysis revealed that the choice of governance arrangements was influenced by two factors. Firstly, the complexity of the service contract played a role in the decision-making. Following on the classic definition of service complexity being referred to as the intricacy and sophistication of the tasks required to deliver a service (Kreye et al., 2015; Shostack, 1987), a facilities management or site infrastructure development/maintenance contract was considered to be more complex than a catering contract. Secondly, the relative capability of the SMEs in the supply base with respect to the complexity of the service was another variable that was taken into consideration. Based on these two variables, the adopted governance mechanism has been illustrated in figure-1. Broadly, in case of simpler services, the network orchestrator actively engaged with SMEs and based on their relative capabilities either grouped the SMEs into an all-SME consortium or made them enter into a joint-venture with a firm with more experience and expertise. In case of more complex services, however, network orchestrator mitigated the risk by engaging global partners in the contract. If the SMEs were relatively more capable, they were entered into a strategic alliance with a global partner. If, however, the SMEs' capabilities were low with respect to the service requirements, the network orchestrator engaged directly with a global contractor, with the SMEs becoming or not becoming a tier-2 supplier to the tier-1 contractor.

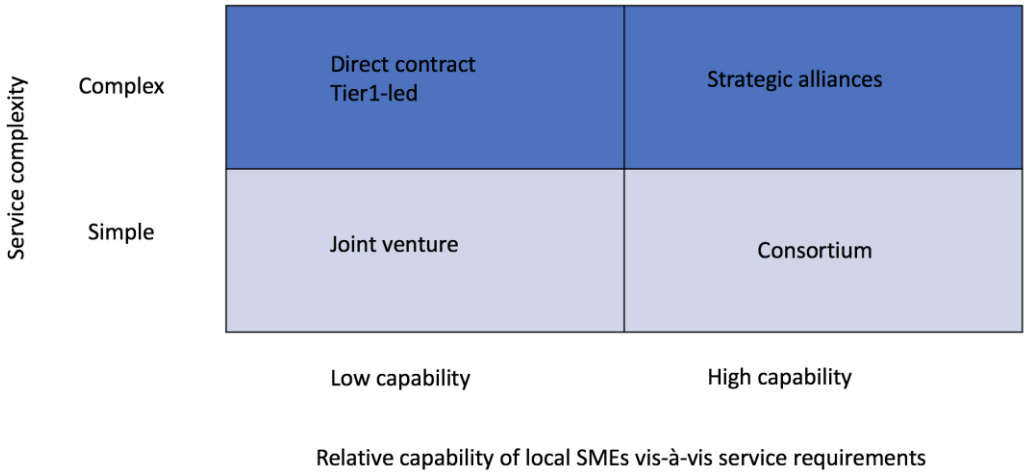

Figure 1: A framework for deciding on governance arrangements for integrating SMEs in complex supply networks

Conclusion

The objective of this paper is to present an illustration and discussion of the governance arrangements adopted by the network orchestrator in integrating SMEs in complex supply network to deliver the supporting ecosystem for a megaproject. The study revealed existence of five governance arrangements adopted by the network orchestrator namely, direct contract, tier1-led contract, strategic alliance, joint venture and consortium. Further analysis revealed the choice of governance arrangement being driven by two factors: the complexity of the service requirements and the existing capability of the supply base with respect to the requirements. This preliminary analysis is part of a larger project exploring the issues around integration and development of local SMEs in complex supply networks and the governance challenges faced by the network orchestrator. Future work will involve an in-depth analysis of the relationship between the partners within a governance arrangement and their relationship with the network orchestrator and its effect on the social and economic value created.

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