Need for Alternative Research Approaches in Construction Management: Case of Delay Studies

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Abstract: Over the years, there have been many studies of delay in construction, and this type of study continues to be popular in construction management research. A synthesis and critical evaluation of delay studies in developing countries reveals that poor project management is cited as one of the main causes of delay. However, despite significant consensus, most published studies fall short of providing clear recommendations for the improvement of project management practice. Moreover, the majority of recommendations are general and not devoted to solving the difficulties associated with particular causes of delay. This paper aims to demonstrate that the root cause of this state of affairs is that typical research into delay tends to be descriptive and explanatory, making it inadequate for solving persistent managerial problems in construction. It is contended that many problems in construction could be mitigated through alternative research approaches, i.e., action and constructive research. Such prescriptive research methods can assist in the development and implementation of innovative tools tackling managerial problems of construction, including that of delay. In so doing, those methods will better connect research and practice, and thus strengthen the relevance of academic construction management. **DOI: 10.1061/(ASCE)ME.1943-5479.0000148.**

CE Database subject headings: Delay time; Construction management; Research; Case studies.

Author keywords: Construction delay; Action research; Constructive research.

Introduction

Over many years, delay has been a popular topic in construction management research, and various delay studies have been carried out for different purposes. Their focus has varied from the identification of causes and responsible parties (Mezher and Tawil 1998; Odeh and Battaineh 2002; Fimpong and Oluwoye 2003; Long et al. 2004; Abdul-Rahman et al. 2006; Assaf and Al-Hejji 2006; Faridi and El-Sayegh 2006; Sweis et al. 2008; Al-Kharashi and Skitmore 2009) to the nature and effects of construction delays (Scott 1993), the delay analysis techniques that can be used by practitioners in the industry (Alkassi et al. 1996; Bubshait and Cunningham 1998; Arditi and Pattanakitchamroon 2006; Mohan and Al-Gahtani 2006), and claims and disputes (Semple et al. 1994; Yates and Epstein 2006; Iyer et al. 2008). However, most prior studies have sought mainly to identify causes of delay.

The literature suggests that the major causes of project delay are related to poor management practice (Mansfield et al. 1994; Ogunlana and Promkuntong 1996; Mezher and Tawil 1998; Al-Momani 2000; Odeh and Battaineh 2002; Abdul-Rahman et al. 2006; Assaf and Al-Hejji 2006; Sweis et al. 2008; Alnuaimi et al. 2010). Most of these studies have identified ineffective planning and control as common factors, and other frequent causes related to project management have also been acknowledged.

There is no doubt that existing delay studies have made valuable contributions by reporting the causes of delay in construction projects, because they have made practitioners aware of major problems. However, despite the evolution of construction project planning and control methods in recent decades and the great efforts that have been put into research for understanding the delay reasons, delay is still a very common feature of projects, as revealed by the literature. Thus, the question arises of what contribution the previous delay studies have made in identifying the causes of delay and practical steps to reduce delays.

This paper has been prepared to serve three purposes. First, it explores and synthesises prior studies on the causes of construction delay in developing countries, examining what causes have been identified and what solutions have been proposed. Second, it critically evaluates these delay studies as to their contribution to solving the problems identified. Third, as this contribution is found to be modest, the possibilities to go beyond the prevailing approach of delay studies are explored.

Synthesis of Delay Studies

Many researchers have striven to identify the causes of delay in construction projects in various countries. Most of the available studies of construction delay in developing countries are listed in Table 1, whereas Table 2 lists the most frequently identified delay causes. It can be seen that many of these are management related. Ineffective planning and control is a factor identified in most studies (87%), with variation from one to another only in the degree of importance. Poor site management (56%) and problems of supply and procurement (69%) are also widely identified as

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Note. This manuscript was submitted on December 6, 2011; approved on July 16, 2012; published online on July 24, 2012. Discussion period open until March 1, 2014; separate discussions must be submitted for individual papers. This paper is part of the ***Journal of Management in Engineering***, Vol. 29, No. 4, October 1, 2013. © ASCE, ISSN 0742-597X/2013/4-407-413/$25.00.

Table 1. List of Delay Studies in Developing Countries

Study	Country	Number
Assaf and Al-Hejji (2006)	Saudi Arabia	1
Assaf et al. (1995)	Saudi Arabia	2
Faridi and El-Sayegh (2006)	UAE	3
Koushki et al. (2005)	Kuwait	4
Odeh and Battaineh (2002)	Jordan	5
Sweis et al. (2008)	Jordan	6
Abdul-Rahman et al. (2006)	Malaysia	7
Alghbari et al. (2007)	Malaysia	8
Mezher and Tawil (1998)	Lebanon	9
Lo et al. (2006)	Hong Kong	10
Fimpong and Oluwoye (2003)	Ghana	11
Mansfield et al. (1994)	Nigeria	12
Kaming et al. (1997)	Indonesia	13
Ogunlana and Promkuntong (1996)	Nigeria	14
Arditi et al. (1985)	Turkey	15
Long et al. (2004)	Vietnam	16

major causes of delay. Delays in the delivery of materials, damage to urgently needed materials, and late procurement, which are all related to poor project management, also occur widely. Taken together, these findings indicate that the fault lies either with those responsible for planning and management, or with the planning and management techniques themselves. In either case, it is apparent that the project planning and management system has an important role in the attempt to overcome delay. Another cluster of problems leading to delays covers labor shortage, problems in material supply, and financial difficulties, all related to the immaturity of the economy, financial institutions, and labor market in a developing country. These are external factors that have to be taken as a given in any project.

It has to be stressed that identifying the causes of delay that have controllable effects and the extent to which these effects can be minimized is the main contribution of delay studies from a managerial viewpoint. Therefore, the focus here is on the internal causes of delay related to contractors' management. External factors, such as environmental causes and those related to the supply chain, can be handled only at the level of the whole economy and in the long term. What can be changed in the shorter term and in individual projects are management and related factors.

Critical Evaluation of Previous Delay Studies

It is vital to indicate clearly that the delay studies being critically evaluated here are examples of the common approach of doing delay studies. It is this approach to research that is being criticized, not delay studies in general, nor individual delay scholars and their work.

The question considered here is as follows: What is the contribution of delay studies to practically minimizing the causes of delay?

The practical relevance of delay studies and their contribution to solving problems are related to the recommendations that they make. Table 3 summarizes these recommendations as follows: 31% of studies mention improving planning and control, whereas four of the 16 (25%) recommend improving site management. Improvements to human resource management are recommended by 37.5% of the studies examined. Among other recommendations, improving communication and collaboration between the parties, improving financial support, and minimizing design changes are suggested by 37.5, 37.5, and 19% of the studies, respectively.

The following subsections criticize existing studies on three grounds. First, not all studies make practical recommendations. Second, planning and control are found to be ineffective by the majority of the studies, yet they typically do not recommend solutions to this problem. Third, while a few studies do recommend improvements, they do not identify the necessary tools to facilitate them.

Recommendations Not Made

Table 3 shows that 25% of the studies fail to recommend ways to overcome the causes of delay identified. Different reasons may be given for this, such as that the aims of the study were limited to identifying causes, or that funding was limited. However, it can hardly be argued that a delay study would have other motivation than to facilitate the removal of causes of delay or at least to minimize their impact; from this perspective, the failure of the studies to discuss practical solutions is a clear shortcoming.

Recommendations Do Not Match Findings

In the majority of the studies, it appears that the recommendations provided do not match the findings. Fig. 1 shows the frequency of causes and corresponding recommendations in delay studies. Returning to Table 2, take ineffective planning and control as an example. It is interesting to note that 14 of the 16 studies (87%) mention this factor, which suggests that they should make recommendations to mitigate its impact, yet only five do so. Similarly, supply chain and procurement problems are mentioned in 69% of the studies, giving the impression that this is a particularly problematic area, whereas poor site management is cited in 56% of the studies, making it the third most often repeated cause of delay, yet few studies propose solutions addressing either of these factors.

Table 2. Occurrence of Delay Causes Identified in Previous Studies

Delay causes	Delay studies (1, 2)[a]	(3)	(4)	(5, 6)	(7, 8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	Number of occurrences
Poor planning and control	YY	Y	Y	YY	YY	Y		Y	Y	Y	Y	Y	Y	14
Poor site management	Y	Y		Y	YY	Y	Y	Y					Y	9
Labor shortage and productivity		Y		YY	YY		Y		Y	Y				8
Material supply chain and procurement	Y		Y	YY	Y		Y	Y	Y		Y	Y		10
Financial difficulties	YY			YY	YY				Y		Y	Y		9
Change in design	Y			YY	Y	Y	Y				Y	Y		8
Subcontractor-related problems	Y				Y	Y	Y							4
Poor communication and coordination				Y	YY		Y	Y			Y			6
Weather	Y			Y	YY		Y		Y		Y			7
Others	YY	Y		Y	Y		Y	Y	Y		Y			9

[a]Numbers between brackets refer to previous delay studies; see Table 1.

Table 3. Summary of Recommendations from Previous Delay Studies

Recommendations	Delay studies															Number of occurrences
	(1)[a]	(2)	(3)	(4)	(5)	(6)	(7, 8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	
Improve planning and control	Y	No recommendations	Y	Y		No recommendations	Y		Y	No recommendations					No recommendations	5
Improve site management and supervision	Y		Y				Y						Y			4
Minimize design change	Y			Y			Y									3
Improve financial support	Y			Y			YY		Y		Y					6
Improve materials supply and procurement											Y	Y		Y		3
Improve productivity							Y					Y				2
Improve human resource management			Y		Y		Y	Y	Y				Y			6
Improve communication and coordination							YY	Y	Y		Y		Y			6
Adopt new management techniques								Y						Y		2
Adopt new approach to contract award					Y											1
Others	Y		Y	Y	Y		Y					Y				6

[a]Numbers in brackets refer to delay studies; see Table 1.

Recommendations Are Not Practical

Although a few studies do recommend improvements to management practice, they do not identify the tools to facilitate such improvements or indicate how the recommendations could be implemented. The following are some examples.

Over a decade ago in Nigeria, Ogunlana and Promkuntong (1996) proposed that owner associations, designers, contractors, suppliers, finance houses, educational institutions, manufacturers, and the government should cooperate to provide the infrastructure necessary for efficient project management. However, the research fell short of determining the nature of such infrastructure or how to adopt it within the construction industry.

Two years later in Lebanon, Mezher and Tawil (1998) urged the industry to adopt innovative management techniques, team building, and value engineering to increase efficiency and effectiveness. However, the researchers did not specify the innovative management techniques to be adopted, nor did they offer examples of techniques that could be used to improve team building.

In a similar vein, in Jordan, Al-Momani (2000) argued that the findings presented in his study provided good guidance for managerial intervention, but did not specify what kind of intervention, in what area of project management, and how this intervention could be put into practice on a construction site.

More recently, in Saudi Arabia, Assaf and Al-Hejji (2006) recommended that contractors should consider planning and control as continuing processes during construction, matching these with the resources and time required to develop the work and to avoid delay, cost overruns, and disputes. There is, however, need for clarification as to how this could be done and what kind of planning tools might be used in following this recommendation.

In a study set in Hong Kong, Lo et al. (2006) recommended that comprehensive strategies be formulated to minimize variations, whether initiated by clients or consultants. A clear and thorough client brief is considered the most useful strategy for reducing variations, whereas contingency allowances may be incorporated for those variations that inevitably remain. The outstanding question here is as follows: What kind of methods could help to minimize such variations in a comprehensive manner?

Conclusions

Most existing delay studies suffer from limitations regarding their contribution to solving the problems that they identify. Similar causes of delay emerge across the studies, but a great share of authors recommends no practical solutions or methods to improve the situation. Regarding the recommendations that have been made (see Table 3), it can be clearly stated that the majority do not contribute much to problem solving. For instance, they are specific neither to particular problems nor to particular causes.

Moreover, these studies do not explore the factors behind the causes of delay. For example, a common cause of delay is ineffective planning and control, yet none of the studies examines the underlying reasons for this, to determine whether planning is ineffective because of inadequate planning tools and techniques, for example, and/or because untrained people have responsibility for formulating and realizing the plans.

Reasons for the Relative Failure of Delay Studies

The examination of delay studies shows that they tend to identify the same causes, but are inconsistent in their practical recommendations. The key issue here is that delay studies predominantly represent the descriptive and explanatory type of research, which is

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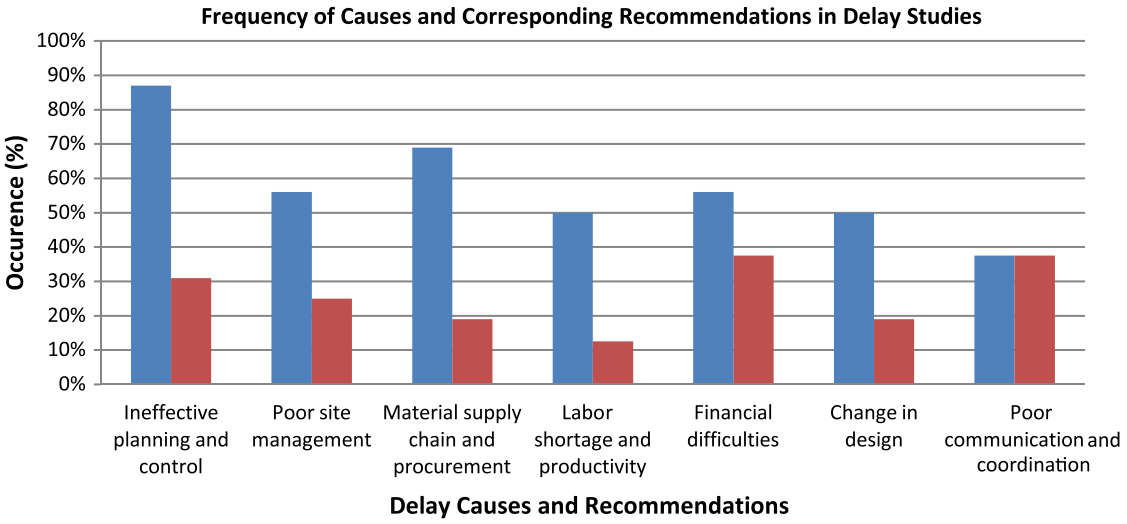

Fig. 1. Frequency of causes and corresponding recommendations in previous delay studies

common in academic research into organizations and management (Van Aken 2005; Denyer et al. 2008; Holmström et al. 2009). There are at least four potential reasons for this relative failure of delay studies to produce managerially relevant knowledge.

First, the knowledge produced by descriptive and explanatory research is not the type that is needed in management; descriptive knowledge is distinct from prescriptive knowledge, according to Denyer et al. (2008). Although it may be possible to translate descriptive knowledge into prescriptive knowledge, as these authors explain, this means that a separate translation process is needed.

Second, the methods used in delay studies, such as surveys and questionnaires, are not necessarily suitable for finding the root causes of problems. The 5 Whys method (Razeghi 2008), as used in the Toyota Production System, provides a good illustration here of the contention that when seeking the root cause of a practical problem, it is often necessary to penetrate several layers of cause and effect. Another example is the Last Planner System (Ballard et al. 1996; Ballard and Howell 2003), in which the causes of noncompletion of planned assignments can be found through an in-depth and detailed record of the reasons for such noncompletion on site, associated to both medium and long-term planning and control. Analysis of reasons can help to avoid their occurrence in future tasks, and shows where attention should be for better results. In methods such as questionnaires, in which the questions to respondents are prepared in advance, it is not easy to uncover several layers in this way.

The third explanation is that the descriptive and explanatory research discussed is limited by its sample to poor practice. In delay studies of construction in developing countries, the projects to be studied are rarely well managed, in the sense of best practice in project management or production management, as promoted by professional bodies. Thus, it is not possible to study and analyze the best practice for its possible shortcomings and counterproductive effects.

Finally, as argued in analyses based on complexity theory, the assumption of stable cause and effect mechanisms in the phenomena studied, as routinely made in descriptive and explanatory research, may simply be inappropriate. Kurtz and Snowden (2003) argued that alternative approaches in such situations include probing for patterns, then acting on the system and sensing the reaction. One framework for this acting and sensing cycle is action research. This argument is supported by Easterby-Smith et al. (2002), who identified a need to rethink some of the traditional techniques and methods in management research.

Thus, there are several problems associated with descriptive and explanatory research as applied to delay studies. The difficulties of the considered delay studies to propose practical recommendations are arguably attributable to the nature of the research methods employed, which focus on identifying and describing the current state of affairs, and do not adequately support the definition of tools or methods to address the problems in practice. Indeed, Denyer et al. (2008) contended that one of the reasons for the much discussed problem of relevance affecting the academic study of management is that it has been limited to the production of descriptive knowledge. In alignment with this, Koskela (2011) has identified the well-known 1959 reports (by Pierson and Gordon & Howell) on the future of business education in the United States as the root cause of the relevance problems of management research.

Way Forward

Alternative Approaches

In light of the aforementioned arguments, there is a clear need for alternative approaches to construction management research that would allow academics to influence practice. This is in alignment with what is argued by Holmström et al. (2009): that there is a need for an approach that facilitates discovery and problem solving in management research. The same authors ask pertinently whether researchers are merely observers and evaluators of practitioners' problem-solving activity, or whether they should themselves become problem solvers. In response to this rhetorical question, they offer design science research as an example of a way to bridge the gap between theory and practice. They state that design science research is conducted under many different rubrics: action science, action research, action innovation research, participatory action research, participatory case study, and academe-industry partnerships. Similar views have been presented by other scholars, e.g., Van Aken (2005), Järvinen (2007), Koskela (2008), and Voordijk (2009). Two main forms of alternative research approaches, namely, action research and constructive (or design science) research, are briefly described as follows.

In many disciplines, researcher-practitioner collaboration has been practiced under the umbrella label of action research (Clark 1972; Susman and Evered 1978; Argyris et al. 1985; Eden and Huxham 1996; Reason and Bradbury 2001). In this approach, a practical problem is analyzed through an iterative cycle of problem identification, diagnosis, planning action, taking action, and evaluation. A solution (taking action) is proposed through interactions between researchers and practitioners (Hult and Lennung 1980; Baskerville 1999; Naoum 2001; Herr and Anderson 2005).

Action research enables the reflection and data collection process to focus on aspects that cannot easily be captured by descriptive research approaches (Eden and Huxham 1996). It can assist in responding to the practical concerns of people and providing solutions to existing practical problems (Järvinen 2007). To make academic research relevant, researchers should try out their theories with practitioners in real situations and real organizations (Avison et al. 1999), enabling organizations to directly benefit from advances in knowledge.

Constructive research is characterized by the solution of problems of theoretical and practical relevance (Lukka 2003). It focuses on developing constructs (e.g., methods, models, and physical artifacts) that can be tested in practice, providing theoretical contributions (Van Aken 2005; Holmström et al. 2009; Voordijk 2009). Järvinen (2007) argued for the existence of two categories of constructive research, i.e., conceptual and technical development. Conceptual development refers to the development of different models or tools that do not describe an existing reality, but on the contrary, help to create a new reality. Technical development, in contrast, produces a physical device as a result (this may, for example, be a software). Thus, Järvinen (2007) described that conceptual development produces a description of a desired reality, whereas the technical development produces the performance (physical) of this reality.

According to Kasanen et al. (1993), constructive research is composed of six steps: (1) identification of the problem with theoretical and practical relevance; (2) understanding of the issue to be researched, usually through literature review and empirical studies; (3) construction of the solution in the form of a physical device or model; (4) implementation and test of the proposed solution; (5) connections between the solution and theoretical developments; and (6) analysis of the scope of applicability of the solution.

Thus, it is contended that novel management techniques could be developed and practically implemented through nontraditional research approaches such as constructive and action research. Consequently, contributions could be made to the practical concerns of people in the field and to the theory of the field.

Application of the Alternative Approaches to Construction

In construction management, there have been only a few attempts to examine the applicability of action research or constructive research (e.g., Hauck and Chen 1998; Cushman 2001; Barker et al. 2004; Rezgui 2007; Azhar et al. 2010; Oyegoke 2011).

However, as illustrated through the case of delay studies, a critical insight is that the practical development and implementation of new management tools and techniques cannot be achieved by typical research such as surveys and questionnaires. Instead, there is a need for research approaches that allow researchers to participate actively and influence practice while creating new knowledge. Action and constructive research (Järvinen 2007) are also instrumental in overcoming the four reasons for the failure of delay studies, as discussed previously:

- These research approaches result in directly practicable knowledge;
- They provide room for root cause analysis;
- The best practice prescriptions can be focused on; and
- Especially through action research, complex sociotechnological systems can be acted on and sensed, as appropriate for this kind of study objects.

Illustrative examples of recent studies employing action and constructive research are offered as follows.

Azhar et al. (2010) developed an action research study focusing on improving accessibility and availability of information to support senior managers in a construction owner organization. The action that was taken involved designing and implementing a data warehouse. The authors argue for an increase in the use of action research in construction management, and conclude it enables academia to more directly influence and improve industry practices.

A recent study by Oyegoke (2011) highlighted the need for constructive research to support construction project management. The study argued that practical and innovative solutions, grounded by valid research instruments, can be developed and applied in practice through the approach. He illustrated this through a case in which a new procurement method was developed using constructive research.

Finally, Rocha (2011) used constructive research to support industry to increase the value of affordable housing through the application of mass customization. The research resulted in a conceptual framework that can be adopted by organizations of the house building sector in defining customization strategies. The study highlighted that constructive research enabled the proposition of operational constructs, which supported the direct application of knowledge by helping companies to devise their own customization strategies.

The studies mentioned previously demonstrate some of the benefits in developing research in close collaboration with industry partners, and evidence success in solving practical problems and generating new knowledge in the form of systems, models, or frameworks. They therefore provide examples of how prescriptive research facilitates the practical development or/and implementation of managerial techniques.

Conclusion

This paper has offered a simple analysis and evaluation of the findings and recommendations of published studies of construction delay in developing countries. Their findings on the causes of delay cluster clearly around two issues, management and project environment, but their recommendations poorly match these findings and contribute in a rather limited way to problem solving. Indeed, the recommendations, where made, contain little practical advice. Moreover, very little research has been carried out into the underlying causes of delay. Thus, it can be argued that the utility of conducting more traditional studies on delay is limited, because their contribution to solving practical problems is modest at best.

The reason for this relative failure of delay studies is argued to relate to the nature of the research methods employed, which have commonly been descriptive and explanatory. Such research tends to focus on analysis and explanation and on problems and their immediate causes, while paying little attention to discovering their root causes and thus to identifying possible solutions.

In this context, this paper recommends that rather than solely explanatory studies, nontraditional research approaches such as constructive and action research should be utilized to generate

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practical managerial techniques or to test extant techniques in new environments. It is argued that the implementation of such techniques has the potential to enhance practical performance, to tackle some of the persistent managerial difficulties in construction, and to contribute to knowledge in construction management.

References

Abdul-Rahman, H., Berawi, M., Berawi, A., Mohamed, O., Othman, M., and Yahya, I. (2006). "Delay mitigation in the Malaysian construction industry." *J. Constr. Eng. Manage.*, 132(2), 125–133.

Alghbari, W., Kadir, M., and Azizah, S., and Ernawati, A. (2007). "The significant factors causing delay of building construction projects in Malaysia." *J. Eng. Constr. Archit. Manage.*, 14(2), 192–206.

Al-Kharashi, A., and Skitmore, M. (2009). "Causes of delays in Saudi Arabian public sector construction projects." *Constr. Manage. Econ.*, 27(1), 3–23.

Al-Momani, A. (2000). "Construction delay: A quantitative analysis." *Int. J. Project Manage.*, 18(1), 51–59.

Alkassi, S., Mazerolle, M., and Harris, F. (1996). "Construction delay analysis techniques." *Constr. Manage. Econ.*, 14(5), 375–394.

Alnuaimi, A., Taha, R., Mohsin, M., and Al-Harthi, A. (2010). "Causes, effects, benefits and remedies of change orders on public construction projects in Oman." *J. Constr. Eng. Manage.*, 136(5), 615–622.

Arditi, D., Akan, G. T., and Gurdamar, S. (1985). "Reasons for delays in public projects in Turkey." *J. Constr. Manage. Econ.*, 3(2), 171–181.

Arditi, D., and Pattanakitchamroon, T. (2006). "Selecting a delay analysis method in resolving construction claims." *Int. J. Project Manage.*, 24(1), 145–155.

Argyris, C., Putnam, R., and Smith, D. (1985). *Action science*, Jossey-Bass, San Francisco.

Assaf, A., and Al-Hejji, S. (2006). "Causes of delay in large construction projects in Saudi Arabia." *Int. J. Project Manage.*, 24(4), 349–357.

Assaf, S., Al-Khalil, M., and Al Hazmi, M. (1995). "Causes of delay in large building construction projects." *J. Manage. Eng.*, 11(2), 45–50.

Assaf, S., Al-Khalil, M., and Al Hazmi, M. (1995). "Causes of delay in large building construction projects." *J. Manage. Eng.*, 11(2), 45–50.

Avison, D., Lau, F., Myers, M., and Nielsen, P. (1999). "Action research." *Commun. ACM*, 42(1), 94–97.

Azhar, S., Ahmad, I., and Sein, M. (2010). "Action research as a proactive research method for construction engineering and management." *J. Constr. Eng. Manage.*, 136(1), 87–98.

Ballard, G., and Howell, G. (2003). "An update on Last Planner." *Proc., 11th Int. Group of Lean Construction Conf.*, Blacksburg, VA.

Ballard, G., Howell, G., and Casten, M. (1996). "PARC: A case study." *Proc., 4th Int. Group of Lean Construction Conf.*, Birmingham, England.

Barker, R., Childerhouse, P., Naim, M., Masat, J., and Wilson, D. (2004). "Potential of total cycle time compression in construction: Focus on program development and design." *J. Constr. Eng. Manage.*, 130(2), 177–187.

Baskerville, R. (1999). "Investigating information systems with action research." *Comm Assoc Inform Syst*, 2(19), 7–17.

Bubshait, A., and Cunningham, M. (1998). "Comparison of delay analysis methodologies." *J. Constr. Eng. Manage.*, 124(4), 315–322.

Clark, P. (1972). *Action research and organizational change*, Harper & Row, London.

Cushman, M. (2001). "Action research in the UK construction industry—The B-Hive Project." *Proc., IFIP WG 8.2 Working Conf. on Realigning Research and Practice in Information Systems Development*, The Social and Organizational Perspective, Boise, ID.

Denyer, D., Tranfield, D., and van Aken, J. E. (2008). "Developing design propositions through research synthesis." *Organ. Stud.*, 29(3), 393–413.

Easterby-Smith, M., Thorpe, R., and Lowe, A. (2002). *Management research: An introduction*, 4th Ed., Sage, London.

Eden, C., and Huxham, C. (1996). "Action research for management research." *Br. J. Manage.*, 7(1), 75–86.

Faridi, A. S., and El-Sayegh, S. M. (2006). "Significant factors causing delay in the UAE construction industry." *Constr. Manage. Econ.*, 24(11), 1167–1176.

Fimpong, Y., and Oluwoye, J. (2003). "Significant factors causing delay and cost overruns in construction of groundwater projects in Ghana." *J. Constr. Res.*, 4(2), 175–187.

Hauck, A., and Chen, G. (1998). "Using action research as a viable alternative for graduate theses and dissertations in construction management." *Int. J. Constr. Educ. Res.*, 3(2), 79–91.

Herr, K., and Anderson, G. (2005). *The action research dissertation*, Sage, Thousands Oaks.

Holmström, J., Ketokivi, M., and Hameri, A. (2009). "Bridging practice and theory: A design science approach." *J. Decis. Sci.*, 40(1), 65–87.

Hult, M., and Lennung, S. (1980). "Towards a definition of action research: A note and bibliography." *J. Manage. Stud.*, 17(2), 241–250.

Iyer, K., Chaphalkar, N., and Joshi, G. (2008). "Understanding time delay disputes in construction contracts." *Int. J. Project Manage.*, 26(2), 174–184.

Järvinen, P. (2007). "Action research is similar to design science." *Qual. Quantity*, 41(1), 37–54.

Kaming, P., Olomolaiye, P., Holt, G., and Harris, F. (1997). "Factors influencing construction time and cost overruns on high-rise projects in Indonesia." *Constr. Manage. Econ.*, 15(1), 83–94.

Kasanen, E., Lukka, K., and Siitonen, A. (1993). "The constructive approach in management accounting research." *J. Manage. Account. Res.*, 5, 243–264.

Koskela, L. (2008). "Which kind of science is construction management?" *Proc., 16th Int. Group of Lean Construction Conf.*, Manchester, UK.

Koskela, L. (2011). "Fifty years of irrelevance: The wild goose chase of management science." *Lean Constr. J.*, IGLC Special issue, 1–11.

Koushki, P., Al-Rashid, K., and Kartam, N. (2005). "Delays and cost increases in the construction of private residential projects in Kuwait." *Constr. Manage. Econ.*, 23(3), 285–294.

Kurtz, C., and Snowden, D. (2003). "The new dynamics of strategy: Sense-making in a complex and complicated world." *IBM Syst. J.*, 42(3), 462–483.

Lo, T., Fung, I., and Tung, K. (2006). "Construction delays in Hong Kong civil engineering projects." *J. Constr. Eng. Manage.*, 132(6), 636–649.

Long, N., Ogunlana, S., Quang, T., and Lam, K. (2004). "Large construction projects in developing countries: A case study from Vietnam." *Int. J. Project Manage.*, 22(7), 553–561.

Lukka, K. (2003). *The constructive research approach, Series B 1*, Turku School of Economics and Business Administration, Turku, Finland.

Mansfield, N., Ugwu, O., and Doran, T. (1994). "Causes of delay and cost overruns in Nigerian construction projects." *Int. J. Project Manage.*, 12(4), 254–260.

Mezher, T., and Tawil, W. (1998). "Causes of delays in the construction industry in Lebanon." *Eng. Constr. Archit. Manage.*, 5(3), 252–260.

Mohan, S., and Al-Gahtani, K. (2006). "Current delay analysis techniques and improvements." *Cost Eng.*, 48(9), 12–21.

Naoum, S. (2001). *Dissertation research and writing for construction students*, Butterworth Heinemann, UK.

Odeh, A., and Battaineh, H. (2002). "Causes of construction delay: Traditional contracts." *Int. J. Project Manage.*, 20(1), 67–73.

Ogunlana, S., and Promkuntong, K. (1996). "Construction delays in a fast-growing economy: Comparing Thailand with other economies." *Int. J. Project Manage.*, 14(1), 37–45.

Oyegoke, A. (2011). "The constructive research approach in project management research." *Int. J. Manag. Project. Bus.*, 4(4), 573–595.

Razeghi, A. (2008). *The riddle: Where ideas come from and how to have better ones*, Wiley.

Reason, P., and Bradbury, H. (2001). *Handbook of action research: Participative inquiry and practice*, Sage.

Rezgui, Y. (2007). "Exploring virtual team-working effectiveness in the construction sector." *Interact. Comput.*, 19(1), 96–112.

Rocha, C. (2011). "A conceptual framework for defining customization strategies in the house building sector." Ph.D. thesis, Federal Univ. of Rio Grande do Sul, Porto Alegre, Brazil.

Scott, S. (1993). "The nature and effects of construction delays." *Constr. Manage. Econ.*, 11(5), 358–369.

Semple, C., Hartman, F., and Jearges, G. (1994). "Construction claims and disputes: Causes and cost/time overruns." *J. Constr. Eng. Manage.*, 120(4), 785–795.

Susman, G., and Evered, R. (1978). "An assessment of the scientific merits of action research." *Administrative Sci. Q.*, 23(4), 582–603.

Sweis, G., Sweis, R., Abu Hammad, A., and Shboul, A. (2008). "Delays in construction projects: The case of Jordan." *Int. J. Project Manage.*, 26(6), 665–674.

Van Aken, J. (2005). "Management research as a design science: Articulating the research products of mode 2 knowledge production in management." *Br. J. Manage.*, 16(1), 19–36.

Voordijk, H. (2009). "Construction management and economics: The epistemology of a multidisciplinary design science." *Constr. Manage. Econ.*, 27(8), 713–720.

Yates, J., and Epstein, A. (2006). "Avoiding and minimizing construction delay claim disputes in relational contracting." *J. Prof. Issues Eng. Educ. Pract.*, 132(2), 168–179.