Managing major and mega projects: opening up for new research eras

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1 Editorial boards
2 Editorial
7 Megaprojects redefined – complexity vs cost and social imperatives
   Alexandra Pitts, Stewart Clegg, Daphne Freeder, Shankar Sankaran and Stephen Burdon
35 Increasing project benefits by project opportunity exploitation
   Pernille Eskerod, Karyne Ang and Erling S. Andersen
53 Megaproject management and leadership: a narrative analysis of life stories – past and present
   Shankar Sankaran
80 The governance of major public infrastructure projects: the process of translation
   Maude Brunet and Monique Aubry
104 A methodology based on benchmarking to learn across megaprojects: the case of nuclear decommissioning
   Diletta Colette Invernizzi, Giorgio Locatelli and Naomi J. Brookes
122 A fuzzy-based decision support system for ranking the delivery methods of mega projects
   Moza Tahnoon Al Nahyan, Yaser E. Hawas, Mohsin Raza, Hamad Ajassmi, Munjed A. Maraqa, Basil Basheerudeen and Mohammad Sherif Mohammad
144 Organizing inter-firm project governance – a contextual model for empirical investigation
   Simon von Danwitz
158 Evaluating the impact of the land acquisition phase on property owners in megaprojects
   Vince Mangioni
174 The hierarchy of public project governance frameworks: an empirical study of principles and practices in Norwegian ministries and agencies
   Gro Holst Volden and Bjorn Andersen
198 Linking workplace burnout theories to the project management discipline
   Kam Jugdev, Gita Mathur and Christian Cook
222 Book review


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Editorial

Special issue on managing major and mega projects: opening up for new research eras

In 2017, we proposed to the Board of the Project Organising Strategic Interest Group of the European Academy of Management (EURAM) Conference, a special topic track titled: “Managing major and mega projects: opening up for new research eras.” This special research topic was selected and included in the program of the 2017 EURAM Conference held in Glasgow, Scotland, from June 21 to June 24. From this research track, six papers were offered the opportunity to be published in a special issue and Emerald Group Publishing sponsored the Best Paper Award for the special topic in megaprojects. We take this opportunity to congratulate once again Dr Maude Brunet and Professor Monique Aubry of UQAM, Canada who have won the Best Paper Award, at the conference, for their paper titled: “The governance of major public infrastructure projects: the process of translation.”

To the six papers selected from the conference, we added three additional papers (Papers 1, 8 and 9) that came from the regular submission process of the Journal and also concerned the management of megaprojects. Finally, to complete this issue, paper 10 that links workplace burnout theories to the project management discipline and a book review by Professor Derek Walker on organizational project management were included.

Since ancient times, civilizations have had a fascination with large-scale monuments and buildings. Today, the appeal of megaprojects persists and their reach has grown globally, as well as into outer space and cyberspace (Pitsis et al., 2017). Governments around the world are committed to investing billions of dollars alongside significant ongoing private sector investment in infrastructure (Infrastructure & Projects Authority, 2016) which often tend to be megaprojects. These governments wish to establish the right framework to ensure that the right projects are delivered; to identify priorities and structure the financials ((Departmental Plan, 2017-2018; Miller et al., 2001). The goals of these megaprojects would also include the quality of life of individuals, benefits to society, the growth of a national economy, sustainable development of the infrastructure and the development of entire cities (Fischer and Amekudzi, 2011). These ambitious goals, which are transformational in impact, require management practices able to deliver benefits not only in terms of economic growth and societal change but also more intangible outcomes such as ecological sustainability, social capital and human well-being (Bornstein, 2010). Current assessment models of these megaprojects mainly focus on indicators of economic performance, risk analysis and cost benefit of projects (Van Marrewijk, 2015; O Oliomogbe and Smith, 2013; Priemus et al., 2008). Limited assessment models seek to include non-financial benefits through the integration of social or environmental indicators (World Bank Group, 2015; Vanclay et al., 2015; Dani, 2003). Firms and governments that are not paying attention to taking societal and environmental factors into account can cause grief with some clear examples. For instance, the Broken Hill Petroleum mining incident in Brazil is a recent one that almost destroyed the Australian company. The exact cause of the burst dam is not known but it appears that the mine owners and the operator failed to live up to their due diligence responsibilities as outlined in the OECD guidelines for multinational enterprises (Szoke, 2015; OECD, 2011). Responsible social and environmental conduct cannot be undermined when production costs increases and commodity prices fall. Neglecting such evaluation that identify, mitigate and prevent adverse impacts makes it more difficult to manage such large complex projects and deliver benefits from them.

Given the increasing importance of megaprojects, there is a need for a better understanding of the multifaceted aspects entailed in managing them predicated on the notion that
infrastructure projects must not only be cost-effective but should also meet societal needs such as building social capital, creating well-being and broad-based prosperity. Thus, it is timely to provide analysis of the main features that make up megaprojects. It is also judicious to explore new eras of focus for megaprojects with a special attention on the mutual impact of megaproject and society drawing on the broad literature of organizational project management (Sankaran et al., 2017; Drouin et al., 2013), project and program management as well as from allied fields such as organization theory, institutional theory, strategic management, cultural and historical perspectives (Clegg et al., 2017; Lenfle and Loch, 2016; Van Marrewijk, 2015). As raised by Van Marrewijk (2015, p. 14), megaprojects are “the outcome of social interactions just like any other form of organising that occurs within a multiple context of socially interdependent networks.” Thus, there is a need to provide a broader conceptual lens to better understand social impacts and human behavior in megaprojects. Although we cannot claim that the papers selected for this special issue address all the matters related to the complexity of managing major and mega projects, each of these papers brings a fresh perspective to the merit of providing new and different insights for the advancement of knowledge on that topic. What follows is a short description of each paper that we hope should inspire you to read them in full.

Paper 1. “Megaprojects redefined-complexity vs cost-and social imperatives” by Daphne Freeder, Alexandra Pitsis, Stewart Clegg, Shankar Sankaran and Stephen Burdon sets the table in providing an overview from the literature on how best to define megaprojects in contemporary contexts. These authors raised the need for a definition that encompasses a complex matrix of characteristics, inclusive of positive and negative aspects, which are not necessarily industry or sector specific. Points for future research are also identified, including: contexts, procurement, institutional perspectives, constituting megaproject cultures, and sustainability.

Paper 2, “Increasing project benefits by project opportunity exploitation,” by Pernille Eskerod, Karyne Ang and Erling Andersen suggests a new research area for megaprojects, i.e. the phenomenon of project opportunity exploitation as a means to increasing project benefits. The authors studied the Astoria-Megler Bridge that spans the Columbia River between Astoria, Oregon and Point Ellice near Megler, Washington, in the USA as a good social opportunity example. This bridge brought pride and fame to his community despite skepticism around its construction.

Paper 3, “Megaproject management and leadership: a narrative analysis of life stories – past and present,” by Shankar Sankaran gains insights into the management of megaprojects from life stories published about four megaproject managers: two contemporary project managers in the Asia-Pacific Region, who led large infrastructure development projects; and two landmark megaproject managers in the USA. Six books were used for the analysis of the life stories. The use of life stories has been a useful exercise to learn about the leadership attributes of megaproject managers, past and present.

Paper 4, “The governance of major public infrastructure projects: the process of translation,” by Maude Brunet and Monique Aubry received the Best Paper Award of the research track. It investigates the process of translation of an institutionalized governance framework as adapted to a major project in practice. The authors raised the point that although infrastructure projects have been studied for decades, most of these studies have emphasized economic or contingency-based perspectives. Little is known about the way actors translate and enact those governance frameworks into practice. Understanding this translation process will lead to a better understanding of the overall performance of major infrastructure projects.

Paper 5, “A methodology based on benchmarking to learn across megaprojects: the case of nuclear decommissioning,” by Invernizzi, Locatelli and Brookes. These authors also raised the lack of a single and universally accepted definition of major and megaprojects.
They said that these projects often provide fewer benefits than what were originally expected and are affected by delays and cost overruns. It is still extremely hard to gather lessons learned from these projects in a systematic way. This paper presents an innovative methodology based on benchmarking to investigate good and bad practices and learn from the case of nuclear decommissioning projects and programs.

Paper 6, “A fuzzy-based decision support system for ranking the delivery methods of mega projects,” by Yaser Hawas, Moza Al Nahyan, Mohsin Raza, Hamad Aljassmi, Munjed Maraga, Basil Basheerudeen and Sherif Mohammad Mohammad. This paper presents a framework to devise a system for ranking of traditional project delivery methods regarding their suitability against the varying levels of mega project attribute. The survey data were used to calibrate the fuzzy logic model of the granular component. The envisioned system index reflects the suitability on an ordinal scale.

Paper 7, “Organizing inter-firm project governance – a contextual model for empirical investigation,” is by Simon van Danwitz. According to this author, management of major inter-firm projects requires a coherent, holistic governance framework to be effective. This conceptual paper proposes an integrative analytical model of inter-firm project governance, building upon contingency theory and drawing from established constructs rooted in organization theory.

Paper 8, “Evaluating the impact of the land acquisition phase on property owners in megaprojects” is by Vince Mangioni. This paper examines the impact of the land acquisition phase and site assembly of land for large-scale infrastructure road projects and its impact on property owners. A review of one of the largest roadwork projects currently underway in Sydney, Australia demonstrates the adverse impact that has resulted in property owners challenging the approach used by government to acquire land for this project. Similar case studies are used to set out the key measures that should apply internationally in mitigating challenges from property owners in the land acquisition phase. It further shows that while adequate statutory provisions are important, it is the practices of acquiring authorities that ultimately determines the success and expedition of this initial important phase of these projects.

Paper 9 is “The hierarchy of public project governance frameworks: an empirical study of principles and practices in Norwegian ministries and agencies” by Gro Volden and Bjorn Andersen. The authors study public project governance frameworks in various ministries and agencies in Norway, following the introduction of a framework at the topmost level (i.e. the Cabinet) which applies to the very largest projects. The study finds that all of the agencies have introduced their own project governance frameworks, which are basically consistent with recommendations from the project management literature and with the Cabinet’s overall requirements in Norway. By contrast, only one ministry has taken a formalized role as project owner. Governance tasks thus seem to be extensively delegated to the subordinate agencies. This even includes strategic tasks such as project selection and portfolio management, and implies there is a risk that public project governance has a narrow and internal focus.

This last paper closes the topic on major and mega projects. We completed this issue with Paper 10 by Kam Jugdev, Gita Mathur and Christian Cook on “Linking workplace burnout theories to the project management discipline.” Given the demanding and stressful nature of project work, with a view to explore established concepts of burnout within the project management context, this paper examines two instruments: the Maslach Burnout Inventory and the Areas of Worklife Survey. Since there is a paucity of literature in project management anchored within the Maslach Burnout Inventory and the Areas of Worklife Survey, this article proposes a high-level model on burnout in project management, drawing on the literature underlying these two instruments. The paper contributes to an improved understanding of the determinants of project manager burnout, engagement, turnover and retention.
Finally, Professor Derek Walker has carried out a book review of the *Cambridge Handbook of Organizational Project Management*, edited by Sankaran, Müller and Drouin. We hope you will enjoy reading this special issue, Nathalie Drouin, Editor-in-Chief with the collaboration of Professor Stewart Clegg, University of Technology Sydney, Professor Shankar Sankaran, University of Technology Sydney, Professor Martina Huemann, WU Vienna University of Economy and Business and Professor Alfons Van Marrewijk, VU University Amsterdam.

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References


Further reading


Megaprojects redefined – complexity vs cost and social imperatives

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Abstract

Purpose – The purpose of this paper is to provide a brief overview from the literature on how best to define megaprojects in contemporary contexts. There is a need for a definition that encompasses a complex matrix of characteristics, inclusive of positive and negative aspects, which are not necessarily industry or sector specific. Whilst megaprojects have often been described and defined in terms of cost, they are more accurately delineated by their convolutions. Intricacies arise from political intrigues surrounding funding of such projects and managing and governing complex social and organizational relations. Points for future research are also identified.

Design/methodology/approach – An analysis of international megaproject literature over the past five years combined with seminal works was undertaken, drawing on the broad literature of project and program management combined with elements of organizational theory. Whilst some examples are cited, in-depth case analysis has not been covered.

Findings – Albeit that the scale of some megaprojects is comparable to national GDPs, seven more characteristics beyond size have been identified, which distinguish megaprojects from large projects. These include: reach; duration; risks and uncertainties; widely disparate actors; areas of controversy such as dispute resolution; and legal and regulatory issues.

Research limitations/implications – The paper takes a broad overview and whilst some examples are cited, in-depth case analysis has not been covered. The overview does however provide a good synopsis of the future research areas that warrant exploration.

Practical implications – The paper identifies a range of analytical areas for major future research including further exploration of institutional analysis. Areas for further analysis include stakeholder issues; collaboration and understanding between technical and business personnel and reforming notions of procurement and contractual arrangements.

Social implications – Rigorous stakeholder engagement is critical for success in megaprojects, and collaborative learnings need to be exchanged. The longer term social and economic impacts need to be viewed as an imperative rather than a hindrance to the planning and execution of megaprojects and complexity rather than cost more aptly defines megaprojects.

Originality/value – The paper moves the definition of megaprojects to beyond measurement on the basis of cost to complexity and social and economic variables.

Keywords Innovation, Complexity, Economic, Social, Characteristics, Megaprojects

Paper type Literature review

Megaprojects are changing the face of Sydney, Australia. The Westconnex which entails 33 kilometers of a new motorway scheme currently under construction and Barangaroo a precinct redeveloped from shipping and stevedoring facilities to commercial and recreational spaces are just two of the most evident projects because they are very advanced in their impact. It is in this context of the increasing importance of megaprojects to...
1. Multifaceted aspects of defining megaprojects

In the past, historical megaprojects have left many famous landmarks: the Pyramids, the Great Wall of China and so on. Since ancient times it seems that a number of civilizations have had a fascination with large-scale monuments, buildings, activities and events, usually as defensive or symbolic expressions of power and status. The appeal of megaprojects persists globally in current times with advocacy from both political and developer proponents expressed, for example through large-scale urban transformation projects and substantial financial expenditure.

Megaprojects have been broadly described as “large-scale, complex investments that typically cost a billion dollars and up, take many years to develop and build, involve multiple public and private stakeholders, are transformational, and impact millions of people” (Flyvbjerg, 2014a). It is, however, not the cost but the complexity that marks out a megaproject. The intricacies arise from the politics associated with funding, managing and governing complex social and organizational relations. Involvement ranges from committed stakeholders amongst the contractors and civic authorities to those that are resistant, embedded in existing communities, social movements and advocacy organizations.

This paper aims to present a brief snapshot of what megaprojects mean in today’s terms. It outlines the common problems, key characteristics benefits that are intended as well as misgivings about the problems that such projects present, together with ideas around solutions for maximizing benefits and minimizing the more challenging issues.

Cost is often seen as the criterion for deeming something a megaproject. For instance, both the European Union and the International Project Management Association (IPMA, 2011) explain them in these terms. A megaproject is defined, across all industries, as one for which the benchmark is that it costs more than “100 million euros” (Hu et al., 2015). However, this is not really satisfactory: a 100 million euros spent on a project in a deserted territory or one that suffers under highly authoritarian rule is hardly the same as one conducted in a democracy in which there are active citizens. The classification of megaprojects needs to be more nuanced, taking into account the trajectory of the term in academic and practitioner publications.

Navigating the way the term is positioned across publications such as Flyvbjerg’s (2014a) Megaproject planning and management: Essential readings and The Oxford Handbook of Megaproject Management suggest a number of critical and persistent themes. First, there is significant continuity between the management of megaprojects and large-scale project management. The broad historical contexts for the initial notion of megaprojects are discernible within the discipline of project management. These are centred on the way the project manager’s role has changed to take into account projects embedded in “advanced technology industry,” involving larger and more complex projects and tasks. Project Management has emerged as a profession characterized by particular sets of skills and technical expertise (Gaddis, 1959 in Flyvbjerg, 2014a), applied to large-scale projects. What might simply be a large-scale project in one context of relatively simple political and organizational relations could be considered a megaproject in another situation that posed far more in the way of complexity to be managed.

Megaprojects need to be approached through more than their scale even though the scale of some megaprojects is comparable to national GDPs. The inherent intricacies also require consideration (Ansar et al., 2016) “Bigness entails multiple problems and unpredictable interactions across dimensions” – problems and intractability linked to economies of scale and “investment fragility” (Ansar et al., 2016). However, there is more to a megaproject than simply size and finance.
Based on a review of prominent literature characterizing megaprojects (Biesenthal et al., 2018) seven more characteristics were identified that make them different from complex or large projects: reach; duration; risks and uncertainties; widely disparate actors; arenas of controversy; legal and regulatory issues. They suggest that what differentiates megaprojects is their reach and the broad impact they have on society and the environment.

Megaprojects have often been studied within a sector or industry; however, increasingly they are not industry or sector specific but extend across an institutional field. An institutional field may be defined as comprised of those “sets of organizations that, in the aggregate, constitute a recognized area of institutional life; key suppliers, resource and product consumers, regulatory agencies, and other organizations that produce similar services or products” (DiMaggio and Powell, 1983, p. 148). Actors and organizations within an industry will constitute such a field “whose participants interact more frequently and fatefully with one another than with actors outside of the field” (see Scott et al., 1994, pp. 207-208). The complexity of the megaproject field is generated by the fact that this frequent and fateful interaction, contra other elements of Scott’s definition (he stresses the importance of a “common meaning system”), is frequently a contested terrain. The larger the project, the more complex the institutional field, and the more frequent and fateful the interaction, then the more contested and complex one would anticipate the project to be. A megaproject is not only big, in terms of scope and scale and costs, it is also big in its potential for politics in and around the project.

The institutional fields in which megaprojects most frequently cluster center on the following:

1. Goods and services across a range of businesses and sectors:  
   - infrastructure, water and energy, information technology; and  
   - industrial processing plants, mining, supply chains, enterprise systems, government administrative systems, defence, intelligence, air and space exploration, urban regeneration, and major events.

2. Mega change management:  
   - strategic corporate initiatives and change programs, mergers and acquisitions, banking, big science; and  
   - National Health Care Systems.

3. Examples of megaprojects:  
   - high-speed rail lines, airports, seaports, motorways, hospitals, national health or pension ICT systems, national broadband, the Olympics, large-scale signature architecture, dams; and  
   - wind farms, offshore oil and gas extraction, aluminum smelters, the development of new aircrafts, the largest container and cruise ships, high-energy particle accelerators, and the logistics systems used to run large supply-chain-based companies like Amazon and Maersk.

Each of the institutional fields constituted by projects in these areas will differ, with different stakeholders, relevancies, and problems. Megaprojects, as a generic concept for useful research may not be appropriate across all fields, i.e. no one size fits all. Each constitution of an institutional field has specific issues and these emerge from contextualized problem situations across different phases and cycles of the design, planning and implementation phases. At times when solutions or explanations surrounding a megaproject are sought, these are necessarily mixed. There is need for a definition of megaproject that encompasses a complex matrix of characteristics, positives and negatives,
Making sense of megaprojects

Megaprojects have been seen through a power and sensemaking lens (Flyvbjerg, 1998; Clegg et al., 2017) that sharpens the focus on a number of elements. These include the ways in which contractual relations shape the “norms of competitive contracting,” facilitating quite specific project power relations, often expressed in terms of the drive to ensure contractual expectations of profit and meeting of schedules, as well as cost control, leading to cost cutting. On these criteria, megaprojects are notoriously unsuccessful: they routinely do not come in on time, on budget, on specifications or predictions as to their value. The narratives representing megaprojects are telling in their metaphors: perhaps the most pervasive is that of “escalation” – of commitment, of costs, of complexity, of conflict. If narrative is critical to the ways in which megaprojects are perceived, such that the coherence of their storyline is important in framing a semblance of success (Low and Sturup, 2014), assisting in the determination of which projects are deemed to be a triumph, there are very few success stories. Much more common are metaphors that see unsuccessful megaprojects as the norm, representing some kind of uncontrollable species. “Megaprojects are a completely different breed of project in terms of their level of aspiration, lead times, complexity, and stakeholder involvement. Consequently, they are also a very different type of project to manage” (Flyvbjerg, 2014b). Megaprojects have also been described as the “wild beast” of the project world (Zidane et al., 2013) and likened to unruly trolls – difficult to tame and control (Klakegg, et al., 2016).

One of the reasons that megaprojects are regarded in such metaphorically grim terms may well be the provenance of project management discourse and its relative autonomy from more established areas of organization theory, well versed in uncertainty, complexity and conflict and their management. Boiled down to its essentials Flyvbjerg et al.’s (2003) influential work suggests two propositions: first, that megaprojects will routinely exceed estimates of their risk in terms of costs, completion, and other performance indicators. Second, they will regularly exceed estimates of their risk in terms of costs, completion and other performance indicators because those associated with their commissioning and implementation will use deceptive indicators and misleading projections resulting in the misallocation of scarce resources (Flyvbjerg et al., 2003, p. 20).

While the first proposition is undeniable, it does not follow that the second proposition is true. If it were, the institutional field that constitutes megaprojects would be populated by participants who are incapable of learning from experience that the rules they are applying will not produce the predicted results. This would imply that no institutional learning takes place in the management of government, public sector bureaucracies, banks and share portfolios. The assumption being made seems to be that large-scale organization is normally characterized by rationality and that any deviation from the rational norm must be aberrant. We think that there must be a better explanation for the dismal outcomes that Flyvbjerg et al. (2003) have identified, if only because we are neither convinced by the normalcy ascribed to rationality per se nor are we inclined to believe in widespread conspiracies against the public interest.

First, let us consider the general critique of rationality. It is a foundation stone of modern management, that it is premised on rationality. Rationality flows from headquarters, through heads of departments, into action, via rational decision making. Problems are defined; all the relevant information that leads to an optimal solution is collected; experts work on that information to create plans; these plans are carefully evaluated, and an optimal solution decided; then, knowing what is to be done, implementation follows with constant evaluation to correct any deviant loops away from the plan. Modern project management holds these truths to be infallible. Modern organization theory is less sanguine.
March and Simon (1958) express doubt that decision makers really do look for optimal solutions. They suggest that they cannot because they never have sufficient information to be able to do so. Instead, they look to “satisfice,” a new word coined to suggest that they aim to create the most satisfactory outcomes that they can, given what they know, are able to access, and process. People generally have bounded rationality; they operate with limited search, imperfect knowledge, and finite time. Megaproject sponsors, financiers and managers are no different; they too work within the bounds of their own rationality. Hence, they are not so much operating according to the norms of economic rationality – having perfect knowledge contained in an unambiguous price signal about the choice of substantively similar perfectly competitive goods – as operating under the stresses of the situation, processing what is at hand and what they know, to try and work out what they will do. Pushing the logic of this scenario a little bit further Cohen et al. (1972) suggest that the logic of organizing in complex organizational situations is akin to the logic of what they call the garbage can. Decisions are made when solutions, problems, participants, and choices flow around and coincide at a certain point. The adjacencies, much as garbage in a trashcan, are often purely random. Or as Starbuck (1983) suggested, organizations are not so much problem solvers as action generators, generating problems to which they already have the solutions.

Now if these traits characterize organizations, there will be much more characteristics of projects. Here there is usually no singular centre of calculation and control but many collaborators; each project, by definition, is unique, and requires unique learning and transfer of knowledge; projects are characterized by an identity that is ambiguous, has fuzzy limits, and a duality between objects and actors who are willing them into being (Engwall, 1998). Projects are complex: they are not marked by routine repetition of short time cycles. They involve multiple competencies, each of which will be characterized by its specific rationalities: those of the contractor’s project management; those of the sub-contractors; the client and client’s architectural team; the political sponsors of the project, plus any other agencies that assume stakeholder interests in the project. As in March et al.’s (1972) garbage can model, where random alignment of different rationalities, decisions and actions occurs, the overall project logic will not necessarily see these rationalities well-aligned with each other.

Thinking of how megaprojects become funded, one can suggest that launching megaprojects and keeping them going presents ample opportunity for what Brunsson (1992) calls the organization of hypocrisy to occur. Hypocrisy is generally be thought of as a form of insincerity where one acts as if one had qualities or convictions that one does not really have; nonetheless, megaprojects would never occur without substantial amounts of falseness. If government and finance demand risk analysis and hard figures for project proposals, then the job of project brokers and managers is to try and produce them, even if they know that the figures they are dealing with are highly imprecise and speculative. Otherwise, no project would ever get talked into being. Facing a demand for certainty while confronting much that is unknowable and undecidable may well make hypocrisy the norm.

In addition, there are inherent features of project management and organization, once it has been talked into being, which will tend to produce further hypocrisies. In the context of the construction industry, the contract and its associated documents are the central framework shaping managerial discourse. Most contracts are of the kind that is referred to as hard money contract – where the construction being undertaken is bid for on the basis of the specifications in the contract, for a definite price, and where the most competitive tender wins the contract. What this does is to set up a constitutive framework in which the meaning of the contract plays an essential role. Despite recommendations to the contrary in the procedural handbooks of the industry, contracts are never unequivocal; they are highly indexical and whoever is interpreting them is likely to do so from a position that indexes a specific set of interest; that is, contracts cannot be read simply as a precise and unequivocal set of instructions for delivering a projected outcome. There are at least two reasons for this, we argue. Both are questions of
context – one immanently material to the conditions in which the specific contract is enacted and the other transcendentally constitutive of all contracts.

The immanent reasons are simple. Contractual specifications, typically, are large and complex bodies of documentation: not only are there the documents on which the work is bid but there are also detailed consultants’ reports and associated documents. In an ideal world these would exist in an absolute and seamless correspondence of all detail from one document to another such that no document ever contradicted another or was in conflict with it. Given the vast amount of paper – comprising detailed specifications, reports, and projections – associated with complex projects, many hands, at many times, deploying many distinct skills, produce these texts. More often than not there will be points of ambiguity or even disagreement between them. Project personnel will be more or less skilled game players, displaying a mastery of occupational and organizational rhetoric that enable them to make something out of the opportunities presented. Potentially the greater the complexity, the greater there is opportunity.

What makes the organization of hypocrisy unique in the world of megaprojects is the time-lagged nature of these phenomena. While most people may expect a rational model of organizations, with consistency between talk, decisions and action, in megaprojects the time lapses between the talk (and other forms of discourse such as the project brief and other documents), the incremental and interlinked nature of the decisions, and the delayed action in terms of final project outcomes means that the organization of hypocrisy should be the expected norm.

2. Trajectory of megaprojects in the literature

Academic landscape

Complications aplenty attach to developing an academic focus on megaprojects. What one should expect are recommendations for limiting opportunities for organizational hypocrisy. A review of various literatures suggests areas in which this might be done. In terms of academic papers found on Business Source Complete (BSC)[1], the following subject terms emerged:

- Project management
- Infrastructure (economics)
- Construction project management
- Economic development
- Construction industry
- Cost control
- Management
- Strategic planning
- Urban growth
- Urban planning

The broad academic focus of work on megaprojects demonstrates varied ways of exploring the topic, including accounts from urban planning as well as more technically focused areas such as Construction Engineering and Management (CEM) and Project Management. Research emerges as a specific area of interest.

Practitioner landscape

The practitioner landscape[2] produces only a slightly different focus. The overlap in subject focus (same BSC search) was very similar but there were a couple of critical differences highlighting the shift of focus to more finance and trade-related areas (highlighted in italic):

- Construction Industry
- Infrastructure (Economics)
- Project management
- Construction contracts
- Petroleum industry
- Railroads
- Economic Development
- Investments
- Conferences and Conventions
- Contracts
- Finance
- Economic development
White paper/policy reviews
In essence, the policy reviews outlined a number of pragmatic solutions in handling megaprojects on a wider societal level. These papers take into account the economics and relationships of diverse stakeholders.

LSE growth commission report. In 2013, LSE Growth Commission published a report on economic growth in the UK for the next 50 years. This report explored institutions and policies inherently connected to the impetus for growth. Besley et al. (2013) developed a paper summarizing the findings of the report in Investing for prosperity: skills, infrastructure and innovation, highlighting three core areas of focus – human capital, infrastructure and technology. The report outlined that the key area of long term and well-considered provision of infrastructure was inherently connected to economic growth best seen as a nodule in a suite of reforms and changes. Considering large infrastructure as a form of megaproject invariably links it to the economic outlook of a nation. As such megaprojects are seen as an active component of the economy conceived in a systemic manner.

The Commission proposed a number of new institutions and processes to deal with issues around poorly managed national infrastructure development and economic growth. This included an Infrastructure Strategy Board (ISB) to play a role in providing expert independent advice and an Infrastructure Planning Commission to deliver on the ISB’s strategic priorities. A number of events took place subsequent to the 2013 report, with the National Infrastructure Commission being set up (on an interim basis on October 5, 2015) to examine the future of the UK’s needs for “nationally significant infrastructure.” Doing so was seen as integral to assist in maintaining UK competitiveness amongst G20 nations. The other aim included was to provide greater stability for investors by focusing on “long term” approaches for national investment decisions.

The findings of the LSE report are applicable to the Australian context where we also see a lag in productivity and a need for public service innovation, smarter ways of investing and carrying out large projects.

Roads to riches
Exploring white papers and policy reports relevant to the Australian context one sees similar themes emerging about a need for better regulation around large transport infrastructure projects. The Grattan Institute Report, “Road to Riches: better transport investment,” discusses how government spending on transport infrastructure in the last ten years has been unprecedented and at the same time poorly considered. Although the Mining Boom and GFC influenced government spending and stimulus, it has been argued that large sums of money were used in misaligned projects and that activities were influenced more by a political agenda than community needs (Terrill et al., 2016). We should expect that this would be the cases: in the absence of any controls on hypocrisy we would expect political self-interest to be paramount in determining funding priorities. Cities are the “engines of national economic growth” (Terrill et al., 2016, p. 2). Cities in Australia face increasing populations, congestion and competition yet spending on major projects within them is determined by political agendas and vote-seeking by politicians. This has shaped investment spending, resulting in it being poorly designed and executed.

The establishment of Infrastructure Australia is aimed at improving spending on infrastructure but much more could be done to strengthen the institutional forces at play. A rationale, which includes a transparent process, is needed to ensure that projects are well argued with realistic parameters in their proposals. The Grattan Institute
The report outlines three recommendations to address problems around transport infrastructure projects:

(1) Government should not commit to transport infrastructure projects before an evaluation takes place by an independent body and a business case is developed. These need to be tabled in Parliament. This has not been the case with major recent megaprojects such as WestConnex.

(2) Once tabled in Parliament, the projects need to be progressed to completion. Where the community benefits outweigh the cost, this determines the need for all such projects to be built and these projects should be prioritized for government spending. These criteria of public value have not been spelled out clearly.

(3) Commonwealth funding needs to be considered as separate from GST entitlements, with a focus on the national economy, regardless of which state the project is located within (Terrill et al., 2016).

**MGI reports**

According to the McKinsey Global Institute Report (MGI) (2016) on Bridging Global Infrastructure Gaps, $2.5 trillion is invested globally in infrastructure such as transport, water, communication/telecom systems. This amount is not adequate, the report suggests, when taking into account the increasing needs of businesses and the population depending on such infrastructure.

The report estimates that global infrastructure investment from 2016 to 2030 needs to be approximately $3.3 trillion a year just to meet expected rates of growth. MGI forewarns that if the current underinvestment continues, the global shortfall will be $350 billion per year, possibly triple this amount if the UN Sustainable Development Goals are taken into account. This estimation also envisages lower economic growth and lack of services as needed for the populations, both business and domestic, short of such investment. The MGI Report highlights the more complex aspects of megaprojects and their place in global economics.

The report builds on a 2013 report (McKinsey Global Institute Report (MGI), 2013) and updates estimates of the world’s infrastructure needs and how these are not being fully met. As such the report makes recommendations for addressing global infrastructure gaps.

The MGI (2016) Report also outlines a series of changes required:

- An increased need of public infrastructure investment with the government playing a significant role by increasing funding streams. User charges, capturing property value, selling existing assets and using proceeds for new infrastructure are all recommended (MGI, 2016).

- Changes to financial frameworks are recommended with the suggestion that public accounting standards be aligned with corporate accounting whereby infrastructure assets depreciate over a life cycle as opposed to adding to deficits during construction, reducing ”pro-cyclical investment behaviour” (MGI, 2016).

- Tapping into investment in privatized sector would need regulatory certainty with acceptable risk adjusted returns and other processes, such as land access, permits and approvals.

- Public Private Partnerships (PPPs) are important in infrastructure projects – the report indicates that there is a question as to whether PPPs deliver on efficiency and lower costs. Still, they play a role as a source of future financing and account for 5-10 percent of total investment. The report highlights that public and corporate investment is a more significant issue (MGI, 2016).
$120 trillion in assets are tied up in banks and institutional investors – these could support projects in infrastructure. The vast majority, i.e. 87 percent of these funds, come from advanced economies while the greatest need is in middle-income economies. The report highlights that cross-border investment principles will be required to match investors with projects. A number of issues need to be addressed such as: regulatory rulings on investment on infrastructure assets; absence of an efficient market, and most importantly, improving the pipeline of profitable projects (MGI, 2016).

Accelerating productivity growth in the Construction Industry: the MGI (2013) report demonstrated that improving on a number of areas such as “project selection, delivery, and management of existing assets” could amount to 40 percent savings (MGI, 2016, p. viii). In the 2016 report, MGI completed comprehensive diagnostics measuring the efficiency of infrastructure systems in 12 countries. It identified the need for improvement in most economies, including the advanced ones, with scope to “build stronger capabilities with learning institutions with strong oversight” (MGI, 2016, p. viii).

The report also outlined a need for rigorous assessment benchmarking aspects of infrastructure development and the development of global best practices assisting in compiling and identifying areas to yield best-targeted results.

### 3. Characteristics

**Key variables**

Clearly, in conceptualizing what are the significant variables in managing megaprojects we need to include at least the following parameters:

- **Size**: this could include the size of the project or the size of the impact.
- **Cost**: a specific value included in many technical definitions. Flyvbjerg links cost to a number of levels (see Table I).
- **Uniqueness**: megaprojects by their very nature include some overt factor that could be deemed unique.
- **Schedule**: a schedule tied to contractual milestones and project management, an inherent timeline for the project completion is usually indicated as a part of the megaproject process.
- **Scope**: a comprehensive sense of what the whole project includes in terms of time, content and delivery.
- **Governance**: a clear line of governance and delineation of process and power of decision making is the engine room of the megaproject.
- **Stakeholders**: there are complex relationships, including inter and intra relationship pertaining to stakeholder interest in the megaproject. These include social, financial, environmental, community and other more implicit and hidden stakeholders.

<table>
<thead>
<tr>
<th>Prefix</th>
<th>$10^n$</th>
<th>Scale</th>
<th>Project type</th>
<th>First heard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mega</td>
<td>$10^6$</td>
<td>1 million</td>
<td>Megaproject</td>
<td>1850s</td>
</tr>
<tr>
<td>Giga</td>
<td>$10^9$</td>
<td>1 billion</td>
<td>Gigaproject</td>
<td>1960s</td>
</tr>
<tr>
<td>Tera</td>
<td>$10^{12}$</td>
<td>1 trillion</td>
<td>Teraproject</td>
<td>2000s</td>
</tr>
<tr>
<td>Peta</td>
<td>$10^{15}$</td>
<td>1 quadrillion</td>
<td>Petaproject</td>
<td>?</td>
</tr>
</tbody>
</table>

**Source**: Flyvbjerg (2014a, p. xv)

**Table I.**

*Project size in US$*
Complexity: this is also an inherent aspect of the megaproject which includes multiple levels within all the stated characteristics and how these influence each other positively or negatively.

Risk: is often conflated with complexity and decision-making but is a characteristic that drives the finer and more volatile aspects of the megaproject.

Optimizing value – from a social and economic point of view.

In terms of scale, Flyvbjerg explored a number of terms used to describe megaprojects and the timescale in which these emerged; however, despite the emergence of these other terms, the main terminology evident in the literature persists as “megaproject,” dating from the 1850s.

Overall, these discriminant terms are not particularly conceptually useful. The reasons are as stated previously: cost does not solely a megaproject make. We need to factor in the full range of variables.

Disciplining megaprojects
Disciplines relevant to megaprojects include:

- engineering;
- architecture;
- environmental planning;
- science;
- business;
- organization and management theory;
- project management; and
- urban planning.

Another set of categories emerged through citation analysis (in the next section) in terms of top research areas. While not an exhaustive list, these included:

- business economics;
- environmental sciences ecology;
- geography;
- public administration;
- engineering;
- urban studies;
- government law;
- social sciences other topics;
- construction building technology; and
- energy fuels.

In terms of approaches the following are some of the organizing categories in general use.

Historical perspectives. In exploring historical aspects of megaprojects, such as post Second World War projects, the practices of project management and its technical systems
are highlighted. The changes over time emphasize the emergence of relevant and effective practices, some of which are held as possible systems for current megaprojects (Lenfle and Loch, 2017). These authors suggest that a possible return to previous project management systems and practices that have been deemed effective could be drawn on for new methods for dealing with current dilemmas in megaprojects, especially around core areas such as uncertainty, contractual aspects and stakeholder interests.

Events: Olympics. Mega events, such as the Olympics, have been deemed to be megaprojects. A number of urban developmental modes have been attributed to the building and development for Olympics. The large scale “spectacle” of opening ceremonies (Broudehoux, 2010; Tien et al., 2011; Müller, 2011) are often seen as complex megaprojects, with the Berlin 1936 Olympics often being cited as the first case of upscaling the Olympics to a mega event, which generated a desire to present these events in a new grand schema.

The Olympics could be deemed to be a “classic” megaproject as they have all the features – time constraints, a budget that needs to be maintained, politics, economics, stakeholder interests, a diversity of other actors with varying levels of empowerment and disempowerment, in addition to issues associated with a highly concentrated temporality as well as the longevity of the assets and their further use after the event is over.

Innovation and diffusion of megaprojects
Megaprojects are subject to cycles and fads, on a large scale:

When these projects are viewed historically and situated within a global context, the cyclical nature of urban mega-project development comes into clearer focus. Indeed, there are a variety of common cycles of mega-project innovation and diffusion that can be identified (Siemiatycki, 2013, p. 162).

Economics urban planning, cost of urban land
Megaprojects have also been linked to large-scale urban development and shifts in ownership to large corporations or from the public to the private sector (Sassen, 2016). These megaprojects conjure up the notion of large scale or global “real estate,” affecting large populations through geographic and economic dislocation. At the core of this dislocation are the ways in which the fundamental needs of different stakeholders are variously accounted for.

4. Citation analysis
A citation analysis for 2011-2016 was undertaken, to gain a schematic picture of how the term “megaproject” traversed different areas of literature. There were literature reviews/bibliographic analysis previously published for the topic of Megaprojects with a focus on CEM for the period 2000-2010 (Hu et al., 2015) and 2008-2011 (Peng et al., 2012). These reviews served as a general background on the issues and themes covered in the years preceding and as aids to assessing developments in more recent years within the timeframe of this research.

The databases used:

- Web of Science (WoS – v5.22.3) – this database was used to capture the wider disciplines, topics and themes for citation analysis. WoS allowed a glimpse into all areas and disciplines where megaprojects were mentioned, along with associated terms. This allowed an exploration which was not purely focused on CEM.
- BSC – this database was used to focus on a specific business and management view of megaproject for the literature review.
Although WoS and BSC were the main databases used, Scopus and Factiva were also used to enhance some elements of the literature review:

- Scopus – wider focus, analytics.
- Factiva – to gage the topics discussed in past five years in much wider publications, also looking at what has been newsworthy (search conducted August 1, 2016).

Each database had specific criteria and parameters, which varied across the different databases. The citation analysis provides an amalgam of findings across all searches.

A number of key terms were gleaned from the initial literature search (Flyvbjerg, 2014b). The terms identified were searched in field tags for “Topic” and also if the terms were contained in the “Title” (Table II).

**WoS**

**WoS citation analysis – sub-areas.** Refined searches: a number of sub-areas were excluded to focus on relevant megaproject research area. Non-related articles, where the primary focus was not on megaprojects despite the specific terms coming up in the search, were removed. The search identified almost 100 areas of research where the term megaprojects were noted in the TI and TS field. A number of these were excluded such as astronomy and astrophysics, food science technology, clinical science, epidemiological studies, etc. This yielded a total of 783 items.

When specifically focusing on megaprojects as a word in the title of the article or supplied as a topic term, there are 398 items which give a more defined picture of a number of subareas as outlined below:

1. Most cited articles with citation counts (WoS) (2011-2016):
   
   Flyvbjerg (2014b) was the most highly cited paper in the top 1 percent of its academic field based on a highly cited threshold for the field and publication year (Data from Essential Science Indicators on WoS).

<table>
<thead>
<tr>
<th>Database</th>
<th>Field and no. items</th>
<th>Terms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web of Science</td>
<td>TS = Topic (398)</td>
<td>Primary:</td>
</tr>
<tr>
<td></td>
<td>TI = Title (155)</td>
<td>“Megaproject” OR “Megaprojects” OR “Mega project” OR “Mega projects”</td>
</tr>
<tr>
<td></td>
<td>TS = Topic (1,174)</td>
<td>Additional:</td>
</tr>
<tr>
<td></td>
<td>TI = Title (104)</td>
<td>“Complex project” OR “Complex projects” OR “Large project” OR “Large projects”</td>
</tr>
<tr>
<td></td>
<td>Additional combined: 1,174</td>
<td>“Large-scale program” OR “Large-scale programs” OR “Large-scale programmes”</td>
</tr>
<tr>
<td></td>
<td>All sets combined = 1,558</td>
<td>“Large program” OR “Major program” OR “Major programmes”</td>
</tr>
<tr>
<td></td>
<td>Refined: 783</td>
<td></td>
</tr>
<tr>
<td>Business Source</td>
<td>AB = Abstract</td>
<td></td>
</tr>
<tr>
<td>Complete</td>
<td>TI = Title (114)</td>
<td></td>
</tr>
<tr>
<td>Scopus</td>
<td>TITLE-ABS-KEY = 1,459</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Refined: 672</td>
<td></td>
</tr>
<tr>
<td>Factiva</td>
<td>Primary in title or leading paragraph:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total count: 7,295</td>
<td></td>
</tr>
</tbody>
</table>

Table II. Summary of database searches
The primary combined search (398) was filtered for citation counts — high to low (again another level of exclusion occurred for non-relevant items) (Figure 1 and Table III).

Another search was conducted on WoS for the top authors across the set for record counts. This was an item set by the parameters of the database. Table IV highlights top authors within this search were as follows.

Top author record counts — i.e. number of records on WoS.

Although Flyvbjerg is positioned lower in the list of record counts, in the citation counts for the same set, he tops the author list.

(2) Country of origin of megaproject articles published:

Table V highlights the origins and regions from which publications are coming from. The top four countries listed include Australia. This result highlights Australia as a dynamic country in terms of publication output on megaprojects. The top two countries are the USA and England.

(3) Research institution publishing articles:

Institutions listed in the publications are highlighted in Table VI. Amsterdam University tops the institutions for record count.

(4) Publication years:

Record count for publication for the years 2011-2016. Note that 2016 is not indicative of the total and only includes counts to October 2016 (Figures 2 and 3).

(5) Top ten journals publishing on megaprojects (WoS) by record count.

(6) Top journals publishing on megaprojects (WoS) by citation count of most cited papers.

The top journals by citation count (2011-2016) are as follows:

6. *Habitat International*.

When compared to Table VII, it is interesting to note that a number of journals such as Cities, *Korean Journal of Construction Engineering and Management* and
do not show up for the higher citations despite having higher representation in record counts. From a comparative analysis, *International Journal of Project Management* is significant in both representation on the WoS database and citations.

The citation statistics may show a bias due to the sampling criteria. Had we used more generic terms such as complex systems or complexity we would have

<table>
<thead>
<tr>
<th>Journal article title</th>
<th>Authors</th>
<th>Source title</th>
<th>Publication year</th>
<th>Total citations</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Should we build more large dams?</td>
<td>Ansar, Atif; Flyvbjerg, Bent; Budzier, Alexander; Lunn, Daniel</td>
<td><em>Energy Policy</em></td>
<td>2014</td>
<td>39</td>
</tr>
<tr>
<td>6. Maximizing strategic value from megaprojects: The influence of information-feed on decision-making by the project manager</td>
<td>Eweje, John; Turner, Rodney; Mueller, Ralf</td>
<td><em>International Journal of Project Management</em></td>
<td>2012</td>
<td>18</td>
</tr>
<tr>
<td>8. Providing cleaner energy access in Indonesia through the megaproject of kerosene conversion to LPG</td>
<td>Budya, Hanung; Arofat, Muhammad Yasir</td>
<td><em>Energy Policy</em></td>
<td>2011</td>
<td>16</td>
</tr>
<tr>
<td>10. Articulating Intra-Asian Urbanism: The Production of Satellite Cities in Phnom Penh</td>
<td>Percival, Tom; Waley, Paul</td>
<td><em>Urban Studies</em></td>
<td>2012</td>
<td>13</td>
</tr>
<tr>
<td>13. Urban mega-projects for a “world-class” riverfront - The interplay of informality, flexibility and exceptionality along the Yamuna in Delhi, India</td>
<td>Follmann, Alexander</td>
<td><em>Habitat</em></td>
<td>2015</td>
<td>8</td>
</tr>
</tbody>
</table>

Region Ekonomika I Sotsiologiya do not show up for the higher citations despite having higher representation in record counts. From a comparative analysis, *International Journal of Project Management* is significant in both representation on the WoS database and citations.

The citation statistics may show a bias due to the sampling criteria. Had we used more generic terms such as complex systems or complexity we would have
produced a differently skewed sample, oriented perhaps more to fields such as organization theory.

(7) Research areas of megaproject articles in journals (Table VIII).

**BSC**

BSC was used to determine differences in a number of areas of the citations for the term megaproject. It allowed for a more detailed view of the landscape differences between practitioner areas and academic areas.

Terms were searched in the abstract, title and keyword field using the term megaproject and its variations. A total of 404 items were found. Articles include academic scholarly

<table>
<thead>
<tr>
<th>Author</th>
<th>Record count</th>
<th>% of articles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hu Y.</td>
<td>7</td>
<td>1.759</td>
</tr>
<tr>
<td>Chan A.P.C.</td>
<td>5</td>
<td>1.256</td>
</tr>
<tr>
<td>Kharitonova V.N.</td>
<td>5</td>
<td>1.256</td>
</tr>
<tr>
<td>Le Y.</td>
<td>5</td>
<td>1.256</td>
</tr>
<tr>
<td>Flyvbjerg B.</td>
<td>4</td>
<td>1.005</td>
</tr>
<tr>
<td>Giezen M.</td>
<td>4</td>
<td>1.005</td>
</tr>
<tr>
<td>Sovacool B.K.</td>
<td>4</td>
<td>1.005</td>
</tr>
<tr>
<td>Chang A.</td>
<td>3</td>
<td>0.754</td>
</tr>
<tr>
<td>Davies A.</td>
<td>3</td>
<td>0.754</td>
</tr>
<tr>
<td>Doucet B.</td>
<td>3</td>
<td>0.754</td>
</tr>
</tbody>
</table>

Table IV. Record count for authors (WoS, 2011-2016)

<table>
<thead>
<tr>
<th>Countries/territories</th>
<th>Record count</th>
<th>Percentage of total items</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>55</td>
<td>13.819</td>
</tr>
<tr>
<td>England</td>
<td>44</td>
<td>11.055</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>29</td>
<td>7.286</td>
</tr>
<tr>
<td>Australia</td>
<td>26</td>
<td>6.533</td>
</tr>
<tr>
<td>Peoples Republic of China</td>
<td>26</td>
<td>6.533</td>
</tr>
<tr>
<td>Canada</td>
<td>23</td>
<td>5.779</td>
</tr>
<tr>
<td>Brazil</td>
<td>13</td>
<td>3.266</td>
</tr>
<tr>
<td>Mexico</td>
<td>12</td>
<td>3.015</td>
</tr>
<tr>
<td>Germany</td>
<td>11</td>
<td>2.764</td>
</tr>
<tr>
<td>South Africa</td>
<td>9</td>
<td>2.261</td>
</tr>
</tbody>
</table>

Table V. Records ranked by country (top ten)

<table>
<thead>
<tr>
<th>Institution</th>
<th>Record count</th>
<th>% of total items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Univ Amsterdam</td>
<td>11</td>
<td>2.764</td>
</tr>
<tr>
<td>Univ Oxford</td>
<td>9</td>
<td>2.261</td>
</tr>
<tr>
<td>Tongji University</td>
<td>8</td>
<td>2.010</td>
</tr>
<tr>
<td>University of California System</td>
<td>8</td>
<td>2.010</td>
</tr>
<tr>
<td>University of London</td>
<td>8</td>
<td>2.010</td>
</tr>
<tr>
<td>University of Oxford</td>
<td>8</td>
<td>2.010</td>
</tr>
<tr>
<td>Univ Utrecht</td>
<td>7</td>
<td>1.759</td>
</tr>
<tr>
<td>Delft University of Technology</td>
<td>6</td>
<td>1.508</td>
</tr>
<tr>
<td>Hong Kong Polytechnic University</td>
<td>6</td>
<td>1.508</td>
</tr>
<tr>
<td>University of Technology Sydney</td>
<td>6</td>
<td>1.508</td>
</tr>
</tbody>
</table>

Table VI. Records ranked by institution

Complexity vs cost and social imperatives
peer reviewed (157), trade publications (147) and magazines (55). The citation analysis confirmed the view that academia and industry (through topics covered in the publications) were both committed to the exploration of megaprojects as a phenomena on many different levels from financial, economic to social and entrepreneurial areas.

**Factiva**

The Factiva search yielded 7,295 counts of the primary terms in the title of lead paragraph. As Factiva is mainly a search of news items it highlighted new topics around megaprojects. The search was conducted in August 2016.

The most dominant themes concerned domestic and regional politics and political news in general. Other subjects to emerge included megaprojects being mentioned in the contexts

![Figure 2. Number of publications (2011-2016)](image)

<table>
<thead>
<tr>
<th>Journal title</th>
<th>Record count</th>
<th>% of total items</th>
</tr>
</thead>
<tbody>
<tr>
<td>International Journal of Project Management</td>
<td>24</td>
<td>6.030</td>
</tr>
<tr>
<td>Habitat International</td>
<td>13</td>
<td>3.266</td>
</tr>
<tr>
<td>Project Management Journal</td>
<td>8</td>
<td>2.010</td>
</tr>
<tr>
<td>Region Ekonomika I Sotsiologiya</td>
<td>8</td>
<td>2.010</td>
</tr>
<tr>
<td>Cities</td>
<td>7</td>
<td>1.759</td>
</tr>
<tr>
<td>International Journal of Urban and Regional Research</td>
<td>7</td>
<td>1.759</td>
</tr>
<tr>
<td>Energy Policy</td>
<td>6</td>
<td>1.508</td>
</tr>
<tr>
<td>Journal of Construction Engineering and Management</td>
<td>6</td>
<td>1.508</td>
</tr>
<tr>
<td>Journal of Management in Engineering</td>
<td>6</td>
<td>1.508</td>
</tr>
<tr>
<td>Korean Journal of Construction Engineering and Management</td>
<td>6</td>
<td>1.508</td>
</tr>
</tbody>
</table>

**Table VII.** Top ten journals publishing on megaprojects

![Figure 3. Factiva: megaproject in title or leading paragraph (2011-2016)](image)
of corporate/industrial news; plans/strategy; transport; regulation/government policy; urban planning/development; contracts/orders; environmental news; capacity/facilities and facility openings. There were also themes of Corporate Crime/Legal Action and International Relations, Partnerships/Collaborations and Contract Tenders spread across the documents found.

5. Common problems

Areas already identified in the literature

Merrow (2011) succinctly identified and classified common problem areas in megaprojects, albeit that they were for large industrial projects. That said, the commonalities and propositions put forward prove useful, in developing a picture of issues, which are at the heart of megaprojects in general. These include:

- greed and how this manifest in megaprojects;
- schedule pressures – cutting corners, opportunism;
- the need to develop a business case early in the life of the megaproject;
- the need for stronger planning at the initial phases, costs to be realistically incurred;
- cost reductions without respecting the scope definition;
- rethinking the contractors obligations – issues of transferring risks to contractors; and
- continuity issues – project managers changing lack of continuity (Merrow, 2011).

The areas identified by Merrow focuses on addressing specific problem issues. Chief amongst these were the following:

- Governance – needs for transparent processes, robust governance, ethical considerations, communication strategy.
- Contract design, ambidextrous project management, developing the front end of the project with deliberation and effort.

Building on the Iron triangle

In the past five years the emergence of a consistent view of common problems surrounding megaprojects has seen the emergence of a new perspective enveloping a more complex view of the volatility of current global environments from which megaprojects emerge. This includes economic, environmental and psychological elements, taking into account the

<table>
<thead>
<tr>
<th>Research areas</th>
<th>Record count</th>
<th>% of total items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business economics</td>
<td>130</td>
<td>32.663</td>
</tr>
<tr>
<td>Environmental sciences ecology</td>
<td>116</td>
<td>29.146</td>
</tr>
<tr>
<td>Geography</td>
<td>94</td>
<td>23.618</td>
</tr>
<tr>
<td>Public administration</td>
<td>76</td>
<td>19.095</td>
</tr>
<tr>
<td>Engineering</td>
<td>72</td>
<td>18.090</td>
</tr>
<tr>
<td>Urban studies</td>
<td>59</td>
<td>14.824</td>
</tr>
<tr>
<td>Government law</td>
<td>43</td>
<td>10.804</td>
</tr>
<tr>
<td>Social sciences other topics</td>
<td>36</td>
<td>9.045</td>
</tr>
<tr>
<td>Construction building technology</td>
<td>28</td>
<td>7.035</td>
</tr>
<tr>
<td>Energy fuels</td>
<td>26</td>
<td>6.533</td>
</tr>
</tbody>
</table>

Table VIII. Research areas of megaproject articles in journals

Complexity vs cost and social imperatives
complex systems in which managers and leaders are now expected to engage. It is no longer just a question of being on time, within budget and scope.

Building on analysis to date, what are the factors and actors that influence performance? (Table IX).

6. New areas of focus for megaprojects and revisiting previous themes

In terms of dominant areas to emerge as significant key themes for research and application on the topic of megaproject, the following empirical foci require further detailed consideration. These areas typically dovetail in strengthening megaprojects. Number 1 is a further exploration of institutional analysis, reforming of institutional focus and the need for institutional forms with powers to coordinate megaprojects activities on a national and global level. This includes looking at relevant issues around:

- governance;
- stakeholder issues;
- collaboration and understanding between technical and business personnel (Merrow, 2011);
- networked knowledge between industry and academics;
- design led thinking and co-creation on projects;
- complexity, volatility of global environment;
- reforming notions of procurement, contractual issues;
- exploration of different models for supply and demand networks and connections; and
- leadership as a priority in megaproject – reflexive practitioners, design led innovation, engineers, managers and leaders.

Based on the discussions thus far a number of analytical areas suggest themselves as major areas for future research focus. We identify the following areas as critical:

- Context: the context of megaprojects, how it is shaped, how the megaproject’s unfolding interacts with context and recursively reframes the context, creating a more or less stable “political” environment for the project.
- Procurement: failure to fully understand the procurement process in the development of megaprojects can lead to disproportionate level of problems. Hart (2015) outlines that the ability to detect weakness in the initial stages of large government contract being executed, and the ability to address these weaknesses early in the procurement process can lead to more successful megaprojects (p. 4).
- Institutional perspectives: how do megaprojects shape institutional frameworks and how do institutional frameworks frame megaprojects? Megaprojects will often be situated in the midst of competing and sometimes contradictory institutional logics, which Thornton and Ocasio (1999, p. 804) define as “the socially constructed, historical patterns of material practices, assumptions, values, beliefs, and rules by which individuals produce and reproduce their material subsistence, organize time and space, and provide meaning to their social reality.” The institutional field is invariably pluralistic. In complex institutional fields different practices, values, beliefs, rules and senses of temporality, materiality and spatiality can all come into play. Who and what are the institutional entrepreneurs that launch megaprojects? What strategies with what rhetoric do they use to make their case? What are the consequences in terms of the major variables of the different strategies and rhetoric?
<table>
<thead>
<tr>
<th>Author</th>
<th>Problem</th>
<th>Problems and areas identified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morris and Hough (1987)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collingridge (1992)</td>
<td>Decision-making processes in big organizations, Trial-and-error learning</td>
<td>Limitations in human capacity to control and understand complexity, Problem changes over time, Inflexibility in technologies (projects), Changes are costly and painful-inhibit critical scrutiny</td>
</tr>
<tr>
<td>Miller and Lessard (2000)</td>
<td>Institutional frameworks, decision-making, and project sponsoring</td>
<td>Handling turbulence in project environments, Opportunism and omission, Decision-making is not fully rational, Coordination and cooperation, Design of institutional frameworks</td>
</tr>
<tr>
<td>Flyvbjerg et al. (2003)</td>
<td>Better and more rational decision-making and communication, Institutional arrangements, accountability, and handling risk</td>
<td>Applying the wrong method is a minor reason for forecasting failures, Poor data are a more important for predicting failures than methodology, Discontinuous behavior and the influence of complementary factors, not included in predictions, Unexpected changes of exogenous factors, Unexpected political activities or missing realization of complementary policies, Appraisal bias of the consultant and the project promoter</td>
</tr>
<tr>
<td>Altschuler and Lubroff (2003)</td>
<td>Theoretical analysis, National patterns over time, Intergovernmental aspects</td>
<td>Handling complex networks of practices and roles, The public sector leadership role, Handling harmful side-effects, Conflict between local support and central financing, Project financing models, Cost escalation and underestimation</td>
</tr>
<tr>
<td>Last 5Years Merrow (2011)</td>
<td>Understanding projects, Business decisions before starting projects, Making project decisions</td>
<td>Unbalanced allocation of value-greed, Schedule pressure-cutting corners, opportunism, Developing a detailed business deal early, Weak planning upfront, Cost reductions without respecting the scope definition, Trying to transfer megaproject risks to contractors, Firing project managers for cost overruns-lack of continuity</td>
</tr>
<tr>
<td>Morris (2013)</td>
<td>History of project management, Management of projects, Aligned supply: focusing on value</td>
<td>Realization of business outcomes, Relevance of project management in light of global changes and challenges, Shaping the context to allow project success, Alignment of suppliers and sponsors, Clarity of objectives</td>
</tr>
<tr>
<td>Hart (2015)</td>
<td>Dealing with large project government contracts, Project Director managing procurement</td>
<td>Dedicated focus of project director, Human element – best talent needed, identifying scope in real terms</td>
</tr>
</tbody>
</table>

Table IX. Megaprojects and the main problem areas identified (continued)
Constituting megaproject cultures: creating collaborative practices between clients, stakeholders and contractors in megaprojects adds to complexity. We need more research on how to establish cooperation regimes in these large projects and programs and how to understand and improve the dynamics of cooperation, often tied up with the legal and contracting forms governing the collaboration. Findings from a longitudinal ethnographic study of public-private collaboration in the Dutch construction industry in the period 2006-2011 (van Marrewijk et al., 2014) found the significance of cultural relevance and communication with diverse stakeholders. Other research has pointed to the importance of a designed culture for the megaproject (Clegg et al., 2002).

Coordinating disciplinary knowledges: any megaproject requires considerable boundary work in terms of disciplinary knowledges and considerable translation between them. What are the key boundary objects facilitating coordination and how are they used (Naar and Clegg, 2018).

<table>
<thead>
<tr>
<th>Author</th>
<th>Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flyvbjerg (2014b, 2016)</td>
<td>Conventional megaproject delivery – is highly problematic with a dismal performance record in terms of actual costs and benefits</td>
</tr>
</tbody>
</table>

Table IX. Source: Adapted from Table I in Klakegg et al. (2016)
• Becoming megaproject managers: what processes are instituted, how do managers learn to manage complex emergent processes (see Bjørkeng et al., 2009).

• Financing megaprojects: how finance arrangements shape management and organization of megaprojects and their subsequent success or failure.

• Lifecycle costs and projects: how is the megaproject lifecycle calculated, with what consequences?

• Megaproject leadership: how does leadership operate in contexts marked by pluralities of organizations, stakeholders, and their respective leaders? What is the role and what are the practices of the project leader and the project leadership teams (Pitsis et al., 2003)?

• Megaproject paradoxes and politics: critical to the success of a megaproject is the need for sensitivity to ethical concerns. This relates to problems in balancing the interests of various stakeholders in an ethical and pragmatic manner, it also connects with the need for robust governance mechanisms agreed upon by all stakeholders early in the phase of megaproject development. “Projects are a mixed blessing for democratic politics” Keane (2012, p. 660) states when he articulates another paradox of megaprojects: that the power relations embedded in their existence are based on agreed upon activities in a democratic society, yet at the same time “power relations embedded within the megaproject come wrapped in a canopy of multiple realities; hidden agendas are protected by various efforts at producing silence that functionally depends upon volumes of public rhetoric, things being said and displayed to the outside world” (p. 662).

• Megaprojects and sustainability: On March 9, 2015, a group of concerned citizens including “farmers, scientists, authors, philanthropists, Indigenous leaders, and opinion setters” sent a letter to the G20 outlining a number of critical concerns with the increasing level of investment in megaprojects (Sign-on letter to the G20 March 9, 2015, Regarding: G20 Plans for Infrastructure Finance). The letter outlined the perils of continuing down the path of creating more and more megaproject at a cost to the environment and its communities. The demand for more sustainable projects is hardly likely to abate. With the increasing population of major cities globally, the need for megaprojects is not abating. Global cities and their elites frame and assert the need for megaproject building and development and its accompanying (expected) economic growth. The main impetus driving this force is the desire for “spectacle” linked to the economy of these cities. These developments entail an increased demand for energy – where there is an exponential growth in the number of energy generating infrastructure projects and accompanying levels of investment. There are issues with security about the ownership, development and creation of these types of projects. Amongst these are “nuts and bolts” issues of sustainably supplying the needs of a city’s growing population and the inherent desire for the expansion of cities, i.e. energy, water, housing, transport, health, social aspects entertainment and sport.

• Global megaprojects: because of the ever-growing demand for the construction of megaprojects, developed countries have a significant advantage in research on megaprojects, due to their relevant experience, including countries such as the UK, Australia and the USA. Hu et al. (2015) outline that research in developing countries such as Russia, India, Turkey, Vietnam (Hu et al., 2015) is lacking. The needs of developing countries foreground the global landscape, with developing countries predicted to invest another $22 trillion in infrastructure (2008-2017) (Economics, 2008 as cited in Hu et al., 2015). Projects that are large scale, complex and ambiguous,
involving multiple stakeholders, will continue to pose major problems of juggling limited resources, conflicting terrains and diverse stakeholders.

- Megaprojects and disruptive technologies: some flexibility must be built into large infrastructure project timelines and planning to allow for benefits to be derived from technology improvements. As an extreme example costly desalination plants were superseded by far more effective and less expensive membrane technology that was developed prior to the completion of commissioned desalination plants.

7. Solutions and value propositions

Despite the ever-increasing issues presented by megaprojects, the fact is they are a reality of the twenty-first century. Developing solutions and dialogue around how to improve on issues related to megaprojects is a vital concern. The next section briefly discusses some areas and value propositions.

An organizational learning focus

According to Flyvbjerg (2016), megaprojects keep on repeating the same mistakes. This suggests that insufficient organizational learning is occurring that can offer better access to systems that work in specific megaprojects as repositories of knowledge that are useful. Learning across megaprojects needs to be linked to specific similarities in characteristics and features, taking into account stakeholders, governance, sustainability, etc. Databases that are repositories of processes, designs, problems and solutions need to be developed.

Learning from the past: aggregating past insights

Learning from the past is critical (Lenfle and Loch, 2017, p. 1). Haynes (2011) outlines the significance of“sustained leadership and accountability systems” in literature on megaprojects. She outlines a concern for the need to draw from past lessons and to “figure out a way to aggregate our acquired insights and tell the stories in a way that is accessible to those on the front lines” (p. 197).

Networked information

Solutions and experience (creation of international databases) are promoted that might possibly tap into pre-existing data collection, i.e. see COST – European Cooperation in Science and Technology which was set up in 1971 by 19 member countries and currently includes 35 member countries. COST is an intergovernmental framework aimed at facilitating the collaboration and networking of scientists and researchers at a European level: see their research framework.

Longer terms evaluation of projects

These include the development of surveys and evaluations that capture what works and what does not work for specific types and sectors, i.e. “Project Close-Out Stage” (Fahri et al., 2015) – evaluation beyond project close – reassessing the parameters of what a successful project is and taking into account evaluation criteria and other criteria for evaluation (Lehtonen, 2014).

Rethinking governance as situated and relational, not static

The significance of good governance to alleviate pressure points in the project is widely recognized. This area is a foundational aspect of megaprojects and is a cohesive element of many of the disparate aspects that make up the megaproject’s successes or failures. “We must give proper attention to the ways in which project governing happens in a
situated, relational sense, rather than just focusing solely on governance as a set of pre-designed Sanderson (2012, p. 441).”

Governance in a technically rational domain may need rethinking in terms of ideas about the “reflexive practitioner” and the usefulness of design thinking in creating collaborative focus. Procurement process and contract needs time spent on “design and development” in addition to the design and development of the actual megaproject (Hart, 2015). The role of the project director, as someone fully dedicated to the project on a full-time basis that spends time in the initial phases identifying potential issues (Hart, 2015), has also been suggested as an area for further development. Redesigning the concept of contractual relationship, even the idea of what a contract is in megaprojects, is important as pioneering research by Pitsis et al. (2003) suggests. There is a need to link the whole area of megaproject management more closely with complex systems and complexity theory, taking into account new ways of working with systems thinking, along with incorporation of institutional theory as the theoretical foundation (in stakeholder management, project planning and procurement and project monitoring and control) for developing megaproject research further (Hu et al., 2015).

8. Conclusions
Understanding some of the mechanisms behind the technical issues is only part of the story for improving the completion of megaprojects. The impetus for the ongoing development of megaprojects is a complex convergence of social, economic, engineering and scientific ventures.

The issues raised in this paper bring into question the need for value and competitive advantage on a much different level. Megaprojects occupy an important place in global relations and drive a number of explicit and implicit economic agendas. The multitude of tasks that bring them to the point of completion is an illusion, as megaprojects are entities of an ongoing nature. In reality, all tasks associated with the development of megaprojects are connected to complex practices that require a dynamic and ambidextrous way of thinking around projects and the manner in which they are carried out.

The contemplation of megaprojects paradoxically brings into light a vortex of positives and negatives, depending on the elements at play and the technical and business competence of those involved. They are seen as a force of massive prosperity and economic success for stakeholders. They are also seen as destructive forces of doom and massive failure, outmoded projects in a time where resources are scarce and environmental concerns dominate.

The uncontrollability factor lies at the crux of megaprojects and the compelling need to seek mastery in the form of highly competent technical expertise and engineering brilliance – This paper has explored some of the ways humanity seeks to tame these juggernauts of mixed blessing, better known as megaprojects.

Notes
1. The following publishers of academic peer reviewed articles on megaprojects frequently arose: Elsevier Science; AACE International; Taylor & Francis Ltd; American Society of Civil Engineers; Project Management Institute; Finance & Credit; Sage Publications Inc; University of Technology Sydney; Sage Publications, Ltd; Emerald Group Publishing Limited.

2. Amongst the publishers for practitioner/trade related articles the following names arose, showing a marked difference to the academic list of publishers: Mee Media FZ LL; BNP Media; Project Management Institute; Pennwell Corporation; Sourcedemia, Inc.; DVV Media UK Ltd; Faversham House Ltd; INS Communications Pte Ltd; Oildom Publishing Company of Texas, Inc. and CPA Australia.


References


Further reading


Appendix. Case studies

Trio of Stadiums in Sydney[3]
Background: in September 2015, Premier Baird and Mr Ayres announced a commitment to new infrastructure that included a trio of stadiums: in Parramatta, Moore Park and an indoor arena to serve the inner city, CBD.

Objectives of the proposal: development of stadiums for sports events in Sydney. Creation of a new indoor arena to replace Entertainment Centre.

Issues: Subsequent to this announcement, it did not take long for the Premier to backtrack on the proposal to build the stadium at Moore Park. This was due to disagreements with Sydney rugby league teams and their “revolt” against plans, highlighting the need for consultation and engagement with relevant stakeholders and their economic interests.

Another element of “stadium strategy for Sydney” was the construction of an indoor arena to replace the Entertainment Centre. It became obvious that the business case development for this project proved to be weak with the change of ownership of the basketball team Sydney Kings. This change was critical as the new owners of the team also owned Qudos Bank Arena (previously Allphones Arena) that, in effect, dominated the selection of a preferred venue for any indoor events played by the Sydney Kings. This case highlights the volatility of ownership, function and business case analysis. Government interests (vote seeking) and corporate interest often clash.

Core issues contributing to problems:
- stakeholder interest not considered;
- power relationships in the sporting financial landscape;
- owner of real estate affecting dealings and progress;
- political promises for votes;
- failure to consider the logistics of various aspects of sporting venues; and
- front end planning and business case not developed adequately.

This is a current and ongoing project and as such will be interesting to follow.

Cross-city tunnel[4]
Optimistic estimates of projected usage of Cross-city tunnel vs actual usage.

Background: the initial concept of the tunnel was discussed in 1998 (Cross City Tunnel Pty. Ltd, 2007). Eight consortia expressed interest by October 23, 2000 and on February 27, 2002, it was announced that the Cross-City Motorway Pty. Ltd was the winning consortium. Consortium included financiers, Cheung Kong Infrastructure of China, Bilfinger Berger of Germany and RREEF Infrastructure of Australia.

Objectives of CCT: reduction of traffic in Central Sydney and as a result easing traffic congestion and improving environmental amenity in the CBD and to improve the east to west traffic flows. The project involved the construction of a 2.1 km twin two-lane motorway east and west beneath central business district of Sydney. The project sum: $AUD680 million.

PPP with a design-build-operate arrangement under a 30-year concession agreement. The project was started on January 28, 2003 and delivered ahead of schedule, i.e. officially opened on August 28, 2005.

Issues:
- High levels of expectations.
- Traffic forecast for the tunnel was predicted to be 90,000 vehicles per day.
To encourage the use of the tunnel there was a three week free toll period overcome the low usage of the tunnel, the free toll was further extended for 2.5 weeks. The tunnel usage during this period increased to 53,000 vehicles per day. Despite this attempt to increase usage, the number of vehicles dropped by almost 50 percent when the toll was reinstated (Smith, 2005; Wikipedia, 2006; Zou et al., 2008).

The core issues that contributed to the failure of the project included:

- inaccurate traffic forecasts;
- high toll levels;
- government closing off the surface roads to direct the traffic into the CCT;
- flawed concession agreement;
- the public client and the private consortium arguing openly in public;
- no toll subsidy or compensation from the government; and
- the toll level, possibility of a Government contribution was not open to negotiation.

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Increasing project benefits by project opportunity exploitation

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Abstract

Purpose – Exploitation of project opportunities may bring more benefits than stipulated in the initial business case, and even stakeholder benefits that nobody thought of at the project initiation. The purpose of this paper is to suggest a new research area for megaprojects, i.e. the phenomenon of project opportunity exploitation as a means to increase the project benefits.

Design/methodology/approach – This is a single case study of an infrastructure megaproject, i.e. the construction and operation of a 50+ years old American bridge. Data cover information regarding 60+ years old historical documents, newspaper articles, interviews and video-recordings.

Findings – The findings of this paper are as follows: exploiting all opportunities created by the project and increasing project benefits require involvement from many categories of stakeholders; stakeholders get more involved in exploiting the opportunities created by the project when they are proud of the project; for some of the project-related opportunities, it might take a long time before they can be exploited (and related benefits achieved); and celebrating achievements of the project stimulate stakeholders to exploit opportunities created by the project and contribute to further project benefits.

Research limitations/implications – Only few interviews were conducted. Interviewees were biased as all were very proud of the bridge. This is a single case study of a “rare species”, not representing most megaprojects.

Practical implications – To enhance project opportunity exploitation and increased benefits, the project owner (team) must continuously communicate about the project, also after project execution.

Originality/value – This study contributes to a gap within the literature on the phenomenon “project opportunity exploitation”. This is a very rich case study and of a “rare species”.

Keywords Stakeholders, Transformational, Megaproject, Project benefits, Project history, Project opportunity

Paper type Research paper

Introduction

Every project is expected to bring value to its constituents (Martinsuo and Killen, 2014). In order for a project to be initiated, the stipulated project value (defined as expected benefits minus expected costs due to the project) in the business case analysis must be considered as sufficient by the decision makers, whether this is the initiators themselves or a funding body. This is basic project management wisdom and basic business logic as well.

Every project management practitioner and researcher knows how difficult it is to ensure the stipulated value creation, and we find it safe to say that the raison-d’être for the
project management discipline is to figure out how to enhance that the expected benefits can be harvested, and that the costs are not exceeding what was planned.

In this paper, we aim to bring in another stream of thinking. Instead of “just” focusing on what was accepted as “good enough” in the business case analysis at the project initiation, we want to discuss how to increase the project value by increasing the benefits achieved by the project.

Since the very establishment of the project management discipline, it has been commonly accepted that a project due to its uniqueness is confronted with uncertainty that needs to be managed. Defining uncertainty as anything that is not certain (Chapman and Ward, 1996, 2004), it becomes clear that uncertainty may lead to both threats and opportunities for the project (e.g. Chapman and Ward, 1996). However, Lechler et al. (2012) point to a research gap in the current literature by stating that “the nature and significance of value-related opportunities stemming from uncertainty on the project level is not well understood” (p. 60). By project value opportunities, Lechler et al. (2012) mean (while giving credit to Lechler and Byrne, 2010) “a potential to alter the quality and/or exceed the predefined stakeholder value of a project” (p. 60).

Lechler et al. (2012) claim that the research gap exists due to limiting premises within the established classic project management paradigm. A core one is that the discipline is focusing on optimization within the constraints of time, budget, scope (and up-front agreements with stakeholders, we add), and does not include the notion of value maximization. The result is that opportunity identification and exploitation is not really seen as an activity related to project management. This is in line with Kreiner (1995) who states that threats and opportunities beyond those originally projected may be seen as noise or nonsense due to the project manager’s “local rationality” within the project perspective, and not something that should be taken seriously. Unfortunately, hereby risking the relevance of the project to be eroded, and missing the potential to achieving benefits that could have been achieved, if the project manager (and other project representatives, we add) had focused on it. Kreiner (1995) states that the underlying reason is that relevance issues are seen as an initial concern on the part of decision makers. The implication is that relevance is not really considered after the project approval has been given, neither in the project execution phase nor in the project operation phase. This corresponds with the optimization approach in opposition to a maximization approach, as pointed out by Lechler and Byrne (2010) and Lechler et al. (2012, 2013), i.e. focusing on optimization within the given constraints of time, budget, and scope, instead of maximizing project value (with or without sticking to the constraints).

As the understanding of value maximization and project opportunities is not sufficiently developed within the project management discipline, we draw (in line with Lechler et al., 2012, 2013) on another discipline within business and management, i.e. the discipline of entrepreneurship. In line with the original work of Joseph Schumpeter (1934), Eckhardt and Shane (2003) define entrepreneurial opportunities as “[…] situations in which new goods, services, raw materials, markets, and organizing methods can be introduced through the formation of new means, ends, or means-ends relationship” (p. 336). Translating this into the project context and combining it with project value, project opportunities can be seen as situations in which additional value (compared to the baseline stipulated value at the project approval time) can be created in the project execution phase and in the project operation phase. The project opportunities can generate positive consequences if they are identified and exploited, like, for example use of the project deliverable(-s) to other purposes or by other stakeholder groups than intended.

Why study value creation in megaprojects?
Megaprojects seem to continuously grow in scale and frequency globally, and therefore it is especially important to understand issues that accompany these constructions (Flyvbjerg, 2014; Gellert and Lynch, 2003; Winch, 2017). The phenomenon of megaprojects has gained
tremendous interest within the project management literature the later years, and a vast number of publications have come to live (e.g. Warrack, 1993; Flyvbjerg et al., 2003; Mok et al., 2015; Flyvbjerg, 2017). Flyvbjerg (2014) argue that “Never has systematic and valid knowledge about megaprojects therefore been more important to inform policy, practice and public debate in this highly costly area of business and government” (p. 8).

Per definition, megaprojects consume numerous resources and impact numerous people, even across generations. It is therefore especially important that they bring excessive benefits to their initiators, their stakeholders, and the society at large. This holds true regardless of the “currency” in which we measure benefits. (In the next section, we look into the benefits concept in depth.)

If a project is carried out as planned, and the project deliveries are put into use as planned, we would expect the planned project benefits for the beneficiaries to be the ones that were stipulated in the business case analysis at the project approval point in time. It is well known that uncertainties, as well as a long time perspective, may make the estimations of costs and benefits indeed very difficult. The megaproject literature is full of examples of projects that unfortunately neither stayed within the project budget, but heavily exceeded the estimated costs, nor achieved the expected benefits. Flyvbjerg et al. (e.g. 2003, 2014, 2017) who have done a number of ex post evaluations, i.e. systematically compared actual with forecasted costs and benefits, report on a high number of projects that should not have been initiated based on the ex post cost-benefit analyses. Flyvbjerg (2014) labels the phenomenon as "the iron law of megaprojects" and describes it as "Over budget, over time, over and over again" (p. 6).

Even with this background of numerous megaprojects that are financial failures and severe delays, and thereby risk not to generate the stipulated value, the aim of this paper is to contribute to the understanding of a different situation, i.e., on how projects sometimes generate more value than stipulated. Based on the simple definition of value above, i.e. the difference between benefits and costs, this can happen due to the fact that either the sum of actual costs becomes lower than stipulated in the budget, or the sum of benefits becomes higher than expected. We limit ourselves to focus on the benefits, leaving the costs out of the equation. Achieving more benefits than stipulated can happen out of pure luck, i.e. major uncertainties turn out in a way that is advantageous to the project. It can also be that the project initiators are biased toward what we can call careful, conservative or pessimistic benefits estimates. These two drivers for increased benefits achievement will not be dealt with in this paper. Instead, we study the phenomenon “project opportunity exploitation” as a means to increase the project benefits.

Research question
Project opportunity exploitation can be studied in any kind of project. However, it seems as especially relevant to study in megaprojects due to the fact that “the [concept of the] project lifecycle, capturing the events between the start and the end date of the project (Meredith and Mantel, 2006; PMBoK, 2013), fails to capture the longer term effects that megaprojects usually produce” (Sato and Chagas, 2014, p. 625). Hence, we argue that the understanding of the longer term effects due to project opportunity exploitation in megaprojects is too limited. This is in line with Winch (2017) who claims that gaps in the literature exist when it comes to (among other factors he mentions) the link between megaprojects and society, specifically focusing on the societal benefits that may come out of megaprojects, and the stakeholder role in megaprojects of future generations.

With this paper, we want to contribute to the understanding of the positive effects megaprojects may produce in both the short and the long terms, based on exploitation of project opportunities that were not known or mentioned at the time of project approval. To our knowledge, no other publications have addressed the phenomenon by collecting
historical and current data over a time period on 60+ years as we do in the empirical study underlying the paper.

The above argumentation leads to the research question:

RQ1. How can project opportunity exploitation be enhanced?

In addition to a respond to the call for research on megaprojects, the paper also addresses a call for making use of project history (Söderlund and Lenfle, 2013). More details will be presented in the methodology section.

We answer the question by conducting an empirical study of a 50+ years old bridge in the USA, the Astoria-Megler bridge, that connects the states Washington and Oregon at the west coast. This bridge is relevant because it actually generated substantially more value than stipulated in the business case at the time of project approval. In the empirical study, we explore how the project value has been increased by identification and exploitation of project opportunities.

This paper is outlined as follows: first, the theoretical framework is offered. Hereafter, the research methodology is presented, including a justification of the single case studied. Next, a section on the findings is presented, followed by a discussion and finally, the conclusions.

Theoretical framework

In this section, we present theoretical concepts and frameworks that can be helpful to answer the research question.

The concept “megaproject”

More definitions of a megaproject exist. Warrack (1993), for example, looks at megaprojects’ landmark roles in society, while Flyvbjerg (2014) goes beyond scale and impact, placing a watershed price tag, as he considers megaprojects to be the ones that cost over a billion USD. However, for the purposes of this paper, we will use the definition placed forth by Gellert and Lynch (2003): “[Megaprojects are] projects which transform landscapes rapidly, intentionally, and profoundly in very visible ways, and require coordinated applications of capital and state power” (pp. 15-16). Gellert and Lynch (2003) propose four types of megaprojects, i.e. infrastructure, including ports and water and sewer systems; extraction, for minerals or oil; production, including manufacturing; and consumption, namely massive theme parks, tourist sites and real estate.

The concepts “project benefits,” “project value” and “project opportunity”


Value in itself is a complex phenomenon due to the multiple expectations and multiple assessments of value by multiple stakeholders. This multiplicity often makes value and benefits a subjective notion – the concepts are not a fixed entity, and they vary in how they are perceived and influenced (Ang and Killen, 2016). In this paper, we do not differentiate between project benefits and project value. It is to some extent a subjective concept. It should be measured in broad terms not only moneywise, but also as improved efficiency, improved sustainability, an emotional component, e.g. feeling proud, etc. This is in line with Chang et al. (2013) who state that perceived value of a project will not only relate to something functional or commercial, but also to something experiential, whether this would be cognitively or emotionally.
The core theoretical framework underlying this paper is to some extent inspired by the work by Lechler et al. (Lechler and Byrne, 2010; Lechler et al. 2012, 2013) on project uncertainties, project value maximization and project opportunities. Leaving the more basic definition of value presented earlier (value = sum of benefits minus sum of costs), we here see a more advanced definition: “A project’s value is defined as the value a project creates for its stakeholders. The project value could be defined by one or any combination of performance criteria, such as efficiency, technical effectiveness, and the satisfaction of a project’s stakeholders, with emphasis on clients and shareholders” (Lechler et al., 2013, p. 12). Striving for project value maximization in opposition to just obtaining the preplanned value, it is important to understand that the value concept is defined in a relativistic sense, meaning that we are not trying to calculate the maximum value of the project as this can never be done accurately. Instead, we are interested in value going beyond what was preplanned, hereby also satisfaction beyond preplanned satisfaction, i.e. enhanced project value (Lechler et al., 2013). As we do not differentiate between value and benefits, it also means enhanced, i.e. increased, project benefits, compared to the preplanned.

Applying the concept of project value on megaprojects, we realize that a core differentiation between what we can call regular project and megaprojects is that the megaproject for certain will have a major impact on numerous people and very often the society at large, and not only clients and shareholders.

In order to maximize project value, i.e. project benefits, it is important to focus on unexpected or unforeseen project situations (i.e. project uncertainties) that potentially can impact the value of the project significantly in a positive direction (Lechler et al., 2013).

Lechler et al. (2013) refer to Schumpeter’s (1934) concept of “entrepreneurial profit” within the field of entrepreneurship, when they explain that a project opportunity, e.g. an unconventional solution to a specific project situation that was not known or foreseeable at the planning stage, represents the potential for creating extraordinary project value.

The core concept project value opportunity is defined as “Project opportunities that provide the potential to exceed the predefined stakeholder value of a project during that project’s implementation” (Lechler et al., 2013, p. 17), in other words, the potential for creating value that is beyond the project stakeholders’ initial requirements and expectations.

<table>
<thead>
<tr>
<th>Concept</th>
<th>Definition or contents</th>
<th>Table I. Multiple conceptual definitions, nature and realms of value and benefits</th>
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</thead>
<tbody>
<tr>
<td>Value (basic understanding)</td>
<td>Sum of benefits minus sum of costs</td>
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<tr>
<td>Value (advanced understanding)</td>
<td>Complex phenomenon due to multiple expectations, multiple assessments of value by multiple stakeholders</td>
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<tr>
<td>Project value</td>
<td>The value a project creates for its stakeholders. The project value could be defined by one or any combination of performance criteria, such as efficiency, technical effectiveness, and the satisfaction of a project’s stakeholders, with emphasis on clients and shareholders</td>
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<td>Nature of value and benefits</td>
<td>Relativistic, contextual</td>
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<td></td>
<td>Tangible and intangible</td>
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<td>Hard benefits, soft benefits</td>
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<td>Subjective – not a fixed entity, varies in how it is perceived by various stakeholders</td>
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<tr>
<td>Realms of value and benefits</td>
<td>Preplanned</td>
<td></td>
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<td>Unexpected, unforeseen</td>
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<td>Serendipitous</td>
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<td>Positive or negative (the negatives are called dis-benefits)</td>
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Sources: Ang and Killen (2016), Ang et al. (2016), Lechler and Byrne (2010) and Lechler et al. (2012, 2013)
A core message in Lechler et al. (2012, 2013) is that project opportunities, i.e. potentials to improve the initial value proposition of the project, do not occur automatically. They have to be sought and identified. Only hereby they can be exploited. This search for innovative solutions to improve the project’s value proposition is a management challenge – and this challenge is related to a change in mindset. The traditional mindset (i.e. satisfying the project initiators/stakeholders by ensuring that the project is “on time, within budget, and to specifications” so that the preplanned value can be obtained) should be replaced with a mindset for maximizing the value of the project. This mindset should lead to identification and exploitation of business opportunities during the execution phase of the project, but also beyond the execution i.e. project lifecycle opportunities, e.g. in the lifetime of a construction that is the result or deliverable of a construction project, in other words, the project operation phase. When dealing with megaprojects, we realize that we should not only focus on a project’s execution phase but also on the whole project lifecycle, i.e., also on the usage phase of the project deliverables, meaning the operation phase which may be really long, counting more human generations.

An interesting question related to the discovery and recognition of the potential value opportunities is the who-question. Who is actually involved in the search and identification? In their research, Lechler et al. (2013) identify project managers as the roles or stakeholders that most often discover opportunities for increased value during project implementation, i.e. what we have called the execution phase above. Other stakeholder groups that directly or indirectly represent the interests and perspectives of the project owners and sponsors (and have a business perspective on projects) are also occasionally involved in discovering value opportunities.

Lechler et al. (2012, 2013) point to two types of value opportunities:

1. achievement of stakeholder benefits that nobody thought of or mentioned at project initiation; and

2. fulfilling the intended stakeholder benefits to a larger extent than expected.

For our study, it is the first type that is relevant.

When studying value opportunities for megaprojects that have a long lasting lifecycle, potentially over more human generations, the who-question gets really interesting. Who of potential stakeholders are actually discovering value opportunities of the project? – and how is the value realized? This question is also asked by Ang et al. (2016), “value for whom, by whom” when exploring value constructs in multi-stakeholder project environments. The authors found that the understanding of value stems from multiple “micro-constructs” of value emanating from a variety of stakeholders. The ability to capture the various stakeholders’ views of value can assist project managers with identifying further opportunities and enhance decision making for future outcomes and value maximization (Ang and Killen, 2016).

Another interesting issue is in which “currency” to measure the project value. Based on their own research, Lechler et al. (2013) claim that “exploited opportunities may have an impact on multiple aspects of project value. Schedule, budget, quality, financial returns, non-financial returns, stakeholder satisfaction, and shareholder satisfaction are all potential beneficiaries” (p. 59). What they see is that management is especially focused on improving the level of satisfaction of the stakeholders and the shareholders.

“Earlier research also indicates that positive uncertainties such as synergies and learning are not always exploited in project portfolios even if they may generate significant opportunities” (Martinsuo et al., 2014, p. 735). The need for focusing on opportunities and not only risks has already been addressed by, e.g., Kreiner (1995), Ward and Chapman (2003, 2008), Atkinson et al. (2006) and Perminova et al. (2008). However, the implications of incorporating opportunity management in project management have not yet been investigated in any detail.
Research methodology
The research is based on a single case study (Eisenhardt, 1989), and the selected case is chosen because it is rich and powerful (Siggelkow, 2007) for improving our understandings of added value creation based on identification and exploitation of opportunities related to a megaproject.

The particular megaproject studied falls in the group of infrastructure megaprojects. Further, it relates to Söderlund and Lenfle’s (2013) call for studying project history, e.g. by studying single landmark projects and their narratives. This includes documenting the project in-depth by describing its background, what happened during project implementation, as well as the various effects of the project. This is, for example, done by the following authors identified in Söderlund and Lenfle (2013): Hewlett and Anderson (1962) on the Manhattan project; Sapolsky (1972) on the Polaris project; Brooks et al. (1979) on the Apollo project; Morris and Hough (1987) on the Concorde project, the Channel link project, and more; and Hughes (1998) on the Atlas project, the SAGE project, and more.

Justifications for selection of the case
The Astoria-Megler bridge (hereafter Astoria bridge) is the longest continuous truss span bridge in North America (Great Columbia Crossing Celebrates 25th Year, 2006), and, having celebrated its 50th anniversary in 2016, it is also a historical landmark of economic, touristic, political and aesthetic significance. A photo of the bridge can be seen in Plate 1.

The first recorded proposal of the Astoria bridge was given in 1928 (Bridge Timeline, 2016). 25 years later, a partnership was formed between Port of Astoria, Oregon State Highway Department, the Washington Toll Bridge Authority and Pacific County, Washington to assess the feasibility for building a joint bridge. Finally, in 1961, the legislatures of the states of Oregon and Washington agreed to fund the project.

The original intended benefit was an infrastructural improvement for people crossing the Columbia River, in order to go from the state of Oregon to the state of Washington or the

Source: Photo courtesy of Ron Reiring (Creative Commons Attribution 2.0, 2017)
opposite route. The bridge was completed in 1966, and was the completing segment of US Route 101, which links Washington to California (and hereby also Canada and Mexico), running along the West Coast of the USA (Astoria-Megler Bridge, n.d.).

While the Astoria bridge does fall well into Gellert and Lynch’s (2003) description of a megaproject, two characteristics set it apart from the majority of projects Flyvbjerg (2014) analyzed – the first is its budget, which only ran in the millions, and the second, perhaps more notable distinction, is that it was constructed on budget, on schedule and with unexpected benefits. The latter is one of the reasons we chose this particular project – as Flyvbjerg (2014) laments such successful projects are few and far between – and they therefore need to be studied carefully as especially revealing cases for any useful lessons.

Even though the bridge does not fully live up to Flyvbjerg’s (2014) price tag of over a billion USD to be considered a megaproject, it is worth noting that according to different calculation methods the then-value of the project (USD24 million) would translate in up to half a billion USD in 2016 (according to MeasuringWorth.com, accessed January 27, 2016), and thereby to some extent comply with present-day megaproject concepts.

This project is also interesting due to the fact that its construction followed a somewhat reversed trend – instead of a megaproject that started in fanfare and ended in embarrassment, this project was ridiculed from the start, but constructed nevertheless and ended up defying critics. At the time of construction, both the project’s scale and budget were met with opposition (Associated Press, 1962, 1978, 1994; Astoria Bridge, n.d) and it was even called a “bridge to nowhere” (Associated Press, 1978, p. 11c). However, it ended up – surprisingly – surpassing even the expectations of its proponents as the toll taxes covering the construction costs could be lifted two years ahead of schedule, due to unexpectedly high traffic volumes (McCorkle, 2006).

Furthermore, choosing a project that has celebrated its 50th anniversary is also a response to Söderlund and Lenfle’s (2013) call for investigating historical projects that can reveal interesting information.

Analyzing a megaproject which outcome, i.e. the bridge, has been in operations for 50+ years, allows us to directly address one of the literature gaps that Winch (2017) identifies – accounting for future generations as a stakeholder, because the value adding of some of the project opportunities identified and exploited is already visible.

Data collection
The case study explored stakeholder perspectives of the impact of the Astoria bridge by evaluating the stakeholders’ value perceptions and lived experience of their environments as a result of the bridge as a megaproject. Multiple data collection methods were utilized in the case study to strengthen the quality of the research (Yin, 2014), incorporating both historical and current data, using in-depth interviews and publicly available documents including historical documents, photographs and websites. In order to provide the necessary historical perspective, secondary data from newspaper articles published around the time of construction and opening of the bridge (e.g. Associated Press, 1962; Judge what he will do, 1966; Sherman, 1967; Associated Press, 1978) were collected. The aim was to identify opportunities identified and exploited at that time and the arguments for and against exploitation. Newer articles (e.g. Associated Press, 1994) provided an overview of how the bridge was used by the users and later generations.

Multiple informants at various levels provide multiple perspectives on the focus of study. Informants were asked about their experiences before, during and after the construction of the bridge, where relevant. The informants have been classified under the following stakeholder groups:

- project owners (e.g. state department of transportation);
- project members (e.g. construction workers);
local businesses and NGOs;
local citizens; and
general public (e.g. from the states of Oregon or Washington, but not locally in Astoria).

In total, 14 individuals from the states of Oregon and Washington were interviewed in 2016, using a semi-structured interview protocol (see Table AI) to develop a multi-perspective understanding of the Astoria bridge. Interview durations ranged from 45 to 90 minutes.

The interviews contribute to a thick description of the case study, hereby allowing a deep understanding, and are triangulated with the analysis of documents, videos and photographs.

Data analysis

This paper mainly builds on the interview data. A thematic analysis of the interview data was conducted using a combination of manual and CAQDAS (QSR NVivo) approaches.

Recognizing that different researchers may produce findings that are not identical and that have non-overlapping components (Thomas, 2006), the data were iteratively analyzed by all three authors to identify project opportunities mentioned by the interviewees that led to project value higher than stipulated at the project approval time. The authors ultimately converged their individual analyses. This collaborative experience amounted to a dynamic dialogue as the researchers interrogated and revisited the data iteratively, compared findings, and then built abstractions and more "what ifs" with any new patterns that emerged (Stake, 1995). The findings result from multiple interpretations made from the raw data by all three researchers.

Findings

Our data show that several opportunities to increase the project benefits have been identified and exploited in the execution phase and in the operation phase of the construction project of the Astoria bridge. Opportunities that brought stakeholder benefits that nobody thought of or mentioned at project initiation (Lechler et al., 2013). To give the reader opportunity to interpret the raw data him- or herself as much as possible for better insights, most of the opportunities are presented in direct quotations:

A lot of people, not local people, but a lot of people thought this was “The Bridge to Nowhere” and [that] it was just a terrible waste of taxpayer money. Well, we have certainly proved them wrong on that! It's been a huge economic boon to our entire area, both Oregon and Washington (No. 9, Local business & NGO).

That bridge […] put a lot more people in the Long Beach area for tourism […] (No. 7, Project member).

Astoria has become a destination (No. 9, Local business & NGO).

In 2002, which is not that many years ago, we had $365,000 dollars in room tax dollars collected in Astoria. This year, we had $1.5 million! (No. 9, Local business & NGO).

Our bridge is also movie star! Not only has it had lots of commercials filmed on it for Chevy and Ford, they’ve had their cars and trucks on the bridge being filmed, but it also had a role in the movies “Short Circuit”, “Kindergarten Cop”, and “Goonies”, all three of which were filmed here in Astoria! (No. 9, Local business & NGO).

I know that there is a sales tax in Washington, and Oregon does not have sales tax. Those fifteen thousand people that live on the Peninsula across the river, many of them will come over the bridge and stop at the groceries and shop here but they don’t have to pay the sales tax (No. 4, Local citizen).
The bridge is also used by utility companies to span the Columbia River with communications and fiber-optic cables. “So, it does more than just carry people! It directs ships, it tells the weather, and it aids in communication. It’s a pretty good partner for what we’ve built, I’ll tell you! These were things that we didn’t know about when we started original construction!” (No. 9, Local business & NGO).

The area (and the strive for building a bridge) got well known through an activist group, the Astorian Clowns, who traveled up and down the coastline to participate in small city fairs and other events (more details follow below).

In addition, the bridge is used for an annual event in the form of a run that attracts many runners and walkers (Great Columbia Crossing Celebrates 25th Year, 2006).

Further, the celebration of the 50 years’ anniversary 50 years after the project completion gave stakeholders in Astoria as well as the states of Oregon and Washington a unique opportunity for organizing several events and collection of material (DePledge, 2015). Even a delegation from Astoria’s sister city in Germany, Waldorf, sent a delegation of 18 people to the rededication celebration event (Goicochea, 2016). It all helped to build and sustain the pride and identity of Astoria for all stakeholders, i.e. a benefit that first materialized after 50 years.

The data show that the project is generating revenue and creating employment to a much higher extent than stipulated. The bridge works as a connector of people to places. The access and connectivity generates opportunities for economic growth and consequently transforms the surroundings. The bridge enables and enhances networks and relationships between the two states and this greatly results in an economic “boom” in the regions. This has especially benefited the generation of stakeholders that came after the project initiators and other people at that time.

The expressions of political delight in the bridge construction were less obvious from the interviews but are visible from the newspaper articles from the time before the construction (Judge what he will do, 1966) and speeches from the 50 years celebration (Goicochea, 2016). In the 1950s (conceptualization and pre-construction period), there were strong political debates between the Astorian leaders and the states on whether such an investment should proceed. Actual public engagement, however, came through an unknown stakeholder at project initiation, the Astorian Clowns, who had a key role as “city ambassadors” in marketing the project in order to obtain buy-in from both the states of Oregon and Washington (Daly, 2016). The clowns were reportedly “instrumental in garnering support for the building of the Astoria-Megler bridge. Naysayers called it ‘the bridge to nowhere,’ but that didn’t bother these guys who, clearly, were men of vision – leaders in their community – clown suits notwithstanding” (Jeff Daly, interview, Hipfishmonthly, 2011).

A business representative mentioned that the clowns played a key role in promoting the bridge project to the community, as follows, “the bridge decision was being bantered about by politicians in Salem and Olympia, our state capitals of both states. That is where a lot of the work was being done, but the clowns brought it to the masses. They brought it to the common people on the streets” (No. 9, Local Business & NGO). This is confirmed by an article contributed by a local, Jeff Daly, whose father was an original Astorian Clown (Daly, 2016). Afterwards, the clowns continuously played a role in getting Astoria known in a positive way.

Plate 2 (Daly, 2016) shows the clown car painted with an image of a bridge and the slogan “Let’s build the bridge.” This car made its appearance in the parades in the states of Oregon and Washington.

What made this interesting is that the clowns were an anonymous entity in the early days (Daly, 2016). They also played a key role in meeting with key stakeholders like the city officials and the legislature about the bridge proposal. “They’d do a parade and then get invited to a dignitaries’ ‘do’ at night. Twelve guys would show up in snappy red blazers and
ties […] no clowns in sight. Talk about making stuff happen. They’d be talking to governors and heads of state. Wow!” (interview with Jeff Daly, by Hipfishmonthly, 2011).

The launch of the bridge in 1966 was a major milestone for the Astorian leaders, the local community and the clowns:

Without the Astoria Clowns, we would not have the Astoria bridge […] There’s no doubt about it (Former Astoria Mayor, Willis Van Dusen).

The magnitude of success was beyond the expectations of the stakeholders. More commuters used it than were initially projected. The tolls were taken off the bridge once the cost of the bridge constructions was recuperated, in accordance to the state legislature.

From the interviews, most stakeholders observed that the bridge has had a much greater positive impact on the community than expected at the time of project approval. For instance, the local public tended to comment that the bridge impacted positively on their lives, and could observe that the business and economy were affected positively. Being local to the area, time savings and convenience are key benefits the bridge provides to the local communities. Those who were involved in its construction perceived that the bridge strongly impacted on the lives of the locals and economy, whilst the business representatives were able to recognize and relate to the high impact the bridge has had on the lives of locals and businesses, thus contributing to the economy. They were also more likely to discuss how some of the benefits from the bridge were unexpected or beyond their expectations. From the government speeches transcribed (Goicochea, 2016), government representatives focused on the impact the bridge has had in terms of the economy and what the bridge represented.

**Dis-benefits**

Acknowledging that a megaproject also may impact some of its stakeholders in negative ways, we have identified dis-benefits related to the Astoria bridge in the data set.

The informants generally admit to very few dis-benefits compared to benefits and value. The bridge replaced the Astoria-Megler ferry. Upon retrospection, a fragment of the community viewed the closure of the ferry services as a dis-benefit as it affected local
complementary businesses in the area like cafes and hotels servicing ferry users. However, as the bridge was being constructed, the businesses received new clientele in the form of construction workers and suppliers. Today, most favor the bridge over the ferry for its time savings and convenience. However, one of the historic ferry services will be revived and operated as a tourist attraction. The ferries and the bridge are connected in the hearts and minds of its community, as stated, “Before the bridge, ferries shuttled folks between Astoria and Washington. Their histories are connected, as the beginning of the bridge was the end of the ferries” (The Ferries, CCHS, 2016).

Discussion
Applying a process model, e.g. inspired by Andersen (2008) with the following phases:
- project initiation (incl. planning and organizing);
- project execution; and
- project operation.

Reveals that the time from the first idea of a bridge to the start of the project execution phase was 33 years (1928-1961). The project execution phase took five years (1962-1966). The project operation phase has now lasted more than 50 years (1966-now).

More of the opportunities identified relate to usage of the project deliverable, i.e. the bridge, in the operation phase. The bridge became used for more purposes than originally planned, i.e. not only for transportation but also as a setting for movies and commercial filming, as a carrier for fiber-optic cables, as a research venue for researching various lights, as a venue for a running event, and more. Third parties are involved in identifying and exploiting the opportunities, e.g. movie makers, researchers, communication companies, utility companies, sport organizations and non-profit temporary event organizers in the form of the 50 years anniversary committee. Some of the extra benefits identified are for individuals (like sales tax avoidance and a role as an event committee member), while some of the benefits are for the local society such as increased tourism and Astoria as a destination. The data clearly show that synergies are created. The 50 years anniversary was an event for the local people, but it was also an opportunity to strengthen the relationship to the friendship city, Waldorf, in Germany, as well as it was an opportunity for more stakeholders incl. politicians to do speeches. It even generated increased business in Germany, as the German delegation requested a local stone-sculpture artist was asked to make an item to bring to Astoria as a gift to the community. All the interviewees seemed immensely proud of the bridge, and also surprised themselves, that the bridge was not only used for transportation purposes but also for a number of business opportunities and non-profit/leisure-related opportunities, providing significantly increased personal benefits and societal benefits compared to what was planned at the project initiation. It became very visible in the data that some of the benefits were (and still are) harvested by the project owner (team), i.e. representatives of the State of Oregon and the State of Washington, while other benefits were (and still are) harvested by many other stakeholder groups. In addition, many different types of stakeholder groups are involved in the project opportunity exploitations. Further, the generated benefits are not decreasing over the years. Instead, some of the biggest benefits were harvested due to the 50 years project finalization anniversary. Of course, these benefits could not have been harvested earlier.

From these examples, the benefits (values) for different stakeholders can be said to be multi-leveled and multi-dimensional benefits and opportunities residing in the short- and long-term horizons and in the tangible and intangible realms of the project. Project value (and therefore potential opportunities) is inter-connected and could evolve during the course
of project management as found by Ang and Biesenthal (2017). Typical project management approaches may fail to harness the diversities and complexities of project opportunity in these instances.

The above findings lead us to propose the following:

\( P1. \) Exploiting all opportunities created by the project and increasing project benefits require involvement from many categories of stakeholders.

\( P2. \) Stakeholders get more involved in exploiting the opportunities created by the project when they are proud of the project.

\( P3. \) It might take a long time before some of the opportunities created by the project are exploited and the related benefits achieved.

\( P4. \) Celebrating the achievements of the project stimulate stakeholders to exploit the opportunities created by the project and contribute to further benefits of the project.

As of managerial implications of the findings, it seems clear that continuous communication is very important. This may point to other project representatives than the project manager in a central role. Important contributions to a further discussion of the role of the project owner (team) can be found in Bryde and Volm (2009), Karlsen (2010) and Andersen (2012).

Project owner involvement for information and knowledge sharing seems very important in the sense that the project owner (team) must take a long-term perspective (involving the project operation phase) and giving a continuous and sufficient focus within the project operation phase in order to enhance project opportunity exploitation. The reason is that to enhance project opportunity exploitation, the project needs to be so present in the minds of (potential) stakeholders so that they choose to identify and exploit the opportunity. A shared vision of a group of stakeholders, e.g. like an event committee, may be helpful. Also a focus on why stakeholders should be proud of the project seems important. In addition, the project representations must understand that multifaceted measures on project benefits must be used.

In sum, the findings point to the necessity of continuous communication about the project from the project owner (team), also after the project execution phase, in order to enhance project opportunity exploitation and increased benefits.

**Conclusion**

The research underlying this paper was guided by a research gap in the current project management literature on the phenomenon “project opportunity exploitation.” Realizing that megaprojects consume numerous resources and impact numerous people, even across generations, a better understanding on how to enhance the achievement of further project benefits than the ones mentioned and estimated in the business case analysis at the time of project initiation would be valuable for the megaproject’s stakeholders as well as for the society at large.

In sum, this paper is advancing the understanding of megaprojects and the concept project opportunity exploitation by means of a longitudinal case study, using both archival data and primary data. The single case study of the construction and 50+ years operation of a bridge inspires us to answer the research question “How can project opportunity exploitation be enhanced?” with the following statements.

Project opportunity exploitation can be enhanced by:

- encouraging and accepting the involvement of many categories of stakeholders that can take advantage the project for their own purposes;
enhancing that stakeholders are proud of the project, and thereby will engage in or even initiate activities that are generating further benefits to themselves and/or others;

- realizing that project opportunities may materialize after a long time (like, for example the opportunity of the 50 years project finalization anniversary to celebrate); and

- celebrating achievements of the project and thereby stimulating stakeholders to exploit the opportunities created by the project, which will contribute to further benefits of the project.

A key contribution of this paper is new knowledge on a phenomenon that so far only has been investigated to a very limited extent.

A limitation to the research is that the analysis mainly rests on the primary data, i.e. a limited number of interviews, whereas the rich data set needs more analyses. In addition, all interviews very clearly biased in the sense that the interviewees were very proud of the project and the bridge. We did not check out whether this positive attitude was representative for all stakeholders. A third limitation is that only a single case study was undertaken. It would be fruitful to undertake more studies to enrich the understanding of the phenomenon investigated. In future research, it is important to find more cases that can be studied with a long-term perspective, i.e. including project opportunity exploitation in both the project execution phase and the project operation phase, as it is done here. A fourth limitation is that the selected project was a “rare species” due to the fact that it was completed “in time, within budget, and to specifications,” i.e. complying well with the triple constraints, while at the same time exceeding the estimated benefits in the form of achieved revenue from the bridge toll years earlier than expected. So, the project did not follow Flyvbjerg’s “iron law of megaprojects.” It could be interesting to study project opportunity exploitation in megaprojects that are not deemed so successful, e.g. because they do not meet the constraints and/or do not meet the expectations on benefits.

References

Andersen, E.S. (2008), Rethinking Project Management – An Organizational Perspective, Prentice-Hall, Upper Saddle River, NJ.


Lechler, T.G. and Byrne, J.C. (2010), *The Mindset for Creative Project Value*, Project Management Institute, Newtown Square, PA.


Increasing project benefits


Further reading

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(The Appendix follows overleaf.)
Appendix

Scene setting
As we have already discussed, we are writing an article about the construction of Astoria bridge for a journal on symbolic megaprojects. We would like to know more about how the locals feel about the bridge now and back during construction.

How long have you lived in Astoria? (Maybe also ask about age if appropriate. Listen for any indications of where they may have been present during the bridge construction)

What is your current role in the city?

What does the bridge mean/signify to you personally?

What is the overall public sentiment about the bridge nowadays in your opinion?

Personal questions
(If the interviewee seems too guarded, leave for the end when they may be more relaxed talking)

With the 50th anniversary coming up it is time for memories, so what is your earliest memory connected to the bridge?

What is your best memory connected to the bridge? (if not answered in previous questions)

Can you tell us any funny or interesting stories that have to do with the bridge?

Bridge construction
(only if old enough to remember)

Do you remember the construction of the bridge? (if not answered in previous questions)

If yes, was it a big thing for the community, was there a lot of media coverage? Was there an overall sense that something big was happening?

Did anyone you know work on the construction? (alternatively: was anyone you know personally involved in the construction or affected by it in any way?)

Do you remember any specific incidents from the construction? Could you tell us more about this?

We read a very interesting story about the Astoria clowns and how they were instrumental in getting the bridge built. Do you know more about this?

Apparently, the bridge was met with a lot of criticism and mocked as “the bridge to nowhere”. What was the local sentiment about that, do you know/remember?

Bridge operation
50 years later what would you say are the changes that the bridge brought about? (if not answered in previous questions)

What was the impact on the local economy? During construction and after it opened? (if not answered in previous questions)

Did it have any positive or negative effects on the environment? (if they are not sure, prompt with “on the quality of the air or the salmon population, etc.”?)

The slogan of the anniversary celebration is “Bridge to Everywhere” is that a sign that the bridge has defied all initial criticism?

As a local resident, what are your biggest concerns regarding the bridge nowadays?

If you could go back to the time it was first built and had the power to introduce changes, what would those be?

There have been comments in the media that maintenance and operation costs more than it cost to build and the toll should never have been lifted. What do you think about it? (if not answered in previous questions)

What do you think future generations will make of the bridge?

Table AI.
Interview guide

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Megaproject management and leadership: a narrative analysis of life stories – past and present

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Abstract

Purpose – The purpose of this paper is to glean leadership lessons of megaproject managers through the life stories of four purposefully selected managers from two contemporary and two landmark megaprojects.

Design/methodology/approach – A narrative inquiry approach applying thematic analysis is used to capture lessons learnt from these stories with a focus on leading megaprojects. Narrative analysis has been used in organization studies and this paper is an attempt to use it in project management research.

Findings – Common strategies used by all four megaproject managers to be successful include: selecting the right people and building their capability; building trust with stakeholders; dealing with institutional power and politics effectively; and having the courage to innovate. There were also some differences in the approaches used by these managers due the times in which these projects were implemented.

Research limitations/implications – The use of narrative inquiry is new to project management literature. As the life stories were not presented in the same way it was difficult to analyze them in the same manner, and further data had to be collected. This could have been avoided if it were feasible to collect narratives directly from the megaproject managers. This is being planned in future research emerging from this paper.

Practical implications – This study helps megaproject managers to exhibit leadership attributes that would be required to execute such large complex projects that have wide implications for the society, economy and the environment.

Social implications – Megaprojects are often considered major displacements that cause social and geophysical issues that affect the environment. Lessons learnt from these stories could be useful to avoid such issues. The stories analyzed showed the human side of the megaproject managers toward people related, health and societal issues.

Originality/value – Narrative inquiry is new to project management literature. In the past, project management literature has focused on extracting lessons learnt from historical and classical projects, but lessons from life stories of project managers have not been used for the same purpose.

Keywords Narrative inquiry, Project leadership, Narrative analysis, Megaprojects, Life stories, Power and politics

Paper type Research paper

The ideal megaproject leader is: “the vision, the conception, the knowledge of the whole and every part, the anticipation of every problem of execution” as John Roebling, the genius behind the Brooklyn Bridge was described.

Introduction

The aim of this paper is to gain insights into the management of megaprojects from life stories published about four megaproject managers: two contemporary project managers in the Asia-Pacific Region, who led large infrastructure development projects; and two landmark megaproject managers in the USA. The books used for the analysis of the life stories are:

3. The Builders of the Bridge: The Story of John Roebling and His Son, by David Steinman.
It is hoped that the narrative analysis method used in this paper will motivate project management researchers to explore the use of this method in their research. While narrative analysis has been used in organizational research (Boje, 2001; Czarniawska, 1998; Czarniawska-Joerges and de Montheux, 2004), it does not seem to have been used extensively by project management researchers. Hence, this paper is expected to contribute both to the growing literature on megaprojects and the use of novel approaches to studying (Drouin et al., 2013).

The paper is set out as follows. It starts with a brief literature review to explain why this study was undertaken and the research question(s) addressed. This is followed by an explanation of the methodology used including its philosophical underpinnings, the method used and how data were collected and analyzed. Next, the life stories of four megaproject managers are summarized, highlighting critical moments that led to them to exhibit leadership qualities in the projects they managed. This is followed by a discussion on the key strategies adopted by these managers, with a view to learning about leading and managing megaprojects from practice. The paper concludes with some reflections on the limitations of the method used, with some suggestions on how these can be overcome.

**Literature review**

Life stories of leaders are often used as way of understanding leadership in practice and to facilitate leadership development in organizations. Recent examples of some contemporary life stories that have served as an inspiration for managers and leaders are those of: Steve Jobs (Isaacson, 2011); Richard Branson (2011); Paul Allen (2011); and Martha Stewart (2005).

Biographical accounts of leaders have also resulted in the development of some new leadership theories such as authentic leadership (George, 2003) and servant leadership (Greenleaf). Narratives and stories have been recognized as a way of learning about leadership (Taylor et al., 2002), dealing with complexity (Boal and Schultsz, 2007), understanding cross-cultural influences and diversity (Grisham, 2006; Barker and Gower, 2010), helping to develop new leaders (Ready, 2002) and leading/managing change (Fleming, 2001; Adamson et al., 2006).

Telling inspiring stories has been identified as an important trait of modern leaders, resulting in papers being published on how to develop this capability (Harris and Kim Barnes, 2006; Denning, 2006; Sinclair, 2009). However, leadership stories have also been criticized as manipulative and unethical (Auvinen et al., 2013) and a masculine form of leadership archetype (Olsson, 2000). Recently, life stories of women as leaders have started appearing, which is helping to recognize the role of women as leaders (e.g. Sanberg and Scovell, 2013; Stewart, 2005).

Thus, life stories have been used to help us to understand what drove leaders to achieve success, their trials and tribulations, the development of new theories of leadership development and reasons why such stories are useful in studies about organizations.

Czarniawska (1998) points out the importance of studying narrative forms of reporting in organization studies, stating that they will help us to “enter into a dialogical relationship with organizational practice” (p. 17).
As projects are considered “temporary organizations” (Lundin and Söderholm, 1995, 2013), project management researchers and practitioners could also benefit from the analysis of narrative forms of reporting, such as life stories. The temporal nature of projects is conducive to create stories that can have a clear beginning and an end following the life cycle of a project.

Storytelling has been promoted as a means of project management development in large organizations like NASA that manage multimillion dollar projects (Lauffer and Hoffman, 2000), and for knowledge management in project-based companies (Koskinen and Pihlanto, 2008). Storytelling has been used as a valuable tool for capturing lessons learnt from projects (Amtoft, 1994; Anbari et al., 2008; Schindler and Eppler, 2003; Sense, 2007). Recently, storytelling has been used to study the role of narratives in innovation project leadership (Enninga and van der Lugt, 2016). Thus, the importance of storytelling in project management has been recognized as a means of project manager development, knowledge management, innovation and capturing lessons learnt.

In their editorial for a special issue in the *International Journal of Project Management* on project history, Soderlund and Lenfle (2013, p. 653) urge more research in this area is needed as “project management scholars have something to contribute to the study of history – through gaining a better understanding of the capabilities of project managers, the practices and techniques used in the projects of our past, and the effects those capabilities and practices have had on subsequent projects and, perhaps even their effect on the general societal and industrial development.” Söderlund and Geraldi (2012) also guest-edited a special issue on “classics in project management” where they suggest that “Telling the stories of the classics connects us to our collective memory, establishing a link with the ‘great minds’ of the past, awakening interesting and relevant ideas that have been forgotten or overlooked over the years” (p. 560). This paper builds upon the valuable work started by Soderlund and colleagues but with a focus on life stories and on megaprojects. It is specifically focused on life stories of megaprojects with a view to study project leadership, as this is an area of special interest to the author.

The overall research question that this paper addresses is:

**RQ1.** What can we learn about managing and leading megaprojects from the life stories of megaproject managers?

The purpose of this paper is not to provide a critical review of the lives of these megaproject managers but to extract lessons from their stories that can help us to be more successful with megaprojects which are often portrayed as failures (Flyvbjerg, 2014; Lenfle and Loch, 2017; Clegg et al., 2017; Pollack et al., 2017).

**Methodology**

The philosophical underpinning of this study is the epistemology of constructivism as the investigation is “constructed through discourse in the context of individual histories” (Beazley, 2013, p. 3). Its ontology is interpretivism as it is based on historically situated interpretations of the world by life historians (Gray, 2014, p. 23) and the methodology is phenomenology, which is the worldview that reality is “grounded in the people’s experiences of social reality” (Gray, 2014, p. 24). The method used is narrative inquiry.

The data used in this paper are qualitative as the data sources are life histories published as books or in book chapters. Some literature and publicly available data were also used to reinforce the findings from the life stories. The study uses narrative analysis based on the how narrative approaches are used in organization and management studies (Czarniawska, 2004; Maitlis, 2013; Andrews et al., 2007).

According to Maitlis (2013, p. 494), narrative analysis can be conducted using thematic, structural and dialogic performance techniques, of which thematic analysis is the most common.
The aim of thematic analysis is to identify key themes from a narrative or set of narratives. This form of analysis was selected for this paper as “structural analysis prioritizes the way in which story is told” (Maitlis, 2013, p. 497).

Stories are essentially individual constructs of human experiences, and have limitations that may affect objectivity in presentation (Mitchell and Egudo, 2003). Findings from narratives are also not easy to generalize and may need another form of corroboration.

Despite its limitations, narrative analysis is a useful method we can borrow from the social sciences to capture lessons from practice. The author would like to suggest that project management researchers could find ways to collect narratives directly from megaproject managers, instead of relying on published life stories, to enable the other forms of analysis to increase the rigor of this approach.

Life stories from books

The paper starts with a description of key points gleaned from the two contemporary life stories of megaproject managers – those of Elattuvalapil Sreedharan and Grahame Campbell.

The author of this paper now lives and works in Australia but started his career as an engineer working in project teams in India. He was impressed with the success of the Delhi Metro Project and was curious to know how a retired public servant, dubbed the “Metro Man,” could successfully complete the Delhi Metro Project in India when the organization of the Commonwealth Games that were held in New Delhi around the same time proved to be a disaster. (www.telegraph.co.uk/sport/othersports/commonwealthgames/8016654/Commonwealth-Games-2010-disastrous-build-up-has-killed-off-Indias-Olympic-dream.html). On reading the Sreedharan’s impressive life story by Ashokan (2015), the author became curious about whether there were any life stories of megaproject managers in Australia had been published. At this time, he happened to meet Grahame Campbell and found that he had published his autobiography. The author then decided to compare these two life stories to see what could be learnt from them:

Sreedharan’s secrets of success: “Making the common man part of the grand scheme and giving him a clear vision of the ultimate benefits that would come his way”.

We trust the contractor, we give him 80% of the bill within 24 hours. There is no cash flow problem to fight (Elattuvanapil Sreedharan).

While Ashokan’s book describes several projects in which Sreedharan was involved, three stand out as examples of his leadership, ingenuity and how he dealt with power and politics: the reconstruction of the Pampan Bridge; the building of the Konkan Railway; and the Delhi Metro.

The three projects

The Pampan Bridge (http://myrameswaram.com/pamban-railway-bridge) connects the town of Rameswaram located at the Southern tip of India to Pampan Island from where there were once ferry services to Sri Lanka. In 1964, a massive 240 km/hour cyclone destroyed one end of the bridge, causing huge loss of life as a train traveling on the bridge was washed away. This disaster required a major reconstruction of the bridge, which brought Sreedharan into national prominence. While the Pampan Bridge cannot be classified as a megaproject, it is included in this paper as an example of how Sreedharan demonstrated his capability to “think outside the box,” which became one of the trademarks of his style of in later megaprojects.

The second project, The Konkan Railway (www.konkanrailway.com), is a 741 km line that connects Mangalore and Mumbai. It was a very difficult and risky project due to the many hurdles faced in laying lines through a treacherous landscape that included swamps, rapids
over rivers and jungle. The line required 2,000 bridges (the longest being over 22 km over the Sharavati River) and 92 tunnels (the longest being nearly 65 km with the tallest viaduct of 64 meters in height). The project posed several technical, financial, emotional and psychological challenges and was plagued by floods, evacuations, public protests and accidents resulting in loss of life (www.konkanrailway.com/pages/viewpage/construction_challenge).

The project commenced in late 1990 and was completed in 1998 to coincide with India’s 50th anniversary of independence. The overall cost of the project was 2,048.13 crores (379.31 million US dollars). From a global megaproject perspective, it may not qualify as a megaproject in terms of cost, but it does so in terms of its scope, and meets the characteristics of a megaproject defined by Flyvbjerg (2017) as: “a major infrastructure project that attracts a high level of public attention or political interest because of substantial direct and indirect impacts on the community, environment, and budgets” (http://flyvbjerg.plan.aau.dk/whatismegaproject.php). Zhai et al. (2009) add that “megaprojects exhibit extreme complexity, substantial risks, long duration, and extensive impact on the community, economy, technological development, and environment of the region or even the whole country.” This project certainly had many of these characteristics even though it did not cost over a billion US dollars.

The third project, the Delhi Metro (www.delhimetrorail.com/about_us.aspx), is a metro rail network of 213 km in the Indian capital, and has 160 stations. The first phase of the construction was completed in two years and nine months, ahead of time, in 2005, and the second phase in four-and-a-half years in 2011. This phase also included an airport link, and the Metro has now has crossed the boundaries of Delhi into neighboring Haryana and Uttar Pradesh states. Phase 3 is expected to be completed in 2017. The cost of Phases 1 and 2 are around 64 million and 80 million rupees, respectively, a total of 2.1 billion US dollars. Phase 3 is estimated to cost 5.2 billion US dollars. A fourth phase is also planned.

Critical incidents extracted from the three projects

Pampan Bridge

The Pampan Bridge required the replacement of 125 steel girders that were destroyed by the cyclone. The expectation from Sreedharan’s superiors was that the bridge would be rebuilt in six months. The original plan was to have the replacement girders built offsite in fabrication facilities located Gujarat or Assam, far away from Madras (now Chennai), and shipped to Rameswaram. The six-month timeline was a political decision made without consultation with the people tasked with rebuilding the bridge. To make matters worse, Sreedharan was then told that the timeline had been reduced further to three months. Sreedharan knew that it was impossible to rebuild in three months using new girders built offsite and transported to the construction site. “Sreedharan scrambled for alternative solutions, while ideas and instructions came thick and fast from the administration” (Ashokan, 2015, p. 61).

At this time, it emerged that some local fishermen had found some of the girders that had been washed away close to the coastline. Sreedharan decided to go on an expedition to find more girders with the fishermen. They found several girders which had not been damaged badly. Sreedharan then decided to use the salvaged girders. He designed and built a crane locally along with a sturdy barge to pull the girders out of the water. He also found a group of locals who were experts in hauling big objects. While the first girder took a week to be installed, productivity improved and subsequent girders took less time. In the end, all 125 girders were repaired and repositioned. “All this was accomplished with the help of machinery designed and developed (locally) during the course of reconstruction, for the sole purpose of meeting the unique needs and circumstances of the project” (Ashokan, 2015, p. 4). The bridge was completed in 44 days, beating the reduced deadline of three months and as the last girder was being raised the minister of railways was still...
making a statement in parliament that the bridge was making good progress unaware that it was nearing completion.

This clearly shows Sreedharan’s capacity to use innovative means to solve unanticipated problems in projects. In addition to finding solutions locally, he identified the right people to do the hauling job, even if they were not technically qualified, demonstrating willingness to take risks to achieve the goals of the project.

**Konkan Railway**

The Konkan Railway project involved four Indian states (Maharashtra, Goa, Karnataka and Kerala) with conflicting political environments, which made uniform agreements difficult. It was financed as a Build, Operate and Transfer project and faced several financial problems during its execution. The government had also stipulated an aggressive timeline, which seemed impossible at first.

The idea for the Konkan Railway originated in the 1890s, during the British Rule but detailed plans were drafted only in 1977. It was finally expedited by George Fernandes who was Railways Minister in the 1980s. Sreedharan had also joined the railway board at that time. The railways, on the other hand, were not very supportive as they did not think that the project would be successful. Sreedharan had to rely on the support of Fernandes, the Project Sponsor, who was determined to get the project done under his watch.

Sreedharan then had to convince Fernandes that the Konkan Railway would not be successful if conventional financing through the government’s annual rail budget was the only source of funding. He proposed a new way of financing and setting up a Special Purpose Vehicle to manage the project. Fernandes supported the idea and got the Prime Minister’s support for it. However, it was a different story with the ministers and officials in the state governments as some of the states were governed by parties not aligned with the central government. Yet, their support was critical to the success of the project.

Fernandes was able to convince the chief ministers of Maharashtra and Goa to support the project, but Sreedharan felt that it would be difficult to get the approval from Kerala and Karnataka. He decided to shoulder this responsibility himself, telling Fernandes: “It would be hard to get them to join the projects because of their political allegiance. Instead let me make some moves at Officers’ level” (Ashokan, 2015, p. 122). Sreedharan’s strategy worked and all four states were finally behind the project. Before starting the project, Sreedharan took an undertaking from Fernandes that “there would be not be any external intervention or influence during the mission’s planning and delivery. The mission must be completely empowered politically and administratively” (Ashokan, 2015, p. 125).

Sreedharan was then appointed Chairman and Managing Director of the newly formed Konkan Railway Corporation (KRC). As one of the first important tasks, he commissioned a new survey for alignment of the proposed rail line as he was skeptical about the accuracy of the previous alignment completed by Southern Railway. This task proved to be dangerous due to accessibility issues using normal modes of transport. “Into this situation rode the Kawasaki bikers. Around 400 youth, fresh out of engineering colleges, took up the challenge of [carrying out the survey] with the support of Kawasaki.” These Kawasaki motorbikes were specially equipped to work in difficult terrain. The task was completed earlier than expected, saving time and overcoming the shortcomings of earlier surveys and was more acceptable to the local population. It also saved cost by routing the line in areas that were easier to access.

Sreedharan’s focus then turned to get the right people who he could rely on to complete the project. He personally vetted applications based on qualifications, skills and job experience – all appointments were strictly based on merit.

While preparations were underway, the central government lost its majority and Sreedharan lost the support of his Project Sponsor Fernandes. However, the new
Railway Minister, Jaffer Sharief, also supported the project. But he announced in parliament that it would be completed in five years (even before the surveys had been completed and with the relocation of 43,000 families was yet to start).

Land acquisition was identified as a critical issue and team members personally approached the families to be relocated to sell the benefits of the project to them and address their concerns individually. People were told “Give us your land and relocate to a place you’d like to move to. Build another house and live in a rented home until it’s done. Whatever might be the expense the Konkan team will recompense you within a year and half” (Ashokan, 2015, p. 134). Several other measures were taken to take the sting out of having to relocate. The project team always ensured that local people affected by the project were given accurate information during project execution. In Goa, youngsters were again sent on motorcycles to spread the news of the positive outcomes from the new line to the community.

Land acquisition for infrastructure projects is a tedious process in India, administered by local government authorities who were not known for their speedy action. “The reason why land acquisition was speedily accomplished on the Konkan and Delhi Metro projects was not because the state governments pushed harder, but because of Sreedharan’s policy of transparent and direct contact which yielded the desired results” (Ashokan, 2015, p. 135).

Although some critics deemed Sreedharan’s processes as bordering on the illegal, there were others who believed that time was critical and agreed that waiting did not help. Despite all his efforts, Sreedharan ran into difficulties when the government in Kerala changed hands. This triggered community resistance and the project had to be suspended for ten months.

Another strategy adopted by Sreedharan to avoid legal battles during land acquisition was also effective. “The Konkan team’s solution was to get signed documents from the land owners pledging the transfer of their assets in the presence of revenue authorities” (Ashokan, 2015, p. 137). While this may seem unusual, several steps taken by the Konkan team showed their concern for people-related issues during the land acquisition process. New wells were dug when access to the old ones were lost, fruit trees lost were suitably compensated, materials from houses that had to be demolished that could be reused were given away free to those who needed them, places of worship were preserved, cemeteries were relocated and relocation assistance was generous.

Another innovation used to make the project team conscious of schedule was the use of “reverse clocks.” Sreedharan borrowed this idea from the Kudremukh Iron Ore Project. These were clocks that ran backwards and “were brought in as part of a conscious decision to get the construction works done according to a predetermined schedule” (Ashokan, 2015, p. 139). They were installed in all offices and sites to instill a consciousness about time passing among all who worked on the project.

Several steps were taken during construction to keep the project on schedule and of good quality avoiding any rework. Petrol bunks were installed when a fuel shortage occurred during the Iraq-Kuwait war. Plants were installed at various, locations to expedite the building of tunnels and bridges. Stocks of steel and cement were kept onsite to avoid shortage. An independent agency was hired to assure the quality of work. Systems for medical care and vigilance were carefully planned. When it became necessary, Sreedharan and his team hopped on a plane and traveled overseas to secure the appropriate equipment and machinery. When contractors lacked the appropriate machinery, they were given company machinery on the understanding that they would keep to the schedule. The project team also helped contractors to choose appropriate machinery.

As the work progressed and obstacles arose, other innovative solutions had to be found. Techniques such as “incremental launching” to hoist large structures, “ballast-less track” to secure tracks without frames that also helped reduce maintenance, and “speed turnouts” to help trains are some examples. Konkan rail also used welded rails, which was not
common practice, and workers were sent to Japan to learn this skill. This helped in the prefabrication of rails to install them more easily when the terrain was difficult. Cost was also reduced considerably through this innovation. Worker comfort was also paid attention to by allowing workers to work in an air-conditioned environment to dig comfortably. When ventilation of very long tunnels proved to be a problem, experts were again sent abroad to help import world class ventilation systems.

Despite all these measures, the project was delayed by two years partly due to ten months of fierce opposition initiated by groups with political, religious and community support demanding the realignment of the track that had been approved previously with community consultation. These protests grew to become a national issue and eventually resulted in the prime minister halting the project. A judge was commissioned by the central government to investigate the issues and recommended that the original alignment was still the best choice. However, the commission imposed certain conditions for continuing the work to allay the fears of the community. Construction then resumed with some specific precautions to be taken to reduce ecological impact.

Another major problem that delayed the project was difficulties with the financing. The state governments had floated bonds, which then had to be sold at a lower price due to a financial scandal that that rocked the Indian stock market at that time. There were also instances of rework of construction work due to unanticipated geo-technical issues. The floods of 1994 in the Mahad region in Maharashtra added to the difficulty of transport and worker movement, slowing down the project.

Despite all these unexpected challenges, the project was finally completed and gained international recognition and served as a model for future rail projects in India.

Sreedharan attributed the success of the project to “the freedom he had enjoyed and the authority he was able to wield while in the top post of KRC, which was a new entity and remarkably different from the Railways” (Ashokan, 2015, p. 175).

The lessons learnt for Sreedharan’s strategies in the Konkan project were:

1. ensuring sponsorship of the project from governments and using various channels to garner this support;
2. identifying key bottlenecks of land release and making sure contractors were on schedule through innovative ways of dealing with these issues;
3. the use of reverse clocks to build a sense of urgency within the project team; and
4. making himself available to resolve problems in the field as they arose.

Delhi Metro

When the plans for the Delhi Metro started gathering momentum, Sreedharan’s name came up again to be appointed as the Project Manager. He was now already past 65 years of age and ready to retire at the end of the Konkan project. Sreedharan’s advice was sought to find a suitable manager to lead the project as a legal statute prevented him from being appointed to lead DMRC as it was partly owned by the Indian Government. In the end, the panel had to find a way to circumvent this obstacle as Sreedharan was deemed the ideal candidate. A physical fitness test was ordered, which he passed. Finally, the cabinet secretary took a bold decision. He recommended that “If this country could be governed by a seventy-five-year-old, why could not a sixty-five-year-old Sreedharan run an organization such as DMRC?” (Ashokan, 2015, pp. 181-182). As before, Sreedharan demanded complete freedom in delivering the project and selecting his team before undertaking the project.

Sreedharan again personally oversaw the hiring process, recruiting over 100 employees. They were mostly young people between the ages of 18 and 30, a majority from the railways.
The hiring took some time, which provoked criticism from the media, but Sreedharan felt getting the right people was critical. Ethics and personal integrity were always important to Sreedharan and the new recruits had to sign a declaration that included a nine-point code of conduct including a commitment to ethics. He himself provided an example by thwarting early attempts in the project to influence appointments, and by not yielding to vested interests.

One of the important steps Sreedharan took was to investigate the latest technologies adopted in metros around the world. Two teams of 20 of newly recruited staff were sent to eight countries in Asia and Europe to learn all aspects of metro systems. Engineers were also sent for training overseas as DMRC did not have its own training facility.

The administration was kept lean and officers were given authority to carry out the multiple tasks allocated to them and resolve complex issues, with a high priority on quick decision making. Decision making on the same day was encouraged. Weekly meetings were held but no minutes were taken.

Laying a metro in a crowded city generated many problems as the first phase started with three lines called red, yellow and blue. Plans were challenged as soon as they were made public, resulting in changes supported by backroom pressure groups. This resulted in doubts about the timely completion of the project among the public.

DMRC made a strategic move to offset the noise, by starting on a line that had minimum objections. DMRC held open forums with the police, water authorities and related government offices, in addition to the general public, which gave it an early indication of the troubles to come later and how to smoothen the progress.

Land acquisition was conducted in the same way as the Konkan Project, by directly contacting land or house owners to assess their needs. They were told that the alignment was fixed but they would be offered fair compensation and help to relocate. DMRC received the full support of the Delhi Government and the backing of the chief minister.

One of the major hurdles for the project was the presence of religious places that had to be relocated at DMRC’s expense. “Although the government was responsible for taking these measures, DMRC stepped in, realizing the government’s lackadaisical business as usual attitude, and themselves reached out to the traders” (Ashokan, 2015, p. 195). Japan International Cooperation Agency was the main funders for the project but it was unclear if their loan would come through when India started nuclear tests in Pokhran. However, the project team was optimistic and continued with the project, and the funds eventually arrived.

Sreedharan paid particular attention to legal matters as several hundred issues arose due to land acquisition, tax problems and contracts, which were resolved with speed. He insisted he was kept informed of the status of all the cases that were handled.

The project also had good media support, which helped. This was achieved by the project team by building rapport with the media and having an energetic and motivated public relations team from the start. The public relations department developed several communication strategies to maintain positive public support. Despite all these precautions, public anger tended to boil over from time to time, with angry mobs venting their frustrations by locking up public officials in one instance, and issuing death threats and throwing rocks at senior managers.

Building the rail line in a busy city turned out to be a nightmare that involved dealing with everyday traffic, reducing effects on buildings close to the line, and taking care of underground pipes and cables. There were also several court cases filed against the alignment and a Delhi Metro Railway (Operations and Maintenance) Act had to be passed in 2002 to contain these issues.

The strategy of looking after contractors was repeated, as in Konkan, and payments were made on time so that work could progress. Top management even proactively inquired about pending bills with contractors. The finance department was involved in the project
detail so that they could have a grasp of what was going on and be ready to help overcome financial constraints.

Sreedharan ensured that the public's concerns were addressed by "making the common man part of the grand scheme and giving him a clear vision of the ultimate benefits that would come his way" (Ashokan, 2015, p. 202).

The reverse clocks that worked effectively in the Konkan project were also used in the Delhi Metro to build consciousness about the project schedule.

Sreedharan's personal, simple style of working acted as a role model to others and helped improve productivity. He would, in general, keep to eight hours of work but he used this time productively without wasting it. He would pay a visit to construction sites on Saturdays to review work in progress and address any issues.

There was one incident that nearly caused Sreedharan to resign from his position. This had to do with the choice of gauge for the Delhi Metro. The Indian railway's policy was to use broad gauge but metros worldwide were using standard gauge. The type of gauge used would have a trickle-down effect on the procurement of railway carriages, and the decision was escalated to the Cabinet and the Home Minister was asked to intervene. When the decision was announced that broad gauge would be used, Sreedharan was prepared to resign, but was persuaded by the Lieutenant Governor of Delhi to stay on. The issue was then raised to the Prime Minister by the Delhi Chief Minister but the Railway Board's decision prevailed and the first phase of the metro used broad gauge, a decision that was later regretted. It was changed to the standard gauge from the second phase. Sreedharan commented that "the decision to go with the broad gauge was the most severe blow he had endured in his entire career spanning half a century" (Ashokan, 2015, p. 209).

During the second phase of the project an accident which cost seven lives forced Sreedharan to resign as he took moral responsibility for it. This was because he had taken measures to improve workplace safety after a previous incident. But the government was not prepared to let Sreedharan go and senior ministers from the central and state governments pleaded with him to stay on at least until the end of Phase 2, which he agreed to do.

After delivering the first two phases of the Delhi Metro, Sreedharan stepped down in 2011. The success of the Delhi metro has revived interest in other Indian cities to build metros and the DMRC has been asked to be advisory consultants for many of these projects. Sreedharan was asked to be the advisor of the Chennai and Kochi metros.

The lessons we can learn from Sreedharan's strategies in the Delhi Metro project, in addition to what was observed in the Konkan railway, are:

(1) putting in place a code of conduct to keep the project squeaky clean;
(2) ready to be saddled with the responsibility when issues arose and even offering to resign, clearly indicating that the buck stopped with him;
(3) setting a personal model for working efficiently as well as effectively;
(4) looking out for new technologies that would speed up and enhance the project;
(5) ensuring that stakeholder communication was managed well so that the media was supportive of the project; and
(6) arguing for decisions that he believed in, such as the use of standard gauge and reluctance to use PPP contracts.

Grahame Campbell

Campbell's maxim: "At each turn in the evolution of my thinking, I was conscious of the learning process and the need to build on opportunities that presented themselves".
The autobiography of Campbell is not focused on the megaprojects that he led but on his life as an engineer and his love for music. Therefore, the following description includes extracts from his earlier projects that helped him to become a megaproject manager. The author also decided to interview Campbell specifically about his experience in two megaprojects, which has been added to the data collected from his autobiography.

Campbell’s book starts with finding himself in the midst of a war in Northern Iraq, where he was working on a project. “When I finished my university studies in civil engineering ten years earlier, I never anticipated, much less imagined, that I would find myself in these far-flung outposts of the world, sometime in the middle of a war zone trying to make sense of the brief and complete the project” (Campbell, 2016, p. xiv). Campbell’s career, unlike Sreedharan’s, took him all over the world, working on projects in a variety of countries. Campbell also worked mostly in the private sector and, unlike Sreedharan, his role in megaprojects was that of a contractor delivering the projects.

Campbell, like Sreedharan, also worked in the railways in his early career. He started work at the NSW Railways as a Junior Designer in Sydney, working on construction projects for an electrification project. This is when he became interested in project management and enrolled in a master of engineering science degree. His master’s thesis was related to managing major projects, which was put in practice by his supervisor, who became the chairman of Shell Australia.

Campbell continued working while studying for his Masters, which also gave him an opportunity to apply what he learnt to his work. This is quite common in Australia compared with India, where you completed your education before starting work. After his initial experience with the railways, Campbell joined McDonald Construction in Mascot and realized that life in the private sector was very different from the public sector. “I’ve just left a job where I had an office, car, driver and secretary. A couple of thousand people were under my control. Now I have a desk among a dozen others” (Campbell, 2016, p. 106). The private sector was also a revelation on how contractors were treated in projects. When he submitted a project cost estimate to his superior he was asked to cut down the prices quoted by sub-contractors.

“Keep finding ways to shave their prices. They have to think that you’re the winning contractor and want to be on the winning team. This is a big deal for them, and you can tell them it’s a long-term relationship” (Campbell, 2016, p. 109).

He was learning how projects worked. “I was beginning to understand the roles of various participants in project development. The owners employed engineers to design the works and, in turn, contracted suppliers of equipment and materials in different combinations for constructors to build the project. Finance arrangements sometimes influenced the legal documents which brought everything together” (Campbell, 2016, p. 114). He then moved on to work for CMPS, a consulting firm in Sydney, and was sent to Melbourne to be a project control engineer where he was warned not to get too close to the contractors when he tried to resolve issues collaboratively. He was frustrated with the elitist attitude of his firm and decided to focus on the “relationship between design and construction activities” in a project for his masters, which later changed to “the integration of design functions into major projects” and was to have a big influence on how he worked on major projects.

The work with CMPS took him to several projects around the world, starting with a mining project in Indonesia and then back to Australia on a pipeline project carrying gas from Victoria to Sydney. His experience with the commercial aspects of projects gave him an insight into how projects start and how they are managed; why cost and time needed close attention; how to work well with contractors; and understanding construction methodologies to be able to use new techniques.

At CMPS, he started working on large oil and gas pipeline projects, and their foray into a gas project by Australian Gas Light Company taught him how politics has a big influence
on project decisions. The Victorian Government was trying to protect the local industry from competition with Sydney, which made CMPS give up on a Victorian-based project and switch to South Australia. It also brought him into contact with American partners. He learnt that American and Australian engineers were trained differently. “In Australia we had standard disciplines – civil, mechanical etc. – but the Americans had pipeline engineers who combined various aspects of these areas” (Campbell, 2016, p. 164). Further work on the pipeline involved crossing the Blue Mountains and this is where he found that laying a pipeline along, what seemed like large tracts of unused land, resulted in clashes with environmental groups opposing the project with media support. Aboriginal people were afraid of their sacred sites being at risk. This led to delays in the project as the government commissioned an inquiry. Campbell became frustrated with all the turbulence. He learnt that “Engineering was not about physics, chemistry and calculations. There are many forces bearing on the problem: some of them, it must be said, were imagined, but all were considered and dealt with. We had used sophisticated computer modelling which had finally been swamped by tariff rules and political pipe dreams” (Campbell, 2016, p. 178).

Campbell then worked on projects for Huffco (a major player in the oil and gas industry around the world), working on projects in Trinidad, Bangladesh and the USA. After ten years working overseas on various oil and gas projects, Campbell returned to Sydney and rejoined CMPS.

In the meantime, oil prices crashed, affecting the oil and gas business and CMPS suffered. Campbell joined the company’s board and realized that they needed to develop a new suite of services to be viable. The jobs they were winning had only 20 percent engineering content while project services had increased to 80 percent. The growth of CMPS was being neglected by its management. At this stage, Campbell was appointed CEO and Managing Director.

This led to a review of the CMPS business to weed out non-performing parts so that the company could be more focused and collegiate. Soon, he found that the consulting engineering business was becoming lucrative. “Construction companies and equipment suppliers were attempting to take the lead role in projects and the traditional clients were attracted to the apparent lower risk” (Campbell, 2016, p. 440). He realized that while it was risky taking equity positions on bigger projects, he felt his international exposure had prepared him to undertake the higher risk. This strategy brought new projects in Indonesia, including projects with Japanese partners who funded the project.

The new strategy eventually led CMPS into the private road business when the new Liberal Government in New South Wales announced a plan for private toll roads around Sydney. He formed a company called State Wide Roads to bid for toll roads, and they were successful with their first project. It was 12.2 km leg of the 64 km long M4 Western Motorway running from East to West through the Western suburbs of Sydney. This was a big leap for CMPS that opened the doors to later megaprojects.

The M4 project was awarded as a Build, Own, Operate and Transfer project. The estimated cost of the overall project in 2008 dollars is $458 million or US$354 million (Audit Office Report, 2009). Success with the toll road brought new challenges but also prestige as such an asset had not so far been owned and managed by an engineering company anywhere in the world. “The greatest day in the 75 years history of CMPS was upon us” (Campbell, 2016, p. 457). By winning this contract, Campbell felt that they had crossed a threshold. He also felt that CMPS’s strength “lay on our professionalism and [we] fought hard to convince our clients that their welfare was our principal objective” (Campbell, 2016, p. 457).

Through participation in the M4 project Campbell realized that most engineering companies in Australia lacked management skills and this was an opportunity to change. The company had to have financial skills, if they were to be a leader in project management.
They also needed independent board members who could give them impartial and objective commercial advice.

The M4 project was going well and interest rates were falling and the project was increasing in value. The project also finished nine months early. Campbell explained to the media why they were successful in building and operating the M4: “We were a small united team focused on a simple premise: nobody was paid a fee or a dividend until we generated revenue and at such a time the shareholders will be the first in line” (Campbell, 2016, p. 465). He also felt proud that they had moved on to take an engineering and management role at an appropriate time in the market.

The success of the M4 project led to the winning of the 22 km Melbourne CityLink in a consortium put together by Transurban. The highway included new freeways, tunnels and a 30 meter bridge at a cost of AUD $2.2 billion.

These projects led Campbell to believe that “Engineering as a career was not a technical journey but a learning curve including cultural, social and management situations” (Campbell, 2016, p. 479), that knowledge of procurement, contracts and inspection are key aspects to manage a project business and “projects are delivered by teams that have leaders and specialists from a wide spectrum of skills” (Campbell, 2016, p. 479).

Working as a Board Member in CMPS had provided Campbell with additional knowledge on improving the commercial approach to project development. He felt that “having a strong risk approach to contracting allowed all forms of engagement from the earliest stage of the concept [and] the evolution of the project would be flexible, according to emerging circumstances” (Campbell, 2016, p. 481).

The author met Campbell to gather some more information about his involvement in megaprojects. Campbell explained that when CMPS entered the project management business he was frustrated by the way in which tenders were prepared in Australia, with little room for innovation. So he started thinking about ways in which he could create an environment where he had more control of the process which, in turn, led him to bid for toll roads in New South Wales. He had some experience in building toll roads in Queensland, but they were financed by the government. He then joined hands with Alan Livingstone and decided to bid for the M4 project as the New South Wales Government was interested in organizations that could build, own and operate toll roads. Campbell and Livingstone decided to establish a company called State Wide Roads and assembled a team. CMPS had no funds to finance the project. They managed to secure a 100 percent loan from a prominent Australian bank with some sharing of equity. Campbell also decided that they would not appoint a main contractor but manage all the contractors as they had built a good team who were capable of doing so. From his perspective, having a small dedicated team was a key to manage such a project. He also felt that, as a private company, it was easier for them to negotiate small deals with the public affected by the project so that the project could progress smoothly. He quoted an incident when they had to place a crane in someone’s backyard for some time and, in exchange, built them a swimming pool that they would enjoy for a long time. The M4 was finished nine months early and one of the main reasons was that Campbell and Livingstone were “directly making decisions all the time.” The people who were affected by the construction were compensated quickly, minimizing any holdups. Campbell said that while there were overriding issues to take care of, if you did not deal with the small issues that arose daily they would soon become bigger issues. One of the other key strategies was that CMPS proposed a very simple contract for the project, which made it attractive to the government.

The lessons to be learnt from Campbell’s involvement in the M4 project were:

1. his courage to take on the risk of financing the project;
2. establishing a reliable and effective small team to manage the project;
(3) dealing effectively with affected stakeholders and making spot decisions to look after their interests; and

(4) paying attention to seemingly smaller issues and clearing them quickly.

Based on the success of the M4 project in Sydney, CMPS decided to work with Transfield to bid for the Melbourne CityLink project. CMPS also were given a good reference by the New South Wales Government to the Victorian Government. Even though the two projects were in Australia, there were local differences on how projects were implemented in Sydney and Melbourne. So CMPS was careful to select contractors from Melbourne for the project. Although the CityLink faced some issues due to the nature of the soil where excavations had to be done, the problems that arose were sorted out quickly and it was also a successful project. Campbell explained that until you work in a particular location and understand the environment, it is difficult to get the project going. But once the dynamics are established it is all systems go.

The main additional lesson learnt from the CityLink project was the care and attention paid to localization, or the context, and solving problems as they arose:

*The Roeblings*

Colonel Roebling may never walk across this bridge, as so many of his fellowmen have done today, but while this structure stands all who use it will be his debtors.

According to McCullough (2011), the Brooklyn Bridge was aimed at overcoming hurdles residents of Brooklyn faced in their daily commute to New York City across the East River for work. The bridge was conceived by John Roebling, who declared that “it will be the greatest engineering work of the continent and of the age” (McCullough, 2011, p. 17).

However, there were several concerns as to whether the bridge could be built at all. First, it was the largest suspension bridge conceived at that time. Second, it was also the first suspension bridge that was to use steel cables, which was a new metal in those days.

While Washington Roebling was the Chief Engineer who ultimately built the Brooklyn Bridge, John Roebling, his father, was the first Chief Engineer to be appointed to build the bridge. It was John’s dream to design and build a very long suspension bridge. But an accident took his life before the construction started, and Washington took over the project to realize his father’s dream. So, this paper will look at the contributions of both father and son for our data. To distinguish between them, John Roebling will be referred to as J. Roebling and Washington Roebling as W. Roebling.

When the bridge got its backing, J. Roebling was appointed as the Chief Engineer due to his reputation as a bridge builder. The committee that approved the bridge opined that “the construction of a suspension bridge of a magnitude unprecedented in the previous history of such works demanded the greatest experience and developed ability that could be obtained” (Steinman, 1950, p. 304).

J. Roebling and his son visited bridges in England, Germany and France to gain more knowledge about sinking foundations for the bridge. They also went to Krupp in Germany to study the new structural material (steel) that they planned to use. J. Roebling worked hard to complete the surveys, design and costs in three months to submit a report for approval. In his presentation of his proposal, he also sold the social benefits of building the bridge with an elevated promenade. He said that the elevated promenade “will allow people of leisure and old and young to stroll over the bridge on fine days. I need not state that in a crowded commercial city such a promenade will be of incalculable value” (Steinman, 1950, p. 309).

J. Roebling proposed a cost of US$7,000,000 with a future estimated capacity of 40,000,000 people using it annually, and explained how the bridge could pay for itself through railway passenger fares without any tolls for the vehicular traffic. He also appealed
to the stakeholders by stating that “As a great work of art, and a successful specimen of advanced engineering, this structure will forever testify to the energy, enterprise, and wealth of that community which shall secure its erection” (Steinman, 1950, p. 313).

However, J. Roebling’s plans met with public opposition and he had to find a way to win support for his proposal. To convince the public, J. Roebling decided to ask a select group of experts to review and confirm his plans and estimates. Seven eminent engineers were assigned to judge his work including one of the Roeblings’ competitors and some who were previously critical of his work. Many meetings ensued including a visit to see the bridge J. Roebling had built in Cincinnati. After two months of exhaustive study and discussion, J. Roebling’s plans were finally approved. All opposition had been quashed and final, detailed survey work started. At this stage, however, J. Roebling met with an accident while taking observations for the bridge alignment.

With J. Roebling’s death, everyone thought that the Brooklyn Bridge would not be built as he “was the vision, the conception, the knowledge of the whole and every part, the anticipation of every problem of execution” (Steinman, 1950, p. 322).

W. Roebling then stepped into continue the work. He had received his training from his father, had been educated as an engineer and had been in the army, and his courage had been tested in action. Beside his father’s engineering instincts, he had also inherited “his concentrated devotion and unconquerable tenacity of purpose” (Steinman, 1950, p. 324).

One of the early challenges W. Roebling faced was how to use pneumatic caissons (a large, watertight bell-like chamber, which is open at the bottom to keep the water out by air pressure on the top so that underwater construction work could be carried out) to lay the foundations at either end of the bridge. After much trial and error, one caisson was in place. But the work did not prove easy as the soil was hard to excavate and the tools used were ineffective. It was also difficult to work in the caisson. As one of the people who worked on the bridge said: “Everything [inside the caisson] wore an unreal, weird appearance. There was a confused sensation in the head, like the rush of many waters” (Steinman, 1950, p. 332). Frequent blowouts occurred causing tension, and there were some accidents as well.

W. Roebling decided to solve some of the issues by personal experimentation. He fired his revolver several times in a caisson followed by small blasts of powder to see if using small explosions would make the excavation easier. Finally, the technique of using powder to start small explosions was adopted. It was also difficult to work under the caisson in darkness. There were no electric lights. Candles proved expensive and emitted smoke. So W. Roebling redesigned the candles using a special chemical treatment to reduce the smoke.

As the work progressed, it was hard to find people willing to work in a compressed air atmosphere inside the caisson unless higher wages were paid. The men working in the caisson also started experiencing discomfort due to the large amount of free carbon that created respiratory problems. In addition, there was the danger of becoming paralyzed by staying for a long time in the compressed air, which came to be known as “caisson disease.” The paralysis occurred due to the nitrogen that was liberated in the blood and tissues during decompression. Several workers suffered cramping effects that were known as the “bends.” Deaths started occurring, creating a public furor.

One morning in 1872, W. Roebling himself succumbed to caisson disease and had to be carried out. He attempted to return to work but collapsed again. At the age of 35, he became paralyzed, tortured by pain, as well as slowly going blind and deaf. However, he continued to direct the work from his sick room. “From an upper bay window of his home on Columbia Heights he anxiously followed the work though field glasses, while he prayed for strength and struggled for time” (Steinman, 1950, p. 368).

W. Roebling’s wife Elizabeth then came to his aid, even though she had no technical knowledge of the work. She studied under her husband’s guidance, grasped his ideas and learnt to speak the language of the engineers. She made daily inspections of the work...
and carried out his instructions. “She became his co-worker and his principal assistant – his inspector, messenger, ambassador, and spokesman – his sole contact with the outside world” (Steinman, 1950, p. 369).

W. Roebling also faced other hardships besides poor health. There were allegations of corruption and misappropriation of funds in the project, which raised public suspicion, and he was asked to provide an account of his expenditure. Finally, due to the cost escalation and jealousy that a private company was handling so much public money, the government took direct responsibility for the project. However, W. Roebling and his staff were retained to complete the work.

The next major issue arose when the steel cables for the bridge had to be purchased. The cables had stringent specifications prepared by J. Roebling. To avoid any public criticism, a resolution was adopted that “bids from any company in which any Trustee, Officer or Engineer of the bridge has an interest will not be received or considered” (Steinman, 1950, p. 388). This resolution essentially disqualified W. Roebling’s family firm, run by his brothers, from bidding for the cable. This could jeopardize the project as the Roeblings’ family firm was the best equipped to supply the cable. Therefore, in the best interests of the bridge, W. Roebling sold off his stock in the firm.

Three months before the cable stringing was completed, some unsavory site practices came to W. Roebling’s attention. Tests carried out on the cable revealed that the high-quality wire required for the cable was being substituted with poor-quality wire. The damage had already been done as the poor-quality wired had already been worked into the cables. This put him on the spot. Installed wire could not be removed without hampering the work, so finally the contractor was instructed to add good wire as well in the cables to strengthen them.

In 1878, a severe storm hit the city causing damage to the waterfront, but the bridge survived. Public opinion was building up against the increased blowout of the cost to $13,500,000, and some felt that the bridge was an experimental design and that storms would easily damage it. It was suggested that the bridge should not be funded anymore and work was halted at the end of November 1878. However, work started again despite these rumors, and the chief engineer was asked to explain how the cables would be able to bear the weight of the bridge. W. Roebling defended the design.

Enemies of the bridge then started pointing out that W. Roebling was physically disabled and therefore unfit to continue with the work. A resolution was passed by the Mayor of Brooklyn appointing the first assistant engineer as the chief engineer. W. Roebling decided to fight against this injustice and his wife read out a statement to the American Society of Civil Engineers, and public confidence was restored.

On the day the bridge was opened, Roebling was not at the festivities while his contribution was finally being acknowledged publicly: “Colonel Roebling may never walk across this bridge, as so many of his fellowmen have done today, but while this structure stands all who use it will be his debtors” (Steinman, 1950, p. 415).

The lessons we can learn from the stories about the Roeblings are:

- ability to innovate to meet unanticipated requirements;
- courage and determination (despite life-threatening events) to carry out the task at hand;
- ability to effectively deal with political and public issues; and
- care and concerns given to workers working under incredible hardship and danger during the work.

*John Frank Stevens*

There are three diseases here: malaria, yellow fever, and cold feet – and the worst is cold feet.
While there were three project managers (chief engineers as they were called in those days) in the Panama Canal project, this paper will focus on the life story of John Stevens, who had a significant impact on some of the key decisions taken to complete the project.

Panama Canal in, Panama Canal out

In 1905, the Panama Canal was facing a crisis due to the resignation of its Chief Engineer John Wallace. At a meeting between William Taft, Secretary of War, Theodore Shonts, President of the Isthmian Canal Commission (ICC) and US President Theodore Roosevelt to discuss this issue, Taft, who knew of Stevens’ reputation, proposed that he could take on the job.

President Roosevelt who had assumed that everything was fine with the project until Wallace resigned, became more aware of the issues involved and appointed Shonts as Head of the ICC to sort them out. At that time, yellow fever was raging at the work site and Shonts declared that it was important to improve the conditions at site by stating that “Life on the Isthmus is to be made healthful, comfortable and enjoyable before the real work of digging the canal is begun” (Steinman, 1950, p. 89).

When appointed Chief Engineer, Stevens had undertaken a guarantee from Roosevelt that he had full authority over the project. “I was not to be hampered or handicapped by anybody high or low in my attempts to straighten matters out” (Steinman, 1950, p. 92). Roosevelt was also reported to have told Stevens to report to him directly. He felt that Panama was a real mess and told Stevens “I don’t know in the least what you are to do, but […] you get busy and battle like hell” (McCullough, 1977, p. 462). Stevens soon learnt that there were several constraints placed on the chief engineer due to the politics surrounding the project, even though Shonts told newsmen that Stevens had “well defined ideas of his own, and will be given an absolutely free hand” (Foust, 2013, p. 93).

When Stevens finally arrived at the site in July 1905 with Shonts, he met with Colonel William Gorgas, a US Army Physician, who was the Chief Sanitary Officer dealing with yellow fever and malaria that was affecting the workers building the project.

His first impression about the conditions at the site was disheartening: “Conditions could have been worse, but they were bad enough. No real start at any effective work on the canal proper had been made, no organization worthy [of] the name had been effected, and sanitary reforms were really just beginning, little new plant had been provided, and little that was absolutely needed had been ordered. And plant and material that had been under requisition for months [were] so delayed in delivery as to paralyze the efforts of those who, to the best of their ability and means, were trying hard to get results” (Foust, 2013, p. 99).

Stevens found that the French, who were previously involved in the project, had left behind equipment that was practically unusable. He also found that he seemed to have limited powers over sanitation, accounts and materials. His famous quote about the site was “There are three diseases here: malaria, yellow fever, and cold feet – and the worst is cold feet” (Foust, 2013, p. 101).

He decided that his first task was to make Panama a healthy and a congenial place to work in. Within a short period, Stevens placed “the whole weight and resources of the Engineering Department – men, material, and money” (Foust, 2013, p. 104) at Gorgas’ disposal, as he felt it was a priority to make the site healthy. Gorgas was thankful to Stevens’ trust in him: “You were the only one of the chief officials who believed in the sanitary work we were doing, and who was not taking active measures to oppose us and I mean this to apply to the whole ten years, before and after your time” (Foust, 2013, p. 104).

As Gorgas’ work progressed, Stevens set about gathering technical experts from various fields to start the construction work. He selected several people he knew from previous projects to ensure that a competent team was assembled. Stevens’ method of working with key personnel was “to assign each of them a well-defined but broad area of discretion and to
allow wide leeway in quotidian tasks, much as he sought for himself, but to expect quick and demonstrable progress in return” (Foust, 2013, p. 110).

The next problem was to recruit new workers. In 1906, there were US and Caribbean African-American people who worked on the site, but they were not getting on with each other. He preferred Chinese workers as he had used them in his previous projects. Roosevelt initially objected to Chinese labor, but finally agreed to Chinese, Northern Spaniards and Japanese workers although he preferred white labor.

Next, Stevens had to build Panama City so that it would be a comfortable place to work in. At the time Stevens arrived in Panama, it was described as “the dirtiest city extant with any pretensions of civilization. There was no system of drainage there at all, and no proper water supply” (Foust, 2013, p. 116).

But the biggest controversy that had to be resolved was to decide on the type of canal to be built – a sea-level canal with a tidal lock or a high-level crossing with major dams and multiple locks. An international board of consulting engineers was appointed to make the decision while. But Roosevelt was pushing for a sea-level crossing that would allow shipping to flow freely.

Stevens accompanied the engineers on two site visits in October 1905. He was recalled to Washington in December 1905 to examine both proposals. He kept away from the controversy due to his political understanding of the situation, but observed that “The work of getting the design of the canal was practically taken out of my hands” (Foust, 2013, p. 121). Finally, the engineers opted for a sea-level canal in November 1905, even though it cost more.

In the meantime, a Journalist named Poultney Bigelow started publishing news that the work in Panama was being carried out in “wasteful and costly fashion” (Foust, 2013, p. 124). Soon, the canal work became a political football and the Democrats joined in the fray.

Stevens was summoned to Washington again in January 1906, to testify in front of a Senate Committee, where he gave evidence on the differences between the two options: “a sea-level and tidal lock canal and the high-locks and lake alternative: the latter could be built in no more than eight years at the outside at an estimated cost of $147 million, and the former could be built in twelve to fifteen years at a cost of perhaps $250 million” (Foust, 2013, p. 132). It took several months to settle the issue, but Stevens managed to slowly erode support for the sea-level model. Stevens was forthright in stating his own preference: “my faith is pinned to a lock canal” (Foust, 2013, p. 132) and spelt out his arguments for his choice clearly.

In the end, Roosevelt finally gave his support for the high-lock canal in February. The canal issue dominated the political scene but Stevens was back at the site and refused to go back to Washington saying, “I have said all I can to the committee about the type [of canal] and protest against being called to leave work, as it will be of no benefit” (Foust, 2013, p. 134). He started 12-hour workdays to speed up the work. Finally, the government made a clear decision in June 1906, stopping any monies to be spent on the sea-level canal. Roosevelt also appointed Stevens as a member of the ICC, giving him access to decision making that was not given to his predecessor.

Once the political storm had passed, the next big issue was who would build the canal? Private contractors or the government? Stevens favored contracting, but insisted on “intelligent specification” (Foust, 2013, p. 141). He also agreed that government policing was important. There were issues during contracting, with complaints of preferential treatment directed at Shonts. The arguments continued and, finally, the government retained control of some of the crucial sectors they felt were too difficult for private companies to manage, and a risk-sharing approach was taken.

While Roosevelt admired Stevens, the relationship started deteriorating as he felt that Stevens was sensitive to close scrutiny and was not politically savvy. He wrote to
Taft: “Stevens is an admirable man. He can render himself worse than valueless in just one way, and that is by thinking himself indispensable, and therefore that he does not have to regard public opinion at home as represented in Congress, or public opinion on the Isthmus as represented in the Government of Panama. I guess it is a mighty good thing that you and I are going down to the Isthmus” (Foust, 2013, p. 146). There were also reports that Stevens and Shonts were at odds with each other.

As the bids for the Canal construction opened in January 1907, Shonts resigned to take up a lucrative offer. In the meantime, the ICC announced that there would be a new invitation for bids, which upset Stevens. He was soon to be appointed chair of ICC (the position held by Shonts) as well as the chief engineer and president of the railway, thus giving him sole command. However, Stevens tendered his resignation soon after, at the end of January 1907, stating that he could not “bear up under [the strain] for the next eight years” (Foust, 2013, p. 154), and expressed his wish to go back to the railway service that suited his “training and inclination” (Foust, 2013, p. 154).

Stevens was given a spectacular sendoff, and his successor, George Goethals, told reporters: “I have never seen so much affection displayed for any man. And if I can carry things on so as to build up a similar feeling when I get through, it will be the proudest work of my life” (Foust, 2013, p. 162).

The lessons we can learn from the life story of John Frank Steven are:

- caring for the welfare of the people at site;
- addressing the importance of health and safety;
- ability to skillfully navigate the political issues with the US Government and project sponsor;
- determination to stick with own decision (about the type of canal);
- belief that people will do their work (giving Gorgas the freedom to fight yellow fever and malaria); and
- firm belief that you need the right people with experience to complete a complex project.

Analysis and discussions

Contemporary projects

The following are some themes that emerged from the analysis of the narratives in the life story that deal with management and leadership issues.

Selecting the right people and giving them adequate training as well as challenging tasks and responsibility with authority was a key theme that can be observed from Sreedharan’s life story. In both the Konkan and Metro projects he took the time to get the right people on board. His reputation as a successful project manager also had benefits in people wanting to work on his projects. In the Delhi Metro, “There was relentless attempts early on to influence appointments […] Sreedharan stuck to his convictions and decisions, regardless of the consequences of not yielding to vested interests” (Ashokan, 2015, p. 184). In the Konkan project, he created zones of responsibility as “the intent was to empower employees to take decisions and avoid the culture of dependency on superiors in trivial matters” (Ashokan, 2015, p. 142). His belief was that the leadership of the team should be lean and should not micromanage. He ensured that the project’s different divisions communicated well and obtained a dedicated communications line to minimize disruptions, as this was at a time when the internet was not working very efficiently in India, and even telephone lines were unreliable.

Smoothen commercial aspects of the project by minimizing financial and legal issues. The use of novel methods to acquire land in Konkan and Metro using front-end processes to
secure the land and the legal processes that followed was a bold move. Such a strategy may not have worked in other countries but Sreedharan set up a PR machinery to build a positive image of the project to maintain public support. Although land was acquired speedily, people’s needs were always taken into account. Sreedharan had a very high social conscience. While he held firmly to the need to push through the project, believing in its social benefit, he was prepared to listen, and also built up this capacity in his teams. His motto was “executing project with least inconvenience to the public” (Sreedharan, 2008, p. 7). The strategy to trust contractors to prepare their invoices using their own measurements and pay them in advance to minimize cash flow problems was another important strategy. “We trust the contractor, we give him 80% of the bill within 24 hours. There is no cash flow problem to fight” (Sreedharan, 2008, p. 7). Finance officers were also made to feel part of the project so that they could assist in resolving financial hurdles.

Building trust was another important strategy which was seen in the way he treated contractors as partners rather than as ways to cut costs. Having meetings with them on a regular basis to resolve their issues was a proactive way of building and maintaining trust. Contractors were also selected carefully to avoid adverse effects.

Dealing effectively with power and politics was one of his major strategies, such that he was the first choice when the Delhi Metro was ready to go. He was himself in a powerful role as a CMD in Delhi Metro and on the Railway Board in Konkan, but he also knew how to influence others when he had to deal with power and politics affecting the project. In both the Konkan and Delhi Metro projects, he obtained a commitment to non-interference at the start with the projects’ main sponsors. At times, when it became clear that a different path had to be pursued to overcome obstacles, he was also unafraid to do that. As an example, his strategy to find a way to obtain permission for the Konkan project through the administrators rather than the government shows he knew how to play the political game when needed. His continuing connection with schoolmates who became powerful bureaucrats, networks he created with senior people in the railways and having the ear of central and state government ministers are all examples of his capacity to work with power and politics smoothly while keeping his eye on the main game: the project itself.

Being ready to innovate was another characteristic, which started at the Pampan Bridge with retrieving the girders from the sea to be able to complete the project on time, and finished with developing several innovations to overcome obstacles at both Konkan and Delhi Metro.

One of the questions that comes to mind when you read Sreedharan’s biography is the role he played in the projects. His projects had project managers, so he was not the day-to-day project manager. However, his influence on the management of the project was pervasive. He was certainly at the helm like a project director who looks after all strategic issues. But from time to time he also did not hesitate to get his hands dirty. He was technically competent to design innovations. He regularly visited the construction sites and tried to resolve problems in situ. Do other megaprojects have a similar role? Are such attributes essential for major infrastructure and construction projects that need a good balance of management/leadership skills as well as technical skills? This is worth further investigation.

The autobiography of Campbell did not provide similar insights about the management of the M4 and CityLink projects. Moreover, Campbell was on the contractor’s side of the project and did not have to face some of the scrutiny to which Sreedharan was exposed. On the other hand, Campbell bore more financial risk as his company would have become bankrupt if the project had failed. This has happened in other motorway projects in Sydney, such as the Cross City Tunnel and Lane Cove Tunnel. Sreedharan was not a project sponsor as the governments were the main sponsors of the Konkan and Delhi Metro projects.
But from Campbell’s autobiography and a subsequent clarifying interview, we can unearth some similarities between his approaches and Sreedharan’s.

**Ability to innovate.** Campbell was also innovative as he used concrete pumping in one of his earlier projects to save time, and found this was the first major use of concrete pumping in Australia (Campbell, 2016, p. 93).

**Realising the value of trust.** He also realized the value of trust and the importance of risk management when in one of the projects he was pricing he left out the loading required by his superior. Fortunately, they did not win the job. His boss forgave him for the error and then explained how the company had previously been burnt in two projects by not anticipating the risk. “That’s why we put the loadings on the big jobs” (Campbell, 2016, p. 112).

**Be at hand to resolve issues.** Campbell also realized the value of appraising issues first hand, by going to the site to get a feel for the issues, much like Sreedharan’s site visits, even though he got sunburnt. “I still needed to understand the scope of the operations. So I visited the remote camps around the site” (Campbell, 2016, p. 147). He also learnt that commercial issues can sometimes override technical issues when making decisions in projects. “We had used sophisticated computer modelling, which had finally been swamped by tariff rules and political pipe dreams” (p. 178).

**Courage and determination to take the risk to enter new business areas.** When CMPS decided to enter the road business by bidding for the M4 project, there were concerns that the project was too risky as they had never ventured into something like that before. Campbell had to stand firm to explain his position at a critical meeting with the chairman, after which he realized that “The meeting brought to a head undcurrents created by my new style of leadership and direction” (Campbell, 2016, p. 453). During this time, he also learnt how to deal with banks who wanted to lend money for the project. He learnt how to spread the risk in the project to satisfy the financiers. This helped CMPS to get a good deal with the Commonwealth Bank of Australia. CMPS also felt confident that the road could be built ahead of time at half the cost estimated by their competitor Main Roads, and even though the interest rate was high (17.5 percent), they predicted it would come down so they would be able to make a profit. While Campbell realized bidding to take equity in a road project was a turning point for CMPS, he felt that “most people in the company had no idea of the importance of the win. In a strange way it attacked the base on which the company was formed” (Campbell, 2016, p. 457). This shows how Campbell was able to take a bold step that paid off. “We opened the M4 motorway nine months early, to great acclaim […] A new chapter in privatized infrastructure was emerging” (Campbell, 2016, p. 463). But he was surprised that the media focused on the tolls people had to pay instead of the success story CMPS had created. “I was learning that politics is about perception and facts are incidental” (Campbell, 2016, p. 465).

Campbell’s role in megaprojects also crossed the line between business management and project management. In this way, his role was somewhat similar to Sreedharan’s in that he did not look after the daily running of the project, but was also different as he was a contractor and not the owner of the project.

If we compare Sreedharan’s and Campbell’s career paths, both started their journey as engineers but became megaproject managers following different paths. However, each, in his own way, exhibited leadership. As a public servant, Sreedharan learnt his ropes in ports and railways and came to manage megaprojects commercially in organizations in which the public sector still had a great deal of influence. In most projects, he was appointed as the project manager by the government. On the other hand, Campbell was in government service for a very short time but spent most of his life working in the private sector. He came to lead megaprojects as a business strategy to reinvigorate an excellent engineering firm
and lead it into a new business sector by assuming some risk. Both had to take personal risks to become leaders. Both learnt that projects were more than engineering jobs and megaproject managers had to develop their own understanding of risks – commercial, social and political. Both learnt from experience to be successful in their own endeavors. “At each turn in the evolution of my thinking, I was conscious of the learning process and the need to build on opportunities that presented themselves” (Campbell, 2016, p. 479).

However, there was one striking difference in their attitude. Sreedharan would allow for a lot of time at the start of the project to listen to everyone, but once the project started he would stick to the plan as much as possible. “His thoughtful views on development projects had always been that suggestions and opinion have value and their rightful place during the planning phase. Developed countries throughout the world follow such an approach. They would take a long time to plan such projects, especially in the case of infrastructure development projects such as alignment for railway lines. Opinions and suggestions from the public would be solicited at this time. When the final blueprint has been drawn and construction had begun, there would not be any more changes. The project would have to be carried out, whatever the obstacles” (Ashokan, 2015, p. 168).

Campbell preferred to allow for development during the project: “I had learnt from the Americans that EPCM [engineering procurement and construction management] allowed development to be progressing through stages without commitment to a final price” (Campbell, 2016, p. 477). He believed that fixing the design could kill innovation.

This difference in management styles shows that megaproject managers must adapt to milieu of the project and their own role in it.

While the context in which megaprojects were managed by the two managers might have created differences in style, there are some similarities in their approach. The interview with Campbell revealed the following strategies that led to success in the two megaprojects he was involved in, which echoed Sreedharan’s approach:

1. establishing a small, capable team to look after the project;
2. dealing effectively with issues, big or small, in a timely way;
3. as a contractor, to think like a businessman while bidding for turnkey projects, and learning about legal and commercial issues, to ensure that the project is financially viable; and
4. understanding the importance of local content in the project – using local companies for projects in Melbourne.

Landmark projects
Some of the common leadership themes that emerged from the stories of the Roeblings and Stevens are summarized as follows.

Courage and determination. A lot of courage was needed in those times to stand up for one’s convictions.

J. Roebling was convinced that he could build a suspension bridge longer than any that had been built before, which was “unprecedented in the previous history of such works” (Steinman, 1950, p. 304), in treacherous seas as “a specimen of advanced engineering” (Steinman, 1950, p. 313), using steel cables, which had also not been done before. W. Roebling continued to work in the caissons despite the risk of being exposed to “caisson disease” which, in the end, paralyzed him. He still would not give up but trained his wife to help him supervise the construction, with his “concentrated devotion and unconquerable tenacity of purpose” (Steinman, 1950, p. 324).
Stevens knew that getting rid of disease at the Panama Canal site was a priority, and gave his full support to Gorgas – “the whole weight and resources of the Engineering Department – men, material, and money” (Foust, 2013, p. 104) to deal with these issues, even though others were not convinced that Gorgas was up to the task.

Caring for people as well as society. Stevens was very concerned about the unhealthy state of the site and supported Gorgas fully to get the site ready, and reconstructed Panama City. Businessmen observed that when Stevens had completed the reconstruction, you doubted that “you will find a cleaner looking town of its size from Maine to Texas” (Foust, 2013, p. 116).

W. Roebling was always at the site when danger was present. Once, a fire was discovered in the caisson, and he immediately took charge of the situation and organized its containment. He remained in the caisson for several hours, finally collapsing from exhaustion. In another incident at the caisson, he was trapped in a terrifying situation when rapidly rising water created a panic among people and, once again, his presence of mind and quick thinking saved the day.

Adroit handling of political issues. Although politics and public opinion constantly affected the project, Roeblings and Stevens faced them bravely and answered all criticisms. All three megaproject managers overcame public or political opposition, and each had his own way of doing this. J. Roebling agreed to invite the scrutiny of experts, some of whom were his competitors, to gain public and political support for his proposal. W. Roebling sought the support of the American Society of Civil Engineers when he was dismissed from his position by the Mayor of Brooklyn. Stevens felt that a sea-level canal was not the right answer, but he had to bide his time as others, including Roosevelt, were in favor. He slowly eroded support for the sea-level model before expressing his own view.

Dedication to work. W. Roebling’s dedication was extreme. Even when paralyzed, he continued to do the work with his wife’s help.

Stevens was equally dedicated. He knew exactly what the priorities were and focused on them. First, it was clean up, next the labor, then settling the type of canal and getting suitable contractors. He extracted an undertaking from Roosevelt that “I was not to be hampered or handicapped by anybody high or low in my attempts to straighten matters out” (Foust, 2013, p. 89).

Lessons learnt
Table I summarizes the lessons learnt from the project management strategies used by leaders of the landmark megaprojects described in this paper.

Conclusions
The use of life stories has been a useful exercise to learn about the leadership attributes of megaproject managers, past and present. There are many similarities of strategies used although some of these may be context- and the time-specific. For example, labor issues were not a major concern in contemporary megaprojects, nor were issues related to race as in the Panama project. The recruitment of people had to be done more systematically in contemporary projects due to public scrutiny in India compared with the landmark projects. This was not an issue for Campbell as he owned the company that carried out the megaprojects.

The study of life stories has given some insights into how megaprojects are led in practice. The four life stories show that there are some commonalities, such as bold decision making, applying knowledge gained from experience, self-reliance, managing stakeholders, selecting appropriate people and giving them responsibility and authority, awareness of commercial, legal and social issues, and being able to innovate, which are the necessary
attributes needed to manage megaprojects successfully. However, megaprojects seem to need someone who can act as a leader, in addition to managers who run the daily project activities. This raises the question as to whether there is someone who is required to deal with institutional issues who also possesses a deep knowledge of the project. Recent literature seems to suggest this. According to Chi et al. (2014), “institutional management” should precede “technical management” in large infrastructure projects. Sankaran et al. (2017) suggest that institutional management should continue through the life cycle of the projects. This role is more than that of a project owner in publicly funded projects as opposed to organizational projects.

Life stories are useful but since they are already in the format in which they are written, they are more difficult to analyze than case studies where the researcher can ask specific questions. If the author had been able to get the narratives directly from the managers he could have used more sophisticated methods of analysis. The interview with Campbell was very useful to clarify specific issues that were not apparent from his autobiography. In the landmark projects archives have provided much data that may also need to be looked at in contemporary projects.
The author would like to encourage project management researchers collect more narratives from megaproject managers around the world to identify common lessons learnt that can help future megaproject managers.

References


Foist, C. (2013), John Frank Stevens: Civil engineer (Railroads Past and Present), Indiana University Press, Bloomington, IN.


Further reading


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The governance of major public infrastructure projects: the process of translation

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Abstract

Purpose – The purpose of this paper is to investigate the process of translation of an institutionalized governance framework as adapted to a major project in practice. Although infrastructure projects have been studied for decades, most studies have emphasized economic or contingency-based perspectives. Of those studies, some researchers have focused on governance frameworks for public infrastructure projects, and their impact for shaping the front-end phase of those projects. Yet, little is known about the way actors translate and enact those governance frameworks into practice. Understanding this translation process will lead to a better understanding of the overall performance of major infrastructure projects.

Design/methodology/approach – This qualitative research is based on a case study of one public infrastructure project in the health sector in Quebec, Canada. Through non-participant observation and interviews, the planning phase of the project is presented as it unfolds.

Findings – The process of translation is presented, from the ostensive, institutionalized governance framework, to appropriation into performative practices, which resulted in 12 specific practices: four “structuring” practices at the institutional level, five “normalizing” practices at the organizational level and three “facilitating” practices at the project level.

Originality/value – The main contribution of this paper is to enrich our understanding of the governance of major public infrastructure projects with process- and practice-based theories.

Keywords Infrastructure projects, Translation, Public projects, Governance framework, The practice perspective

Paper type Research paper

1. Introduction

Nowadays, major infrastructure projects constitute one of the most important sectors of development in the world. Between 2013 and 2030, the estimates for infrastructure spending (mainly delivered as large-scale projects) are about US$ 3.4 trillion per year (The McKinsey Global Institute, 2013, cited in Flyvbjerg, 2017, p. 85). At a global level, megaprojects (defined as projects of US$ 1 billion or more) are increasingly used for delivering a wide range of goods and services, and their scale tend to increase as well (Flyvbjerg, 2017). The governance of projects has been studied more extensively as a specific object of inquiry around the year 2000 onwards (Ahola et al., 2014). The governance of major infrastructure projects is a subject of importance in project management, as there have been several seminal studies revealing the mechanisms and complexities of such complex and costly undertakings (c.f. Ahola et al., 2014). Even if the subject has been studied for some time, still to this day the performance of those projects is unsatisfactory: the wrong projects are selected, the costs are underestimated and the benefits are overestimated (Flyvbjerg, 2017).

In order to strengthen their ability to manage and control major infrastructure projects, some governments (most notably the UK and Norway) have adopted a governance framework, defined as “an organized structure established as authoritative within the institution, comprising processes and rules established to ensure projects meet their purpose” (Klakegg et al., 2008, p. s30). The explicit objectives of these governance
frameworks are to habilitate decision makers to take better-informed decisions in the front-end phase (by having accurate definition of needs, options and cost estimations), and to define the process by which the project is to be managed, with the designation of imputable actors (Christensen, 2011; Williams et al., 2009). Yet, preliminary inquiries into the improvement in project performance by having such governance frameworks in place is somewhat inconclusive (Committee of Public Accounts, 2012; Samset and Volden, 2013). Whereas project governance has gained recognition as an important object of inquiry, what is actually done by the different actors having to manage those projects has been studied much less (Williams and Samset, 2010).

This research aims at understanding how a governance framework is translated into practice, and how the actors appropriate themselves to – and adapt – the institutionalized framework. This research gap is quite important to tackle, as the level of investments put into major projects is quite high, and the overall performance of these projects is still deficient (Flyvbjerg, 2011). Therefore, the research question addressed in this paper is:

RQ1. How does the translation process unfold from an institutionalized governance framework into practice for a public infrastructure project?

This paper presents partial results of a doctoral thesis inquiring about how a governance framework for public infrastructure projects is translated into practice. In the next section, the theoretical background of the process approach, translation and the practice perspective is exposed. Next, the methodological approach is presented, followed by the results. Then, the main results are discussed, and a conclusion opens up on contributions and avenues for carrying on with this research.

2. Theoretical background

Project management is an inter-disciplinary field of study which has expanded substantially in the past decades (Söderlund, 2011). By looking, specifically, at major public infrastructure projects, it is suggested that so far, most of the existent literature on infrastructure projects have mobilized either economic, contingency-based or institutional perspectives (e.g. Flyvbjerg, 2014a; Miller and Lessard, 2000). Yet, several other theoretical perspectives are increasingly being mobilized in project management, and could contribute to opening up theoretical perspectives of research concerning major infrastructure projects. We propose that mobilizing processual theoretical perspectives to study the governance of major public infrastructure projects might generate important insights and thus contribute significantly to the enrichment of our current knowledge. More specifically, the translation process from an institutionalized governance framework into practice is studied in order to generate new understandings. This section is divided into a literature review covering the process approach, translation and the practice perspective.

2.1 The process approach

Process data are gaining recognition and usage within organization theory (Hernes, 2014; Langley et al., 2013). Nicolini (2012) argues that in the last three decades, there has been a radical shift in the academic community, as the object of inquiry has shifted from organizations as entities, to organizations as theoretical discourses, to the study of organizing as a social process. Pettigrew (1997, p. 338) defines a process as “a sequence of individual and collective events, actions, and activities unfolding over time in context.” Langley and Tsoukas (2010, p. 2) also adopt this view, by highlighting the centrality of time, and posing questions about “temporally evolving phenomena.” The process approach is broad and inclusive of many sociological theoretical perspectives, as long as they adopt the underlying ontology of reality as processes (Rasche and Chia, 2010). Namely, the actor-network
theory (ANT) and the practice perspective are contained within the process approach (Hernes, 2010; Shotter, 2010; Hallgren and Söderholm, 2011). Translation as a concept is important in both theoretical perspectives, yet it differs to some degree.

2.2 Translation

According to ANT, translation is a constructed and on-going process, a movement into space and into time connecting actants, from one context to another (Michaud, 2011). Callon (1986, p. 19) defined translation as “the mechanism by which the social and natural worlds progressively take form.” Or, as Lindberg and Czarniawska (2006, p. 295) put it: “translation can be regarded as the mechanism whereby connecting is achieved.” Yet, another definition provided by Akrich et al. (2006, p. 243, our translation) is that “to translate is to describe, to organize a world populated by actants.” Callon (1986), studying the building of actor networks through scallop fisheries, has described this process of translation as “problematisation, interessement, enrollment and mobilization.” It is a construction until a stabilization is achieved.

Translation as used in the practice perspective is somewhat different in scale than in ANT. In this sense, it refers rather to a micro-translation, or micro-practice. For example, Rouleau (2005) has studied micro-practices of strategically making sense and giving sense among middle managers, and found four main micro-practices: translating the orientation, over-coding the strategy, disciplining the client, and justifying the change. Gherardi and Perrotta (2013, p. 255) rightfully note that: “practice-based theorizing has developed a vocabulary made up of verbs: learning, organizing, belonging, understanding, translating, and knowing.” Teulier and Rouleau (2013, p. 314) propose a hybridization of those theories, acknowledging that “translation studies have under-examined the way translation is done in practice.”

2.3 The practice perspective

Rouleau (2007, p. 219) situates the practice perspective in a new stream in organization theories, along with discursive theories. Far from being dominant in organization theories, those new approaches nevertheless contribute significantly to a renewed conception of the organization by exploring new avenues which include the analysis of interactions, conversations and interpretations (Rouleau, 2007). According to Nicolini (2012, pp. 1-2), “the notion of practice has become, in fact, increasingly popular among work and organizational scholars and, in recent years, we have witnessed a dramatic growth in analyses utilizing terms such as practice, praxis, interaction, activity, performativity, and performance.”

For Whittington (2006, p. 619), whose work in strategy-as-practice research has been quite influential, practices are “shared routines of behavior, including traditions, norms and procedures for thinking, acting and using “things,” this last in the broadest sense.” He contrasts this term with the Greek word praxis, which refers to “actual activity, what people do in practice” (Whittington, 2006). Johnson et al. (2007, p. 26) explain that practices can be understood as two distinct notions: as “what people engage with” and as “what people do.” On the one hand, they compare practices “as what people engage with” to Feldman and Pentland’s (2003, p. 101) concept of “ostensive routines,” which are “the ideal or schematic form of a routine […] the routine in principle.” On the other hand, Johnson et al. (2007, p. 27) relate practices “as what people do” both to Whittington (2006)’s concept of praxis and to Feldman and Pentland’s (2003, p. 101) concept of “performative routines,” which are “specific actions, by specific people, in specific places and times. It is the routine in practice.” Feldman and Orlikowski (2011, p. 1245) specify that the ostensive and performative aspects are not oppositional but mutually constitutive. Building on the theory of routines as practices (Feldman and Orlikowski, 2011), we use in this paper the terms
“ostensive practice” and “performative practice” to distinguish between practices as “what people engage with” and as “what people do” (Johnson et al., 2007).

One of the most prominent streams of practice-based studies conducted in the general field of management being “strategy-as-practice” (Vaara and Whittington, 2012), it is of interest to consider the many contributions of these research for further development of the recent practice turn in project management, namely “project-as-practice” (Blomquist et al., 2010; Hallgren and Söderholm, 2011). Strategy-as-practice has developed as an alternative view of the general trend of strategy in organization studies, which has come to view strategy as inherent of an organization, without consideration about how it is applied and developed by actors once the strategic plan is adopted at the corporate level (Johnson et al., 2007). Thus, strategy-as-practice re-institutes the significance of what managers are actually doing[1]. Accordingly, it requires a more micro-level of understanding, and the need to consider multiple theoretical lenses to make sense of those complex phenomena (Johnson et al., 2007). Johnson et al. (2007) identify four main theoretical resources for strategy-as-practice research: situated learning, sensemaking and organizational routines, institutionalist perspectives, and the ANT.

Along with the lines of ANT, Gherardi (2012, p. 77) emphasizes that practices are sociomaterial and temporal, with agency being distributed between humans and non-humans, and asserts that theories of practice “locate the source of significant patterns in how conduct is enacted, performed or produced.” Referring explicitly to ANT and the work of Latour, Gherardi (2012, p. 87) states that “we can examine how the translation process creates the link between human and non-human actors, and the connections among past, present and future.”

This research adopts those processual views. More specifically, this research relates to one of the perspective of practice-based studies, rooted within the sociology of work, as “exploration of the gap between what organizational rules prescribe and what people actually do in their situated working practices” (Gherardi 2012, p. 132). Despite its social and academic importance, the translation of a governance framework for major public infrastructure projects is a subject on which there has been relatively little research (Williams et al., 2010). Having reviewed the process approach, the concept of translation and the practice perspective, we now turn to the methodological approach adopted for addressing this question.

3. Methodological approach
As relatively little research has been done in this regard, the overall goal of the research is heuristic: it aims at identifying variables, assumptions and causal mechanisms involved (George and Bennett, 2005). This exploratory study is qualitative, as part of the interpretativist and constructivist paradigm (Corbin and Strauss, 1990; Guba and Lincoln, 2005). The inductive approach and grounded theory are privileged to collect field elements that enable a better understanding of phenomena, which can be used to develop theories in a subsequent phase (Corbin and Strauss, 2008).

The research strategy adopted for this paper is a case study of a public project managed by the Quebec government (Yin, 2009). The context is the socio-political context of Quebec (Canada), and the project selected is a major infrastructure project having to comply with the Quebec governance framework (QGF) for public infrastructure projects (Secrétariat du Conseil du trésor, 2014). The project under study is about the construction of a new wing for an existing hospital in Quebec, Canada. At the time of the fieldwork, the project was in the planning phase. The total estimated costs are about $155 million (CAD), and the scope encompasses an extension of the hospital that will provide new and improved services of four areas of medical specialization. To keep project’s anonymity, a fictive name was given to it: project Multi-Poles (project MP). For this project, seven interviews have been carried with various team members, and eight meetings were observed for a total of 29 hours.
The strategy for data collection included a preliminary phase (a pilot) in 2014 to test the initial analysis of public data. Field research has been conducted from September 2015 to June 2016, and included retrospective data along with real-time observations. Data collection is based on a set of approaches whose main components are non-participant observation in project meetings and semi-structured interviews. Interviews have been carried out with different project actors, until saturation (Yin, 2009). Additionally, 15 interviews were conducted more specifically on the QGF, regarding its objectives, and its perceived performance to improve overall projects success. An analysis of documentation completes the data collection. Table I presents a summary of collected data.

Data collected in interviews were transcribed and coded using the qualitative data analysis software NVivo. For observed meetings, detailed notes were taken and coded in the same software. The main analysis strategy consisted of using grounded theory, starting with a flexible frame and revising it according to insights generated by data collected (O’Reilly et al., 2012). Starting from the conceptual framework of the doctoral thesis, we initially coded the interviews, and revised the coding as well as the framework in an iterative cycle (Charmaz, 2006). From a focus coding on main themes addresses (called first order concepts in Gioia et al., 2013), we move to an axial coding (second order themes in Gioia et al., 2013; O’Reilly et al., 2012). The translation process is studied according to different actors and actants: organizations involved (public and private), project teams, individuals (politicians, civil servants and private experts), and artifacts (non-humans). Other analysis procedures include temporal bracketing, and a systematic analysis of various governmental documents. The data analysis strategies chosen (grounded theory, temporal bracketing and systematic analysis) are high in accuracy and somewhat limited in simplicity and generality, even though the transferability could be important (Langley, 1999). This approach to theory development using discovery, flexibility and reflexivity has been encouraged by several influential researchers (Alvesson and Kärreman, 2007; Klag and Langley, 2013; Locke, 2011). Having explained the methodological approach to this study, results are presented in the next section.

### 4. Results

This section presents results from the study of project MP. To start with, the QGF for public infrastructure projects – the institutionalized, ostensive practice – is briefly presented. Then, the initiating and planning phases of project MP are developed and illustrated with a timeline. Next, 12 practices that have been observed during the fieldwork are presented. And finally, it is exposed that the process of translation of the governance framework is multilevel, occurring at institutional, organizational and project levels.

<table>
<thead>
<tr>
<th>Number of interviews</th>
<th>Number of meetings observed/number of hours</th>
<th>People interviewed</th>
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<tbody>
<tr>
<td>Quebec governance framework</td>
<td>15</td>
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<tr>
<td>Project MP</td>
<td>7</td>
<td>8/29 hrs</td>
</tr>
</tbody>
</table>

Table I. Data collected

Data collected Total 22 8/29 hrs
4.1 The QGF for public infrastructure projects

The QGF, adopted in 2008, had as a main objective to frame rigorously infrastructure projects, especially in the front-end and in the planning phases, in order to prevent overspending, delays, and to manage responsibly public funds (Secrétariat du Conseil du trésor, 2008). This governance framework was revised in 2010, and again in 2014, to reflect organizational changes and learning made by actors through its enactment into projects. All major infrastructure projects, defined as over $50 million (CAD) and under provincial jurisdiction, have to comply with this governance framework[2]. The current version of the QGF is a legal document of 13 pages, adopted in February 2014, and entitled “Directive sur la gestion des projets majeurs d’infrastructure publique” (Secrétariat du Conseil du trésor, 2014).

Basically, the QGF presents the project life cycle, main deliverables required at each phase and actors involved. Once the deliverable is completed during a specific project phase, it has to go through a gate: a decision-making point. If the project is accepted and goes through this gate, then the next deliverable has to be developed and approved before going through the next gate. This process, widely known in project management as the stage-gate model, is used to manage projects, especially in the front-end and planning phases, as it allows decision makers to pull out of a project at any of those gates without any major financial commitment (Project Management Institute, 2013). The QGF presents a project life cycle of five phases, of which the first three ones are of crucial importance: the front-end, the initiating phase, the planning phase, the executing and the closing phase. For the first three phases, important deliverables have to be presented to decision makers (the Council of Ministers) before going through the gate and being officially approved in order to start the next project phase. Table II below summarizes main deliverables to be produced and approved for the first three phases, along with an overview of the content[3].

The main actors involved in the QGF are politicians and civil servants. Political actors are involved at two times. First, the Minister sponsoring a project has to approve all main deliverables before they are presented at the Council of Ministers: the project information sheet, the opportunity case (Dossier d’opportunité – DO) and the business case (Dossier d’affaires – DA). Second, the Council of Ministers approves those deliverables, before the project has authorization to start the execution phase and is provisioned. Public administration actors from several organizations are involved. A unit within Secrétariat du Conseil du trésor (SCT, Quebec Treasury Board Secretariat), “Direction générale de la gouvernance des projets d’infrastructure,” is responsible for the governance framework, for its evolution and implementation. This unit also reviews internally projects’ documentation, validates information and emits formal recommendations for the Council of Ministers before final approval[4]. The governmental project manager is Société québécoise des infrastructures (SQI)[5]. This organization was created in November 2013, and was the result of the merging of two previous organizations: Infrastructure Québec and Société immobilière du Québec. SQI is responsible for the production of projects’ documentation, yet, a separate internal unit is also in charge of validating projects documents for quality assurance (QA). Clients of a project are, most of the time, two-fold: the Ministry sponsoring the project (the paying client or the sponsor) and the local operator (the user).

4.2 Project MP’s development: from the initial request to the end of the planning phase

A timeline of project MP is presented in Figure 1 below, positioning its development as well as specific practices as they took place. Unfolding the project process accordingly is a possible strategy for making sense of data collected (Langley, 1999). A narrative strategy complements this temporal bracketing in order to develop thick description of project episodes and practices. However, due to word constraints, the narrative elements are synthesized in this paper.
Table II. QGF project phases, deliverables and overview of content

Source: Secrétariat du Conseil du trésor (2014, pp. 8-11)

Figure 1. Timeline of project MP
According to the hospital representative interviewed, initial discussions about the need to expand specific medical services into a new constructed extension to the hospital were initiated around 2007. Originally, the project scope was much smaller, and it was included in the hospital Property Development Plan. Years of negotiation with the Ministry of Health assessing functional needs led to a substantial expansion of the scope, resulting in a formal political command in 2013. The Council of Ministers then requested that the functional and technical program be revised and that an initial business case (DAI, Dossier d’Affaires Initial) be produced. At the time, the framework in place requested a DAI in order to analyze needs and possible options for a specific project[6]. The DAI was submitted to Secrétariat du Conseil du trésor (SCT) in March 2014. Yet, SCT analysts asked that an additional technical feasibility study be done and included into the analysis, regarding risks associated with earthquake resistance. This technical study was conducted over the summer of 2014, as the project team revised the initial DAI to convert it into an opportunity case (DO, Dossier d’opportunité) in order to comply with the newly adopted governance framework. However, the impact was not substantial, as the two documents requested similar information. The DO was approved at the Council of Ministers in October 2014. Yet, the official ministerial letter authorizing the start of the planning phase came in December 2014.

Throughout the planning phase, from December 2014 to June 2016, a number of practices have been observed and positioned on the timeline. They are documented in the next section (see Table III). A significant episode in the project was the departure of the SQI project manager from the organization, in May 2016. Another SQI project manager was assigned about two weeks before that, in order to facilitate the transition. Impacts were limited for the planning phase, as the business case that had been finalized at this stage, was undergoing QA. In June 2016, the DA was submitted to the Council of Ministers for approval, in order to undertake the executing phase of the project.

4.3 The process of translation of the governance framework: illustration through practices

For project MP, 12 different practices have been identified and are presented in Table III. These are: P1-granting/managing professional contracts, P2-implementing a project management office, P3-detailing the chosen option, P4-participating in project steering committee, P5-participating in project coordination meetings, P6-conciliating between main stakeholders, P7-performing an integrated design process, P8-performing value analysis, P9-performing risks analysis, P10-elaborating the business case (DA), P11-elaborating and actualizing the project management plan (PMP), P12-performing QA. The practices have been observed during the fieldwork and/or reported by actors during interviews. As those practices are positioned on the timeline (Figure 1), some were punctual, and others on going. For each practice, Table III presents the practice as prescribed by the QGF or other organizational rules; the appropriation of the practice by project members (illustrated by excerpts from interviews), and; the performative practice, as observed (situated action).

From analyzing practices and government documentation, we observed an emerging multilevel process of translation, which is explained next.

4.4 The multilevel nature of the translation process: institutional, organizational and project levels

Taking the 12 practices presented in Table III, we analyzed them according to their origin, to the institutional actor who requested them. Figure 2 presents the process of translation as it occurred through time for project MP, separating practices by their origin of requirement, whether from the institutional, the organizational or the project levels.

The QGF specifically requested four practices adopted for project MP, at the institutional, government-wide SCT level. Those are: P3-detailing the chosen option,
<table>
<thead>
<tr>
<th>Practice</th>
<th>Organizational rules – as prescribed</th>
<th>Required by</th>
<th>Translation (appropriation)</th>
<th>Performative practice (adaptation)</th>
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<td>P1-granting/</td>
<td>A service agreement is established at the beginning of the project between SQI and the client ministry</td>
<td>SQI</td>
<td>No contract is awarded prior to authorizations: &quot;On the other hand, it is certain that before the authorization is granted, it is not possible to issue tenders, it is not possible to go to no matter what part of execution, it is not possible to disburse in the end nothing, it is just the internal staff, it goes as 'go as I push you,' as it can be realized.&quot; Impression that there is little room for financial maneuvers, that program changes are difficult to fund: &quot;Because there, they recognized that there were program changes, undeniably. But any changes to the program should be the subject of additional funding from the ministry. […] I understand that the minister, the deputy who is going to say: I am pleased to announce an investment of 50 million […] he does not want to learn that the first 50 million is now to be 100 million, he does not want to do that […] But at the same time, one must also be realistic; a cat is a cat, when you make a preliminary design, well, there is an artistic vagueness, we cannot control everything, we will work for 2 or 3 years to reveal the prototype finely. You cannot imagine, even if you are competent, that you have measured everything, that you have conciliated everything, that you have coordinated everything, there is a small problem&quot; Concluded contracts are awarded at the beginning of the planning phase, once the ministerial letter of authorization has been received. A separate authorisation is required from the client ministry of the project in the case of change orders and program changes. For this project, professional contracts were awarded early in 2015. Discussions on change orders and program changes took place during risk analysis, coordination meetings and at the project steering committee.</td>
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<td>managing professional contracts</td>
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<td>P2-implementing a project management office (PMO)</td>
<td>No organizational rules</td>
<td>Project</td>
<td>Need for major project to make full-time implementation worthwhile: &quot;I would say frankly that's fine, but it's not as effective as I would have liked. Because the project is not big enough. You have to agree, a project office in reality is really interesting when everyone is around the table, but for that you have to have a large volume.&quot;, &quot;If we create this, the size of the project has to generate a sufficient fee so that someone like me can devote themselves to this project&quot; Adaptation according to available resources: &quot;Usually we are here, I try to be here 2 to 3 days/week, but it's also</td>
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<td>for setting up a project</td>
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<td>To facilitate the coordination of professionals and the consultation of medical groups, the project team decided to centralize the work at a PMO located on the hospital site for which offices have been rented since the beginning of 2015. During the planning phase about 30-50 people work there. The meeting room offers a place for meetings, a videoconference is available</td>
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<td>P3-detailing the chosen option</td>
<td>The SCT directive requires that the business case presents, in detail, the best option. Similarly, the SQI macro-process consists of four iterative procedures under “Detailing the selected option”: P6. Conduct / finalize required studies; P7. Manage risks; P8. Formalize the functional and technical content of</td>
<td>Organizational adaptation of the level of detail of plans and specifications at SQI: “In fact there is nothing, in the directive itself there is nothing that is required. They do not require a compulsory advancement level to return; […] So between the DO and the DA, and it becomes like a kind of prerogative of the SQI if you want. It’s up to us to decide, because from the moment your DA crystallizes your budget of the project, you have to be at a fairly advanced level of comfort to close the envelopes. And what I see, and there is a lot of debate here internally, what I usually see on the majority of projects that I have is that usually we go to the end of the preliminaries to return for the DA.”, “The SQI had set itself the objective of always evaluating projects on at least 100% preliminary plans and specifications, to have</td>
<td>This practice is at the heart of the planning phase and is the main input to the development of the business case. While formal documentation (SCT and SQI) focuses on project management parameters, project team members focus on project content (concept, preliminary drawings and specifications (PDS)). Architects lead the team to detail the chosen option (project content) and coordinate the different disciplines. The SQI project manager ensures that the overall process is respected, while project members of the SQI internal expertise support and question professionals. At the end of each stage (concept, preliminary plans and specifications 66%,</td>
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<td>the project; P9. Formalize project schedule and cost</td>
<td>such a precision that, when attesting the case, one is able to be certain that the project will go well and that we will not be had at the budget level, because we know that after that going back is impossible. Adjustment of the level of detail of plans and specifications according to project needs: “We managed to convince the management that in this case, given the precision that we were going to achieve, and we would emphasize preceding phases, the concept, preliminary plans and specifications, to evaluate the project at 66% and to be hanged with that figure. We will know in a few weeks if it worked, as the DA has been submitted […] Now that the project is in the loop we cannot really back down, and in a few weeks when we get the 100% we’re going to be able to confirm whether we were right or not. There will be small fluctuations, but I do not think it’s catastrophic to the point where we’re lost, so it’s a project that should normally go through, except that it should not be the rule, in that case we wanted to take advantage of sequences, of windows”</td>
<td>preliminary plans and specifications 100%), a report is made by SQI resources, to which professionals must respond, in order to obtain approval to start the next step For this project, the concept stage was finalized in November 2015, while the PDS at 66% were finalized before the DA was submitted in early 2016</td>
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<td>P4- participating in project steering committee</td>
<td>The members of the project steering committee are defined in the service agreement between the client and SQI. This practice contributes to SQI procedures P5- participate in decision-making and P10- accountability</td>
<td>Help decision-making: “The projects steering committees come up in projects post-mortems as a strong element in order to facilitate decision-making and aligning project actors. People felicitate us for having such structures in place” Role of the project manager to be the vector between the decision makers (senior officials) and the project team: “When I see the project manager who plays a decisive role in the discussion at a steering committee, I think it is up to him to be the vector which makes the connection between the field, what happens, and major stakes”</td>
<td>The meetings are about every three months, plus others if necessary. The composition of the committee may vary according to the needs but is generally: the SQI project manager and his/her superiors, project managers (ministry and the organization initiator of the project) and their superiors. A project progress report is usually submitted prior to the meeting. A videoconference is used because some participants are in different cities and locations The purpose of these meetings is to help decision-making. This practice is important for governing the project, guiding and deciding on issues. Much of the conciliation between the parties takes place during</td>
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Table III.
Meetings of a technical and strategic nature: “For me the raison d'être of this meeting is the opportunity to have once every two weeks the organization, the SQI and all the professionals around a table. This morning we talked about several technical points, it is true, we are at the beginning of a phase and there is a transition of project managers, but it is nevertheless a meeting where we speak of important issues” The content of the meetings is adapted to the needs of the project and the team: “There are other things that come together, it is certain that in the last few weeks, we have skipped a few because precisely when the bulk of the concept was frozen or crystallized, everybody had something else to deal with, there were meetings that were used for other things, to make adjustments, presentations, to ensure that everybody could ask questions, we had a little different interaction. Rather than coordinating the project, we allowed ourselves more, for example our Quebec team, to question what had been done, how, to make a kind of wrap-up of all this, and to make sure that everyone has the same understanding, it is often that which fails”

This practice is essential in order to manage the project. Conciliation requires a lot of time and energy from the project manager, the project team and the steering committee. There is a lot of interpretation from all sides, a lot of additional information comes up during project planning, decisions are delayed or re-evaluated. Conciliating is a practice that is done on an ongoing basis.
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<th>Practice</th>
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<th>Performative practice (adaptation)</th>
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<td>P7-performing an Integrated Design Process (IDP)</td>
<td>New formal SQI procedure from 2015, to be carried out for all new projects</td>
<td>SQI</td>
<td>Workshop at the beginning of the planning phase: “In 2015, when we started working, [...] we had IDP sessions with people from the University of Quebec, with the aim of doing some analysis, and with carts, to sort out the various issues, the issues we had. So we had this exercise this summer, in 2015, in IDP, to work and analyze all this. [...] All professionals, all disciplines, SQI people, clinical people, we had clinical [and technical] representatives, I was there. There were several exercises, I could show you, we had a charter with the different carts” Could have been done more upstream: “It was constructive, but ideally this exercise could have been done much more upstream, as for me, we should have done this at the very beginning, when we prepare our PFT. In fact, when we did our PFT, we probably did the same type of exercise but without supervision, and it could have been improved. We may have done it late in the process but it's a good thing too”</td>
<td>This practice aims to foster active collaboration between all project stakeholders in order to optimize the quality of infrastructure requirements, concepts, plans and specifications. Applies both in the initial phase and in the planning phase. This integrated design process aims to optimize the collaboration and coordination of different expertise, to foster the development of a global vision of the project and information sharing For this project, an IDP workshop was held during the planning phase in June 2015, led by an external resource to the project</td>
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<td>P8-performing value analysis</td>
<td>Value analysis was mandatory during the planning phase with the previous version of the governance framework</td>
<td>SQI</td>
<td>Allows optimizing the chosen solution: “To question ourselves on our solutions, to say we have taken the right solution, what are the other options for solution that one could make, which one is better or best. [...] Value analysis is quite important, this also we did with someone who</td>
<td>Value analysis for this project was conducted in November 2015 for two consecutive days, with a realignment of the strategy and objectives at the end of the first day. The workshop was facilitated by an external consultant and brought together all</td>
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<th>Translation (appropriation)</th>
<th>Performative practice (adaptation)</th>
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<td>However, since 2014, SCT does not formally require it, but it encourages the adoption of this practice. SQI requests that it be made for all projects over $ 5 million and has developed an internal process: IT-GP-0.30.025_AnalysisValeur</td>
<td>Reconcile stakeholder expectations through a rational analysis: [Stakeholders] found it difficult to question certain elements, for example, new standards</td>
<td>Various conceptual solutions were analyzed in order to optimize the project and its costs</td>
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<td>P9-performing risks analysis</td>
<td>formal analysis is requested by SCT Directive and SQI macro-processes “Risk Analysis” and “Risk Management.” Formal procedure and standardized SQI models</td>
<td>Integration of value analysis with plans, estimates and business case: “We integrated results of the value analysis, it was also appended, I think they have succeeded to optimize the project for about 4 million dollars, I think they have applied measures for about 2 million”</td>
<td>Following the workshop, a report was delivered by the external consultant, which served as the basis for negotiating specific components of the project. The results of this workshop were incorporated into the business case, resulting in cost reductions</td>
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<td>P10-elaborating the Business Case (BC)</td>
<td>Formally requested in SCT Directive for the planning phase. Required in the SQI macro-process in the planning phase P.11-Complete the business case. Formal</td>
<td>Impression that risk analyzes must be very detailed: “There is a generalized fear, it will not be said, but we will look at a cost”</td>
<td>During implementation of the DO, a qualitative analysis is carried out with the project team (SQI and clients) and animated by internal resources specialized in risks. This analysis is revised and quantified during the development of the DA, with the same actors and mandated professionals</td>
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| Structure of the BC according to the directive: “We have taken up the canvas that is associated with the directive, if you look at the table of contents it exactly follows the table of contents that is suggested in the directive. We started from the data we had in the DO […] and missing information was produced. In the BC, we add the project management plan, it is basically that” | Collaborative practice: “Essentially we shared a little bit the | Results of the analysis are used to calculate risk reserves and are recorded in the project budget. They reflect the level of detail of the chosen option. The main risk categories studied: strategic risks, design and construction risks (change in scope), social risks, site and environmental risks, financial and legal risks. For this project, the risk analysis was held in a one-day workshop in November 2015 |

| during implementation of the DO, a qualitative analysis is carried out with the project team (SQI and clients) and animated by internal resources specialized in risks. This analysis is revised and quantified during the development of the DA, with the same actors and mandated professionals. Results of the analysis are used to calculate risk reserves and are recorded in the project budget. They reflect the level of detail of the chosen option. The main risk categories studied: strategic risks, design and construction risks (change in scope), social risks, site and environmental risks, financial and legal risks. For this project, the risk analysis was held in a one-day workshop in November 2015. All practices carried out during the planning phase lead to the development of the business case, which will be reviewed for quality and submitted for approval by the Council of Ministers. As much as possible, the business case is drafted internally at SQI by a dedicated resource (a strategic advisor), which is guided by the project manager. For this project, the drafting of the BC in the first | members of the team, including professionals. Various conceptual solutions were analyzed in order to optimize the project and its costs. Following the workshop, a report was delivered by the external consultant, which served as the basis for negotiating specific components of the project. The results of this workshop were incorporated into the business case, resulting in cost reductions. |

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Practice Organizational rules – as required by Translation (appropriation) Performative practice (adaptation)

P11 - elaborating and actualizing the project management plan (PMP) and standardized SQI model

The PMP is formally requested in SCT Directive for the planning phase. Required in the SQI macro-process in the initial phase D5. Develop and implement the PMP; and the planning phase P4. Update the PMP and continue its implementation. A model is formal and standardized at SQI

Task. [...] Most of the parts were ordered to different entities, different chapters, regardless of who was responsible. We made a revision so that the document is more fluid, so that there is a pen that is held from one end to the other, because it is a long one. In this specific case, because we had a resource shortage, because it is extremely cumbersome, [an external firm] has been mandated. He had knowledge, it was more technical, he does not really have a say on the content, we guide him, and they try to assemble this to make it happen. And to follow up on the issues as well"

Quarter of 2016 was mandated externally, as internal resources were limited at that time, mobilized on other projects. The external consultant who wrote the BC had prior knowledge of the project, since he had also been mandated to draft the DO

P12 - performing quality assurance (QA)

SCT Directive requires SQI that the business case be certified by SQI, OP/IP and the client Minister before being submitted to SCT for advice and to the

The different roles of the DO / DA editors: "It is a different, more detached, more independent vision, which makes it possible, it is difficult. So people perceive themselves as the government watchdogs. If you start on this foot of war you will not go far, everyone, nobody gives you information and nobody talk to you, and there it is hell. One has to

Uncertainty about the usefulness of this plan: "Honestly I do not know how much it is really used or if it is just that the directive says you have to do a PMP"

This practice aims to assist the project manager in structuring and managing the project. According to SQI procedures, the PMP should be done at the beginning of the initial phase and approved by the project steering committee. For this project, the PMP was developed at the end of the planning phase as a requirement for the business case (to which it is appended) and not as a tool for structuring the project

This practice is a new role for SQI since 2014, as before it was done by external reviewers. This practice is still being developed. It has an impact on internal capacity because some resources who wrote DO and DA were reassigned to quality assurance. However, organizational expertise increases as
<table>
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<th>Practice</th>
<th>Organizational rules – as prescribed by</th>
<th>Translation (appropriation)</th>
<th>Performative practice (adaptation)</th>
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<td>Council of Ministers for approval</td>
<td>follow up and helps the project team, often as it happened to me in a project: I saw it skid, and there I said to me it has no pace, it slips, it slips, I imposed a mitigation plan to what was happening, and they were able to put it back on the road. Sometimes you have to do something that prevents you from going into the wall”</td>
<td>Advantage of upstream dialog: “But what we tell them, the message [of the SCT], is to say that you gain if you call us quickly, an upstream meeting, it is all the spirit of the exercise, of the directive, so that if there are problems, we can be able to flatten them, to settle them before the final versions. Otherwise, it obliges us to do analyzes, without being always negative, but putting down big drawbacks, and sometimes the minister is obliged to be summoned”; “SCT told us, because we had, I had two meetings […] They told us we had a very nice file, very well documented. This is good. And when we had their comments, we had 38 questions. […] Then, when we submit the file, all is attached, and that's why it's easier, I am less afraid for the next steps to go to approval at the Treasury Board than to have something where it has been submitted and we do not know what's going on with it, whether it's going to be good or not”</td>
<td>learning takes place</td>
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<td>SQI requires a quality assurance process once the business case is completed and before attestation, as described in the macro-process: P12. Confirm the quality review</td>
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<td>The objective is to involve quality assessors at the beginning of the process, before the DO or DA is completed. One-on-one meetings to present the project for preliminary validation are held, both internally at SQI and with SCT and clients. A roadmap has recently been developed to plan and monitor specific actions required for each project. For this project, the person in charge of the project at SQI had a good knowledge of the file as she was previously involved in the development of the DO. The DA quality assurance was carried out between April and May 2016, in order to obtain the necessary attestations. Two presentations were also made to SCT for initial validation.</td>
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P9-performing risks analysis, P10-elaborating the business case (BC), P11-elaborating and actualizing the PMP. Moreover, a unit in charge of internal procedures and rules at SQI translated the overall QGF, and that resulted in formal SQI documentation complementing the governance framework: a macro-process, specific procedures, templates and tools to be used by project team members. Thus, five practices required by SQI were performed by the project team. These are: P1-granting professional contracts, P4-participating in project steering committee, P7-performing an integrated design process, P8-performing value analysis, P12-performing QA. This is a translation from the institutional level to the organization level at SQI, which the project team had to perform in addition to the translation of the QGF in order to produce the expected deliverables. Additionally, the project team performed three practices which emerged out of the project’s needs rather than out of ostensive practices. These are: P2-implementing a project management office, P5-participating in project coordination meetings, P6-conciliating between main stakeholders. In Figure 2, all practices are positioned on a timeline, allowing seeing a temporal dynamic of those practices. For the project and the organizational level, practices tend to occur early in the planning phase and keep on throughout the phase, whereas institutional practices are more scattered throughout the phase and last until the end.

This section presented the QGF for public infrastructure projects, and the way it has been translated for project MP, through the process illustrated by the timeline and through the identification of 12 practices. Additionally, a multilevel process of translation, at institutional, organizational and at the project levels, has been introduced. The next section discusses those results in line with the relevant literature.

5. Discussion
This section touches upon two themes in order to discuss the main results. First, the process of translation is considered from a theoretical standpoint. Then, the emerging theme of organizational change is tackled.

5.1 The process of translation of the governance framework
The process of translation of the governance framework resulted for project MP in appropriation of ostensive practices through actors’ perceptions and adaptation through performed practices. In all, 12 practices in the planning phase have been observed, and have been analyzed according to their level of requirement, resulting in three categories of practices, each assuming an overarching function: “structuring” practices at the institutional level, “normalizing” practices at the organizational level and “facilitating” practices at the project level. According to Biesenthal and Wilden (2014), conceptualizations of project governance should adopt a multilevel nature. This implies a more political view on
the process, by analyzing which actors are dominant in each stage, and how their needs and actions affect the process. Moreover, those three categories of practices appeared to have a dominant underlying objective, based on Brunet and Aubry’s (2016) three dimensions of a governance framework for major public projects (legitimacy, accountability and efficiency). Although more research would be needed to confirm this emerging pattern, for now what we have observed is that an underlying, implicit objective could be associated with each level.

Structuring practices. Four practices resulted from requirements at the institutional level, from SCT directive: P3-detailing the chosen option, P9-performing risks analysis, P10-elaborating the business case (DA), P11-elaborating and actualizing the PMP. Those practices refer to specific deliverables to be produced for the project business case (DA), for getting approval of the overall project-planning phase. Those practices are asked from “Direction générale de la gouvernance des projets d’infrastructure,” a unit within SCT, and permeate through all governmental layers so that project actors enacted them the way they perceived it was required. We suggest that legitimacy is the overarching function of those practices enacted at the institutional level, which allows shaping and structuring the project until approval of the phase.

Normalizing practices. Five practices have emerged out of SQI organizational needs and have been enacted into project MP: P1-granting professional contracts, P4-participating in project steering committee, P7-performing an integrated design process, P8-Performing value analysis, P12-performing QA. Those practices are related to the recent developments of SQI as an organization having to normalize its projects practices, which is developing new roles of expertise, adding value to individual projects, and coordination between projects at the organizational level. We suggest that accountability is the overarching function of those practices enacted at the organizational level, as SQI new role is in line with recent institutional and organizational change that have occurred in recent years regarding public policy of major public infrastructure projects in Quebec.

Facilitating practices. Three practices were enacted out of project MP’s specific needs: P2-implementing a project management office, P5-participating in project coordination meetings, P6-conciliating between main stakeholders. Those practices emerged out of facilitating needs at the project level, are mostly related to coordination needs, and consider mostly human aspects. We suggest that efficiency is the overarching function of those practices enacted at the project level. Next, some considerations about organizational change are offered.

5.2 Organizational change
As it has been shown (see section 4.1), the governance of major public projects in Quebec has been constantly evolving since 2008. The new governance framework, adopted in 2014, imposed modifications that had to be known and understood by project actors. Moreover, SQI, which was constituted in November 2013, has an enforced role in major public infrastructure projects, being the project manager and having to comply with the institutional governance framework. Yet, SQI resulted from the fusion of two previous organizations, and has been adapting to this new reality ever since. The mechanisms of managing a project have stayed more or less stable, yet projects are conducted in an environment which is in constant evolution and change. Notably, the emergence of performative practices in project MP and organizational practices from SQI reflects the undergoing adaptation and change.

Although attempting to study organizational change from a theoretical perspective is out of the scope of this research, the results nevertheless reflect this contextual reality. In line with process studies, change is the only reality, as stability does not exist per se (Hernes, 2014).
As practices are not only limited to a micro-level but also exist on a meso and macro level (Gherardi, 2012), there would be rich possibilities to analyze the data collected from a change perspective. This resonates with Feldman and Pentland (2003)'s proposition to study endogenous change in organizational routines, in order to understand the dynamics between stability and adaptability. Change implies that actors adapt and learn, from their experience and that of others (Bresman, 2013). An organization's absorptive capacity is also important to consider in order for the requested change to be successful (Todorova and Durisin, 2007). Having discussed our results in line with theories and emerging themes, we now conclude with contributions and avenues for future research.

6. Conclusion
Since the birth of project management in the 1950s, major engineering and infrastructure construction projects have been a continuous and important object of inquiry, first with military projects, then extending to the construction of buildings, transportation and power systems (Morris, 2013). The governance of projects has been studied for decades now (Ahola et al., 2014). However, too often, the wrong projects are selected, the cost estimates are underestimated and the benefits of the project overestimated (Flyvbjerg, 2014b). This has led Flyvbjerg (2011) to propose the “iron law of megaprojects”: “Over budget, over time, over and over again.”

Project studies extended from a technical discipline to an inter-disciplinary one (Geraldi and Söderlund, 2018). Over the last two decades, project management research has improved substantially in quality and rigor (Turner, 2010), rapidly expanding as a subfield of management and organization studies (Söderlund, 2011). Thus, the variety found in the study of project management lends support to theoretical pluralism and to the interdisciplinarity of the field (Söderlund, 2011). As it has been argued, the theoretical perspectives of process studies, translation and the practice-based view are on their way to becoming more important in the field of project management, as insights from social sciences are expanding project management research (Floricel et al., 2014). Within project management, the study of major infrastructure projects has always been – and still is – a subject of importance (Flyvbjerg, 2017). The process of translation, from an ostensive practice to a performative practice as applied to the governance framework for public infrastructure projects, has not been investigated so far, to our knowledge. The theoretical field explored is vast and still offers numerous possibilities. This is in line with the grounded theory approach, which is used as a method to generate theory as the data is collected. Here, we advance one possible avenue for theorization, considering hybridization, which is important in social sciences to generate theory (Denis et al., 2007).

In line with literature on the practice perspective, this research sheds light on the way project actors enact an institutional governance framework. The process of translation is exposed and specific practices are identified, allowing an understanding of distinctions between what is prescribed and what is actually done. This research aims to contribute to the emerging field of projects-as-practice (Cicmil et al., 2006), by exploring the gap between what is prescribed in the QGF and what people do in practice. As Sahlin-Andersson and Söderholm (2002, p. 22) argues: “we learn that in order to understand the outcome of a process, it is of value to learn about the process.” By mobilizing the practice perspective, it is possible to open the black box of the micro-process of the institutionalized, ostensive governance framework, and study its translation by actors.

For now, this case study presents data from only one project. The overarching doctoral research from which this paper was produced included a multiple-case study of four major projects, all having to comply with the QGF. Further inter-case analysis will prove useful in order to find patterns, differences, and time dynamics (Eisenhardt, 1989). This paper proposes a single-case qualitative study to investigate the governance of projects as it is
actually done by actors (as it is translated from the institutionalized governance framework), which will increase knowledge in the field as most studies up to now have focused on the formal governance framework. At the practical level, this research will approach possible solutions to maximize the benefits in terms of optimizing public finances, transparency and ethics.

Acknowledgments
This doctoral research was funded by the Social Sciences and Humanities Research Council of Canada and the ESG UQAM Chair in Project Management. The authors wish to thank the Quebec government for allowing this research to be conducted, and all participants who contributed to make this possible. An earlier version of this paper was presented at the EURAM 2017 conference (SIG Project Organizing), and received the Emerald Publishing Award Best Paper within the special topic track on Mega and Major Projects, along with the IPMA-PMI – Best Student Paper Award. The authors are grateful to Nathalie Drouin, Joseph Facal, Marian Thunnissen, Diletta Colette Invernizzi and participants of the EURAM 2017 conference who attended this presentation for their useful comments on earlier drafts of this paper.

Notes
2. One exception is for road transportation projects, as the governance framework applies for projects over $100 million (CAD).
3. For the phases of executing and closing, project reports have to be given to the Quebec Treasury Board (SCT) twice a year for the execution phase, and once the project is closed for the final report. Additionally, if there is a modification to the project scope, schedule and costs above the planned estimates approved initially, the Minister promoting the project (the client) has to formally ask the Council of Ministers for approval of this modification.
4. The recommendations are first transmitted to the Treasury Board, a permanent committee of the Executive Council composed of 5 Ministers, and then to the Council of Ministers for approval.
5. SQI may also support the project manager in some instances. In those cases, its main role is to perform quality assurance of the main project deliverables. For transportation projects, the Ministry of Transport is directly involved with SCT.
6. Although the new version of the QGF was implemented in February 2014, a transitional clause allowed for projects in development that the documentation under the former governance framework be submitted for approval before June 20, 2014.

References


IJMPB 11,1


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A methodology based on benchmarking to learn across megaprojects

The case of nuclear decommissioning

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Abstract

Purpose – The literature lacks a single and universally accepted definition of major and megaprojects: usually, these projects are described as projects with a budget above $1 billion and a high level of innovation, complexity, and uniqueness both in terms of physical infrastructure and stakeholder network. Moreover, they often provide fewer benefits than what were originally expected and are affected by delays and cost overruns. Despite this techno-economic magnitude, it is still extremely hard to gather lessons learned from these projects in a systematic way. The purpose of this paper is to present an innovative methodology based on benchmarking to investigate good and bad practices and learn from a portfolio of unique megaprojects.

Design/methodology/approach – The methodology combines quantitative and qualitative cross-comparison of case studies and statistical analysis into an iterative process.

Findings – Indeed, benchmarking offers significant potential to identify good and bad practices and improve the performance of project selection, planning, and delivery.

Research limitations/implications – The methodology is exemplified in this paper using the case of Nuclear Decommissioning Projects and Programmes (NDPs).

Originality/value – Indeed, due to their characteristics, NDPs can be addressed as megaprojects, and are a relevant example for the application of the methodology presented here that collects and investigates the characteristics that mostly impact the performance of (mega)projects, through a continuous learning process.

Keywords Benchmarking, Methodology, Megaprojects, Cross-case study, Nuclear decommissioning

Paper type Research paper

1. Introduction

Major and megaprojects are often defined as projects with a budget above $1 billion with an high level of innovation and complexity (Flyvbjerg et al., 2003; Van Wee, 2007; Merrow, 2011; Locatelli, Mariani et al., 2017). However, already in the mid-1980s, Warrack (1985) argued that $1 billion is not a constraint in defining megaprojects, since sometimes a relative approach is needed. In fact, in some contexts, a much smaller project (such as one with a $100 million budget), could constitute a megaproject. Similarly, Hu et al. (2013) claim that a deterministic cost threshold is not appropriate for all countries, and a relative threshold such as the GDP should be used instead.

Even without defining a single threshold, megaprojects share the characteristics of not only being extremely expensive and long, but also politically sensitive, since they are often commissioned (at least partially) by the governments and involve a large number of external and internal stakeholders. Moreover, these projects are both influenced by the context in which they are delivered and they are able to influence the context themselves (Merrow, 2011). Additionally, due to the size and complexity of both their physical infrastructure and stakeholder network, it is still extremely hard to gather and investigate lessons learned from these projects in a systematic way.

Due to this techno-economic, political, and social magnitude, megaprojects have risen significant interest not only among practitioners, but also among academics. Nevertheless,
due to their uniqueness, it is still extremely hard to gather good and bad practices and develop empirically based guidelines in a systematic way.

This paper addresses this challenge, presenting a methodology to improve learning across projects and ultimately investigates the project characteristics (i.e. the independent variables) that impact most on the project performance (i.e. the dependent variable).

This methodology is based on benchmarking. Benchmarking refers to the process of comparing projects and, as explained in Section 2, it offers significant potential to investigate the characteristics that impact most on the project performance. This methodology is applied to Nuclear Decommissioning Projects and Programmes (NDPs), as NDPs are extremely complex, long, and expensive, with a budget that often exceeds $1 billion; they are politically sensitive and involve a large number of external and internal stakeholders (LaGuardia and Murphy, 2012; Invernizzi et al., 2017c). Therefore, NDPs can be addressed as megaprojects.

Nevertheless, this methodology can be adapted to all major and megaprojects where the uniqueness of projects and the low number of cases available hinder the use of analysis based on big numbers.

The rest of the paper is organized as follows. Section 2 critically reviews recent research on benchmarking and compares benchmarking studies applied on the construction industry. Section 3 stems from the literature and proposes a methodology to adapt the benchmarking approach to the situation where the number of cases is low and the information available is scattered. Then, this methodology is exemplified using the case of NDPs in Section 4. Section 5 is dedicated to discussion and conclusions.

2. Benchmarking analysis in the literature
The meaning of the term “benchmarking” has been widely discussed in the last decades and, as shown in Table AI, there are different definitions of “benchmarking” and of the benchmarking “steps and/or phases” in the literature. Already in 1992, benchmarking had been described through 49 definitions (Anand and Kodali, 2008, quoting (Spendolini, 1992)) and through a different number of steps and phases. More recently, Anand and Kodali (2008) reviewed 35 published models and highlighted that there are only 13 common steps of the benchmarking analysis, out of 71 investigated. Therefore, before performing a “benchmarking analysis,” it is fundamental to agree on its definition. In this research, the authors follow the PMBOK (2013, p. 116) definition, where benchmarking involves “comparing actual or planned practices, such as processes and operations, to those of comparable organizations to identify best practices, generate ideas for improvement” and it provides “a basis for measuring performance.” Garnett and Pickrell (2000, p. 57) assert that benchmarking is “a continuous process of establishing critical areas of improvement within an organization […]” that it offers “the means to identify why ‘best practice’ organizations are high achievers, and how others can learn from best practice processes to improve their own approach.” Ramirez et al. (2004) also state that it is necessary to complement a quantitative benchmarking system with a qualitative-based one, in order to establish causal relationships. This demonstrates the need to adapt benchmarking case by case. Within the construction industry, benchmarking has already been used to compare projects in order to identify successful projects and the reasons for their success, and the interest in benchmarking is significantly increasing because, through finding examples of superior performance, firms can adjust their policies and practices to improve their own performance (El-Mashaleh et al., 2007; Costa et al., 2006; Ramirez et al., 2004). Table AII compares benchmarking analysis applied to the construction industry, highlighting, each study, the aim of the research, the method or model described or adopted, the steps of the analysis and highlights, and the data collection and the number of case studies investigated.
Concerning benchmarking applied to the construction industry (Table AII), the following conclusions can be drawn:

- Benchmarking analysis is suitable to determine the performance of a company, using input metrics (e.g., safety expenses and management expenses) and output metrics (e.g., cost performance, schedule adherence, customer satisfaction, safety performance, and profit) (El-Mashaleh et al., 2007).

- “Lessons learned from other companies can be used to establish improvement targets and to promote changes in the organization” (Costa et al., 2006, p. 158), but there is a need to upgrade existing benchmarking initiatives and devise new ones.

- Qualitative benchmarking can enable the comparison of management practices, discover relationships between performance data, and determine industry trends. Also, being based on the perception of key personnel, this approach can be applied as part of a continuous improvement program (Ramirez et al., 2004).

- The benchmarking process is as important as the benchmarks themselves (Garnett and Pickrell, 2000), therefore the selection of cases is pivotal.

In conclusion, the benchmarking analysis is recognized to be a valuable tool to improve the performance of projects delivered in different industrial sectors and in different countries. However, the aforementioned analyses are not directly applicable when the number of projects is low and/or the information available scattered (e.g., construction megaprojects and decommissioning megaprojects), and where a single and globally recognized benchmark is missing. Therefore, a new framework needs to be developed to deal with the complexity and low number of major and megaprojects. Table I compares a few techniques for benchmarking and highlights those that are suitable for megaprojects. Section 3 explains this framework, which is exemplified in Section 4 using NDPs. Other statistical analysis, such as a qualitative comparative analysis (Schneider and Wagemann, 2012), will be considered at a later stage of the research.

3. The methodology to learn across megaprojects

The methodology presented in this paper is based on the seminal work by Kathleen Eisenhardt (1989), who recommends data collection using multiple methods, introduces the concept of “theoretical saturation,” and promotes the deep analysis both of single cases and across cases to develop theories. In particular, the cross-case comparison is an iterative process, where the first step refines the initial hypothesis, the second step verifies the relationships among hypothesis and empirical evidence, and the third step critically compares new theories with existing ones. The case method is described by several authors (e.g., Yin, 2009) and is of significant importance for the current research, even if sometimes criticized due to its limited rigor (Easterby-Smith et al., 2012).

The methodology developed for this research is largely based on empirical evidence, and employs an “inductive” method (rather than a “deductive” one) where “induction” is defined as follows (Gill and Johnson, 2002; Brookes et al., 2015, p. 6): “the induction of particular inferences from particular instances or the development of a theory from the observation of empirical reality.” Figure 1 shows the research framework that has been developed by the authors to ultimately collect good and bad practices, and investigate what drives the project performance.

The first step embraces a preliminary literature review and the collection of case studies. This is complemented by semi-structured interviews and site visits. Case studies are selected according to their relevance, their completeness, and the availability of information. The date when these projects have been delivered is also significant, so the rule
This paper presents the results from the application of the benchmarking system through different methods, i.e. qualitative benchmarking, correlation analysis, factor analysis, multivariate linear regression and sectors trends. Thirteen companies participated to the initial application of the benchmarking system.

Methodology based on benchmarking

<table>
<thead>
<tr>
<th>Reference, aim of the paper and data collection</th>
<th>Method, model or analysis implemented</th>
<th>Applicable for benchmarking megaprojects?</th>
</tr>
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<tbody>
<tr>
<td>“Benchmarking System for Evaluating Management Practices in the Construction Industry” (Ramírez et al. 2004)</td>
<td>(1) Qualitative benchmarking with the class median, used to enable each company to evaluate its position compared to the worse and best case scenario and the median. This comparison is highlighted using the Radar graph</td>
<td>Yes, qualitative benchmarking is suitable between 2 or 3 megaprojects. However, it is not suitable to calculate the median, due to the low number of projects</td>
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<td></td>
<td>(2) Correlation analysis, used to investigate the intensity of the linear relationship between two variables, X and Y. To measure this intensity of the relationship, the Pearson’s coefficient is used. The Pearson’s correlation is a measure of the strength and direction of the linear relationships that exists between two variables measured on an interval scale</td>
<td>No, as to use the Pearson’s correlation, variables should be approximately normally distributed and there should be no significant outliers (Laerd Statistics 2016). Moreover, the cases should represent a random sample from the population. These assumptions are not met by megaprojects</td>
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<td>(3) Factor analysis, that uses the principal components to determine the underlying structure among the different management dimensions and identify relationships not previously established</td>
<td>No, as the principal component analysis requires assumptions (e.g. linearity (Shlens 2005)), that are not met by megaprojects</td>
</tr>
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<td></td>
<td>(4) Multivariate linear regression, that was implemented but discarded due to the weak correlation coefficient caused by the low number of data quantity of data</td>
<td>No, as assumptions for the multivariate linear regression (e.g. linearity, homoscedasticity, etc.) are not met by megaprojects</td>
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<td></td>
<td>(5) Sector trends by management dimensions, by job categories, and by subsectors are used to categorize and analyse survey results</td>
<td>Yes, as trends highlighted during the descriptive analysis of the collected data can yield interesting conclusions</td>
</tr>
<tr>
<td>“Management of Construction Firm Performance Using Benchmarking” (El-Mashaleh et al., 2007)</td>
<td>Data Envelopment Analysis (DEA). DEA is concerned with evaluation of the activities of organizations such as business firms, hospital and government agencies. The organization responsible for converting inputs into outputs is called Decision Making Unit (DMU). DEA uses mathematical linear programming to determine which of the DMU forms an envelopment surface, i.e. an efficient frontier</td>
<td>No, as the number of megaprojects and the information available is too low to implement the DEA</td>
</tr>
<tr>
<td>“Power plants as megaprojects: Using empirics to shape policy, planning, and construction management” (Brookes and Locatelli, 2015)</td>
<td>This research implements the Fisher Exact test to a dataset of a dataset of 12 case studies from several industries, e.g. the nuclear, coal, and renewable resources. The Fisher Exact Test investigates the correlation of single independent variables vs dependent ones and is able to identify correlations within small data sets</td>
<td>Yes, as the Fisher Exact Test is able to identify correlations within small data sets (&lt;30 cases), as it investigates each project characteristics independently</td>
</tr>
<tr>
<td>“Empirical research on infrastructural megaprojects: what really matters for their successful delivery” (Locatelli, Invernizzi, et al., 2017)</td>
<td>This research implements the Fisher Exact Test and Machine Learning techniques. Machine Learning enable rigorous “pattern spotting” analysis of the existing, relatively small dataset, which did not allow the application of multivariate statistical analysis. Three different learning methods are implemented, i.e.: Decision tree, Naïve Bayes and Logistic Regression</td>
<td>Yes, both the Fisher Exact Test and Machine Learning are applicable to megaprojects. Being the Logistic Regression a type of probabilistic model used to predict the class based on one or more attributes (not necessarily continuous), it can be applied to the case of megaprojects</td>
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Source: Invernizzi et al. (2017)

“the newer the better” applies. The output of the first step is the preliminary collection of the projects’ characteristics that impact on the projects’ performance, the selection of case studies, and of the techniques for the data analysis.

The second step consists of the data codification. Indeed, the selected case studies need to be recorded in a standard template. This template could contain several pieces of information grouped into macro-categories, such as:

- an overview of the project, its physical characteristics, and its final end state;
- governance, funding, and contacting schemes; and
- stakeholders and stakeholders’ engagement.
The output of the second step is the development and population of a standard template to allow an easier comparison of projects. From this template, lessons learned can be listed and analyzed.

The third step consists of the operationalization of the independent and dependent variables, i.e., respectively, the project characteristics and their performance (e.g. assessed in terms of cost overruns, Invernizzi et al., 2017a). To do this, it is necessary to differentiate between “concepts” and “constructs,” where a construct is a more formalized definition of a concept, a concept being a “general idea in our heads about a variable which has a part to play in our theories” but that still cannot be observed directly (Lee and Lings, 2008). The measurement of a construct is “the process of moving our theoretical constructs into the real world” […], therefore “once we work out exactly how we can represent our constructs in the real world, we have what can be called an operational definition” […]. So, the operational definition outlines exactly “what in the real world we say represents our theoretical constructs” (Lee and Lings, 2008, p. 161) and implicitly means that operational definitions and constructs are not the same thing, as shown in Figure 2. Constructs can describe the world, which is qualitative, quantitative, complex, and dynamic. However, they are not directly observable, therefore observable measures have to be used instead.

Rossiter (2002) adopts the definition of Edwards and Bagozzi (2000) that describes constructs as phenomena “of theoretical interest” and suggests describing them in terms of
the object, including its constituents or components, the attribute, including its components, and the rater entity, where:

1. the object part of the construct can be singular, collective, or have multiple components, and can be concrete or abstract;

2. the attribute in the construct is the dimension on which the object is being judged, and can be concrete singular, abstract formed, and abstract eliciting; and

3. the rater can be an individual, expert, or a group.

The output of the third step is the creation of a systematic list of the characteristics that impact on the project performance and their operationalization into binary independent and dependent variables, bearing in mind that, due to their nature, only some of them can be operationalized in a concrete way. The fourth step consists of the actual data analysis and it is split into two stages, i.e. the qualitative and quantitative cross-comparison and the statistical analysis and data mining, respectively, 4a and 4b in Figure 1.

The qualitative and quantitative cross-comparison of step 4a highlights the good practices that empirically resulted to be relevant for the successful performance of a project. The correlation[1] of these practices, together with “lessons learned” gathered from published literature (e.g. journal articles, official reports, and case studies), semi-structured interviews with experts, and site visits is then investigated in step 4b. Step 4b consists of the statistical analysis. The statistical analysis needs to address: the low number of cases and their complexity, in other words, their (alleged) uniqueness. This is why the Fisher exact test is implemented first. Indeed, the Fisher exact test is able to identify correlations within small data sets (Leach, 1979), e.g. 20-30 projects and to evaluate whether or not a single independent variable (e.g. a project characteristic) is associated with the presence (or absence) of a dependent variable (e.g. the project performance), using categorical data in the form of a contingency table as input. The output of the test is a $p$-value, which represents how likely it is that the result detected by the implementation of this statistical analysis could have resulted from chance rather than due to a real relationship between the variables in question. In this respect, the smaller the “$p$-value” is, the better. Key features, limitations,
and the implementation of the Fisher exact test applied to large construction projects can be found in Brookes and Locatelli (2015), Locatelli et al. (2017), and Locatelli, Mikic et al. (2017).

Regarding the value of the p-value, the authors suggest to adopt a higher significance level than the one traditionally used, such as a p-value < 0.15 rather than a more typical value of p-value < 0.05. This means that statistically significant findings must be dealt in a circumspect fashion and the actual causation between project characteristics and their performance requires further investigation and validation, e.g. through pilot projects and interviews with experts.

The fifth step is the validation and dissemination of the results.

4. Example of results from the cross-comparison and the statistical analysis
NDPs are complex and affected by high uncertainties, can be characterized by activities that reach national multibillion projects, involve large numbers of partners and stakeholders, and are often (at least partially) commissioned by governments. Therefore, this paper addresses NDPs as megaprojects and uses NDPs to illustrate the methodology described in Section 3. Sections 4.1 and 4.2 illustrate early results from the cross-comparison, while Section 4.3 exemplifies preliminary findings regarding the statistical analysis.

4.1 Cross-comparison between two “similar but different” NDPs
The cross-comparison of NDPs assists the collection of relevant good (and bad) practices, and therefore is envisaged to be performed both within the UK and against other countries (Table II).

Some of the lessons learned from the comparison of two “similar but different” NDPs (Rocky Flats (USA) and Sellafield (UK) are highlighted below. Lessons learned from ten Oil & Gas decommissioning projects are also collected and summarized in Section 4.2.

Rocky Flats (USA) and Sellafield (UK) are compared because these two NDPs (Invernizzi et al., 2017d):

- are recent NDPs;
- share a reasonably similar history (e.g. both facilities were opened for military purposes in the 1940s/1950s and have been affected by major nuclear accidents);
- have a comparable size; and
- had a decommissioning budget in the order of tens of billions of dollar.

Moreover, there is publically available information in English regarding both these NDPs. Rocky Flats was a military nuclear weapons facility in Colorado that produced plutonium and enriched uranium from 1953, and stopped operations in 1989. It was owned by the US Department of Energy (DOE) and was managed by a series of weapons contractors. When Rocky Flats was shut down in 1989, due to the significant radioactivity on site, the US DOE estimated that it would have taken 70 years and $36 billion to decommission it. The project was, however, completed by a joint venture in less than ten years and $ 3.5 billion (DOE, 2013; Cameron and Lavine, 2006; Bodey, 2005/2006). Sellafield is a six square kilometers nuclear site in the UK that contains 99 percent of the UK

<table>
<thead>
<tr>
<th>Nuclear</th>
<th>Non-nuclear</th>
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<tr>
<td>UK</td>
<td>Benchmarking NDPs across the UK</td>
</tr>
<tr>
<td>Non-UK</td>
<td>Benchmarking NDPs across several countries</td>
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</table>
radioactivity. The UK Nuclear Decommissioning Authority estimates that it would take almost £120 billion and more than 100 years to decommission it (NDA, 2017). This can stimulate debate on project temporality (Brookes et al., 2017).

Rocky Flats and Sellafield also present very different aspects. For instance, Rocky Flats stopped operations in 1989, and during its decommissioning, its waste was shipped to other countries in the USA. Conversely, Sellafield is still an operating nuclear site that handles radioactive material shipped both from other countries and other nuclear sites in the UK (Invernizzi et al., 2017d).

Despite these differences, early results and “lessons learned” from this cross-comparison are remarkable. Within the others:

- Funding arrangements and contracting schemes, especially if tailored on single employees. Indeed, Rocky Flats adopted the so-called “abundance approach,” where the aim was to fill the gap between forecasted (successful) performance and “spectacular” performance, i.e. to achieve positive deviance by closing the abundance gap (Cameron and Lavine, 2006). This together with incentives singularly allocated to employees to promote feasible ideas can improve the performance of the NDP.

- The size of the free space available within the perimeter of the nuclear site to manage radioactive waste. In fact, even if the size of Rocky Flats is comparable to Sellafield, Rocky Flats had a “buffer zone” which surrounded the site that proved to be helpful for the management of radioactive material (Cameron and Lavine, 2006). Sellafield, on the contrary, is “packed with buildings” (informal talks with Sellafield employees), which hinders the construction of new facilities to treat and confine the radioactive material.

- Early and timely engagement of stakeholders. Effective communication and the involvement of stakeholders in collaborative action support the smooth delivery of decommissioning projects (Invernizzi et al., 2017c).

These empirically based lessons learned, together with good and bad practices gathered from the literature, are tested with the statistical analysis of step 4b.

4.2 Cross-comparison among Oil & Gas decommissioning projects

In 2015, the expenditure for offshore Oil & Gas decommissioning reached £1.1 billion in the UK and £1 billion in Norway, a considerable increase from the previous year, where £800 million and £770 million were, respectively, spent in the same countries in 2014 (Oil & Gas UK, 2016).

Similarly to NDPs, Oil & Gas decommissioning projects:

- have a multi-million budget;
- are partly funded by the government;
- are affected by a highly regulated environment;
- are affected by cost overrun and schedule slippage;
- have a potentially high environmental impact, as Natural Occurring Radioactive Material might build up, which might cause unexpected radiological issues; and
- are less uncertain than NDPs, but still are affected by high uncertainties.

Therefore, the lessons learned from these ten Oil & Gas projects (summarized in Table III) are also considered to populate the list of project characteristics whose correlation with the project performance can be tested through the statistical analysis. Indeed, most of the cost and schedule drivers highlighted in Table III are shared with the nuclear decommissioning industry.
### Table III.
Summary ten selected Oil & Gas decommissioning case studies

<table>
<thead>
<tr>
<th>Case study</th>
<th>Within budget?</th>
<th>Within schedule?</th>
<th>Cost and schedule drivers highlighted in the close out reports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frigg Field (Total E&amp;P Norge AS, 2011; Total E&amp;P Norge AS, 2003)</td>
<td>No</td>
<td>Yes</td>
<td>More complex operation than originally foreseen; change in removal method</td>
</tr>
<tr>
<td>North West Hutton (NWH) (Jee, 2014; British Petroleum, 2006)</td>
<td>No</td>
<td>No</td>
<td>General lack of track record; lack of available benchmarking; pipeline cutting and removal taking longer than expected; additional vessel mobilizations were necessary; trenching activities took longer than scheduled due to the soil type encountered; delayed due to the intention to combine NWH decommissioning scope with other works to enable technical synergies and cost efficiencies</td>
</tr>
<tr>
<td>Indefatigable (Shell E&amp;P UK, 2014; Shell UK Limited, 2007)</td>
<td>No</td>
<td>No</td>
<td>Costs figures to estimates cost were too old and not corrected with inflation</td>
</tr>
<tr>
<td>Limbe Field (Shell E&amp;P UK, 2014; Shell UK Limited, 2007)</td>
<td>No</td>
<td>No</td>
<td>Inclement weather; greater than estimated duration of the work; need of a guard vessel</td>
</tr>
<tr>
<td>Manifold and Compression Platform (MCP)-01 (Total E&amp;P UK, 2013; Total E&amp;P UK, 2007)</td>
<td>No</td>
<td>Yes</td>
<td>Additional engineering required to ensure a safe and stable removal activity; additional man-hours required to execute the significantly larger work scope; presence of hazardous materials not previously recorded on register gave increased activity both offshore and onshore; additional time at site required additional flotel attendance; more visits by heavy lift vessel required than had been estimated; the decision by the contractor to use the “piece-small” removal process on a large scale; difficulty to contract enough experienced and skilled labor; knowledge management; pre-qualification of “new” techniques should be conducted; control on the availability and reliability of cranes and tools</td>
</tr>
<tr>
<td>Kittiwake SAL Export System (Centrica Energy, 2012; Venture Production plc, 2009)</td>
<td>No</td>
<td>No</td>
<td>The over-spend related to the cost of preservation and onshore storage made necessary by early recovery (£0.4 m) and the weather delay during load in (£0.3 m); availability of a suitable vessel; potential synergies with other projects</td>
</tr>
<tr>
<td>Shelley (Premier Oil, 2015; Premier Oil, 2010)</td>
<td>Yes</td>
<td>Yes</td>
<td>The impossibility of utilizing water jetting methods; the re-use of end fittings to be re-used to make new jumpers; the complexity of the recovery of the “Polyoil” resin-based cable clamps, due to complete disintegration; the discharge of oil-based mud residue during the wellhead cut; Operational and extensive weather delays</td>
</tr>
<tr>
<td>Tristan NW (BRIDGE Energy, 2010; Silverstone Energy Limited, 2010)</td>
<td>No</td>
<td>No</td>
<td>Operational and extensive weather delays</td>
</tr>
<tr>
<td>Fife, Fergus, Flora and Angus (FFFA) (HESS, 2014; HESS, 2012)</td>
<td>No</td>
<td>Yes</td>
<td>Additional scope of work</td>
</tr>
<tr>
<td>Camelot (Helix Energy Solutions, 2013; Energy Resource Technology Ltd, 2012)</td>
<td>Yes</td>
<td>Yes</td>
<td>Impact of processing naturally occurring radioactive material</td>
</tr>
<tr>
<td>Total positive</td>
<td>2/10</td>
<td>5/10</td>
<td>Only two of the Oil &amp; Gas decommissioning projects were completed within the estimated budget. Five over ten were completed within the schedule</td>
</tr>
</tbody>
</table>

**Note:** “Not explicit

**Source:** UK Government (2017)
4.3 Example of results from the first iteration of the statistical analysis: the Fisher exact test
The aim of the statistical analysis is to highlight the correlation between the project characteristics and their performance. Table IV lists four country-specific independent variables, two of which resulted in being correlated with the project performance according to the first statistical test implemented (i.e. the Fisher exact test) to a pool of 30 NDPs. This is a preliminary result, applied on a pool of NDPs. This research aims to increase the number of NDPs to improve the reliability of the results of the statistical analysis.

5. Discussion and conclusion
Due to their techno-economic, political, and social magnitude, megaprojects have risen significant interest not only among practitioners, but also among academics. However, it is still extremely hard to gather good practices and develop empirically based guidelines in a systematic way.

This paper presents an innovative methodology based on benchmarking that combines qualitative and quantitative analysis to collect, select, and investigate good and bad practices and learn from a portfolio of (mega)projects. This methodology is exemplified using the case of decommissioning projects (and nuclear ones in particular), which are still remarkably under investigated, although extremely significant in terms of complexity and budget.

The methodology proposed in this paper starts with the selection of representative megaprojects and the listing of the project characteristics that impact on the project performance according to the literature. This literature is complemented by semi-structured interviews and followed by a qualitative analysis of the information collected. Then, this methodology suggests to apply statistical analysis to assess the correlation between project characteristics and their performance and to validate the results through pilot projects.

In particular, the Fisher exact test is envisaged to be applied first, as it is able to identify correlations within small data sets and to evaluate whether or not a single independent variable (e.g. a project characteristic) is associate with the presence (or absence) of a dependent variable (e.g. the project performance). The output of the test is a p-value, which represents how likely the result detected by the implementation of this statistical analysis could have resulted from chance rather than due to a real relationship between the variables. Other statistical analysis and data mining techniques can be applied at later stages of the research.

<table>
<thead>
<tr>
<th>Independent variables, i.e. the NDP characteristics</th>
<th>Correlation of the independent variables with the dependent variable “50% cost overrun”</th>
</tr>
</thead>
<tbody>
<tr>
<td>The country scores a corruption perception index &gt; 60°</td>
<td>The fact that the corruption perception index in a country is less than 60 is correlated with the presence of 50% of cost overrun. The p-value is lower than 10%, showing a correlation.</td>
</tr>
<tr>
<td>The legal timeframe for review of decommissioning plans is less 2 years</td>
<td>The fact that the legal timeframe for review of decommissioning plans is less 2 years is strongly correlated to the absence of 50% of cost overrun. The p-value is lower than 10%, showing a correlation.</td>
</tr>
<tr>
<td>There are other nuclear facilities still operating in the country</td>
<td>The fact that there are other nuclear facilities operating in the country is not correlated to the absence of 50% of cost overrun. The p-value is &gt; &gt; 15%, showing no correlation.</td>
</tr>
<tr>
<td>The NDP is state owned</td>
<td>The fact that the NDP is state owned is not correlated with the absence of 50% of cost overrun. The p-value is &gt; &gt; 15%, showing no correlation.</td>
</tr>
</tbody>
</table>

**Note:** 
“From Transparency International, as in Locatelli, Mariani et al. (2017) 
**Source:** Invernizzi et al. (2017b)
Acknowledgment
This research has been supported by the UK Nuclear Decommissioning Authority (NDA) through the Grant No. NNL/UA/002. The authors are extremely grateful to all the NDA and National Nuclear Laboratory (NNL) experts for all the support received. The opinions in this paper represent only the point of view of the authors, and only the authors are responsible for any omission or mistake. This paper should not be taken to represent in any way the point of view of NDA, NNL, or any other organization involved in the decommissioning process of nuclear facilities either in the UK or abroad. The authors are also grateful to Alex Prior for having proofread this paper.

Note
1. “Correlation” is here used to explain the relationship between two variables, without specific reference to any linear relationship (i.e. as a synonym of the more generic term “association”).

References
Methodology based on benchmarking

115


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(The Appendix follows overleaf.)
Table AI. "Benchmarking" in the literature

<table>
<thead>
<tr>
<th>Reference</th>
<th>Definition of benchmarking</th>
<th>Highlights relevant for the current research</th>
<th>Steps and/or phases of the benchmarking process</th>
</tr>
</thead>
<tbody>
<tr>
<td>“The benchmarking book” (Stapenhurst, 2009)</td>
<td>Stapenhurst (2009) provides a list of definitions, finally summarizing benchmarking in the “method of measuring and improving our organizational performance by comparing ourselves with the best”</td>
<td>Stapenhurst (2009) provides a comprehensive investigation into the benchmarking analysis, focusing on the benchmarking process and the managerial and organizational aspects of benchmarking</td>
<td>Stapenhurst (2009) summarizes the benchmarking process into three main phases, i.e.: 1. Planning: develop a project proposal 2. Benchmarking performance: recruit and work with participants, collect and compare data 3. Improvement: improve the organization</td>
</tr>
<tr>
<td>“Benchmarking the benchmarking models” (Anand and Kodali, 2008)</td>
<td>According to Anand and Kodali (2008), the definition of benchmarking vary. Key themes include measurement, comparison, identification of best practices, implementation and improvement. The author provides a taxonomy for benchmarking models, dividing them into consultant/expert-based models, academic/research-based models and organization-based models, and finally states that benchmarking should at least be classified into internal and external benchmarking. Anand and Kodali (2008) reveal the presence of 71 benchmarking steps in the 35 different publications analysed. In those, around 13 steps have been addressed by many researchers (40-45%) and are therefore called “common steps” of benchmarking. Excluding the “common steps”, Anand and Kodali (2008) additionally lists 18 new practices, that had an occurrence between 14% and 45%. Lastly, Anand and Kodali (2008) propose a 12-phases that include 54-detailed-step benchmarking model.</td>
<td>Anand and Kodali (2008) highlight the 13 common steps of the benchmarking process: 1. Identify the benchmarking subject 2. Identify benchmarking partners 3. Perform benchmarking study 4. Determine current competitive gap 5. Establish functional goals 6. Develop action plans 7. Implement of action plans to bridge the gap 8. Recalibrate the benchmark 9. Understand the current situation by collecting and analysing the existing information on the subject to be benchmarked 10. Monitor results of the implemented actions 11. Identify the critical success factors or indicators of the subject to be benchmarked 12. Measure the existing state of the subject to be benchmarked with respect to the critical success factors/indicators 13. Form a benchmarking team and identify a leader of the team to carry benchmarking study</td>
<td></td>
</tr>
<tr>
<td>“Benchmarking as an action research process” (Kyro, 2004)</td>
<td>“Even though definitions vary between scholars, the aspects of evaluation and improvement by learning from others are embedded in the definitions regardless of the definer” (Kyro, 2004). Adopting an interpretative, comparative concept analysis, Kyro (2004) suggests that benchmarking can be regarded as a special kind of action research. If so, the author affirms that, more attention should be put on “preliminary planning, observation, reflection and the use of theoretical frame”. Kyro (2004) also provides a detailed comparison of benchmarking and action research, focusing on: (1) the similarity of their purpose, i.e. to improve practices, (2) the researcher’s role, (3) how the processes take place and how they can be either adapted or created, (4) the phase of action research vs the phases of benchmarking</td>
<td>Kyro (2004) provides a review of benchmarking models and a classifications of benchmarking phases compared to action research. Kyro (2004) approaches the benchmarking process as a “two-cycle spiral, where the actual data collection phase is regarded as an action of the first cycle [...] and at the same time is generic enough to be adopted for different forms of benchmarking”</td>
<td></td>
</tr>
<tr>
<td>“An evolutionary approach to Benchmarking” (Fernandez et al., 2001)</td>
<td>“Benchmarking is the process that facilitates learning and understanding of the organization and its processes. It enables organizations to identify the key processes that need improvement, and to Fernandez et al. (2001) propose an evolutionary classification method called cladistics, that distinguishes between different organisational types according to how they evolve and develop new ways of working. The authors firstly list the benchmarking styles (classified into internal, competitive, functional and generic and strategic), highlighting their advantages and disadvantages. Fernandez et al. (2001) also affirm that the benchmarking process is not a “universal yardstick, as it is impossible to establish an absolute measurement in the benchmarking process”.</td>
<td>Fernandez et al. (2001) propose a structured literature review of 6 earlier publications on benchmarking models, highlighting the five generic steps of benchmarking models: 1. Planning 2. Analysis and data collection 3. Comparison and results 4. Change</td>
<td></td>
</tr>
</tbody>
</table>

(continued)
| Benchmarking process formalization and a case study | Büyükozkan and Maire (1998) state that benchmarking is one of the most efficient and effective management tools to help an enterprise to improve its performance. The author also points out some of the obstruction against the benchmarking approach, e.g. industrialists that think that their business processes are very company specific and that it is not ethical to look at other companies’ technology and manufacturing methodology, and the lack of formal benchmarking methodology. Büyükozkan and Maire (1998) define a general benchmarking process to cover the different types of benchmarking (i.e. internal, external, industry, competitive, and generic benchmarking). This process is divided into the following 5 phase, divided into 15 steps and is a cyclical, “never-ending and learning” process. Büyükozkan and Maire (1998) also state the serious difficulties of implementing a continuous improvement activity is that “there are no standard performance metrics to be utilized in such studies” The author then illustrates the methods and tools for the first 5 steps of the benchmarking process through a case study |
| Benchmarking process formalization and a case study | Büyükozkan and Maire (1998) state that benchmarking is one of the most efficient and effective management tools to help an enterprise to improve its performance. The author also points out some of the obstruction against the benchmarking approach, e.g. industrialists that think that their business processes are very company specific and that it is not ethical to look at other companies’ technology and manufacturing methodology, and the lack of formal benchmarking methodology. Büyükozkan and Maire (1998) define a general benchmarking process to cover the different types of benchmarking (i.e. internal, external, industry, competitive, and generic benchmarking). This process is divided into the following 5 phase, divided into 15 steps and is a cyclical, “never-ending and learning” process. Büyükozkan and Maire (1998) also state the serious difficulties of implementing a continuous improvement activity is that “there are no standard performance metrics to be utilized in such studies” The author then illustrates the methods and tools for the first 5 steps of the benchmarking process through a case study |

| Table AI. Methodology based on benchmarking | | | | |
Aim of the research

The aim of this research is to present a comprehensive benchmarking model that uses input metrics (i.e., (1) safety expenses and (2) management expenses) and output metrics (i.e., (1) schedule adherence, (2) cost performance, (3) customer satisfaction, (4) safety performance, and (5) profit) to determine the company performance. The final aim of this paper is the comparison of four benchmarking approaches to use the lessons learned and upgrade the existing benchmarking initiatives to devise new ones. All four initiatives use an interactive online tool for the collection and evaluation of the benchmarking measures. The final aim of this research is to present a comprehensive benchmarking model that uses input metrics (i.e., (1) safety expenses and (2) management expenses) and output metrics (i.e., (1) schedule adherence, (2) cost performance, (3) customer satisfaction, (4) safety performance, and (5) profit) to determine the company performance. The final aim of this paper is the comparison of four benchmarking approaches to use the lessons learned and upgrade the existing benchmarking initiatives to devise new ones. All four initiatives use an interactive online tool for the collection and evaluation of the benchmarking measures.

This research presents the results from the application of different benchmarking systems through different methods: (1) the qualitative benchmarking with the class median, (2) the correlation analysis, (3) the factor analysis, (4) the multivariate linear regression, and (5) sector trends. The final aim of this paper is the comparison of four benchmarking approaches to use the lessons learned and upgrade the existing benchmarking initiatives to devise new ones. All four initiatives use an interactive online tool for the collection and evaluation of the benchmarking measures. This research presents the results from the application of different benchmarking systems through different methods: (1) the qualitative benchmarking with the class median, (2) the correlation analysis, (3) the factor analysis, (4) the multivariate linear regression, and (5) sector trends.

This paper discusses the development and testing of a benchmarking model to be implemented in the construction industry. Benchmarking models which ranged from 5 step to 11 step processes are reviewed and the key features of each stage are highlighted. This paper discusses the development and testing of a benchmarking model to be implemented in the construction industry. Benchmarking models which ranged from 5 step to 11 step processes are reviewed and the key features of each stage are highlighted. This research presents the results from the application of different benchmarking systems through different methods: (1) the qualitative benchmarking with the class median, (2) the correlation analysis, (3) the factor analysis, (4) the multivariate linear regression, and (5) sector trends. This research presents the results from the application of different benchmarking systems through different methods: (1) the qualitative benchmarking with the class median, (2) the correlation analysis, (3) the factor analysis, (4) the multivariate linear regression, and (5) sector trends.
The three benchmarking models are: Fisher et al. (1995) that collected data from 17 companies on 567 projects; Hudson and the Construction Industry Institute (1997-2000) that collected data of 901 projects from 37 owner and 30 contractors; and the Construction Benchmarking Programme or key performance indicator (KPI) model (1998).

The data were collected through a survey questionnaire that was divided into (1) collection of general information regarding the interviewee, (2) firm general information, (3) firm overall performance. Data were collected from 74 construction firms, including general contractors, construction management companies, design/build firms, and subcontractors, involved in residential, commercial, industrial, and heavy/highway construction. The minimum number of DMU in any model should be three times the number of variables, and the model's discriminatory power increases with more DMU and fewer variables.

The four methods are described. The barriers of the implementation of performance-measured systems in the construction industry arise because (1) the construction industry is a project-oriented industry with unique projects; (2) establishing a project performance measurement system and incorporating it into the company routine requires an intensive effort; (3) the responsibilities for data collection, processing, and analysis, in general, are not well defined at the beginning of the project; (4) each project usually has a different managerial team and the use of measures will depend on the capabilities and motivation of each manager. The commonality table is one of the outputs of this analysis, and represents the proportion of the variance explained by the component or factor. The factor analysis found that central office priorities focus on strategic management policies having longer-term competitive impact, while site management emphasizes tactical management dimensions having shorter-term impact.

This paper advances the use of a structured questionnaire to evaluate aspects related to the organizational culture and management of construction companies. The results of the questionnaire are then correlated against the quantitative performance indices obtained from the CDT's national benchmarking study to establish causal relationships. 13 companies initially participated in the assessment, 42 questionnaires were completed by central office personnel and 87 by construction site representatives.

Table AII. Methodology based on benchmarking
A fuzzy-based decision support system for ranking the delivery methods of mega projects

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Abstract

Purpose – The purpose of this paper is to present a framework to devise a system for ranking of traditional project delivery methods, regarding their suitability, against the varying levels of mega project attributes.

Design/methodology/approach – The proposed system employs input and output interfaces and a granular (fuzzy rule base) component for estimating the subjective levels of risks, opportunities, and constraints and then mapping them to a decision matrix. A questionnaire has been designed (using the SurveyGizmo® platform) to collect the perceptions of the various project stakeholders and use them. A total of 127 stakeholders completed the survey form in full.

Findings – The survey data were used to calibrate the fuzzy logic model of the granular component. The envisioned system computes, for each possible delivery method, an index that reflects the suitability (of the corresponding delivery method) on an ordinal scale.

Originality/value – The devised decision support system is likely to lessen the dependency of “accurate decision” on “the experience of the decision-makers.” It will also enable ranking the various project delivery methods based on the various project and stakeholder attributes that are likely to affect the project risks, opportunities and constraints.

Keywords Project delivery methods, Fuzzy logic, Mega projects

Paper type Research paper

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1. Introduction

Mega projects have faced criticism owing to their construction cost and schedule overruns. Flyvbjerg et al. (2003) handpicked four studies which reported up to 500 percent rise in the originally estimated cost of selected transportation infrastructure projects. Such instances hinder the future investments in not only the mega projects themselves, but also other ventures of similar scale. Take, for example, the case of Big Dig in Boston, Massachusetts. It took six presidents and eight governors (including presidential runners-up: Dukakis and Romney) to get the mega project “substantially” completed in 2006 while conceptually kicking off back in the 1970s (Gelinas, 2007; Greiman, 2013). Murray (the Head of the Worcester Chamber of Commerce) while referring to the Big Dig – suggested a rather cautious approach toward bringing the 2024 Murray (2015). This highlights the far-reaching impressions that mega projects may leave on scores of decision makers.

Mega projects are large-scale, complex ventures that typically cost US$1 billion or more, take many years to develop and build, involve multiple public and private stakeholders, are transformational, and impact millions of people (Flyvbjerg, 2014). This definition implies that the factors like the project delivery time, the stakeholders involved and the overall impact of the project, are also important in addition to the threshold value of cost that is typically used to define the mega projects. Fiori and Kovaka (2005) tried to provide a comprehensive definition of the construction mega projects. Their investigations showed that despite significant variations in scope, scale, cost, context, and types; the construction mega projects could be characterized by magnified cost, extreme complexity, increased risk, lofty ideals, and high visibility. Their study focused on the mega project attributes. However, they did not elaborate much on the mega project management and delivery.

There is some relationship between the underlying characteristics of a mega project and the suitability of a particular project delivery method. However, there is still a gap in establishing a comprehensive approach in the literature to quantify this relationship. Some recent studies addressed this relationship partially, and in most cases qualitatively. For instance, Gupta (2015) explained how changes in 34 identified impact factors (related to project development and execution) could help in the successful completion of mega projects. Brookes (2014) stressed the need to concentrate on the impact of financing on mega project governance, technical modularization, and project stakeholders. Kay (2009) highlighted the benefits and challenges associated with the public-private partnership and alternative delivery strategies for mega project procurement. These studies present a critique of the traditional project delivery methods and somehow suggest modifying partially or entirely the project delivery strategy. It is expected that the deviations from the commonly used and known project delivery methods pose administrative, legal and technical challenges. The contemporary mega project industry still relies on (and is likely to keep on building for at least many years on) a set of conventional project delivery methods. These methods are commonly adopted and taken with all their pros and cons. It is, therefore, imperative to quantitatively evaluate “the suitability of these methods” in the context of “the mega project attributes.”

The “quantities” of risks, constraints, and opportunities, under which the mega project is likely to be initiated and executed, affect the chances of successful completion without overrunning to the pre-set time and budget. They also influence the possibility of involving private partnerships and as such the selection of optimal project delivery strategy or method. The items or attributes of risks, constraints, and opportunities are mostly common in all the mega projects, but their levels (quantities) vary. For example, one issue (say technical risk) may be “low” in one mega project and “high” in another. The idea of this research is to establish a model that enables the estimation of such variations and link them to the selection of a suitable delivery method for a mega project. To develop the model, the various sources of risk are investigated and categorized into technical, organizational, management, economic
and financial types, which in turn are quantified subjectively through different indicators by key stakeholders. For example, the Human Development Index, inflation, and the gross domestic product (GDP) of a country are good indicators of the country’s economic risk. Indicators are identified by the various project stakeholders to estimate different levels of risks, constraints, and opportunities associated with the mega project.

In addition to quantifying the mega project attributes, an analysis of the intrinsic properties of various project delivery methods is also required. This analysis should establish threshold levels (of risks, constraints, and opportunities) up to which a certain project delivery method remains suitable. For instance, some delivery methods such as design-bid-build (DBB) are arguably suitable for low to medium management-related risk (e.g. miscommunication and poor coordination), and they become unsuitable for high-risk conditions. Alternatively, the design-build (DB) method can be used in situations of high management-related risk. The problem here is that there is no such distinctive border on what levels suit what methods. The mapping of the risks, opportunities and constraints levels to the various project delivery methods is based on the literature guidelines and expert opinions. One can envision the mapping as a decision matrix that summarizes the suitability of various project delivery methods vs the changing levels of mega project attributes.

Development of a fuzzy-based decision support system (DSS) can simplify the quantification of the mega project attributes, their mapping to the decision matrix, and the estimation of the so-called project delivery method index. The system user (decision maker) may use linguistic terms to subjectively define the attributes of mega project through the input component of the DSS. A fuzzy rule-based component may then interpret these data and estimate the resulting levels of risks, constraints, and opportunities, with the help of predefined rules. Finally, the DSS may employ the output interface to map the estimated levels of mega project attributes to the decision matrix. The DSS is developed using Visual Studio® as an integrated development environment and linked to a fuzzy development tool (FuzzyTECH®) as its inference engine.

This study is likely to add to the current theoretical perspective regarding the contract management in the sense that it provides a framework to better handle some of the “upstream activities” in the overall contract management process. These activities are crucial for the successful contract management; however, they are either ignored or poorly executed. Elsey (2007) pointed out that there are some definitions of contract management, the majority of which refer to the post-award activities, however, a successful contract management is the most efficient if the upstream (pre-award) activities are properly carried out. Pre-award contract management activities are designated by Elsey (2007) as: risk assessment, contract strategy, tender evaluation and contract award. Our work shall furnish a risk-assessment tool that is likely to help in evolving a consensus about the contract strategy and contract award. Such consensus is reached by the means of ranking the suitability of 11 commonly used project delivery methods and selecting the most risk mitigating one under given pre-determined project characteristics, which thereby minimizes contract terms and condition negotiation efforts downstream.

1.1 Research problem and significance
Touran et al. (2009) authored a remarkable guidebook for the evaluation of project delivery methods for the transit projects. They observed that there was no “one” best delivery method for all the projects and that only the characteristics of the project could determine which method might be the suitable one. They suggested, based on literature review and data collected on nine major transit projects, that some pertinent issues have effects on the choice of a project delivery method. They categorized these issues as the project-level issues, agency-level issues, public policy/regulatory issues, lifecycle issues, and other issues. They synthesized a framework with a three-tier approach to shortlist and ultimately track
down the most appropriate project delivery method for a given transit project. However, for the third tier approach, that requires a relatively complex quantitative risk analysis, they recommended involving seasoned professionals outside the agency. One may argue that such expertise (in project management) are not easily available everywhere and, therefore, development of a DSS could have been helpful in this direction.

The overall research questions are as follows:

**RQ1.** How to collectively integrate the different perspectives of the various stakeholders of diverse characteristics and expertise in mega projects?

**RQ2.** Given such diversity in stakeholders' characteristics and opinions, can a process be synthesized to characterize the project itself and its environ, and hence determine the suitability rankings of various project delivery methods?

Apart from risk assessment, the study will help in the quantification of various other characteristics of the mega projects such as opportunities, constraints, stakeholder characteristics, and the prevailing economic situation in the country where a mega project is planned. In this way, the study contributes to the knowledge of project characterization in the context of selection of a project delivery method. To achieve this, a simple fuzzy rule-based approach shall be introduced to quantify the attributes of risks, constraints, and opportunities associated with the mega projects, their stakeholders, and location. The impact of these quantified attributes on the inherent suitability of various delivery methods could then be ascertained in the light of mega project experts' opinion. However as mentioned earlier, such experience is not easily available everywhere. Based on our findings, we, therefore, intend to develop a DSS which could act as a virtual mega project expert. The DSS may also be used to have a second opinion regarding the suitability of various delivery methods, in situations where a project delivery method has already been selected.

Overall, our study is expected to simplify some of the concepts regarding the mega project contract management as discussed above. A growing number of scholars have recently been compiling the knowledge and lessons learned from the mega projects (Flyvbjerg, 2016; Greiman, 2013). Capka (2004) indicated that since not all professionals faced with the mission of successfully delivering mega projects have previous experience with these projects, it is vital that they take advantage of both the lessons learned and the challenges. Capka added, “it makes no sense to set out into unfamiliar territory without a road map when some maps already exist.”

The planned DSS is a multi-criterion decision-making (MCDM) tool that employs fuzzy logic. Section 2 of this paper briefly reviews some of the critical literature about MCDM, fuzzy logic applications in project management, and it also features a brief discussion on various characteristics of the mega projects. Section 3 explains the adopted research methodology in design and the continuous calibration of the DSS. Section 4 details the structure and functions of the DSS with an example calculation to further elaborate the DSS. It also includes the mathematical models of the DSS. Section 5 deliberates on the underlying assumptions used in the development of the model. Additionally, it provides an overview of the capabilities and limitations of the DSS and discusses its sensitivity to the decision matrix entries. A dedicated section on the results of the study has been intentionally discounted and reserved for future articles upon the calibration of fuzzy rule-based of the DSS.

### 2. Literature review

Mahdi and Alreshaid (2005) developed an MCDM tool using analytical hierarchy process (AHP) to assist decision makers in selecting an appropriate project delivery method for construction projects. They identified 34 factors and categorized them into seven areas, namely: project characteristics, owner characteristics, design characteristics, regulatory
(characteristics), contractor characteristics, risk allocation and risk management improvement, and claims and disputes. They demonstrated the sensitivity of their model to change in relative weights of the factor areas, i.e. relative weight (appropriateness) of delivery methods changed when relative weights (importance) of the factors mentioned above are altered. Noteworthy, their study was not particular to the mega projects and had been based on AHP as an MCDM tool. Mega projects are commonly associated with more risks and uncertainties (than ordinary construction projects) owing to their stretched schedules, possible changes in scope, and difficulty-to-predict costs.

When a problem involves more uncertainty, the AHP has been subjected to some scrutiny. Kordi and Brandt (2012) undertook a case study using conventional AHP and fuzzy-AHP as two different techniques of MCDM. They noted that the traditional AHP is sensitive to the level of vagueness in data and can lead to various decisions in situations which pose higher degrees of uncertainty. Fuzzy-AHP and pure fuzzy logic may, therefore, be more appealing to the researchers who wish to develop MCDM models for mega projects.

The application of “fuzzy techniques” has been gaining popularity in the research area of management over the past decade. Chan et al. (2009) provided a thorough review of the various fuzzy techniques in construction management. They indicated that the two fundamental “fuzzy concepts,” namely fuzzy set and fuzzy logic, were extensively applied in construction management research. Among the reviewed articles are the ones for contractor’s selection, competitive bidding strategies, resource allocation, project scheduling, risk management, value management, and risk-assessment systems. Of particular interest is the clustering of the reviewed studies into decision-making applications, evaluation/assessment applications, performance estimation, and modeling.

Another research by Pan (2008) investigated the use of fuzzy logic in selecting the most suitable construction method (among three methods) with a case study of a bridge in Taiwan. Fuzzy logic was constructed to evaluate the three project construction methods using five criteria; quality, cost, safety, duration, and shape. Each criterion was broken further into two or three sub-criteria. The importance of these criteria and sub-criteria was assessed using surveys of a limited number of experts. The paper presented AHP fuzzy model. The premise of this approach is its ability in handling the uncertainty and vagueness involving the mapping of one’s preference to an exact number or ratio. Shi et al. (2014) highlighted the extra risks associated with the growing number of large construction projects. A mixed approach was used to explore the management of delivery risks. The method included the use of fuzzy logic together with data envelopment analysis to assess the delivery risks.

The provision of mega projects with success faces many challenges that are not essentially parts of conventional small size projects. Mega projects particularly face elements of risks, opportunities of investments and constraints on delivery that may not be noticeable for the small projects. Among the significant project risks, are the ones associated with the managerial skills or processes of stakeholders of such mega projects (Al Nahyan et al., 2012). The key management aspects identified as of high importance are communication, coordination, knowledge sharing, and decision making. The lack of communication among parties was reported among the ten most important causes of project delay (Sambasivan and Soon, 2007). Effective communication practices ensure that all the main players are kept fully informed of any problems or difficulties and have procedures for decision making and managing these immediately when they occur and not allow them to disrupt the project (Kerzner, 2013). Zwikael et al. (2005) examined project management practices and concluded that various types of management styles, scope and time management impact on improving the technical performance of projects, while communication and cost management impact on improving overall success measures of projects.

Other researchers have suggested the use of communication effectiveness models, to predict satisfaction levels by contractors and clients at the earliest possible stage in the
3. Research approach

This study, for the sake of explanation, is divided into two phases. The first phase consisted of rigorous literature review and brainstorming sessions with selected experts (as detailed in Section 3.1) to design and develop a prototype of the DSS. The second (ongoing) phase of this study aims at verifying the established prototype of the intended DSS.

3.1 Conceptual design and prototyping (phase I)

The literature review indicated that the selection of a project delivery method is affected by many factors. The research studies differ in the extent of these factors, and categorization. For instance, Mahdi and Alreshaid (2005) examined the compatibility of numerous project delivery methods with various owners and project types. They identified 34 factors and categorized them in seven factor areas as discussed earlier. The Design-Build Institute of America documented that the owner should consider five major factors (namely, owner control, owner relationship, project budget, project schedule and the owner risk) while selecting a project delivery method (DBIA, 2015). Koppinen and Lahdenperä (2004) determined the performance of four project delivery methods based on data provided by interviewees in five different countries. They concluded that the “circumstances” of project size, complexity, objectives (end-results), opportunities to innovate or to generate revenue, and restrictions affect the strategic selection of a road project delivery method.

We decided to get the opinion of construction management professionals to conceive and design the overall model structure which constitutes the core of envisioned DSS. In this regard, a comprehensive questionnaire was developed that consisted of three sections, each requiring approximately ten minutes to complete. The first section consisted of questions regarding the demographic profiling of the respondents. The section also included a question related to the importance of various stakeholders (e.g. clients, consultants, and contractors) at the different stages of the projects (e.g. planning, design, and construction). Section 2 included questions regarding the importance of various risk categories associated with mega projects, risk indicators, and the strength as well as nature of the relationship among risks and their indicators. Likewise, Section 3 consisted of questions on constraints and opportunities associated with the mega projects. A total of 176 professionals initially showed a willingness to participate in the study out of which 127 completely answered the survey questions. Few others responded partially. In general, all the respondents were sufficiently experienced in the construction industry. Figure 1 provides an insight into the demography of those surveyed and their experience in mega project industry.

This survey helped us in establishing that the factors of risks, project’s constraints, and opportunities, which affect the selection of a project delivery method, could reasonably be measured through the indicators mentioned in Table I. However, the respondents were of the view that different indicators affect their parent factor differently.
Assuming that the participants’ opinions are of equal weights irrespective of their experience, the inadequate level of employees technical competency has an average impact level of 2.48 (minimum impact level is 0, and highest is 3) on the overall project’s technical risk. The employees’ technical competency impact is greater than the average impact levels posed by the ineffective study on the technical feasibility of the project (2.3) and the deficient/inefficient work breakdown structure (2.04). These impact levels affect the way technical risk is estimated (refer to Section 4 for further detail). The impact levels of all the indicators (mentioned in Table I) were studied likewise. The survey continues to date and, once completed, a dedicated study of the survey itself, results, data analysis, and model calibration shall be published separately. For more information about the survey and its questions, the reader is referred to RTTSRC (2016).

The risk factors create obstacles to the project success, opportunities influence the attractiveness of the project’s investment portfolio and increase the chances of involving private sectors, and finally, the constraints of the project (e.g. institutional or financial) limit the selection of particular types of delivery methods. Our observations are in line with the relevant literature (DBIA, 2015; Mahdi and Alreshaid, 2005; Touran et al., 2009).

The first phase of the study entails designing a preliminary fuzzy inference engine, based on the above findings, to estimate the relative “quantities” of risks, constraints, and opportunities through subjectively defined sets of indicators as shown in Table I. The inference engine rules map the levels of these indicators to the corresponding risks, opportunities, and constraints levels. These estimated values (levels) of risks, constraints, and opportunities are then mapped to the decision matrix (against various delivery methods) to find which of the methods is the most suitable for the mega project under consideration. The decision matrix is discussed in Section 4 in detail.

Figure 1. Demographics of the survey respondents
<table>
<thead>
<tr>
<th>Factors</th>
<th>Elements of factors</th>
<th>Indicators of elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risks</td>
<td>Technical risk</td>
<td>Inadequate level of employees' technical competency</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ineffective study on the technical feasibility of the project</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inadequate level of design quality and documentation</td>
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<td></td>
<td></td>
<td>Insufficient level of design completion and detailing</td>
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<tr>
<td></td>
<td></td>
<td>Deficient/inefficient work breakdown structure</td>
</tr>
<tr>
<td>Organizational risk</td>
<td></td>
<td>Insufficient time to plan</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inconsistent time, cost, scope and quality objectives</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inexperienced staff assigned to project</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Losing critical staff at crucial point of the project</td>
</tr>
<tr>
<td>Financial risk</td>
<td></td>
<td>Improper budget allocation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ineffective study on the financial feasibility of the project</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inadequate evaluation of stakeholder's previous performance</td>
</tr>
</tbody>
</table>
| Project management risk |                 | (i) Communication Risk  
|                    | (i)                  | Indicators of Communication Risk                                                       |
|                    | (i)                  | Ineffective communication tools                                                        |
|                    | (i)                  | No identification and delegation of key communication personnel                       |
|                    | (i)                  | Difficulty to access information                                                       |
|                    | (i)                  | Infrequent work meetings                                                               |
|                    | (ii)                 | Coordination risk  
|                    | (ii)                 | Indicators of coordination risk                                                        |
|                    | (ii)                 | No existence of a coordination committee/personnel                                      |
|                    | (ii)                 | Improper delegation of signing authorities                                             |
|                    | (ii)                 | No delegation of coordination personnel                                                |
|                    | (ii)                 | Inefficient mechanism for coordination                                                 |
|                    | (iii)                | Decision-making risk  
|                    | (iii)                | Indicators of decision-making risk                                                     |
|                    | (iii)                | Inadequate levels of technical and financial competencies                              |
|                    | (iii)                | Improper delegation of decision-making authority                                        |
|                    | (iii)                | Ineffective decision-making structure                                                  |
|                    | (iii)                | Slow decision making                                                                  |
|                    | (iv)                 | Knowledge sharing risk  
|                    | (iv)                 | Indicators of knowledge sharing risk                                                   |
|                    | (iv)                 | Ineffective teamwork                                                                  |
|                    | (iv)                 | Ineffective knowledge management systems (KMS)                                         |
| Economic           |                     | Country's high inflation rate                                                          |
|                    |                     | Increase in Human Development Index (HDI) value                                        |
|                    |                     | Increase in population size                                                            |
|                    |                     | Increased level of unemployment                                                       |
|                    |                     | Increased cash flow levels in the market                                               |
| Constraints        | Institutional constraint | Inadequacy of the institution’s capability to supervise the project               |
|                    | Institutional constraint | Shortage in institution’s fund                                                        |
|                    | Institutional constraint | Frequent changes in the project objective and scope of work                           |
| Performance constraint |                   | Inadequate provision of incentives and penalties to the employees                   |
| Financial audit constraint |             | Strict regulations in the procurement procedures                                      |
| Regulatory constraint |                   | No clear governmental regulations and policies to encourage private partnership       |
| Opportunities      | Government policies | Existence of policy                                                                    |
|                    | Government policies | Frequent changes in the policy                                                         |
|                    | Institutional transparency | Lack of clarity in technical and financial plans                                    |
|                    | Institutional transparency | Lack of clarity in communication                                                      |
|                    | Institutional transparency | Lack of transparency in information sharing                                            |
|                    | Institutional transparency | Effective integration of decision-making bodies                                        |
|                    | Institutional transparency | Clear consensus on rules of governance                                                |
|                    | Institutional transparency | Effective contracting law                                                            |
| Return on investments |                   | Low capital assets                                                                    |
|                    | Return on investments | Increased profit level                                                                |

Table I. The factors and indicators of the mega projects
Another dimension of this problem (identified during the pilot investigations) is the importance (relative weights) of the risk, constraint, and opportunity groups in determining the suitability of various project delivery methods. At times, a client may desire to opt for a “safe” approach toward project implementation. In such a case, assigning more weight to negative risks in decision making may be helpful. Alternatively, if only opportunities are considered (with a relative weight of 100 percent), the decision on project delivery maximizes to the investment opportunities. Similarly, if the decision maker considers only constraints, a relative weight can be assigned, and as such, both risks and opportunities will not affect the decision making. The client has, therefore, been empowered to alter the relative weights of risks, constraints, and opportunities as causative factors in making decisions.

3.2 Ongoing study (phase II)
Phase II aims at assessing the calibrated DSS prototype in light of more extensive data collection from various stakeholders locally and internationally. The assessment may result in re-calibrating partially or entirely embedded inference engine. This re-calibration process includes:

(1) Calibration of the fuzzy inference engine which means:
   • verification of the identified indicators (in Table I) of risks, constraints, and opportunities; and
   • estimation of the strength of the relationship between the indicators and their respective mega project attributes.

(2) Calibration of the decision matrix.

(3) Validation and verification of the overall fuzzy model.

The verification of indicators (and their relationship with the respective elements) requires input from the mega project experts, which entails conducting exhaustive surveys from the mega project industry worldwide. For this reason, the scope of survey mentioned in Section 3.1 has been broadened to include the opinion of more mega project professionals around the world. An online questionnaire has been designed in this regard, using the SurveyGizmo®, to reach more professionals. Lengthy questionnaires may result in reduced response rates and qualities (Galesic and Bosnjak, 2009). Therefore, a “conditional logic” and scripting has been used in devising a structured study. The logic entails eliminating questions that do not appear relevant or necessary as per the participant’s experience and responses as he/she progresses through the survey. The data collected, through the ongoing study, shall be used to verify the (initially determined) correlation values and the sign of the relationships between the indicators and corresponding elements of risks, constraints, and opportunities. Figure 2 illustrates a sample of the survey responses that were used in calibrating the fuzzy logic and its strength relationships. As can be seen, respondents regard the financial risk to be the most important risk factor, followed then by the technical risk. The majority of those surveyed (48 percent) believe that the technical risk imposes a high level of risk on the project, while only 10 percent see that the technical risk poses a low degree of risk. Among all the indicators of technical risk, the low level of employees technical competency and the insufficient level of design level and documentation were the most important indicators of the overall project’s technical risk.

The verification of the decision matrix is a rather difficult task yet vital as the expertise in mega project management is rare and mostly limited to one or few project delivery methods. A decision model based on the private opinion of an individual expert is, therefore, less likely to represent the whole dynamics of the mega project delivery. We are therefore relying on the collective wisdom of the group of experts (available in the form of
best-practice guidelines) instead of floating a questionnaire for the verification of decision matrix. This audit is crucial as the overall suitability of the project delivery methods is sensitive to changes in the decision matrix. The sensitivity of the DSS to the given decision matrix has been discussed in Section 5.

The verification and validation of the integrated rule-based fuzzy model are the final steps toward the calibration of the DSS. It is noteworthy that the Visual Studio® based (input and output) interface modules (for fuzzification and defuzzification) are integral parts of this fuzzy model. Such models usually require quantification of internal and external accuracy, separately, to ensure that the granular to a numeric interface does not generate any additional error (Pedrycz and Gomide, 2007). We intend to quantify both the internal
and external errors to verify our fuzzy rule base. For the sake of validation, it is required to quantitatively verify the transparency and stability of the fuzzy model. The results of verification and validation processes shall be published once the study is complete.

4. Model structure

The DSS has three components: the input interface, the fuzzy rule-based processing (granular) core, and the output interface. This underlying architecture is common to nearly every fuzzy model which involves a rule-based topology (Pedrycz and Gomide, 2007). The overall model structure is shown in Figure 3.

The input and output components of the DSS are designed to provide an interactive graphical user interface (using Microsoft Visual Studio®). The granular fuzzy core is designed using FuzzyTech®. The input space allows end-users to define mega project attributes through the subjective levels of the indicators (fuzzy sets) of risks, constraints, and opportunities. The terms are “defuzzified” before passing them on to the granular core. Using the fuzzy rule base, the granular core estimates the quantitative values of all risks, constraints, and opportunities. In its calculations, the processing core relies on the built-in correlation value and sign of the relationship between indicators and their respective elements that have been defined for each rule of the fuzzy rule base. Following the handling of the fuzzy core modules, the estimated quantities of risks, constraints, and opportunities are again “fuzzified” (categorized as low, medium or high) based on their magnitude. Finally, the categorized values are mapped to the decision matrix (Table II). This mapping determines the suitability of every project delivery method for the mega project whose attributes were fed to the input space of the DSS.

The cell entries of 1 and 0 in Table II indicate “suitable” and “not suitable,” respectively. This table summarizes the inherent suitability of various project delivery methods, as described in the literature, against the varying levels of infrastructure project attributes. For example, McConachy (1998) suggested that the DB method should be
### Suitability of delivery methods against various levels of risk, constraint, and opportunity types

$L = \text{low level},$ $M = \text{medium level},$ and $H = \text{high level}.$

**Codes:** 1 = Suitable, 0 = Unsuitable

<table>
<thead>
<tr>
<th>Risk types</th>
<th>Project management risk</th>
<th>Technical risks</th>
<th>Organizational risk</th>
<th>Country's economic risk</th>
<th>Financial risks</th>
<th>Institutional constraints</th>
<th>Performance constraints</th>
<th>Financial audit constraints</th>
<th>Regulatory constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project delivery methods</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design-bid-build (DBB)</td>
<td>L</td>
<td>M</td>
<td>H</td>
<td>L</td>
<td>M</td>
<td>H</td>
<td>L</td>
<td>M</td>
<td>H</td>
</tr>
<tr>
<td>Performance based maintenance contracting (PBMC)</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Construction manager at risk (CMAR)</td>
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<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Design-build-warranty (DBW)</td>
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<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Design-build-operate-maintain (DBOM)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Design-build-finance-operate (DBFO)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Build-operate -transfer (BOT/BOOT)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Design build finance operate maintain (DBFOM)</td>
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<td>1</td>
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<td>1</td>
<td>1</td>
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<tr>
<td>Alliance contracting (AC)</td>
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<td>1</td>
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<td>1</td>
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<td>1</td>
</tr>
<tr>
<td>Build-own-operate (BOO)</td>
<td>1</td>
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<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<td>1</td>
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</tbody>
</table>

**Table II.** The decision matrix of the project delivery methods for mega projects.
preferred over the DBB in case the owner lacks necessary experience in supervision of the construction projects (i.e. in high technical risk situations). The same can be seen in the decision matrix (Table II) whereby the DB is referred to as a suitable method for high technical risk while DBB is deemed unsuitable. In this way, under varying levels of the mega project attributes, the decision matrix reflects on the suitability of different project delivery methods whose properties have been discussed extensively in the literature (Molenaar and Yakowenko, 2006; Sande et al., 2015; Touran et al., 2009; Walewski and Jasper, 2001).

To understand the model further, we started with an estimation of the value of technical risk which is a part of the overall project risks. As shown in Table I, the technical risk is likely to be affected by:

- inadequate level of employees’ technical competency;
- ineffective study on the technical feasibility of the project;
- inadequate level of design quality and documentation;
- insufficient level of design completion and detailing; and
- deficient/inefficient work breakdown structure.

To estimate the technical risk, the user indicates the subjective levels (e.g. low, medium, high) of the above indicators for each of the concerned stakeholders. That is, the level of the technical competency of the employees, the effectiveness of the technical study on project feasibility, the level of design quality and documentation, the level of design completion and detailing, and the level of work breakdown structure are all assessed for all concerned stakeholders. This subjective assessment is done by the system user (which is envisioned here to be the “owner” of the project or the client/developer).

These indicators are likely to vary across stakeholders, and as such the resulting technical risk of each stakeholder may also vary. Apart from variations in risks, the importance of stakeholders also varies from one stakeholder to another stakeholder and from one stage of the project to another stage of the project. For example, the technical risk posed by the contractor may not be as important during the planning phase as it is during the construction phase. We can model all these variations mathematically as follows.

Let $R_{tj}$ be the technical risk posed by the $j$th stakeholder and $I_j$ represents the average importance level of the same stakeholder over all the stages of the mega project. The overall technical risk $R_t$ posed by $J$ stakeholders, can be mathematically estimated as follows:

$$R_t = \frac{\sum_{j=1}^{J} R_{tj} I_j}{\sum_{j=1}^{J} I_j}$$

(1)

The value of $I_j$ may be defined by the end-user (using input interface) on a scale from 1 to 9 where a higher value means more importance. The DSS estimates the $R_{tj}$ value by employing fuzzy inference engine which consists of three rule blocks for this estimation. Figure 4 shows a schematic representation of these rule blocks.

Every rule block hosts a set of rules with each rule consisting of a unique combination of the subjective levels of the technical risk indicators. As an example, Table III shows the set of the IF-THEN rules for the block that estimates a part of the total technical risk (say T_Risk_1). The output of any given rule depends not only on the level of indicator but also on the strength (or degree of truth) with which a given indicator represents the technical risk. This strength of relationship of an indicator to its parent attribute (in this case the technical risk) is also called the firing strength and needs to be defined and included for each indicator in every rule.
The varying levels (values) of indicators in a rule block are aggregated through a suitable operator, for example, the minimum operator. This yields one output linguistic term for every rule in the block. These output terms may be aggregated further if required, for instance, in the case of technical risk estimation, the output function (T_Risk_1 and T_Risk_2) must be aggregated to estimate the \( R_{ij} \) value. This aggregation may be achieved through the built-in aggregation methods for example “BSUM: bounded sum of all firing degrees” and the “MAX: maximum of all firing degrees.” The resulting technical risk level (linguistic term) of the third rule block is defuzzified using the center of mass method to estimate the numerical value of \( R_{ij} \). Likewise, the values of technical risk posed by every stakeholder in the mega project shall be estimated one by one and reported as such to the output interface of the DSS.

The output interface will use Equation 1 to combine the individual \( R_{ij} \) values for all the \( J \) stakeholders to estimate the overall technical risk \( R_i \) collectively posed by all the stakeholders such that \( R_i \in [0,1] \). The value of \( R_i \) closer to 0 means an overall low technical risk posed by the stakeholders, and vice versa. The next step is to map these numerical values of \( R_i \) to
the decision matrix. As shown in Table II, the decision matrix accepts only fuzzy terms. The situation binds us to fuzzify the estimated $R_t$ values as low $(L)$, medium $(M)$, or high $(H)$ and to estimate the probability of each category $PR_t(L)$, $PR_t(M)$, $PR_t(H)$ as follows:

1. $\forall R_t \leq 0.25 \leftarrow R_t \in \{L\}, P_{R_t}(L) = 1$.
2. $R_t = 0.5 \leftarrow R_t \in \{M\}, P_{R_t}(M) = 1$.
3. $\forall R_t \geq 0.75 \leftarrow R_t \in \{H\}, P_{R_t}(H) = 1$.

4. In case of $(0.25 < R_t < 0.5)$, it implies low and medium levels of technical risk. That is, a part of $R_t$ belongs to the Low level while the remaining of it belongs to the Medium level. If $P_{R_t}(M)$ represents the proportion of $R_t$ categorized as Medium, and $P_{R_t}(L)$ indicates the proportion of $R_t$ that belongs to Low category then:

$$P_{R_t}(M) = \frac{R_t - 0.25}{0.25}, \quad P_{R_t}(L) = 1 - P_{R_t}(M)$$

5. In case of $(0.5 < R_t < 0.75)$, the procedure mentioned above shall be repeated to find proportions of Medium and High categories as follows:

$$P_{R_t}(H) = \frac{R_t - 0.5}{0.25}, \quad P_{R_t}(M) = 1 - P_{R_t}(H)$$

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<th>WBS</th>
<th>DoS</th>
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Table III. Possible combinations of antecedents and consequents in one of the rule blocks for technical risk estimation
Once fuzzified, the $R_t$ values can be mapped to the decision matrix (Table II). For the cases of ($R_t \leq 0.25$), ($R_t = 0.5$), and ($R_t \geq 0.75$), the $R_t$ value is low, medium, and high, and as such, can be multiplied directly by the corresponding 0 or 1 under the technical risk element against every project delivery method. In case of ($0.25 < R_t < 0.5$), $R_t$ has two proportions of $P_{R_t}(L)$ and $P_{R_t}(M)$. Similarly, in case of ($0.5 < R_t < 0.75$) has two proportions, $P_{R_t}(M)$ and $P_{R_t}(H)$. In both of these cases, the proportions shall be mapped separately to the decision matrix and the results will be added, as per the case. It implies that if the $R_t$ value is categorized as medium and high), and then mapped to the decision matrix against the DBB method (see Table I); the $P_{R_t}(M)$ shall be multiplied by 1 (the cell entry of the decision matrix in the case of DBB and $M$ technical risk category) and $P_{R_t}(H)$ is multiplied by 0 (the cell entry of the decision matrix in the case of DBB and $H$ technical risk category). The results of these multiplications shall then be added. That is, for any project delivery method $k, k \in [1,K]$, the overall suitability score $S_{R,t}^k$ of this method $k$ with respect to the risk $R$ technical category $t$ is estimated as follows:

$$S_{R,t}^k = s_{R,t,L}^k \cdot P_{R,t}(L) + s_{R,t,M}^k \cdot P_{R,t}(M) + s_{R,t,H}^k \cdot P_{R,t}(H), \forall k \in [1,K]$$  \hspace{1cm} (2)

$s_{R,t,L}^k = 1$ if project delivery method $k$ is suitable for the low ($L$) technical ($t$) risk ($R$) condition, and $s_{R,t,L}^k = 0$ otherwise. $s_{R,t,M}^k = 1$ if project delivery method $k$ is suitable for the medium ($M$) technical risk condition, and $s_{R,t,M}^k = 0$ otherwise. $s_{R,t,H}^k = 1$ if project delivery method $k$ is suitable for the high ($H$) technical risk condition, and $s_{R,t,H}^k = 0$ otherwise.

At this point, a relationship is established between the suitability of a delivery method and the technical risk posed on the mega project by the $n$ stakeholders. This relation is a function of the intrinsic response of a certain project delivery method to the estimated technical risk associated with the mega project. By following similar estimation and mapping procedures, we can establish the suitability of project delivery methods against various types of risks, constraints, and opportunities that are associated with the mega project. Finally, by accumulating these results, the overall suitability indices of all delivery methods are estimated.

As indicated earlier, the system user may incline more/less importance to the attributes of risks, constraints, and opportunities. That is, these attributes may have different weights in the decision making. For example, the client (for any reason) may be inclined toward the least risk decisions, and in such a case, he/she may wish to assign more weights to the negative risks, thus enabling himself/herself to select a delivery method which is more suitable under risk conditions. That is why we should able to vary the weights of risks, constraints, and opportunities which are set otherwise (by default) equally affecting the selection of a delivery method. Let $W_R, W_C,$ and $W_O$ represent the assigned weights of risks, constraints, and opportunities respectively in the decision-making process, then:

$$W_R + W_C + W_O = 1$$  \hspace{1cm} (3)

Equation 3 implies that we may assign equal or different weights to the attributes of the mega projects and can also ignore one or more of these factors altogether (by assigning zero weight/s).

The risks, constraints, and opportunities categories are divided into smaller classes, e.g., the risk may be technical, organizational, financial, management, or economic. To empower the decision-maker and to enable studying the effect of these classes on project delivery, the sub-classes are also assigned differential weights. Let $W_{R,t}, W_{R,o}, W_{R,f}, W_{R,m},$ and $W_{R,e}$ represent the differential weights of technical, organizational, financial, management, and economic risks respectively, then we can write:

$$W_{R,t} + W_{R,o} + W_{R,f} + W_{R,m} + W_{R,e} = 1$$  \hspace{1cm} (4)

Similar equations may be written for the weights of the elements of constraints and opportunities. If we combine the corresponding weight factors (in Equations 3 and 4) with
the mapping results for risk, constraints, and opportunities (for a project delivery method); we can estimate an index that reflects the suitability of the specific delivery method for the mega project under study. Mathematically:

$$S^k = S^k_R \cdot W_R + S^k_C \cdot W_C + S^k_O \cdot W_O, \; \forall k \in [1, K]$$

(5)

where $k$ in the superscript represents the project delivery method. $K$ is the total number of project delivery methods under consideration. $S^k_R$, $S^k_C$, and $S^k_O$ represent the overall mapping scores of all the elements of risks, constraints and opportunities, respectively. The overall score of risk is the summation of the scores of each risk category times their relative weights. That is:

$$S^k_R = S^k_{R,t} \cdot W_{R,t} + S^k_{R,o} \cdot W_{R,o} + S^k_{R,f} \cdot W_{R,f} + S^k_{R,m} \cdot W_{R,m} + S^k_{R,e} \cdot W_{R,e}$$

(6)

where $S^k_{R,t}$, $S^k_{R,o}$, $S^k_{R,f}$, $S^k_{R,m}$, and $S^k_{R,e}$ represent the score mapping results of the technical, organizational, financial, management and economic risks, respectively for the $k$ delivery method. Similar expressions were written for $S^k_C$ and $S^k_O$.

The overall absolute score of any delivery method is then estimated using Equation 5. Note that, in Equation 6, if the relative weight of one or more of the risk factors are reduced to zero or changed, the range of the value of the score $S^k_R$ does not remain the same, and as such, $S^k$ will also change (see Equation 5). The possible variations in the resulting absolute values require then standardization of the scores to enable consistent comparison among all delivery methods regardless of the assigned weights.

Equation 5 estimates the overall "absolute" score of each delivery method $k$. To estimate the relative scores, the maximum absolute score is estimated as follows:

$$S_{\text{max}} = \text{Max} \left\{ S^k = S^k_R \cdot W_R + S^k_C \cdot W_C + S^k_O \cdot W_O, \; \forall k \in [1, K] \right\}$$

(7)

The standardized score $\tilde{S}^k$ of any delivery method $k$ is then estimated using the following equation:

$$\tilde{S}^k = \frac{S^k}{S_{\text{max}}}, \; \forall k \in [1, K]$$

(8)

The index $\tilde{S}^k$ – referred to herein as the project delivery method (suitability) index – reflects the suitability of the corresponding $k$ delivery method on an ordinal scale from 0 to 1. The higher the value of $\tilde{S}^k$, the more suitable the method is and vice versa.

A comparison of $\tilde{S}^k$ values for all the delivery methods under consideration can help in determining which of the methods is the most suitable for the mega project delivery. Therefore, the devised DSS plots all the $\tilde{S}^k$ values for a quick comparison as shown in Figure 5. The DB method stands out from the rest due to the high $\tilde{S}^k$ value and is the most suitable method for the arbitrary set of conditions used in this plot.

5. Conclusions and discussions

In general, selection of appropriate project delivery method can contribute to the successful completion of mega projects. The presented model is sensitive to the fuzzy logic model (FLM) membership functions, the inference rule-based and the decision matrix. FLM membership functions are translated directly from the input fed into the system by the end user (client). That is why it is important for the end-user to understand the project environs (subjectively yet) accurately.

The environs of the decision making (regarding the mega project delivery methods) will continue to appear foggy until we bust the myths surrounding the risks, constraints, and
opportunities associated with the mega projects and their stakeholders. Additionally, there is a need to quantify the intrinsic behavior of the project delivery methods vs the varying levels of mega project attributes. There has been so much subjectivity in defining the mega project attributes and the project delivery methods, that the decision making in this regard is likely to be inconsistent. Particularly, the novice decision makers are prone to commit errors while relating the attributes of the mega projects to the suitability of the traditional delivery methods. We believe that a breakdown of these mega project attributes in smaller, more measurable chunks (elements and indicators) is a significant step toward "quantification" of the mega project attributes. It is likely to lead us toward better decision making on mega projects delivery methods.

The devised DSS is likely to lessen the dependency of "accurate decision" on "the experience of the decision-makers." The calibration of the fuzzy rule base of the DSS depends on how accurately the relationships between indicators and their elements have been defined. Thus, it is essential to involve the various stakeholders in understanding the nature of these relationships. Each project has its own lessons and environs that may not be repeated with other projects. This explains why it is rather important to collect information from different stakeholders and about various projects, all over the world. This could be overwhelming, but it is essential for the accurate tuning of the system.

The calibration of the decision matrix is a rather difficult and challenging task. The decision matrix is a summary of how various delivery methods behave under varying levels of risks, constraints, and opportunities. The model is initially developed, as indicated in Section 4, based on intuitive extractions from the extensive review of global best-practice guidelines and literature. More research and perhaps surveys may be needed to fine tune the matrix.

The model allows the end user to change the relative weights of the (whole) groups of risks, constraints, and opportunities. For instance, if only risks are considered (risks are weighted 100 percent while constraints and opportunities are weighted 0 percent each), one can then select best project delivery methods to minimize project risks. Furthermore, the model allows changing the relative weights of individual elements of the risks, constraints, and opportunities groups as discussed in Section 4. Hence, the decisions can be biased toward any of these groups or their elements based on these differential weights.

While this study is focused on the selection of a suitable delivery method for a mega project, some aspects of the study may help in understanding the underlying causes of
success or failure in delivering the mega projects. Decision matrix (Table II) deserves attention in this regard. Primarily, the matrix defines the threshold levels of risks, constraints, and opportunities which suit a given project delivery method. However, digging deeper into the matrix provides another dimension for the discussion. Suppose that for a mega project; DBB method failed to deliver according to the aspirations of the decision makers. One of the possible reasons for the underperformance, as per Table II, is that the mega project faced high risks, against which, the DBB is intrinsically not suitable. Table I may then be used to trace the origin of different risk types, for example, the high project management risk is likely to arise due to poor coordination, communication gaps, lethargic decision making, and absence of knowledge sharing mechanism. Improving the indicators of these risk factors may help in reducing the associated risk and hence avoiding possible failure in delivering the mega project.

An analysis of the sensitivity of the DSS to change in relative weights of the mega project attributes can help in identifying the factors critical to the mega project delivery. For example, if the output of the system is sensitive to the level of financial risk, we need to keep a stricter check on the budget allocation and perform a proper financial feasibility study. Such an analysis can be performed only once the ongoing phase of the study is completed, as it requires the calibration of the fuzzy rule base. The sensitivity analysis of the DSS shall be reported once the fine tuning of the envisaged system is completed.

The value of project delivery method index $S^k$ ranges from 0-1. The scale used here is ordinal i.e. it merely ranks the project delivery methods and as such the intervals on the scale may not be regarded as equal. Also, note that while the highest index value indicates the most suitable delivery method, index values closer to the front-runner may still indicate acceptable delivery methods. For example, regarding Figure 4, the DB is the most suitable method. Nonetheless, if the client cannot adopt DB, he may consider opting for Build-Own-Operate (BOO) as an alternative owing to its high index value (0.83). In cases where more sophisticated analysis is required, the end-user may apply a suitable clustering technique to group the $S^k$ values. Kaufman and Rousseeuw (2009) is a useful reference in this regard.

It is noteworthy that some of the indicators of risk, constraints, and opportunities may interact with one another. Take, for example, the GDP growth and inflation which are two indicators of economic risk. An earlier study (Mubila et al., 2000) specified that the higher GDP growth beyond the country’s nominal GDP is likely to lead to successful project delivery (lesser risk) and vice versa. In the current DSS model, the GDP factor is modeled as a binary variable (True and False). A “true” value indicates that the country’s current GDP growth is higher than its nominal GDP growth value and a “false” value indicates otherwise. The “true” value is likely to lead to negative (lesser) economic risk as such. On the other hand, the investors (in the real world) do not perceive the risks consistently decreasing with an increase in the GDP. They rather desire that the GDP growth should stay around 3 percent (except when the economy is reviving from some recession). This is because even moderate gains in GDP are associated with high inflation rates (Pollin and Zhu, 2006). That is why it is important to base the decision not only on the GDP growth but also to take into account the inflation rate as we considered in the current DSS.

This model may also be used to optimize the criteria for the selection of the contractor and consultant firms at the bidding stage. Suppose that for whatever reasons the DB has been selected as a project delivery method. The DB method can sustain relatively high levels of risk. However, the DB method is not suitable if there are medium or high levels of constraints on performance (Table II). The client firm may, therefore, assign due weight to the performance-track-record of the bidding companies; thus, optimizing the criteria for technical evaluation of the bidders and increasing the chances of successful project delivery straight away from the tender stage. Regarding Table I, an adequate system of performance-based incentives and disincentives is likely to lessen the performance
constraints. Therefore, once awarded the contract, the selected contractor/consultant firm may be required to devise such sort of performance evaluation systems. Thus, the model may be used in several ways eventually aimed at guiding the decision makers toward more rewarding strategies from project planning to execution and complete delivery.

Lastly, the issue of subjectivity in mega project decision making is multipronged and must be addressed in more ways than one. The “quantification” of mega project attributes has been emphasized in this study as an approach to tackle the element of subjectivity in decision making. However, factors like client’s experience, contract management knowledge, and perception about prevailing economic situation in the country may still lead to varied decisions. The extent to which the output of the envision DSS is affected by these factors can be visualized through a sensitivity analysis of the verified model. A few steps may be taken, for example developing comprehensive user manual and strict guidelines, to control any such variations. Having said that, the DSS is likely to be as objective in decision making as an average mega project expert and is particularly intended for the situations where either mega project expertise is not easily available, or the client seeks for a well-informed second opinion for the selection of a project delivery method.

References


Kaufman, L. and Rousseeuw, P.J. (2009), Finding Groups in Data: An Introduction to Cluster Analysis, John Wiley & Sons, Hoboken, NJ.


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Organizing inter-firm project governance – a contextual model for empirical investigation

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Abstract
Purpose – The management of major inter-firm projects requires a coherent, holistic governance framework to be effective. However, most existing models of project governance are limited to a narrow selection of contractual, structural or procedural aspects, and further neglect contextual factors, such as key characteristics of a project and its partners. The paper aims to discuss these issues.
Design/methodology/approach – This conceptual paper proposes an integrative analytical model of inter-firm project governance, building upon contingency theory and drawing from established constructs rooted in organization theory.
Findings – The paper aims to integrate two largely distinct streams of research and synthesize the respective constitutive dimensions of project governance into a coherent conceptual model. Further, interrelationships with contextual factors, such as project-related and partner-related characteristics, and project performance are discussed.
Originality/value – The proposed model purposefully merges two complementary streams of project governance research. As the model further provides clear contextual factors, it strengthens an emerging stream of project research by systematically examining external influences of project organizing. Future research may utilize this model and the suggested operationalization for each of the constructs as a basis to empirically investigate the design and effectiveness of governance regimes of major projects.
Keywords Project management, Project governance, Governance structures, Organization theory, Inter-organizational relations
Paper type Research paper

Introduction

In research and practice, this activity is usually subsumed under the term project governance. Broadly speaking, inter-firm project governance may refer to the management of interrelationships between participating firms in a focal project (Artto and Kujala, 2008, p. 480; Winch, 2006, p. 325). As for any business transaction, the involved partners need to find ways to safeguard, monitor and adapt their resource exchanges (Ahola et al., 2014, p. 1321; Williamson, 1975). In that respect, a feasible project governance framework will provide a basis for decision making by clearly defining roles, responsibilities and accountabilities for a project. When reviewing existing contributions on project governance, most scholars seem to agree that contracts are the most important instruments to manage, control and steer a project.

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Winch (2006, p. 331) argues that external transactions of project organizations need to be governed by a “nexus of treaties” to be effective. Söderlund (2004) found that most of the research on inter-firm projects deals with contracts, transaction costs and inter-firm relationships. Although contracts are a key foundation of governance by providing a joint base of formal regulations and stipulating the roles and responsibilities of each party contributing to an inter-firm project (Hellgren and Stjernberg, 1995, p. 380), they are inherently incomplete (Turner, 2004; Lewis and Roehrich, 2009), resulting in an extensive degree of freedom for involved firms to what extent and in which ways they translate their contractual agreements into necessary project governance structures, hierarchies, work processes and control mechanisms.

Thus, governance aspects can and should not only be dealt from a contractual, but also from an organizational perspective (Grün, 2004, p. 105; Lewis and Roehrich, 2009). In the past, several researchers called for a more intense consideration of organization theory in project research (see e.g. Stinchcombe and Heimer, 1985; Too and Weaver, 2014), but there is still a considerable conceptual gap between the two. More specifically, research lacks a joint understanding of the structures and processes which constitute the organizing of project governance activities. Second, specific insights into how firms engaging in inter-firm projects translate certain contractual agreements into tangible structures and processes governing day-to-day decision making on a strategic level (Guo et al., 2014).

Yet, theoretical and practical guidance on how to design governance regimes for major projects from an organizational design perspective is largely missing. Although the Association for Project Management published two handbooks on project governance (APM, 2007, 2011), it mostly provides a list of questions to be answered when designing a project governance regime (Miller and Hobbs, 2005, p. 47), but provides very limited insights into the factors that should be systematically considered when designing a project governance regime, or which designs are more or less effective in certain situations. Scholars continuously acknowledge the design of inter-firm governance as significantly context-specific (Guo et al., 2014; Joslin and Müller, 2016). That said, project governance should not be designed in a one-size-fits-all manner, but rather be adjusted to certain contextual aspects of a focal inter-firm project (Grün, 2004, p. 6; Morris, 1997, p. 431). However, systematic consideration in project governance research is still in its infancy.

One approach to better understand the influences of certain situational factors on project governance is by systematically incorporating and examining them. Contingency theory is a well-founded and established approach to consider such external influences (Lawrence and Lorsch, 1967; Thompson, 1967; Mintzberg, 1980). For many years, scholars called to further strengthen this context-specific perspective of project research (Williams et al., 2010, p. 41), but the significant influencing factors on project organization in general and project governance in particular still seems unexplored. Established insights from the alliance and partnership governance literature (e.g. Albers et al., 2016) may serve as a key foundation to build upon. Further, earlier contributions which systematically proposed situational factors of related aspects of project management, such as project procurement (Lewis and Roehrich, 2009), may serve as a basis for conceptual development.

To address these aforementioned gaps in project governance research, the following research questions are proposed for investigation:

**RQ1.** What are the key constructs by which inter-firm project governance may be systematically described?

**RQ2.** Which contextual factors of inter-firm projects may influence the establishment and design of a certain governance regime?

**RQ3.** How could a future empirical study operationalize each identified construct and examine interrelationships between contextual factors, project governance dimensions and project performance?
The proposed model can provide a conceptual basis about governance regimes in major inter-firm projects to variety of audiences, but especially to scholars interested in an empirical analysis of project governance. Although governance structures and processes are an integral feature of any large inter-firm projects, research misses evidence on how governance is designed and carried out in practice, and which influencing factors may render certain designs more or less likely and effective.

**Theoretical foundations of project governance**

Today, most major projects involve contributions from several, legally independent organizations which “temporarily pool their resources, capabilities, and knowledge together to achieve the shared goal specified for the project” (Ahola et al., 2014, p. 1321). This specific aspect of a project, being carried by at least two independent firms and, therefore, labeled inter-firm project (also called inter-organizational project or multi-partner project), is currently one of the key areas in project research (Eloranta et al., 2007, p. 52). While the number of firms and their nature varies, typical project participants may be (multiple) project owners, contractors, component or service suppliers (Grün, 2004, p. 5; Eccles, 1981, p. 338).

Organizations carrying out major inter-firm projects need to not only allocate work among project members and coordinate operational day-to-day work, but should also create appropriate structures overseeing and steering such projects, which many regard as a key success factor (Grün, 2004, p. 105; Joslin and Müller, 2016; Bryman et al., 1987). Since projects are in constant change, organizing information and feedback flows as well as a multilevel control of activities are of major importance (Morris, 1997, p. 409). Thus, problems in project control are often associated with improper authority systems (Stinchcombe and Heimer, 1985, p. 38). These challenges are addressed in the distinct field of project governance research.

Project governance may refer to the management of interrelationships between participating firms in a focal project (Artto and Kujala, 2008, p. 480; Winch, 2006, p. 325). As for any business transaction, the involved partners need to find ways to safeguard, monitor and adapt their resource exchanges (Ahola et al., 2014, p. 1321; Williamson, 1975; Burghardt, 2013, p. 62; Morris, 1997, p. 439). Yet, due to the division of work in inter-firm projects but the absence of a sole authority, able to provide sufficient means to coordinate their efforts, parties have to cooperate effectively (Hellgren and Stjernberg, 1995, p. 380; Litwak and Hylton, 1962; Burghardt, 2013, p. 61). Further, involved organizations usually represent their own expectations and objectives toward a project (Hellgren and Stjernberg, 1995, p. 390; Stinchcombe and Heimer, 1985, p. 35), often regarded as a major source of conflicts and resulting underperformance (Ruuska et al., 2009, p. 142). Therefore, the relationships and interactions need to be governed by a coherent project governance framework (or project governance regime (Miller and Hobbs, 2005)), which clearly defines structures, roles, responsibilities and accountabilities for a project (Lewis and Roehrich, 2009). By agreeing on these governance aspects, the parties can jointly mitigate contractual and behavioral uncertainties, unclear responsibilities and opportunism in projects, allowing for more efficient decision-making processes, enhanced inter-firm trust and more collaborative business relationships (Stinchcombe, 1985, p. 38; Caniëls et al., 2012; Arranz and Arroyabe, 2012).

Several scholars highlighted the particular importance of effective governance for major and megaprojects (Guo et al., 2014; Sanderson, 2012). More specifically, recent contributions examined the relationship among project governance practices and project performance in megaprojects (Sanderson, 2012). Empirical studies found that adequate project governance approaches are able to facilitate the identification and handling of risks in major projects (Guo et al., 2014). In the case of major and megaprojects, project governance is seen as a key to handle managerial challenges, for example, the high levels of complexity and goal incongruence inherent to this specific type of projects (Grün, 2004).
However, interestingly, project governance has only recently become an important topic in project management studies (Miller and Hobbs, 2005, p. 47). Recent articles focus on its theoretical foundations and research strands (Ahola et al., 2014; Biesenthal and Wilden, 2014; Too and Weaver, 2014), the interplay of different governance mechanisms (Caniëls et al., 2012; Melander and Lakemond, 2015; Arranz and Arroyabe, 2012) and the relationship between project governance and project performance (Joslin and Müller, 2016; Müller and Martinsuo, 2015).

However, research is still developing a joint understanding of its key definitions, underlying concepts and specific outcomes. Ahola et al. (2014, p. 1322) found convincing empirical evidence that there exists a significant divide in the understanding of project governance in project research. While some scholars comprehend the term as defined above, others regard project governance rather as a concept closely related to corporate governance, which mainly aims for rules of accountability for involved stakeholders of a project (Winch, 2006, p. 325; Müller et al., 2013). This study is explicitly aimed at contributing to the former, regarding project governance as a set of activities "internal to a specific project" which establish "shared practices for safeguarding, coordinating, and adapting" economic exchanges between firms (Ahola et al., 2014, p. 1325).

Scholars of the research strand on project governance are split between characterizations of it as either "a continuous managerial decision-making process" or "as a relatively static set of mechanisms for coordinating and safeguarding exchanges between firms" (Ahola et al., 2014, p. 1324; Hellgren and Stjernberg, 1995, p. 378). This contradiction is also highlighted by Miller and Hobbs (2005, p. 48), claiming that project governance is usually conceptualized as a stable oversight function, whereas the actual activities and the context of a project are regarded as inherently dynamic. However, theoretical concepts and empirical studies especially fall short of providing evidence about the "process" perspective (e.g. Abednego and Ogunlana, 2006, p. 626), but rather restrict their analysis to formal rules or *ex post* outcomes of certain activities (Miller and Hobbs, 2005, p. 42; Hellgren and Stjernberg, 1995, p. 377).

Several scholars suggested ways to overcome this distinct examination of the structures and the processes of project governance. Cherns and Bryant (1984, p. 177) observed that inter-firm relationships in projects are "formally governed" by a contract, but these regulatory structures are "supplemented and moderated" by informal understandings and practices designed to deal with unexpected challenges. This interaction effect is also identified by Olsen et al. (2005, p. 1), which suggests that formal and informal governance complement each other. Based on these observations, this study aims to incorporate these two perspectives of structures and processes on project governance and purposefully bring them together.

**Bridging organizational design and project governance**

Hellgren and Stjernberg (1995, p. 378) suggest that the set-up of "social arrangements" to organize an inter-firm project is a key managerial task, since it provides the basis by which information, authority and risk is distributed among organizations (cf. Stinchcombe and Heimer, 1985, p. 15). Firms may establish governance structures and processes which assign risks, responsibilities and decision-making power to "those with expertise to scrutinize projects have both the opportunity and the incentive to do so" (Miller and Hobbs, 2005, p. 47). If the contributions of firms are interdependent, it requires joint authorities and mechanisms of cooperation to be effective (Stinchcombe and Heimer, 1985, p. 87).

Since major decisions on project governance are generally taken at the highest organizational level of an inter-firm project, this study will focus on the key organizational units established at the top level of hierarchy, encompassing the project roles of project directors and senior project managers. Corresponding organizational units are usually comprised of senior managers holding a steering role, but vary in terms of ongoing
involvement in day-to-day project operations (Morris, 1997, p. 414). It is often argued that these control institutions should be organizationally separate and independent from project management (Morris, 1997, p. 423). Especially large projects are often governed by several organizational units, each involving a specific set of involved parties (Miller and Hobbs, 2005, p. 43). These bodies may demand status reports, updated plans or certain deliverables in an inter-firm project, which imply a major influence on the quality of project execution (Müller and Stawicki, 2007, p. 69).

Surprisingly, relevant research studies on the governance of inter-firm projects have only very seldom treated the organizational design of key organizational units, for example, steering committees, as a focal unit of analysis. Several authors mention that these powerful organizational units are part of a typical inter-firm project organization (Olsen et al., 2005, p. 3; Burghardt, 2013, p. 62), but there are no empirical insights into the major design aspects of these organizational units, what are the roles and responsibilities of involved actors, and what impact a certain design has on the outcomes of a project (Hellgren and Stjernberg, 1995, p. 390; Grün, 2004, p. 129). This study aims to provide a conceptual basis to investigate the organizational design of the top levels of hierarchy in an empirical study.

The role of context in project governance research

While the organizational design of project governance has so far been neglected, several contributions highlight another major gap in research – the relevance of context for project governance. Many argue that an effective project governance regime cannot be determined in isolation, but is highly dependent on the environment in which it is operating. More specifically, a governance regime needs to adapt to the specific project characteristics and contexts of a given project (Ruskska et al., 2011; Söderlund, 2004; Winch, 2006; Joslin and Müller, 2016), or put differently, effectiveness requires a fit between the project governance and the projects’ context (Simard et al., 2016). Miller and Hobbs (2005, p. 49) argue that a “specific governance regime must adapt to the particular project and its context.” Yet so far, literature is missing a systematic identification of relevant influencing factors for project governance, and more strikingly, does not provide a holistic conceptual model outlining the relationships between the context of a project, its governance design and a projects’ performance.

Research has proposed several influencing factors which may be relevant to choose an effective inter-firm governance regime. Burghardt (2013, p. 56) suggests project partners to align their project organization with the specifics of the individual project. Grün (2004, p. 6) highlights the impact of certain aspects, such as singularity, complexity, goals and owner characteristics of a project, as most important when designing its governance structures. In an early contribution, Morris (1997, p. 431) proposes a project’s size, speed and complexity as most relevant for organizational characteristics of a project. Unfortunately, none of these contributions provide specific design characteristics of project governance, or provide recommendations on how to shape such characteristics in certain contexts. Further, few models address dynamic changes in contextual aspects of project governance which may occur during the lifecycle of a project.

A contingency model of inter-firm project governance

Based on the above discussion of the two main research strands (structures and processes) of project governance, the constitutive elements of organizing an inter-firm project governance regime were synthesized to an integrated model (see Figure 1). More specifically, the framework is mainly based on the recent works of Ahola et al. (2014) and Ruskska et al. (2011), merging the two understandings of research on project governance as structure and project governance as a set of rules and procedures. The model focusses on the three main components of project context (divided into project context and partner context), project governance and project performance (time, budget, quality).
These three components were interrelated by adopting the theoretical lens of contingency theory (Lawrence and Lorsch, 1967; Mintzberg, 1980). This established theory assumes that organizations can and should not be designed in isolation, but that their functioning and success and largely dependent on its internal and external situation (e.g. an organization’s institutional environment, competitive landscape or relevant technological developments). Rooted in organization theory, it argues that there is not one perfect way of organizing, but that managerial decision-makers should rather strive to design organizations which ensure a “fit” to its internal and external situation to be successful (Morgan, 1986). Since the context of a project might change throughout its course (Winch, 2006, p. 330), its project governance design has to be continuously adjusted to ensure an external “fit.” Due to these specific theoretical assumptions and features, contingency theory seems to be highly suitable to address the research problems of this paper, and will be assumed in further argumentation.

Answering a recent call of Ahola et al. (2014, p. 1321), this paper further aims to complement existing project governance research with literature dealing with general inter-firm governance aspects. Especially the comprehensive and well-developed literature on alliance and partnership governance may provide several guidelines and design criteria for effective project governance (Albers et al., 2016; Oxley, 1997; Reuer and Devarakonda, 2012; Vanneste and Puranam, 2010). Therefore, several constructs were relabeled to provide a more direct link to general management-oriented governance literature. In order to increase the academic relevance and the likelihood of application as a theoretical foundation for empirical analyses, this paper further suggests adequate indicators for each of the outlined constructs.

While this paper so far mainly focussed on the relationship between a projects’ context and its’ governance regime, the important element of project performance is also included in the proposed model. Several studies found convincing results that project governance regimes imply a significant effect on project outcomes. Crawford and Cooke-Davies (2009, p. 70) revealed the influence of capabilities of the governing individuals on a projects’ success. While stating that the capabilities at the governance-level vastly differ both among individuals and projects, they discovered that 26 percent of the variations in success are explained by the actors’ governance capabilities. In another extensive study, Grün (2004, p. 128) proposed organizational structures to indirectly affect goal achievement in inter-firm projects. A similar finding is brought forward by Morris (1997, p. 442), providing anecdotal evidence about the impact of interactions of project parties on performance. Finally, Joslin and Müller (2016) highlight the key role of stakeholder orientation for project success. Yet, the specific influence
of project governance on project success and its underlying mechanisms still remain vague in existing research, and would be one key finding from an empirical investigation of the presented model.

Project governance dimensions

Organizational structure. A central trait of structuring an organizational entity is its organizational structure. Organizational structures, defined by organizational decision-makers, determine the lines of authority and reporting among participating individuals. They allocate decision-making rights and responsibilities to certain individuals and/or organizational units (Daft, 1992; Schanz, 1994, 112ff). The design of organizational structures, especially on the second level of hierarchy, is directly related to project governance activities, since it provides organizational regulations who receives relevant monitoring knowledge and who holds decision-making authority to steer inter-firm projects toward achieving its objectives (Andersen, 2007, 336f). Scholars commonly differentiate between three different types of organizational structures by which the division of project work may be designed, namely, functional, divisional and matrix organizing (Schreyögg, 1996, 127ff).

Centralization of authority. Especially, decision-making regulations are hardly understood by project research (Hellgren and Stjernberg, 1995, p. 391). However, the authority and decision-making systems, providing legitimacy to certain flows of information, vary greatly between projects (Stinchcombe, 1985, p. 156). One way to measure decision-making power of individuals is the centralization of authority among a project organization. The differences in decision-making authority can, for example, be examined when looking at governance institutions in a given project. While some governing bodies are assigned to solely give non-binding advice to a project, others constitute powerful boards which convene on a regular basis to take key decisions for a project (Burghardt, 2013, p. 63). Although distributed rights for decision making allows internal and external parties to voice concerns about the progress of projects, it also hinders to take quick and disputed decisions (Grün, 2004, p. 132). Analyzing two contrasting cases, Olsen et al. (2005) pinpoint the key implications of different levels of centralization of authority on project outcomes. Researchers may utilize an adapted measure of Menon et al. (1999, p. 36) four-item scale to identify the degree of centralization of project governance authorities in a given project.

Formalization. Formalization describes the degree of establishment and standardization of, e.g., rules, procedures, job descriptions or instructions to constrain work behavior (Albers et al., 2016; Mintzberg, 1980). In this context, researchers often refer to bureaucratic and organic organizational designs, highlighting the two extremes of formalization (Mintzberg, 1980). As other projects tasks, also project governance activities vary in terms of the codification of processes, roles and responsibilities (Crawford and Cooke-Davies, 2009). Involved firms have to decide to which extent they want to formalize and standardize the rules and procedures of a given project governance structure. In an empirical study of a focal project governance regime, scholars may turn to the established indicator scale for formalization by Menon et al. (1999, p. 36).

Specialization. Specialization measures the extent by which responsibilities for specialized tasks are distributed among different individuals and/or organizational units. The degree of specialization is dependent on the division of work, e.g. if individuals or units in an organization mainly carry out very specific tasks, the specialization of the organization is regarded as high (Mintzberg, 1980; Albers et al., 2016, p. 596). Specialization may be designed according to a specialization on certain functions (financing, HR, supplier management, etc.) or objects (roof, infrastructure, brickwork, etc.) of a project (Grün, 2004, p. 108).
For project governance activities, a specific relevance is given for organizational units designed to monitor and govern the project progress. Examples for such units include steering committees, project steering departments, quality review teams or project management offices who are responsible to carry out certain governance activities (Burghardt, 2013, p. 68). In an empirical setting one may identify the establishment and degree of specialization of the aforementioned organizational units in a given project.

**Communication.** Another key design characteristic of an effective project governance regime is its processes to exchange and share relevant information. Managing a project requires the ability to distribute information and instructions fast and effectively between individuals with diverse capabilities and objectives (Austen and Neale, 1984, p. 101). Communication is a vital element of project governance, especially in large, complex inter-firm projects, where technical and managerial information about major issues can provide key advantages to the overall project performance (Hellgren and Stjernberg, 1995, p. 389). One may differentiate between formal (along hierarchical roles) and informal (across hierarchy, based on personal relationships) communication (Stinchcombe and Heimer, 1985, p. 104). A key mechanism to allow for effective communication are project meetings (Austen and Neale, 1984, p. 105). Their configuration can, for example, vary in terms of regularity of meetings, intensity and length of individual meetings, and the degree of involvement of all parties in such meetings (Burghardt, 2013). In an empirical study, one may consider (and adapt) the coordination indicator scale of Hoegl et al. (2004) as a proxy (based on Mott, 1972).

**Dispute resolution.** Researchers and practitioners regard the resolution of disputes (or conflicts) of increasing relevance for the functioning and performance of inter-firm projects (Patzak and Rattay, 2004, 368ff). Settling conflicts can happen informal, based on pre-defined mechanisms, or in court (Dahlgren and Söderlund, 2001). Yet, implementing dispute resolution mechanisms is highlighted as of key importance for effective project governance (Dahlgren and Söderlund, 2001). Empirical investigations could draw relevant and tested questions from Hoegl et al. (2004, p. 52), but further extend them with further aspects of involvement of third parties (e.g. mediators, lawyers).

**Monitoring.** Monitoring activities are of key importance to project governance. Project participants may audit and monitor quality, costs and time during the course of a project. Yet, project monitoring can be carried out in many different ways, and degrees, in practice (Reve and Levitt, 1984). Following earlier contributions, this conceptual model differentiates monitoring activities in terms of their methods, frequency and actors (internal vs external) (Huemann, 2007, p. 214). In an empirical study, the degree of each of these monitoring dimensions may be investigated with direct indicators based on nominal and ordinal scales.

**Contextual dimensions**

As outlined, this conceptual model aims to introduce and integrate several contextual factors which are proposed to directly affect to design of an adequate project governance framework, and, indirectly, the performance of a given project. The contextual factors may be differentiated between project-related (characteristics of the focal project) and partner-related (characteristics of and relationships between the project partners) dimensions (see Figure 1).

**Project duration.** Several authors proposed the temporality of a project to be a key influencing factor on its design and functioning (Jones and Lichtenstein, 2008; Kenis et al., 2009). In terms of project governance, longer time horizons may require more elaborated authority structures or monitoring processes. In an empirical study, the duration of a given project can be measured directly, but should cover both planned and actual duration.

**Task complexity.** The complexity of a project’s task has long been highlighted as a vital external factor for designing a project organization (Hobday, 1998, 2000; Morris, 1997). Task complexity can be caused by different contextual aspects, such as new technologies, methods,
amount of subtasks or pre-defined constraints required for the completion of a project task (Jun et al., 2011; Kim and Wilemon, 2003). Empirical studies may focus on a specific type or consolidate several different sources of complexity. To identify technical complexity, a key issue in many large projects, the indicators by Jun et al. (2011, p. 928) are suggested.

**Task uncertainty.** Task uncertainty may be defined as the clarity of information, uncertainty of causal relationships and time span of feedback available for a given task (Lawrence and Lorsch, 1967). Several authors highlighted the role of uncertainty on project governance (Ahola et al., 2014, p. 1330; Olsen et al., 2005). For example, the structure and mode of functioning of project governance is suggested to be dependent on the nature of uncertainties (Cherns and Bryant, 1984, p. 182). Further, higher technological uncertainty may affect the level of integration of project participants (Morris, 1997, p. 419). Scholars may ascertain the task uncertainty of a focal project by employing proposed indicators by Ebers and Oerlemans (2016).

**Level of task interdependencies.** Another key impact factor on project governance is the degree of interdependence and overlap of the contributions of involved firms (Burghardt, 2013, p. 62). Projects may differ in the degree of integration of tasks by participating firms, such as contractors, designers, consultants and operational managers contributing to a project (Grün, 2004, p. 105). Research identified different types of independencies between firms – either reciprocal, sequential or pooled interdependencies (Bankvall et al., 2010, p. 387f; Thompson, 1967). The level of interdependencies may be measured based on indicators by, e.g., Tatikonda (1999, p. 20).

**Risk & reward structure.** The allocation of risk and rewards is a key factor of project governance. Many contributions discussing contractual aspects of project governance focus to a great extent on risk and reward structures (Abednego and Ogunlana, 2006; Eloranta et al., 2007; Reve and Levitt, 1984). Formal contracts specify which firms have to cover which risks and which rewards they can gain from an inter-firm project. Practitioners make use of several different approaches for the overall risk and reward distribution of a project, most notably the structures of the individual contracts, general contractor and project alliances (Olsen et al., 2005). These contract forms may be used as a basic indicator for measuring influences of risk & reward structures on the design of project governance regimes.

**Number of partners.** The number of participating firms governing an inter-firm project may influence the organizational design of a project governance regime. In research, different requirements for single vs multi-owners of projects were suggested (Ahola et al., 2014, p. 1330). For instance, if a project is owned by several firms, an increased autonomy of decision making may facilitate a more effective cooperation between the firms (Grün, 2004, p. 106). The number of partners can be directly assessed in an empirical setting.

**Collaboration history.** The cooperation history of involved firms may describe the prior collaboration among individual firms in previous, joint inter-firm projects. Actor characteristics, such as their inter-personal and inter-organizational relationships, may determine key processes during the implementation of a project (Hellgren and Stjernberg, 1995, p. 385). Especially trust, which may have been generated in earlier interactions, is seen as a key determinant of project functioning (Winch, 2006, p. 336). Individuals who share a mutual history and, therefore, generated trust are more likely to prefer to work together. Thus, it is argued that the context between actors may influence the design of a project’s governance to control and coordinate economic transactions (Ahola et al., 2014, p. 1329; Cherns and Bryant, 1984, p. 182). Empirically, a study may assess the cooperation history of both involved firms (inter-organizational level) and involved individuals from the firms (inter-personal level).

**Heterogeneity of partners.** The heterogeneity of participating firms in an inter-firm project represents their organizational dissimilarities, such as featuring different sizes,
industry backgrounds or cultural backgrounds. One proposed measure to identify the heterogeneity of involved firms is the geographical, temporal, technological, cultural “distance” between them (Ruuska et al., 2009, p. 143). If firms exhibit an extensive “distance,” their heterogeneity may be relatively high, resulting in an increased need for coordination and communication. This conceptualization by Ruuska et al. (2009) may also be used in an empirical study.

**Discussion and conclusion**

The proposed model outlined in this paper provides a context dependent, holistic framework of organizing inter-firm project governance for major projects. The developed constructs are based on a comprehensive synthesis of two major streams of research, which distinctly focus their understanding of project governance on either a static, structural or an ongoing, procedural perspective. Both points of view have been critically appraised, related to organizational issues, and integrated into a cohesive model of project governance.

To substantiate the conceptual model, a contingency theory approach has been adopted, addressing recent calls by research to strengthen the contextual embeddedness of project governance research. Subsequently, seven governance dimensions and eight contextual dimensions have been developed in detail, based on established constructs rooted in organization theory and propositions by recent contributions to project governance research. The introduced model is explicitly designed as a conceptual basis to allow for subsequent empirical investigation, and therefore also includes suggestions on feasible operationalization of outlined constructs.

This conceptual paper offers several contributions to both research and practice. On the one hand, research is provided with an integrative model of project governance that purposefully merged two complementary streams of project governance research. As the model provides clear contextual factors, it further enhances the emerging stream of project research that systematically considers and examines external influences of project organizing. Research may utilize this model as a theoretical basis to empirically investigate the design and effectiveness of governance regimes of major projects.

On the other hand, practice can consult the proposed framework as an enhanced guideline to holistically design real-world governance regimes. The model may indicate which context and design aspects involved managers should consider when formulating governance structures and processes. Further, a complementary empirical study, investigating the interrelationships among the outlined constructs, will provide practitioners answers about effective project governance designs in differing contexts. This will allow them to take more educated decisions on project governance regimes in the future, which may in turn improve the performance track records of major inter-firm projects.

However, the developed model also has several limitations. First, a temporal, dynamic examination of project governance regimes is not in focus. Governance arrangements may change throughout the course of a given inter-firm project (Miller and Hobbs, 2005, p. 47) when, for example, uncertainties about the projects or its partners is reduced over time (Winch, 2006, p. 330). Therefore, the design of a specific governance system, according to the outlined model, may be continuously adapted during project execution to maintain a fit among context and governance design characteristics. Empirical studies of the model may be most appropriately set-up as an *ex post* analysis, in particular due to its inclusion of (*ex post*) project performance. Second, the model does not provide clearly formulated hypotheses on the interrelationships among both certain design elements and contextual factors and specific design elements. Instead, it is deliberately limited to bringing together key constructs constituting project governance regimes, complemented by theoretically founded propositions of contextual factors which may influence the design of these elements of governance. Third, the model is only limited to conceptual propositions of key
elements of context and design of project governance, but lacks empirical insights. Although the discussed contextual factors were developed from theory, an empirical analysis may reveal that some of them will have only limited or even no influence on the design elements of governance in practice. An empirical examination is, therefore, crucial to test the validity of the model.

References


Lawrence, P.R. and Lorsch, J.W. (1967), Organization and Environment: Managing Differentiation and Integration, Division of Research, Graduate School of Business Administration, Harvard University, Boston, MA.


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Evaluating the impact of the land acquisition phase on property owners in megaprojects

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Abstract
Purpose – The purpose of this paper is to examine the impact of the land acquisition phase and site assembly of land for large scale infrastructure road projects and its impact on property owners. A review of one of the largest roadwork projects currently underway in Sydney Australia demonstrates the adverse impact that has resulted in property owners challenging the approach used by government to acquire land for this project. Similar case studies are used to set out the key measures that should apply internationally in mitigating challenges from property owners in the land acquisition phase. It further shows that while adequate statutory provisions are important, it is the practices of acquiring authorities that ultimately determine the success and expedition of this initial important phase of these projects.

Design/methodology/approach – In measuring the factors that impact the acquisition of land by negotiation in contrast to acquisition by compulsory taking, a case study methodology is used. In this approach, the author reviews two completed projects and the factors that contributed to their success. These are contrasted with the primary case study currently underway in Sydney, the WestConnex project in which a number of adverse factors have emerged that have impacted this project. The review of these cases examined provides options for reforms that should be adopted both in the WestConnex case and across projects internationally.

Findings – It is demonstrated that the impact of the land acquisition phase on property owners with limited ability to rehouse within the same or surrounding locations, results in increases to challenges. This factor has prompted increases in the number of cases that have proceeded to court and potentially impacts the public perception and site assembly phase of large scale road projects. The inability for impacted property owners to relocate themselves has resulted in a breakdown in the ability for acquiring authorities to achieve acquisition by agreement. This is evidenced by significant increases in the number of properties that have been acquired by compulsion since 2016. It is found that the operational provisions of the land acquisition processes were obsolete in NSW, particularly those leading up to acquisition that was originally designed to assist owners. The paper finds that the most important phase of a megaproject is the planning and consultation phase, which includes most importantly the way in which impacted owners are informed, assisted and compensated. It is concluded that the processes engaged in by acquiring authorities rather than the statutory provisions available, will determine the success of the land acquisition phase and perceptions of the project.

Originality/value – The primary contribution of this paper is defining the changing landscape that has led to the adverse impact on property owners in the site assembly process for large scale projects. It identifies the reforms that will enhance opportunity for owners to relocate and rehouse which will expedite the acquisition phase of megaprojects and restore acquisition by agreement rather than by compulsion. This in turn will contribute to improve public perception of large scale projects in urbanised locations.

Keywords Megaproject, Compulsory acquisition, Dispossessed owner, Roadworks

Paper type Viewpoint

Introduction
The term megaproject has a number of different meanings and contexts applying to both the private and public sector. More recently, they have applied to large integrated projects undertaken in unison by the private and public sectors. Megaprojects are described by Marrewijk et al. (2008) as multibillion dollar mega-infrastructure projects that may be commissioned by government and delivered by private enterprise in the form of private public partnerships. More fundamentally, they are described by Altshluer and Luberoff (2003) as an expression of public authority. This authority commences with the initial phase of acquiring the land on which the project is developed. Fiori and Kovaka (2005, p. 1) state
that there is no formal definition of a megaproject, due to their scale, size and diversity, and
are alternatively depicted as a phenomenon. Table I provides a sample of the diversity of
international road, rail and utility megaprojects.

Land acquisition and site assembly are one of the initial steps in the delivery of megaprojects internationally. The strategies employed in taking land and compensating property owners is politically delicate and remains the role of government in undertaking this phase of the project across Commonwealth countries. Allen (2000) defines the role of government in reserving the right to carry out functions beyond those of the private sector, which includes the right to acquire land for community and public purposes. The time required to assemble land depends on a number of factors which includes the project types, its location and impact on property owners. Including land acquisition into project management and delivery of large scale projects will impact the time and cost of a project and may adversely impact public perception.

Land acquisition is formal and legalistic, Mangioni (2010) states that the land is delivered to the private partner for development, with extinguished interests in land converted to a claim for compensation, in which disputes continue for years after the land is acquired. While research has centered on the construction and delivery of megaprojects, what is not well defined is the preceding step of the organizational process of land acquisition and site assembly. This paper reviews land acquisition and compensation principles that are common in Commonwealth countries. With 80 percent of projects commissioned by state government, the land acquisition phase is mainly governed by this tier of government internationally.

This paper demonstrates that while legislation provides important scaffolding in the land acquisition phase, it is the practices of acquiring authorities that ultimately determine the success and acceptance by affected property owners. Case studies are used to demonstrate that successful projects of the past result from the intent of acquiring authorities to go beyond legislation in providing options and assistance that may not always be articulated in statute. It demonstrates that legislation is the minimum level and starting point in accommodating owners that lose homes and businesses due to the acquisition of land. The paper asserts that a pragmatic approach to land acquisition would mitigate cases proceeding to court and expedite the site assembly process.

**Defining complexity in land acquisition**

In defining the complexity of land acquisition, we briefly review the bases on which land may be acquired and the stakeholders that are impacted to demonstrate the complexity of this phase. In the realm of project management of megaprojects, Giezen (2012) aligns complexity with uncertainty, in which these two factors are stated to be interchangeable. It is further highlighted that fewer variables reduce overall project risk. Giezen (2012, p. 783), cited in Olsson et al., further adds that decision making and management of the project needs to remain flexible in order to deal with the uncertainty in the project development phase.

<table>
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<td>USA</td>
<td>USD500 m</td>
<td>2014</td>
<td>Taxes and Fares</td>
</tr>
<tr>
<td>WestConnex-Road</td>
<td>Australia</td>
<td>AUD19 bn</td>
<td>2019</td>
<td>Tolls and Tax</td>
</tr>
</tbody>
</table>


---

**Table I.**

National and international projects
This is particularly relevant to the land acquisition phase as the impact of the taking will vary depending on the individual circumstances of landowners.

The level of complexity in the land acquisition and the site assembly process exposes the variety of acquisition options to be considered by government in the site assembly process (NSW Transport Roads and Maritime Services, 2014). What emerges in the planning phase are matters that require reform in the evolution of the public sector understanding of both the broader community and the dispossessed land owner. Cahn cited in Theodoulou and Cahn (2013, p. 199) defines the differing stakeholder perspectives to be accounted for and breaks-up these stakeholders into institutional (government) and non-institutional (private sector).

In addressing the needs and perceptions of the stakeholders impacted by the acquisition phase, Viitanen et al. (2010, p. 17) defines these into three broad categories. The first category is of the owners whose land is taken for a project and compensation is payable. The second is of the owners nearby the project where no part of their land is taken, but where the project may adversely impact their land due to noise, scale or project type. The third group is defined as society in general that usually benefit from the project, particularly if the project improves services or provides a specific benefit that is definable by the community.

Both Evans and Peck (2011) and the Productivity Commission (2014) demonstrate the impact of these points on project overruns in Australia and internationally in Table II. The term cost is not only strictly confined to construction cost but may also include those costs associated with the site acquisition and assembly of land required for the project. Table II shows a comparison of project cost overruns in Australia being half to those of the international benchmark for rail and road projects. What is not accounted for in this table is the initial land acquisition phase that is not well understood or directly accounted for in the timeline and costs of megaprojects.

Furthermore, defining the categories of stakeholders and how the land acquisition phase impacts these categories are factors to be accounted for in addition to construction cost overruns that determine timely delivery of projects and whether they are within budget. In expanding on this factor, we examine the acquisition of land which encompasses two types of acquisition, partial or total acquisitions (Rost and Collins, 1996). Within each type of acquisitions, different principles and legislative provisions have evolved in assessing compensation across international jurisdictions. Common to both types of acquisitions across international jurisdictions, Hyam (2009) defines solatium, disturbance and market values as among the primary heads of compensation payable in land acquisition cases.

Precipitating the determination of the value for the land acquired, we first examine the two types of acquisitions, partial and total acquisitions and how these diverge in complexity and risk in the site assembly process. The basis of a claim for compensation will depend on the type of acquisition and the impact of the acquisition on the dispossessed party and their retained land in the case of partial acquisitions. The form of acquisition will impact the type of compensation claimable and most importantly will drive the methodology used to assess compensation. Figure 1 summarizes the differences in the heads of compensation and the methods of assessing compensation in both partial and total acquisitions.

<table>
<thead>
<tr>
<th>Project type</th>
<th>Australian benchmark</th>
<th>International benchmark</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No projects</td>
<td>Cost overrun (%)</td>
</tr>
<tr>
<td>Road</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>Rail</td>
<td>4</td>
<td>20</td>
</tr>
</tbody>
</table>

Source: Productivity Commission (2014) and Evans and Peck (2011)
In the case of a partial acquisition, the use to which the acquired land is put and the impact of that use on the land retained by the owner is to be accounted for in the after value of the retained land, this captures the value of the land acquired. This includes any uplift in value where the retained land benefits from the use to which the acquired land is put or conversely, and reflects any loss resulting from an adverse use of the acquired land and its use. The method of capturing either a positive or negative impact is defined by Hyam (2009) as the “Before and After Method” of assessment. This method measures the value of the property before the acquisition and the announcement of the works for which the acquired land would be put to and again after the acquisition where a portion of the land is retained by the dispossessed party. The difference between these two values equals the value paid or offset if the value was enhanced.

In contrast to a partial acquisition, total acquisition of land requires compensation to be assessed on a different basis. This is done by adding the sum of each applicable head of compensation as shown in Figure 1 to determine the dispossessed owner’s total compensation. The term solatium is defined by Brown (2009) as compensation for non-financial loss of an owner’s home or residence, and attempts to address the emotional and personal loss of a residence. In addressing the full impact of the taking, the principles of compensation extend to encompass items such as disturbance. In the case of partial acquisition where there is a decrease in value resulting from increased traffic flow from a new freeway, the owner may request that improved sound barriers and air-conditioning be provided. In the case of a total acquisition, disturbance may also to the cost of refinancing, stamp duty and other relocation costs of a property to a similar value of the property acquired.

The primary and most contested head of compensation in the acquisition of land is market value. While market value is paid, many dispossessed owners are unable to reinstate themselves in alternate freehold homes. In the case of the expansion of Brisbane airport, many owners were elderly and unable to rehouse as pointed out by the Law Reform Commission (1980, p. 18) “The market value of these homes was at the bottom of the Brisbane metropolitan range of values.” It was further stated that in the case of Melbourne, “the older the residential area, the greater the likely average age of the residents and the greater the likelihood that typical values will be at the low end of the market range.”
In assessing compensation in partial and total acquisition cases, Hornby (1996, p. 307) sets out the formula for each type of acquisition (partial and total) in accounting for the various heads of compensation as follows:

**Partial acquisition – value before and value after taking of land method:**

\[
\text{(Before value less after value) plus disturbance plus solatium} = \text{sum of compensation}
\]

**Total acquisition – piecemeal method:**

Market value plus special value plus severance plus solatium plus disturbance = sum of compensation

A further point of note in Figure 1 is the “Option for equivalence,” which encompasses make good in the case of partial acquisition or replacement of an alternate property in the case of an alternate property. This point is the focus of many dispossessed owners who do not or are unable to achieve this objective due to the lack of mitigation commitment and strategy in the way compensation is applied by acquiring authorities.

**Research methodology**

A case study methodology is used to examine the factors that assisted in achieving acquisition of land by negotiation over compulsion. In this approach, we review two former projects and the factors that contributed to the success of this objective in these projects which is then contrasted against the primary case study currently underway in Sydney, the WestConnex project. Kumar (1996, p. 86) refers to the use of retrospective case studies as a way of articulating the phenomenon of a problem or issue that has happened in the past, in which we compare the attributes of the cases against the project presently underway.

Using this approach, we aim to define the factors that were successful in the acquisition phases of the Sydney, M2 Motorway and Boston Big Dig road projects that were undertaken in the 1990s and 2000s. These are roadwork projects that commenced following either legislative reform, or the establishment of defined objectives and a commitment to address the needs of stakeholders, particularly owners impacted by the project. It is shown that the factors examined in the review of these cases, is the approach to achieve acquisition by agreement and to expedite the acquisition phase to the reasonable satisfaction of acquiring authority and property owners.

In examining the former projects and the present case, information has been gathered through the use of document searches as well as the examination of a survey. Hancock and Algozzine (2017, p. 40) define the use of document search and analyse as pertinent in historical reviews being “sources of information about people, phenomena or practices.” These include audit documents, government reports and journal papers as sources of information. In addition to documents sourced in the review of the M2 Motorway project, a survey of dispossessed owners has been discussed. Fowler (2009, p. 1) describes surveys as “a means of quantitatively measuring descriptions of outcomes of a study population.” This survey was undertaken by Prentice (2002) as part of a thesis and was conducted with the assistance of the acquiring authority in the M2 Motorway project.

In drawing relevance from the two retrospective case studies, a horizontal and vertical comparison is undertaken with the WestConnex project. Bartlett and Vavrus (2017, p. 51 and 73) define horizontal comparison as being a comparison of cases with each other, while vertical comparison comprises factors that may be compared within each project and then across the cases reviewed. By way of introduction to the following section, Table III sets out a summary of the objectives, strengths and limitations of the two projects reviewed as well
as the main case study. An absence of consultation with affected owners in the primary case study impacts the perceptions of the project and its cost and delivery.

What is noted in the review of the M2 Motorway and the Big Dig projects is the focus on affected property owners, being in addition to undertaking the project itself. The absence of adequate preparation in the WestConnex project for dispossessed owners has resulted in significant objection to the project and a high volume of legal challenges by owners that had property acquired by compulsion. Following the review of these cases, a summary of the amendments that were introduced to more adequately address the needs of impacted owners in the WestConnex project is set out in the latter part of the next section.

What crystallizes in the comparison of the cases is that some of the new statutory measures introduced in 2016 to assist dispossessed owners in the WestConnex project could have voluntarily been employed without statute prior to the project. The incorporation of these reforms will assist some affected owners; however, the issue is that the introduction of new statutory provisions midway through a project will do little to restore the confidence of impacted owners. This is because many dispossessed owners have resolved that at the point these reforms were introduced, they had lost their homes, could not rehouse within their surrounding community, we are not supported. What has occurred in the primary case study provides important consideration for international jurisdictions in undertaking land acquisition for large scale projects.

**Sydney M2 motorway**

The M2 motorway, originally known as the “North West Transport Link,” is a 21 km road link, of four to six lanes, between Epping Road and the Lane Cove Tunnel in North Ryde and Old Windsor Road and the Westlink M7 motorway in Baulkham Hills Sydney. Construction of the motorway commenced in May 1993 and the roadway was opened in May 1997. In total, 246 houses were required to make way for the motorway in which the Roads and

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**Table III. Project summaries and case study**

<table>
<thead>
<tr>
<th>Projects reviewed</th>
<th>Acquiring authority</th>
<th>Project objective</th>
<th>Project strengths and limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>M2 Motorway</td>
<td>New South Wales Roads and Traffic Authority – State Government</td>
<td>To improve transportation access from the fast emerging residential areas of Sydney’s West to the central business districts and employment hubs of Sydney</td>
<td>Planning, community consultation, options for relocation and broad satisfaction with the acquisition processes are key strengths</td>
</tr>
<tr>
<td>Big Dig Boston City</td>
<td>Massachusetts Department of Highways – State Government</td>
<td>Replacing the six-lane elevated highway with an eight-to-ten-lane underground expressway to improve transportation and productivity within and across the Boston Business Center</td>
<td>Planning, consultation, project location and relocation of businesses and resourced case managers are key strengths</td>
</tr>
<tr>
<td>WestConnex</td>
<td>Transport for NSW – State Government</td>
<td>Improve transportation flows across Sydney through a series of tunnels and roads that remove heavy vehicles from Sydney’s roads, reducing congestion, travel time and evolving an environmentally sustainable road network</td>
<td>Commitment to undertake the project, procurement and contracting arrangements are strengths. Project complexity, funding and property acquisition case management were limitations until new measures were introduced during the project</td>
</tr>
</tbody>
</table>

---

Impact of the land acquisition phase
Traffic Authority (RTA), now known as the Roads and Maritime Services (RMS), were tasked with acquiring and consolidating the land required for this project. The initial acquisition step of the project cost $120 m which was spent on the acquisition of the residential property needed to undertake the development and accounted for approximately 20 percent of the total project cost (Roads and Maritime Services, 2013).

In addition to the acquisition of houses required for the M2 motorway, an offer to surrounding property owners not directly required for the project was made to voluntarily sell at market value to the acquiring authority. While there was no compulsion to sell to the acquiring authority, this step assisted in two ways to expedite the acquisition process. It first provided options for owners who no longer wanted to live near a motorway once completed. In the previous section, these were classified as the second group of stakeholders by Viitanen et al. (2010). The second benefit of the purchase of the additional houses provided an option for those owners who were required to sell, to be given an option to purchase an adjoining property in the same location should they wish to stay in the same location (Burke, 2010).

In measuring the level of satisfaction for compensation paid to owners that were directly impacted by the motorway, during the course of 2001/2002, Prentice (2002) developed and used a survey to assess the impact on dispossessed owners. The primary objective of the research was to assess the level of satisfaction and the experience of property owners that had property acquired during 1992 and 1993 against the objectives of the Land Acquisition Act which was introduced in April 1991. The study was undertaken within approximately five years of completion of the project and within ten years of the introduction of the law governing land acquisition in Sydney New South Wales. Prentice (2002) highlighted that while it would be ideal to have undertaken this research project during the acquisition phase itself, it is not practicably possible due to the sensitivity of impacted owners, and the commercial negotiations between the acquiring authority and these owners.

In undertaking this research during 2002, consent was sought from the RTA NSW (now the RMS) for the researcher to survey dispossessed property owners and to measure the impact of the acquisition of their property. The survey yielded responses from 23 dispossessed property owners representing approximately 10 percent of all owners who had property acquired. Of the 23 owners who responded, 19 owners had their property acquired by agreement, and 4 owners had their property acquired through the compulsory acquisition process. Of the four owners that had their land taken by the compulsory process, none of these acquisitions proceeded to court.

In reviewing the valuation process underpinning the determination of market value, 74 percent of respondents were satisfied with the amount of compensation received, while 83 percent viewed the timeframe in which acquisition was undertaken as being satisfactory. These two factors prior to the reforms that were introduced in 1991/1992 impacted dispossessed parties the most in the acquisition process. In relation to the question on the amount of compensation received, of the 61 percent of owners who objected to the initial offer, approximately one third of these owners had their compensation increased. While it is not possible to examine the amount in each individual case, what is important, is that a process was available for dispossessed owners to seek a review of their compensation as part of the acquisition process was available.

A further point of note was the agreement of property owners not to fight the acquisition process, once they were aware of the works to be carried out and the impact those works would have on their property. In compulsory acquisition cases for roadworks generally across NSW, Bourke (cited in Prentice, 2002, p. 62) sets out the acquisition responses post the introduction of the Act in Tables IV and V. These show that 95 percent of all acquisitions are by agreement, 5 percent by compulsory process with less than 1 percent
proceeding to court. In the case of the Sydney M2 motorway, being the largest roadworks undertaken during the 1990s, 240 properties were acquired by agreement, 6 by compulsory acquisition with two cases proceeding to court.

**Boston Big Dig**

The Boston Big Dig is one of the largest roadworks undertaken in the USA at an estimated cost of $14.1 billion. The project planning phase commenced in the early 1980s and construction occurred between 1991 and 2007. The key objectives of the project were to replace the deteriorated six-lane elevated highway built through the heart of Boston in the 1950s with a state-of-the-art transportation system. The current traffic burden on the Central Artery far surpasses the 75,000 intended capacity. The most recent figures report the 7-mile downtown stretch to handle a daily traffic load of more than 190,000 vehicles (cited in Bushouse, 2002, p. 53). The necessity for this project is stated by Cerasoli (2002) to remove the infamous ten-hour traffic jams and accident rates that were four times the national average.

The elevated Central Artery had just six lanes. The new underground expressway has eight to ten lanes. Altogether, the CA/T project built 161 lane miles of highway in a 7.5 mile corridor, including four major highway interchanges. The old road had 27 on-and-off ramps; the new one has just 14. With an improved surface street system, local traffic exits the main highway and distributes itself on surface roads while through traffic moves more easily under the city. The Massachusetts Department of Transportation (2017) highlights that the environmental benefits resulted in excess of 300 acres of new parks and open space, which includes 27 acres where the existing elevated highway stood, 105 acres at Spectacle Island, 40 acres along the Charles River, and 7 acres as part of an expanded Memorial Stadium Park in East Boston. Because of the new highway system, Boston’s carbon monoxide levels dropped 12 percent citywide.

While the number of properties acquired is not explicit, the non-project costs that included land acquisition (eminent domain) expenses that exceeded $1 bn, represents approximately 7 percent of the project cost (Cerasoli, 2002, p. 6). Alternatively, Bushouse (2002, p. 53) states that eminent domain resulted in $3 bn of “a very expensive process of

<table>
<thead>
<tr>
<th>Question</th>
<th>Satisfied</th>
<th>Dissatisfied</th>
<th>Neutral</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) How satisfied were you with the amount of compensation paid?</td>
<td>74</td>
<td>22</td>
<td>4</td>
</tr>
<tr>
<td>(2) Do you think the timeframe for the acquisition process was suitable</td>
<td>83</td>
<td>17</td>
<td>nil</td>
</tr>
</tbody>
</table>

**Table IV.** Survey summary with results expressed as a percentage

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
</tr>
</thead>
<tbody>
<tr>
<td>(3) If the underground of your land were acquired for a tunnel or easement would you expect compensation?</td>
<td>100</td>
<td>nil</td>
<td>nil</td>
</tr>
<tr>
<td>(4) Did you object to the amount of compensation that was initially offered by the acquiring authority?</td>
<td>61</td>
<td>39</td>
<td>na</td>
</tr>
<tr>
<td>(5) Question to the 61 percent who objected in Q (4) above: did your compensation amount increase?</td>
<td>36</td>
<td>64</td>
<td>na</td>
</tr>
<tr>
<td>(6) In your opinion, do you think that the Commonwealth or State Government should have the power to acquire land?</td>
<td>22</td>
<td>78</td>
<td>nil</td>
</tr>
</tbody>
</table>

**Table V.** Survey summary to questions expressed as Yes or No as a percentage

**Source:** Prentice (2002)
resolving conflicts with businesses, environmental groups, and citizens.” Attributing the primary reasoning for these costs being for the mitigation of cases against the project.

On the project cost, the largest expense after construction of the roadworks is cited as being the relocation of utilities. The project’s underground utility relocation program moved 29 miles of gas, electric, telephone, sewer, water and other utility lines maintained by 31 separate companies. All told, about 5,000 miles of fiber optic cable and 200,000 miles of copper telephone cable were installed (Massachusetts Department of Transportation, 2017). The Boston Dig resulted in fewer acquisitions from much of the roadworks being undertaken below ground level and in many parts, beneath the former elevated roadway that the project replaced. The project had minimal impact on residential property acquisitions it did however result in the use of eminent domain to acquire several commercial and special use properties.

A key strength of the project resulted from the planning phase which included consultation with key stakeholders of the project. In response to the past use of eminent domain in major roadwork projects during the 1950s and 60s, case mitigation and resolution became a primary focus of the Big Dig project. The reality is that mitigation is an expensive process of resolving conflicts with businesses, environmental groups and owners:

Where highway projects once bulldozed the neighborhoods and bisected cities in the name of mobility, the CAT project is reuniting neighborhoods and preserving the fabric of a city, even as it makes dramatic improvements in its transportation system (Central Artery/Third Harbor Tunnel Project Page, 2002 cited by Bushouse, 2002, p. 56).

The commitment to resolution and negotiation over eminent domain is directly addressed by striking the balance between the public’s need to access the city with the private concerns of residents by not taking a single person’s home. Further exemplifying the extent of the mitigation strategy (Bushouse, 2002, p. 56) states that:

[...] continued support for the project, Big Dig planners invested significant effort and funds for mitigation. Planners vowed to keep Boston working with minimal disruption, which meant that any business, citizen, or interest group disrupted had some incentive to complain. In practice, this has meant considerable efforts to work with citizens, businesses, and interest groups to minimize disruption and find workable solutions.

Despite the best intentions for maintaining acquisition by agreement, Massachusetts Highway Department was provided with enabling eminent domain legislation to complete the takings necessary for this project. As at 2001, eight cases were settled, five further cases filed, nine cases were in anticipation of being filed, and a future 72 acquisitions were anticipated. In assisting impacted parties, it was highlighted that the eminent domain legislation required “protanto” (partial or full payment) (Wagner Rudin Centre for Transport Policy and Management, 2017, p. 24). Further added to the mitigation strategy was a measure that allowed affected owners to take the sum offered, while being allowed to petition the courts for up to three years from the date of the taking of their property, which resulted in many of the proposed cases being mitigated.

The introduction of the right to appeal provision was designed to encourage owners that had lost property, to focus on relocation and to assess any potential loss that had not yet crystalized at a later point in time. This is an important mitigation strategy that removes the urgency to appeal or petition the courts in the event that some unforeseen factors or expenses may arise during the relocation phase.

Westconnex – an evolving case study
WestConnex is a 33 kilometer motorway currently under construction and has been described as the “missing link” in Sydney’s motorway networks. It has a price tag of
$16.8 billion, with the full route expected to be open to traffic in 2023 (SGS Economics and Planning, 2016, p. 3). The project will eventually connect two of Sydney’s main motorways, namely the M4 in Western Sydney and the M5 in South-Western Sydney, and will provide drivers more direct access to the city and Port Botany or Sydney Airport. The project primarily caters for the movement of vehicles via a number of tunnels and road links that avoids over 120 sets of traffic lights across the Sydney road network. Similar to the objectives of the Boston Big Dig and the M2 motorway examples, the Westconnex project paves the way for more efficient traffic flow while encouraging a sustainable environment through the reduction of traffic flow on the existing arterial road network.

**Project timeline and cost**
As Australia’s largest single road project, the total project period including concept and planning phases is presently estimated to be 12 years. In contrast to the initial estimate cost of $10 bn, to date the total estimated cost is $16.8 bn. A summary of the project, timeline with key dates follows, which provides a lead into the specific issues of the land acquisition phase that impacts this project (Table VI).

**The emerging challenge**
The WestConnex project comprises new roadways above and below ground via tunnels, with land required for entries and exits to these tunnels. In addition, three new large interchanges where several arterial roads bypass intersections requiring large sections of land within the impacted suburbs. Close to 500 properties have or

<table>
<thead>
<tr>
<th>Date</th>
<th>Progress</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>The WestConnex concept was first developed by Infrastructure NSW as part of the State Infrastructure Strategy 2012</td>
</tr>
<tr>
<td>2012</td>
<td>A formal concept paper for WestConnex was prepared and coincided with the release of the State Infrastructure Strategy. The cost of WestConnex was originally estimated at $10 billion, including property acquisition costs. 75% of this cost would be sourced from user charges, with the NSW and Commonwealth Governments providing the remaining $2-3 billion</td>
</tr>
<tr>
<td>2013</td>
<td>The WestConnex Business Case Executive Summary was published which estimated a higher project cost at $11-11.5 billion; with the NSW Government providing $1.8 billion upfront and the Commonwealth Government providing $1.5 billion over 4 years from 2013-2014</td>
</tr>
<tr>
<td>November 2014</td>
<td>Infrastructure NSW recommended in its State Infrastructure Strategy Update that final business cases be developed for north and south extensions of WestConnex by the end of 2015. Total project costs were upgraded to $14.9 billion, including $1.8 billion for the northern and southern extensions</td>
</tr>
<tr>
<td>March 2015</td>
<td>Construction commenced M4 leg of the project</td>
</tr>
<tr>
<td>June 2015</td>
<td>As outlined in the NSW Budget 2015-2016, with approved scope changes and increases in land acquisition costs, the estimated nominal outturn cost for the WestConnex project was upgraded to $15.4 billion. $993 m in funding was allocated to Roads and Maritime Services in the NSW Budget for WestConnex in 2015-2016, on top of the $324.5 m allocated up to June 30, 2015</td>
</tr>
<tr>
<td>September 2015</td>
<td>Plans were revealed by WestConnex Delivery Authority to build the interchange on a former landfill site in St Peters</td>
</tr>
<tr>
<td>2017</td>
<td>M4 Road widening due to be completed with construction of the tunnel phase to be completed during 2019</td>
</tr>
<tr>
<td>2023</td>
<td>Estimated project completion</td>
</tr>
</tbody>
</table>

Table VI. Project timeline and key dates
are in the process of being acquired for this project, with a majority located within the vicinity of three major interchanges located at Haberfield, St Peter’s and Rozelle in Sydney.

In attempting to mitigate displacement of owners in the M2 motorway case, measures including increased compensation, the availability of alternate property within the surrounding location and case managers to assist dispossessed owners were deployed as part of the planning and were included in the budget for that project. These measures were not available when the acquisition phase of WestConnex commenced in 2013. The impact of the acquisitions on affected owners is anticipated to result in hundreds of cases before the courts in New South Wales adding delay and impacting on the perception of the project.

Moore (2017) highlights that as at March 2017, 175 compensation cases were lodged with the NSW Land and Environment Court for compensation specifically relating to WestConnex. It is further stated that the average hearing duration for most of these cases is between five and ten days, with one case being set down for five weeks of hearing time (Pratt, 2016). Further cause for the referral of the large numbers of cases to court has resulted from a systematic undervaluation of market value that has been identified. Gotgis (2016, p. 8) states that in a sample of 58 properties acquired in the lead up to WestConnex, the NSW Land and Environment Court determined a 57.84 percent variation resulting from undervalued property.

Of these cases, 26 involving residential property with the market value determined by the Court showing an average increase of 38.48 percent. The amount of compensation and more importantly the willingness of the acquiring authority to mitigate losses for large scale projects by negotiation over the compulsory acquisition process impact the cost and public perception of these projects. Russell (2014, p. 8) discusses the public concern over the acquisition phase of the WestConnex project and specifically the “low offers for properties to be acquired, lack of consultation and the cost of challenging compulsory acquisition valuations.”

The emerging challenges above are not new and have been documented internationally in the USA, Canada, Africa and Europe. In the USA, Mangioni (2010) discusses similar impacts and the inability of dispossessed owners unable to rehouse in parts of New London Connecticut that resulted in landmark cases taking a decade to pass through the courts. Viitanen and Kakulu (2009) express the impacts of the lack of framework for assessing compensation and restitution in Poland, Argentina and Nigeria with the devastating impact on property owners. They highlight the nexus between market value and the ability to rehouse, also known as restitution, which is a global problem in acquisition cases.

**Responding to WestConnex**

Faced with the urgent necessity for reform, the New South Wales Government completed a review of the land acquisition principles and process, known as the Russell Review 2014. The government was heavily criticized for not releasing the findings of this review dated February 2014 until late in 2016 when faced with unprecedented appeals to court over the WestConnex project. In responding to the recommendations of the Russell review, Pratt (2016) defines the level of opposition to the acquisition of land, its impact on property owners and the project for which the land is acquired. This opposition has added to the complexity of large scale projects, due to the lack of transparency in the initial phase of the project.

Among the key reforms introduced following the Russell review, Pratt (2016) defines the temporal elements that contribute to improved timelines of the acquisition process and the amount of compensation claimable for non-financial loss. A summary of the main
reforms that aim to minimize future challenges and that harmonize the acquisition process in contributing to expedition and minimizing challenges as follows:

- A fixed six-month negotiation period providing people more time to consider their options and get expert advice.
- Increased compensation for owner inconvenience and non-financial impacts up to a maximum of AUD75,000, including retrospective compensation backdated to February 2014.
- Enable landowners to remain in their properties after acquisition to do so without having to pay rent for up to 90 days.
- Provide for reinstatement in specific cases (e.g. a place of worship or community center).
- Appoint a personal manager acquisitions to coordinate all interactions between affected landowners and the acquiring authority – this manager will help affected landowners to find new homes or business premises, find new schools for children and other services to ease the experience of moving.
- Appoint a place manager to manage all general communication with affected landowners, their neighbors and communities (NSW Government, and Minister for Western Sydney 2016).

To summarize and compare the key factors that define the differences between the M2 motorway, Boston Big Dig and the current WestConnex project, Figure 2 sets out the points defined by Bartlett and Vavrus (2017) as vertical and horizontal factors within and across the projects. While no one project is without issue, the measures observed in the case studies examined serve as benchmarks that may be adopted internationally. In looking to future projects, including the Los Angeles to San Francisco rail link for example, *The Economist* (2016) highlights the eminent domain challenges among other

<table>
<thead>
<tr>
<th>Vertical summary of factors within the projects</th>
<th>M2 Motorway</th>
<th>Boston Big Dig</th>
<th>WestConnex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information and support for affected owners in advance of the project and proposed intended acquisitions</td>
<td>Continued support for the project, Big Dig planners invested significant effort and funds for property and business loss mitigation</td>
<td>Owners advised of the proposed taking of their property by mail. Large number of acquisitions resulted in affected owners not being able to rehouse in the surrounding location</td>
<td></td>
</tr>
<tr>
<td>Voluntary option of selling property adjoining the proposed M2 project to rehouse owners that lost property by compulsion that wished to remain in the same location</td>
<td>Considerable efforts to work with citizens, businesses, and interest groups to minimize disruption and find workable solutions</td>
<td>High number of cases litigated for reasons including the sum of compensation offered. Limited support for dispossessed owners who were left to consult their legal representatives and valuers</td>
<td></td>
</tr>
<tr>
<td>Options existed to review objections to market value offered with increases in compensation made in 36 percent of cases</td>
<td>The project planners underestimated the cost and time needed to relocate existing utilities. Allowing affected owners to take the sum offered, while being allowed to petition the courts for up to 3 years from the taking of their property</td>
<td>Reforms introduced after the acquisition of property: 1. Backdated increase in solatium 2. Case managers introduced to assist owners relocate. 3. Fixed 6 month period to negotiate prior to acquisition. 4. Owners may occupy their homes up to 90 days after acquisition rent free</td>
<td></td>
</tr>
</tbody>
</table>

| Horizontal comparison of factors across the projects |

Figure 2. Comparative summary of key project attributes
factors plaguing the commencement of this project. The factors discussed in the case studies and summarized in Figure 2 may assist in overcoming these factors that delay large scale projects.

Conclusion
This paper commenced by defining land acquisition and site assembly as the first stage in undertaking megaprojects. It was highlighted that this phase is undertaken by government across international jurisdictions due to its complex and legalistic nature and hence it is not ordinarily perceived as part of the project management delivery of megaprojects. In contrast, it has been demonstrated that this important phase may impact the perception and cost of the project and its process is driven and governed by statute. It was demonstrated through the review of case studies of large scale roadworks, that in addition to statute, the approach to planning, consultation, addressing the needs of stakeholders and in particular property owners contribute to the success for delivery of the project.

What has further been shown is that the success of the acquisition phase extends to include the practices and actions of acquiring authorities. This was demonstrated in the reviews of the M2 motorway in Sydney and the Boston Big Dig projects, where opportunities to mitigate the impact on affected property owners was achieved through consultation and providing options and support for impacted property owners. It was further shown that in the primary case study, the WestConnex project, that the same legislative provisions existed at the time the M2 Motorway project had commenced.

It was shown that while cases proceeded to court in the Boston Big Dig, the mitigation of potential cases was a priority, although it was an expensive process. Similarly in Sydney, the M2 motorway review demonstrated that a combination of approaches was used to address the needs of impacted owners. It is clear that the first measure of planning and negotiation between the acquiring authority and property owner greatly assisted in both the Boston and earlier Sydney M2 Motorway projects. In contrast to matters proceeding to litigation, increases in compensation when deemed appropriate were considered by the acquiring authority rather than the court. In the present case, the court has by default become the primary review mechanism and resource in the WestConnex project.

The key factors that have evolved in the acquisition process and the assessment of compensation that compels owners to challenge the sum of compensation offered as was highlighted in the WestConnex project follows in which remedies for such projects may be applied internationally:

1. The sum of compensation offered to property owners must take into account the ability for the dispossessed owner to relocate. The ability for the dispossessed owner to reinstate themselves in an alternate property within the same or surrounding suburb was shown in the WestConnex project is impacted by supply, which impacts the price of similar property. In large scale, infrastructure projects assistance is needed as was shown in the M2 Motorway project where the acquiring authority had voluntarily purchased surrounding property to assist in providing alternate options for affected owners.

2. In addition to point 1, the acquiring authority will need to directly engage with the property owner, invoking an owner focused period to negotiate the purchase and to assist the owner with their relocation. This moves the acquisition from a process driven approach to an owner focused approach in assisting to meet the owners objectives, which in turn progresses the acquisition and site assembly process.
This practice was successfully applied in both the Boston Big Dig and Sydney M2 Motorway projects.

(3) Of the reforms introduced in 2016 in the WestConnex project, the extension of time to six months for negotiation is important. This allows the dispossessed property owner opportunity to adjust to the fact that their property is to be acquired and to find an alternate property to relocate. Further, once the property is acquired, the dispossessed owner is permitted to continue to occupy their property for a further three month’s rent free.

(4) A further provision introduced in the Boston project moved the focus from litigation as a point of last or later resort, by allowing dispossessed property owners the right to partition the court for compensation up to three years after their property was acquired. This temporal element further adds to property owner’s ability to re-establish, to quantify the full financial impact of the acquisition after the taking of their property or business. This measure is one that should be considered by legislators as part of the reform package across all states of Australia and internationally.

As set out in the points above, in the case of the WestConnex project, new provisions were put in place in November 2016 by the New South Wales Government. These provisions are acknowledgment of the need for ongoing improvement to the acquisition process and serve as options nationally and internationally in assisting with the land acquisition phase for future large scale projects. As more large scale projects are undertaken in urbanised locations, reforms will be needed which should constitute the minimum level of assistance to be provided to affected property owners.

While statutory evolution is important, it is shown that the way in which the acquisition of land is applied, rather than the prescriptive legislative provisions will likely impact a more conducive environment for land to be acquired by negotiation. This in turn is an important step in managing and contributing to minimize adverse perceptions and challenges in one of the most critical and initial phases of large scale infrastructure projects (Table VII).

<table>
<thead>
<tr>
<th>Hills M2 motorway</th>
<th>Boston Big Dig</th>
<th>WestConnex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening date</td>
<td>May 1997</td>
<td>2007</td>
</tr>
<tr>
<td>Project period (excl acquisitions)</td>
<td>4 years</td>
<td>16 years</td>
</tr>
<tr>
<td>Project roadway length</td>
<td>21 kms</td>
<td>12 kms</td>
</tr>
<tr>
<td>Project cost</td>
<td>AUD616 m</td>
<td>AUD14.8 bn</td>
</tr>
<tr>
<td>Acquired property</td>
<td>246 residences</td>
<td>97 businesses relocated/ extinguished</td>
</tr>
<tr>
<td>Property acquisition phase</td>
<td>2 years</td>
<td>3 years</td>
</tr>
<tr>
<td>Property acquisition cost</td>
<td>AUD120 m</td>
<td>USD3 bn</td>
</tr>
<tr>
<td>Land acquisition cost as a percentage of the total project cost (%)</td>
<td>19.4</td>
<td>20.3</td>
</tr>
<tr>
<td>Basis on which value is determined for property acquired</td>
<td>Market value plus disturbance</td>
<td>Market value plus disturbance</td>
</tr>
<tr>
<td>Operator (initial)</td>
<td>Abigroup Obayashi</td>
<td>Massachusetts Turnpike Authority</td>
</tr>
</tbody>
</table>

References


Hornby, D.J. (1996), *Appraisal 1 Introductory Valuation*, Double D Products, Wooden ACT.


Impact of the land acquisition phase


Further reading


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The hierarchy of public project governance frameworks

An empirical study of principles and practices in Norwegian ministries and agencies

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Department of Mechanical and Industrial Engineering, Norwegian University of Science and Technology, Trondheim, Norway

Abstract
Purpose – The purpose of this paper is to study public project governance frameworks in various ministries and agencies in Norway, following the introduction of such a framework on the topmost level (i.e. the cabinet) which applies to the very largest projects.

Design/methodology/approach – The study is methodologically designed as a qualitative assessment of project governance frameworks that apply to state-funded investment projects in selected sectors, based on data gathered through document reviews and interviews.

Findings – The study finds that all of the agencies have introduced their own project governance frameworks, which are basically consistent with the recommendations from the project management literature and with the cabinet’s overall requirements in Norway. By contrast, only one ministry has taken a formalized role as a project owner. Governance tasks thus seem to be extensively delegated to the subordinate agencies. This even includes strategic tasks such as project selection and portfolio management, and implies there is a risk that public project governance has a narrow and internal focus.

Originality/value – The paper is a first step toward a better understanding of public project governance as a hierarchical system and the relationship between project owners on three levels, the cabinet, the sectoral ministry, and the government agency.

Keywords Project sponsor, Project governance, Governance framework, Project owner, Public projects

Paper type Research paper

Introduction
Major projects are increasingly used for delivering public goods and services, such as transport infrastructure, defense acquisitions, public buildings, and major ICT projects. They amount to large sums of money and their scale tends to increase (Flyvbjerg, 2014). The McKinsey Global Institute (2013) estimated global infrastructure spending at approximately 4 percent of total global gross domestic product, mainly delivered as large-scale projects.

However, public investment projects face a number of challenges and have varying reputations. There is a wide literature on what Hall (1981) termed “great planning disasters,” projects with cost overruns, time delays, and either none or very limited benefits. In one of the most extensive studies to date, Morris and Hough (1987) examined more than 3,500 major public projects across different sectors and countries. They found that cost overruns were typically in the range 40-200 percent and that very few projects were cheaper than budgeted. A number of more recent studies have confirmed that cost
overruns are common in infrastructure projects in the UK (MacDonald, 2002), Canada (Berechman and Wu, 2006), Australia (Love et al., 2012), Norway (Odeck, 2004), Sweden (Lundberg et al., 2011), the Netherlands (Cantarelli et al., 2012), Slovenia (Makovšek et al., 2012), and China (Ansar et al., 2016). Flyvbjerg, Skamris Holm and Buhl (2003) studied 258 transport projects from 20 countries over a period of 70 years and found that the problem of cost overruns was consistent and applied to nine out of ten projects. Some of the worst examples of overruns are found in sporting events. The authors of a review of all Olympic Games in the period 1960-2016 concluded that the average cost overrun was 156 percent, and that all games had overruns (Flyvbjerg et al., 2016). By contrast, in ICT projects, Flyvbjerg and Budzier (2011) found that the average overrun was moderate (27 percent), but there was a “fat tail,” implying that one out of six projects were “black swans,” with an average overrun of 200 percent.

Cost overrun is a widespread phenomenon. However, the more serious, but equally common problem is when projects do not meet the expectations of users and society. In extreme cases, the whole investment could be wasted. Samset (2003) argued that in order to be truly successful, projects must perform well tactically and strategically, not only operationally. Flyvbjerg, Bruzelius and Rothengatter (2003) and van Wee (2007) documented that in transport projects the demand estimates were of equally poor quality as the cost estimates, and that benefits were often overestimated. Pinto (2006) quoted from an InfoWorld article describing how 29 percent of ICT projects were paid for but not delivered to the customer, 47 percent were delivered but not used, and 19 percent were abandoned or reworked; only a small share of projects was used as delivered or with minor changes. Flyvbjerg and Budzier (2011) referred to a German study that found that 34 percent of companies undertook projects that were not aligned with corporate strategy, and 67 percent of companies failed to terminate unsuccessful projects.

These problems are not limited to the public sector, as highlighted by, for example, Merrow (2011), who documented similar challenges in the private sector. However, the public sector faces some special challenges, including multiple objectives, difficulties in measuring success, and having to deal with a wide array of external stakeholders in the democratic decision-making processes (Klakegg and Volden, 2017). Public projects are the outcome of a political tug-of-war between stakeholders in society, whose needs and priorities will concur or conflict to varying degrees. The outcomes of such processes are unpredictable, as is well illustrated in a study of 60 international projects (Miller and Lessard, 2000). We could also add that the public sector often has internal challenges, such as a weak capacity for designing a strategic vision, lack of skills, and lack of coordination among levels and actors, as noted by the OECD (2015).

Cantarelli et al. (2010) offered four explanations for project failures, each of which may be relevant to varying degrees in specific projects, but generally they may reinforce each other: technical, psychological, economic, and political. The technical explanation is related to the poor project design, incomplete estimation, and lack of tools, methods, and experience. The psychological explanation is based on the concept of planning fallacy and optimism bias, and involves people’s cognitive bias and cautious attitude toward risk. The economic explanation has to do with lack of time and resources invested in the planning phase. The political explanation is closely related to the stakeholders’ incentives and may cause deliberate manipulation of estimates in order to increase the chance that a specific project will be selected.

Special measures are therefore required to ensure that the right projects are selected and efficiently implemented. In line with the four explanations for project failure, a wide range of measures may be relevant, such as training and improved estimation techniques to avoid technical problems, independent reviews to prevent optimism bias, enough time and resources for early planning, and economic incentives for “true speech” and accountability. A number of organizations, particularly in the private sector, have introduced project governance frameworks in recent years, and the literature on project governance is growing.
Some governments have even established an overarching governance scheme that applies to the largest investment projects across ministries and sectors, to deal with common challenges and to ensure project success. Norway was an early mover in this respect and since the year 2000 the country has required external quality assurance (QA) of decision documents, and that key decisions are elevated to the highest political and administrative level (i.e. the cabinet and parliament). The scheme and preliminary effects, some of which are very encouraging, are presented and discussed in works by Samset et al. (2006), Williams et al. (2010), and Volden and Samset (2017a).

However, the Norwegian and similar frameworks introduced at the topmost level of the hierarchy apply only to the largest, most complex, and/or highly innovative public projects, and they focus only on the most critical decision gates, while leaving it to the various ministries and agencies to define the more specific governance arrangements necessary to ensure the success of all projects. In this paper, we explore the scope of project governance frameworks on these subordinate levels, including their main components, their comprehensiveness, and their differences and similarities. We are particularly interested in the hierarchy of the project governance frameworks, with the cabinet at top, the sectorial ministries on the next level, and below them the agencies in which the projects are actually implemented.

We start by reviewing the relevant literature concerning public project governance schemes, and conclude that the hierarchy of such frameworks is an underresearched topic. Thereafter, we present our research questions, methodology, and data, before we present and discuss the findings from seven government agencies and seven ministries in Norway. The final chapter offers some conclusions and recommendations, including the need to strengthen the strategic focus of the public project owner’s role.

**Extant research**

**Governance in relation to projects**

In general terms, governance relates to “all processes of governing, whether undertaken by a government, market or network, whether over a family, tribe, formal or informal organization or territory and whether through the laws, norms, power or language” (Bevir, 2013, p. 1). Governance can thus be studied at different levels and in different fields, such as public governance, corporate governance, global governance, and project governance. A key governance issue is that the interests of the implementing agent will not necessarily be aligned with those of the financing party (Tirole, 2001). Principal-agent theory has been useful to understand this constellation (Eisenhardt, 1989).

The term project governance has only recently become an important issue in the project management community and literature. It refers to the processes, systems, and regulations that the financing party (the project owner) must have in place to ensure that relevant and sustainable project alternatives are chosen and delivered efficiently (Volden and Samset, 2017a). Project governance is thus a system of appropriate checks and balances that enables transparency, accountability, and defined roles in the project, while at the same time supports project managers in delivering their objectives. This corresponds well with what Morris and Geraldi (2011) defined as the institutional level of managing projects, which focuses on shaping the context and conditions to support and foster projects.

When a project is being undertaken by an organization (which is normally the case), a related term is corporate governance, which refers to the mechanisms, processes, and relations by which the corporation is controlled and directed. A much-cited textbook by Müller (2009) defines project governance as a subset of corporate governance, wherein the project governance framework is established to allow projects to achieve organizational objectives and foster implementation that is in the best interests of all stakeholders and the corporation itself. The Project Management Institute (PMI) (2013) defined project governance in a similar way, as “an oversight function that is aligned with the
organization’s governance model and that encompasses the project life cycle [by providing] a comprehensive, consistent method of controlling the project and ensuring its success by defining and documenting and communicating reliable, repeatable project practices.”

Project governance is a relatively new topic of the project management community, and the literature on the topic is fragmented (Ahola et al., 2014). Different conceptual models have been suggested to categorize the various streams of the literature. Williams et al. (2010) distinguished between governance of projects, which aims at efficient delivery, and governance through projects, which aims at choosing the right concepts and ensuring that effects are realized and are sustainable. This corresponds well with Samset’s (2003) levels of project success (i.e. operational success defined by efficiency and cost compliance, and tactical and strategic success in terms of impact on users and society).

Müller (2017) made a distinction between project governance on the one hand and governance of projects on the other hand. Project governance refers to the governance of a single project, and includes such topics as the project manager’s sovereignty and authority, involvement of various stakeholders, and the use of project boards. By contrast, governance of projects refers to governance of groups of projects within an organization, and includes questions such as the institutionalization of project management methodologies, reporting systems, project selection techniques and program and portfolio management. A similar categorization was made by Too and Weaver (2014) and Ahola et al. (2014).

Most of the project governance literature has its origins in the private sector, but the findings and recommendations are also relevant to the public sector. Some studies focus on the governance of state-funded projects at a country level, in relation to political processes and policy forming. Their perspective is on overarching institutional arrangements established by the central governments to ensure that projects succeed across different public organizations (Williams et al., 2010; Klakegg et al., 2015; Volden and Samset, 2017b).

Project governance frameworks

The project governance scheme should be established by the topmost level of the organization, to set the context and the regulatory frameworks within which the projects are implemented. In the following, we will briefly summarize some key findings and recommendations from the literature concerning project governance frameworks and their components. The authors of various studies have emphasized different aspects, depending on their level of analysis, but also on which explanations for project failure they support (cf. Cantarelli et al., 2010). Some authors, such as Flyvbjerg, Bruzelius and Rothengatter (2003), who believe project failure is caused by strategic misrepresentation and irresponsible behavior, highlight economic incentives, accountability, and transparency, whereas others emphasize better tools, techniques, training, and support. In most cases, a combination of measures is recommended. For example, Siemiatycki (2015) discusses remedies to prevent cost overruns and recommends performance monitoring and pay-for-performance contracts as well as better training of project leaders and forecasting techniques that are more precise.

Haanæs et al. (2006) reviewed different models for decision making in major public projects based on best practice in Norway and other countries, and suggest the following minimum requirements:

- clearly defined project phases;
- clearly defined decision points between the phases;
- quality-assured basis for the decisions;
- simplicity; and
- a certain standardization and common terminology.
Likewise, Narayanan and DeFillippi (2012) suggest that project governance schemes incorporate five elements:

(1) stage-gate approval processes;
(2) formal roles and responsibilities;
(3) stakeholder representation;
(4) QA; and
(5) contracts and sign-offs.

Certain project phases are more critical and in need of governance arrangements than others. A number of authors have highlighted the crucial role of the front-end phase (Shenhar, 2004; Williams and Samset, 2010; Morris, 2013; Samset and Volden, 2015). This is the stage from when the idea is conceived until a final implementation decision is made, and during which it is still possible to make changes or to terminate the project, at an affordable cost. Many of the factors that later create problems in the construction phase, leading to cost overruns and other problems, are typically present early in the project definition stage (Morris, 2009). Williams and Samset (2010) note that the choice of concept has the largest impact on strategic project success and is thus highly critical. Similarly, Müller (2009) emphasizes that the selection and prioritization of projects is a key issue in a project governance scheme, and that it is closely related to the organization’s portfolio management.

A number of standards and guidelines have recently been developed to address project governance models further, in particular as part of corporate governance. For example, the Association for Project Management (APM) (2011) has established 13 principles for the governance of project management and defined four main components of such schemes: portfolio management, project sponsorship, project management capability, and disclosure and reporting.

Such principles and guidelines may be more or less detailed and more or less mandatory. Some project governance models are behavior oriented (i.e. require that certain detailed rules are followed, such as common project management methodology), whereas others are outcome oriented and thus give more autonomy to the project manager. These two “paradigms” may also be denoted as bottom-up and top-down (Müller, 2009). Each organization should establish a project model according to its needs, but some standard models exist. For public organizations, the most commonly used scheme internationally is PRINCE2® (Projects IN Controlled Environments, see www.axelos.com). The scheme was developed in the UK, originally for ICT projects, but has since been developed into a more general framework, integrating the governance of projects, programs, and portfolios and with an associated certification scheme.

Some organizations have established project management offices (PMOs) that often have a central role in a project governance scheme (Hobbs and Aubry, 2008; Morris and Gerald, 2011; Müller et al., 2014). Other institutions commonly used in the governance of individual projects are the project sponsor, the project board (or steering committee), and various advisory groups and quality committees (Müller et al., 2017).

Independent QA is an important element of a project model too, as it may ensure more realistic estimations of cost, risk, and benefits, as well as a transparent planning process. All four explanations for project failure identified by Cantarelli et al. (2010) suggest that independent reviews should mitigate the problem, as they ensure that sufficient competence, experience, and resources are brought in, they provide an outside view, and they provide disincentives to manipulate estimates. Volden and Samset (2017b) studied project models at country level and found that in five of the six schemes there were truly
independent reviews of decision documents at key decision gates – in two countries by external consultants from the private sector and in three cases by a designated government agency.

Flexibility is crucial. Although it may be useful to have a common project governance scheme for all projects in the organization, the scheme should not be static, as the need for governance may vary across projects and project phases (Miller and Hobbs, 2005). Müller et al. (2014) identified “organizational enablers” for good governance and governmentality, and their most prevalent finding was the importance of flexibility.

It should be mentioned that although we here focus on governance frameworks, with its formal roles and regulations, there is also a human side of governance. Müller (2017) introduced the term governmentality, which is a combination of “governance” and “mentality,” and addresses such aspects as top management’s attitudes and ambitions regarding project work, support, and confidence in the project manager, and more generally the cultural values that members of an organization share and respect. The two types of governance, structure-based and relationships-based, will interact and strengthen each other (Klakegg and Meistad, 2014).

The ambiguous project owner role
Project governance and project ownership are closely related, as it is the owner who should be responsible for introducing a project governance scheme to ensure that projects are successful. However, there is much confusion in the literature about this role. In large public projects, the government (i.e. the cabinet) may be seen as the owner, ultimately on behalf of all citizens. Similarly, in private projects, the board of directors is the project owner on behalf of all shareholders (Klakegg and Shannon, 2013). In the next step, the role of project owner may be delegated from the true owners to individuals or groups, so-called “governance agents,” according to clear instructions defined by the project governance scheme. In the project management literature, the role of the project sponsor is often highlighted (Helm and Remington, 2005; Kloppenborg et al., 2009). The APM (2011) has defined a long list of responsibilities for sponsors, reflecting the multifaceted nature of the role. The responsibilities include, for example, owning the business case, keeping the project aligned with the organization’s strategy and portfolio direction, focusing on realization of benefits, clarifying the decision-making framework, providing resources, supporting the project manager, and engaging other stakeholders.

Project owners as well as sponsors may face a conflict of interest regarding the “governance perspective” and the “support perspective,” also referred to as the external and the internal perspective on the project (Ahola et al., 2014; Crawford et al., 2008). On the one hand, project governance should have an external focus, representing the organization and the client’s interest, and on the other hand, it should have an internal focus, providing project managers with support so that they fulfill their role efficiently. Olsson and Berg-Johansen (2016) studied seven Norwegian projects and found that the “support perspective” was present in all projects, whereas the strategic and external perspective, focusing on the business case and benefits realization, was more or less absent.

We have already defined the project owner as the financing party. It should be added that the owner is also the ultimate commissioner of the investment, and the one who will control the asset in the operational phase. PRINCE2® distinguishes between three project owner roles, that should all be represented in the project board: the executive, who takes care of the business perspective and provides the funding; the user who establishes whether the project is meeting the needs of the people who will be directly working with the outputs; and the supplier or “do-ability perspective,” which provides confidence that the project’s outputs will be achieved with available resources. Similarly, Klakegg and Olsson (2010)
distinguish between three strategic owner functions (financing, commissioning, and judicially administering) and five tactical owner functions (controlling, broker/facilitator, planning, executing, and operating).

Governance hierarchies – an under-researched topic
It follows from the above that the literature clearly recommends that a project governance framework should be established by the financing party (i.e. the topmost level of the organization) and be aligned with the organization’s strategies and corporate governance model. Several authors have noted that the task is multifaceted, and that different perspectives must be balanced, such as, inter alia, the operational project perspective (governance of projects) and the tactical-strategic perspective (governance through projects), as well as the control and the support perspectives. Some have suggested that different governance functions be filled by different individuals. However, this discussion should also be related to the levels of the hierarchy and the allocation of project owner responsibilities optimally across the levels of an organization.

As noted by Too and Weaver (2014), a governance framework is hierarchical in the same way as a management system, where the top level is accountable for the whole system, but delegates responsibility and authority for defined actions to subordinate levels. One out of very few studies that have explored this topic is Zwikaε and Smyrk (2012), who showed that there are principal-agent relationships at multiple levels of the organization, with the funder (the true owner) on top, who hires a project owner to be accountable for benefits realization, who in turn hires a project manager to be accountable for efficient output. Each level must evaluate the performance of the level below, and for this task they need the right success criteria, governance arrangements, and authority to make decisions. All these elements should be determined by the organization’s project governance framework. In most cases, we would expect that the higher levels of the hierarchy should control the measures to ensure tactical-strategic success, whereas the lower levels focus on operational success. Similarly, that the higher levels place more weight on control and the lower levels on support. And that the higher levels govern with respect to outcome, and the lower levels with respect to behavior. But again, our knowledge is limited since there is a gap in the literature concerning these issues.

Furthermore, the above-mentioned authors discuss projects that take place within the framework of a single organization. We have not identified any studies that explain the allocation of project governance responsibilities across different organizations in the way it occurs in government-funded projects. The ultimate owner of a project funded by the national government is the cabinet, led by the prime minister, who is de facto responsible for all projects under the various ministries. However, this responsibility is normally delegated to the sectoral ministry, and in turn to the relevant subordinate agency where the project is implemented. Each level may want to introduce their own project governance scheme which is aligned with their strategies, project portfolio, competence level, etc. An interesting question is whether these project governance frameworks on various levels are consistent with each other. This is the topic that we seek to explore in this paper, and we find Norway to be a suitable case since a project governance scheme introduced at the topmost level (the cabinet) is already in place.

This study and the Norwegian public project context
The model which forms the basis for our research is shown in Figure 1. As illustrated, there are project owners on three levels of the government hierarchy: the cabinet, the responsible ministry, and the agency. Certainly, it is the parliament, and ultimately the people as voters and taxpayers, who are the real owners of public projects. However, here we limit our attention to the executing power, which, in a parliamentary system,
emanates from the parliament. Furthermore, we focus only on the state and not on local and regional authorities.

Each gray-colored field defines an organization, with its own goals, strategies, types of projects and contextual factors, and associated project governance framework. All the three levels can be said to have ownership in, at least, the largest projects executed by the agencies. In this paper, we investigate to what extent the various levels actually exert project ownership in terms of introducing a stage-gate model or other governance arrangements, and engaging in key decisions concerning projects, programs, or portfolios.

There is a principal-agent relationship between each level. The ministry’s goals and strategies will normally be broader than those of the agency. For example, whereas a public roads agency may wish to build as many highways as possible, with the most fancy and high-tech (and expensive) bridges, subsea tunnels, and so forth, the Ministry of Transport is responsible for all modes of transport, and should balance the need for mobility against life-cycle cost, the environment, and other concerns. A ministry cannot and should not be involved in all individual projects executed by the agencies, but it should require that the most critical decisions are elevated to ministry level, and it should ensure that the agencies have the necessary competence, capacity, procedures, and processes. At top of the hierarchy is the cabinet. The overall allocation of the government budget among the ministries should of course be determined on this level. Major public projects may have impacts that extend beyond a single ministry’s field of responsibility. Certain project decisions may therefore be so important, or involve such a high level of conflict or risk that they should be elevated to the topmost level of the governmental system.

The picture may be more complex than the “pure” structure shown on the left-hand side of Figure 1, with only one ministry and one agency involved. In reality, many different variants exist, where various other ministries and/or agencies are among the most important stakeholders in the project (e.g. in the role of user or regulator). We would like to highlight one model in particular, as shown on the right-hand side of Figure 1, where two different ministries are shown as having ownership interest in the project: one ministry (Ministry 1) is formally responsible for the executing agency (providing the general mandate to operate its business), and another ministry (Ministry 2), which commissions the particular project. Ministry 2 will then be expected to take more of a user/customer perspective. As we will come back to, this is the case with building construction projects in Norway, and it implies a strong need to coordinate the exertion of ownership.

In Norway, an overarching project governance framework was established by the cabinet in the year 2000, and extended in 2005. This scheme represents the “top layer” of the project governance hierarchy. It applies only to the projects exceeding an expected cost of NOK750 million, and comprises only two decision points in the front-end of projects.
The decision documents to be produced before these two decision gates must have a certain content and they must be subject to an external quality assurance (QA):

1. QA1 – QA of choice of concept before cabinet decision to start detailed planning. The basis for the QA1 exercise should be a needs analysis, the project goals, and overall requirements, a possibility study and a cost-benefit analysis of at least three alternative solutions. The reviewer should give recommendations regarding the ranking of alternatives and the decision strategy.

2. QA2 – QA of the management base and cost estimates before the project is submitted to the parliament for approval and funding. The cost estimate must be based on stochastic estimation techniques, where two figures should be calculated, the P50 and the P85 ($P_x$ implies that there is $x$ percent probability that the actual cost will be at or below this level, given the uncertainty in the project). The recommended budgeted cost should be set at or close to P85 whereas the target cost for the agency should be around P50. The difference between the two numbers is the uncertainty provision. On the portfolio level, it should be expected that the projects hit P50 on average so that no provision is spent.

The Ministry of Finance has entered into framework agreements with private consultants who perform the QAs. The final decision is of course a political one. The scheme is shown in Figure 2.

The QA scheme ensures that the project is well prepared and at a sufficient level of maturity when it is approved, and it ensures legitimacy for the final decisions. QA1 concerns the choice of concept and thus the tactical-strategic level of project success, whereas QA2 is intended at efficient project implementation (i.e. operational success). Volden and Samset (2017a) present and discuss the Norwegian scheme and preliminary effects. Generally, it adheres to the recommendations from the literature concerning the components of a project governance framework (stage-gate approval process, clearly defined responsibilities, QA, etc.). It is also a transparent system, as all the QA reports are made publicly available.

Other countries have introduced similar schemes in recent years. In the UK, the Cabinet Office and HM Treasury introduced a similar scheme in the year 2000, and other countries have followed in the subsequent years. The authors of several studies (Williams et al., 2010; Klakegg et al., 2015; Volden and Samset, 2017b) compare the Norwegian and the UK governance frameworks with each other and with those of other countries. Generally, they conclude that it is too early to determine the schemes’ effect on project success, but that there is much to suggest that it has been positive. The schemes have much in common, and those that were first to be implemented have inspired the followers. There are a number of differences between the schemes: Volden and Samset (2017b) conclude that there are two main types of schemes: the schemes in the Scandinavian countries, which are simple in terms of the number of intervention points and which do not intervene significantly in the existing processes and practices in the agencies; and the schemes of the Anglo-American

![Figure 2. The Norwegian quality assurance (QA) scheme – the “top layer” of project governance](image-url)
countries, which are more extensive and behavior oriented, with follow-up points also in the implementation phase, and which exert more centralized control.

The Norwegian QA scheme applies only to the largest projects – approximately 20-30 projects each year. It applies only to the front-end phase, with no instructions concerning the implementation phase. It should also be noted that the QA scheme does not include a decision point between the idea phase and the conceptual phase. Furthermore, there are no instructions regarding project organization (such as the use of governance agents), nor about portfolio management. It is therefore implicitly assumed that the scheme is supplemented by more specific governance arrangements in ministries and agencies. By demanding high quality from the top of the pyramid, a trickle-down effect should be expected, in the form of higher standards at the lower levels. There should also be consistency between the three project governance schemes, in the sense that schemes on the lower levels include the requirements on the higher levels, and specify, refine, and adapt them to the specific sector or project type, to the extent necessary.

For the empirical part of this study, we raise the following research questions:

RQ1. Have Norwegian ministries and agencies introduced project governance frameworks, following the introduction of such a framework at the topmost level? If so, describe the content of the schemes, including any differences and similarities between sectors.

RQ2. Which level, agency or ministry, takes the most active role as project owner and initiator of governance arrangements?

RQ3. Are these frameworks consistent with recommendations from the project governance literature?

RQ4. Are the schemes in the hierarchy (cabinet, Ministry, agency) internally consistent?

RQ5. What are the theoretical and/or practical implications of the findings?

**Data and methodology**

In this study, we investigate project governance arrangements on the ministry and agency levels in seven government agencies and seven ministries in Norway. The study is methodologically designed as a qualitative, case-based assessment of project governance frameworks that apply to the state-funded investment projects in the selected sectors, based on data gathered through document reviews and interviews. We consider this to be a well-suited approach as the study has a descriptive and exploratory purpose rather than to draw universal conclusions. In line with Yin (2013), we believe that the concrete, context-dependent knowledge that can be obtained from case studies is highly valuable and that precisely because of the detailed understanding that is obtained, the results are often relevant to other contexts. We consider this an important step toward a better understanding of how public projects are governed and how project governance arrangements on lower levels underpin and reinforce the QA scheme on the topmost level. This knowledge should also be relevant to other countries with similar project governance frameworks on the cabinet level.

The included agencies and ministries are shown in Table I. The seven agencies were selected because they have had the most projects covered by the QA scheme. Samset and Volden (2013) documented that the projects that undergo external QA are divided as follows: 43 percent road projects, 9 percent rail projects, 14 percent defense projects (material projects and construction), 11 percent ICT projects, 18 percent civil building construction projects, and 5 percent others. All of the agencies are largely project-based organizations. Total investment volumes per year[1] in the sectors follow from Table I.
Note that three of the ministries are included twice because they are responsible for more than one agency. Further, a special comment regarding the ownership of civil building construction projects is required (cf. the right-hand side of Figure 1). Statsbygg is a government agency specializing in providing facilities for various public institutions. The ministry responsible for providing the financial resources for Statsbygg is the Ministry of Local Government and Modernization. However, there is typically a second ministry involved, namely the one that owns the institution that will use the building (e.g. in the case of a prison, the Ministry of Justice). Hereafter, we refer to this ministry as the “client ministry.”

Project governance arrangements can be more or less formalized. For example, a high level of trust and/or frequent communication with the subordinate level may reduce the need for formal requirements. However, as these projects take place within the state bureaucracy, we expect a certain degree of formalization. We therefore focus primarily on the structural aspects of project governance.

The empirical investigation covers the following main topics, which are extracted from literature and underpin the research questions. The list largely corresponds to our interview guide:

- Stage-gate models: have schemes or models defining project phases and decision points, been introduced for projects implemented by the agencies? If so, what characterizes them in terms of, for example, their comprehensiveness or the phases they cover?
- Ministry involvement: what level of involvement have the ministries chosen for projects implemented by their subordinate agencies?
- Roles in governance: are formalized governance agents appointed, such as project sponsors or project boards? Who fill these roles and what are their mandates?
• QA: to what extent is independent QA of decision documents an integrated part of the schemes?

• Threshold: which criteria (threshold level or other) are used to determine when decisions are to be elevated to a higher level and/or specific requirements must be adhered to? How flexible are such requirements in response to individual projects’ needs and properties?

• Uncertainty provision: who controls the provision for uncertainty in the project budget? Do smaller projects not covered by the QA scheme also have project budgets that include a provision for uncertainty?

• Portfolio management: to what extent is project portfolio management an integrated part of the scheme, at each level?

This study builds on document reviews and semi-structured interviews with key interviewees from all of the included ministries and agencies (Table I), a total of 31 people. A challenge during data collection, and a finding in itself, has been the great variability in the availability of written descriptions of the project governance schemes. The Ministry of Defense stands out, with its’ comprehensive descriptions of its project governance scheme Prinsix, including templates and guidelines, which are openly available on the Ministry’s website. Other institutions have provided more or less detailed documentation at our request. Yet others have provided little information, mainly because such written documentation does not exist. This was particularly the case for the ministries’ involvement in the projects and for governance arrangements in the earliest project phases. In these cases, data collection was based on oral sources. Generally, the document review was conducted before the interviews, and the interviewees were asked to verify our understanding of the model and explain some of its elements further when necessary. In few cases, it was an iterative process where we were given access to new documents after the interviews, in which case we were able to contact the interviewees again for subsequent follow-up questions.

All the ministries and agencies with projects that undergo the cabinet’s QA scheme has appointed a contact person, who is available for questions about the quality assured projects and processes. We have access to this list and used it as a basis for contacting the ministries and agencies, and the contact persons helped us identify interviewees. We were looking for interviewees who were highly experienced in project work in general, and had high knowledge of the ministry’s/agency’s project governance arrangements, in addition to having special knowledge of their sectors. Some of the contact persons were themselves among the interviewees. The interviews were in most cases conducted with individuals, but in a few cases more than one person from the same agency or ministry was present simultaneously.

As indicated, the interviews were open and semi-structured, and based on the list of topics presented above. We used the stage-gate model as a starting point and asked the interviewee(s) to explain the life-cycle of a typical project in their sector, from the first idea arises until the operational and maintenance phase. We also asked questions like “what would happen […]” and “who would react […]” when something does not go according to plan. The interviewees were encouraged to talk freely, based on their own personal experiences and knowledge of the various topics. Each interview lasted one to two hours, with one or two researchers present. The researchers prepared a comprehensive interview report following each interview.

Data were collected between February and December 2016. Data from different sources were subsequently compiled and systematized by the researchers, topic by topic. Since the objects of study were few and the topics covered fairly broad, we did not use any formal
content analysis, coding or other quantitative or qualitative analysis software, neither for
the document analysis not the interview analysis. We simply constructed a large table with
the type of project (i.e. the sectors) along the x-axis and the selected topics along the y-axis,
with comprehensive descriptions in the cells. We placed great emphasis on ensuring
comparability across sectors, also in cases where varying terms were used.

A challenge when using interviews as a data collection method is that the information is
inevitably affected by the interviewees’ interpretations and subjective assessments. In our
case, there was a potential risk that some of the interviewees might have had a self-interest
in portraying their own efforts, competence, and project practice in a good light. We
therefore emphasized triangulation of the information obtained from different sources
(written documentation vs oral sources, and ministry vs agency). In a few cases, we
discovered information that we perceived as inconsistent, and then had to go back to the
interviewees and/or check a third source, to clarify the issues.

More generally, case studies are often considered “weak evidence” and biased toward
verification. But as noted by Flyvbjerg (2006), the question of bias applies to all methods,
including, for example, the choices of categories and variables in a quantitative study and
the structure of a questionnaire. Experience indicates that case studies actually contain a
greater bias toward falsification of preconceived notions. Our study, although not intended
to test a set of hypotheses about cause and effect, rested implicitly on a set of assumptions,
and we tried to be open to the fact that they might not hold. For example, even though we
assumed that the topics drawn from the extant literature were the most important ones in
describing these particular governance frameworks, we also searched actively for other
aspects. Similarly, we tried in various ways to questions the assumption that any
improvements in ministries and agencies’ governance schemes after the year 2000 can be
traced back to the introduction of the cabinet scheme.

Presentation and discussion of findings
In this section, we present and discuss the most important findings from our study.
The presentation is basically structured according to the predefined list of topics from
the data and methodology section, but more interesting and/or surprising findings are
highlighted.

Stage-gate models
A key finding in the study was that all or most of the agencies seem to have invested heavily
in their project competence and capacity in recent years. All of the agencies in the study
have introduced formalized stage-gate project models and many of them update and
improve their models regularly to ensure that they are consistent with best practice. Most of
the project models were introduced during the last 15 years, some even more recent, and our
interviewees believed that the QA scheme introduced in year 2000 on the topmost level had
been a major trigger. “The OA scheme taught us which requirements we should ask in the
planning of projects,” said one agency interviewee. All of the models are well adapted to the
QA scheme and ensure that the largest projects are well prepared for the two control points.
The models also seem to have become increasingly comprehensive over time, with
associated guidelines, templates, and procedures, and some interviewees were of the view
that future improvements should be in the form of simplifications.

The two agencies with many ICT projects have both introduced a variant of PRINCE2®
in recent years. The other agencies have introduced similar models, but without referring to
any particular international model. Generally, there are many similarities between the
models. They have between four and six project phases, with decision points between
each phase. The names of the phases are fairly similar (but not identical) across agencies,
and cover the conceptual phase, the detailed planning phase, and the construction phase,
as a minimum. By contrast, the idea phase is included only in one of the project models. The two included agencies with ICT projects stand out for highlighting benefits realization (i.e. the operations and maintenance phase) in their project models.

The models are, with one exception, introduced and managed on the agency level. Only one of the ministries, the Ministry of Defense, has established its own formalized stage-gate model, which applies to defense material projects and is consistent with what happens at the agency level. The interviewees from the ministries generally referred to the QA scheme when asked about project models. The ministries see it as their responsibility to ensure that the subordinate agencies prepare their largest projects according to the cabinet’s requirements, but otherwise there are few regulations from the ministries’ side. Table II shows the project models by the project type.

The earliest phase
As mentioned above, the project models generally do not cover the earliest phase, where the idea occurs and is developed into a conceptual solution. Some of the interviewees referred to this phase as “the political or strategic phase, which is not a part of the project.” Only the Ministry of Defense has introduced a clear instruction as to how project ideas should be treated and who can approve an idea before transferring it to the conceptual phase. “We always approve the idea before any start-up activities on agency level can be initiated.” The Ministry of Defense is clearly responsible for this phase, in close cooperation with the agency.

According to our interviewees, the project ideas occur in various ways. “It is not always clear where they come from,” said an interviewee. In some cases, the idea is identified on the political level, or follows from a new policy or reform. An example provided by one of the respondents was the Pension reform in 2011, which implied a need for a renewal of the ICT systems in the Labor and Welfare Administration. Equally often, however, the idea “occurs” on the agency level, sometimes in close dialogue with internal or external user groups, and based on more or less systematic needs assessments. For example, the National Public Roads Administration has five regional departments, each of which is in close contact with municipalities and other stakeholders, and “picks up” user needs in various informal ways. In the case of civil building construction projects, the idea will often arise at the user agency level (e.g. a prison or a museum), which may start to explore alternatives, sometimes in

<table>
<thead>
<tr>
<th>Type of project</th>
<th>Stage-gate model</th>
<th>Owner of model</th>
<th>Number of phases</th>
<th>Number of decision points</th>
<th>Idea phase</th>
<th>Phases covered by the model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road projects</td>
<td>Yes</td>
<td>Agency</td>
<td>6</td>
<td></td>
<td>X</td>
<td>X X X X X</td>
</tr>
<tr>
<td>Railway projects</td>
<td>Yes</td>
<td>Agency</td>
<td>6</td>
<td>6</td>
<td>X X</td>
<td>X X X</td>
</tr>
<tr>
<td>Defence material projects</td>
<td>Yes</td>
<td>Ministry/agency</td>
<td>6</td>
<td>4</td>
<td>X X</td>
<td>X X X X</td>
</tr>
<tr>
<td>Buildings/locations for the defense</td>
<td>Yes</td>
<td>Agency</td>
<td>4</td>
<td>3</td>
<td></td>
<td>X X X</td>
</tr>
<tr>
<td>ICT infrastructure projects in the health and welfare area</td>
<td>Yes</td>
<td>Agency</td>
<td>5</td>
<td>6</td>
<td></td>
<td>X X X X</td>
</tr>
<tr>
<td>ICT infrastructure projects in the Police</td>
<td>Yes</td>
<td>Agency</td>
<td>5</td>
<td>5</td>
<td></td>
<td>X X X X</td>
</tr>
<tr>
<td>Buildings/locations for civil government institutions</td>
<td>Yes</td>
<td>Agency</td>
<td>6</td>
<td>6</td>
<td></td>
<td>X X X</td>
</tr>
</tbody>
</table>

Table II. Stage-gate models by the type of project

Note: “X” indicates that a phase is covered by the stage-gate model
consultation with Statsbygg (Norwegian Directorate of Public Construction and Property), and eventually the ministry will become involved and the building will be formally commissioned.

The QA scheme is meant to ensure that the choice of concept is elevated to the cabinet level in the largest projects, but not even the QA scheme covers the earliest decision to develop a project idea. It is a well-known critique against the QA scheme that projects sometimes have developed too far when they reach the cabinet after QA1, by which time it is difficult to stop them.

Ministry involvement

The ministries are formally responsible for all projects implemented by subordinate agencies. For the largest projects, the ministries formally submit the decision documents to QA1 and thereafter to the cabinet for approval. However, for smaller projects and for all other project phases, the ministries’ formal involvement is limited in most cases.

The Ministry of Defense stands out for being strongly involved in the projects in all phases, formally as well as informally, particularly in the front end. The Ministry defines itself as the project owner of all projects in subordinate agencies, and it designates a person in the Ministry to act as project sponsor, regardless of project size and complexity. Projects exceeding a certain threshold have to be elevated to the minister (i.e. the political level in the Ministry) for approval. An agency interviewee was not always satisfied with the extensive involvement. “The Ministry is quite detail-oriented, and always tells us which form to fill in,” the person said. But also, “if the documents are of good quality they normally listen to us.”

The other ministries do not use formal project models or assign themselves formal roles in relation to the projects. They may however govern projects in informal ways to the extent that they find it necessary, typically depending on scope, complexity, and political risk. The Ministry of Transport, as owner of large, project-based agencies within road and rail, sees no reason to get involved in individual projects “as long as everything goes according to plan and the project is not politically critical” as one interviewee puts it. Often, the subordinate agencies drive the process, even in the early phases. In civil building construction projects, the client ministry takes responsibility for the conceptual solution, but leaves the detailed planning to the implementing agency, Statsbygg. This is somewhat surprising, given that many strategic decisions and clarifications are needed in this phase as well. Some of our interviewees from the client ministries expressed the view that they, and their user agency, should have been more involved. But they find it difficult in the face of Statsbygg as the professional government construction agency, who “asks for our opinion only when its stage-gate model says so”, as one interviewee puts it. The sponsoring ministry on the other hand, gets involved once the building is formally commissioned. Thereafter, the sponsoring ministry follows the projects, individually and as a portfolio, through the implementation phase, mainly with a cost control perspective.

The two ministries responsible for ICT projects have both appointed senior experts in the ministry to monitor the largest projects closely. “After all, the minister is the ultimate responsible, and he/she needs to know what is going on”, said a ministry interviewee. This is not surprising, as these agencies have experienced serious problems with some ICT projects in the recent past. And also, to quote an interviewee, “because ICT projects change so rapidly that we may have to change the conceptual solution several times along the way.” However, rather than taking a formal project sponsor role, the ministries rest on informal meetings, and the purpose of such activities is to obtain information early. The ministries may request information at a fairly detailed level if they find it necessary, and they sometimes do. If serious problems arise, they will be addressed in the regular meetings between the ministry and the agency’s director general.
The project sponsor role

Our study confirms that the project sponsor role is commonly used in Norwegian public projects. All of the project models included in this study highlight this role. The responsibilities, tasks, and competencies required for the role are defined by the models. They normally state that the project sponsor has ultimate responsibility for the project, is the leader of the project board (if used), and the one who defines the project goals, appoints the project manager, initiates QA, and makes decisions beyond the projects managers' defined authority. However, our data also show that in many cases the sponsor is positioned at a low level in the hierarchy, and thus cannot be expected to take the strategic and high-order perspective on the project that he or she should. Again, the Ministry of Defense stands out in requiring that the project sponsor is located in the ministry, with an additional “local” sponsor in the agency. In all the other sectors, the project sponsor is located only at the agency level. Most of the project models require the role to be filled by a senior manager or even someone from top management. However, as noted by several interviewees, “it is a big challenge that top managers do not have the time and capacity to follow the projects sufficiently closely.” Therefore, in practice, the role is habitually delegated further down in the organization, to a subordinate manager (typically the project manager’s supervisor). Two agencies emphasized that the project sponsor should be someone who is also responsible for benefits realization (e.g. the department that will reap the benefits from an ICT project).

Another observation is that the project sponsor is often appointed rather late in the project life-cycle, after the project has been formally approved for funding, while having no role in the front-end phase, and sometimes not in the operational and maintenance phase either. In some agencies, the project sponsor role is transferred from one person to another as the project enters new project phases and the responsibility changes from one department to another.

Generally, our findings indicate that there is a risk that the governance tasks will be handled from an internal perspective, rather than actually representing user groups and the broader society. This is in line with Olsson and Berg-Johansen (2016) who distinguish between project owner type 1, with an external perspective, in line with recommendations in the literature, and project owner type 2, with an internal perspective, which is what they observed in practice.

Project boards

There is an extensive use of project boards in the agencies. Most of the project models recommend or require the use of boards for projects that are large, complex, or have interfaces with other agencies or key stakeholders, in which case these stakeholders should be represented.

However, an interesting finding is that many of these institutions bear more resemblance to advisory groups and project reference groups than to real steering groups. They often have a large number of board members, including user groups and various other internal and external stakeholders, who are there to obtain information and give advice, but do not necessarily, have a mandate to make decisions on behalf of their organizations. To quote one interviewee, “we tend to include the whole list of stakeholders, so that we do not need a supplementary consultation process.” Another interviewee said “unfortunately, few decisions are made in these meetings. It is sometimes more like a tea party.”

The ministries are normally not involved in such project boards at all. In civil building construction projects, an external advisory committee is sometimes used, on which the sponsoring ministry and the client ministry are both represented. Such committees do not make binding decisions; only recommendations. Traditionally they have been established after the project has been approved, to follow up during project implementation, but the...
trend is now that they are established at an earlier stage. According to our interviewees, experiences are mainly positive, and the committees are found to strengthen the client perspective in the projects.

QA
As described above, the overarching project governance scheme on the top level, with its two mandatory QA reviews, applies to all the largest projects, independent of sector and agency – about 20-30 projects per year.

On the ministry level, there are few additional requirements for QA. The exception is, again, the Ministry of Defense, which uses “red teams” on certain high-risk projects. Furthermore, some ministries routinely consider whether the cabinet’s QA scheme should be applied to projects just below the QA threshold. This has happened in several cases. As noted by one of the ministry interviewees, “the need for QA does not only depend on size, but a broader set of criteria.” For example, ICT projects may be smaller than the other project types in terms of monetary values, but their complexity is often considerably higher.

On the agency level, all project models have requirements in place concerning independent QA. The scope and content of such reviews, and the extent to which they involve truly external experts, vary significantly. In most cases, the QA is performed internally in the agency by people who are independent of the particular project.

Uncertainty provisions and change management
Project budgets may include a provision for uncertainty. As noted, for the largest projects (covered by the cabinet’s scheme), the cost estimate must be based on stochastic estimation techniques, and the budgeted cost is set at or close to P85 while the target cost for the agency is set at P50. Our data show that probability-based cost estimation has spread to smaller projects as well. All the studied projects models include requirements regarding cost estimation and uncertainty provisions, applying not only to QA projects, with budgeted costs and target costs expressed in terms of probabilities, i.e. Px.

There is assumed as an inherent incentive for the implementing party to increase scope and quality and/or to add some slack to the project implementation. Therefore, an effective way to avoid unnecessary spending may be to retain most or all of the provision at a higher level in the project hierarchy. However, our findings show that most of the agencies are given authority to spend the budgeted cost, even for the largest projects. Only three ministries delegate a lower target cost to their subordinate agencies, which must apply to their ministry to spend the provision. In the case of civil building construction projects, the external advisory committee will normally discuss the need to spend the uncertainty provision before it is approved by the sponsoring ministry.

On the agency level, the project models define how the provision is delegated further to lower levels in the project hierarchy. The target cost for the lowest level, the project manager, is generally between P35 and P45. However, there are considerable variations in how the decision hierarchy is defined and how the mandates are given, not least to what extent the project sponsor and/or board is given authority to make decisions concerning the provision.

Portfolio management
Volden and Samset (2017a) note that the Norwegian QA scheme focuses primarily on governance of individual projects and does not include explicit portfolio evaluation requirements. This is in contrast to, for example, the UK scheme, in which QA is required not only for individual projects but also at the program and portfolio levels at regular intervals.
Our study confirms that portfolio management is not considered an important issue in the ministries. An exception is, again, the Ministry of Defense, which takes an active role, not least in the project selection phase. The ministry regularly updates and manages its long-term investment plan for the sector and new projects are assessed against this project portfolio. The two ministries with many ICT projects have also been concerned with project portfolio management in recent years. However, instead of taking care of portfolio management themselves, the ministries require that high-quality portfolio management takes place in the agencies. In the transport sector, a national transport plan is updated by the ministry every four years, and includes all modes of transport (i.e. road, rail, sea, and air). However, the way this has been practiced so far is that the national transport plan is the sum of four independent portfolios, governed by the four agencies, rather than being managed as one holistic plan for the whole transport sector.

By contrast, the portfolio perspective is prominent in all the agencies. The agencies manage their respective investment plans, they compile data on progress and performance for the portfolio, and most of them have some flexibility to re-allocate funds between projects if necessary. However, the extent to which portfolio management is an explicit part of the project model varies. The agencies with many ICT projects stand out as rather advanced. No agencies have established PMOs with portfolio management responsibilities.

Key characteristics of the project governance arrangements in the various sectors are summarized in Table III.

Assessments and conclusions
Public investment projects in Norway and worldwide have traditionally been burdened with problems, to the extent that Flyvbjerg (2014) proposed an iron law: “over budget, over time, over and over again.” There is no easy solution to these problems. In public sector projects, people rarely put their own money at stake, goals are often multifaceted, goal achievement is not easily measurable, and there are many stakeholders within and beyond central government who have opinions on the project. Over time, we have gained a better understanding of the challenges that arise in these political administrative processes, but we still have a long way to go before we fully know how to solve them. What we do know from the existing literature is that having a project governance framework in place will at least make the processes more predictable, and hopefully will result in a decision basis of higher quality, and more legitimate decisions. The Norwegian Government introduced a QA scheme in the year 2000. The scheme ensures that the basis for two key decisions in the front-end of the largest projects is quality assured by truly external experts and that decisions are elevated to the highest level in the political system. The scheme is very simple, applies only to the very largest projects and constitutes the “top layer” of a hierarchy of governance arrangements. Clearly, the success of public projects depends heavily on what happens in the ministries and agencies in which projects are actually implemented. The hierarchy of governance that surrounds public projects has not been thoroughly discussed in the literature. In this paper, we have explored this topic and provided some empirical findings in a Norwegian context.

The first research questioned posed earlier in this paper was to what extent Norwegian ministries and agencies have introduced project governance frameworks. The findings clearly show that the ministries and agencies in the studied sectors have invested heavily in their project competence and capacity since the turn of the millennium. All the agencies (and one ministry) have introduced a comprehensive project model with, for example, clearly defined phases, decision points, roles, responsibilities, and QA. There are more similarities than differences between the models, in terms of phases, decision points, roles, and requirements.

These findings indicate that Norwegian public projects are fairly well governed, first and foremost on the agency level. In light of the general “projectification” of society, it is difficult to
<table>
<thead>
<tr>
<th>Type of project</th>
<th>Ministry role, overall</th>
<th>Agency role, overall</th>
<th>Project sponsor</th>
<th>Project board</th>
<th>Quality assurance additional to requirements in cabinet’s QA scheme</th>
<th>Control of uncertainty provision in the budget (normally P85)</th>
<th>Target costs</th>
<th>Portfolio management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road projects</td>
<td>Limited, informal</td>
<td>Active, owner of stage-gate model</td>
<td>Yes, located in the agency, normally delegated</td>
<td>Not often used. Advisory role. Ministry not involved</td>
<td>QA by agency</td>
<td>Agency</td>
<td>P50 for the regional department, normally P45 for project manager</td>
<td>To some extent, in the agency</td>
</tr>
<tr>
<td>Railway projects</td>
<td>Limited, informal</td>
<td>Active, owner of stage-gate model</td>
<td>Yes, located in the agency, normally delegated</td>
<td>Often used. Advisory role. Ministry not involved</td>
<td>QA by agency</td>
<td>Agency</td>
<td>P50 for the project sponsor, lower for the project manager, lower for project manager</td>
<td>To some extent, in the agency</td>
</tr>
<tr>
<td>Defence material projects</td>
<td>Active, formal, owner of stage-gate model</td>
<td>Active</td>
<td>Yes, located in the ministry, and a local sponsor in the agency</td>
<td>Not often used. Advisory role. Ministry not involved</td>
<td>Cabinet requirements apply to smaller projects as well. QA by ministry and agency</td>
<td>Ministry</td>
<td>P50 for the agency, lower for project manager, lower for project manager</td>
<td>Yes, in both the ministry and the agency</td>
</tr>
<tr>
<td>Buildings/locations for the defense</td>
<td>Active, formal</td>
<td>Active, owner of stage-gate model</td>
<td>Yes, located in the ministry, and a local sponsor in the agency</td>
<td>Often used. Advisory role. Ministry not involved</td>
<td>Cabinet requirements apply to smaller projects as well. QA only ad hoc, by agency QA by agency</td>
<td>Ministry</td>
<td>P50 for the agency, lower for project manager</td>
<td>Yes, in both the ministry and the agency</td>
</tr>
<tr>
<td>ICT infrastructure projects in the health and welfare area</td>
<td>Active, informal</td>
<td>Active, owner of stage-gate model</td>
<td>Yes, located in the agency</td>
<td>Often used. Advisory role. Ministry not involved</td>
<td>Cabinet requirements apply to smaller projects as well. QA by agency</td>
<td>Ministry</td>
<td>P50 for the agency, may be lower for project manager</td>
<td>Yes, in the agency, by requirement from ministry</td>
</tr>
<tr>
<td>ICT infrastructure projects in the Police</td>
<td>Active, informal</td>
<td>Active, owner of stage-gate model</td>
<td>Yes, located in the agency, normally delegated</td>
<td>Often used, supposed to have a steering function but in practice advisory. Ministry not involved</td>
<td>Cabinet requirements apply to smaller projects as well. QA by agency</td>
<td>Agency</td>
<td>P50 for the steering committee and P35 for the project manager</td>
<td>Yes, in the agency, by requirement from ministry</td>
</tr>
<tr>
<td>Buildings/locations for civil government institutions</td>
<td>Limited, informal</td>
<td>Active, owner of stage-gate model</td>
<td>Yes, located in the agency, normally delegated</td>
<td>Only advisory committees are used, including sponsoring and client ministries</td>
<td>QA by agency</td>
<td>Ministry (agency may spend 20% of the uncertainty provision)</td>
<td>P50 for the agency, lower for project manager</td>
<td>To a limited extent. Client ministries have few projects each</td>
</tr>
</tbody>
</table>
determine whether the improvements on the lower levels are caused by the cabinet’s QA scheme, but at least it seems to be an important triggering factor. Clearly, the threat of the project being critiqued by external quality assurers, and possibly rejected by the cabinet on their advice, provides an effective incentive for the agencies to work hard with the decision documents. Our study also confirms that the ministries relate strongly to the QA scheme and see themselves as responsible for ensuring that the requirements are met in the largest projects.

The second research question was which level, agency or ministry, takes the most active role as project owner and initiator of governance arrangements. Our findings show that with one exception (the Ministry of Defense), it is the agency level that takes the most active role as project owner and initiator of governance arrangements. Admittedly, the ministries see themselves as owners of projects implemented by their subordinate agencies, and may be involved in various informal ways. The degree to which they are, seems to depend on, inter alia, project size, political risk, and the agency’s experience and track record regarding project delivery.

The third research question was whether the governance frameworks adhere to the recommendations from the project governance literature. Our findings show that they largely do. They include stage-gate models with clearly defined phases, decision points, roles and responsibilities, and QA of decision documents. We are also quite impressed to see that the agencies regularly use stochastic cost estimation techniques as the basis for determining budgets and target costs, even for smaller projects. However, we also see room for improvements in some areas. Generally, the project owner role should be executed more actively and with a focus that is more strategic (the exception being the defense sector). The project sponsor is mostly located at the agency level and is often an individual at a fairly low level in the organization. Furthermore, in most cases, there is no role for the project sponsor in the crucial front-end phase, where project ideas arise and are selected for development into a concept. Thus, our findings seem to support those made by Olsson and Berg-Johansen (2016), who only observed the more narrowly oriented “project owner type 2” in Norwegian public projects. Furthermore, project boards are widely used, but more often than not they are not truly boards, but rather advisory groups, and they are normally established late in the project life-cycle, after the crucial choice of concept has been made.

The fourth research question was whether the schemes in the hierarchy (cabinet, ministry, agency) are internally consistent. Overall, the answer is yes. We have not found any obvious inconsistencies between governance arrangements on various levels in the hierarchy. Particularly, the schemes on the lower levels are well adapted to the cabinet’s scheme and ensure that the largest projects are well prepared for the two control points. But again, the strategic and external perspective on project governance, which should be taken by the ministry level, is often missing or handled very informally.

The final research question was about the implications of our findings. Overall, it is our view that these project models have a somewhat narrow and internal focus, securing governance of projects, but not necessarily governance through projects, in Williams et al.’s (2010) terminology. At best, they ensure governance through projects in the agency’s perspective, but the impact of the project normally goes beyond the agency. As discussed by Klakegg and Volden (2017), Norway has a strong democratic tradition, an egalitarian culture, and a high level of education, which makes a strong platform for organizing tasks as projects and for delegating authority downwards in the hierarchy. The government’s introduction of the QA scheme was controversial in the beginning, and the introduction of formalized regulations from the ministry level would probably be controversial too. We still consider it a serious weakness that some ministries take such a limited role in the governance of projects, even when it comes to strategic activities such as project selection and portfolio management. It is our recommendation that the ministries should become more involved and actually play the role of “project owner type 1,” formally or informally.
It should be noted that the research topic of this paper was the formal aspects of project governance. Müller (2017) introduced the term governmentality and were concerned with finding the optimal balance between formal and informal governance. The interviewees from the ministries in our study declared that their ministries had an informal dialogue with their agencies. This may very well be sufficient in some cases, but the interviews have also given us an impression that ministry involvement is ad hoc, not always early enough, and that many strategic decisions are, in practice, left to the agencies. A suggestion for future research could be to study these informal processes in more detail, preferably by following specific projects through the various phases, and revealing whether they actually compensate for the lack of formal processes and requirements.

Moreover, it is important to note that the ministries’ governance of projects in subordinate agencies is part of their general governance of the agencies. The ministries set goals for the agencies and may give more or less detailed instructions with regard to, for example, activities and processes, depending on scope, risk, or political aspects. Traditionally, the ministries have not treated the agencies as project-based or governed them in terms of their projects, programs, and portfolios. The findings from our study suggest that they still do not. A relevant topic for future research could therefore be to take a closer look at how project governance could become a more integrated part of public governance.

As noted earlier in this paper, the top-level scheme in Norway and the other Scandinavian countries is very simple compared to, for example, in the UK, where the cabinet has introduced a more comprehensive model on top, including for example detailed processes, templates, and a common project management methodology. We have shown that a simple model on top does not necessarily imply that the governance framework is simple overall, since comprehensive governance models may be introduced by the lower levels. An interesting topic for future research could be to extend the international study conducted by Volden and Samset (2017b) to include all levels of the hierarchy, not only the top level. A more comprehensive governance scheme on top could be expected to result in harmonization of project practices across sectors and to strengthen public sector competence within project management and project governance. However, the result could also be a more bureaucratic system with less flexibility and autonomy available for the agencies.

Note
1. Including not only the largest projects for which external quality assurance is required, but also smaller investment projects.

References


Samset, K. and Volden, G.H. (2013), “Investing for impact: lessons with the Norwegian State project model and the first investment projects that have been subjected to external quality assurance”, Concept Report No. 36. ex ante academic, Trondheim.


Further reading

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Linking workplace burnout theories to the project management discipline

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Abstract

**Purpose** – Given the demanding and stressful nature of project work, with a view to explore established concepts of burnout within the project management context, the purpose of this paper is to examine two instruments: the Maslach Burnout Inventory (MBI) and the Areas of Worklife Survey (AWS). Since there is a paucity of literature in project management anchored within the MBI and the Areas of Worklife Survey (AWS), this paper proposes a high-level model on burnout in project management, drawing on the literature underlying these two instruments.

**Design/methodology/approach** – Using a conceptual approach, the paper reviews the social psychology literature on burnout and then the narrow stream of literature on burnout in project management. The paper develops and proposes a conceptual model as a foundation to explore the links between the determinants of project manager burnout/engagement and turnover/retention.

**Findings** – This paper contributes to an improved understanding of the determinants of project manager burnout, engagement, turnover, and retention.

**Practical implications** – The driver for this research is to contribute to the emerging literature on burnout in project management and strategies to help improve engagement and retention of project managers in the discipline – specifically, their tenure in organizations and/or the profession.

**Originality/value** – This paper contributes to the topic of burnout in the project management context. An improved understanding of the stressors in project management contexts, and the mechanisms to mitigate the stress, can add to our understanding of project manager well-being, engagement and retention, improved project success, and healthier work environments.

**Keywords** Project management, Employee engagement, Employee retention, Employee turnover, Worklife balance, Workplace burnout

**Paper type** Conceptual paper

1. Introduction

Workplace burnout is a global phenomenon (Schaufeli, Leiter and Maslach, 2009) that many can relate to either personally or in relation to others. Referred to as an extreme stress phenomenon, workplace burnout is “a fundamental crisis in the psychological connections that people establish with work” (Leiter and Maslach, 2016, p. 91) and the long-term consequence of mental strain (Demerouti et al., 2002). Stress stems from internal and environmental demands that affect psychological well-being (Haynes and Love, 2004). Psychosocial stressors contributing to workplace burnout include “long hours, greater workloads, job uncertainty, poor prospects for pay and promotion, ambiguous roles on projects, and time and budget pressure that accelerate the risk of mistakes or compromise standards of quality and ethics” (Korman, 2010, p. 24). In addition to the work itself, elements of the work environment, including technology, enable us to stay connected 24x7. With the fast pace and frequency of information flow, it becomes increasingly difficult to
achieve worklife balance. Increased workloads compound job pressures. Economic downturns add to employee stress as firms consider and employ such human resource interventions as reduced staffing, fewer paid hours of work, reduction of benefits, rollbacks in compensation, and early retirement incentives and options, to name a few. Stress can lead to disengagement and burnout (Appelbaum and Finestone, 1994). One estimate suggests that 50-70 percent of employees become disengaged at their workplace (Wollard, 2011). Jones and Chung (2006) refer to disengagement as "cognitive turnover." Burnout can also lead to career plateauing (Appelbaum and Finestone, 1994). Burnout manifests across diverse cultures, work settings, and occupational groups (Maslach et al., 2010). In a broad review of the research on organizational stress, Cooper et al. (2001) present the work trends that make theoretical and empirical research on organizational stress important, including new technology, globalization, outsourcing, contingent and short-term employment, virtual or remote teams, flexible work arrangements, an increase in women in the workforce, and changes in worklife balance.

This conceptual paper applies existing theories of workplace burnout to the project management discipline. The paper develops and proposes a conceptual model as a foundation to explore the links between the determinants of burnout/engagement and turnover/retention. This paper is a first step toward empirical research concerning project manager burnout, engagement, turnover, and retention, through which the authors seek to add value to project-oriented organizations that aim to recruit and retain high performing project managers. The global project management professional pool is significant in size, with the largest professional organization, the Project Management Institute, having about half a million certified practitioners worldwide (Project Management Institute, 2017).

Project managers work in diverse sectors including, but not limited to, information technology (IT), financial services, energy, manufacturing, healthcare, construction, and government. Organizations generally have multiple projects underway and in addition to continuing project management staff complements, sometimes retain project managers on contract. "Project-based work has long been characterized as frenetic, fast paced, and dynamic" (Pinto et al., 2014, p. 578). Given the complex and demanding environments within which project managers function, these positions can be challenging to fill, as they require domain specific knowledge and industry experience, in addition to project management expertise. It can also be very costly to recruit experienced and specialized practitioners.

Project managers are particularly susceptible to burnout. Practitioners typically face high expectations and acute pressures to deliver projects on time and within budget, and to reconcile changing expectations on scope (often due to over-optimism, inexperience, or profit maximizing tactics and initiatives on the part of project sponsors) (Smith et al., 2011). Anecdotally, practitioners express frustrations about project stressors such as unrelenting or outrageous deadlines, having to perform in crisis-ridden environments, and the pressure to be available 24x7.

Consisting of four stages (initiating, planning, executing, and closeout), projects are unique undertakings and temporary in nature (Project Management Institute, 2013). Throughout the project life cycle, project managers have daunting responsibilities and often face unrealistic expectations related to schedules, deliverables, and budgets (Pinto et al., 2014). Projects are also fraught with risks and uncertainty (Haynes and Love, 2004), especially during the protracted implementation stage, where the level of effort is the greatest (Larson and Gray, 2014). As supported by literature on lessons learned, Williams (2008) and Korman (2010) found that job stressors are compounded at the end of the project life cycle. However, individual stress and motivation levels can vary over the project life cycle (Gällstedt, 2003). Consequently, stress and burnout may not be specific to a project phase, and may not be consistent across projects or professionals, thus representing avenues for research.
Project success is a shared responsibility among key stakeholders, yet all too often the burden of failure is placed on the project manager’s shoulders (Müller and Jugdev, 2012). Moreover, many project managers tend to overachieve (Jolivet and Navarre, 1996) and erroneously blame themselves (Barker et al., 1988) for project failures. Referred to as the “mea culpa reaction” (Maslach and Jackson, 1982, p. 10), recurrent stressful work environments can lead to the internalization of problems and the perception that they stem from within. Feelings of personal responsibility and incompetence are fueled when project managers are overworked, under-resourced, when managerial support is weak or lacking, and in times where a disparity exists between the project manager’s authority and his/her responsibility. These factors can contribute to stress and burnout and upset worklife balance (Turner et al., 2009). Furthermore, these elements can contribute to intentions to quit and actual turnover, which can be costly at the individual, team, project, organizational, and societal levels.

An organization’s structure, whether flat or bureaucratic, functional, divisional, or matrix, determines the project manager’s degrees of responsibility and authority. For example, in a weak matrix, the project manager has some authority but most rests with the functional manager (Larson and Gray, 2014). In a project-oriented structure where the organization’s mission is achieved through projects, project managers have extensive responsibility and authority. Depending on the organizational structure for projects, the human resources functions are also decentralized and shared between the line manager, project manager, and human resources department (Keegan et al., 2012). Keegan et al. examined the human resource interplays in terms of project personnel well-being and stress. Within different organizational structures, relevant aspects of workplace wellness can be overlooked or under-serviced and the human resource systems may emphasize functional practices over care and concern for employees in terms of ethical treatment (Turner et al., 2008).

In new product development contexts, project managers often engage in firefighting, which is “the unplanned allocation of resources to fix problems discovered late in a product’s development lifecycle” (Repenning, 2001, p. 285). Repenning posits that the lack of effective planning and risk management strategies cascades into firefighting. This firefighting is detrimental to organizational performance and contributes to increased error rates, fatigue, burnout, and voluntary turnover (Shih et al., 2013).

Given the demanding and stressful nature of project work, the paucity of literature on burnout in project management presents an opportunity to apply existing theories of workplace burnout to study project manager burnout and engagement. There is a specific opportunity to examine project manager burnout and engagement as mediating the relationship between the determinants of project manager turnover intention and actual turnover. With a view to explore established concepts of burnout within the project management context, this paper uses a conceptual approach to review and apply the well-developed literature on workplace burnout and engagement as advanced by social psychologists and the narrow stream of burnout in project management. This manuscript specifically examines two instruments: the Maslach Burnout Inventory (MBI) and the Areas of Worklife Survey (AWS). Since there is limited literature in project management anchored within the MBI and the AWS, this paper proposes a high-level model on burnout in project management, drawing on the literature underlying these two instruments. This conceptual model examines determinants of project manager burnout/engagement and turnover/retention as a step toward further empirical research. The intention is to develop an improved understanding of project management stressors for project management scholars who are concerned with employee engagement and retention. The research has direct applications to the project management profession and is positioned to contribute to project management practice, specifically the human resources knowledge area. A heightened awareness within the project management and human resource
management community about the concepts of burnout and engagement in project managers is an important first step in constructively addressing work-related stressors in project-oriented organizations. An improved understanding of the stressors in project management contexts, and potential mechanisms to mitigate stress, can add to our understanding of project manager well-being, engagement and retention, improved project success, and healthier work environments, thereby enhancing project success and productivity, particularly in project-oriented organizations.

In their review of the literature on organizational stress, Cooper et al. (2001) provide the theoretical background and motivation for scholars and practitioners to develop comprehensive models that can be applied in interventions to reduce workplace stress and burnout. They conclude that there is a lack of commonality in definitions of stress and burnout, while sources of stress have been classified based on origin, job or organization, social, and intrapsychic. They suggest the need for more research on role stress that relates to role ambiguity, role conflict, and role overload. They point out the need for effective organizational interventions to address burnout on the job through comprehensive models.

With a comprehensive model of organizational stress and burnout as an ambitious end objective, this paper is a starting point that focuses on those burnout theories from social psychology that underlie two prevalent tools, the MBI and AWS, to apply these to a specific organizational context – project management. This paper is a first step in a longer term program of research to adapt the tools for the project management context and then enhance the model with other theoretical lenses.

In the sections of the manuscript that follow, the authors first present concepts of workplace stress, burnout, and engagement from the social psychology literature and introduce two well-established, valid and reliable instruments developed out of this theoretical base: the MBI (Maslach et al., 2010) and the AWS (Leiter and Maslach, 2011). The conscious focus on this literature holds the intention of linking the social psychology tools of MBI and AWS to project management. The authors plan to elaborate the conceptual framework beyond this phase of the research to include additional models and an expanded survey tool. This section is followed by a review of project management literature that draws on theories of stress and burnout to extract established variables and relationships between stressor variables and organizational outcomes. Based on the literature, the paper then presents a high-level conceptual framework to link the determinants of project manager burnout, engagement, turnover, and retention to these outcome variables. The conceptual model is intended as a first step toward empirical research to test these linkages and lead to the development of prescriptive hypotheses and recommendations to enable the recruitment and retention of high performing project managers in project-oriented organizations. The driver for this research is the need to improve engagement and retention of project managers in the discipline – specifically, their tenure in organizations and/or the profession. Prior empirical research on workplace burnout, engagement, turnover, and retention that is anchored in the MBI and AWS are reviewed. The concluding section addresses the next steps that are aligned with the motivation to advance this research.

2. Social psychology concepts of stress, burnout, and engagement
This section highlights social psychology concepts related to stress models, followed by the burnout and engagement frameworks.

2.1 Stress models
Mark and Smith’s (2008) review article critiqued the dominant psychological theories and models on the work-related stress process. Their review emphasized the importance of individual differences (such as anxiety, personality, self-esteem, coping styles, hardness and personality type) in the models. The stress models cover individual differences to
varying degrees. The review also discussed empirical research related to each model. Of note, the paper also distinguished between the interactional and transactional models of stress:

Interactional models focus on the structural characteristics of the stress process, i.e. which stressors are likely to lead to which outcomes in which populations, however transactional views are more cognitive, and focus on the dynamic relationship that occurs between individuals and their environment in terms of mental and emotional processes (p. 8).

Whereas some researchers anchor their research within interactional models of stress, others use transactional models. Although details of the stress models are beyond the scope of this paper, the interactional frameworks include the person-environment fit (French et al., 1974), job characteristics (Hackman and Oldham, 1976), job demands control support (JDCS) (Karasek, 1985), Vitamin (Warr, 1986), and Michigan models (Mark and Smith, 2008). The transactional models include the effort-reward imbalance model, cognitive relational approach, Cox’s transactional model of work stress, demand-skill-support (DSS) model, demand induced strain compensation model, and job demands-resources (JDR) model (2008).

The MBI is based on the Person-Environment Fit model (Kristof-Brown et al., 2005), which focuses on the “interplay of resources and stressors” (p. 61) on a burnout to engagement continuum. Other stress models such as the JDR model treat resources “as factors that contribute autonomously to healthiness, irrespective of the reduction of stressors” (Brom et al., 2015).

Individuals vary in their stress tolerances and coping abilities (Rodriguez-Muñozab et al., 2009). A person’s overall sense of coherence can make one vulnerable or resilient to depression and burnout (Tselebis et al., 2001). For example, those challenged in trying to mentally detach from work during the evenings experience difficulties related to job stress recovery at work (Sonnettag et al., 2008). Avoidance coping strategies and Type A personalities are associated with poorer health status (Nowack, 1991). As a counterproductive behavior (Samnani et al., 2014), disengagement involving depersonalization (Sias, 2004) and has repercussions for employees, coworkers, and organizations (Schullery, 2013). In addition to affecting productivity and profitability, disengagement can impact safety, well-being, and turnover (Wollard, 2011). Just as the spiral into burnout involves processes related to ineffective coping abilities, recovery involves effective coping processes (Regedanz, 2008).

Coping refers to how individuals deal with sources of stress (Carver et al., 1989). “Resilience is the process of negotiating, managing and adapting to significant sources of stress or trauma” (Windle et al., 2011, p. 18). The coping literature spans control-oriented coping, which can buffer stress, and avoidance coping practices (Koeske et al., 1993; Gibbons, 2010). For example, optimism can enhance the intervention effects on burnout (Littman-Ovadia and Nir, 2014) and psychological flexibility can buffer “the negative impacts of emotional job demands on emotional exhaustion and subsequent performance” (Onwezen et al., 2014, p. 163). In terms of effective coping, individuals also vary on their resilience, which is the “positive adjustment to adversity” (McAllister, 2014, p. 55). Resilience enhances engagement and builds personal strengths through optimism, healthy attitudes and relationships, emotional insight, life balance, spirituality, and reflexivity (Jackson et al., 2007). The next two sections introduce concepts on burnout and engagement.

2.2 Burnout

In the 1970s, research on burnout originated from studies of the burnout syndrome that counselors experienced in their work with drug addicts (Freudenberger, 1974). Freudenberger, a psychologist who experienced burnout twice in his career, was not only
a pioneer researcher but also one of the first to use the term, burnout. By the 1990s, burnout was recognized as a legitimate diagnosable medical disease in countries with well-developed social security systems—i.e. Sweden and The Netherlands (Friberg, 2009). Burnout continues to be conceptualized differently as countries affix it with either a medical or a nonmedical label (Schaufeli, Leiter and Maslach, 2009). In their reflective article on 35 years of research on burnout, Schaufeli et al. indicated that over the last 40 years, social, economic, and cultural developments transformed American society from an industrial society to a service-based economy. During this time, idealistic helping professionals who initially viewed their work as “callings” became frustrated and disillusioned with the establishment as their work-focused personal values clashed with corporate values. The authors described burnout as “a metaphor for the draining of energy” (p. 206) and explained that whereas engaged individuals were synonymous to a burning fire with a radiant output of heat, those experiencing burnout were more like smoldering fires.

Burnout is a societal problem that can lead to mental illness. Compounding factors related to personality and the work environment can also lead to burnout (Halbesleben and Buckley, 2004). Workplace burnout is “a crisis in one’s relationship with work” (Maslach et al., 2010, p. 20), and therefore the concept is more severe and different from occupational stress (which is stress related to one’s job) and job dissatisfaction. Research indicates that burnout can lead to depression (Maslach and Leiter, 2008). Burnout also differs from depression even though the two concepts involve some common signs and symptoms. Burnout affects the bio-psycho-social-spiritual aspects of life (Schwartz, 2007) and the devastating spillover effects disturb home and workplace dynamics (Contrada and Baum, 2010). Unfortunately, individuals experiencing such mental health issues may not seek medical help because mental health and burnout continue to be stigmatized. These stigmas pertain to self-perceptions of weakness and failure. Regrettably the stigmas also apply to recovery as “there is still a stigma attached to therapy” (Maslach, 2003a, p. 213).

The manifestations and consequences of burnout involve cascading effects. For example, work-related strain can lead to negative job attitudes, chronic physiological symptoms, and work absences (Aronsson et al., 2000). Burnout can negatively affect one’s personal life and relationships (Innstrand et al., 2008). Burnout also has societal implications. Based on a 2003 report, “The American Institute of Stress calculates that workplace stress costs to the US industry about 300,000 million dollars a year in absenteeism, health costs, and programs to help workers manage stress” (Jiménez et al., 2014, p. 48). As of 2013, with the financial cost adjustment, this was estimated to increase to $402 million (Hassard et al., 2014).

Businesses bear the economic costs of employee health as evident from productivity losses, opportunity losses, presenteeism (where employees are at work when they are not well), absenteeism, turnover intentions and actual turnover, and short and long-term disability costs (Lim et al., 2008). These alarming financial costs and the direct and indirect economic burdens of illnesses are significant and measurable (Kessler et al., 2004). Since individuals can habituate to negative routines and disengage emotionally, psychologically, and socially, they can affect others in the workplace through such habituation. The ensuing interpersonal conflict and communication issues can compound workplace discord. For example, habituation can affect absenteeism and presenteeism (Wang et al., 2003). In presenteeism, employees are “at work but not working” (Johns, 2010, p. 520) so the productivity and quality of their work is lower (Koopman et al., 2002) and initially, the impacts are “invisible” (Hemp, 2004). Interestingly, presenteeism affects productivity more than absenteeism (Dewa et al., 2004). Both absenteeism and presenteeism can be addressed with preventative and proactive measures (Johns, 2010).

Burnout has significant organizational policy implications. Organizations typically have well-established human resource policies and procedures in place as well as employee
assistance programs (EAPs) designed to assist employees in their address of competing priorities (e.g. working full time and caring for an aging parent), or to obtain information to manage their work or life (e.g. referrals to counselors, financial planners, or daycare providers). Increasingly, organizations use policies that aim to enhance worklife balance and offer flexibility for how work can be completed through such options as telecommuting, flexible hours or compressed work schedules, and company sponsored daycare programs (Fiksenbaum, 2014). Literature on designing and implementing such practices addresses generational differences in work values (i.e. intrinsic, extrinsic, social, leisure, and altruistic values) (Schullery, 2013), tailoring wellness initiatives to specific conditions (Burton et al., 2004), and refresher sessions to help employees manage stress over the long term (van Wyk and Pillay-Van Wyk, 2010). Attitudes and perceptions toward workplace wellness issues and the stigmas associated with illness or being ill can potentially lead to employees viewing well intending policies negatively and further contribute to the problem of presenteeism (Grinyer and Singleton, 2000).

Although the literature predominantly emphasizes the problem of burnout and its antecedents and outcomes, a growing body of literature concentrates on engagement, which is at the opposite end of the burnout-engagement continuum (Maslach et al., 2010).

2.3 Engagement

Engagement is a positive state of mind (Schaufeli, Leiter and Maslach, 2009). The burgeoning literature in positive psychology focuses on what is going right (Nath, 2011). Engagement involves having energy, involvement, and professional efficacy (Maslach et al., 2012).

In positive psychology, another word for engagement is “flow” (Csikszentmihalyi, 1997). Flow is like being “in the zone” or experiencing a “runner’s high.” The elements of flow are absorption (activity immersion), enjoyment, and intrinsic motivation (Bakker, 2005). The literature indicates that the following constructs enhance workplace well-being and engagement: high performance work systems (Fan et al., 2014), leader member exchange theory and mentoring (Thomas and Lankau, 2009), staff-supervisor relationships (Prins et al., 2008), and workplace flexibility (Pitt-Catsouphes and Matz-Costa, 2008).

In the neoclassical sense, meaningful work is “binding and ennobling” (Bunderson and Thompson, 2009, p. 32) such as the calling to be a member of the clergy or the calling that idealistic helping professionals in the 1960s and 1970s initially experienced in their work (Schaufeli, Leiter and Maslach, 2009). For most people though, work is meaningful when they are engaged (Lips-Wiersma and Morris, 2009) because work enhances personal needs (Shuck and Reio, 2014). For example, new opportunities at work can enhance engagement (Schmitt et al., 2013) and well-being (Shuck and Reio, 2014). Effective organizational leadership and a healthy culture can also enhance engagement (Lips-Wiersma and Morris, 2009). Furthermore, personal engagement can mediate the relationship between group engagement and individual performance (Luth et al., 2012).

Given the personal, organizational, and societal burdens of burnout, it is not surprising that workplace burnout is an important and evolving area of organization and management research. Additionally, the benefits of workplace engagement at the individual level (energy, involvement, and professional efficacy – as discussed in the next section), as well as how engagement can enhance team dynamics and ultimately, organizational performance, underscore the need for more research in this area as it pertains to project management. Several tools have emerged from the research in this area and the authors discuss and draw on two dominant ones, the MBI and AWS.

2.4 MBI

Research and literature on burnout has evolved and burgeoned. Maslach et al. (2010), a social psychologist, developed the now prominent process model – the MBI. Her early
research on the MBI in 1981 was based on studies with human services workers (Maslach and Jackson, 1981). The work that followed on burnout predominantly involved three sectors – healthcare providers, educators, and those in service industries. Maslach and Leiter subsequently developed three distinct MBI instruments – one for human services, one for educators, and a general survey (MBI-GS) (Maslach et al., 2010). The MBI model had the greatest acceptance in burnout research (Jiménez et al., 2014) and by the 1990s, was used in 93 percent of the journal articles and dissertations (Schaufeli, Leiter and Maslach, 2009). Two alternatives to the MBI are the Oldenburg Burnout Inventory (Demerouti et al., 2010) and the Copenhagen Burnout Inventory (Kristensen et al., 2005).

The MBI model examines worklife experiences by assessing personal and organizational values. The three-factor model is based on perceptions and reactions to the social contexts of work on the burnout-engagement continuum (Maslach et al., 2010). “In relation to the continuum, the model proposes that with increasing misfit in relevant work characteristics, the probability of suffering from burnout symptoms increases” (Kristof-Brown et al., 2005). Research on the MBI has evolved over the years with models labeled as transactional, process, and phase in nature (Leiter and Maslach, 2016).

The MBI-GS consists of 16 questions on job-related feelings and takes between 5 and 10 minutes to complete. The three dimensions (subscales) of burnout in the MBI-GS are:

1. Exhaustion: “wearing out, loss of energy, depletion, debilitation, and fatigue” (Leiter and Maslach, 2016, p. 89);
2. Cynicism: detachment and “depersonalization, negative or inappropriate attitudes, detached concern, irritability, loss of idealism, and withdrawal” (p. 89); and
3. Professional inefficacy: a lack of accomplishment and “reduce productivity or capability, low morale, and an inability to cope” (p. 89).

In contrast, the three dimensions (subscales) of engagement in the MBI-GS are:

1. Energy;
2. Involvement; and
3. Professional efficacy (Maslach et al., 2012).

Figure 1 portrays these concepts on a continuum.

Using a seven-point Likert scale, the MBI-GS asks participants to identify their job-related feelings. The anchors of the scale are (0) “never” and (7) “every day” with the midpoint at (3) “a few times a month.” The questions in the MBI-GS assess self-perceptions
along a scale for each dimension. For example, an individual’s responses to the questions on exhaustion/energy would reflect whether that person feels more fulfilled and involved or otherwise more exhausted. Sample questions from the MBI-GS are: “I feel emotionally drained from my work”; “I doubt the significance of my work”; and “I can effectively solve the problems that arise in my work” (Maslach et al., 2010, p. 62).

2.5 AWS
In the realm of interactional and integrated models of psychosocial well-being (Mark and Smith, 2008), the French et al. (1974) theory stated that “the degree of fit, or lack of fit, between demands and coping abilities” (p. 311) determined well-being vs the amount of stress and coping abilities. Maslach and Leiter used the French et al. approach to the person-environment fit theory in developing the AWS (Maslach and Leiter, 2008; Leiter and Maslach, 2011). In the AWS, the mismatch or incongruity between a person and the job leads to burnout. When there is a good fit (or match) between the person and work environment, then there is engagement (Brom et al., 2015). Maslach and Leiter identified the following six workplace domains (subscales) as predictors (antecedents) of either burnout or engagement:

1. Workload – the workload dimension refers to high job demands leading to fatigue and then exhaustion. An example of this would be when project managers experience overload with deadlines and the competing priorities of multiple stakeholder demands.

2. Control – control pertains to exercising professional decision-making autonomy and having adequate resources to do the work (Karasek et al., 1998). Control enhances work experience, commitment, and professional efficacy. In contrast, the lack of control (role conflict), contributes to inefficacy, interpersonal conflict and a lack of control over work. An example of this involves project managers working with suboptimal budgets and a lack of key project team resources.

3. Rewards – the range of rewards span financial, organizational, or social incentives. Employees feel vulnerable and neglected when rewards are inconsistent with expectations. In the project management context, an example of this may involve one team member being recognized and rewarded over the entire team.

4. Community – refers to the quality of social interactions at work. A healthy community fosters engagement and teamwork and is important for project success. An example of a lack of community could involve elements of a toxic work or project environment.

5. Fairness – stems from equity theory and effort-reward imbalance models, i.e. Expectancy Theory balances effort and expertise (inputs) with rewards (outputs). Fairness relates to self-worth and mutual sharing is central to a sense of shared community. In the project management context, an example of this could involve a team member being promoted based on who that person knows in the organization vs legitimate achievements and competencies.

6. Values – are “at the heart of people’s relationship with their work” (Leiter and Maslach, 2011, p. 7). Faced with value conflicts, employees may trade-off between the work they want to do and what they must do. For example, project managers are frequently pressured to meet time, cost and scope expectations from clients who do not understand that the three dimensions are in conflict with each other, warranting trade-offs (Müller and Jugdev, 2012).

Toward conceptual coherence on burnout and work-related stress, the AWS spans the domains of worklife as covered to varying degrees by others (Maslach, 2003b).
“Even though labeled differently, conceptually the six areas are already included in the five core characteristics of the Job Characteristics model by Hackman and Oldham” (Kristof-Brown et al., 2005, p. 281). In addition, the AWS concepts of workload and control “are reflected in the Demand-Control model of job stress” (p. 95) as developed by Karasek et al. (1998). Furthermore:

Reward refers to the power of reinforcements to shape behavior. Community captures all of the work on social support and interpersonal conflict, while fairness emerges from the literature on equity and social justice. Finally, the area of values picks up the cognitive – emotional power of job goals and expectations. (Leiter and Maslach, 2003, p. 95)

The AWS consists of 28 questions and takes 15 minutes to complete. Using a five-point Likert scale, the AWS asks participants to express how they feel about their work. The anchors of the scale are (1) “strongly disagree” and (5) “strongly agree” with the midpoint at (3) “hard to decide.” Sample questions from the AWS are: “I have so much to do on the job that it takes me away from my personal interests” (workload); “I have professional autonomy/independence in my work” (control); “I do not get recognized for all the things I contribute” (reward); “Members of my work group cooperate with one another” (community); “It’s not what you know but who you know that determines a career here” (fairness); and “The organization is committed to quality” (values) (Leiter and Maslach, 2011, p. 31-32).

Findings based on the MBI and AWS indicate that emotionally exhausted employees distance themselves emotionally and cognitively (Maslach and Leiter, 2008). Exhaustion can lead to cynicism, which in turn involves other distancing behaviors, including self-doubts about professional efficacy (Maslach et al., 2010), which is the inability to perform to expectations (Halbesleben and Buckley, 2004). Exhaustion and cynicism are harmful to self-confidence (Leiter et al., 2010) and detrimental to problem solving (Maslach et al., 2010) which can contribute to suboptimal teamwork and negatively impact productivity. Exhusted individuals feel very depleted and unable to meet work-related demands. Burnout then, can be interpreted as a matter of degrees on the three subscales of exhaustion, cynicism, and inefficacy (Schaufeli, Leiter and Maslach, 2009). Although burnout is a continuous variable, interest in dichotomizing it to diagnose burnout led to scoring systems where “low,” “average,” and “high” scores (the phased model of burnout) have been used (2009b). Goodman and Boss (2002) adopted the phased model and their results indicated that hospital employees who left the organization had higher burnout phase scores. Recently, Leiter and Maslach (2016) proposed that “people could experience various patterns of burnout, which might change at different points in time” (p. 89). They referred to this as person-centered profiles and proposed that in addition to being burned out or engaged, individuals could also be classified as overextended (based on their exhaustion profile), disengaged (based on their cynicism profile), and ineffective (based on their efficacy profile). Based on the aforementioned foundational research on burnout and engagement, the next section examines research on stress and burnout applied to the project management context.

3. Project management literature on stress and burnout
Some research is evident on sources of stress, coping strategies, and burnout in the project management field although there is a scarcity of research on burnout and engagement in project management, let alone research on project management based on the MBI and AWS. In this section, the authors review some relevant studies that informed their work.

Using the behavioral psychology approach as per the majority of research on burnout, Moore (2000) studied exhaustion in technology-based project professionals. Although the extant literature uses the operational definition as developed by Maslach et al. (2010), Moore used the term “work exhaustion” as synonymous to “job burnout.” Antecedents to exhaustion
included work overload, role conflict, role ambiguity, a lack of autonomy, and a lack of rewards. In keeping with the extant literature, the author concluded that, compared to personality differences, job factors were more significant in predicting work exhaustion. The consequences of exhaustion included reduced job satisfaction and organizational commitment as well as greater intentions to turnover and actual turnover. By surveying 270 research participants and including open-ended questions, Moore’s multivariate analysis, content analysis, and thematic findings indicated that “exhaustion was shown to partially mediate the effects of workplace factors on turnover intentions” (2000, p. 141). Shih et al. (2013) extended prior research on the antecedents of exhaustion by surveying Taiwanese IT workers \( (n = 504) \) and found support for depersonalization and diminished personal achievement as antecedents to burnout.

Some project management literature focused on singular elements of burnout. Richmond and Skitmore (2006) used a critical incident analysis approach \( (n = 12) \) and reported that IT project managers were stressed by a lack of control over resources—a finding supported in other studies (Gällstedt, 2003). A lack of resources leads to feeling overwhelmed, overloaded, and exhausted (Moore, 2000). Furthermore, organizational priority problems compound stress levels (Gällstedt, 2003). Rather than using the dominant behavioral psychology approach to burnout as spearheaded by Maslach (2011), Pawlowski et al. (2007) used a social representation approach in their study of IT project managers. By interviewing 20 participants, they found that IT project managers experienced stress due to feeling overworked, a lack of supervisory support, and when work commitments pervaded home life. In their storytelling study, Smith et al. (2011) interviewed eight IT professionals and found that optimism and effective stress management were “soft competencies” that influenced project success. Prescriptively, they suggested that project managers should strive to be positive but realistic. Given that psychological resilience is a complex concept, this superficial recommendation likely undermines the complexities of stress and burnout. Smith et al. also indicated that the project plan should guide the work underway. Richmond and Skitmore (2006) also support the importance of effective planning as an effective coping mechanism, and problem solving over emotion-focused coping. The use of a well-developed project plan is similar to motivating project managers with clear goals and has been reported to reduce stress (Gällstedt, 2003).

Compared to the IT sector, fewer burnout studies were evident in the engineering, procurement, and construction domains. Similar to the IT literature, these studies spanned work stressors and conflict (Sedström, 2007), burnout (Leung et al., 2008), psychological well-being through self and one’s social support system (Love et al., 2009), and worklife balance (Turner et al., 2009). Construction project managers work in crisis-ridden environments and dynamic social structures (Leung et al., 2011). Leung et al. examined job stress, burnout, and physiological stress in 108 construction project managers. Claiming the MBI-GS lacked theoretical consistency for the burnout construct, they limited their study to items specific to exhaustion, cynicism, reduced professional efficacy, and depersonalization. Their multivariate analysis model indicated that job stress was an antecedent of burnout, which in turn predicted physiological stress.

Haynes and Love (2004) conducted an empirical study \( (n = 100) \) of construction project managers and their abilities to cope with work-related stressors. The study used the Lazarus and Folkman (1987) coping instrument, based on the transactional theory of coping. This model involves an appraisal of the stressful situation followed by an assessment of the threats and benefits, and concludes with resolution. They found that affect and the ability to cope influenced adjustment levels. Similar to findings from the IT sector, workload was the most significant stressor for project managers followed by working long hours, and the lack of time with family. Inexperienced project managers were at a greater risk for adjustment problems. “Project value was negatively associated with anxiety and stress, suggesting that
higher levels of anxiety and stress were associated with projects of lower value, or vice versa” (p. 137). Similar to an earlier study in engineering indicating that social support counterbalances burnout (Bodensteiner et al., 1989, p. 309) and the findings from the IT literature (Richmond and Skitmore, 2006), Haynes et al. found that project managers who used problem-focused coping (rather than emotion-focused coping) and those with a more positive affect were better adjusted. In an examination of how coping mechanisms relates to personality, Aitken and Crawford (2007) used the Carver et al. (1989) coping instrument to empirically study 71 project managers from 10 organizations. Similar to the IT sector findings, active coping and planning strategies appear to have helped project managers facing stressful situations. Dolfi and Andrews (2007) examined project manager personality characteristics and the relationships between optimism and the work environment (n = 858). They found that optimism helped practitioners overcome work-related challenges. More optimistic project managers also rated their work environment as less negative. Using the occupational health psychology demand-control-support model, Chiocchio et al. (2010) examined stress in 687 participants – those working in an engineering/construction organization (project-oriented) as compared to those working in healthcare services (non-project-oriented). They also developed their own instrument on the Project Involvement Index, which examines the number of projects worked on and the percentage of time spent on projects within the past month. Employees working on projects in non-project-oriented organizations experienced lower degrees of mental health well-being and higher distress as compared to employees working on projects in project-oriented organizations.

In a more recent study, Pinto et al. (2014) examined personnel in four organizations spanning IT, engineering, manufacturing, and medical device technology (n = 353, 25 percent women). They used the MBI-GS to assess burnout, the Job Content Questionnaire (JCQ) to assess social support and psychological demands (strain development) (Karasek, 1985; De Jonge et al., 1995), and a job autonomy scale (De Jonge, 1995) to assess the span of work control. The various instruments they used were specific to their research questions. Their findings showed that job control and social support moderated cynicism and emotional exhaustion. They also found support for earlier studies whereby women reported greater emotional exhaustion. In their 2016 publication (based on the same data set, n = 208), Pinto et al. examined the dimensions of burnout by work title (i.e. project managers, engineers, and project team members) across project type (i.e. construction, research, and development, and IT). Although there was “no significant difference in perceived job demands across both job title and project type” (Pinto et al., 2016, p. 91), project managers reported higher levels of emotional exhaustion than other job classifications. Given the challenging and demanding nature of their work, construction project personnel also reported higher levels of emotional exhaustion than those within the other project classes. In their research, Pinto et al. (2016, 2014) used a transactional framework – the JDCS. Whereas the JDCS model included social support in later iterations, it continues to be critiqued for its limited coverage of job characteristics (Mark and Smith, 2008). In contrast to the stream of research by Pinto et al. other project management studies based on the JDCS instrument used singular elements of job demands, control, and support (Nordqvist et al., 2004) or discussed project overload narrowly by focusing on multi-tasking (Zika-Viktorsson et al., 2006).

The next section presents the authors’ proposed conceptual model on project manager burnout and engagement. Similar to Pinto et al. (2016, 2014), the authors intend to use the MBI-GS in their empirical research. However, the authors plan to use the AWS, an interactional model based on the Person-Environment Fit model, which encompasses subjective perceptions of stress, rather than the transactional JDCS model use by Pinto et al., which has limited coverage of job characteristics (Mark and Smith, 2008; Kristof-Brown et al., 2005).
A conceptual framework was developed drawing on the concepts on burnout and engagement as well as the related antecedents and outcomes from the literature to address the central research question:

**RQ1.** In project-oriented organizations, what are the determinants of project manager burnout vs engagement and the relationship of these variables to project manager turnover intentions or actual turnover?

The high-level framework provided in Figure 2 links factors that are determinants of employee burnout, engagement, turnover, and retention to these outcome variables. The model presents project manager burnout and engagement as mediating the relationship between these determinants and project manager turnover and retention.

In Figure 3, the conceptual framework is elaborated using the variables from the MBI-GS and AWS and highlights determinants as identified from the literature, which are specifically relevant to project management contexts. The researchers account for individual differences as independent variables in this model. Individual differences would arise in the form of personal demands and personal resources and can be expected to predict the intermediate and dependent variables.

Descriptive hypotheses linking the variables in the conceptual framework are proposed for elaboration and testing in a future stage, which will entail empirical research. It is expected this future research will lead to recommendations of use for organizations that...
seek to maintain project management capability as a source of competitive advantage (Barney and Wright, 1998), on the assumption that project management personnel are important organizational assets, particularly for project-oriented organizations. At a high level, the five general hypotheses proposed are:

\[ H1. \] Work environment stressors will significantly relate to project manager burnout/turnover.

\[ H2. \] Work environment stressors will significantly relate to project manager engagement/retention.

\[ H3. \] Individual differences will significantly relate to project manager burnout/engagement.

\[ H4. \] Individual differences will significantly relate to project manager turnover/retention.

\[ H5. \] Project manager burnout/engagement will significantly relate to project manager turnover/retention.

In the authors’ research agenda, the MBI-GS and AWS instruments will be adapted to develop a survey tool to study project manager turnover and retention as outcomes of project manager burnout and engagement, and to examine the links between the underlying worklife determinants of these dependent and intermediate variables. Given that both the MBI-GS and AWS are valid and reliable leading instruments in the field (Schaufeli, Bakker and Van Rhenen, 2009), the intention is to adopt them for an empirical exploratory study. The MBI-GS measures the three dimensions of the burnout-engagement continuum: exhaustion-energy, cynicism-involvement, and professional inefficacy-efficacy. Each of these six variables and their relationship to turnover vs retention will be tested. The AWS measures six areas of worklife, which the authors hypothesize as determinants of burnout and engagement. The relationship between these six determinants as predictors of the intermediate and dependent variables will also be tested. Additional independent variables that are hypothesized to be determinants of burnout, engagement, turnover, and retention are drawn from the project management literature. The primary stressors that the authors hypothesize will impact burnout vs engagement and turnover vs retention include role conflict and ambiguity, workload and work demands, resource constraints, perception of control, community, rewards, values, and fairness. Furthermore, the authors hypothesize that individual differences, personal demands, and personal resources will impact burnout vs engagement and turnover vs retention.

This study will enable the authors to examine the organizational areas of work that specifically contribute to project manager burnout vs engagement and turnover vs retention and the relationships among these. This approach will also enable the authors to explore other context variables in relation to burnout and turnover (e.g. gender, industry context, profession, experience, and certification). Using factor analyses and multivariate analyses, the researchers plan to examine the potentially complex relationship among observable and latent variables. Given the paucity of research in the project management field on burnout, an improved understanding of the stressors in project management contexts and the mechanisms to mitigate the stress can contribute to project manager well-being, engagement, retention, improved project success, and healthier work environments, thereby enhancing organizational productivity. The proposed research agenda is anticipated to contribute to the robust empirical literature on workplace burnout, engagement, turnover, and retention.

5. **Empirical research on workplace burnout, engagement, turnover, and retention anchored in the MBI and AWS**

The empirical research that draws on the social psychology concepts of stress, burnout, and engagement can be leveraged to study factors that influence project manager burnout,
engagement, turnover, and retention in project-oriented organizations. Based on the theory and related research questions and concepts of interest, burnout study designs varied in both complexity and instruments used to operationalize measures. Literature diversity was predominantly evident in terms of the independent variables researchers selected as stressors. In the literature, researchers used the three MBI instruments as well as other instruments to explore the relationships among the independent and dependent variables, primarily examining how areas of worklife predict burnout vs engagement and influence retention or turnover. Burnout was either an intermediate variable or dependent variable in these studies, and turnover and retention were the dependent variables. Unlike the psychology and human resources fields where empirical research on burnout using the MBI and AWS instruments is extensive, directed searches within the field of project management revealed little research on burnout and engagement anchored in the MBI and AWS, along the lines of this proposed conceptual model. Although the project management contributions by Pinto et al. (2016, 2014) used the MBI, their research focused more on job demands and resources (as per the JDCS model). Furthermore, Pinto et al. did not explore the concepts of engagement, turnover, or retention.

Although the well-established MBI instrument is the most widely used in burnout research (Jiménez et al., 2014), some studies used alternative instruments, for example, the Oldenburg Burnout Inventory (Demerouti et al., 2010), the JDR model (Karatepe, 2011) or the Utrecht Work Engagement scale (Handa and Gulati, 2014). Other studies used organizational historical records to detect burnout (Goodman and Boss, 2002). Researchers also explored the relationships between demographic factors such as age, years of experience, gender, and burnout (Zaidi et al., 2011). For example, gender was used to predict emotional exhaustion with work-family conflict as a mediator (Rubino et al., 2013).

Considerable burnout literature included voluntary turnover or turnover intention as a dependent variable. The Kelloway instrument (1999) on turnover was widely evident in the literature (Bushra, 2012; Harrison and Gordon, 2014; Gul et al., 2012; Leiter and Maslach, 2009; Goodman and Boss, 2002). It was noteworthy that regardless of the turnover measures used, the items presented similarly. Sample items included: “I plan on leaving my job within the next year, I have been actively looking for other jobs, and I want to remain in my job” (Leiter and Maslach, 2009, p. 334). Some researchers created a total score related to their turnover items to ascertain higher intentions of quitting (Angermeier et al., 2009). Other studies assessed organizational commitment as a precursor to retention or turnover. Using the AWS, Ching-Fu and Yu (2014) considered organizational commitment and turnover intentions. Some researchers combined leadership styles with organizational commitment in relation to turnover intentions (Gul et al., 2012; Ciftcioglu, 2011; Herda and Lavelle, 2012). Burnout was studied extensively as a mediator of turnover or turnover intentions; burnout was also combined with other variables, such as job satisfaction (Dewa et al., 2014; Bushra, 2012). For example, one study examined burnout with organizational politics and turnover intentions (Ing-Chung et al., 2003).

Satisfaction encompasses both workplace and life satisfaction. Whereas the AWS focuses on areas of worklife satisfaction, some studies examined both areas in the burnout literature (Hayes and Weathington, 2007). Some researchers used concepts related to workplace satisfaction, for example, a participative work climate. For example, Angermeier et al. (2009) found that a participative work climate contributed to less burnout and a lower likelihood of turnover. Still others included the concepts of workplace incivility, empowerment, and resonant leadership in their research (Laschinger et al., 2014; Laschinger et al., 2009).

Civility and work climate relate to organizational citizenship behavior, which relate to values. Values are addressed in the AWS. Some researchers explored organizational citizenship behavior and both intrinsic and extrinsic work values (Ying-Wen, 2012). For example, one study examined value conflicts related to cynicism, which in turn
increased the potential for turnover (Harrison and Gordon, 2014). Leiter and Maslach (2009) found that with respect to worklife areas, value conflicts and inadequate rewards were the most critical dimensions related to burnout and that cynicism was the primary burnout dimension for turnover.

Concepts of fairness relate to justice. Ciftcioglu (2011) underscored the importance of firm fairness in the social exchange relationship between employees and their employer. Ceylan and Sulu (2010) studied the relationship between fairness in decision-making (procedural injustice) and job stress. They also examined powerlessness and social isolation (dimensions of work alienation) as mediators of this relationship. Still related to justice, others studied the connection between injustice and stress to examine the role of organizational justice, burnout, and organizational commitment to understand absenteeism (Chênevert et al., 2013).

Coping abilities relate to one’s personality. For example, some studies, like the one by Handa and Gulati (2014) used the big five personality scale to assess extroversion and conscientiousness as elements of burnout. Other studies used coping measures to assess stress along with role conflict and role ambiguity questionnaires (Wilkerson and Bellini, 2006) to assess burnout. The relationships between role conflict, ambiguity, and burnout level were also examined (Özkan et al., 2012). Hsieh and Wang (2012) examined job stress, burnout, and personality trait measures to examine the internal/external locus of control from a job-demands perspective. These authors focused on the effects of organizational and individual characteristics on burnout.

The aforementioned reflects a breadth of research on workplace burnout, engagement, turnover, and retention, primarily anchored in the MBI and AWS. The authors intend to leverage this research in the project management context, which currently has a paucity of empirical research on burnout in project managers, project stressors, and related coping strategies.

6. Conclusion
Workplace burnout results in productivity loss and employee turnover. Workplace burnout presents significant opportunities for prevention and intervention. In the quest for competitive advantage, businesses focus on their most valuable assets. Beyond the assets on balance sheets, the strategic management literature indicates that the real sources of sustainable competitive advantage tend to be the intangible resources of an organization, such as, a company’s reputation, culture, organizational networks, and employee know-how (Hall, 1994). Organizations that invest extensively in programs to develop and support employees appreciate that it is engaged employees (an organization's mental capital), that improve productivity, and drive competitive advantage and innovation (Barney and Wright, 1998). Project management capability is increasingly being acknowledged as a source of competitive advantage for firms (Jugdev et al., 2007; Mathur et al., 2007, 2014) making the case for the need to understand and address workplace burnout in project managers. Given the demanding and stressful nature of project work, knowing what may increase engagement could forestall burnout and increase retention in project managers, which in turn has the potential to advance competitive advantage, particularly for project-oriented organizations.

This paper is an early outcome of a longer term research agenda that aims to contribute to the growing body of literature on workplace burnout and to the scant body of literature on burnout in project managers. The conceptual model presented in this paper is intended as a step toward empirical research leading to the development of prescriptive hypotheses and recommendations for project-oriented organizations that strive to improve engagement and retention of high performing project managers. The broad objective is to contribute to workplace wellness in project-oriented organizations, influence positive implications on project success, enhance productivity, and ultimately, sustain and augment existing organizational competitive advantages through project management capability.
References


De Jonge, J. (1995), *Job Autonomy, Well-Being, And Health: A Study Among Dutch Health Care Workers*, Maastricht University, Maastricht, NL.


Lim, K.-L., Jacobs, P. and Dewa, C. (2008), How Much Should We Spend on Mental Health?, Institute of Health Economics, Edmonton.


Further reading

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Introductory comments
There have been several handbooks related to project management (PM) published over recent years, for example *The Oxford Handbook of Project Management* (Morris *et al.*, 2011), which provided a useful update of an earlier handbook for managing project also co-edited by Morris (Morris and Pinto, 2004). There are also several PM handbooks that have been developed as major texts useful for undergraduate and postgraduate students that are updated regularly, for example the fifth edition by Turner (2014) and others stretching back 30 years (Cleland and King, 1988). However, as the entire academic field of project work has been growing significantly over the past decade or so and the issue of what is project work and how is it being theorised indicates, as recently investigated (Artto *et al.*, 2017), that it is a wide field that is continually emerging in new directions. Thus more recent PM handbooks have tended to reflect this diversity and extended scope for example in the expanding field of interest into megaprojects (Flyvbjerg, 2017). This book (Sankaran *et al.*, 2017) falls into the category of providing mainly new and some established concepts and perspectives of project work and how it fits into more general management of business through projects and programmes.

Given that this field is expanding and emerging into previously uncharted territory, practitioners and students of project work need a concise single source with which to access current ideas and reports on empirical work that may have been recently published. Some of the material, concepts and study reports, appearing in this book may have been recently discussed in journals or through conference proceedings but these sources are otherwise unknown to the general readership interested in project work. Therefore, this book provides not only a useful way to access these ideas, concepts and research reports but the references cited in each chapter provide a very useful resource. It becomes and almost fulfils a role of being a research assistant undertaking a literature review. The book is a highly current resource that provides a very valuable service to practitioners and students.

The book structure and content
The book editors are experienced researchers and writers and so they ensure that the book is a coherent “handbook” of logically linked content chapters and these are structured in logical sections (parts) that are well explained by the editors in terms of what the reader may expect to read about in the chapters in each part. For example, Part 1 is introduced by Professor Nathalie Drouin with its theme being strategy. Part 2 is titled “Organisations” and is introduced by Professor Ralf Müller, Part 3 has the theme of “People” and Part 4 “New Directions”, both introduced by Professor Shankar Sankaran.

The book’s Foreword by Professor Jörg Sydow makes a very pertinent point in saying that “[…] goes beyond capturing the organization as a relevant context for temporary organizing by investigating PM at the organizational level of analysis.
Thereby, it nicely bridges micro-organizational behaviour and more macro-organizational theory perspectives. The way that the parts (sections) combine provide a window on new and emerging developments in what the editors term “organizational project management” (OPM).

This perspective on project work pushes the field forward from the more traditional view of PM as espoused by the major PM institutions into areas identified in the “rethinking project management” special issue in The International Journal of Project Management (Winter et al., 2006) and revisited in the International Journal of Managing Projects in Business in a special issue focussing on ten years on from that seminal 2006 special issue featuring contributions from some researchers engaged in that 2006 network of researchers as well as recent researcher in project work. Readers interested in that special issue should search for Volume 9, Issue 4 of the journal (Walker, 2016).

I now briefly discuss the book to review it from my own perspective as a Researcher, Teacher and Supervisor of doctoral candidates. I provide a person’s view and so other readers of this book will obviously take away different insights to me. In my opinion, it is an excellent handbook that is well written and developed, provides genuinely novel contributions and I would recommend it to my students, colleagues and friends.

**Part 1 – Strategy**

Part 1 comprises five chapters each builds a coherent picture of projects being the means to deliver organisational strategy thus being observed from the organisational rather than the PM perspective. This group of chapters reinforces and supports an increasing interest in programme and portfolio management that has developed to help us understand the link between a project output and the outcome impact that it presents on the organisation. Chapter 1 introduces the book and its aims and focus by explaining the nature of OPM as an integrating mechanism by taking organisational theory as its theoretical lens. It clearly illustrates how effective OPM integrates the project and its outcome on effectiveness through being a cohesive part of programs and portfolios within an organisation.

Chapter 2 has its focus on business decisions over the project’s extended lifecycle (pre-project activities, project execution and post-project activities) from both the supplier and customer perspective. Its authors (Martinsuo et al., 2017) provide an integrated linking of these business decisions across the project lifecycle from the organisational perspective of how that affects the supplier as well as client’s business interests.

Chapter 3 (Holzmann et al., 2017) helps to explain the perceived importance of OPM in generating organisational success or lack thereof, particularly with the Table 3-2 on page 41 and bullet points on page 42.

Chapter 4 (Jugdev, 2017) provided insights about the connections between the organisational mission and its competitive advantage through critical analysis of a resource based view and limitations in the Project Management Institute’s OPM3 framework. This chapter recognises the complex nature of integrating strategy through projects and note that “[...] For much too long, the input-process-output approach to project management has dominated our thinking, as has the perspective that project management is an operational construct. [...] Astute senior executives understand that not all deliberate strategies will materialize. They also understand that sometimes, emergent strategies are the ones worth capitalizing on [...].” (p. 52).

The last chapter in this section (Part 1, Chapter 5) addresses project portfolio management (Turner and Müller, 2017) also takes a dynamic capabilities perspective but from the portfolio perspective and suggests, based on a survey, that organisations that can reconfigure their resources through the way they undertake OPM may have gain superior competitive advantage as a result.
Part 2 – Organisations
This next section of the book, introduced by Ralf Müller explains how the next five chapters address organisational implications for OPM. This is mainly focussed around governance and how organisations are prepared for managing projects within the strategic demand framework set by the organisation as well as how this intent unfolds iteratively on the ground to cope with reality. It is an important section of the book as it informs our understanding of evolving and emerging forms of project actualisation.

Chapter 6 (Turner and Müller, 2017) draws upon significant and well recognised previous work, including empirical research, to focus the chapter on OPM. For readers not aware of the prior work, or who have poor access to their previous publications, this chapter is a boon. It clearly and with great focus presents core insights into how projects governance is different to corporate governance. It shows how project governance may fit into the overall host’s organisational framework and that applies to both project-based and project-oriented organisations where project delivery is either the business of the organisation or the organisation conducts its business through a series of projects with a programme and/or portfolio of projects.

Chapter 7 (Kopmann et al., 2017) takes an organisation-level perspective on strategy and portfolio management with a focus on both intended and emergent strategy and how managing emergency is coped with and may be harmonised from both the top-down as well as bottom-up influences. The authors argue that “emergence is unavoidable in strategy implementation and thus should be considered in OPM. The question is not whether we need to manage emergence, but rather how to do it: fight it or embrace it” (p. 101). They propose that project portfolio management is the linchpin in harmonising top-down and bottom-up OPM.

Chapter 8 (Patanakul and Pinto, 2017) provides a link between the OPM and programme management concepts and indicates current practice. It highlights issues such as “[…] managing complexity, navigating through political landscapes; program management is Stakeholder management, managing benefits, the role of technology and design for solutions, and process and governance” (p. 117).

Chapter 9 (Aubry and Lavoie-Tremblay, 2017) uses several case studies to discuss the project management office (PMO) from an organisational design perspective. It makes several contributions including a coherent theory of organising for projects as an alternative to the more common transaction cost economics view of the function and design of PMOs.

Chapter 10 (Tywoniak and Bredillet, 2017) connects governance and risk/uncertainty management with opportunity management using design thinking as part of the problem-solving role within OPM. It acknowledges and focusses on the complexity of projects and how governmentality (the way that governance is thought through and interpreted) shapes the way that risk, uncertainty and ambiguity is navigated through. Project governmentality moves away from governance is confined to only that which can be known, identified, measured and monitored to consider the way that uncertainty and ambiguity can be addressed through a design thinking approach. This perspective highlights the role of people and their interpretation of how they see and cope with risk, uncertainty and ambiguity. The chapter leads to the next section quite nicely.

Part 3 – People
This section, introduced by Shankar Sankaran, identifies people as a key factor in OPM. Chapter 11 (Keegan et al., 2017) builds on the author’s extensive work on human resource management (HRM) issues in OPM along with citing other well-regarded sources familiar with many readers. They identify and discuss HRM practices and processes linking the project and the project-based organisation in their Table 11.3 (p. 160). They note, and
identify, a useful body of emerging literature in the HRM of OPM that provides a sound basis for interested researchers in this area to build upon.

Chapter 12 (Eskerod, 2017) uses a Danish case study to explore stakeholder engagement in OPM and identifies and discusses seven challenges faced by the project regarding stakeholder influence and engagement. Eskerod’s contrasting a project-centric approach with a stakeholder-centric approach provides readers with useful insights. It places the stakeholder’s value proposition as a central part of OPM and she outlines challenges that may have been glossed over in the past as being of minor importance.

Chapter 13 (Packendorff et al., 2017) develop the concept and term “balanced leadership” in OPM. The balance stems from thinking about how leadership action shifts from the hierarchical top-down vertical style to a shared leadership style when team members with the expertise or capabilities to best lead decision-making and action. This interplay between the vertical and horizontal is explored and explained. It reminded me somewhat of the Cynefin framework and leadership styles being changed depending on the level of situational order and disorder (Snowden and Boone, 2007).

Chapter 14 (Drouin and Sankaran, 2017) discusses what a team is and how it effectively operated with the OPM context. Using five experts for interviews revealed the importance of teams in integrating team effort required to deliver projects. Their review of literature on themes on project teams yields a useful source of references for students of this topic. This chapter stresses integrated project delivery through the integration required of a whole range of teams through the supply chain that need to contribute to and be harmonised to deliver projects.

Chapter 15 (Hoffman and Boyle, 2017) provides a case study of OPM from a knowledge services perspective. Case studies from NASA always seem to be interesting. NASA has always had a keen interest in organisational learning and knowledge management within a programme and project context. The chapter discusses the Rapid Engagement for Accelerated Learning (REAL) initiative. It provides some useful insights into what tools NASA uses and how they are used in an OPM context. The REAL KM model appears to be to be an advance building on the Kolb (Boyatzis and Kolb, 1995; Kolb, 1984) action learning and SECI (Nonaka et al., 2001) models applied with a programme of projects context.

Chapter 16 (Pollack, 2017) starts with a discussion about the differences between change management and PM that I found enlightening. It also stressed the integration role of OPM and how change management aspects link to this as well as project and programme stakeholder engagement. In explaining the literature heritages of both the change management and PM disciplines, Pollack provides interesting sources that students of both disciplines may access and the chapter also demonstrates how the two discipline mindsets can be integrated in OPM.

Chapter 17 (Braun, 2017) reports on a literature search on PM collaborative behaviour competences for OPM. After screening ten journals concerned with PM topic; he focused on 25 papers for analysis. He isolated three clear themes: sharing behaviour, improvising behaviour and what he describes as extra-productive behaviour. These themes are illustrated well in Table 17.2 (pp. 254-255) for sharing behaviour and in Table 17.3 (pp. 257-258) for extra-productive behaviours and improvising behaviour. He also discusses consequences of these behaviours under team flexibility and within project and beyond project performance. I found this an interesting complimentary chapter for my own research into integrated project delivery and alliancing. I am sure that many readers will find the focus on cross team collaboration useful for their own work.

Chapter 18 (Algeo and Connell, 2017) investigates OPM and project portfolio management from the people competencies by exploring roles and their required skills. Their Figure 18.1 (p. 270) details 11 competencies that provides a useful checklist for many
readers and it was good to see that the chapter also links these with the framework that Cicmil (2003, 2006) developed building a OPM perspective based on earlier work by Dreyfus (2004). This chapter expands the discussion in this competencies area.

Part 4 – New directions
This final section is introduced by Shankar Sankaran with the first chapter, Chapter 19 (Kvalnes, 2017) discussing a much neglected topic in OPM, ethics. Kvalnes introduces well-established ethical theories to frame the chapter then uses a tool he developed which is illustrated in Figure 19.1 (p. 288). The tool, the navigation wheel, identifies six important ethical dimensions to consider when making decisions and taking action in project work. This topic in OPM has been underexplored but given that trust is so closely linked to people feeling that their treatment meets their ethical expectation standards (Mayer et al., 1995), it is important from a collaboration and stakeholder engagement perspective. One question that is often raised in OPM is what does an ethical decision and action look like? This chapter provides some useful guidance on that score.

This segues well into Chapter 20 (Ang and Biesenthal, 2017) which takes a broad view of value from the perspective of the project, how that fits in with and aligns with programs and onto portfolios. Often the concept of value at the project level can distort actual value achieved at the organisational level. Many examples of how optimising value generation at the project level is seen to impede optimisation of programmes of work or portfolios so that the expected benefit fails to be delivered due to excessive focus at the project level at the expense of the organisational or indeed at the end-customer level. This chapter aims to fill that gap through reporting on a live case study. This chapter introduces and lays groundwork for further future studies in this important area.

Chapter 21 (Remington, 2017) builds on the previous work by Remington’s extensive studies into project complexity and leadership of complex projects (Remington, 2011; Remington and Pollack, 2007) by discussing two case studies. The case studies have a focus on how to collaborate across team disciplines and this is highly relevant to OPM. This chapter provides additional insights into OPM in complex project environments to complement those offered by other writers (but not mentioned in this chapter) in this domain such as Snowden (Kurtz and Snowden, 2003; Snowden, 2002; Snowden and Boone, 2007).

Chapter 22 (Keeyes and Hueman, 2017) discusses an important element of ethical OPM, sustainable development. This chapter adds a further dimension to the ethics and stakeholder value perspectives of OPM. The chapter addresses the issue of shared sustainable value which has been more recently been discussed by Porter as an element of competitive advantage (Porter and Kramer, 2011). This focus is gaining interest in OPM as it seeks to explore how projects can be structured and strategised to derive benefit and value far in excess of the business-as-usual narrow focus on each organisation or person involved in projects pursuing self-interest. The chapter makes a valuable contribution to OPM.

Chapter 23 (Turner and Lecoeuvre, 2017) provides an interesting twist on the idea of marketing and OPM. Instead of it being mainly about the marketing efforts of a project orientated organisation seeking to gain project work, it uses marketing theory to discuss how internal marketing within the project envelope of cross-discipline teams and other relevant stakeholder to ensure that their value propositions are considered and through what these authors describe as “marketing” ensure that all are engaged in the project. It provides, I believe, a useful perspective to take when thinking about stakeholder engagement, ethics and other value-related aspects of OPM.

Chapter 24 (Van Oorschot, 2017) takes its focus on the link between shared physical and mental spaces of teams delivering projects and innovation. It takes, in my view, a very novel approach in discussing the key concepts. It uses the analogy of evolving trends in transport
where motor, bicycle and pedestrian traffic share a pathway and how that can force innovations and improved optimisation of traffic and applies this to OPM. I found it a nice and quirky way to make the point and the argument was I find, compelling. The key to triggering innovation is to find the enablers and accentuate these within systems. By thinking in shared-space terms, there are greater opportunities for diversity and divergent thinking to unearth innovative approaches. This is a far cry from the command and control OPM mindset.

The final chapter, Chapter 25 (Delerue and Cronje, 2017), examines the reason for and current application of trends in social media which is a cutting-edge tool in OPM today. While the use of e-mail and other forms of shared information tools have been in use on projects for many years now (Tucker et al., 1999), the impact of other social media tools and applications is under-reported upon within the OPM context. This chapter also investigates the use of social media from a symbolic perspective which sheds new light on this trend for those of us interested in OPM.

Conclusions
Finally, the book has a brief conclusion couple of pages from all three editorial authors that wraps the book up nicely. In general, I would argue that this book makes a valuable contribution with new materials for those interested in OPM and project work. It takes an organisational-level perspective in the main and fills a number of gaps in the current book-level literature. One criticism that can be made about handbooks is that they frequently contain chapters that have a lot of content discussed by chapter authors in journal articles published perhaps several years prior to the book’s assembly. This may be true. However, we should consider that many readers are students or practitioners who simply do not have access to the many thousands of journal publications that academics at most universities do regularly access. This less privileged readership will find most of the handbook chapters an eye-opener. Those of us academics, who are lucky to have access to so many journals, may read a chapter and find much of the content somewhat familiar but we can gain value from the authored chapters presenting fresh perspectives and current citations. One hidden value for those of us who are academics with books such as this one is that it does a lot of research literature searching for us. If we focus on the citations and references, we can find a lot to follow up on.

I would recommend that this book be considered as a serious reference book and that for many students and practitioners that this would be a highly valuable resource.

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References


