Maximizing strategic value from megaprojects: The influence of information-feed on decision-making by the project manager

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Maximising Strategic Value from Megaprojects: The Influence of Information-Feed on Decision-making by the Project Manager

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Abstract

Large projects are notorious for erosion of value during execution. Decisions made by project managers have a significant impact on the strategic value of the asset delivered, and those decisions depend on the information feed on which they are based. This study uses theories of organizational behaviour, decision-making and program management to investigate the impact of information feed used by project managers on the strategic value delivered by mega projects in the oil&gas industry. A global survey of 69 managers of mega-projects was conducted. Results showed that information feed to project managers significantly influences the strategic value created by megaprojects. Also some moderating effects of contextual factors on this relationship were found. The contextual factors that influenced project manager decision-making relate to what they perceived to be Senior Management drivers for their projects. However the hypothesised moderating influence of project manager experience on decision-making was not found – an interesting observation. It was found that the extent to which project managers feel in control should influence the scope and quality of information-feed that should be sought. Four risk areas were observed as significant to long-term value creation from megaprojects: government relations; host community relations; contract management and procurement; and the influence of multi-location execution.

Key words: Megaprojects, program management, strategic value, decisions

Introduction

Megaprojects are programs that integrate strategically-aligned projects into one very large project (Miller & Lessard, 2000; Jaafari, 2004), and are used by the oil&gas industry to deliver key strategic assets. In recent years, most of the large oil&gas companies have been re-investing much of their annual profits (up to 90% in some cases) as capital expenditure , (Royal Dutch Shell, 2008; ExxonMobil, 2007; BP, 2007). Megaprojects typically do not leave the socio-economic life of communities impacted by their implementation the same. The financial and social stakes on megaprojects are so large they can endanger the survival of corporations and threaten the economic stability of the countries involved (Miller & Lessard, 2000).

The performance of megaprojects in the oil&gas industry has seen little improvement over the last decade (Merrow, 1988; Merrow, 2003; Fayek et al, 2006). Underperformance includes substantial shortfalls in benefits such as financial performance of the delivered assets, social acceptability, regulatory compatibility, and future business opportunities (Merrow, 1988; Merrow, 2003; Miller & Lessard, 2000; Fayek et al, 2006). The seeds of this underperformance are often sown early in the execution phase, yet not much can be found in literature on this phase of megaprojects (Miller & Lessard, 2000; Grun, 2004).

Organizational behaviour theory suggests the ability of a person within an organization to influence its strategic direction is a function of the amount of resource allocation he or she controls (Brower & Gilbert, 2007), and not necessarily his or her seniority. The managers of megaprojects can be responsible for the allocation of between $0.3 billion to $20 billion. The ability of these senior project managers to influence corporate strategic direction should not be underestimated. Failure of just one project can potentially wipe out the entire annual

profit of an oil&gas conglomerate. The strategic performances of businesses are underpinned by decisions, and the cost of poor decisions can be high. This study aims to draw attention to how the decision-making of project managers during project execution can impact on the long-term strategic goals of corporations. Two research questions are addressed:

- which factors of information-feed supporting project managers' decision impact the strategic value delivered by megaprojects for the sponsoring organization the most?
- how can the decision framework of the managers of megaprojects be enhanced?

Information is critical as an input into the decision process. A positive correlation has been established between business performance and decision-making practice (Thomas et al, 1993; Mackie et al, 2007), and since a program is a temporary organization, a correlation between program performance and decision practices should be expected (Thiry, 2004). Flyvberg (2007) has observed that the main challenges of megaprojects is inadequate, unreliable or misleading information; and conflicts between decision making, policy and planning.

The perspective of this research is from the view point of the project manager, with focus on how decisions made by the project manager during execution impact on the strategic value delivered by the megaproject to the sponsoring organization. Figure 1 illustrates the typical project delivery process followed by most oil&gas corporations. The process is decision-based, but heavily biased towards the project front-end where the most value is created. The execution phase activities and deliverables enable the realisation of value, and is where projects managers take the lead.

Insert Figure 1 about here

In the next section we consider the nature of megaprojects, and then decision-making on megaprojects and we introduce the hypotheses. We then describe the research methodology and results of the study. We conclude by discussing the implications of the study.

Theoretical framework and hypotheses

Megaprojects and the program management paradigm

A megaprojects is a special case of a program, and as such is a set of multiple, but related projects directed towards a common strategic, business objectives; which generates benefits beyond those that would have been generated had the projects been done individually, (Office of Government Commerce, 2007; Project Management Institute, 2006, 2008). This is the nature of oil&gas megaprojects, which are essentially programs that integrate strategically aligned, commercially viable and logistically combinable projects under a single management umbrella. They usually cost over $1 billion, involve high uncertainty, comprise intangible benefits and promise attractive long-term outcomes (Miller & Lessard, 2000; Flyvberg et al, 2003). Compared to traditional projects, they have long project and product life-cycles, are significantly less predictable in terms of time and scope (Cooke-Davies, 2002), demand substantial irreversible commitments, have high probabilities of failure, and a skewed reward structure (Miller and Lessard, 2000).

The managers of megaprojects often adopt traditional modes of project delivery because that is their basic training and experience. In this mode, the manager's energy is devoted to low level management of contracts, focusing on time and cost (i.e. project efficiency as defined by Shenhar & Dvir, 2007) without adequate attention to how to attain the best overall results (Halman & Braks, 1999; Asrilhant et al., 2007; Turner et al, 2009, Turner et al, 2010),

thereby negating the longer-term strategic views that inform the initiation of the projects. As program managers their focus should be on strategic objectives and business benefits, requiring more of a leadership role than a management one (Murray-Webster & Thiry, 2000; Shao, 2010; Shao et al., 2011). From inception to the start of revenue generation, megaprojects can take 5 to 12 years (Reinhards, 1989), while operational life-can be between 7 to 30 years. This long-term nature makes megaprojects vulnerable to uncertainty and ambiguity, emphasizing a need for a strategic decision making in their management (Office of Government Commerce, 2007), rather than the tactical short-term efficiency management of traditional project execution (Project Management Institute, 2008).

Applying a program management paradigm to megaprojects helps address this, being about benefit management, stakeholder management and ensuring effective governance (Project Management Institute, 2006; Office of Government Commerce, 2007). It provides a framework that easily identifies changes, makes causes and effects clear, and enables good demarcation between risks and opportunities (Murray-Webster & Thiry, 2000). Recognising megaproject managers as essentially program managers; they are therefore responsible for navigating the megaproject through the ambiguities of strategy and its emergence, providing leadership, including managing cultural and political issues involving other parts of the organization (Thiry, 2004; Shao, 2010) and external stakeholders. To be effective as program managers, it is necessary to obtain and process the right information to reduce ambiguity (Thiry, 2004).

Challenges of Megaproject Execution

Megaproject stakeholders are numerous, as is the diversity of their objectives, (Shao, 2010). Significant stakeholders in the oil&gas industry include National Oil Companies and Governments, local communities, NGOs with interest in socio-cultural and environmental sustainability, employees (including the project team), and shareholders. With such a constellation of stakeholders, it is inevitable that megaprojects will attract high socio-economic and political interest, and high industrial and public attention. It is therefore key that the strategic goals of their sponsors and stakeholders and how they are linked to the project itself are clear (Turner et al, 2009). Usually Megaprojects are placed under high time and cost pressure (Merrow, 1988, 2003; Miller & Lessard, 2000). Of the project managers surveyed in this research, 85% indicated they were under moderate to very high cost and time pressure. These pressures generate systemic influences within projects. For example, it has been shown that time pressure can impair decision quality (Chu & Spires, 2001).

Strategic Value in the Oil & Gas Industry

Strategy realisation, the basis for megaprojects, is principally about decision-making (Sull, 2007), and the managers of megaprojects are responsible for big, and often high-consequence decisions (Klein, 1989). Their decisions are a double-edged sword as their interpretation of strategic issues affecting their projects directly influences how the team responds (downward influence), and how senior management perceives challenges (upward influence). However, studies show project managers have been ineffective at responding to emergent strategy, and the integration of strategic intents with the results generated by these large, long-duration projects (Thiry, 2004; Morris & Jamieson, 2004). Major players in the oil&gas industry have adopted a sustainable development approach for determining the value of their longer-term strategies for growth and profitability (BP, 2008, Royal Dutch Shell, 2008; ExxonMobil,

2007), reflecting a response to the evolving reaction of society to the energy industry and its historical socio-economic and political impact. All the major players investigated expressed sustainable development as their core business value for projects that will be executed in pursuit of strategy. Sustainable development objectives of these companies are largely similar. The commonly expressed strategic objectives were:

- making significant socio-economic contribution to the society
- health, safety, security and environmental responsibility (HSSE)
- economic profitability of the business
- earning the admiration of key stakeholders

The extent to which these strategic objectives are achieved, is taken as indicative of the worth (value) of any strategic results obtained. These sustainable development measures are aligned with the balanced score card for organizational performance evaluation (Kaplan & Norton, 1996), and the Diamond Approach (Shenhar & Dvir, 2007) suggested for projects. The diamond approach presents five main success dimensions for projects:

- project efficiency
- impact on customers and users
- impact on project team
- business and direct organizational success
- preparing for the future

Achievement levels of these sustainable development objectives were adopted in this study as the basis for indicating strategic value obtained from projects within the oil&gas industry.

Decision Theory in Megaprojects

In a general sense, a decision is a position, opinion or judgment reached after consideration (Miller, 2009). It is a cognitive phenomenon, and the outcome of a complex process of deliberation, which includes an assessment of potential consequences and uncertainties (Müller et al, 2009). Skinner (1999) defined a decision as a conscious, irrevocable allocation of resources with the purpose of achieving a desired objective, indicating that it involves thinking, judgment and deliberate action. So a decision is only regarded as such when it has been communicated someway and accepted for implementation. Basic elements of a decision process include information seeking, ascription of meaning (interpretation), applying a decision criteria and subsequent implementation action (Thomas et al, 1993).

Decision theory has its root in economic theory, with the assumptions that people make decisions to maximize utility based on self-interest and rationality (Skinner, 1999; Mackie et al., 2007): the *expected utility or normative decision theory*. This however does not consider the possibilities or effects of moderating or intervening factors that make decisions reference-dependent (Kahnemann, 2002). Nonetheless expected utility theory has been applied in the oil&gas industry with some success (Mackie et al, 2007), and has been the predominant model for normative decision making (Tversky & Kahnemann, 1992). The theory is considered idealistic however because it focuses on how people should make decisions (Mackie et al, 2007) rather than how they actually make decisions (Skinner, 1999). Technical people in the oil industry have been observed to exhibit a tendency for normative approach to decision making, thereby weakening their ability to deal with uncertainty (Capen, 1976; Mackie et al. 2007). Project management in the oil&gas industry is dominated by

technical people, and probably more than a few are struggling with tendencies towards this normative thinking phenomenon. An alternative approach is the *descriptive decision theory*.

Descriptive decision theory deals with how people actually make decisions. It postulates that people make decisions by choosing ways to satisfy their most important needs even if they do not have all the required information and their choice is not optimal (Mackie et al, 2007). When people are faced with making decisions under uncertainty they simplify the challenge by relying on heuristics or rules of thumb (Kahnemann & Tversky, 1979; Tversky & Kahnemann, 1992) that are largely rooted in acquired knowledge and past experiences. There are two relevant offshoot of descriptive theory:

- the theory of bounded rationality (Simon, 1976; Kahneman, 2002)
- prospect theory (Kahnemann & Tversky, 1979, 2004)

Both recognize the ample limitation of human beings to be rational most of the time, and postulate that inductive thinking is more natural (Arthur, 1994; Kahneman, 2002; Kahnemann & Tversky, 2004).

Prospect theory explains decision making under risk (Kahnemann & Tversky, 1979, 2004), which more realistically reflects megaprojects. The theory distinguishes two phases in the decision process, framing and valuation. *Framing* consists of a preliminary analysis of the prospects offered (by the challenge) to the decision maker, leading to a representative construction of his or her perception of the challenge, associated contingencies and possible outcomes. A heuristic simplification of perceived risks or challenges takes place such that the decision-maker can make some meaning out of it. During this phase, the quantity, quality

and timeliness of information (*information feed*) available to the decision maker; past experiences, and knowledge about relevant subject matter will have huge effects on how he or she models the possible prospects, which is the outcome of this process. Information timelines have also been hypothesized as a factor due to the time pressure that most project managers are under. Time pressure affects decision-making (Hwang, 1994), and information suffers degradation when not delivered timely (Greer & Kroop, 1983). *Valuation* follows framing in which the decision-maker assesses the value of each prospect based on an "opportunity-threat" or a "gain-loss" principle, and then chooses accordingly (Thomas et al., 1993; Kahnemann & Tversky, 2004). Prospects are consequently labeled, for example as "opportunity" or "threat".

Ultimately the aim of decision-making is to minimize surprises, which arise from mismatches between what actually happens and what was expected to happen (Gharajedaghi, 1999). Four reasons, largely related to the management of information to support decisions, have been advanced for why mismatches can occur following decisions (Gharajedaghi, 1999):

1. wrong information or input data – a decision process problem
2. wrong implementation of what was decided
3. change in the assumed context after the decision was made (such as business or social context around the project). This may be caused by poor awareness of the environment or by a chance event
4. the decision itself may be fundamentally flawed in quality, which would be a problem with the decision approach or process.

Information-Feed in Decisions

Various studies have established that the root cause of almost all project failure can be traced back to human error or misjudgement (Johnson, 2006; Virine & Trumper, 2008), and poor judgement can often be traced back to the way the decisions were made (Hammond et al, 1998). As making decisions is considered the most important job of any executive (Hammond et al, 1998), the ability to make right decisions on projects should be a principal indicator of project management professionalism. Unfortunately despite the reported moderate-to-poor performance of megaprojects (Merrow, 2003; Miller & Lessard, 2000; Fayek et al, 2006), many project managers presume their decision-making capabilities are above average (Massey et al, 2006), and consequently care little about improving the quality (Capen, 1976; Goodwin & Wright, 2004; Virine & Trumper, 2008). This attitude could influence the rigor of their approach to seeking information in support of decision-making, and potentially result in more wrong judgement than should have been otherwise.

Information feed (or scanning) (Thomas et al, 1993) involves searching external (Coulter 2000) and internal (Thomas et al, 1993) environments to identify important issues or events that could affect the organization and its objectives. It is a key element of the decision process enabling managers to formulate expectations about the future (Greer & Kroop, 1983). As top decision-makers will usually have access to far more information than they can deal with (Mintzberg, 1978, Thomas et al 1993), they become selective in favour of information they consider to be most useful. It has been established that decision-makers who use more information tend to be more comfortable in dealing with ambiguity and uncertainty and consequently more positive with labelling their challenges (Thomas & McDaniel, 1990). Externally-focused information-feed in particular is considered more influential in facilitating this (Thomas et al, 1993; Coulter, 2000). Those who are positive with labelling (as suggested

by prospect theory) tend to project positive outcomes with expectations of “gain” or “opportunity” (Dutton & Jackson 1987) rather than “loss” or “threat”. They also tend to have a fair amount of control on organizational or project direction. In contrast, “threat” labeling implies a negative situation in which a likely loss is projected by the decision maker, and over which he or she feels relatively little control (Dutton & Jackson, 1987).

Early detection of system disturbances is enhanced through good and timely information-feed (Dutton & Duncan, 1987) allowing for pro-activeness. Less timely information is generally considered inferior because the manager’s expectations will contain greater error (Greer & Kroop, 1983). On the other hand, decision makers tend to use less information when they believe they are knowledgeable about their business environment or situation than when they feel it is poorly understood (Thomas & McDaniel, 1990). Decision makers may sometimes not be right in this judgement however. The quality and quantity of information available to decision-makers in business organizations was found to correlate with the quality of their decisions (Thomas et al 1993; O'Reilly, 1982). As project management is similarly underpinned by decisions, one can expect that the information-feed to the project manager (as a key decision-maker) will influence project performance and derivable strategic value.

The extent to which a business leader or project manager feels in control of strategic issues is an important influence on how information gathering towards decision support and interpretation will be approached (Thomas et al 1993; Kahnemann 2002; Müller 2003). Several studies have argued that most people see threats as uncontrollable, and that opportunities are characterised by a high degree of controllability (Thomas & McDaniel 1990). This study investigated sense of controllability as a measure of the extent to which the project manager feels in charge of the project. The level of confidence of being in control

would largely be influenced by how the project manager perceives the quality and effectiveness of risk management on the project. Based on the works of Morris & Hough (1987), Miller & Lessard (2000), and initial interviews of seven project managers (with a combined experience of 130 years) during the early stages of this study, ten areas of greatest challenges on megaprojects were identified:

1. contracting and procurement management;
2. government relations management (as McKenna et al, 2006, noted, the decision mechanisms of host governments are often unclear and can lead to significant complications);
3. host community relations management;
4. joint venture interface management;
5. health, safety, security, and environmental (HSSE);
6. multi-location management of fabrication and facilities integration;
7. implementation of local content policies;
8. project governance;
9. managing the core project team (individual aspirations, job satisfaction, etc.), including attaining cohesion within the broader team; and
10. impact of multi-cultural leadership within the project.

These challenges are consistent with what Miller & Lessard (2000) identified as the top failure factors in large projects. Most of the challenges are political and social with potential to affect decision-making. Technical risks seem less challenging. Overall, governance

remains a challenge on many megaprojects (Miller & Lessard 2000); and factors related to technical content and project-economics seem to have less significant impacts.

This discussion informed two hypotheses for the study:

H1A: The information-feed in support of the Project Manager's decision on oil&gas megaprojects will have a significant influence on the level of derivable strategic value.
H1B: The magnitude of external focus within the information feed in support of the project manager's decisions on oil&gas megaprojects will correlate positively with the long-term strategic value realised.
H2: The project manager's perception of his or her level of controllability will significantly influence information feed on the project.

Contextual Influences on Project Decisions

Organizational (Thomas et al., 1993), personal and project characteristics (Müller et al., 2009) are contextual factors, and may influence decision-making. For example they could influence the project manager's approach to information feed and how challenges may be classified as "threats or opportunities" (Ford 1985) – a moderating influence. In particular, what a project manager perceives as important to senior management (an organizational context) is expected to influence his or her management priorities, hence decisions. This also informs the project manager's perception of how he or she may be measured, hence his or her behaviour. Literature on organizational behaviour and decision making also infer that experience plays an important role in decisions (Kahnemann, 2002), and has a positive relationship with decision outcomes (Dane, 2008). So the project manager's professional experience (a personal context) could be expected to influence the information framework

adopted on the project, hence potential impact on strategic outcomes. This discussion informed the third hypothesis:

H3A: The project manager's perception of senior management drivers (an organisational context) will moderate the relationship between information-feed and strategic value from oil&gas megaprojects.

H3B: The project manager's professional experience (a personal context) will moderate the relationship between information-feed and strategic value from oil&gas megaprojects.

Research model

Figure 2 illustrates the hypotheses and represents the research model for the study.

Insert Figure 2 about here

Methodology

The study perspective taken is the descriptive decision theory school, and the research questions demanded analysing historical data from practitioner experiences on megaprojects. We adopt a positivist epistemology and test the three hypotheses using a deductive research design, applying a quantitative approach of probabilistic survey sample requiring minimal interference with the research objects (Czaja & Blaire, 2005; Cooper & Schindler, 2006). The primary target population was the managers of megaprojects employed by oil&gas companies. These are people with responsibility for entire megaprojects or substantial parts of them. The survey questionnaire was pre-tested on five senior project managers and refined based on pre-test results before the actual survey, which was web-based. Results analysed did not include those from the pilot. All scaled responses were based on a 5-point Likert

scale, and reliability checks were done at sub-scale level (Field, 2009). The main variables were summarised by taking means of their underlying sub-variables. Data reliability and validity is discussed within succeeding sections. The hypotheses were tested using results from bi-variate correlation analysis, ANOVA, multiple regressions, including moderated hierarchical regression (MHR) analysis.

Independent Variables

There are two independent variables in the research model:

Information Feed (Scanning): Elements measured were the quantity, quality and timeliness of information gathered by project managers. These were combined to form the construct variable, *Information-Feed*. Deriving from how the questions were constructed, these same sub-variables could also be segregated as internally or externally focused information as a means of further sensing where problems may be coming from. The components of Information-Feed included:

1. Performance information on corporate financial services, HR management and performances *(Corporate Performance factor)*
2. Information on "pulse" of internal and external stakeholders, *(Stakeholder Pulse factor)*
3. Information on project efficiency, stakeholder management, benchmarks, etc. *(Project Performance factor)*
4. Timeliness of information to the project manager towards decision-making *(Information Timeliness factor)*

Measurement items for this scale were adapted from literature and previous research works (Thomas et al, 1993; Gioia, 1986). This is also the dependent variable for Hypothesis H2.

Controllability (Sense of Control): This measurement was based on how threatened the project manger felt about the ten areas of greatest challenge derived from literature and the qualitative interview of senior project managers discussed earlier in this paper (refer section on "Information-feed in Decisions"). The perceived significance of the risks posed by each challenge formed the basis of measuring how well in control project managers felt.

Moderating Variables

There is one moderating variable in the research model:

Contextual: The variable has two main components. First was the project manager's perception of what his or her senior management drivers were, for example: cost; schedule; stakeholder management; safety; quality; economics; etc. The second was information on the project manager's professional tenure, obtained as a measure of experience (Garvey & Reimer, 1979, Crawford, 2007). To further understand the context of responses some categorical and ordinal data on company type, demographics, role on project, project cost and so on were gathered.

Dependent Variable

There is one dependent variable in the model:

Strategic Value: Strategic value was measured from the viewpoint of the executing project managers. Items measured were those sustainable development goals found common to the

super-majors, and they centre around earning the admiration of key stakeholders and economic performance, namely:

- *Value to Partners*: how well project performance is aligned with corporate objectives and aspirations of the Host Government and Co-venturers on the project.
- *HSSE Compliance*: health, safety, security and environmental performance on the project towards ensuring that the asset delivered can be safely operated.
- *Profitable Asset Performance*: economic profitability from operating the asset delivered by the project.
- *Value to Host Community*: making significant socio-economic contribution to the society

These variables have not been weighted in this study.

Analysis

Data and Sample Characterisation

A total of 107 responses were received, out of which 69 were used in the analysis. Responses from non-oil&gas project managers (N=8), and low input responses (N=30) were eliminated. The sample size exceeds the minimum requirement of 5 cases per variable for regression (Tabachnick & Fidell, 1989), as over 12 cases per regression variable was achieved. While all the projects are considered major due to reported complexity, about 15% of them cost less than $1 billion. The projects analysed were spread across all regions of the world: Middle East; Far East; Australasia; Africa; Europe; North America; South America; Russia/Caspian. The largest number of projects were in Africa (35%) and the least in South America (<5%). Almost 90% of respondents said their project were joint ventures, showing that most oil&gas

companies consider megaprojects as too risky for single-company sponsorship. Such relationships however could complicate project execution due to challenges of obtaining consensus. About 80% of the projects analysed were completed within the last six years, which is about 25% of the typical life-span of deliverables from a megaproject. While longer-term value is, of course, not fully realised within 25% of the asset's operational life, this should be enough time to permit evaluation of the long-term strategic value indicators as proposed in this study.

An analysis of variance (ANOVA) was done on the mean scores of industry types, observed statistical modes of project costs, and the roles of respondents on projects. Results indicated that there were no significant differences in mean ($p>0.1$), hence all responses could and were analysed as a single data set. Data reduction was implemented using factor analysis. For instance, the variables in the long-term strategic value construct was reduced from 6 to 4 groups; information feed construct increased from 3 to 4 variables; variables in "controllability" and "senior management driver" constructs were reduced into 4 groups each.

The construct variables as described above formed the input to the regression analyses that tested the hypotheses. Regression results showing standardised beta values of all significantly influential factors are presented in the appendix.

Results and Discussion

Information –Feed in support of project manager decisions (H1)

All four subvariables that make up the information feed construct were regressed as a block, and in a stepwise backward entry mode with each of the strategic value subvariables. This

regression algorithm eliminates non-significant variables and therefore does not present the beta values of such variables. The block approach (rather than regression of each information feed variable) better simulates the reality of simultaneous occurrence and interactive influences of the factors (subvariables) on each other. Two of the four information feed factors, information on stakeholder pulse and project performance, significantly influenced long-term strategic value indicators, while corporate performance information and information timeliness did not (see Table 1). The table shows the significant standardized Beta values. All R^2 values are above the 0.02 triviality threshold (Cohen 1988; Müller 2003). In general, the results show that long-term strategic value is influenced by information feed during project execution, hence supporting Hypothesis H1A. Note that almost 40% of the variance on the measure of how much the venture partners (strategically) valued the project is explained by information feed, indicating the importance of adequate and quality information in securing partner goodwill.

Insert Table 1 about here

The corporate performance information factor had the lowest score (mean = 2.96), confirming that project managers are right to give it the least attention compared to other information feed factors. Of all the information feed factors evaluated in this sample, information timeliness received the greatest attention from project managers (mean score of 3.68) despite its insignificance to long-term value. This is likely to be achieved at some expense of quality and adequacy. While it is true that poor timing of information can degrade information value (Greer & Kroop 1983) and hinder proactiveness, this problem, however, seems more salient with regard to short-term decisions, which are required to manage the tactical objectives on megaprojects. It thus seems more information-gathering energy is put

where it is least needed, information timeliness - an indication of the prevailing short-term focus in decision-making.

Integrating project performance information into project manager decisions has a double-edged influence, a positive influence on promoting project value to direct investor partners, while exerting a negative influence on similar value to host communities who have their interest mainly tied to the benefits they expect to receive from the project (and not the anticipated benefits to the corporation). So, when attention to host community relations is poor, good project performance will mean little to the communities. The mean score of 2.9 associated with how host communities valued projects in the sample studied is below average and the lowest of all long-term strategic value indicators (3.0 is neutral), indicative of predominant apathy to the projects by host communities. So the negative correlation between project performance information and project value to host communities should be expected. In fact, from our experience, communities can become antagonistic as a way to express their perception that corporate gains are being made at their expense.

Information on stakeholder pulse had the greatest influence across all long-term strategic value indicators (see Table 1). The pulse measured is of those stakeholders outside the project team (such as government, joint venture partners, host communities, and asset operators), so it is an externally focused information variable. The results show that project managers are more effective in creating value when they are able to factor information on current stakeholder pulse into their decisions. This supports Hypothesis H1B, and indicates that project managers' level of awareness of relevant events and trends in the external environment surrounding their megaproject does significantly affect the quality of their decisions and, consequently, the long-term value obtained from the megaproject. It also

underscores the strong interaction of megaprojects with society. This result aligns with outcomes of similar studies in organizational management (Thomas et al. 1993), and with Coulter's (2000) claim that external environment analysis is very important to successful strategic management in business organizations.

Sense of Controllability and Information-Feed system (H2)

All controllability factors mean scores were less than 3.0 (Table 2). By these low ratings, megaproject managers confirmed they felt exposed to key execution risks. Based on prospect theory, cases like this where project managers feel inadequately in control imply that they will have higher tendency of negative (threat) valuations of prospects presented by challenges on their projects, and therefore frequently prone to expecting poor performance than success. This is not a good psychological state to be in frequently, especially for megaproject managers that influence such significant amount of corporate resources. A noteworthy observation is that the significant risk factors have to do with relationships that are largely external to the project team – for example government, contractor and project governance. This is evidence of the strong external interest in, and the influence of governance issues on megaprojects, as compared to traditional projects. This supports findings from earlier studies (Miller & Lessard, 2000; Jaafari, 2004). Miller & Lessard's (2000) concluding that the quality of relationships with human institutions is a major success factor on large projects. These external influences on megaprojects which are by nature volatile and dynamic cannot be wished away. They tend to wrestle control from project managers, and can affect the core business if not well managed (Cattaneo 2009).

Insert Table 2 about here

Except for mitigations against risks from team characteristics ($p<0.1$), all the controllability factors were significantly influential on information feed at the $p<0.05$ level. It follows that, in designing the information feed framework for megaprojects, the project manager should ensure that controllability concerns are adequately factored in, for example, in securing quality data that enable status monitoring in the identified risk exposure areas.

Interestingly, the quality of mitigation against risks from contractor relations has a negative influence on two factors, corporate performance information (beta = -.419) and information timeliness (beta=-.239). This suggests that project managers tend to give less emphasis to securing corporate information and pursuing timeliness of information as the project team's relationship with contractors gets better. The storyline implied here is that, as contractor relationships improve on the project, information sharing becomes more qualitative and proactive, hence the relevance of corporate performance information and information timeliness could become lower to the project manager. The reverse may be painfully untrue though when contractor relations are suboptimal, as getting more timely information or/and quality corporate performance information cannot substitute for the cultivation of good relationships between contractors and the project teams.

Three underlying elements of the controllability factors where project managers said they experienced most vulnerability with risks were multi-location execution (mean = 1.97) and HSSE management (mean = 2.03), both associated to the project team; also contracting and procurement (mean = 2.06), an element associated with contractor relations risks (Table 3).

Insert Table 3 about here

Of the three, only the contracting and procurement risk mitigation element that underlies the controllability factor identified as contractor relations has a significant relationship with information-feed, hence should receive the greater attention. The few project managers who felt more in control (those with risk mitigation capability ≥ 4.0) were clearly differentiated by their approach to information feed. They used better-quality information more consistently. Their mean scores on a scale of 5 were 3.0 or higher, or 10% to 30% higher than those of lower-performing megaprojects.

Contextual Influences (H3)

This hypothesis was tested by moderated hierarchical regressions based on recommendations by Sharma et al (1981) for identifying and analysing moderator variables. All subvariables of "information feed" and "senior management priority" constructs were centred and cross-product terms were created thereafter (Jaccard et al., 1990; Eweje, 2010). The interactive influences from the regressions results is summarised below in Tables, while tables 4 to 8 contain the details. Three of the four senior management drivers have significant moderating influences on how the megaproject manager's decisions create long-term value. These three drivers are:

- "achieving profitable operations", which purely moderates the impact of Project Performance information feed on Strategic Value to Partners (Tables 4 and 5), and quasi moderates the impact of Corporate Performance information feed on Strategic Value from Profitable Asset Performance (Tables 4 and 6);
- "stakeholder support" is a pure moderator of the impact of Project Performance information feed on Strategic Value to Partners (Table 4 and 5), and a pure moderator of

the impact of Corporate Performance information feed on Strategic Value to Host Communities (Table 4 and 7);

- "project schedule" is a pure moderator for the impact of Information-feed on Stakeholder Pulse on Strategic Value to Host Community (Table 4 and 8)

This result indicates that project managers are allowing their awareness of senior management's drivers to influence their value-creating decisions. Consequently Hypothesis H3A is supported.

Insert Tables 4 to 8 about here

The results though show that the HSSE-Quality variable as a "senior management driver" was not significant in influencing project managers' decisions toward long-term value as was expected (see Table 4). Similarly, no significant moderating effect was established on the strategic value indicator, "HSSE compliant operation". In essence, despite acclamation of HSSE as a high priority and core value in the annual reports of oil&gas industry companies' megaproject teams' attentiveness to HSSE appears to lag behind senior management rhetoric. This was a surprising finding indeed, as the logical expectation is that such strong management emphasis on this driver should influence decisions. Another study extending this one did show that the high preference for efficiency (for example, schedule and cost) among company executives during the execution phase of megaprojects is counterproductive and did lessen project managers' focus on HSSE and quality issues (that is a negative correlation), making the company rhetoric less influential (Eweje, 2010). As suggested by Irwin & Baron (2001), circumstances or context issues can sometimes provoke decision

makers to override or inconsistently apply their corporately stated values. In the case of this study, the organisational context of intense pressure for high project efficiency performance provoked an inconsistent response of megaproject managers to the core value of HSSE.

The project management experience variable, surprisingly, also did not produce any significant interaction in the regressions with each of the information feed subvariables. Hence Hypothesis H3B is not supported. Dane (2008) explained this phenomenon by contending that "procedural experience," "tactical experience," and "localised experience" rather than simply "professional tenure" (that is number of years practicing a profession) explain decision effectiveness. Procedural experience is capability to adhere to the rules and procedures that govern a profession; tactical experience is that derived from historical encounters with similar situations; and localised experience is familiarity with the techniques, strategies, and likely positions of other professional players and business leaders within the area of operation. Other studies have established that a professional's ability to make accurate judgements does not necessarily improve over time (Dawes, Faust & Meehl 1989; Camerer & Johnson 1991). This non-improvement in quality of judgement despite increasing tenure on the job has been attributed to professionals not doing enough to recognise or overcome their cognitive biases, hence limiting their opportunity to learn from their experiences despite increasing professional tenure (Dane 2008).

Conclusions and Recommendations

We proposed two research questions:

- which factors of information-feed supporting project managers' decision impact the strategic value delivered by megaprojects for the sponsoring organization the most?
- how can the decision framework of the managers of megaprojects be enhanced?

We have established there is a significant relationship between information-feed during the execution phase of oil&gas megaprojects and the long-term strategic value of the project, with externally-focused information types having the greatest influence. We corroborate the findings of Spetzler et al. (2005) that poor knowledge of dynamics in the external environment is a large contributor to underperformance. The four components of information feed studied have a significant impact on the four components of strategic value we identified from the literature search. Information on stakeholder pulse however has the greatest impact. When relationship with host communities is not so good, information about project performance has an adverse impact on value to the host community with improvements to one leading to lower performance in the other. We saw that the quality of the project manager's decisions will be influenced by their perception of the desires of senior management, but surprisingly not by their tenure practicing the project management profession. If project managers can better understand how the quality of information feed influences their decisions, they would be positioned to take better decisions and improve the performance of the megaprojects they are managing.

The results also suggested that most managers of megaprojects felt exposed to key execution risks. It was also found that the quality of risk mitigation on megaprojects does significantly influence information feed to the project. Hence the design of information-feed systems for megaprojects should be risk-based. The level of clarity on information requirements for project decision support and how the desired information can be qualitatively obtained and

managed can be seen as a critical indicator of how well a megaproject is positioned for success. A framing session to address decision support is recommended very early in the execution phase. Suggested issues to address include identification of key decision areas critical to project success and who the responsible parties are; what the major exposures for the project are; what information is needed to support quality decisions; sources of data acquisition and how to secure data of adequate quality; and establishing a decision framework.

This study shows that a superior risk management system enhances a project manager's sense of control over the project and better positions the manager to make value-creating decisions. Recognising the major areas of risk exposure and factoring them into the information feed framework was found to ultimately improve the quality of decisions. The information feed system should especially keep the project manager apprised of performance in risk areas, particularly areas with weak mitigation in place, so as to foster proactive interventions. This makes investing in a qualitative project risk coordinator a key resource in support of decisions. The stronger the project manager's sense of control is over risk exposures, the more likely his or her project information feed system will create better long-term strategic value. Most important aspects to focus on towards achieving a good sense of control on megaprojects are managing risks from contracting and procurement relations, in addition to paying good attention to other soft issues such as project governance, government relations, and managing the challenges that social diversity and geographic dispersion pose to the project team.

People tend to uphold values more strongly in contexts where they are buying or have something to gain, whereas they tend to compromise values when selling, giving up, or losing

something (Irwin 1994). Consequently the behaviour of most project managers within this study sample in ascribing inadequate significance to HSSE as a core value is indicative of a fear of loss. It is likely they have greater fear of defaulting on cost and schedule than on HSSE. In almost all probability, senior management or the project decision board, by their actions are giving the impression that project efficiency such as cost and schedule should take higher priority, contrary to their rhetoric on core values, for example HSSE. Senior managers need to be aware of their conscious and subconscious practices for rewarding performance as it would influence project team behaviours.

The inconclusive judgement on the influence of project manager experience on information-feed can be corrected by future research that would consider the influence of procedural, tactical and localised aspects of professional experience as suggested by Dane (2008).

The limitations of the study are in the relatively small sample size and low R^2 values. Sixty-nine responses to the questionnaire limit the generalizability of the results. Larger variations by country and project size and type do seem likely due to relatively few responses spread globally. This is also indicated by the relatively low levels of practical significance (R^2) shown in Table 2. Careful application of the results in practical settings is advised, and should be preceded by a comparison of the settings at hand with the settings described. However, the value of this study may extend well beyond the oil&gas industry to the extractive and energy industries in general, and perhaps to other industries that execute megaprojects. Careful application may be necessary where characteristics of the business environment differ significantly from those of the oil&gas industry, for instance, in space and aviation. So an extension of the study to other industries, social or government organization where megaprojects are instruments of strategy realisation will be useful as a validation.

While this study has established that there are significant links between information-feed in support of decision-making by project managers and strategic value derivable from megaprojects, it has not come up with what a viable information management system directly supporting the project manager in his or her decision could be. A research that could come up with a simple and easy-to-use information management system primarily focusing on supporting the megaproject manager's decision-making would be a good complement to this study. It would also be an important aspect of enhancing the decision framework for these project managers that could potentially have huge influences on corporate strategic direction.

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Tables and Figures

Table 1: Regression Result of Information-Feed (IV) and Strategic Value (DV)

			Dependent Variables			
			Value to Partners	HSSE Compliance	Profitable Asset	Value to Host Com
Independent Variables	Information on:	Mean	3.96	3.23	3.52	2.90
	Corporate performance	2.96				
	Stakeholder pulse	3.12	.484****	.374***	.340***	.538****
	Project performance	3.65	.277***			-.193*
	Information Timeliness	3.68				
	R^2		.385	.140	.116	.289
	Regression F		20.62****	10.91***	8.76***	12.17****

* = p<0.1

** = p<0.05

*** = p<0.01

**** = p<.001

Table 2: Regression Result of Controllability Factors (IV) and Information Feed (DV)

			Dependent Variables Information on:			
			Corporate Performance	Stakeholder Pulse	Project Performance	Timelines
Independent Variables	Mitigation of risks from	Mean	2.96	3.12	3.65	3.68
	Team characteristics	2.32	.258*			
	Govt relations	2.76		.316***		
	Contractor relations	2.14	-.419***			-.239**
	Governance	2.65			.275**	
	R^2		.112	.100	.076	.057
	Regression F		4.18**	7.43***	5.47**	4.07**

* = p<0.1

** = p<0.05

*** = p<0.01

**** = p<.001

Table 3: Scores for Underlying Variables of Controllability

Underlying variables Controllability	Mean
Risk mitigation capability	
Contracts and procurement	2.06
Government relations	2.55
Host community	3.00
Joint venture	2.48
HSSE	2.03
Multi-location	1.97
Local content	2,72
Project governance	2.65
Project team	2.43
Cultural diversity	2.87
Team cohesion	4.25

Table 4: Summary of the Moderating effect of the relationships between "Information Feed Variables" and "Strategic Value Variables" by "Senior Management Drivers"

	Dependent Variable Strategic Value			
Independent Variable Information feed	Value to Partners	HSSE Compliance	Profitable Asset	Value to Host Com
Corporate perform			**Q**: PO	**P**: SS
Stakeholder pulse				**P**: PS
Project perform	**P**: SS, PO			
Information Timeliness				

Legend

P = Pure moderator

Q = Quasi moderator

Significant Senior Management Drivers

PO = Profitable operations

SS = Stakeholder support

PS = Project schedule

Table 5: Moderation of relationship between "Project Performance information" and "Strategic Value to Partners" by "Senior Management Drivers"

Variable entered	Dependent variable: Strategic Value - *Valued by Partners (Govt & JV)* Strategic Value (N=69)					
	Step 1		***Step 2***		***Step 3***	
INFORMATION ON PROJECT PERFORMANCE	.411	***	.403	**	.392	**
PERCEPTION OF SNR MGT (SM) DRIVER - STKHOLDER SUPPT			-.017		.121	
PERCEPTION OF SNR MGT (SM) DRIVER - PROFITABLE ASSET OPERATION (OPS)			.156		.097	
PERCEPTION OF SNR MGT (SM) DRIVER - HSSEQ			.061		.051	
PERCEPTION OF SNR MGT (SM) DRIVER - PROJECT SCHEDULE			.018		-.015	
Info on Project Performance x SM Driver (Stakeholder Support)					.295	*
Info on Project Performance x SM Driver (Profitable asset ops)					.275	*
Info on Project Performance x SM Driver (HSSEQ)					-.204	
Info on Project Performance x SM Driver (Schedule)					-.210	#
F for regression	13.58	***	3.23	*	3.83	***
F for change	13.58	***	0.70		0.17	**
R-square	0.169		0.204		0.369	

Main table contains standardized coefficient betas

* $p \leq 0.05$	# $p \leq 0.10$
** $p \leq 0.01$	VIF < 5
*** $p \leq 0.001$	

Table 6: Moderation of relationship between "Corporate Performance information" and "Strategic value from Profitable Asset Performance" by "Senior Management Drivers"

Variable entered	Dependent variable: Strategic Value - *Profitable Asset Performance* Strategic Value (N=69)					
	Step 1		***Step 2***		***Step 3***	
INFO ON CORPORATE PERFORMANCE	.147		.178		.144	
PERCEPTION OF SNR MGT (SM) DRIVER - STKHOLDER SUPPT			-.050		-.122	
PERCEPTION OF SNR MGT (SM) DRIVER - PROFITABLE ASSET OPERATION (OPS)			.287	*	.278	*
PERCEPTION OF SNR MGT (SM) DRIVER - HSSEQ			-.119		-.078	
PERCEPTION OF SNR MGT (SM) DRIVER - PROJECT SCHEDULE			-.053		-.111	
Info on Corp Perf x SM Driver (Stakeholder Support)					-.012	
Info on Corp Perf x SM Driver (Profitable asset ops)					.414	**
Info on Corp Perf x SM Driver (HSSEQ)					.042	
Info on Corp Perf x SM Driver (Schedule)					-.061	
F for regression	1.49		1.25		2.28	*
F for change	1.49		1.16		3.34	*
R-square	0.022		0.090		0.258	

Main table contains standardized coefficient betas

* $p \leq 0.05$	# $p \leq 0.10$
** $p \leq 0.01$	VIF < 5
*** $p \leq 0.001$	

Table 7: Moderation of relationship between "Corporate Performance information" and "Strategic Value to Host Communities" by "Senior Management Drivers"

Variable entered	Dependent variable: Strategic Value – *Valued by Host Communities* Strategic Value (N=69)				
	Step 1	***Step 2***		***Step 3***	
INFO ON CORPORATE PERFORMANCE	.194	.249	*	.298	*
PERCEPTION OF SNR MGT (SM) DRIVER - STKHOLDER SUPPT		-.264	*	-.123	
PERCEPTION OF SNR MGT (SM) DRIVER - PROFITABLE ASSET OPERATION (OPS)		.408	**	.302	*
PERCEPTION OF SNR MGT (SM) DRIVER - HSSEQ		-.014		-.045	
PERCEPTION OF SNR MGT (SM) DRIVER - PROJECT SCHEDULE		-.018		-.151	
Info on Corp Perf x SM Driver (Stakeholder Support)				.435	**
Info on Corp Perf x SM Driver (Profitable asset ops)				-.092	
Info on Corp Perf x SM Driver (HSSEQ)				-.185	
Info on Corp Perf x SM Driver (Schedule)				.078	
F for regression	2.63	3.23	*	3.52	**
F for change	2.63	2.29	*	3.30	*
R-square	0.038	0.204		0.350	

Main table contains standardized coefficient betas

* $p \leq 0.05$ # $p \leq 0.10$

** $p \leq 0.01$ VIF < 5

*** $p \leq 0.001$

Table 8: Moderation of relationship between "Information on Stakeholder Pulse" and "Strategic Value to Host Community" by "Senior Management Drivers"

Variable entered	Dependent variable: Strategic Value - *Valued by Host Communities* Strategic Value (N=69)					
	Step 1		***Step 2***		***Step 3***	
INFORMATION ON STAKEHOLDER PULSE	.485	***	.420	***	.350	**
PERCEPTION OF SNR MGT (SM) DRIVER - STKHOLDER SUPPT			-.149		-.230	#
PERCEPTION OF SNR MGT (SM) DRIVER - PROFITABLE ASSET OPERATION (OPS)			.218		.107	
PERCEPTION OF SNR MGT (SM) DRIVER - HSSEQ			-.045		.046	
PERCEPTION OF SNR MGT (SM) DRIVER - PROJECT SCHEDULE			-.036		.104	
Info on Stakeholder Pulse x SM Driver (Stakeholder Support)					.108	
Info on Stakeholder Pulse x SM Driver (Profitable asset ops)					-.092	
Info on Stakeholder Pulse x SM Driver (HSSEQ)					.110	
Info on Stakeholder Pulse x SM Driver (Schedule)					.330	**
F for regression	20.57	***	4.95	***	4.49	***
F for change	20.57	***	1.04		3.09	*
R-square	0.235		0.282		0.406	

Main table contains standardized coefficient betas

* $p \leq 0.05$	# $p \leq 0.10$
** $p \leq 0.01$	VIF < 5
*** $p \leq 0.001$	