PAPERS

Symbols, Sublimes, Solutions, and Problems: A Garbage Can Model of Megaprojects

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ABSTRACT

In this article, we deploy Cohen, March, and Olsen's (1972) garbage can model of decision making to produce a different lens on the performance of megaprojects. Using a sample of firms involved in hydrocarbon megaprojects, we show that the problems given the most public attention by the industry are different from those responsible for budget overruns. Furthermore, the attribution of reasons for exceeding project budget differs between project owners and supply chain firms. This is consistent with garbage can model predictions around problem latency when the multifaceted symbolism of these projects drives divergent prioritization of problems in project execution.

KEYWORDS: megaprojects; garbage can model; problem solving; oil and gas

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INTRODUCTION

Megaprojects are an important vehicle for the development of organizations, cities, and nations. Many of these projects are now so large that they have been called 'terraprojects' (Flyvbjerg, 2014). While the lure of these ventures is the potential transformation they bring to businesses that benefit from the investments and governments in terms of taxes, royalties, and economic development, there is also significant risk. The poor track record of megaproject performance is well documented, with Flyvbjerg (2014, p. 11) pointedly summarizing it as "over time, over budget, over and over again." The paradox is that even with this history, megaprojects continue to be sanctioned and often with the same risk factors. This cycle continues and the frequent failure to learn is an important phenomenon for both academics and practitioners to investigate.

Clearly, rational choice models of planning and decision making have limited utility in explaining the recurrent problems of complex megaprojects. In challenging the rational planning model, Stinchcombe and Heimer (1985) suggested that all large projects have elements of unforeseen problems and opportunities and are more akin to innovations. Indeed, the view of rational optimization in project management has been recently challenged by a more emergent/adaptive view (Brady, Davies, & Nightingale, 2012; Davies, 2014; Lenfle & Loch, 2010), and Flyvbjerg has been central in explaining the apparent irrationality of megaproject planning with concepts from behavioral economics (Flyvbjerg, Bruzelius, & Rothengatter, 2003).

A behavioral psychology lens can certainly challenge traditional rational decision assumptions (e.g., Flyvbjerg et al., 2003; Flyvbjerg, Garbuio, & Lovallo, 2009; Kahneman, 2012). However, there is some difficulty in applying theories of individual decision processes to megaprojects that are temporal phenomena involving a vast number of decision makers within many organizations (Baum & Ingram, 2002; Davies, Dodgson, & Gann, 2016; Molloy & Chetty, 2015; Steen & Kastelle, 2012).

Individuals are subject to optimism, availability, and search biases but how can megaprojects have cognitive bias? Although the cognitive bias of project managers exists, there is also a milieu of complex organizational processes that are at work. It follows, therefore, that purely cognitive explanations of actions in large, complex projects have limited explanatory power. In their review of the strategic decision-making literature, Eisenhardt and Zbaracki (1992) conclude that although decision makers are boundedly rational, power wins battles of choice and chance matters. Agency is therefore a distributed and emergent property that emerges from organizing processes rather than residing with actors (Law, 1992; Steen, Coopmans, & Whyte, 2006). Not only is agency distributed within megaprojects, the actors themselves frequently change during the long design and construction period, which may last for several years (Brookes, Sage, Dainty, Locatelli, & Whyte, 2017). Project manager turnover in organizations is highest during project execution, and the senior managers at the end of the project may be different from those in the beginning (Parker & Skitmore, 2005).

Understanding decisions at the level of megaprojects means greater consideration of political, institutional, and psychosocial processes (Flyvbjerg, 2005; Pinto, 2000; Saint-Macary & Ika, 2015; Williams & Samset, 2010). The socio-technically constructed dimension of organizational problems and decisions is accentuated in megaprojects because of their sheer size and the involvement of multiple stakeholders and technologies (Maylor, Turner, & Murray-Webster, 2013; Molloy & Chetty, 2015). Within these projects, there will be differences in dominant logics and discourses, not only among the various stakeholders, but also within the organizations responsible for delivering the project (Saint-Macary & Ika, 2015; van Marrewijk, Ybema, Smits, Clegg, & Pitsis, 2016). Flyvbjerg (2014), following Frick (2008), alludes to the bias that megaproject decision makers face due to the seductive power of 'sublimes,' such as the technological sublime—"the rapture engineers and technologists get from building large and innovative projects" (Flyvbjerg, 2014, p. 8). Other forms of sublimes include public visibility for politicians, economic sublimes such as large monetary deals for business people, and an aesthetic sublime in the guise of beauty for designers and architects (Flyvbjerg, 2012, 2014). Different agents may therefore view the megaproject as a symbol of technical expertise, political power, or economic strength, and consequently they will see the problems and solutions involved in the design and delivery of the project from different perspectives as well.

Literature Review

The Garbage Can Model of Decision Making

One influential model of organizational decision making that goes beyond individual agents as the locus of decision making is Cohen, March, and Olsen's garbage can model (GCM) (Cohen et al., 1972; Eisenhardt & Zbaracki, 1992). In this model, an organization is ". . . a collection of choices looking for problems, issues and feelings looking for decision situations in which they might be aired, solutions looking for issues to which they might be the answer, and decision-makers looking for work" (Cohen et al., 1972, p. 2). The formal articulation of the original GCM is relatively simple with interrelations among problems, solutions, participants, and choice opportunities that occur over time. Problems can be ambiguous with goals often discovered through the decision-making process. Solutions are potential answers looking for problems. Causal relationships are unclear, and the connection between means and ends is not well defined because the connection is unclear. Participants in the decision-making process come and go and their focus of attention is unstable (Cohen et al., 1972; Levitt & Nass, 1989; Magjuka, 1988). Problems attach themselves to choices and the solutions absorb energy from the actors, which affects the quantity of problem-solving energy that is available in the system (Lomi & Harrison, 2012).

The garbage can metaphor in the model originates from the idea that choice opportunities are garbage cans into which actors place problems and solutions. The mix of garbage in a single can depends on the availability of alternative cans and the rate that the 'garbage' is being deposited and cleared (Jann, 2015). Although based in the Carnegie School of bounded rationality (Cyert & March, 1963), the extension that the GCM provides revolves around dynamism, temporality, and ambiguity. Fluid participation, multiple and unpredictable decision points, and the integration of these observations are important features of the model (Jann, 2015; Sager & Rielle, 2013).

The GCM has been applied using various organizational research methods, including simulations, case studies, and field studies (Cohen, March, & Olsen, 2012; Jann, 2015; Lomi & Harrison, 2012; Magjuka, 1988; Masuch & LaPotin, 1989; Pinfield, 1986). An important criticism of the original model is that it lacks consideration of organizational structure and control processes and therefore is a very atypical representation of organizations (Perrow, 1977; Sager & Rielle, 2013). However, Padgett (1980) published a similar simulation to the original GCM paper (Cohen et al., 1972) but included management variables such as hierarchical differentiation, standard operating procedures, and centralized control and showed that garbage can decision-making processes could still operate under these conditions.

Megaprojects as Garbage Cans

Applying the GCM to a megaproject means to reorientate from a rational decision-making process that posits a particular order of events to one that considers uncertainty, unexpected events, and complex processes that connect solutions to problems. This fits with the activities within a megaproject, in that outcomes are largely dependent on those involved in the decision, and those attendant to that particular decision vary greatly depending on the situation (Brookes et al., 2017; Cohen et al., 2012).

This decision-making process is very different from the simple linear model in which a series of choices are considered, examined as to their consequences and alignment with predetermined objectives, which then leads to a decision (Cohen et al., 1972; Eisenhardt &

Zbaracki, 1992). As applied to megaprojects, the tenets of GCM posit that decisions are more likely to be the aftereffects of accidental collisions between opportunities to make choices (extreme in the megaproject case due to extensive stakeholder and community interfaces); solutions that are looking for problems to solve (including technologies and services); inconsistent participants (firms, who throughout the project will have varying influence and motivations to engage in decision making); and problems, which may arise from nearly infinite loci (e.g., conflict between firms, stakeholder management, technological interactions, and weather delays) (Eisenhardt & Zbaracki, 1992; Hellgren & Stjernberg, 1995; Stinchcombe & Heimer, 1985).

The GCM model has the potential to explain the frequently observed disconnect between problems and solutions in megaprojects through an organizational, rather than cognitive, theory of decision making. Furthermore, while psychological biases have been deployed to explain the front-end design and sanction of (mostly public sector) megaprojects, there has been less attention paid to decision-making processes and problem solving through construction to completion (Brookes et al., 2017; Olaniran, Love, Edwards, Olatunji, & Matthews, 2016). As we shall argue, this is where GCM has particular utility in providing explanations for decision-making processes and outcomes in the complex environment of megaprojects. The GCM has been criticized for being more applicable to situations in which technologies are ambiguous and the time frames for the streams of decisions and solutions to interact are long (Eisenhardt & Zbaracki, 1992). However, this is a good description of many megaprojects, especially the development of very large liquefied natural gas projects, which we used as the setting for this research (Olaniran et al., 2016).

In this article we use GCM as a way of explaining the differences in problems identified by businesses that are attributed to megaproject delays and cost overruns in the Australian oil and gas industry. By comparing media reports from business and industry associations with survey data, we show that the large operator companies who own the megaproject focus their attention on external regulatory issues that involve actors such as the government and labor unions. However, the problems that are identified by managers of service companies who are constructing the project are actually quite different and relate more closely to the performance of the project. From a rational choice perspective this is hard to understand, but from a GCM viewpoint we can see this outcome as a result of conflicting agendas and solutions to a stream of multiple problems over time.

This article now provides background on the research setting—in our case, the Australian oil and gas industry. We describe the context and provide a description of the method used to capture the public narrative that surrounded the problems facing the industry at the time of our study. The article then provides an overview of the GCM and then shows how it can be applied to a megaproject context where the symbolism of these projects generates different motivations for undertaking them. Based on the GCM, we advance propositions of how problems arise, which reflect the underlying agendas of the different agents who are involved in the project. Furthermore, the structuring of these complex projects predicts a high level of problem latency during which problems may linger within the project without being resolved. This problem latency creates cost and schedule overruns. We then describe the research method used to test these propositions and discuss findings from our data analysis. The article concludes with a discussion of how the GCM can provide new ways of conceptualizing performance problems in megaprojects and generate broader research opportunities for agent-based simulation in megaproject research.

The Case of Australian Liquefied Natural Gas Megaprojects: Symbols, Sublimes, Solutions, and Problems

The Australian gas industry has long been challenged by having vast reserves and a small local market. As gas prices rose after 2005, liquefying this gas and shipping it to international customers became economically feasible. Large global oil companies either acquired smaller Australian companies or formed joint ventures with other local and international companies to access reserves and capital. Even for the size of these companies, the cost of these projects was significant at between US$23 billion and US$60 billion (Ford, Steen, & Verreynne, 2014).

For some of these companies, the investment represented the business sublime of a strategic transformation and a new growth strategy and at the same time, technical breakthroughs in extracting gas from coal was symbolic of the engineering expertise of these companies. In the East Coast Australian coalfields, three projects competed in a race to be the first to ship liquefied natural gas (LNG) cargo. By 2012, over US$220 billion had been committed to LNG megaprojects in Australia.

However, soon after these projects commenced, delays and cost overruns began to emerge (Chambers, 2013; Ford et al., 2014). The oil and gas industry had been critical of government regulation and industrial relations and in the media turned its attention to blaming external factors, including the government and unions for many of the problems (Ernst & Young, 2014). Symbolically, these projects became ideological battlegrounds between business, government, and environmentalists. The three East Coast projects were especially contentious, because the gas delivered to the port for liquefaction and export came from coal seams (also called coal-bed methane). Not only did this use the process of hydraulic fracturing (or 'fracking') to release the gas, it also necessitated the drilling of thousands of smaller wells across a very large area, which included farmland (Ford et al., 2014). With this large footprint and public interest, these projects became powerful symbols for environmentalists, the gas companies, and government but with very divergent meanings and prioritization of problems. The environmental lobby was able to use the coal seam gas projects as a rallying point for other interest groups, including many 'green' voters in the cities and some sections of the agricultural industry, which also forced regulatory responses from the government (Australian Broadcasting Corporation [ABC], 2013). The Queensland Labor government used the projects to project an image of prosperity, including an election promise to return royalties from the project to voters in the form of an education scholarship worth US$1.6 billion over 10 years (Hurst, 2012). Similarly, the projects became a contested subject for the ongoing political debate on industrial relations. In Western Australia, the massive Gorgon gas project, developed by Chevron, had started with a construction budget of around US$37 billion and was headed for a budget of US$60 billion by 2017. While the project was environmentally challenging due to the protected status of the area it was operating in, as well as a breakthrough CO_2 capture and underground sequestration plant that was attached to the project, the attention of the industry turned to the high wages and unionization within the workforce of 5,000 employees to explain the cost blowout. Claims of average wages for low-skill construction workers of US$150,000 and an infamous example of a chef being paid US$350,000 were widely publicized (Ellem, 2014).

Much of the public debate on the projects happened in the print media, with the project owners keen on highlighting problems external to the project, which were threatening to delay completion or increase costs. For this reason, we conducted a systematic survey of the business press, which showed the attribution of problems by the industry to external factors such as government regulation and industrial relations. Our data source was the Factiva database, which comprises over 30,000 news and information sources, including the *Australian Financial Review*, *The Guardian*, *Reuters*, *The New York Times*, *The Wall Street Journal*, and *Dow Jones Newswire,* covering more than 22 million public and private companies. We searched the Factiva database for new reports published between 2010 and 2015 mentioning Australian oil and gas cost overruns and blowouts and found 65 reports. We scanned these reports, coded the commonly cited specific problem attributions, and categorized these into internal and external factors (Figure 1). High costs of doing business, a factor that refers to the cost of doing business in Australia more generally (Commission, 2014) were most frequently cited, with labor costs and availability also receiving attention. Consistent with the politicized nature of these projects, the complaints about labor availability were often linked to work immigration visas, which were mostly opposed by the unions due to the perceived threat to Australian workers (Ellem, 2014).

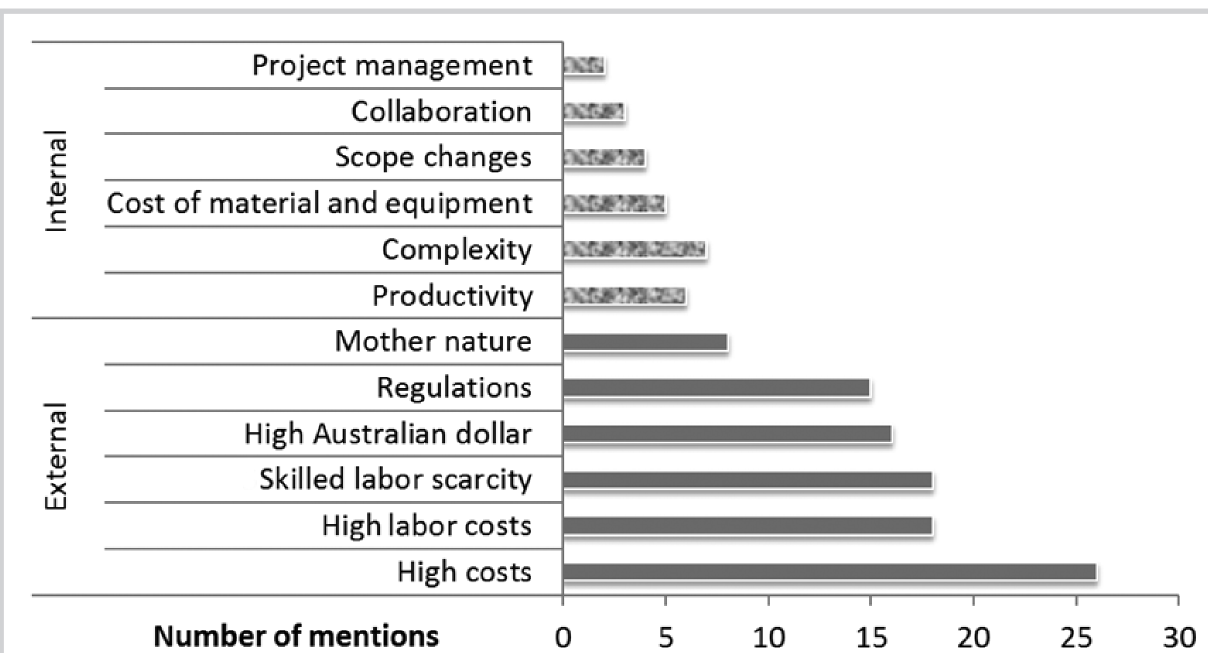

Figure 1: Reasons cited for oil and gas project overruns in the print media (2010–2015).

From a GCM perspective, an external problem focus from project owners can be seen as part of the megaproject garbage can in which there is a stream of problems, solutions, participants, and choice opportunities that are processed through the garbage can over time. At the outset these projects became decision-making situations where long-standing industry concerns about unionized labor and government regulations could be aired and framed as an obstruction to the business sublime of creating a world–first industry, However, what were the consequences of this problem stream entering the megaproject garbage can at the beginning of the project? Pinfield (1986) argues that these circumstances, where there are divergent agendas with problems being prioritized over others, are more likely to trigger garbage can processes. As described in the original Cohen et al. (1972) model, there may be a stream of potential solutions to these problems but also a limited amount of energy that participants can expend on the decision-making process to make choices.

In a simulation of the garbage can model under these assumptions, Cohen and colleagues show that problems are infrequently resolved and, as the demands on the system increase in the hierarchical decision-making structure most descriptive of megaprojects, the prospects for problem resolution fall further. Furthermore, Cohen et al. (1972) suggest a path dependency, where decision makers work on active problems with active choices and therefore '. . . decision-makers and problems tend to move together from choice to choice. Thus, one would expect decision-makers who have a feeling that they are working on the same problems in somewhat different contexts, mostly without results' (Cohen et al., 1972, p. 10). The garbage can model indicates that problems can persist without solutions, especially in the megaproject context of hierarchical decision making and increasing load in the system with the emergence of unforeseen complications and drive for speed in delivery, which are typical of these oil and gas projects (Floricel & Miller, 2001; Merrow, 2012; Miller & Hobbs, 2005; Olaniran et al., 2016).

In addition, in the megaproject environment of many firms working in a network of contractual relationships there is a feature of segmented generation of streams of solutions (Ford et al., 2014). In all cases with the Australian oil and gas megaprojects that are within our sample, the project owners—being the oil and gas companies—commenced the project with a systems integrator firm that would engineer, procure, and construct (EPC) the project on behalf of the owner (Olaniran, Love, Edwards, Olatunji, & Matthews, 2015). While this allows the owner to transfer risk to the EPC firm to make the project less risky for funding purposes, it also effectively divides the project into segmented packages delivered by different firms. This project delivery structure also reinforces the hierarchical decision-making structure that slows the matching of problems and solutions in the GCM.

In this study, we are particularly concerned with the divergent attention of megaproject owners and service companies within the project to focus on different problems. The GCM predicts that given the segmented organizing structure of oil and gas megaprojects there will be an accumulation of unresolved problems disconnected from solutions. With the locus of decisions existing primarily with the project owners (operators), we should be able to see differences in the types of problems identified by them compared with the service companies in the supply chain who are more structurally separated from these choices. This leads us to the first research proposition:

> *Proposition 1 (P1): The rank order of problems identified by service companies within megaprojects will be different from those of the project owners.*

Problem latency can result in delays later in the project when these unresolved problems finally emerge to disrupt the critical path of the project. Merrow (2012), in his survey of oil and gas megaprojects, finds that there is a relationship between aggressive scheduling and cost overruns. While the stakeholders in the investment community exert pressure on boards and executives to achieve faster project delivery, this actually slows delivery due to disputes and technical problems (Merrow, 2012). This observation is also consistent with GCM predictions, where increasing load in the decision-making system can slow the matching of problems and solutions. Problem latency will be evident through the relationship between problems identified by businesses and project performance measures. Following from Proposition 1, although there may be high-profile attention given to some problems that were dominant at the beginning of the project by project owners, there is a likelihood of the accumulation of latent problems throughout the project network, which have a bigger impact on project performance. Thus, Proposition 2 is stated as follows.

> *Proposition 2 (P2): Lower ranked internal project problems will be more closely related to poor project performance than the publicly visible external factors prioritized by project owners.*

To test these propositions we conducted a cross-sectional industry survey of megaproject-involved firms in the Australian oil and gas industry, which we describe next.

Methods

Survey and Variables

A survey instrument originally developed by the Cambridge Centre for Business Research (Cosh & Hughes, 2000, 2003; Cosh, Hughes, Bullock, & Milner, 2009; McCarthy, Oliver, & Verreynne, 2017) was adapted for use in the Australian oil and gas industry setting (Ford et al., 2014; Ford, Verreynne, & Steen, 2017). This adaptation was done through face-to-face interviews with experienced oil and gas managers and consultants to test for completeness and validity. The survey instrument was then piloted with a larger group of managers.

The purpose of the survey was twofold, namely (1) to understand the perceived problems facing firms in the oil and gas industry and (2) to understand the managerial practices that they employ to address these challenges. This approach allowed us to gain a snapshot of the perceptions of those firms that made up the industry supply chain—from owners/operators of the project through to construction firms and other businesses that supply specific components and expertise. Specifically, the survey asked firms several questions regarding their innovation activities, collaboration behaviors, and competitive environment. It also asked questions about factors that have caused firms difficulty in meeting business objectives in the past three years, such as "Given your firm's history in the last three years, which of the following factors have acted as a significant limitation or barrier on your ability to meet your business objectives?" Answers were collected via a five-point Likert scale (ranging from 1—insignificant limitation to 5—crucial limitation). The 24 items and their shortened variable names are shown in Table 1, pointing to a wide range of internal and external factors that affect projects. While some of these variables, such as access to overseas labor and high costs due to the strong Australian dollar, are specific to the research context, we note that these barriers are broadly in line with other studies of oil and gas projects (Merrow, 2012; Olaniran et al., 2015).

An additional dichotomous variable regarding budget overrun was created to support means testing and to be used as the dependent variable in logistic regression analyses. This variable is called 'budget exceeded,' and it takes the value of one if the firm answered that "exceeding budget and/or schedule in projects" is a significant or crucial limitation with regard to meeting business objectives (a 4 or a 5 on the Likert scale). It takes the value of zero if not. We used this variable as the measure of project performance, because being able to stay on budget is usually the main indicator of project success in the oil and gas industry where projects are commenced with sales agreements in place. The financial penalties for not having gas ready for shipment are severe so the construction budget tends to expand to avoid completion delays (Ford et al., 2014).

We conducted exploratory factor analysis (EFA) on the list of barriers to identify latent "barrier" constructs. Principle components analysis with Varimax rotation was used to validate the general view in the literature that megaproject constraints could be grouped into external and internal factors. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy achieved was 0.751, above the 0.7 suggested minimum (Field, 2009). Six separate factors were identified, however, only the first two factors explain enough variance to be considered in subsequent analyses (Table 2). The first factor contains nine items and accounts for most of the variance. The items in the factor include governmental regulations, including red tape and environmental compliance; social license to

	Variable	Description		Variable (cont'd)	Description (cont'd)
1	Risk sharing	Inequitable risk sharing in contractual relationships	13	Competition	Increasing competition
2	Meet incentive	Ability to meet incentive targets on contracts	14	Red tape	Government regulations and compliance (red tape)
3	Scope	Scope changes in projects	15	Lengthy approval	Lengthy project approval processes
4	Contractual disputes	Contractual disputes	16	Green tape	Environmental compliance (green-tape)
5	High cost	High cost of doing business in Australia (strong A$)	17	Regulatory uncertainty	Environmental regulatory uncertainty
6	Poor productivity	Poor labor productivity	18	Current bottlenecks	Current infrastructure bottlenecks
7	Skilled labor	Skilled labor	19	Future bottlenecks	Future infrastructure availability uncertainty (ports, rails, etc.)
8	Management skills	Management skills	20	Social license to operate	Social license to operate (land access, community relations)
9	Marketing skills	Marketing and sales skills	21	Overseas labor	Access to overseas labor
10	Technological learning	Learning about technology	22	Immigration processes	Immigration processes
11	Technology acquisition	Acquisition of technology	23	Labor reporting	Mandatory labor reporting and disclosure
12	New technology	Implementing and using new technology	24	Changes to allowances	Changes to employee allowances and concessions

*Shown in order of appearance in the survey instrument

Table 1: The 24 barriers to meeting business objectives.*

Factor Name	External Constraints	Internal Constraints
Variance explained	**38.6%**	**12.6%**
Cronbach's alpha	**0.90**	**0.84**
Immigration processes	0.825	
Overseas labor	0.818	
Green tape	0.702	
High cost	0.677	
Regulatory uncertainty	0.673	
Poor productivity	0.623	
Red tape	0.611	
Social license to operate	0.584	
Labor reporting	0.504	
Contractual disputes		0.794
New technology		0.752
Meet incentive		0.714
Risk sharing		0.714
Scope		0.491

Table 2: Exploratory factor analysis results.

	Sample (n)
Operators	10
Service	44
Total	54

Table 3: Megaproject firms involved in the sample.

operate; macroeconomic factors, such as increased project costs due to the strong Australian dollar; and labor-related issues, such as immigration, productivity, and compliance reporting. These factors can be considered '*external* constraints' that megaproject firms face.

The second factor that emerged contains all of the contract-related items in the survey: contractual disputes, incentives, risk sharing, and scope changes and also includes troubles implementing technology. We called this factor '*internal constraints.*' No items had loadings of below 0.49.

Sample

The data were obtained through tele phone interviews with oil and gas executives from a range of firms operating in the Australian oil and gas industry. The Australian Petroleum Production and Exploration Association (APPEA) was the source of respondents. APPEA is the peak industry body for the Australian oil and gas industry who supported the survey by writing to its membership about the survey. With this support we were able to achieve a 30% response rate, which reflects a relatively high response rate when targeting executives (Baruch, 1999). The delineation is made between oil and gas operators (e.g., Shell, Chevron) and service (supply chain) firms (e.g., Schlumberger, Bechtel) in line with industry parlance (Perrons & Donnelly, 2012). Not all APPEA firms are involved in megaprojects, so we asked whether firms were involved in any of the industry oil and gas megaprojects and defined these as having capital budgets exceeding US$1 billion, giving several named examples of well-known projects for reference. Using this question, we identified a set of 54 megaproject-involved firms (Table 3). This is the sample used in the analyses contained in this article.

Data Analysis

To explore the nature of internal barriers leading to potential cost overrun outcomes, we undertook four analyses, which are discussed next. Analysis was conducted using SPSS version 22.

We first ranked the list of barriers presented in Table 1 by calculating the mean score for each of the 24 items. The purpose of this exercise was to understand where firms ranked internal project constraints relative to a host of other barriers, which ostensibly lead to cost and overruns including government regulations and low productivity (Chambers & Kitney, 2011).

Logistic regression, using maximum likelihood estimating techniques to produce odds ratios that describe the relationship between the independent variables and the dichotomous outcome variable, was employed to understand the predictive power of various constraints on the 'budget exceeded' performance variable. Odds ratios are interpreted similar to ordinary least squares regression: one unit increase in the predictor results in an increased or decreased likelihood that outcome will be achieved, and that increase (or decrease) is equal to the odds ratio. Probabilities and odds have a simple relationship. Odds (O) are the probability (P) of an event over the probability of non-event as summarized in Equation 1.

$$o = \frac{p}{(1-p)} \text{ and } p = \frac{o}{(1+o)} \qquad (1)$$

Robustness Testing

Several tests were used to ensure the validity and reliability of our results. First, we used the Mann–Whitney U test of means, which is a non-parametric test for comparing continuous or count variables across two groups based on mean rank scores (Field, 2009) to test for response bias. While we did not consider it to be a concern because the sample frame included firms in the leading industry trade group in Australia, which covers most of the firms in the industry (APPEA, 2012), we did perform additional analysis. We assumed that late responders will resemble the characteristics of non-responders, following Armstrong and Overton (1977). We split the sample into early and late respondents demarcated by the halfway mark of the collection campaign (De Villiers & Van Staden, 2010) and tested differences using Mann–Whitney and cross tabulation using Pearson exact test (for binary variables). Only one variable, 'skilled labor,' showed any bias ($p < 0.05$, two-tailed). Therefore, we conclude that non-response bias was not an issue in our analyses.

We also tested for common method bias because our data came from single respondent surveys. We undertook the Harmon single factor test (Leiponen & Helfat, 2010; Podsakoff & Organ, 1986) for this purpose. This test uses EFA to identify whether a single factor accounts for the result. We applied this test to the variables used in the logistic regression analyses in particular. In Model 1, we found that three factors emerged and the first factor accounted for less than 48% of the variance. In Model 2, two distinct factors emerged and the first accounted for less than 47% of the variance. It is reassuring that at least two factors emerged, particularly because these models are parsimonious and thus the test is overly conservative in such cases (Podsakoff & Organ, 1986).

To test for multicollinearity we took the same variables used in the logistic regression and subjected them to linear regression and inspected the collinearity diagnostics. This analysis revealed that both Models 1 and 2 were free from multicollinearity. The value inflation factors (VIF) were no greater than 3 and the average was 1.8 for both, indicating that multicollinearity is not a concern (Field, 2009).

Results

The mean rank order of the "barriers to meeting business objectives" for megaproject-involved firms is shown in Figure 2. This figure demonstrates the

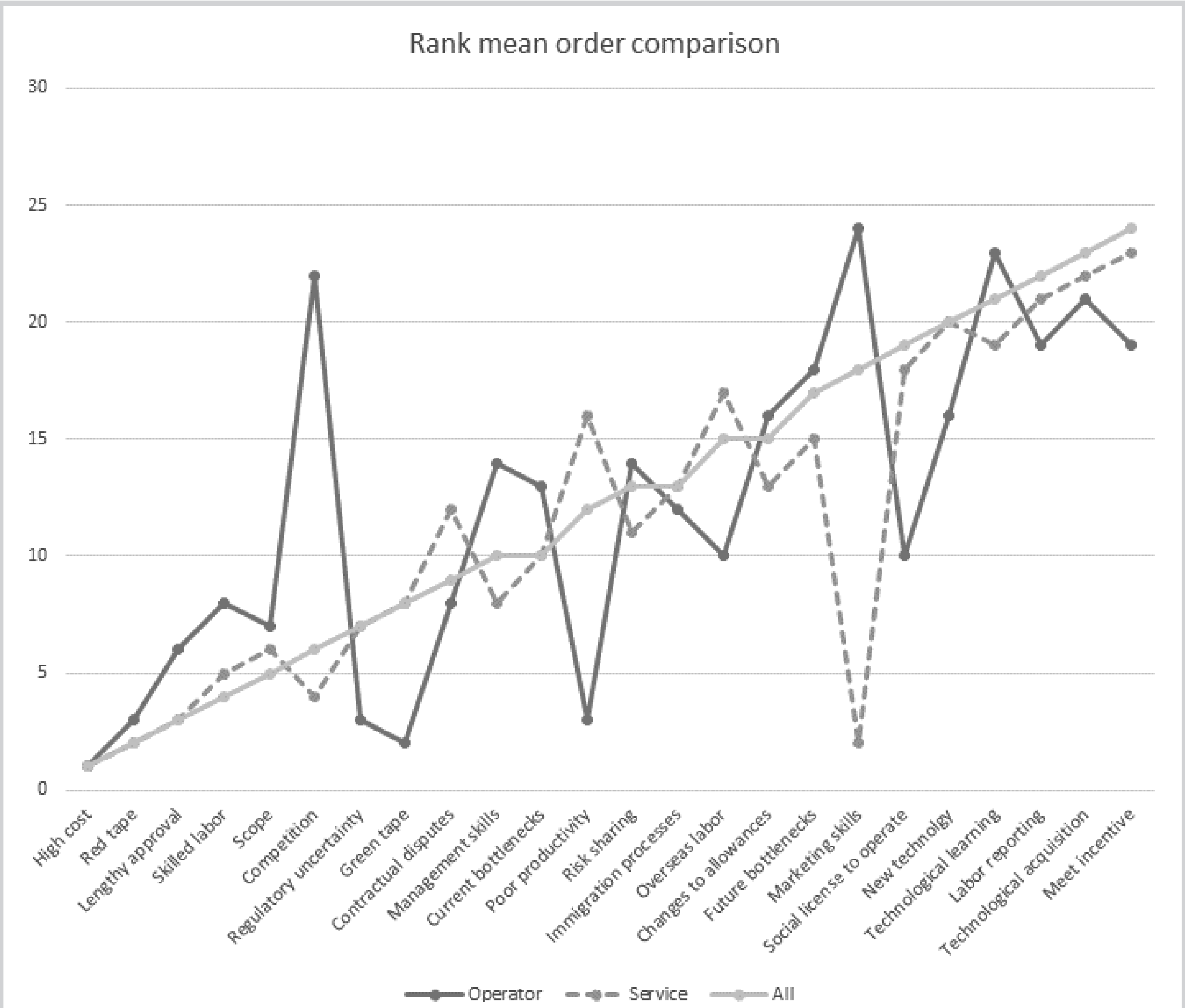

Figure 2: Mean rank of "barrier" Likert scores comparing operator ranking with service firm ranking.

differences in the rank of the "barriers" between the oil and gas operators and the service companies delivering the project. It reveals, for instance, that the high costs associated with the strong Australian dollar are the primary concern of the whole sample as well as for operators and service firms individually. However, the divergences between the solid line (operators) and dashed line (service companies) are noticeable in several places. Consistent with the media coverage data shown in Figure 1, operators rank prominent government issues around regulation and environmental compliance as important barriers. Poor productivity is another barrier that the operators rank highly compared with the service firms and this relates to union disputes over workplace flexibility. In terms of internally related issues: scope changes rank eighth and sixth, respectively, whereas sharing of risk ranks 15th and 11th, respectively, and meeting incentive targets ranks 20th and 24th, respectively. This observed divergence in perception of barriers to project performance is supportive of the thesis behind the first research proposition on the existence of garbage can processes in the megaproject environment.

Mann–Whitney test of means difference was also used to test if differences for 24 of the "barriers" between the group having significant or crucial challenges with budget and scope ('budget exceeded' = 1) and the group that did not ('budget exceeded' = 0). These results are shown in Table 4 and indicate that the only significant differences ($p < 0.10$, 1-tail) between these groups are scope changes and contractual disputes. The estimated size is moderate, with 'scope' at 0.30 and weaker with contractual disputes at 0.19. The rest of the items fail to meet standard levels of significance.

	Median	Mann–Whitney U	Z	Exact Sig. (1-tailed)	Effect Size (r)
Risk sharing	2.00	8.00	−0.89	0.23	0.12
Meet incentive	1.00	12.00	0.00	0.60	0.00
Scope*	3.00	2.00	−2.22	0.02	0.30
Contractual disputes+	2.00	6.00	−1.38	0.07	0.19
High cost	3.00	11.50	−0.11	0.50	0.02
Poor productivity	1.50	8.50	−0.78	0.26	0.11
Skilled labor	2.50	8.00	−0.88	0.22	0.12
Management skills	2.00	7.50	−1.02	0.23	0.14
Marketing skills	2.00	8.00	−1.22	0.33	0.17
Technological learning	1.00	6.00	−1.58	0.17	0.22
Technology acquisition	1.00	10.00	−0.52	0.33	0.07
New technology	1.00	8.00	−0.91	0.29	0.12
Competition	2.50	8.50	−0.85	0.36	0.12
Red tape	3.00	7.50	−1.00	0.20	0.14
Lengthy approval	3.00	7.00	−1.09	0.20	0.15
Green tape	2.00	10.00	−0.44	0.36	0.06
Regulatory uncertainty	2.00	7.50	−1.01	0.14	0.14
Current bottlenecks	2.00	11.00	−0.22	0.43	0.03
Future bottlenecks	1.00	12.00	0.00	0.52	0.00
Social license to operate	1.00	8.00	−0.89	0.26	0.12
Overseas labor	2.00	10.00	−0.46	0.46	0.06
Immigration processes	2.00	7.50	−0.99	0.23	0.13
Labor reporting	1.00	9.00	−0.71	0.40	0.10
Changes to allowances	2.00	12.00	0.00	0.60	0.00

+ $P < 0.1$, *$P < 0.05$

Table 4: Mann–Whitney test of mean differences of all barriers against 'budget exceeded.'

To further investigate this relationship we undertook logistic regression analysis. The intent of this analysis is to go beyond the simple fact that internal project management and exceeding budget are related. Rather we wanted to see if internal project constraints can predict whether megaproject-involved firms are exceeding budget compared with high-profile external problems. To do this, a dichotomous dependent variable called 'budget exceeded' was used as the dependent variable in the logistic regression. This variable takes the value of 1 if the firm has "significant" or "crucial" issues exceeding budget and/or schedule. The remaining five items in the internal constraint factor are then used as independent variables. As control variables, the raw variable 'high cost' is used because it is the number one complaint of the sample and is an obvious potential driver of budget overruns. In addition, log size (number of employees) is used as a control (Table 5).

The logistic regression of internal constraints reveals that scope, contractual disputes, and implementing new technology significantly predicts having difficulties with exceeding budget. Strictly speaking, with a one increment increase in scope toward becoming a crucial barrier (toward 5 on the Likert scale), the odds of 'budget exceeded' are increased by 3.5 (an approximate 77% probability that 'budget exceeded' will equal 1). In other words, with increased scope challenges, there is a 77% chance that a firm will have "significant" or "crucial" issues exceeding budget and/or schedule. It is worth noting here, the relationship between odds and probabilities is *probability = odds/(1+odds)*. Similarly, a one unit increase in 'contractual disputes' means the odds of 'budget exceeded' increase by 2.4 (an approximate 70% probability that 'budget exceeded' will equal 1). Interestingly, RISK SHARING shows a negative relationship; that is, it increases by one unit, the odds of 'budget exceeded' *decrease* by 0.4 (only about a 29% probability that 'budget exceeded' will equal 1). 'Meet incentive' shows no significant relationship. Importantly, nether of the control variables (high cost or log size) are significant in the model, implying that scope, contractual disputes, and implementing new technology are more powerful predictors of 'budget exceeded.'

Whereas the first model controlled for 'high cost' (exchange rate effect) alone, the model shown in Table 6 controls for the entire external constraint factor identified from the exploratory factor analysis. Here, the relationship for scope increases to odds of 4.2 (a one unit means approximately that an 80% probability that 'budget exceeded' will be achieved). Contractual disputes do not achieve significance. Risk sharing has a slightly lower albeit still negative

Dependent Variable: 'Budget Exceeded'				
Variables	**B**	**S. E.**	**sig**	**Exp(B)**
Risk sharing	−0.93	0.63	+	0.40
Meet incentive	0.10	0.65		1.10
Scope	1.26	0.59	*	3.52
Contractual disputes	0.87	0.67	+	2.39
New technology	0.81	0.60	+	2.25
High cost	0.34	0.42		1.40
Log size	0.28	0.62		1.32
Constant	−8.55	2.88	**	0.00
Chi-square	25.97			
Sig.	0.00			
−2 Log likelihood	31.24			
Nagelkerke R Square	0.584			
+(p < 0.1), *(p < 0.05), **(p < 0.01), ***(p < 0.001)				

Table 5: Model 1—Logistic regression controlling for 'high cost' and business size.

Dependent Variable: 'Budget Exceeded'				
Variables	**B**	**S.E.**	**sig**	**Exp(B)**
Risk sharing	−1.11	0.69	+	0.33
Meet incentives	0.03	0.65		1.03
Scope	1.43	0.64	*	4.17
Contractual disputes	0.75	0.66		2.12
New technology	0.82	0.58	+	2.26
External constraints	0.95	0.63		2.59
Log size	0.30	0.63		1.35
Constant	−9.60	3.13	**	0.00
Chi-square	27.82			
Sig.	0.00			
−2 Log likelihood	29.39			
Nagelkerke R Square	0.616			
+(p < 0.1), *(p < 0.05), **(p < 0.01)				

Table 6: Model 2—Logistic regression controlling for 'external constraints.

relationship to 'budget exceeded.' Implementing new technology is still significant and positive at similar levels to Model 1. Importantly, in this model the 'external constraints' factor is not associated with budget overrun. Comparing these results to the public debate on project performance in the print media (see Figure 1), we can see that, although scope change is most significantly related to budget overrun based on the data analysis, it ranks tenth in public media prominence and seventh by operators in the survey ranking of project performance barriers.

Discussion

We find differences between the position in the supply chain and the attribution of problems from the ranking data. Compared with the service company subset, operators are more likely to focus attention on high-profile external problems such as environmental regulation (so called 'green tape'), poor labor productivity, access to overseas labor, and slow governmental processes. Consistent with Proposition 1 and the survey of media articles shown in Figure 1, these are external factors in the public domain, where the project is a contested symbol of economic progress in the face of government regulation. Tests for statistical significance between differences in the rankings showed that the internal factors of scope change and contractual disputes were most different between the operator and service company subsets.

When these cited problems (barriers to meeting business objectives) were regressed against the budget overrun dependent variable, we find that only the internal factor 'scope changes' is significant at the $p < 0.05$ level, whereas problems with new technology are significant at the $p < 0.1$ level. High-profile external factors are not significantly related to project cost overruns when these internal barrier items are included in the model. The latency of the internal constraint factor is important because it emerges from the exploratory factor analysis that reveals underlying relationships between variables.

The results are congruent with the thesis behind Proposition 2, where we advanced the notion that less publicly prominent problems, which turn out to be internal project management issues, would indeed be associated with poor project performance. Scope change usually becomes an issue when the project needs to deviate from the original plan (Petit & Hobbs, 2010). These are responses to situations or unexpected events that have materialized in the course of the project and are reactive in nature (Hällgren & Maaninen-Olsson, 2005; Söderholm, 2008).

Our findings are different from the study by Merrow (1988) who was able to attribute megaproject underperformance to external factors, such as labor shortages and government regulation. However, that study of 47 megaprojects used public-domain information such as press releases and company reports to generate the data for analysis. Our study casts doubt on these results, because this information has a different purpose from mere 'reporting,' and the political and stakeholder maneuvering in these documents cannot be brushed aside (White & Hanson, 2002). Any study based on this public information is likely to accentuate the more symbolic external factors cited by project owners and major stakeholders in meeting project performance objectives.

While this study is not a robust test of the garbage can model, these findings are certainly consistent with what the GCM would predict under conditions that are a consequence of how these oil and gas megaprojects in our study are structured into segmented work packages. These garbage can processes are exacerbated by the symbolic character of megaprojects, which leads to divergent prioritization of problems for the organizations that are associated with the project from the outset. This affects problem solving in response to emergent situations and has material consequences for project performance. Energy and attention are diverted to address external issues, allowing latent problem accumulation within the internal management of the project.

The project management literature contains many studies that survey an industry or a location to discover success factors or barriers for successful project delivery. Although these studies may be valid for smaller projects, the finding that different businesses within the project have divergent prioritization of problems casts doubt on these studies when large projects are involved. Surveying the project owner will reveal a particular problem or success factor set that may be different from other businesses within the supply chain. Similarly, megaproject studies that use public information, such as reports and media releases, are also likely to miss latent problems hidden within the megaproject 'garbage can.' This has practitioner implications for performance reviews of megaprojects. Owners of megaprojects routinely conduct 'lessons learned,' but our research shows that these reviews must include inputs from firms in the supply chain to understand the complexity of problem and solution streams in order to learn how to better deal with them.

GCM processes can occur in megaprojects and it is certainly the case that megaprojects have a history of producing a very wide variety of outcomes in terms of budget and time to completion (Flyvbjerg, 2005). Nonetheless, evidence is emerging of alternative megaproject delivery models, which are more capable of encouraging coherent problem solving and producing more consistent delivery outcomes. For example, Davies and colleagues describe the role of the T Five agreement, which provided an overarching collaborative framework for the governance of the Heathrow Terminal Five project. This project was ground breaking in terms of on-time delivery and safety and was noteworthy for its rapid response to emergent problems (Davies, Gann, & Douglas, 2009). Merrow (2012,

p. 42) also notes the rarity of functional integration in oil and gas megaprojects where ". . . reservoir functions, facilities engineers, and drillers work in harmony and mutual comprehension." He also suggests that integrative management is more common in smaller projects because ". . . each function and sub-function has not (yet) evolved into an organization with turf to defend and walls to build."

A possible insight into why these megaproject integrating agreements and collaborative organizing models might work can be found in a study of the publishing industry, where GCM processes resulted in surprisingly uniform outputs due to strong institutional forces around the decision environment that placed a 'lid on the garbage can' (Levitt & Nass, 1989). In contrast to Thompson's (1967) model where organizations with uncertain technological cores should buffer that core from the environment, megaprojects should seek to create collaborative institutions like the T Five agreement to avoid problem latency (Levitt & Nass, 1989). This progress in megaproject delivery models is consistent with Padgett's (1980) practical findings from garbage can simulation studies where the most efficient decision outcomes resulted from structural organizational design and appropriate personnel selection for management roles rather than reactive management to problems as they occur.

There are some limitations to this study. The most obvious one is that garbage can processes are an unobserved variable due to the nature of the survey, which doesn't capture processes. As was mentioned earlier, this article is not a true test of the GCM in megaprojects. While we develop propositions that are grounded in the GCM and we find that the results are supportive of these propositions, this is different from a true test of the model (Eisenhardt & Zbaracki, 1992; Lomi & Harrison, 2012). Another limitation is that our setting of the oil and gas industry has an unusual level of technological uncertainty due to the world-first construction of unconventional gas to LNG facilities. This would accentuate GCM processes, which may not be as dominant in projects with lower levels of technological uncertainty or shorter duration (Cohen et al., 2012).

It has been over 40 years since Cohen et al. (1972) first articulated the GCM and the testing of the model in a simple computer simulation in FORTRAN. Since that time, the capacity for researchers to simulate complex systems has increased exponentially and agent-based modeling is now a well-established research methodology that is applied across a variety of disciplines, including business and economics (Bonabeau, 2002; Holland, 1995). While it would be possible to experiment with parameters in the older GCM to replicate different forms of megaprojects, agent-based modeling (ABM) offers a vast literature in simulation methods to study multi-agent processes, such as the coordination and completion of a megaproject and different conditions. One of the challenges of megaproject research is that studies are frequently based on small samples or single case studies. ABM creates an opportunity to change starting conditions such as contracting relationships, information flow, decision flexibility, and compare these with observed outcomes. This type of study is not constrained by access to data, which is a challenge in current research (Jann, 2015; Lomi & Harrison, 2012). Cohen, March, and Olsen's pioneering simulation work, using very basic computers, offers a direction in megaproject research that has thus far been overlooked.

Conclusions

This article offers a different explanation of megaproject performance based on the garbage can theory of organizational decisions. In our case of oil and gas megaprojects in Australia, public discussion of symbolic external issues, such as government regulation and industrial relations, is also reflected in our survey of the large oil and gas companies who own the project, but these issues are not the main performance barriers for the service companies that are constructing the project. Exploratory factor analysis reveals a latent group of internal problems, especially scope changes and technology, which are more influential in determining cost overruns. This latency is consistent with the existence of garbage can processes within megaprojects.

The GCM endeavors to model the decision-making and problem-solving processes of organizations in a way that is more grounded in the dynamics of organizations. Rather than assuming simple and linear decision processes, it adopts a more sociological view that is sympathetic to the complex, pressured, and contested decision-making environment of megaprojects. Over the course of several years of megaproject research, we have conducted nearly 100 hours of interviews with executive managers and, while they are highly skilled professionals, they also make it clear that they are operating in a complex organizational context where the best course of action is often only obvious in hindsight. We also saw instances where problems emerged in the project but these were left unsolved due to other priorities. In the words of one manager: "We kept kicking the can down the road." This reality is certainly consistent with a GCM view of the organization. While our application of it to a megaproject setting might seem controversial when compared with the normative project management literature, which focuses on an optimistic view of front-end design and planning (Davies, 2014; Olaniran et al., 2016; Williams & Samset, 2010), it does offer alternative explanations for the recurrent problems in megaproject performance and provides interesting prospects for future research.

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References

Armstrong, J. S., & Overton, T. S. (1977). Estimating nonresponse bias in mail surveys. *Journal of Marketing Research*, 396–402.

Australian Broadcasting Corporation (ABC). (2013). *Red tape limits oil and gas industry productivity.* Retrieved from http://www.abc.net.au/news/2013-05-27/red-tape-limiting-oil-and-gas-industry-productivity/4714308

Australian Petroleum Production and Exploration Association (APPEA). (2012). *About APPEA.* Retrieved from http://www.appea.com.au/about-appea/

Baruch, Y. (1999). Response rate in academic studies: A comparative analysis. *Human Relations, 52*(4), 421–438.

Baum, J. A., & Ingram, P. (2002). Interorganizational learning and network organization: Toward a behavioral theory of the interfirm. *The economics of choice, change, and organization: Essays in memory of Richard M. Cyert*, 191–218. Cheltenham, UK: Edward Elgar

Bonabeau, E. (2002). Agent-based modeling: Methods and techniques for simulating human systems. *Proceedings of the National Academy of Sciences, 99*(suppl 3), 7280–7287.

Brady, T., Davies, A., & Nightingale, P. (2012). Dealing with uncertainty in complex projects: Revisiting Klein and Meckling. *International Journal of Managing Projects in Business, 5*(4), 718–736.

Brookes, N., Sage, D., Dainty, A., Locatelli, G., & Whyte, J. (2017). An island of constancy in a sea of change: Rethinking project temporalities with long-term megaprojects. *International Journal of Project Management, 35*(7), 1213–1224.

Chambers, M. (2013). *LNG projects face more delays, blowouts: IEA*. Retrieved from http://www.theaustralian.com.au/business/mining-energy/lng-projects-face-more-delays-blowouts-iea/story-e6frg9df-1226667134309

Chambers, M., & Kitney, D. (2011). Resource mega-projects hit by $8bn cost blowout. *The Australian,* January 10.

Cohen, M. D., March, J. G., & Olsen, J. P. (1972). A garbage can model of organizational choice. *Administrative Science Quarterly*, *17(1),* 125.

Cohen, M. D., March, J. G., & Olsen, J. P. (2012). "A garbage can model" at forty: A solution that still attracts problems. *The garbage can model of organizational choice: Looking forward at forty* (pp. 19–30). Bingley, West Yorkshire, England: Emerald Group Publishing Limited.

Productivity Commission. (2014). *Relative costs of doing business in Australia: Retail trade: Productivity Commission Research Report*, September. Canberra, Australia: Productivity Commission.

Cosh, A., & Hughes, A. (2000). *British enterprise in transition: Growth, innovation and public policy in the small and medium sized enterprise sector 1994–1999.* Technical Report. Cambridge, UK: ESRC Centre for Business Research.

Cosh, A., & Hughes, A. (2003). *Enterprise challenged: Policy and performance in the British SME sector 1999–2002.* Cambridge, UK: ESRC Centre for Business Research.

Cosh, A., Hughes, A., Bullock, A., & Milner, I. (2009). *SME finance and innovation in the current economic crisis.* Centre for Business Research, Retrieved from http://www. cbr. cam. ac. uk/pdf/crcr_econcrisis. pdf.

Cyert, R. M., & March, J. G. (1963). *A behavioral theory of the firm*. Englewood Cliffs, NJ: Prentice Hall.

Davies, A. (2014). Innovation and project management, In: Dodgson, M., Gann, D., Phillips, N. (Eds.), *The Oxford handbook of innovation* (pp. 36). Oxford, UK: Oxford University Press.

Davies, A., Dodgson, M., & Gann, D. (2016). Dynamic capabilities in complex projects: The case of London Heathrow Terminal 5. *Project Management Journal, 47*(2), 26–46.

Davies, A., Gann, D., & Douglas, T. (2009). Innovation in megaprojects: Systems integration at London Heathrow Terminal 5. *California Management Review, 51*(2), 101–125.

De Villiers, C., & Van Staden, C. J. (2010). Shareholders' requirements for corporate environmental disclosures: A cross country comparison. *The British Accounting Review, 42*(4), 227–240.

Eisenhardt, K. M., & Zbaracki, M. J. (1992). Strategic decision making. *Strategic Management Journal, 13*(S2), 17–37.

Ellem, B. (2014). *What is happening on Chevron's Gorgon project?* University of Sydney, Business School, Sydney, Australia.

Ernst and Young. (2014). *Adapt to win: How Australian oil and gas companies improve productivity in challenging times*. Ernst and Young: Australia.

Field, A. (2009). *Discovering statistics using SPSS.* Thousand Oaks, CA: Sage Publications.

Floricel, S., & Miller, R. (2001). Strategizing for anticipated risks and turbulence in large-scale engineering projects. *International Journal of Project Management, 19*(8), 445–455.

Flyvbjerg, B. (2005). Design by deception: The politics of megaproject approval. *Harvard Design Magazine*, 22, Spring/Summer, 50–59.

Flyvbjerg, B. (2012). Why mass media matter and how to work with them: Phronesis and megaprojects, in Flyvbjerg, B., Landman, T., Schram, S., eds., *Real social science: Applied phronesis* (pp. 95–121). Cambridge, UK: Cambridge University Press.

Flyvbjerg, B. (2014). What you should know about megaprojects and why: An overview. *Project Management Journal, 45*(2), 6–19.

Flyvbjerg, B., Bruzelius, N., & Rothengatter, W. (2003). *Megaprojects and risk: An anatomy of ambition.* Cambridge, UK: Cambridge University Press.

Flyvbjerg, B., Garbuio, M., & Lovallo, D. (2009). Delusion and deception in large infrastructure projects: Two models for explaining and preventing executive disaster. *California Management Review, 51*(2), 170–194.

Ford, J. A., Steen, J., & Verreynne, M.-L. (2014). How environmental regulations affect innovation in the Australian oil and gas industry: Going beyond the Porter Hypothesis. *Journal of Cleaner Production, 84*, 204–213.

Ford, J. A., Verreynne, M.-L., & Steen, J. (2017). Limits to networking capabilities: Relationship trade-offs and innovation. *Industrial Marketing Management*. In Press.

Frick, K. T. (2008). The cost of the technological sublime: Daring ingenuity and the new San Francisco–Oakland Bay Bridge. In Priemus, H., Flyvbjerg, B., van Wee, B., eds., *Decision-making on mega-projects: Cost benefit analysis, planning, and innovation* (pp. 239–262). Northampton, MA: Edward Elgar.

Hällgren, M., & Maaninen-Olsson, E. (2005). Deviations, ambiguity and uncertainty in a project-intensive organization. *Project Management Journal, 36*(3), 17–26.

Hellgren, B., & Stjernberg, T. (1995). Design and implementation in major investments—A project network approach. *Scandinavian Journal of Management, 11*(4), 377–394.

Holland, J. (1995). *Hidden order: How adaptation builds complexity*. New York, NY: Basic Books.

Hurst, D. (2012). Primier pledges to fast track $4000 scholarship scheme. *Brisbane Times* (February 12).

Jann, W. (2015). Michael D. Cohen, James G. March, and Johan P. Olsen, A garbage can model of organizational choice. In *The Oxford handbook of classics in public policy and administration*. Oxford, UK: Oxford University Press.

Kahneman, D. (2012). *Thinking fast and slow.* New York, NY: Farrar, Straus and Giroux.

Law, J. (1992). Notes on the theory of the actor-network: Ordering, strategy, and heterogeneity. *Systemic Practice and Action Research, 5*(4), 379–393.

Leiponen, A., & Helfat, C. E. (2010). Innovation objectives, knowledge sources, and the benefits of breadth. *Strategic Management Journal, 31*(2), 224–236.

Lenfle, S., & Loch, C. (2010). Lost roots: How project management came to emphasize control over flexibility and novelty. *California Management Review, 53*(1), 32–55.

Levitt, B., & Nass, C. (1989). The lid on the garbage can: Institutional constraints on decision making in the technical core of college-text publishers. *Administrative Science Quarterly*, 190–207.

Lomi, A., & Harrison, J. R. (2012). *The garbage can model of organizational choice: Looking forward at forty* (pp. 3–17). Bingley, West Yorkshire, England: Emerald Group Publishing Limited.

Magjuka, R. (1988). Garbage can theory of decision making: A review. *Research in the Sociology of Organizations, 6*, 225–259.

Masuch, M., & LaPotin, P. (1989). Beyond garbage cans: An Al model of organizational choice. *Administrative Science Quarterly*, 38–67.

Maylor, H. R., Turner, N. W., & Murray-Webster, R. (2013). How hard can it be? Actively managing complexity in technology projects. *Research-Technology Management, 56*(4), 45–51.

McCarthy, S., Oliver, B., & Verreynne, M.-L. (2017). Bank financing and credit rationing of Australian SMEs. *Australian Journal of Management, 42*(1), 58–85.

Merrow, E. W. (1988). *Understanding the outcomes of megaprojects*. Santa Monica, CA: RAND.

Merrow, E. W. (2012). Oil and gas industry megaprojects: Our recent track record. *Oil and Gas Facilities, 1*(02), 38–42.

Miller, R., & Hobbs, J. B. (2005). Governance regimes for large complex projects. *Project Management Journal, 36*(3), 42–50.

Molloy, E., & Chetty, T. (2015). The rocky road to legacy: Lessons from the 2010 FIFA World Cup South Africa stadium program. *Project Management Journal, 46*(3), 88–107.

Olaniran, O., Love, P., Edwards, D., Olatunji, O., & Matthews, J. (2016). Chaos theory: Implications for cost overrun research in hydrocarbon megaprojects. *Journal of Construction Engineering and Management, 143*(2), 05016020.

Olaniran, O. J., Love, P. E., Edwards, D., Olatunji, O. A., & Matthews, J. (2015). Cost overruns in hydrocarbon megaprojects: A critical review and implications for research. *Project Management Journal, 46*(6), 126–138.

Padgett, J. F. (1980). Managing garbage can hierarchies. *Administrative Science Quarterly*, 583–604.

Parker, S. K., & Skitmore, M. (2005). Project management turnover: Causes and effects on project performance. *International Journal of Project Management, 23*(3), 205–214.

Perrons, R. K., & Donnelly, J. (2012). Who drives E&P innovation? *Journal of Petroleum Technology, 64*(12), 62–72.

Perrow, C. (1977). Ambiguity and choice in organization. *Contemporary Sociology: A Journal of Reviews, 63*, 294–298.

Petit, Y., & Hobbs, B. (2010). Project portfolios in dynamic environments: Sources of uncertainty and sensing mechanisms. *Project Management Journal, 41*(4), 46–58.

Pinfield, L. T. (1986). A field evaluation of perspectives on organizational decision making. *Administrative Science Quarterly*, 365–388.

Pinto, J. K. (2000). Understanding the role of politics in successful project management. *International Journal of Project Management, 18*(2), 85–91.

Podsakoff, P. M., & Organ, D. W. (1986). Self-reports in organizational research: Problems and prospects. *Journal of Management, 12*(4), 531–544.

Sager, F., & Rielle, Y. (2013). Sorting through the garbage can: Under what conditions do governments adopt policy programs? *Policy Sciences, 46*(1), 1–21.

Saint-Macary, J., & Ika, L. A. (2015). Atypical perspectives on project management: Moving beyond the rational, to the political and the psychosocial. *International Journal of Project Organisation and Management, 7*(3), 236–250.

Söderholm, A. (2008). Project management of unexpected events. *International Journal of Project Management, 26*(1), 80–86.

Steen, J., Coopmans, C., & Whyte, J. (2006). Structure and agency? Actor-network theory and strategic organization. *Strategic Organization, 4*(3), 303–312.

Steen, J., & Kastelle, T. (2012). Thinking, fast and slow: Great for practitioners but not so great for academics. *Prometheus, 30*(4), 465–467.

Stinchcombe, A. L., & Heimer, C. A. (1985). *Organization theory and project management: Administering uncertainty in Norwegian offshore oil*. Oxford, UK: Oxford University Press.

Thompson, J. (1967). *1967 Organizations in action*. New York, NY: McGraw-Hill.

van Marrewijk, A., Ybema, S., Smits, K., Clegg, S., & Pitsis, T. (2016). Clash of the titans: Temporal organizing and collaborative dynamics in the Panama Canal megaproject. *Organization Studies, 37*(12), 1745–1769.

White, R., & Hanson, D. (2002). Corporate self, corporate reputation and corporate annual reports: Re-enrolling Goffman. *Scandinavian Journal of Management, 18*(3), 285–301.

Williams, T., & Samset, K. (2010). Issues in front-end decision making on projects. *Project Management Journal, 41*(2), 38–49.

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