Communication, coordination, decision-making and knowledge-sharing: a case study in construction management

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Abstract

Purpose – *This paper aims to examine four key management processes, namely, communication, coordination, decision-making and knowledge-sharing, to determine how these impact on transportation infrastructure project success. The context for this study is the construction of a major highway in the United Arab Emirates.*

Design/methodology/approach – *Multiple sources of data are used in this case study that include the following: examination of various documents relating to the project in question; interviews with ten key stakeholders involved with the construction of the project; observations made during the site visit and interviews conducted with four site engineers; a focus group conducted with six key stakeholders involved in the project; and finally interviews conducted with the Minister of Public Works and the Director-General of the Ministry of Public Works. Analysis was conducted using NVivo.*

Findings – *Identification and involvement of key stakeholders, particularly in the early phases of a construction project, is found to be highly critical. Managers must develop detailed understanding of stakeholders' influence in terms of their legitimacy, power and urgency in achieving effectiveness of the management processes.*

Originality/value – *The study highlights how different stakeholders influence communication, coordination, decision-making and knowledge-sharing at different stages of the construction project. Hence, understanding stakeholder's level of legitimacy, power and urgency across the different stages of a project is highly critical.*

Keywords *Decision making, Construction industry, Coordination, Knowledge sharing, Communication*

Paper type *Research paper*

Introduction

In a recent article, Guo *et al.* (2014) highlight that "complexities and uncertainties are endemic in large infrastructure construction projects" (p. 815) and that "case studies have implications for the organization and management of major infrastructure construction projects, particularly in situations of high-risk, complexity and high performance requirements." (p. 824). In their paper, these authors present a comparison of two mega construction projects – one in China and the other in New Zealand – to understand how different governance arrangements influence the process of risk management and hence project outcomes. There is growing recognition of the need to undertake in-depth case study research examining the various factors that impact on the success or otherwise of construction projects.

Along with the increasing complexity and uncertainty in large infrastructure construction projects, there has been growth in the application of the stakeholder theory by researchers in this field. Littau *et al.* (2010) highlight this development over the period 1984 to 2009 in their meta-analysis of articles published in the leading project management journals and

conclude that "stakeholder theory is becoming an important approach in project management [research]." (p. 25). Alongside academic interest in applying stakeholder theory in this field, there has been parallel interest in examining construction supply chains. Recent publications in this respect includes Prakash and Mohanty (2015) who focus on supply chain management of road construction projects, while Pryke (2009) is a collection of articles on supply chain management concepts, including case studies, in the construction industry.

Guo *et al.* (2014) recognise that their "study limited the scope of analysis by emphasising project-wide stakeholders and their relationships. The context, within which the project stakeholders operated, such as the political, economic and social factors, was left outside the scope of analysis" (p. 824). It is these gaps in the literature that provides the motivation for this paper which presents an in-depth case study that examines how key stakeholders influence the success of a transportation infrastructure project recently completed in the United Arab Emirates.

The aim of our study was to identify improvements that can be made to management processes that ultimately impact on transportation infrastructure project success. In achieving this aim, we undertook a qualitative approach to data collection that involved the following phases:

- examination of various documents relating to the project in question;
- interviews with ten key stakeholders involved with the construction of the project;
- observations made during the site visit and interviews conducted with four site engineers;
- a focus group conducted with six key stakeholders involved in the project; and
- interviews conducted with the Minister of Public Works and the Director-General of the Ministry of Public Works.

The remainder of the paper is structured as follows. The next section provides a brief review of the relevant literature followed by the section that outlines the research approach adopted for this study. The findings are then presented followed by the discussion section and conclusions section which highlights the contributions made from this study and suggestions for future research.

Literature review

Establishing the basic transportation infrastructure within a country is regarded as a catalyst to accelerate overall economic growth. In many countries, infrastructure developments are inherently characterised by an active government role, especially in developing countries where a relatively small percentage of infrastructure has been privatised (Doh and Ramamurti, 2003). Governments have multiple roles in infrastructure projects: sponsor/investor; consumer/customer; rule-maker/regulator; and mediator/moderator of opposition political and non-governmental interests (Doh and Ramamurti, 2003). Hence, federal and local governments are key stakeholders in infrastructure development projects, as is the case in the UAE.

El-Sayegh (2008) identified and assessed the significant risks in the UAE construction projects based on their impact and probability – the impacts are of concern to all stakeholders. Economic risks such as inflation and sudden changes in prices, shortages in resources supply and availability including material, labour and equipment are significant. Other important risks identified are owner risks such as tight construction schedule, improper intervention and change of design. Hence, contractors need to negotiate construction schedules with owners, if possible, or at least allow for time contingency and

buffers in their schedules. Guo *et al.* (2014) investigated how different project governance structures affect the management of risks. A top-down centralised, single-agent governance implied a more responsive, controlling approach to project risks, whereas alliance governance structure created a sense of ownership and encouraged proactive solutions to risk sharing across participant organisations.

Gkritza and Labi (2008) studied the likelihood and amount of discrepancies in highway projects. Their findings indicate that the contract award amount and specified contract period are influential factors of cost overruns. It was found that the longer the specified contract period, the higher the probability that it will incur cost overruns and the larger the amount of cost overruns. Hence, effectiveness of the management processes is critical to overall project success.

In examining the importance of management processes to infrastructure project success, we make use of stakeholder theory, recognised as important by Littau *et al.* (2010). This is briefly discussed below.

Stakeholder theory

Freeman (1984) defined stakeholders as any group or individual who can affect, or is affected by, the achievement of a corporation's purpose. In another definition, (Mitchell *et al.*, 1997) described a project stakeholder as a person or group of people who has a vested interest in the success of a project and the environment within which the project operates. Vested interest is defined as having possession of one or more of the stakeholder attributes of power, legitimacy or urgency (Mitchell *et al.*, 1997). *Legitimacy* is the moral or legal claim a stakeholder has to influence a particular project; *Power* refers to a stakeholder's capacity to influence the outcome of a given project; and *Urgency* is the degree to which a stakeholder's claim is urgent or compelling.

There are essentially two categories of stakeholder: internal stakeholders, who are actively involved in project execution, and external stakeholders, who are affected by the project. During the different stages of a construction project, various stakeholders express their needs and expectations about the project, which often conflict with each other and not all their expectations can be met (McManus, 2002). "The ability to understand the often hidden power and influence of various stakeholders is a critical skill for successful project managers. Without attention to needs and expectations of a diverse range of stakeholders, a project will probably not be regarded as successful, even if the project manager was able to stay within the original time, budget and scope" (Bourne and Walker, 2005, p. 650).

In evaluating the needs and expectations of stakeholders, Olander's (2007, p. 277) analysis develops a stakeholder impact index "to determine the nature and impact of stakeholder influence, the probability of stakeholder exercising their influence and each stakeholder's position in relation to the project – are they proponents or opponents?". Based on the work by Olander, Nguyen *et al.* (2009) applied stakeholder impact analysis in Vietnam to investigate stakeholders' impact on state-owned civil engineering projects. Their analysis, based on responses to a questionnaire survey completed by 57 project managers, showed that "clients had the highest level of impact on the projects, followed by project managers and the senior management of state-owned engineering firms" (p. 1129).

Yang *et al.*'s (2014) deployed both qualitative and quantitative methods to analyse the "underlying meaning of stakeholders' attributes, behaviours, and decision-making strategies from the practitioners' perspectives". Their analysis indicates the "influence of stakeholder-related factors on the decision-making strategies" (p. 74).

Mok *et al.* (2015) present a systematic review with respect to stakeholder management studies conducted in the context of mega construction projects, covering research

published over the period 1997 to 2014. They identify four major research topics from this review. These are:

1. stakeholder interests and influences;
2. stakeholder management process;
3. stakeholder analysis methods; and
4. stakeholder analysis.

These authors emphasise the importance of national context, identifying the "impact of national culture on this discipline" (p. 446).

In another review, Chan and Oppong (2017) identify 49 common stakeholder expectations and classify these into social, environmental and economic sustainability objectives. These authors conclude that for "effective management, project managers (PMs) must know stakeholder opportunities and threats, fulfil social responsibilities, establish common goals, apply appropriate strategies, and enhance stakeholder satisfaction" (p. 736).

In the context of hospital construction projects, Collinge (2016) analyse a "series of vignettes to illustrate stakeholder management practice in action" and combine these with "the insights of a client relations manager with direct responsibility for stakeholder management affairs. The article provides practical guidance for practitioners and explores how stakeholder management issues revolve around the emerging event, with a supporting apparatus to facilitate communication and collaboration being critical to stakeholder interests and concerns being addressed" (p. 394).

Using social network analysis methodology, Dilio (2012) developed a framework to measure social sustainability performance of public infrastructure projects and demonstrated its application through a case study in Australia. This is likely to increase in its importance as a future research topic, given the attention paid to sustainable development in all aspects.

Key management processes

Along with stakeholder importance, the key elements identified in the literature review as likely to be important are the four management processes in construction project management, namely, communication, coordination, decision-making and knowledge-sharing. We consider these to be absolutely critical to project success and must receive careful attention by management.

Successful projects appear to be those that comprise ongoing, clear and effective communication practices between stakeholders, clients and the project management team in particular. The literature on construction management has widely emphasised the role of communication in effective management. Zwikael *et al.* (2005) examined project management practices and concluded that various types of management style, scope and time management can impact on improving technical performance of projects, while communication and cost management impact on improving overall success measures of projects. Other researchers have suggested the use of communication effectiveness models to predict satisfaction levels by contractors and clients at the earliest possible stage in the project life cycle (Soetanto and Proverbs, 2002). To minimise defective designs and subsequent overrun of cost and schedules, Zou *et al.* (2007) reported that the design team needs to establish an efficient communication scheme among the designers. Stewart (2007) stressed that strategic implementation of innovative information and communication technologies are essential for the long-term survival of construction firms. The lack of communication among parties was reported among the ten most important causes of project delay by Sambasivan and Soon (2007).

Olanrewaju *et al.* (2017) state that Malaysian construction sector's poor performance has its roots in poor communication. These authors conducted a cross-sectional study (questionnaire survey) involving 80 site workers and find a number of causes including:

- the absence of a shared language between superiors and workers;
- workplace stress;
- superiors' and their colleagues' attitudes towards site workers;
- misinterpreting of instructions; and
- poor communications skills among workers.

In their conclusion to this study, Olanrewaju *et al.* (2017) emphasise "that unless communication issues are addressed, the construction sector is likely to perform poorly" (p. 769).

Strong and effective coordination effort between key stakeholders is vital to keeping everyone informed of progress and any associated issues as they arise. Timmermans and Beroggi (2000) stressed the importance of coordination between organisations with diverse objectives. The concept of international coordination for transportation infrastructure projects was addressed by Short and Kopp (2005). Chen and Partington (2006) emphasised the ability of project managers to coordinate activities on site. Lack of coordination among project participants was identified as a key risk factor in Australian projects (Zou *et al.*, 2007). In the UAE, particular emphasis has been given to this coordination issue, especially among various governmental agencies. The Executive Council of Abu Dhabi issued the "Policy Agenda for the year 2007-2008", where coordination was emphasised many times throughout the report.

A more recent study by Alaloul *et al.* (2016) examined coordination factors that influence building project performance in Malaysia. Based on an initial list of 53 coordination factors identified, the authors conducted three rounds of a Delphi Study to rank these factors, selecting 16 of the most important factors. The top three factors identified were:

1. scheduling;
2. quality assurance plans in which all parties were involved; and
3. contract documents, again having all parties participating.

Decision-making typically involves identifying and choosing among alternatives, based on the values and preferences of the decision-makers. The necessity of a feed-back loop to gain insights on decision-making in various projects was emphasised by Short and Kopp (2005), suggesting that to improve planning processes and decision-making, it would be helpful to look back at past decisions and extract lessons from them. Decentralised communication channels are known to facilitate better information flow and decision-making when problems arise. Clients who have decentralised communication channels ease communication and facilitate faster decision-making (Soetanto and Proverbs, 2002). Sambasivan and Soon (2007) identified client's slow decision-making as primary factor for project time and cost overrun.

Erdogan *et al.* (2017) develop a nine-stage model for solving decision-making problems in construction and apply this in a real case study. They identify the following set of criteria:

- technical experience;
- performance recourses;
- financial stability;
- management performance and employees qualification;

- capacity;
- safety record; and
- operation and equipment.

To address the problems associated with subjective decision-making, Kasiazek *et al.* (2015) developed an informatics tool called ESORD that allows a hierarchy to be established (ranking) of different types of solutions on the basis of mathematical calculations to solve difficult problems in construction.

Finally, with respect to decision-making, Abbasianjahromi *et al.* (2018) make use of the Kano model in selecting subcontractors and develop a fuzzy multi-attribute decision framework to select the best subcontractor. These authors go on to validate the accuracy of this framework in a case example.

Knowledge-sharing is a means of increasing useful knowledge within the organisation. Ways to do that include encouraging communication, offering opportunities to learn, promoting and sharing of appropriate knowledge artefacts. Knowledge-sharing represents an important "feed-back" loop and Jackson and Klobas (2007) stressed the need to develop a knowledge-sharing process model for project managers. Kovacs and Paganelli (2003) further noted that data and knowledge interchange is critical for improving efficiency and standardise operations of complicated distributed organisations.

Tan (2015) focuses on the policies and institutions in Singapore to show construction knowledge is continuously tapped to achieve high levels of quality in construction. Yu and Yang (2018) present a review of knowledge management (KM) research in the construction industry and propose an expanded research framework to encourage and guide future research. Their review led to the following conclusions:

- KM research has significantly blossomed in the past two decades with a great potential;
- Major topics of KM were changing in terms of technology, technique, organisation, attribute of knowledge and research objectives; and
- Past studies were centred around management organisation, managerial methodology and approach and managerial objective.

Our study adds to the growing body of literature examining management processes in the construction industry. These include a recent study by Ferreira *et al.* (2015) that examined purchasing activities in the construction industry. These authors developed and applied a purchasing portfolio model to a construction company which enabled it to define its purchasing strategy. Other papers have focussed on understanding construction supply chains – see for example Briscoe *et al.* (2004), Tennant and Fernie (2014) and Behera *et al.* (2015).

Research methodology

Our overarching research question in this study is: "How important are management processes in the successful completion of a large construction project?" The context for our study is the construction of a major highway in the United Arab Emirates.

In adopting the appropriate research approach, it is important to adopt proven research techniques. Hence, for this study, a qualitative approach was selected for our investigation.

Qualitative research is an inductive method of inquiry used in many different academic and applied disciplines. Researchers using qualitative methods (case studies) gather an in-depth understanding of natural and human behaviour and the reasons that govern such phenomena. Techniques commonly used include interviews (structured or unstructured),

focus group discussions, literature and material reviews and observation techniques (Myers, 1997).

Case study research aims to provide a detailed understanding of a complicated issue or object and can extend experience or add strength to what is already known through previous research (Myers, 1997). Case studies emphasise detailed contextual analysis of a limited number of events or conditions and their inter-relationships. The process of developing an in-depth case study approach is defined by the objectives of the research project. The primary objective of our study was to understand how key stakeholders (in terms of power, legitimacy and urgency) affect communication, coordination, knowledge-sharing and decision-making, which eventually impact on the project success.

Interviews were used as the main method of data collection, involving key stakeholders representing sponsors/clients, government departments, project management firms, consultants and contractors. Yin (1994) considers interviews to be more a "guided conversation" rather than a structured inquiry while Bewley (2002) recommended that interviews with the goal of theory generation need to be less structured as the information can describe unexpected reasons for specific phenomena. The principal limitations of interviews, noted by Yin (2009), are that they are extremely time-consuming and expensive, and it is difficult to access persons of power and set interview appointments.

The Dubai-Fujairah Highway (DFH) project in the UAE was selected as the case study, given the problems and difficulties experienced during its history. Project inception and the initial study for the DFH commenced in 1999 with the highway eventually opened to the public in 2012. The project has an interesting history and was therefore selected as a suitable case for in-depth examination in this research project.

A brief outline of the procedures relating to the conduct of the interviews, site visit and the focus group is presented below.

Document examination

Many files, containing reports and correspondence relating to the DFH Project from its inception to the time when the in-depth case study was conducted, were identified. Four major files were considered important in this study and were examined in details. The content of the files reflect all the circumstances of the project, the procedures adopted and the difficulties faced at its various stages, especially during the planning and design stages. Issues relating to communication, coordination, knowledge-sharing and decision-making were studied to identify their impacts on project outcomes.

Face-to-Face interviews

The interviewees were selected from stakeholders who were considered to possess the three attributes of legitimacy, power and urgency in different combinations and to varying degree. The DFH Project commenced in December 1999. Some of the staff involved in the very early stages of the project was unfortunately not able to be interviewed as there had been many changes to the structures of the organisations involved in the DFH Project. The ten individuals selected for interviews represented sponsors/clients, government departments, project management firms, consultants and contractors. All ten interviewees held senior management level positions and continued to play a key role and influence the flow of work relating to the DFH Project. All but two of the ten interviewees were males, with one female project manager and a female utility executive. Overall, eight of the ten interviewees were directly involved in the management of activities of the DFH project. More specifically, two of the interviewees were involved in the construction activities, two involved in the design activities and two in the planning activities. The interviewees exhibited good understanding of the research work and were cooperative, willing and happy to share their

own experience and knowledge of the project. The interview was structured into a number of relevant sections, dictated by the purpose of the task. All interviews were digitally recorded.

Focus group discussion

Zikmund (2000) noted that the focus group is a form of qualitative research in which a group of people are asked about their perceptions, opinions, beliefs and attitudes towards a product, service, concept, advertisement, idea or packaging. Using the same criterion as for selecting the ten interviewees, participants for the focus group discussion session were selected based on having two or all three stakeholder attributes: legitimacy, power and urgency (Mitchell *et al*, 1997). The focus group discussion was intended to produce data and insights that would be less accessible without interaction found in a group setting. It is important to note here that participants were viewed as possessing important knowledge about the DFH Project, and they had experience, needs, and perspectives that the researchers hoped to learn more about. The six participants included in the focus group were representatives of the consultants (design and site supervisor), the contractors, the project management firm and the Ministry of Public Works.

Site visit and discussion with site engineers

An on-site visit was included for a better understanding of issues associated with the DFH project and to obtain additional details from the workers on-site that are not always available from senior staff. In addition to the site observation activities, the visit also included a 60 minute open discussion forum with four site engineers. Three of the four site engineers were Resident Engineers (RE) of the project, while the fourth was a Deputy Resident Engineer.

Other data collected

Finally, discussion lasting approximately 90 minutes each was held with the Director-General of the Ministry of Public Works (MPW) and the Minister of Public Works to incorporate their views on the DFH project.

Data analysis. The large amount of data collected was analysed using the NVivo software; a proprietary software package for the organisation and analysis of complicated non-numerical unstructured qualitative data. It is primarily used by qualitative researchers working with very rich text-based and multimedia information; where deep levels of analysis on small or large volumes of data are required (QSR10, 2012). The software allows users to classify, sort and arrange thousands of pieces of information; examine complicated relationships in these data; and combine subtle analysis with linking, shaping, searching and modelling. NVivo accommodates a wide range of research methods, including network and organisational analysis, action or evidence-based research, discourse analysis, grounded theory, conversation analysis, ethnography, literature reviews, phenomenology and mixed methods research (Richards and Morse, 2007; Richards, 2005; Coffey *et al.*, 1996).

Results

The project: Dubai-Fujairah highway (DFH)

During the 1990s, the UAE witnessed a significant increase in activities relating to economic development, tourism, and construction. The Ministry of Public Works (MPW) identified a substantial increase in traffic movement on the road linking the Eastern Coast with the Western Coast, which passes through many residential, commercial and industrial areas. The MPW developed a number of plans to facilitate traffic movement as well as to generate economic and agricultural development and open new horizons for business opportunities for the population living in the area. By the end of 1999, the MPW had decided to build a

new highway linking the Eastern Coast with the Western Coast of the country. The DFH was intended to serve a number of cities in the Emirates of Dubai and Fujairah including Mileha, Shouka, Aukhdeirah, Kadrah, Asfany, Al Firfar and Al Hayl.

The DFH Project involved constructing a new route in accordance with the highest international standards. This was expected to reduce the travel time between the destinations and minimise the number of road accidents. At the start of the project in 1999, the estimated budget was AED 350m; however, the cost had escalated to AED 1.43bn by July 2009. Hence, the DFH Project can be considered a unique mega project. Mega projects are huge undertakings that can cost $1bn or more, require resources that run into millions of man hours, numerous stakeholders, an extraordinary amount of interlinks and completion time of five years or more. They usually generate high public attention (Li and Guo, 2011).

Table I shows that the time saved in travel on the new highway was expected to be almost 30 min. Furthermore, significant benefits with respect to safety and environmental issues were also expected from the DFH Project. The aim was to reduce right-angle and rear-end crashes by 80-100 per cent reduction and to control speeds by Speed Rader Detectors and Early Warning Systems as well as increasing the width of the safety shoulders along the highway. In addition, the DFH Project would benefit residents in many cities by reducing sound, air and heat pollution, as it bypasses high density residential areas. Moreover, the DFH Project takes into consideration other environmental issues such as the wild life and the destruction of valleys and mountains. The DFH design consists of three interchanges and six underpasses to facilitate free movement of traffic through a very tough mountainous area and complicated geological strata. The tough natural terrain necessitated high rock cuts (over 100 metres in some locations), and construction of bridges to avoid existing utilities and high pressure water and gas lines. Accordingly, the DFH Project is deemed to be not only a very complicated project but also one of very strategic importance to the nation.

After the completion of the design, the DFH Project was divided into two tenders – Contract 1 covering 17.35 Km and Contract 2 covering 22.65 Km of the DFH. The project was tendered at the end of 2003, and both contracts awarded to the one construction contractor in July 2006.

Initially, the DFH was designed for 120 Km/h speed limits, but as the tenders were higher than the initial estimated budget (AED 350m), the designer was asked to perform value engineering to reduce the total cost. Among the value engineering (usually defined as the ratio of function to cost) attempts was to reduce the design speed to 100 Km/h; however, the estimated cost of this alternative was still higher than the initial budget. Accordingly, the initial budget of AED 350m was increased. Approximately six months into the construction of the DFH, the MPW made the decision to increase the design speed again to 120 Km/h and to construct an additional lane to make it three lanes in each direction. This decision delayed the completion of DFH project significantly and the total time scheduled for completion of the highway increased by almost four times. This also increased the project cost. To reduce the time for completion of the construction processes, the MPW, in early

Table I Comparison between Meleiha Road and the DFH project

Key measure	*Existing Sharjah – Fujairah Road*	*New Dubai- Fujairah Highway*
Total distance	96 km	84 km
Speed limit	80 km/h	120 km/h
Trip time	72 min	42 min
Car crash reduction	Specific figures not available	Estimated 80-100%
Traffic capacity	3,600 vehicle/h in each direction	6,000 vehicle/h in each direction

Source: File D

2009, decided to delete some parts of Contracts 1 and 2 and float it in Tender 3. Construction included the building of five utility bridges and two high cut areas with a construction cost of AED 423m. This had increased the DFH project budget from the initial estimate of AED 350m to AED 1.43bn.

Since the inception of the DFH Project, a number of major events have taken place that has impacted on its progress. These include hiring of new consultants, design variations and re-tendering of contracts. Thirteen different milestones have been identified and these are illustrated in Figure 1.

Given the substantial amount of data that has been collected in this study, it is not possible to present the detailed analysis here in this paper. Below, we present the overall key findings.

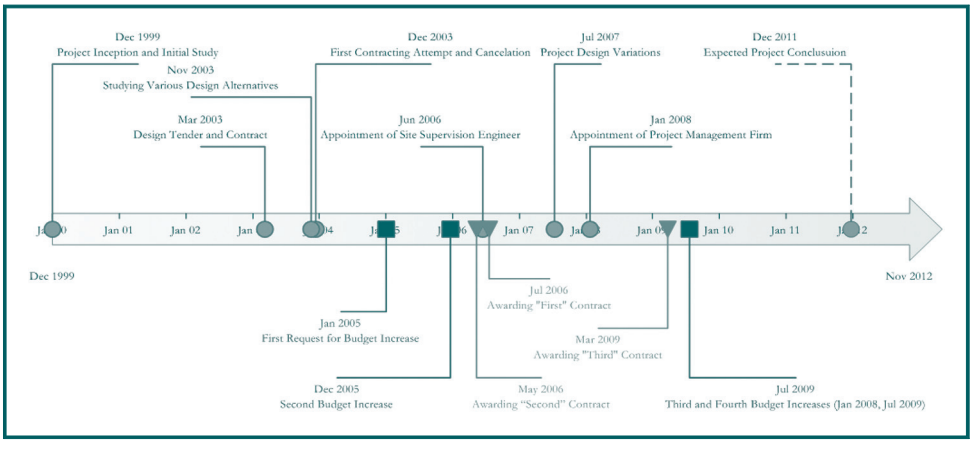
Findings from the examination of DFH project documents

A deficiency on how decision-making was carried out, especially in the earlier stages of the DFH Project was identified. This was clearly evident by the various changes introduced and ineffectiveness since inception in establishing the project specifications including the number of lanes and design speed. Even after the project design stage was finally completed, there were still no definitive decisions on these characteristics leading to further changes later on. There were also deficiencies identified in communication and coordination among federal and local government authorities leading to several variations, redesign and repeated progress interruptions.

The slowness of decision-making in the early stages of the project significantly affected the work progress and resulted in considerable time overrun. This was evident from the assignment of one design consultant at the early stages and then the re-assignment to another further on. The assignment initially of a construction contractor and then re-tendering the contract and assigning it to another, led to significant difficulties and delays. In addition, the assignment of a consultant for the re-design and then another one later for the same task also highlights inefficiencies in decision-making and unnecessary waste.

Inaccurate and continuing poor estimations of the project budget with the subsequent ongoing need for additional funding also led to considerable delays and major cost inflations. For instance, in 2005, the budget was initially increased from AED350m to AED500m, then again only a few months later when the project was retendered to more

Figure 1 Summary of DFH project milestones



than AED872.6m. Throughout the project execution, the anticipated budget grew to exceed AED1.4bn (a four-fold increase in budgeting over six years).

There was clear evidence that the initial design was not well developed or scoped, largely due to the inexperience of many individuals involved initially in the DFH project. This resulted in many variations and redesigns during subsequent stages of the project.

Interviews with key stakeholders of the DFH project. The findings from the interviews conducted with ten key stakeholders involved in the DFH project emphasised the importance of the planning and design stages. The important stakeholders involved in these stages of DFH project were the local authorities, the MPW and the utility service firms. Contractors, consultants, community users and financial institutes were ranked lower in importance during the early project stages.

There was disagreement among the ten stakeholders interviewed over whether the DFH project was successful. Three of the ten interviewees clearly indicated that the project was not successful in terms of meeting budget, time schedules and achieving quality standards, while others were less committal. Other success measures reported to be lacking included good coordination and communication within the Ministry, stakeholder satisfaction, competent and experienced clients and consultant staff and proper construction management. The main reasons for project delays were design changes, mixed client instructions, technical issues and improper design and coordination.

The reasons given for cost overrun included poor design and lack of communication, coordination, and knowledge-sharing amongst the stakeholders. Changes in design and requirements, changes in requirements by federal government, inadequate planning study, and cost inflation were also highlighted. The overall quality of the DFH project was considered to be good generally by those interviewed, although they did express suggestions for further improving the quality. These included faster decision-making by the client, better specifications, better safety considerations, proper management and supervision of staff, the introduction of standard risk management procedures, better accessibility through the tunnels and issues of improved accountability.

Interviewees indicated a number of management concerns or deficiencies in the implementation of the DFH Project. These included budget variations and insufficient coordination, communication, decision-making and knowledge-sharing, especially in the early project stages. Others also included a lack of management expertise especially poor technical abilities of client staff and lack of concern for safety. The majority of the interviewees thought that these concerns were valid throughout both the planning and design stages of the DFH projects.

A number of suggestions were made on how communication in the DFH project could have been improved, namely better communication with high level authorities, forming a committee of all stakeholders to provide input into the project, and importantly, greater commitment by the stakeholders to improved communication policies. There was agreement that coordination of the project was somewhat lacking initially. The main suggestions to improve coordination among stakeholders in the DFH project included establishing committees, improving documentation and establishing alliances. There was consensus that coordination had improved markedly during the project life-cycle.

Decision-making was largely considered to be “Top-Down” and suggestions for improvement included a stronger commitment to wider decision-making processes and follow-up; more decision-maker visits to the construction site; wider delegation of authority and power; more competent, professional and experienced staff; the need to build a solid management team; and greater trust.

The extent of knowledge-sharing among stakeholders was generally considered satisfactory, although variable throughout the life-cycle of the project. Suggestions for

improvement included creating appropriate databases and dissemination, holding regular committee meetings with targets and goals, regular media involvement to disseminate to the whole community, sharing project management tools and changing contracting arrangement from confrontational to alliance.

Results obtained from the focus group discussion

The findings from the focus group discussion session held provided additional issues that had not been mentioned in the face-to-face interviews with the ten stakeholders. These can be summarised in the points below:

- No accurate scoping of the study was conducted at the initiation stage of the project and a lack of experienced staff which led to poor decision-making early on. Final decisions were generally always taken by the client (the MPW). Inadequate specifications in the initial design, primarily in the number of lanes and design speed and other design parameter changes continued to be introduced even throughout the construction stage.
- Disbanding the project committee during the construction stage was not considered to be beneficial to the project overall. Focus group participants thought that it would have been better if this committee continued until the completion of the DFH Project.
- Meetings between the various stakeholders were not held regularly and focus group participants strongly believed that these meetings should be held more frequently that would have resulted in resolving many of the issues experiences in the DFH project.
- Generally, stakeholder satisfaction was negatively affected by the inadequate and unclear project scope and the frequent design changes. There were multiple consultants involved in the project and no specific authority was given to them and the contractors that also contributed to stakeholder dissatisfaction.
- Especially during the earlier stages of the project, adequate knowledge-sharing systems were not in place which also contributed to poor project progress and outcomes.

In summary, the above points to:

- inexperience on the part of the early management staff, perhaps because the DFH Project was a novel, large project;
- poor decision-making and poor alternative choices;
- changes in design and budget constraints;
- limited knowledge-sharing; and
- the lack of experienced of the staff by the Client during the early stage of the project.

Site visit – Dubai Fujairah highway

The DFH project site visit included an assessment of work progress captured mainly by site examination, observing work activities, and open discussions with four site engineers. The site visit was especially beneficial in providing an overview of many of the issues raised during earlier interviews and discussions, and from a clearer understanding the DFH project process generally. The considerable delays in decision-making and the time taken to communicate between the client and the site engineers was considered by those at the site to be primarily caused by the unnecessary presence of the project management firm. It was highlighted that this led to little or no interaction between the site engineer and the construction team and was not justified. There was limited authority in decision-making

given to the site engineers and there was no particular system in place for knowledge-sharing on-site.

Generally, there was a view that the project experienced unnecessary delays due to the project management firm and that progress would have been much faster without their presence. Communication and coordination among all the stakeholders with the construction team was somewhat lacking. Not surprisingly, there was, however, no mention of any delays caused by the contractors themselves.

Interviews with the Director-General and the Minister of Public Works

The interviews conducted with the Director-General of the MPW and the Minister of Public Works confirmed much of what was highlighted from examining the project documents, the site visit, stakeholder interviews and the focus group discussion session.

Both the Director-General and the Minister indicated that the major reasons for delay and cost overruns of the project were the result of the complicated nature of the DFH Project and inadequate decision-making due to the considerable ambiguity of the project. Unsuitable and inadequate managerial skills at the early stages of the project had led to improper planning, improper integration during the various project phases, inaccurate design, poor communication, inappropriate transfer of duties and design problems associated to variations and claims.

The Minister emphasised the importance and later improvements in coordination, communication, decision-making and knowledge-sharing in the DFH project that enhanced performance; reducing decision-making time and meeting the final budget allocated. The technical administrative problems that existed during the early stages of the project were acknowledged and the Minister emphasised that there were no clear project objectives and proper specifications developed early on. The frequent variations and redesigns to satisfy a changing project specification in number of lanes and speed limit requirements led to excessive budget increases and delays.

The Director-General and the Minister provided details on the modified strategies, procedures and techniques adopted by the MPW for new mega projects being constructed. These changes included the following:

- The adoption of a different management strategy where the MPW now pays greater attention to the project.
- External consulting firms are now involved during the early stages of the project and a management committee is always established.
- Improvements in communication and collaboration within the management committee and between all stakeholders. There is a serious attempt to develop a better understanding of capabilities of the other stakeholders and contractors involved in the project.
- There is now considerable delegation of responsibilities to other stakeholders and the project management skills have improved considerably.
- A knowledge database has been established and appropriate information is shared widely among all MPW departments, and other key stakeholders.

As a result of the above changes, subsequent construction projects initiated and completed by the MPW have resulted in significant improvements in terms of project outcomes. Based on the above findings, the next section presents the discussion, specifically relating to stakeholder's influence and management processes/ practices.

Discussion

Overall, the results from both phases of the study confirmed that planning and design phases are the most important in executing a mega transportation infrastructure project successfully, and that they can significantly affect project completion and success. Local authorities, federal government and the client (the MPW) are the most important stakeholders, especially during the planning and design phases. Blair (1996) discussed this as a critical step in the evolution and growth of management research. Moreover, Weston and Copeland (1992) and Cleland and King (1994) also argued that detailed planning is fundamental behind successful development and implementation of large-scale infrastructure projects.

The Dubai Fujairah Highway (DFH) project case study involved many important stakeholders from its inception to completion. The importance of these stakeholders was seen to be based on their possession of the attributes of legitimacy, power and urgency mentioned by Mitchell *et al.* (1997) in the Stakeholders Theory. While this theory has been subjected to modern criticisms by Key (1999) and Fassin (2008), others such as Oliverio (2007), Ackermann and Eden (2011) and Jensen and Sandstrom (2011) still claim it has considerable merit in clarifying dynamic processes in project management today. Recent reviews/studies by Mok *et al.* (2015), Chan and Oppong (2017), Collinge (2016) and Dilio (2012) highlight the growing importance of stakeholder theory in construction management research and its application in construction projects.

The stakeholder's level of legitimacy, power and urgency however, was shown to vary across the different stages of the DFH Project. The stakeholders emphasised aspects of key management process (communication, coordination, decision-making and knowledge-sharing), impacting in different ways over the various stages of a project life cycle, as noted by Mitchell *et al.* (1997). Importantly, though, as originally reported by Freeman (1984), stakeholder theory's main strength is its simplicity and clarity in explaining stakeholder interactions in these projects, and shown to be evident in the findings of the DFH project.

Project success can be defined in many different ways as illustrated by the results here. The simplest form of success came down to the project being on time and on budget, although stakeholder satisfaction was also noted as important. Atkinson (1999) also claimed that project success primarily involved cost, time, and quality, consistent with the views of many who were interviewed in this study. However, other views by the participants here such as stakeholder satisfaction and acceptance, and long-term benefits to the travellers were also identified. Kerzenr's (2006) outlined a seven dimension framework of success factors, namely, within time, within budget, proper performance, acceptance by the user, mutual agreement, without disturbance, project quality and adopting corporate culture. Clearly, there are many ways of defining the success or otherwise of mega projects such as the DFH and one must be careful not to use simple criteria when judging success. Importantly, the benefits of the DFH project will provide easier access to many communities across the remote areas of the UAE which should not be overlooked.

Although management practices in transportation infrastructure projects in the UAE were considered to be generally good, there was agreement that further improvements were needed in coordination, communication, decision-making and knowledge-sharing between all the stakeholders. Azzopardi (2010) argued of the need for construction organisations today to focus on globalisation and pace of change to stay ahead of its competitors. This clearly demands a strong focus on the four key management processes examined in this study. The lack of knowledge-sharing and poor decision-making, along with a lack of qualified contractors with appropriate technical capability and shortage of skilled engineering and other staff, were key factors in the DFH project's lack of success. Ultimately, the inability to constrain costs and time overruns go against today's needs for successful construction projects in the UAE.

Delegating authority for decision-making to other stakeholders seems important to improve the quality of outcome and the speed of decision-making. Developing detailed procedures and regulations too is important. Among the key elements identified by Katzenbach and Smith (2007) for successful work teams is relying on members with strong technical and interpersonal skills and an ability and willingness to learn. As such, the need for them to be more involved and trusted in making project decisions is fundamental for the success of the whole team. Collins (2001) stressed the importance of having the right staff and leadership for the long-term success of an organisation, a lesson to be learned here also.

Contribution of our study

This papers supports and strengthens the work of Mitchell *et al.* (1997) on the importance of stakeholder management – in this case in the context of the construction industry and with respect to management processes. Our case study analysis highlights the influence that different stakeholders have on the management processes at different stages of the construction project. Hence, understanding stakeholder's level of legitimacy, power and urgency across the different stages of a project is highly critical. This is also the first study in the context of a highway (a mega project) constructed in the United Arab Emirates and agreed to by the various practitioners engaged in our case study research (focus group). The insights provided in this paper are of significant value to practitioners/decision-makers. In summary, the study highlights that:

- The planning and design stages are most important that can significantly affect project completion and success. Decision-makers must ensure that these two stages are completed effectively by involving all stakeholders and relevant knowledge and experience is shared amongst all stakeholders involved.
- The power, urgency and legitimacy of each stakeholder varies across the different stages of a construction project and hence influences the different management processes, namely communication, coordination, decision-making and knowledge-sharing. This will require different management styles and approaches to be adopted across the different project stages.
- A broad range of project success measures should be developed covering social, environment and economics aspects. The DFH project case study presented in this paper highlights the importance of social benefits for the communities affected by the project.
- All stakeholders need further development of their competencies in the management processes involved. This will continue to be the case as construction projects become larger and complex with increasing levels of uncertainty. Collaboration amongst the stakeholders need to be emphasised strongly – leading to high levels of trust being developed so that effective decisions can be made without wasting resources.

Conclusion

Responding to the call for case study research in the construction industry (Guo *et al.*, 2014), this paper has examined stakeholder influence on management processes involved in the construction of a major highway in the United Arab Emirates. The key management processes examined are communication, coordination, decision-making and knowledge-sharing. Multiple sources of data were used in this case study that extended from its initial inception in 1999 to its completed, taking over 10 years. Identification and involvement of the key stakeholders in the early phases of a construction project are critical. Developing an understanding of their influence in terms of their legitimacy, power and urgency goes a long way in the effectiveness of the management processes.

A limitation of our study is that it is based on a single case study. However, we have used multiple sources of data to overcome the common concerns raised in qualitative research. Future research in this area should use multiple case studies as well as comparative studies involving construction projects completed in different parts of the world, for example comparing developed countries with developing countries.

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