

Characteristics of the infrastructure megaproject ecology

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Research Problem

Seeking more contextual ways of understanding projects, scholars describe how megaprojects within regions may benefit from a range of interconnections, operating as a project ecology (e.g. Grabher and Ibert 2011). Describing a London infrastructure megaproject ecology, Davies explains that this is formed by the “*constellation of organisations involved in each other’s past, current and future projects*” (Davies 2017, p.122). In such settings organizing is heterarchical and relational, involving diverse forms of formal and informal organizing that bring together individuals, firms, projects and communities over different timeframes (Grabher and Thiel 2014, Brookes, Sage et al. 2017, Sydow and Windeler 2020).

While such work has discussed how ecologies may differ, for example in the extent to which they enable cumulative practices or involve disruptions across projects (Grabher 2004), it needs extended to better understand the characteristics of different infrastructure megaproject ecologies and how projects benefit from being part of a concentration of projects in a geographical context. This is important given the significant practical challenges of addressing grand challenges and planetary boundaries in project-based industries (which are going to require innovation across projects rather than point solutions) and the theoretical challenges of temporality across diverse forms of organizing, where we need to understand how to facilitate situated learning within and across projects. Thus, our guiding question is how do infrastructure megaprojects benefit from the broader set of megaprojects within their geographical context?

Research Methodology

As part of a larger ongoing study, this paper is based on our secondary analyses of data on the megaprojects in the Sydney region. Sydney is an interesting case as it has a substantial planned pipeline of projects (INSW, 2022), it is a significant metropolis covering more than 1,735 square km (670 sq mi) and there is a regional ‘six cities’ strategy to create new urban centres (GCC, 2022), to house the existing population of approximately 5 million and the substantial anticipated population growth. It is part of the resilient cities network.

Approximately 1 in 5 people in Australia living in Sydney, where Australia are highly rated by the Global Infrastructure Hub (GIHub, 2022), with lowest scores indicating the long duration between public announcement of a tender and awarding a contract. The first author is also familiar with the London megaproject ecology enabling us to compare and contrast our findings in Sydney with the extant literature on the London case. In order to study the heterarchical organizing through which innovation is fostered in an infrastructure megaproject ecology we take a historical approach, bounding our study to innovation across infrastructure megaprojects in the last 25 years, with consideration of the pipeline of upcoming projects.

A list of infrastructure megaprojects planned for NSW/Sydney and the key organisations involved was compiled, covering the key ongoing projects and those planned in the next 20-25 years. As a first step, a search of the NSW government and City of Sydney websites was conducted to identify the current strategic planning documents for Greater Sydney. This list was used as a basis to identify the potential stakeholders’ organisations and then cross-referenced with those organisations identified online through a general search for infrastructure by sector in NSW. Those identified on the list were operating as leaders of infrastructure projects as industry organisations, capable owners and project sponsors. Further archival work was then used to develop detailed notes on the major projects using a variety of sources, including project websites, databases such as Factiva and

publicly available information on professional institutions and communities. These online sources describing government policy and plans, current and future infrastructure projects and the structure of industry organisations, capable owners and project sponsors that form the megaproject ecologies.

Approach

Recent work on infrastructure megaproject ecologies (e.g. Brunet and Cohendet 2021) develops a tradition of work on project ecologies. The term project ecology refers to the interrelations between projects and firms, personal ties, localities, and networks, which form a relational physical and organisational space for collaborative practices (Grabher 2002, Grabher and Ibert 2011). Projects are thus viewed as ‘temporary associations’ of individuals coming together from different organisations in a geographic area to form project teams (Grabher and Ibert 2011). While there are diverse understandings of what constitutes an ecology (MacAulay, Davies et al. 2022), this work seeks to provide a more contextual understanding of the project, and has examined regional interdependencies in projects in fields as diverse as advertising (Grabher 2002), biomedicine (Newell, Goussevskaia et al. 2008), software (Grabher 2004, Ibert 2004), housing (Hedborg, Eriksson et al. 2020, Hedborg and Karrbom Gustavsson 2020) and transportation (Siemiatycki 2011). Such project ecologies are heterarchical, characterised by ambiguity, redundancy and loose coupling, with the temporary projects drawing forms of legitimisation, expertise, control and finance from more enduring institutional and organisational structures (Grabher and Thiel 2014, Sydow and Windeler 2020). Although project collaborations may occur through inter-organisational project networks, project ecologies are formed where there is a predominance of project-based organising in an organisation field, such as in construction or infrastructure development.

In interpreting the behaviours of the individual projects within the ecology, Davies (2017) drew from Gernot Grabher’s work into project ecologies, describing them as the “*dense network of personal ties, organizational and institutional relationships found in geographical clusters of project-based activities*” (p. 122). The epistemic community provides a the wider knowledge sources from outside the boundary of the project team and firm that can be drawn from, such as the knowledge held by the project sponsor, suppliers and other professional groups from past experiences or case studies, including for example, knowledge on project delivery models and organizational architectures (Denicol, Davies et al. 2021). Work suggests that such ecologies may have different strengths and weaknesses, with for example work on governance indicating that diverse groups may have relatively low or high levels of *contextual interaction* and relatively low or high levels of *research focus* (Song, Song et al. 2022).

Key Findings

Our case of the Sydney megaprojects ecology shows that there are specific regional characteristics that shape the ability of projects to benefit from the broader set of megaprojects in their geographical region. In the Sydney case there are also competing demands, with skills shortages in key areas of project work. Over the last 25 years the pipeline of projects in and around Sydney have grown in complexity from relatively simple ‘greenfield’ projects such as roads, to more complex urban projects such as metros.

Table 1 shows some examples of major projects in and around Sydney. Supporting these projects are a range of institutions at Federal and State level, these include Infrastructure Australia and Infrastructure NSW. Less formally professional institutions and private consulting forms collate and provide access to knowledge via knowledge hubs, this includes the Engineers Australia Resource Centre and Transport Australia Society, NSW Energy and Resources and the knowledge resources collated by companies such as Arcadis and Pitt&Sherry.

We are in the process of further analysing this data and will have more analyses to report in the full paper. However, it is clear that two aspects of the project ecology in London – learning legacy

reports (developed from the London 2012 Olympics); and innovation programs (developed from Crossrail) are missing. At the same time as delivering increasingly complex and large megaprojects, there has also been a need to attend to bushfires, a pandemic and floods.

Table 1: Examples of Major Infrastructure Projects in the Sydney Region

Type	Example Projects
Major Transport Infrastructure Projects	Sydney Metro \$16bn to date (largest urban rail project in Australian history) Sydney Light Rail (CBD and South East light Rail ~\$3.147bn, Nov 2020 Auditor-General report) WestConnex (ongoing) \$12bn
Other major infrastructure projects	Snowy Hydro, Sydney 2000 Olympics (\$6.6bn) NorthConnex Tunnel (\$3 bn) South-West Rail Link (\$1.8bn) Sydney Airport Link (\$900 million at 2000 prices, opened for the Olympics) Epping-Chatswood Rail Link (\$2.35bn, replaced by Sydney Metro)
Major building projects	Barangaroo development (One Sydney Harbour) Sydney Tech Central (including Atlassian Tower) Parramatta CBD
Examples of Planned Major Infrastructure Projects	Western Sydney Airport \$5.3bn Western Sydney Infrastructure Plan, \$2.9 bn Bays precinct Waterloo Development

Implications

Our study contributes to work on more contextual ways of understanding projects, expanding understanding of how megaprojects within regions may benefit from a range of interconnections, operating as a project ecology. In the Sydney case there are benefits, but also challenges, associated with a cluster of complex megaprojects. By going beyond the existing work in the London infrastructure megaproject ecology it makes salient the regional specificity of aspects of the megaproject ecology, where Sydney faces particular challenges associated with skills shortages and climatic changes, and differs in the mechanisms established for transferring lessons learned. There is also significant learning across jurisdictions, and our study reveals, for example, the large number of individuals that have moved from London Crossrail to Sydney Metro. This gives us new directions to explore in our ongoing research, and suggests a contribution to the wider literature on project ecologies, where lessons learned can be transferred through individuals, through codified standards and processes, and through communities.

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