Understanding the causes and cures of poor megaproject performance: A systematic literature review and research agenda

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Abstract
Megaprojects are not just challenging in terms of their scale, but because of the level aspiration, complexity, uncertainty and urgency they entail. They take many years to complete, involve numerous public and private stakeholders, and have pervasive (positive and negative) economic, social and ecological impacts. They are shaped by government policy, different procurement routes, funding, and private capital markets. They usually fail to achieve the sponsor's original objectives. This systematic literature review consolidates the literature of the management of megaprojects and contributes to practice and research by increasing our understanding regarding the causes and cures of poor megaproject performance. The review is based upon the analysis of 6.007 titles and abstracts, and 86 complete papers. We suggest five avenues for future research: (1) Clienting and Sponsorship, (2) Planning and Incentivizing the Supply Chain, (3) Bridging the gap with manufacturing, (4) Organizational structures, and (5) Understanding multiples dimensions.

Keywords: Megaproject management; Performance; Causes; Cures; Strategies; Practices; Front-end, Execution

1. Introduction

Megaprojects are the delivery model used to produce large-scale, complex and one-off capital investments in a variety of public and private sectors such as infrastructure, defense, mining, manufacturing plants, healthcare, big science, air and space exploration and major sporting events. With a total capital cost of $1 billion (USD) or more, megaprojects are extremely risky ventures, notoriously difficult to manage and often fail to achieve their original objectives (Altshuler and Luberoff, 2003; Flyvbjerg et al., 2003; Merrow, 2011; Priemus and Van Wee, 2013). In 2013, McKinsey suggested that $57 (USD) trillion would be spent on infrastructure investment between 2013 and 2030 (McKinsey, 2013). With spending on global megaprojects at $6 to $9 trillion annually, Flyvbjerg (2014) emphasizes that this is 'the biggest investment boom in human history", as reported by The Economist in 2008. Despite the increase in the frequency and size of megaprojects undertaken around the world, most are late, over budget and fail to achieve their original objectives. The megaproject "performance paradox" refers to the irony that more megaprojects are undertaken despite the likelihood that the will struggle to achieve the most basic targets (Flyvbjerg et al., 2003). Cost overruns, time slippages and poor operational outcomes are common. According to one estimate, nine out of ten megaprojects are over budget and overruns of more than 50% are not uncommon (Flyvbjerg, 2014: 9). In the United States, for example, the Boston Big Dig was originally planned to open in 1998 but was delivered in 2007, nine years late with a USD 14.8 billion budged, more than 500% over budget (Greiman, 2013). The Channel Tunnel, the underwater railway connecting the UK and France, was 80% over budget (Morris and Hough, 1987).

Research identifies many factors that contribute to the successful delivery of large projects, such as a focus on value creation, strong project leadership, a high-performance culture and collaborative project teams (Dvir and Shenhar, 2011). Some of the key dimensions that make megaprojects so difficult to manage include their size (Morris and Hough, 1987; Flyvbjerg et al., 2003; Merrow, 2011), uncertainty (Stinchcombe and Heimer, 1985; Miller and Lessard, 2000; Shenhar, 1993, 2001; Shenhar and Dvir, 1996; Floricel and Miller, 2001; Flyvbjerg et al., 2003; De Meyer et al., 2006; Lenfle and Loch, 2010; Brady et al., 2012), complexity

(Shenhar and Dvir, 2007; Davies and Mackenzie, 2014; Brady and Davies, 2014), urgency (Morris and Hough, 1987; Shenhar and Dvir, 2007) and institutional structure (Scott et al., 2011). Sponsors and clients responsible for megaprojects need to address all of these dimensions, but recent research (Gil, 2009; Davies et al., 2009; Davies et al., 2016) suggests that dealing with complexity and adapting to uncertainty and fast-changing conditions encountered during downstream execution is a neglected but vitally important cause of poor megaproject performance.

Megaprojects are considered the most complex type of project and have been classified as "system projects" (e.g. Airbus A380) managed by a large prime contractor or "systems of systems" projects which are usually managed as a program with multiple interdependent projects sharing the same vision cascaded down from the sponsors (Shenhar and Dvir, 2007). Established as a standalone temporary organization, megaprojects can be led by a client team, prime contractor or some form of temporary alliance, joint venture or coalition of multiple parties (owners, sponsors, clients, contractors, suppliers and other stakeholders) that work jointly on a shared activity for a limited period of time in an uncertain environment (Jones and Lichtenstein, 2008; Merrow, 2011). Each project is usually decomposed into many smaller inter-related projects and organized as a program. A systems integrator organization – the client, prime contractor or delivery partner – is established to coordinate the efforts of numerous subgroups and suppliers involved in project activities (Davies et al., 2009; Merrow, 2011; Davies and Mackenzie, 2014). This organization manages the overall program and the interfaces between projects, deals with external suppliers through separate contracts, and is accountable for meeting time, cost and quality performance goals. A megaproject is also a temporary process extending over many years or even decades from front-end planning and design, through construction, integration and testing to back-end handover to operations (Artto et al., 2015).

The research aimed to deepen and extend our understanding of the causes and cures of the megaproject paradox. To achieve this aim, the objectives of our systematic literature review were to:

1. Identify prior research on megaprojects (including adjacent literature on large engineering projects, major projects, grand-scale projects and other related terms);
2. Categorize the research according to how it identifies the main causes of poor megaproject performance (e.g. inadequate front-end risk identification, poor governance structure, escalating commitment, inadequate owner capabilities, and misaligned objectives);
3. Categorize the research according to the cures (concepts, strategies and practices) offered to resolve the megaproject paradox (e.g. transparency, owner team structures, and capabilities);
4. Identify novel strategies and practices deployed around the world to improve megaproject performance (e.g. integrated project teams, alliancing, risk-sharing contracts);
5. Identify new research topics, questions and methodologies (e.g. action research, process studies and ethnographies) that offer novel insights into the causes and cures of the megaproject paradox;

6. Host workshops with leading practitioners and scholars to evaluate the adequacy of existing and new concepts, strategies and practices for improving megaproject performance.

2. Research methods

Originally developed in the medical sciences to consolidate information from several sources, a systematic literature review is a transparent, rigorous and detailed methodology used to support decision making (Tranfield et al., 2003). This research method is used to build theory by accumulating knowledge and evidence after analyzing a large number of studies and methods, thereby increasing the consistency of the results and the conclusions (Akobeng, 2005). Informed by Denyer and Tranfield (2009) and Tranfield et al. (2003), our systematic literature review was undertaken in three stages:

- Planning stage: identification of the needs of the review and develop the protocol, which defined the overall strategy, the keywords and its interactions in the search for articles;
- Development stage: selection of the articles, data extraction, assessment and data synthesis;
- Dissemination stage: connect the research findings with ongoing conversations in the academic literature and with practice through accessible material for practitioners.

2.1 Planning Stage

We have identified a list of potential journals, conferences, books and reports where material for the research is likely to have been published. This list enabled our study to address high impact-factor journals from the management, planning, the built environment and other fields as well as the most recognized conferences, books and reports. However, this list was only a guidance (i.e. main project management journals) since systematic literature reviews follow a rigid protocol throughout all stages. Arguably, the rigid structure of systematic reviews is a major limitation when analyzing the research field of management and organization studies, where the terminology is not convergent as in medical sciences, but rather divergent with authors developing different conceptualizations and terminologies to refer and explain the same phenomenon. Another limitation encountered by the research team was the impossibility of including books in the review, which are very relevant in the project management field, and particularly influential in the management of megaprojects domain.

- The review team identified keywords on the subject based on their prior experience through the mechanism of brainstorming in two one-hour meetings. The keywords were grouped in three categories: Megaprojects synonyms, Success synonyms and Failure synonyms. The full list of synonyms for each category can be found in the Appendix 1.
- The keywords were organized into two search strings, which were used to search the papers on academic databases. The first included all Megaprojects synonyms associated with Success synonyms, such as (“large-scale project*”) AND (“benefit*”); The second included all Megaproject synonyms associated with failure synonyms, such as (“grand-scale project*”) AND (“failure*”).

2.2 Development Stage

We have undertaken a systematic search for academic articles in two of the largest academic online databases: Web of Science and Scopus, from all years until September of 2017. The search for articles was conducted through the combination of keywords in three areas of interest: Synonyms for the term Megaproject most commonly used in the literature, Success synonyms and Failure synonyms. Keywords were combined for the two areas and a single file created for each combination was exported from each online database.

(1) The academic databases Scopus and Web of Science were chosen to conduct the search for papers using the strings identified in steps (1) and (2) of the Planning Stage.

(2) The first string, related to Megaprojects and Success returned Scopus (3423) and Web of Science (2498). The second string, related to Megaprojects and Failure returned Scopus (1659) and Web of Science (880). The papers from the two search engines were then consolidated on Mendeley aiming to exclude duplications, resulting in two folders: 1. Megaprojects AND Success consolidated (4964); and 2. Megaprojects AND Failure Consolidated (2067). These two folders were consolidated one more time to exclude duplications between then into a folder called Megaprojects AND Success AND Failure (6007), as illustrated by Figure 1. On both databases only journal articles were included, the resulting conference papers, reports and book chapters were excluded.

- On Scopus the papers were limited to the following subject area: Business, Management Accounting; Computer Science; Decision Sciences; Economics, Econometrics and Finance; Energy; Engineering; Social Sciences; Environmental Science; Materials Science; Multidisciplinary and Undefined.
- On Web of Science the papers were limited to the following subject area: Architecture; Area Studies; Business Economics; Computer Science; Construction Building Technology; Energy Fuels; Engineering; Environmental Sciences Ecology; Geography; Government Law; International Relations; Materials Science; Metallurgy Metallurgical Engineering; Operations Research Management Science; Public Administration; Science Technology Other Topics; Social Sciences Other Topics; Telecommunications; Transportation; Urban Studies; Water Resources.

(3) Titles and abstracts of articles were analyzed according to the inclusion and exclusion criteria (Appendix 2), reducing the number from (6007) to (1075).

(4) The review team met to cross-check and discuss the results of the evaluation by title and abstract, and given the remaining high number (1075) decided to further categorize the papers into three categories. This strategy was adopted aiming to isolate and exclude the high number of papers about Public Private Partnerships (PPPs) and financial mechanisms.

(5) Using the inclusion and exclusion criteria the articles were separated into categories A (248), B (216) and C (611). Category A represented articles of Size, category B represented articles where the focus was around Complexity and category C list represented articles of contractual arrangement, funding, financing (i.e. PPP literature) and had little focus on managerial aspects of megaprojects.

(6) The papers included categories A (248) and B (216) were consolidated again (464) and in light of the high number the review team adopted the strategy of employing the impact factor as a measure to maintain the quality and reduce the number of papers to

be entirely reviewed. The review team has analyzed the list of 464 papers and concluded that the megaproject literature is still concentrated in project management journals, therefore it was strategic to limit the impact factor to a number necessary to include the main journals of the field. It was agreed that papers submitted in academic journals with impact factor above (1.70) would be included for this review. By limiting he impact factor to above (1.70), it was possible to include the main journals of project management, Journal of Engineering Construction and Management (ASCE) (1.73), Journal of Management in Engineering (2.01), Project Management Journal (PMI) (2.71), Automation in Construction (2.91), and International Journal of Project Management (4.03).

(7) The final list contained (145) articles that were filtered from the initial (6007) following steps (3)–(6). The (145) articles were read from start to finish and (86) were considered to inform the review. Using an extraction sheet on Microsoft Excel, relevant information related to descriptive data (title, authors, journal, year, etc) and information that answered the initial research questions (aims and objectives, causes, cures and future research) was extracted in a structured fashion. A full description of the extraction spreadsheet can be found in Appendix 3.

(8) The articles were reviewed aiming to extract the causes and cures of megaprojects. The process of extracting the causes and cures through an in-depth analysis of each paper, enabling the reviewer to associate each cause or cure to an emerging category, followed Saldaña's coding manual (2016). Therefore, each cause or cure was used as a code and associated to a category, which represented one entry in the extraction Excel spreadsheet.

(9) After all papers were reviewed and the extraction finished, the review team met again to discuss their independent analysis and consolidate the categories into themes. The categories of each author were analyzed over 1.50hrs and six themes emerged from its consolidation.

(10) After the six themes were defined, the review team has identified three predominant concepts in each theme that assisted to explain the causes and cures for the megaproject paradox. Each concept was supported by examples of academic quotes extracted from the analyzed 86 papers.

(11) In an effort to connect the findings of the systematic literature review with industrial strategies and practices, the review team identified industry reports from the last five years where those concepts were discussed.

(12) The six themes were validated with Professor Peter Hansford from University College London, who served as chief construction adviser for the UK government and has large industrial experience providing advice on megaprojects.

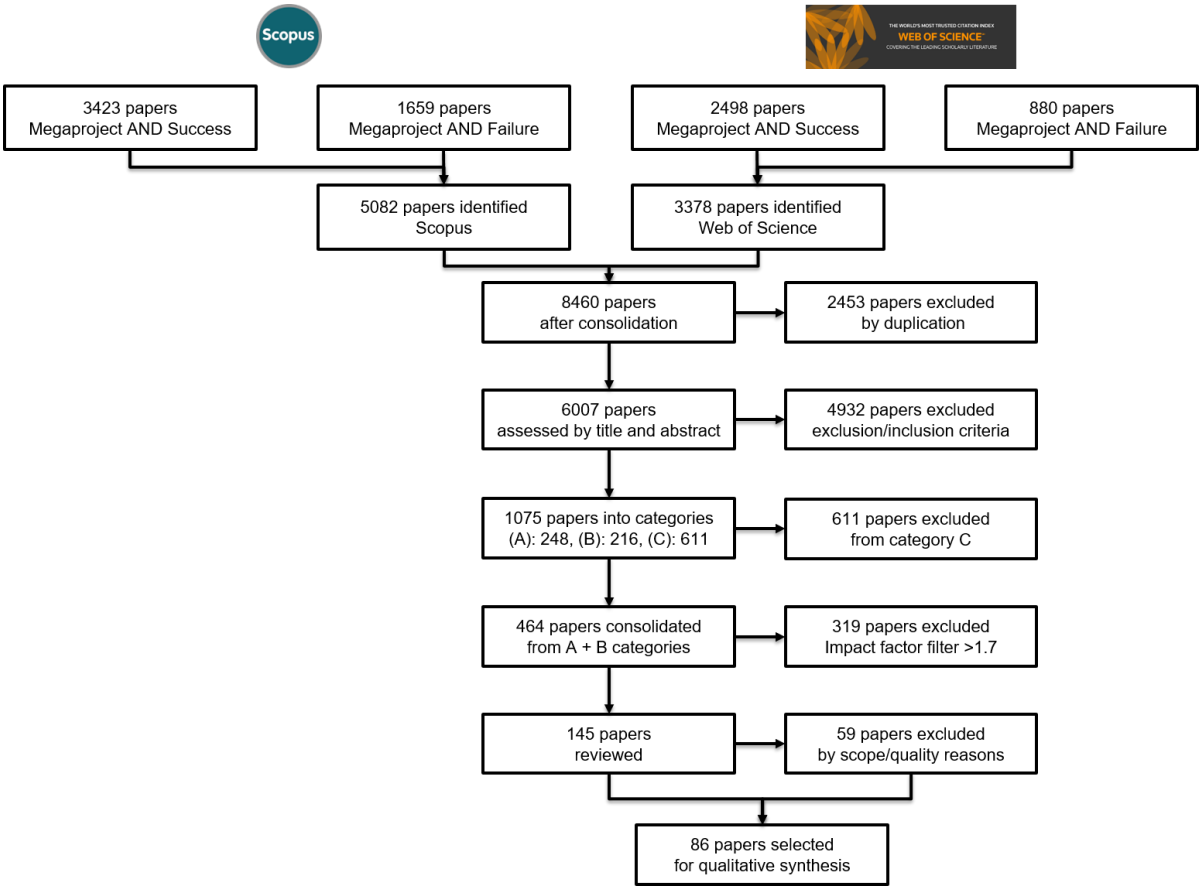

Figure 1: Steps of Systematic Literature Review

The findings were presented, assessed and verified in two workshops. Both workshops generated a productive, lively and hugely insightful discussion. Participants were critical of the existing literature and called for new, more engaged and holistic research to understand the variety of institutional, behavioral, organizational and other factors affecting the performance of megaprojects from front-end planning through execution to operational outcomes.

3. Results

After executing the analysis as outlined in the methods section, we returned to the literature set of 86 articles and clustered the main causes and cures into six themes. The themes are: (1) Making Decisions, (2) Define Strategy, Governance and Procurement, (3) Manage Risk, Opportunity and Innovation, (4) Lead, Assemble and Develop Capable Teams, (5) Engage and Manage Stakeholders, and (6) Coordinate and Integrate the Supply Chain. These six themes make sense of the sample and reveal the main causes of poor performance as found in the academic literature, as illustrated by Figure 2. Each theme is further sub-divided by concepts that help to discuss the causes and cures of poor megaproject performance and contribute to the ongoing conversations of the literature.

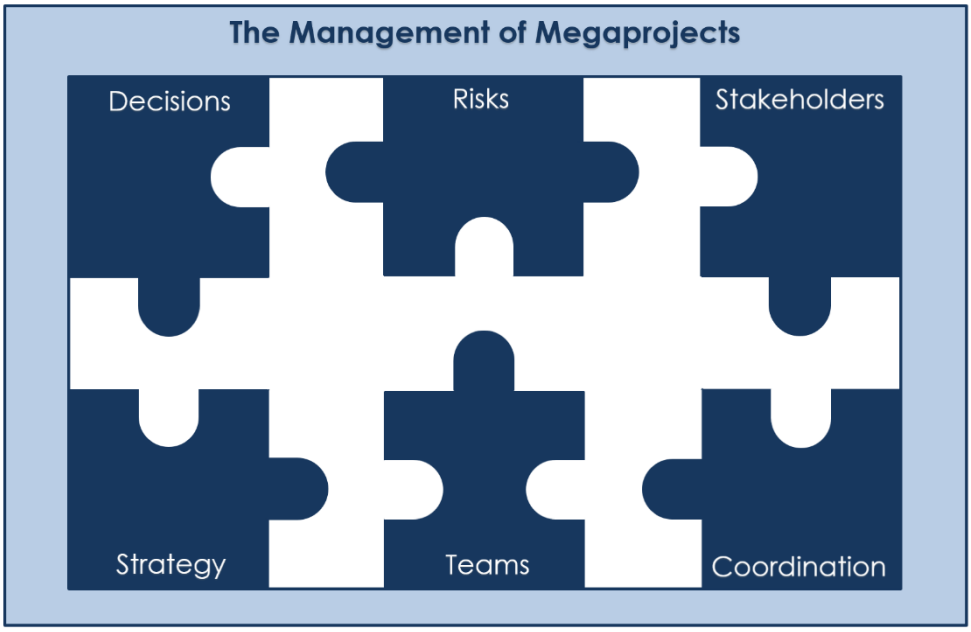

Figure 2: Causes and cures for the megaproject paradox.

The papers categorized under each theme are documented together with a comprehensive list of extracted strategies and practices. We should point out that organizational learning does not appear as separate theme: this is the need to capture learning from each megaproject to improve the performance of subsequent ones. This issue was raised in both of our workshops. However, our literature review showed that learning is a thread running through all six themes. In theme 1, for example, optimism bias can be mitigated by reference class forecasting and gaining an outside view of the project – both involve capturing and acting upon the learning gained from previous projects. Theme 4 makes direct reference to the importance of learning and capability building.

The exclusion of highly influential books on large-scale projects was identified as a limitation in both of our workshops. Many pioneering project management ideas first developed in books such as the concept of a strong owner (Morris and Hough, 1987), the front-end definition in Morris (1994), and the owner-contractor interface in Merrow (2011), which appear as key references in the papers identified in our literature review. Therefore, although these books are not identified in our review, their profound influence on the research undertaken on megaprojects is evident in many of the articles appearing in our review.

Both workshops also pointed out that some key papers on megaprojects – such as Winch (2014) on the role of the owner operator and Gil (2009) on client-supplier relationships – were missing from our literature. As we pointed out, although papers that do not fit the inclusion and exclusion criteria (megaproject performance, scale or size) did not appear in our literature, their influence on research undertaken is evident.

3.1 Theme 1: Making Decisions

A significant body of literature on megaprojects performance is related to making decisions. Theme 1 identifies how behaviors in the front-end and during execution are associated with poor performance in decision making. There are 13 out of 86 articles primarily associated with this theme. The majority of the articles in this theme reject technical explanations as the main reason for inadequate forecasting and discuss poor performance as a result of psychological and behavioral reasons and how these affect decisions making. The three most

predominant concepts in this theme are: (i) Optimism bias (delusion): executives being overly optimistic and thus overestimate benefits and underestimate costs; (ii) Strategic misrepresentation (deception): executives strategically misrepresent the truth and look to satisfy their own incentives; and (iii) Escalating commitment: the human behavior pattern in which executives continue to support a decision that is deemed unsuccessful instead of taking alternative course of action.

3.2 Theme 2: Define Strategy, Governance and Procurement

The second theme encompasses the definition of strategy, governance and procurement. This part of the literature comprises the decision-making processes during the initiation and planning phases of a megaproject, which the literature usually addresses as the front-end stage of projects. The decisions made at this stage have the power to influence the subsequent stages and are critical to achieve the outputs and outcomes of the project. There are 17 out of 86 articles primarily associated with this theme. The three most predominant concepts in this theme are: (i) Sponsor, Owner, Operator: associated with the roles and responsibilities of these entities throughout the project life-cycle, with particular emphasis to the front-end stage; (ii) Governance: linked to the definition of roles and delegation of authority formally and informally, at organizational and individual levels; and (iii) Delivery Model Strategy: related to the strategy adopted by companies to organize themselves combining in-house and external capabilities to deliver the project.

3.3 Theme 3: Manage Risk, Opportunity and Innovation

This theme captures the literature that is addressing risk, opportunity and innovation, with 16 out of the 86 articles reviewed primarily discussing these topics. The three most predominant concepts are: (i) Technological novelty: first of a kind technologies have frequently being associated to innovation; (ii) Flexibility: the ability to be adaptive and responsive to changing circumstances; and (iii) Complexity: it is the underlying factor that has huge implications to the performance of megaprojects and projects need innovation to overcome it. Published articles investigating megaprojects initially covered technology development processes and analyzed strategic decisions to overcome risks megaprojects in the Software and Telecommunications industries.

3.4 Theme 4: Lead, Assemble and Develop Capable Teams

This theme refers to relations amongst the project team, individual competencies, skills required and organizational capabilities found to be contributing to the performance of megaprojects. There are eight out of the 86 articles reviewed primarily associated with this theme. The three most predominant concepts are: (i) Project leadership: the need for a project champion, a dedicated leader who is committed to the success of the project; (ii) Competencies: competencies and skills individuals forming project teams need to acquire; and (iii) Capabilities: organizational capabilities and learning are important for the delivery of such large projects.

3.5 Theme 5: Engage and Manage Stakeholders

The fifth theme is about engaging and managing stakeholders. This part of the literature covers various factors considered to be ‘outside of the project environment’. There are 10 out of 86 articles primarily associated with this theme. The three most predominant concepts in

this theme are: (i) Institutional context: covers a set of formal organizational structures, rules and informal norms for service provision; (ii) Stakeholder fragmentation: the excessive number of parties and their interrelatedness, which often results in an intense level of interaction amongst involved stakeholders; and (iii) Community engagement: the processes and engagement activities by which the project involves the local population regarding the progress of the project.

3.6 Theme 6: Coordinate and Integrate the Supply Chain

The sixth theme comprises coordinating and integrating the supply chain. This part of the literature is associated with the mechanisms used by different types of organizations (clients, delivery partners, main contractors, tier 2 suppliers) to coordinate and integrate a very fragmented network of suppliers. There are 22 out of 86 articles primarily associated with this theme. The three most predominant concepts in this theme are: (i) Program management: associated with systems, procedures and tools to monitor and control the project and the organizations delivering parts of it; (ii) Inter-organizational relationships: linked to the establishment of relationships and its management throughout several phases of the project; and (iii) Systems integration: related to the technical and managerial capabilities of integrating several components produced by different parties in order to deliver an operational asset to the client.

4. Conclusions

To deepen and extend our understanding of the causes and cures of the megaproject paradox., our research systematically reviewed the academic literature on the performance of megaprojects and drawing upon 86 papers has suggested six themes with concepts contributing to their performance across the project lifecycle. The six themes summarizing our research findings are: Making Decisions; Define Strategy, Governance and Procurement; Manage Risk, Opportunity and Innovation; Lead, Assemble and Develop Capable Teams; Engage and Manage Stakeholders; and Coordinate and Integrate the Supply Chain. Three predominant concepts under each theme were identified to illustrate some of the practices used to improve the performance of megaprojects. To further enrich the description of each concept, we provided a detailed analysis with direct quotes from literature as a vehicle of improving our understanding. In addition, we validated the findings from the systematic review through a session with an experienced industrial policy adviser and two workshops with academics and practitioners.

Considering the process of conducting a systematic literature review and the feedback received, we recognize that some key books and articles are missing from our literature review, but they are still highly relevant in shaping research undertaken in the field. The absence of books is explained as a limitation of the methodology and of some influential articles by understanding that the management literature encourages the development of new concepts and terminologies to advance the field, which sometimes are missed when searching through a specific set of keywords.

Our research categorized what is known about megaprojects, unpacked what is unknown, identified potential impacts for practice, and outlined a research agenda, a comprehensive list of future research directions is presented in Appendix 11. Considering the publication timeframe and the efforts to collect data in project management research, arguably recent

publications reflect results of studies conducted several years ago, therefore we recognize that our literature review might not capture the most recent practices and strategies being applied in megaprojects. In an attempt to overcome this limitation, workshops with leading practitioners and academics were conducted to capture the most recent developments and their reflections on future research avenues.

Upon reflection of our six themes and two workshops with leading academics and practitioners, we suggest the following five avenues for future research:

1. The role of clients and sponsors. There is a need to improve our understanding of the roles, responsibilities and capabilities of organizations that undertake operations and a portfolio of major capital projects to expand or change the business. In addition, there is a need to better understand the dynamics of this capability in temporary 'pop-up' organizations, created with a single purpose of delivering the project and disbanding when the task is completed. Research should explore the idea of an "intelligent client" concept and how clients are organized to achieve achieve their strategic objectives in ongoing operations and temporary capital projects. Assurance and its value to a client organization is another avenue to be explored.

2. Planning and Incentivizing the Supply Chain. Megaprojects have complex supply chains comprised of hundreds of contracts with contractors, consultants and subcontractors. There is a need for more guidance on rules, procedures and methods helping clients know how much capability to build in-house and how to break down each project supply chain into manageable packages. More research could explore how clients use influence and negotiation skills to manage multiple contracts, including how to balance the competing interests, different behaviors and priorities of numerous suppliers involved in a megaproject. Studies might examine how suppliers are incentivized to achieve their objectives during different stages and transitions in the life cycle of a megaproject, from the front-end planning, through design and construction to the back-end handover to operations.

3. Bridging the gap with manufacturing. Considering the productivity gap between construction and other industries, there is a need for more research to examine how manufacturing methods (e.g. Engineer-to-Order to Assembly-to-Order production) and advanced digital technologies (e.g. augment reality and artificial intelligence) may be applied to complete megaprojects more efficiently and effectively. Future research is needed to revisit the literature of systems integration and off-site manufacturing in high-volume sectors and consider how these practices apply to the construction industry, building on the concept of modularity in megaprojects. Comparisons with other manufacturing industries could help to understand how the dynamics of how innovation is pushed or pulled in complex megaproject supply chains.

4. Novel organizational forms. There is a need for more conceptual research to better understand how novel organizational forms and arrangements between clients, delivery partners and suppliers are being developed to improve performance of megaprojects. Research is required to explore hybrid public and private organizational forms and entrepreneurial structures in megaprojects.

5. Understanding multiple dimensions. There is a need for more research to better understand the multiple dimensions impacting on the performance of megaprojects such as

governance, technology, people leadership, packaging or contracting. Research should identify the interdependencies between these dimensions in complex megaprojects and which dimensions have the most significant impact on performance. There is a need to identify and explore how institutional and cultural contexts impact on the planning and execution of megaprojects in different parts of the world. More research needs to be undertaken on the role of stakeholders and how their often conflicting interests, needs and priorities impact the benefits generated by megaprojects.

A large body of the literature claims that the main causes of the megaproject paradox are due to inadequate definition of risk and poor decision-making in the front-end and offers some cures to provide a way out of the paradox. Although our systematic review recognizes the importance of decisions at the early stages of megaprojects, by categorizing the literature into six major themes it became clear that there is a need for a more a holistic consideration of the system to inform decisions throughout the project. A more holistic decision-making framework may be required to understand precisely how these various dimensions – the six themes identified in our research – work together and contribute the causes and cures of poor megaproject performance.

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Appendix 1 – Lists of Synonyms

Megaproject Synonyms:

Megaproject; Major project; Large scale project; Large scale construction project; Large scale urban development project; Large engineering project; Large construction project; Large project; Large technical system; Large construction program; Large program; System of systems; Grand scale project; Unique project; Complex products and systems; Global project; Mega capital project; High rise project; High rise construction project; Transformational project; Complex project; Complex program; Teraproject; Teraprogram; Gigaproject; Gigaprogram; Giant project; Giant program; Public works project; Macro engineering project; Infrastructure project; Infrastructure program; Complex infrastructure project; Monumental project

Success Synonyms:

Benefit; Output; Outcome; Value Legacy; Achievement; Accomplishment; Attainment; Delight; Complete; Punctual; Efficiency; Effective.

Failure Synonyms:

Failure; Breakdown; Break; Collapse; Decline; Deficiency; Deterioration; Disruption; Overrun; Delay; Late; Shortfall; Shortage; Insufficient; Incomplete.

Appendix 2 – List of Exclusion/Inclusion Criteria

Exclusion criteria:

The article is part of conference proceedings;

There is no abstract available;

The article is in not in English.

Inclusion Criteria:

The concept of megaproject has to be essential for the intervention and therefore explicitly mentioned;

Project failure / success / performance has to be the objective or one of the objectives of the intervention;

The study has to be based on empirical data collection (i.e. qualitative or quantitative process or outcome parameters are reported), state of the art literature, or conceptual paper with strong theoretical focus of some aspect of performance.

Appendix 3 – Extraction Form

Group Categories	Code	Description
Demographics	Authors	List of authors
	Title	Title of article
	Year	Year of publication
	Journal	Title of journal in which the article was published
	Journal Category	Category of science upon the Journal is classified according to ABS Academic Journal Guide 2015
	Journal's Impact factor	The impact factor of the journal the article was published
Sample	Country	Country from which the data were collected
	Applied Industry	Industry from which the data were collected
	Sampling/data collection	Clear description of population/case/documents characteristics
Research Design	Paradigm	Pragmatic, Social construction, Advocacy
	Research methodology	Qualitative, Quantitative, Mixed method
	Method	Case study, Literature review
	Limitations of study	Methodological limitations
Findings	Aim and objectives of study	The goal the articles tried to address
	Causes of failure	Categorize research according to how it identifies the main causes of poor megaproject performance
	Cures	Categorize research according to how it identifies the main cures of poor megaproject performance
	What is not known	Areas for future research clearly stated