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CONCEPTUAL FRAMEWORK OF PROGRAM ORGANIZATION FOR MANAGING CONSTRUCTION MEGAPROJECTS – CHINESE CLIENT'S PERSPECTIVE

Yi HU,¹ Albert P.C. CHAN² and Yun Le³

ABSTRACT

The volume of construction megaprojects has increased exponentially in China since the past two decades because of striking economic achievements and fast urbanization. Over two hundred construction megaprojects, each of which with costs exceeding RMB 5 billion (nearly USD 700 million), were initiated in China between 1990 and 2009. However, projects of that scale are usually beset with poor performance problems, such as cost overruns, safety incidents, functional and quality defects, poor environmental and sustainable performance, etc. Program management has been widely advocated as a major tool to improve the megaproject performance at the overall organizational level. This paper reports the result of an extensive literature review of over 100 journal articles and books published in the past decade. By reviewing these publications, a conceptual framework of program organization comprising 22 factors was identified. These factors are grouped into three categories, program organizational environment, program organizational capacity, and program organizational motivation, and constitute a full organizational framework for managing construction megaprojects from the client's perspective. In addition, unstructured interviews with participants involved the Shanghai Expo construction client organization were also conducted to identify program organizational factors (POFs), which resulted in 20 POFs. Eighteen of them are the same as identified from the literature representing 82% of commonality. The program organizational framework was further refined by interviews with experienced practitioners and two additional POFs were identified. Although this framework needs validation by empirical data, it can provide an overall picture for scholars and practitioners to appreciate key issues of program organization in managing megaprojects.

KEYWORDS: Program organization; construction megaprojects; client organizations; China.

INTRODUCTION

The volume of construction megaprojects has increased exponentially in China since the last three decades because of striking economic achievement and fast urbanization. A recent investigation conducted by the Tongji University (Le 2009) revealed that 203 construction

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megaprojects costing over RMB 5 billion (700 million USD based on the exchange rate of USD 1= RMB 7 in 2009) were initiated from 1990 to 2009. However, projects of that scale are usually beset with problems of poor performance, such as cost overruns, safety incidents, functional and quality defects, and environmental pollutions (Xue, et al. 2008; Le 2009). Flyvbjerg et al. (2003) stated that low performance is a common problem for construction megaprojects worldwide.

Program management approach has received growing concerns from the industry and academics for its capability in improving the performance of megaprojects. Project Management Institute (2006) defined it as “the centralized coordinated management of a group of related projects to achieve the program’s strategic benefits and objectives”. Beehler (2009) stressed its merits for the client in procuring megaprojects through a comparison analysis with two traditional approaches, design/bid/ build and design/ build approaches. This statement has also received extensive support from the academic community (Arrto et al. 2008; Lycett et al. 2004; Remington and Pollack 2007). However, previous studies seldom provide a practical framework for the client to utilize this new approach in practice, in particular for construction megaproject clients (Milosevic et al. 2007). Two surveys conducted in the US and the UK respectively both revealed that there exists a growing demand for the application of program management approach in the construction industry (Rasdorf et al. 2010; Shehu and Akintoye 2009). However, Rasdorf et al. (2010) and Milosevic et al. (2007) noted that there was a lack of clarity and understanding in program management that might result in a lack of interest in this discipline.

In order to fill this gap, current work aims to disclose the full ingredients of program organization. Program organization refers to the client organization adopting program management approach to manage a megaproject. The specific objectives of the current work include:

- (1) What are the program organizational factors (POFs) for managing construction megaproject?
- (2) How do experts involved in the Shanghai Expo construction evaluate this conceptual framework in terms of validity?

RESEARCH METHODOLOGY

The whole research process included three phases as shown Figure 1:

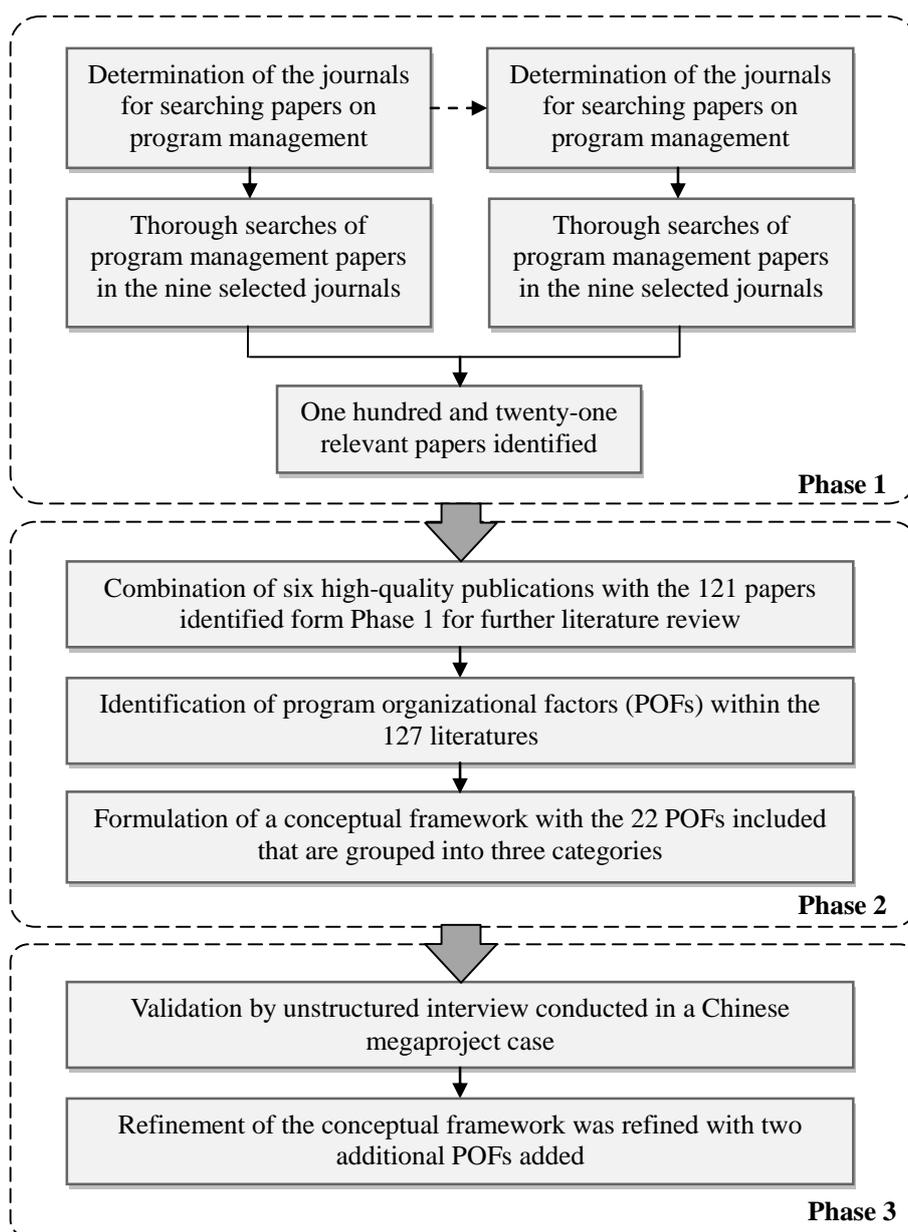


Figure 1 Research Process

In Phase 1, a two-round structured literature review was conducted to identify the papers on two different topics, program management and construction megaprojects respectively, published in the peer-reviewed construction journals between 2000 and 2010. The first round review adopted a method similar to Tsai and Wen (2005) and Ke et al. (2009). The whole review process included three steps:

- (1) Journals published the most number of papers on program management in the period of 2000-2010 were identified by two research engines, the Web of Science (WoS) and the Scopus. Both of these two selected engines contain the world's largest peer-reviewed literature covering over 10000 journals. Common keywords, such as "program management", "programme management", "program control", "programme control", "program controlling", "programme controlling", "program organization", "programme organization", "program coordination", "programme coordination", "program manager",

and "programme manager", were used in the "title/abstract/keyword" field of search engines under the "architecture/business/construction/engineering" sub-area. As a result, four journals were identified as shown in Table 1.

- (2) The four- journal list identified from Step 1 was refined by adding five additional peer-reviewed journals in construction and project management. Four of them were from the journals with the top-six ranking in the Chau's (1997) CEM journal ranking list, and the other is Project Management Journal published by the Project Management Institute, a well-known project management institution in the US. The list with nine journals included was determined.
- (3) Thorough searches in the nine selected journals were conducted, and thirty-seven papers were identified and considered valid on the topic of program management by further examining on their abstracts individually.

Because only limited literature on program management was identified, another round of structured literature review on construction megaprojects was conducted. Arrto et al. (2008) noted that program management research roots in megaprojects. Thus another round of searcher on megaproject papers in the nine selected journals identified in Round 1 was conducted. Actually the nine-journal list was also validated through exploratory searches by Wos and Scopus. The five journals with the most number of megaproject papers published in the past decade were also included in the nine-journal list identified from Round 1. Thus the list was also appropriate to conduct the complementary search on megaproject papers. Common search keywords included "megaproject," "mega project," "large project," "major project," and "complex project". Within the nine same journals, 87 papers were identified and consider valid on construction megaprojects after double examinations. In the end, a total of 121 papers excluding three repeated papers in these two rounds of literature review were identified. All the search works were conducted between January and February 2011. The details of two rounds of structured literature review are shown in Table 1.

Table 1 Results of two rounds of structured literature reviews on program management and construction megaprojects respectively

No.	Journal Title	Code	Number of papers on program management	Number of papers on construction megaprojects	Total
1	<i>International Journal of Project Management</i>	IJPM	26 (31) *	25 (36) *	50
2	<i>Project Management Journal</i>	PMJ	6	18 (5) *	24
3	<i>Leadership and Management in Engineering</i>	LME	1(3) *	3(8) *	4
4	<i>Journal of Construction Engineering and Management-ASCE</i>	JCEM	2(2) *	14(21) *	16
5	<i>Journal of Asian Architecture and Building Engineering</i>	JAABE	2(2) *	2	2

6	<i>Construction Management and Economics</i>	CME	0	9(10) *	9
7	<i>Engineering, Construction and Architectural Management</i>	ECAM	0	11	11
8	<i>Journal of Management in Engineering-ASCE</i>	JME	0	1	1
9	<i>Proceedings of Institution of Civil Engineers-Civil Engineering</i>	PICE-CE	0	4(6) *	4
	Total		37	87	121

Notes:

- (a) The numbers marked with “*” mean the corresponding journals with the most papers either on program management or on construction megaprojects identified by the WoS and the Scopus.
- (b) The numbers in the brackets are the bigger one of the two numbers, the numbers of papers publish by the corresponding journal either by Wos or by Scopus in the Round 1 and 2 literature reviews.

In Phase 2, the identification of program organizational factors (POFs) was conducted through further examining the 121 papers identified. In addition, other six publications from reliable source were also used in the process for identifying POFs. Two of them were the papers from peer-reviewed business journals, *California Management Review* and *MIT Sloan Management Review*; the others were books published by well-recognized institutions and scholars in the program management field such PMI. In this phase, a conceptual framework of 22 POFs was formulated.

In Phase 3, an unstructured case-based interview was conducted to identify POFs from the client organization of the Shanghai Expo construction. Haigh (2008) noted that undertaking an unstructured interview is particularly useful for getting the new theory behind a participant’s experience. The case selection of the Shanghai Expo construction was because the client established an integrated program organization though employing a consultant and successfully accomplished the prescribed megaproject objectives (Ding 2010; Le 2009; Rasdorf et al. 2010). Qualified experts from the client organization of the Shanghai Expo construction were invited to attend the interview. The findings of the interviews validate 81% of the POFs identified from the literature and elaborated the conceptual framework with two new POFs added. The interviews were conducted in January 2012.

CONCEPTUAL MODEL OF PROGRAM ORGANIZATION

The aim of reviewing these literatures was to identify POFs that are components of a program organization employed by its client to reach program goals (Rockart, 1982). They are critical for program organization managing construction megaprojects. Since one of the authors has involved in the client organization of the Shanghai Expo construction for nearly two years, such an experience may improve the validity of POFs identified. In addition, two criteria were employed in the process of identifying POFs: (1) The identified POFs should be consistent with the experience of the Shanghai Expo construction; (2) The items defining each POF should be clearly and easily understandable to industry professionals. Finally, 22 POFs were identified as shown in Table 2.

Table 2 Categories of POFs by previous studies

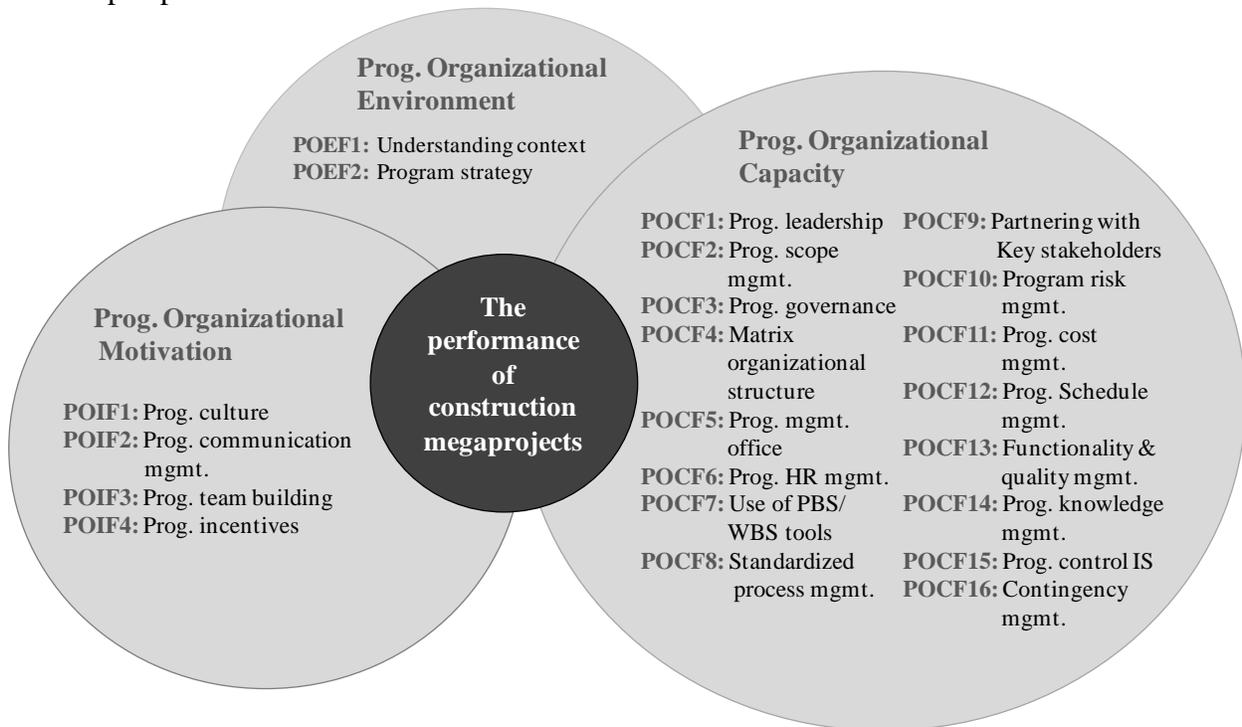
Categories/ POFs	CONTEXT		CAPACITY													MOTIVATION							
	Understanding Context	Prog. Mgmt. strategy	Prog. leadership	Prog. scope mgmt.	Prog. governance	Matrix organiza- tional structure	Prog. mgmt. office	HR mgmt.	Use of PBS/WBS	Standardized process mgmt.	Partnering with key stakeholders	Prog. risk mgmt.& insurance	Pro. schedule mgmt.	Prog. cost mgmt.	Function & quality assurance	Prog. knowledge mgmt.	Prog. Control information system	Contingency mgmt.	Prog. culture	Prog. communication management	Prog. Team building	Prog. incentives	
Previous Studies																							
Artto et al. (2008)					√		√																
Brady & Davies (2010)																	√						
Buuren et al. (2010)			√		√					√													
Crawford & Nahmias (2010)			√	√	√				√	√	√		√	√				√	√	√			
Davies et al. (2009)									√								√						
Dvir & Shenhar (2011)			√	√						√						√		√					
Gray (2001)	√																						
Geraldi et al. (2010)								√									√						
Greiman (2010)										√													
Kim et al. (2009)				√												√							
Ko & Paek (2008)						√	√		√													√	
Kumar & Hsiao (2007)			√																				
Lehtonen & Martinsuo (2008)					√																		
Lycett et al. (2004)				√	√	√						√				√		√	√				
Maylor et al. (2006)		√		√	√				√												√		
Modig (2007)						√																	
Molenaar (2005)											√		√										
Nguyen et al. (2004)			√	√	√		√						√		√	√		√	√			√	

Table 2 (Continued)

Categories/ POFs	CONTEXT		CAPACITY																MOTIVATION				
	Understanding Context	Prog. Mgmt. strategy	Prog. leadership	Prog. scope mgmt.	Prog. governance	Matrix organiza- tional structure	Prog. mgmt. office	HR mgmt.	Use of PBS/WBS	Standardized process mgmt.	Partnering with key stakeholder	Prog. risk mgmt.& insurance	Pro. schedule mgmt.	Prog. cost mgmt.	Function & quality assurance	Prog. knowledge mgmt.	Prog. Control information system	Contingency mgmt.	Prog. culture	Prog. communication mgmt.	Prog. Team building	Prog. incentives	
Previous Studies																							
Nieminen & Lehtonen (2008)					√				√														
O'Laery & Williams (2008)																	√						
OGC (2003)				√						√	√			√		√	√						
Partington et al. (2005)	√			√	√	√					√	√	√	√									
Pellegrinelli/ Pellegrinelli et al. (2002, 2007 & 2009)	√		√	√	√	√	√		√	√	√		√	√					√	√	√		
PMI (2006)				√	√				√	√	√	√	√	√			√			√	√		
Rasdorf et al. (2010)		√	√																				
Reiss et al. (2006)	√	√		√	√		√		√	√	√		√	√	√					√			
Remer & Martin (2009)			√																				
Schexnayder et al. (2004)											√												
Shehu & Akintoye (2009 & 2010)			√		√		√	√	√		√		√							√	√		
Thirty/ Thiry & Deguire (2002 & 2007)					√										√								
Tang et al. (2008)																							√
Wellman (2007)			√			√														√			
Total	4	3	10	11	14	6	5	3	2	9	8	9	3	8	5	5	5	4	4	9	5	2	

Note: “Prog.”—“Program”; “mgmt.” —“management”.

These POFs are grouped into three categories, program organizational environment, organizational capacity and organizational motivation, in terms of the development project organization framework developed by IDRC and IADB (2002). According to IDRC and IADB (2002), these 22 POFs are grouped into three categories, program organizational environment, program organizational capacity and organizational motivation. They include two program organizational environment factors (POEFs), 16 program organizational capacity factors (POCFs), and 4 program organizational motivation factors (POMFs). Figure 2 shows the proposed program organization framework for managing construction megaprojects from the client’s perspective.



Note: “Prog.”- “Program”; “Mgmt.”- “Management”.

Figure 2 Program organization model for managing megaprojects

Program Organizational Environment

POEF 1: Understanding Context

Program context is the environment within which a program will operate (Reiss et al. 2006; Gray 2001). It usually correlates with the administrative, technological, economic, and socio-cultural factors (Lusthaus et al. 1995). Pellegrinelli et al. (2007) and Partington et al. (2005) both affirmed the importance of understanding context in managing a program. Program organization needs timely response to address the change of the environment (UNDP 1993).

POEF 2: Program Strategy

Program strategy can be defined as “a direction in a program that contributes to success and survival of the program in its environment (Arrto et al. 2008).” Since a construction program is a long-term undertaking that usually needs a more-than-three-year or even longer period to

execute, the development of an execution strategy is even more important than that in project management. OGC (2003) and PMI (2004) both stated that a program needs to deliver the strategic benefits, thus working out a strategy is indispensable for program organization to realize these benefits. In the construction industry, program strategy may refer to how to establish an effective client organization in managing construction programs. Rasdorf et al. (2010) noted that more and more clients would like to employ external program management consultants, thus an integrated organization with the strong capability can be established to procure programs.

Program Organizational Capacity

POCF 1: Program Leadership

Program leadership correlates with good leadership and clear direction setting at all levels within a program organization (Reiss et al., 2006). Many scholars highlighted the importance of leadership in program management (Pellegrinelli et al. 2007; Remer and Martin 2009; Shehu and Akintoye 2010; Dvir & Shenhar 2011). Some project management associations, such as IPMA and ICCPM, have also been heavily engaged in this field in the last decades and published many relevant standards (IPMA 2006; ICCPM 2008). However, Rasdorf et al. (2010) pointed out that there exists a lack of consideration on construction industry background in current program management standards.

POCF 2: Program Scope Management

Program scope management refers to identify, measure, and achieve the expected benefits that a program is intended to deliver (PMI 2006). It also includes timely adjustment on program scope during program execution. Lycett et al. (2004) stated that program exists to create value by improving the management of project isolation. Partington et al. (2005) advocated that program scope management plays a leading role in managing programs. But the current difficulty for program management is a lack of a systematic method in relevant works that can change the stakeholders' benefits into workable measures (Shehu and Akintoye 2009). Dvir and Shenhar (2011) also added that defining program scope is a time-consuming work. Nowadays construction project is moving towards a more complex regime of objectives (Swan and Khalfan 2007). Thus the development of workable measures of program benefit may be even more challenging.

POCF 3: Program Governance

Program governance refers to a decision board that sustains external resource input and ensures program progress in accordance with requirements of major stakeholders with various interests (Nguyen et al. 2004; Reiss et al. 2006). Program governance board may include senior governmental officers, sponsors, industry partners, and other major external stakeholders. Several scholars affirmed the important role of program governance in constructing an effective program organization (Partington et al. 2005; Flyvbjerg et al. 2003; Arrto et al. 2008). Shehu and Akintoye (2010) noted that program governance board plays an important role in sustaining ample resources for program execution throughout the lifecycle. Buuren et al. (2010) stressed

four merits of program governance that cannot be achieved by traditional project management as shown in Table 3.

Table 3 Merits of program governance comparing with traditional project management (Buuren et al. 2010)

No.	Merits
1	Interdepartmental integration among government.
2	Multi-level governance integration.
3	Increasing coherence between projects.
4	Speeding-up decision-making.

POCF 4: Matrix Organizational Structure

Matrix organizational structure correlates to an organizational form in which staff should report to departmental head and project leaders respectively. Program clients usually employ it to construct management organizations (OGC 2003). The matrix organizational structure includes roles and responsibilities of program organization as well as their clear-cut relationships with project breakdown structure and major benefits of stakeholders (Reiss et al. 2006). Lycett et al. (2004) stated that necessary caution should be paid to program roles and responsibilities in designing program organizations.

POCF 5: Program Management Office

Program management office (PMO) is a collection of functions that serve for the program decision level (Reiss et al. 2006). PMO can serve three functions in program organizations: (1) coordinating the relationships between projects and cross-functional working (Shehu and Akintoye 2010; Arto et al. 2008); (2) operating or supervising program control information system (Le 2009); and (3) dealing with different information needs (Reiss et al. 2006). Reiss et al. (2006) gave detailed explanations on PMO’s information dealing function as shown in Table 4.

Table 4 PMO’s information dealing function (Reiss et al. 2006)

No.	Function details
1	Deal with information from, and feedback to the program decision level
2	Make instructions from program to its projects and feedback from them
3	Deal with other information needs between the program and relevant operational functions

POCF 6: Program Human Resource Management

Program human resource (HR) management refers to the qualified staff and training support if necessary. Shehu and Akintoye (2010) stated that lack of qualified staff is one of major obstacles in constructing effective program organizations. Geraldi et al. (2010) agreed with their opinion, adding that competent staff is indispensable for the competitiveness of program management

organizations. Besides attaining competent staff, program organizations should also configure their staff properly based on work and responsibility requirements so that staff within program organization can best fit for their work requirements. Shehu and Akintoye (2010) added that providing process training can facilitate the staff's work in program organizations.

POCF 7: Use of Project Breakdown Structure/Work Breakdown Structure Tools

Project breakdown structure (PBS) / work breakdown structure (WBS) provide necessary communication between a clear understanding and statement of technical objectives the program-level and results of the work to be performed (PMI 2006). Shehu and Akintoye (2009) stated for the importance of the use of proper tools that can align constituent projects to program strategy. Son et al. (2010) added that the use of WBS is an indispensable procedure for application of program management information system. Le (2009) further developed PBS tool based on WBS, stressing that PBS can be used as a supplement for the use of WBS in program management, and the combination of these two tools can provide multiple-channel communications among program objectives, program work, program organization and program information system (Wang et al. 2011).

POCF 8: Standardized Process Management

Standardized process management is the design and implementation of standard process for all project management works by applying experience in the manufacturing industry to improve management efficiency and attain continuous improvement. Actually organization can be viewed as processes (Steel 2002). Thus program process is the core of program organization (Reiss et al. 2006; Crawford and Nahmias 2010; Shehu and Akintoye 2009). Maylor et al. (2006) stressed that program process plays an even more important role than that in project management. Pellegrinelli et al. (2007) also added that program process is the key for establishing an effective program plan and control system. Since a program may involve various process groups throughout the program lifecycle (Reiss et al. 2006; PMI 2006), standardizing these process groups may improve overall management performance. Some current empirical studies on megaproject cases, such as the London Heathrow airport 5, and Shanghai Expo construction, provided direct evidences for this statement (Le 2009; Brady and Davies 2011).

POCF 9: Partnering with Key Stakeholders

Partnering with key stakeholders (internal) refers to establish a strong partnering relationship with key internal stakeholders within a program (Chan et al. 2008). In the construction program, they refer to designer, contractors, and suppliers. Recently more studies disclosed that program stakeholder management plays an important role in sustaining program success (Reiss et al. 2006; Pellegrinelli et al. 2007; Crawford and Nahmias 2010). Davies et al. (2009) and Greiman (2010) both highlighted the importance of partnering with major contractors in managing megaprojects through proper contract arrangement, stating that a more workable partnership alliance can be established by developing an integrated strategy between the client and major contractors. Buuren et al. (2010) further analyzed the institutional strategies on improving the cooperation between the client and relevant government, such as incorporating governmental officers into program governance board.

POCF 10: Program Risk Management and Insurance

Program risk management refers to maintain the program's exposure to risk at an acceptable level (Pellegrinelli et al. 2002). Lycett et al. (2004) stated managing risks at the program level needs addressing the strategic requirement, thus it is more important than that at the project level. Previous studies indicated that program risk management not only should follow the proper process such as the process advocated by OGC (2003), and the effectiveness issue needs to be considered in the execution of the corresponding process (OGC 2003). Some megaproject clients want to transfer most risks to contractors using procurement methods, such as design/ build, but it is not totally risk-free. Davies et al. (2009) pointed out that megaproject (program) risk is so big that not a single party can take all risk. Thus it needs to work out a balanced strategy that can properly share major risks among all major stakeholders. Recently US transportation agency made an attempt to introduce client insurance program in managing megaproject risks (Schexnayder 2004), and it may be a feasible strategy dealing with some extreme situations (Partington et al. 2005).

POCF 11: Program Cost management

Program cost management refers to the activities that control program expenditure in the approved budget. It is one of core management activities ensuring program success. Although program organizations usually face a strict financial constraint imposed by program context (Shehu and Akintoye 2010), they face more risks in cost overruns than that in projects (Molenaar 2005). Partington et al. (2005) added that a matured program organization needs to have a clear awareness of budget ambiguities and financial certainty at the program beginning.

POCF 12: Program Schedule management

Program schedule management refers to activities of ensuring that the program will produce its required deliverables and solutions on time (PMI 2006). Since completion is one objective of the "iron triangle", it is also a core management activity in program management. Partington et al. (2005) regarded it as a work with the strategic significance in program management.

POCF 13: Program Functionality and Quality Management

Program function and quality management refers to determine function and quality requirements and ensure meeting these requirements during program duration (Reiss et al. 2006). Since a construction program is usually initiated to deliver a long-term operation facility or an infrastructure, program functionality and quality management is vital to meet such demands. PMI (2006) defined it as a core process in all the program management processes. Crawford and Nahmias (2010) stressed that quality management is one of core competencies for a program manager. In addition, special attention may be given to the handover of mega building facilities. This is because some unexpected incidents may happen in the handover of mega facilities, such as London Heathrow Terminal 5, and Hong Kong new international airport (Davies et al. 2009).

POCF 14: Program Knowledge management

Program knowledge management refers to capture and share knowledge through monitoring and review to improve a program’s likelihood of success (Reiss et al. 2006). Shehu and Akintoye (2010) stated that construction programs can benefit significantly from sharing some resources of projects that will help to improve the accuracy and efficiency of executing the projects within a program. Reiss et al. (2006) classified program knowledge into three categories as shown in Table 5. Dvir and Shenhar (2011) stressed that programs should maximize the use of existing knowledge, often in cooperation with outside organizations. Lycett et al. (2004) added that more effective knowledge transfer can be obtained in programs through identifying and improving upon transferable lessons, and it usually happens in two different levels within a program, project to program and project to project.

Table 5 Categories of program knowledge (Reiss et al. 2006)

No.	Categories
1	Organizational context
2	Best practices
3	Program and project lessons learned

POCF 15: Program Control Information System

Program control information system (PCIS) refers to an information management system that can collect, process and analyze all the sub-project information regularly and report program progress regularly to decision makers. More and more researchers recognized the necessity to establish a management system to control all the objective measures at the program level (Shehu and Akintoye 2009; Pellegrinelli et al. 2007; Lycett et al. 2004). PCIS may take this job. Since 1990s, Germany and China have developed their own PCISs successfully and utilized them in managing megaprojects, e.g. the Munich international airport, German rail network reunion, and Shanghai Expo Construction (Greiner 1998; Le 2009). Recently South Korea has also been developing its own PCIS to manage urban renewal megaprojects in order to improve program performance and management efficiency (Kim et al. 2009). In addition, PCIS can be used as a communication platform facilitating collaborative works among designers, contractors, the client and other stakeholders (Davies et al. 2009).

POCF 16: Contingency Management

Contingency management refers to the capability dealing with any accidental or unexpected events/disaster. Projects are inherently uncertain and face unexpected events, especially in megaprojects. For instance, some incidents happened in handover of London Heathrow Terminal 5, and similar incidents also happened in Hong Kong International Airport (Brady and Davies 2010; Davies et al. 2009). Thus program organizations need to make fast response to these events. However, this issue may be underestimated by previous studies (Arrto et al. 2008). Geraldi et al. (2010) stated three pillars for program contingency management as shown in Table 6.

Table 6 Three pillars for program contingency management (Geraldi et al. 2010)

No.	Pillars
1	Responsive and functioning structure at the organizational level
2	Good interpersonal relationship at the group level
3	Competent staff at the individual level

Program Organizational Motivation

POMF 1: Program Culture

Program organizational culture manifests itself in the formal and informal rules of a program organization (IADB and IDRC 2002). Since most client program management organizations are of temporary nature, they need the common culture that may help improve organizational coherence within program teams and make the realization of its mission possible. Pellegrinelli (2002) added that program culture plays an important role in improving the capacity of program organization. Through investigating more than 400 megaprojects in various industries since the late 1950s, Dvir and Shenhar (2011) noted that program needs to create a revolutionary culture that can later spread to an entire organization and greatly contribute to program success.

POMF 2: Program Communication Management

Program communication management involves two categories, internal and external communication. Shehu and Akintoye (2010) stated that lack of cross-functional communication is one of major obstacles in setting up an effective program organization, and conversely timely and effective communication between project teams or across the organizational boundaries can greatly contribute to program success (Nguyen et al. 2004). Reiss et al. (2006) shared the same idea with them, adding that internal communication should be treated as independent management activity to plan and execute in program management activities. In addition, Pellegrinelli et al. (2007) also stressed that external communication plays an importance role in understanding stakeholders' interest so that a successful strategy can be worked out.

POMF 3: Program Team Building

Program team building refers to build individual and group competencies to enhance program performance (PMI 2006). Ko and Paek (2008) stated that program management team is usually a temporary union, but it still needs to operate as a real team. Pellegrinelli (2002) added that a strong program team usually comprises a diverse group of people from different organizations. Thus program team building is vital to unite these people and improve their coherence in order to sustain program success. Shehu and Akintoye (2010) stated that the staff training program may serve as an effective method in program team building.

POMF 4: Program Incentives

Program incentives refer to incentives that are commonly used to reduce overall contract cost, to control time and to increase the support of specific performance goals such as productivity, quality, safety, technological progress, innovation and management. In the construction industry,

incentives are a long standing and widely used means in improving performance. Contract incentive is one of the most common incentives. European Construction Institute (2003) stated that it can be employed to strengthen the work partnership between the client and key stakeholders, such as contractors, so that high program performance can be obtained. This method has been practiced in some megaprojects and regarded as an effective method in improving different program performance, such as safety, quality environment protection, and innovation (Tang et al. 2008; Davies et al. 2009).

Chan (1994) stated that the responsibilities of project manager can be grouped into five categories, planning, organizing, coordinating, controlling, and motivation, which echo the key characteristics of program organizations:

- (1) Program organizations are more sensitive to the environment; and a long-term strategy needs to be worked out that should reflect active response to the limits of the environment.
- (2) Coordination and integration are the core capacities for program organization. They are the items used with the most frequency in previous program literature (PMI 2006; OGC 2003; Davies et al., 2009). Most POCFs take both roles of these two categories, such as PMO, program cost management, or program quality management.
- (3) Program organization needs to concern more on motivation, and the program organization framework reported in current work also includes four factors. Chan (1994) reinforced the importance of motivation activities within project organizations and has a positive relation with the size of the project.

FINDINGS OF INTERVIEWS IN THE SHANGHAI EXPO CONSTRUCTION CASE

As shown in Table 7, five selected interviewees served in the senior management level of the case project's client organization, one interviewee from the client and the other four from the management consultant. The actual number of interviews conducted was determined by the saturation of data when no more new category emerged (Glaser 1978). In addition, three criteria were employed to identify eligible participants from the megaproject case as follows:

- (1) Experts should have at-least-ten-year construction management experience.
- (2) Experts must have hands-on experience in the megaproject case.
- (3) Experts should have enough sound knowledge and understanding of the client organization of the megaproject case.

In order to improve the validity of unstructured interviews, these five experts have different CEM specialties and involved in different divisions of the client organization in the megaproject cases, in particular in the functional division at the program level.

Table 7 Background of the five interviewees

No.	Positions within the client organization	Origins	Professional specialties	Industrial experience
A	Head of Pro. Mgmt. office	Mgmt. consultant	Design mgmt., contract mgmt., & team building.	20 years
B	Associate head of Pro. Mgmt. office	Mgmt. consultant	Team mgmt., organizational coordination, & integration mgmt.	12 years
C	Associate head of Pro. Mgmt. office	Mgmt. consultant	Schedule mgmt., & PMIS.	10 years
D	Associate head of Pro.Mgmt. office	Mgmt. consultant	Design mgmt., & PMIS.	10 years
E	Associate head of Cost & Contract Mgmt. Division	The client	PMIS, and contract & cost management	12 years

Note: ‘Pro.’=program; ‘mgmt.’=management; ‘PMIS’=Project management information system.

In the interview processes, the five experts could freely express their opinions by providing answers to the interview question on what are POFs for the Shanghai Expo construction client organization, and all the interviews were recorded with the consent of the interviewees for better reference. Each interview typically lasted for nearly an hour and dialogues were transcribed into written reports after the interview. The accuracy of the reports was verified by the corresponding interviewees prior to subsequent analysis. Qualitative interview data acquired from the interviews were coded by constant comparative method using the qualitative data analysis software NVivo 9.2 (King, 2008).

Table 8 The list of identified POFs from the interviews

No.	POFs	Expert A	Expert B	Expert C	Expert D	Expert E	Support rate
1	Program schedule management	√	√	√	√	√	100%
2	Program scope management	√	√		√	√	80%
3	Program cross-functional integration and coordination (Program management office)	√	√		√	√	80%
4	Program cost management	√	√		√	√	80%
5	Program Procurement management		√		√	√	80%
6	Program risk management		√	√	√	√	80%
7	Program quality management		√		√	√	60%
8	Program human resource management		√		√	√	60%
9	Program communication management		√		√	√	60%
10	Program Strategy (Vision)		√	√			40%
11	Program culture	√		√			40%
12	Process management			√	√		40%
13	Program organization structure		√	√			40%
14	Program control information	√		√			40%

	system						
15	Use of PBS/ WBS tools	√		√			40%
16	Program governance			√			20%
17	Partnering with key internal stakeholder management			√			20%
18	Program leadership			√			20%
19	Program emergency management			√			20%
20	Program technology management	√					20%
	Total number of POFs identified	8	11	12	10	9	

As shown in Table 8, a total of 20 POFs were identified from the interview. The top nine POFs that received the highest support rates (80% or above) coincide with those advocated by the project management knowledge framework of Project Management Institute, the US. All the interviewees stressed that the activities of “integration” and “coordination” play more important roles in these nine POFs in managing a program than those in managing a project. It reinforces the findings of Chan (1994) and Kerzner (2009) that the core activities in managing megaprojects are to coordinate and integrate activities across multiple, functional lines. Furthermore, all the interviewees also agreed that the coordination and integration activities at the program level in managing a megaproject faces more challenge than those in managing a project. In addition, another 11 POFs were identified, and most of them represent the soft issues of project management. The support rate for each of the 20 POFs identified from the interviews also demonstrates the relative importance of each POF.

Two new POFs, namely, program procurement management and program technology management, were identified from the interviews. Both of them can be grouped into the category, program organizational capacity. The remaining 18 POFs are common as shown in Table 2. Thus the interview results also validated 81% (18 in 22) of the 22 POFs identified from previous literature. They show a high consistence with previous knowledge. In addition, the detailed interviews and examinations of archival documents related to the two new POFs were conducted.

POMF 17: Program Technology Management

Program technology management refers to establish an independent design management system within the client organization, including responsible department, plan making and check, and process control. All the interviewees advocated that program technology management was a core work for the client managing the Shanghai Expo construction. Nowadays construction megaprojects may face an increasing technical complexity from the changing environment. In order to realize the sustainable construction, the increased utilization of new technologies in construction such as 3D technology, energy conservation technologies, and new construction materials is an inevitable trend in the construction industry (Harty, et al. 2007). The archival documents also indicated that the Shanghai Expo construction adopted hundreds of energy conservation and green construction technologies in its design and construction process (UNEP 2009). In addition, in order to pursue technology transfer strategies with an “introduction-absorption-digestion- innovation” policy, construction megaprojects in China also play a major role in testing and innovating new construction technologies (Chi and Javernick-will 2011). It

may further increase the technical complexity needed to be faced by the client. The Shanghai Expo construction may be a typical example for such a statement as mentioned above. Therefore, program technology management is a critical and highly influential factor for client program organizations in managing megaprojects.

POMF 18: Program Procurement Management

Program procurement management refers to establish an independent procurement management system within the client organization, including establishment of the responsible department, plan making and check, and process control. Interviewees stated that the client of the Shanghai Expo construction faced multiple challenges in procurement management such as decision makings on selections of designers, contractors and suppliers, procurement management of value-in-kind equipment provided by sponsors, and contract and payment management. It is because a construction megaproject usually involves a great number of participants. The examination of the archival documents indicated the Shanghai Expo construction involved nearly 400 internal participants and signed nearly 1000 contracts with them. Therefore, program procurement management is an often-overlooked but critical aspect for client program organizations managing megaprojects.

RESEARCH SIGNIFICANCE

According to the Engineering News-Record, there exists a global surge in construction megaprojects (Wood 2010). Thus the establishment of a clear and practical model of program management based on existing literature and empirical evidences may be a timely work for the clients managing megaprojects. The conceptual model of program organization developed by current work may facilitate the client's successful delivery of a construction megaproject. Practitioners can learn how to build an effective program organization in procuring megaprojects and sustain its effectiveness to accomplish the prescribed objectives. This research study can also be a key to understand an overall picture of a program organization, and the client can learn about the principal factors for setting up an effective organization to run megaprojects with high performance.

In addition, research on how to apply program management approach to procure construction megaprojects has attracted the growing interest of researchers and institutions. Thus this research not only benefits the construction industry and the general public as a whole, but also the educational field, enabling an exchange of culture and practice in a worldwide manner. For instance, the UK government is also investing GBP 6.2 millions in partnership with the Oxford's Saïd Business School, to set up a leadership academy for senior megaproject leaders (Simons 2012). The current work paves the way for further investigation on program management in construction.

LIMITATION AND FUTURE RESEARCH WORK

Since program management is an obscure and debatable concept, the development of a conceptual framework with the practical value is a big challenge. The current work has developed a conceptual framework of program organization including 24 POFs identified from previous studies, and then improved it with two additional POFs added in terms of empirical evidences collected from a Chinese megaproject case. However, such a model should be further

refined through examining the relative importance of these 24 POFs and identifying the key POFs within them so that a simplified framework with a bigger application value can be obtained. Such an improvement of the conceptual framework is considering to be conducted in the future study.

CONCLUSIONS

The topic of program management has been discussed with increasing popularity in the past two decades, but an agreement to a common definition can hardly be reached. The increasing number of construction megaprojects worldwide further has triggered the growing demand to apply this new approach into the megaproject practice. While most discussion considers the concept for program management in general, little emphasis is placed on particular organization framework, such as client's organizations. A conceptual framework incorporating the principal factors of a program organization in general is necessary for clients to evaluate the effectiveness of their organization in managing megaprojects. The current work has made mixed efforts though comprehensive literature review and interviews expert from a real case so that a conceptual framework of program organization with 24 POFs included was formulated, and most POFs were validated by interview feedbacks.

Moreover, program organization framework presented in the current work may not be confined to the construction megaproject itself, but to the project participants, end-users, and even outsiders as well. This framework enhances previous studies on program management and sets a benchmark for later researchers, especially in further investigating POFs for the client in managing megaprojects. It enriches the knowledge of both the research community and professionals in the industry about program organization in managing megaprojects in pursuit of better management and program performance.

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REFERENCES

- Artto, K., Martinsuo, M., Gemuenden, H. G. and Murtoaro, J. (2008a) "Foundations of program management: A bibliometric view," *International Journal of Project Management*, 27 (1), 1-18.
- Artto, K., Kujala, J., Dietrich, P. and Martinsuo, M. (2008b) "What is project strategy?" *International Journal of Project Management*, 26(1), 4-12.
- Beehler, M. E. (2009) "Lessons learned on mega projects," In M. W. Vogt (Eds.), *Proceedings of Electrical Transmission and Substation Structures Conference 2009: Technology for the Next Generation*, American Society of Civil Engineers, Fort Worth, Texas, pp.71-78.
- Brady, T. and Davies, A. (2010) "From hero to hubris-Reconsidering the project management of Heathrow's Terminal 5," *International Journal of Project Management*, 28 (2), 151-157.
- Buuren, A.V., Buijs, J.M. and Teisman, G. (2010) "Program management and the creative art of cooperation: Dealing with potential tensions and synergies between spatial development projects," *International Journal of Project Management*, 28 (7), 672-682.
- Chau, K.W. (1997) "The ranking of construction management journals," *Construction Management and Economics*, 15 (4), 387-398.

- Chan, A. P. C. (1994) “Managerial responsibility of project managers,” *Australian Institute of Building Papers*, Vol.5, 1993/1994, 109-120.
- Chan, A. P. C., Chan, D.W. M., Fan, W. C. N.L. Lam, P.T.I. Yeung, F.Y. (2008). Achieving partnering success through an incentive agreement: lessons learned from an underground railway extension project in Hong Kong, *Journal of Management in Engineering*, 24 (3), 128-137.
- Chi, C. S.F. and Javernick-will, A. N. (2011) “Institutional effects on project arrangement: high-speed rail projects in China and Taiwan,” *Construction Management and Economics*, 29 (6), 595–611.
- Crawford, L. and Nahmias, A.H. (2010) “Competencies for managing change,” *International Journal of Project Management*, 28 (4), 405-412.
- Davies, A., Gann, D. and Douglas, T. (2009) “Innovation in megaprojects: System Integration at London Heathrow Terminal 5,” *California Management Review*, 51 (2), 101-125.
- Ding, H. (ed) (2010) *Shanghai Expo Engineering Construction* [only the Chinese version], Shanghai scientific and Technical Publishers, Shanghai.
- Dvir, D. and Shenhar, A. J. (2011) “What great projects have in common?” *MIT Sloan Management Review*, 52 (3), 18-21.
- European Construction Institute (ECI) (2003) *Long-term Partnering—Achieving Continuous Improvement and Value*. European Construction Institute, London.
- Flyvbjerg, B., Bruzelius, N. and Rothengatter, W. (2003) *Megaprojects and Risk: An Anatomy of Ambition*. Cambridge University Press, Cambridge.
- Geraldi, J.G., Lee-Kelley, L. and Kutsch, E. (2010) “The Titanic sunk, so what? Project manager response to unexpected events,” *International Journal of Project Management*, 28 (6), 547-558.
- Glaser, B. G. (1978) *Theoretical Sensitivity: Advances in the Methodology of Grounded Theory*, Sociology Press, Mill Valley, California.
- Gray, R. J. (2001) “Organizational Climate and Project Success,” *International Journal of Project Management*, 19 (2), 103-09.
- Greiner, -I. (1998) “Application of construction project control system: A case study of German mega rail project [Only the Chinese version],” *Project Management [Chinese Journal]*, 9(4), 47-49.
- Haigh, R. (2008) “Interviews: a negotiated partnership,” In A. Knight, L. Ruddock (eds.) *Advanced Research Methods in the Built Environment*, Wiley-Blackwell, Chichester.
- International Centre for Complex Project Management (ICCPM) (2008) *Complex Project Manager Competency Standards, Version 3.3*. Retrieved 15 October 2010, From: http://www.iccpm.com/images/stories/PDFs/Publications/CPM_Competency_Standards_-_V3.3.pdf.
- International Development Research Center (IDRC) and Inter-American Development Bank (IADB) (2002) *Organizational Assessment: A Framework for Improving Performance*. Ottawa: International Development Research Centre.
- International Project Management Association (IPMA) (2006) *ICB-IPMA Competency Baselines, Version 3.0*. Retrieved 10 April 2010, from: <http://www.ipma.ch/downloads/Pages/Certification.aspx>
- Ke, Y.J., Wang, S.Q., Chan, A.P.C. and Cheung, E. (2009) “Research trend of Public-Private-Partnership (PPP) in construction journals,” *Journal of Construction Engineering and Management*, 135(10), 1076-1086.

- Kerzner, H. (2001) *Project Management: A System Approach to Planning, Scheduling, and Controlling*, 7th ed., John Wiley and Sons, New Jersey.
- Kim, J. H., Yoon, J. Y., Kim, K. H. and Kim, J. J. (2009) “Conceptual model of intelligent program management information systems (iPMIS) for urban renewal mega projects,” *Journal of Asian Architecture and Building Engineering*, 8 (1), 57-64.
- King, A. (2008) “Using software to analyse qualitative data,” In A. Knight, L. Ruddock (Eds.), *Advanced Research Methods in the Built Environment*, John Wiley and Sons, Chichester, West Sussex, pp. 135-143.
- Ko, O. Y. and Paek, J. H. (2008) “Korea experience project management consortium on the US forces Korea relocation program,” *Journal of Asian Architecture and Building Engineering*, 7 (1), 85-92.
- Kumar, S. and Hsiao, J.K. (2007) “Engineers learn ‘soft skills the hard way’: Planting a seed of leadership in engineering classes,” *Leadership and Management in Engineering*, 7 (1), 18-23.
- Le, Y. (2009) *Five Key Techniques for Large and Complex Construction Project* [Only the Chinese version], A Research Report for Shanghai Scientific and Technology Committee, Tongji University, Shanghai.
- Lehtonen, P. and Martinsuo, M. (2008) “Change program initiation: Defining and managing the program-organization boundary,” *International Journal of Project Management*, 26 (1), 21-29.
- Lusthaus, C., Anderson, G. M. Andrien and Murphy, E. (1995) *Institutional Assessment: A framework for Strengthening Organizational Capacity for IDRC’s Research Partners*, International Development Research Center, Ottawa.
- Lycett, M., Rassau, A. and Danson, J. (2004) “Programme management: a critical review,” *International Journal of Project Management*, 22 (4), 289–299.
- Maylor, H., Brady, T., Cooke-Davies, T. and Hodgson, D. (2006) “From projectification to programmification,” *International Journal of Project Management*, 24 (8), 663-674.
- Milosevic, D.Z., Martinelli, R.J. and Waddell, J.M. (2007) *Program Management for Improved Business Results*, John Wiley and Sons, Hoboken.
- Modig, N. (2007) “A continuum of organizations formed to carry out projects: Temporary and stationary organization forms,” *International Journal of Project Management*, 25 (8), 807-814.
- Molenaar, K. R. (2005) “Programmatic cost risk analysis for highway megaprojects,” *Journal of Construction Engineering and Management*, 131 (3), 343-353.
- Nguyen, L. D., Ogunlana, S. O. and Lan, D. T. X. (2004) “A study on project success factors in large construction projects in Vietnam,” *Engineering, Construction and Architectural Management*, 11(6), 404-413.
- Nieminen, A. and Lehtonen, M. (2008) “Organizational control in programme teams: An empirical study in change programme context,” *International Journal of Project Management*, 26 (1), 63-72.
- O’Leary, T. and Williams, T. (2008) “Making a difference? Evaluating an innovative approach to the project management Centre of Excellence in a UK government department,” *International Journal of Project Management*, 26 (5), 556-565.
- Office of Government Commerce (OGC) (2003) *Managing Successful Programmes: Delivering Business Change in Multi-projects Environments*, The Stationary Office, London.

- Partington, D., Pellegrinelli, S. and Young, M. (2005) “Attributes and levels of programme management competence: An interpretive study,” *International Journal of Project Management*, 23 (2), 87-95.
- Pellegrinelli, S. (1997) “Programme management: organising project based change,” *International Journal of Project Management*, 15 (3), 141-9.
- Pellegrinelli, S. (2002) “Shaping context: the role and challenge for programmes,” *International Journal of Project Management*, 20 (3), 229–233.
- Pellegrinelli, S., Partington, D., Hemingway, C., Mohdzain, Z. and Shah, M. (2007) “The importance of context in programme management: An empirical review of programme practices,” *International Journal of Project Management*, 25 (1), 41–55.
- Pellegrinelli, S. and Garagna, L. (2009) “Towards a conceptualisation of PMOs as agents and subjects of change and renewal,” *International Journal of Project Management*, 27(7), 649-656.
- Project Management Institute (PMI) (2006) *The Standard for Program Management*, Project Management Institute, Newtown Square, Pa.
- Rasdorf, W., Grasso, B. and Bridgers, M. (2010) “Public versus private perceptions on hiring an external program manager,” *Journal of Construction Engineering and Management*. 136 (2), 219-226.
- Reiss, G., Anthony M., Chapman, J., Leigh G., Pyne, A. and Rayner, P. (2006) *Gower Handbook of Programme Management*, Gower, Aldershot.
- Remer, D.S. and Martin, M.A. (2009) “Project and engineering management certification,” *Leadership and Management in Engineering*, 9 (4), 177-190.
- Remington, K. and Pollack, J. (2008) *Tools for Complex Projects*. Gower, England.
- Rockart, J. F. (1982) “The changing role of the information systems executive: A critical success factors perspective,” *Sloan Management Review*, 24(1), 3–13.
- Schexnayder, C.J., Weber, S.L., and David, S.A. (2004) “Transportation agency use of owner-controlled insurance programs,” *Journal of Construction Engineering and Management*, 130 (4), 517-524.
- Shehu, Z. and Akintoye, A. (2009) “Construction programme management theory and practice: Contextual and pragmatic approach,” *International Journal of Project Management*, 27(7), 703–716.
- Shehu, Z. and Akintoye, A. (2010) “Major challenges to the successful implementation and practice of programme management in the construction environment: A critical analysis,” *International Journal of Project Management*, 28, 26-39.
- Simons, J. (2012) “Editor’s letter,” *Project*, Association for Project Management, UK, issue 246, pp.3.
- Son, M. J., Kim, S. R., Jin, R. Z., Cho K. M. and Hyun, C. T. (2010) “Development of the Intelligent Program Management Information System (I-Pgmis) Framework for Mega-Projects,” In J. G. Teng, *Proceedings of the First International Conference on Sustainable Urbanization*, The Hong Kong Polytechnic University, Hong Kong.
- Steel, R. P. (2002) “Turnover theory at the empirical interface: problems of fit and function,” *Academy of Management Review*, 27 (3), 346-360.
- Swan, W. and Khalfan, M. M. A. (2007) “Mutual objective setting for partnering projects in the public sector,” *Engineering, Construction and Architectural Management*, 14 (2), 119-130.

- Tang, W.Z., Qiang, M.S., Duffield, C. F., Young, M. D. and Lu, Y. M. (2008) “Incentives in Chinese construction industry,” *Journal of Construction Engineering and Management*, 134 (7), 457-467.
- Thiry, M. (2002) “Combining value and project management into an effective programme management model,” *International Journal of Project Management*, 20 (3), 221–227.
- Thiry, M. and Deguire, M. (2007) “Recent developments in project-based organizations,” *International Journal of Project Management*, 25 (7), 649-658.
- Tsai, C. C. and Wen, M.C.L. (2005) “Research and trends in science education from 1998 to 2002: A content analysis of publications in selected journals,” *International Journal of Science Education*, 27(1), 3-14.
- United Nations Development Programme (UNDP) (1993) *Human Development Report 1993*, Oxford, New York.
- United Nations Environmental Programmes (UNEP) (2009) The Environmental Impact Assessment Report of Expo 2010 Shanghai China, retrieved 2 November 2011, from: http://www.mep.gov.cn/pv_obj_cache/pv_obj_id_31F5A773F5AA14C147650F6BCA21652E5EBE6D00/filename/P020100421509153237050.pdf
- Wang, G. B., Tan, D., Jia, G. S. and Zhou, Z. F. (2011) “PBS-based integrated breakdown structure model for mega project management information system in China,” In J. G. Teng, *Proceedings of the First International Conference on Sustainable Urbanization*, The Hong Kong Polytechnic University, Hong Kong.
- Wellman, J. (2007) “Leadership behaviors in matrix environments,” *Project Management Journal*, 38 (2), 62-74.
- Wood, D. (2010, 8 September) “Global Surge in Mega-Projects Forecast at Contractors Conference,” *Engineering News Record*.
- Xue, Y., Anbari, F. T. and Turner, J. R. (2008) “Maximizing results from key infrastructure projects: The case of China,” *Proceedings of 22th International Project Management Association World Congress*, Roma, Italy.