Starting From Scratch: A New Project Delivery Paradigm

Rahman AZARI\(^1\), Yong-Woo KIM\(^2\), Glenn BALLARD\(^3\), and Seong-Kyun CHO\(^4\)

\(^1\) Assistant Professor, College of Architecture, University of Texas at San Antonio, 501 W. Cesar E. Chavez Blvd., San Antonio, TX 78207; PH (210) 458-3010; FAX (210) 458-3091; email: rahman.azari@utsa.edu

\(^2\) Associate Professor, Department of Construction Management, University of Washington, 120 Architecture Hall, Box 351610, Seattle, WA 98195; PH (206) 616-1916; FAX (206) 685-1976; email: yongkim@uw.edu

\(^3\) Director, Project production system laboratory and Adjunct associate professor, Civil and Environmental Engineering Department, University of California, Berkeley, CA 94720-1712; ballard@ce.berkeley.edu

\(^4\) Ph.D., Ministry of Land & Transportation, Korea; seongkyuncho@ce.berkeley.edu

ABSTRACT

Extensive research and published material exists addressing owner, contractor and supplier relationships and contracting methods. Also, there exist a variety of capital project delivery systems in construction industry which all aim at delivering projects to project owners with desired quality and within expected cost and schedule. These project delivery systems are pre-defined systems and processes each defined to address some of the many problems that keep owners of projects from achieving their desired results. Previous literature, however, indicates that the outcomes of applying these delivery processes are still disappointing to owners and not promising to a major part of the construction industry. The major objectives of this Construction Industry Institute (CII)-funded research were to identify an innovative approach to project delivery, to challenge the industry and its customers to create conditions for ideal project delivery paradigm, and to provide suggestions on how to approximate the ideal in imperfect conditions.

The research objectives were attempted through a combination of qualitative and quantitative research methods. A comprehensive review of existing literature in the field and creative thinking workshops were steps in the research to achieve the vision to the new ideal project delivery system, and to develop the hypothesis. The hypothesis was then tested and validated through statistical analyses and case-study research. We concluded that superior project performance can be achieved by breaking existing paradigms and implementing organizational integration, alignment of interests and management-by-means through new project delivery systems.

INTRODUCTION

Project delivery systems are used in the construction industry for organizing the performance of a construction work and assigning the roles and responsibilities to project parties. Several types of project delivery systems have been created in the industry, mostly in the last few decades, to help owners achieve their time, cost and quality targets. Systems are usually selected and applied in a project based on project characteristics, project priorities, owner preferences and sources, and market
conditions. The project delivery systems are pre-defined systems and processes each defined to address some of the many problems that keep owners of projects from achieving their desired results. The impact of these project delivery systems on project performance and success, however, is not promising to a major part of the construction industry.

The purpose of the present CII-funded research was to put aside the conventional methods and iterative improvement approach and start from scratch to develop a new and innovative approach. By assuming a scenario where no convention exists, the researchers are not constrained by the inefficiencies of legacy systems. Accordingly, the primary purpose of this research is to answer the essential question: “If the capital project industry did not exist and a new need was created for it, what would it look like?”

Therefore, the major objectives of this research may be stated as follows:

a. To identify an innovative approach to capital project delivery that can be applied and adapted to the context of individual projects in order to achieve the best outcomes.

b. To challenge the industry and its customers to create the conditions in which the ideal project delivery system can be realized.

c. To provide suggestions on how to approximate the ideal project delivery system within constraints that have not yet been removed.

We also hypothesize that:

Complex, uncertain and quick projects perform better when designed and managed in accordance with alignment of interests, organizational integration, and management-by-means (lean) methods.

LITERATURE REVIEW

Many efforts have been made to define the terms “project delivery method” and “project delivery system”. There is, however, no general consensus on definition of the terms.

Miller et al (2000) defines project delivery system as “a system for organizing and financing design, construction, operations and maintenance activities that facilitates the delivery of a good or service”. Construction Industry Institute (2001,b) asserts that a suitable project delivery would attribute roles and responsibilities in an “optimal” way for the project activities to perform. Oyetunji and Anderson (2006) further state that “project delivery system defines the sequence of project phases, parties involved in the project and implicitly assigned roles and responsibilities to project parties”.

Furthermore, the Associated General Contractors of America (AGC 2004) defines project delivery method as “the comprehensive process of assigning the contractual responsibilities for designing and constructing a project.” It further states that “a delivery method identifies the primary parties taking contractual responsibility for the performance of the work”.

Some literature highlight the major elements of PDSs as “project phasing”, “project (or team) relationships” and “compensation approach” (Anderson and
Oyetunji 2003; Construction Industry Institute 2001,a,b). Pishdad and Beliveau (2009) categorize elements of project delivery and contracting strategies into macro and micro elements. Macro elements, as they define, are organizational structure, phasing & sequencing strategy, contract type, and award strategy. Moreover, Micro elements of PDS, according to them, include: task assignment, risk measurement/allocation/sharing/mitigation, contractual reinforcement strategy process management, and contract characteristics.

Various efforts have been made to develop criteria for selection of PDSs. Gordon (1994) presents a two-part selection method for choosing a PDCS: 1. Organization selection (based on project drivers, owner drivers and market drivers) and 2. Contract selection. Project, owner and market drivers, as he defines, are in fact drivers for choosing a specific PDS.

In another attempt, Al Khalil (2002) categorizes factors affecting selection of a PDS into project characteristics, owner needs and owner preferences. Mearig (2004) groups the primary factors affecting the selection of project delivery systems into need and success factors.

However, despite various attempts to characterize selection factors for project delivery systems, the construction industry has not been able yet to achieve the desirable outcomes through these systems. Traditional approaches to project delivery have been inefficient and ineffective due to a variety of reasons ranging from fragmentation of people and specializations, to diverse and sometimes conflicting goals and interests of the stakeholders, to ineffective management approaches and so forth (CMAA 2010, Egan 1998, CII 2012). The condition of capital projects is even worse because of high degrees of uncertainty, complexity, and speed involved in these projects. The project delivery systems, we believe, should be designed to adapt to the context of projects.

Lean Construction Institute (LCI, 2009) states that project delivery systems have three basic domains of “project organization”, “operating systems” and “commercial terms” which for a PDS to be coherent, the structures within these domains must be “aligned and in balance”.

RESEARCH METHODS

A mixed-method (quantitative/qualitative) methodology was applied in order to achieve the research objectives. A comprehensive review of existing literature in the field and creative thinking workshops were steps in the research to achieve the vision to the new ideal project delivery system, and to develop the hypothesis. The hypothesis was then tested and validated through statistical analyses and case-study research.

The main phases of the research were literature review and creative thinking workshops to develop and refine the hypothesis. In creative thinking processes, innovative ways of thinking are applied in order to generate ideas and to understand and evaluate them more comprehensively. These thinking processes are especially pursued in organizations because of their needs to respond to changes and concern for innovation (Kaufman & Sternberg 2010). The result is imagination, invention, development, alteration or improvement of a concept. This method was applied in order to gain input from industry on the research subject. Based on literature review
and the outcomes of creative-thinking workshops with CII team members, the characteristics of future state Project Delivery Systems (PDSs) and their causes were identified.

To test the hypothesis that complex, uncertain and quick projects perform better when designed and managed in accordance with alignment of commercial interests, organizational integration, and Management-By-Means methods and measure the correlations between the variables of the hypothesis, the available CII benchmarking database was used to perform statistical analysis. We determined variables in the database that were able to capture organizational integration, alignment of commercial interests, Management-by-Methods and project performance and used them as independent and dependent variables in a regression model.

Not all relevant variables were found in the database. As a result, a complementary questionnaire survey was used to collect data on case study projects volunteered by CII members. The results of a survey on case studies were used as an additional tool for testing the hypothesis in areas where CII benchmarking data was insufficient. The case studies were scrutinized to explore in practice how project delivery systems are designed and managed on challenging projects, and how effective those designs and management methods have been. Based on the data collected through the surveys on 20 case studies, two indices were created. The Challenge Index (CI) was made using the average of complexity, uncertainty and speed challenges in each case study. Similarly, Performance Index (PI) was created as an indicator of success. The relationships between the two indices were then studied. Also, alignment of commercial interests, organizational integration and Management-By-Means in case studies were scored and their relationship with the mentioned indices were analyzed. Finally, an analysis of the case study surveys was conducted to qualitatively test the hypothesis of the research.

RESULTS

The research team began its exploration by literature review and creative workshops with CII members to formulate the ideal project delivery system. The product of this process is the outline presented in Figure 1.

The major characteristics of an ideal project delivery system were outlined as:

- Delivers to customers what they need to achieve their objectives, within their conditions of satisfaction. (Note: this is a version of the lean ideal.)
  - predictable outcomes
  - defect-free execution
  - retention of positive competition.
- Relational
  - Everyone feels valued.
  - Relationships survive the project.
- Management system
  - Holistic optimization; optimization of the whole, not the parts.
- Collaborative financial management
  - financial transparency
  - alignment on compensation.
• Promotes learning
  ➢ Individuals are enabled to develop their capabilities, to become all they can be.
  ➢ Learning from each project is carried forward to future projects.

Subsequently, the team brainstormed what might cause such a vision to be realized. The product of this further visioning process is the outline presented in Figure 2.

![Figure 1. Ideal Project Delivery System](image)

Figure 1. Ideal Project Delivery System

The major components of this second outline and their key subcomponents are the following:

• Project definition process
  ➢ Identifies conditions of satisfaction.
  ➢ Involves contractors in an integrated organization.

• Commercial terms
  ➢ relational contract (as opposed to a transactional contract)
  ➢ participants selected on the basis of performance
  ➢ value-based compensation

• Design
  ➢ Targets are set for cost with contractor participation and design is steered toward targets.
  ➢ A set-based strategy is used to generate, evaluate, and select from design alternatives.

• Management
➢ The right to make immediate corrections is widely distributed in the project organization.
➢ Work is structured to minimize handoffs.

Figure 2. Causes of Desired Project Delivery System’s Characteristics.

In order for the vision to be validated, it was necessary to reduce the number of variables and to express their relationship in the form of a hypothesis. The independent variables were consolidated into three: alignment of interest, organizational integration and management methods. The dependent variables were reduced to two: performance against budget and performance against schedule. Three contextual variables were added: project complexity, uncertainty and speed. These variables were then formed into a testable hypothesis:

Complex, uncertain, and quick projects perform better when designed and managed in accordance with alignment of interests, organizational integration, and management by means (lean) methods.

The team performed a statistical analysis using the CII benchmarking database to seek correlations between the independent variables (i.e., alignment of interests, organization integration, and management-by-means) and the dependent variables (i.e., project outcomes—time and cost). The team found positive support for the correlation between teamwork, as an organizational integration (OI) indicator, and project performance (figure 3 and 4). However, there was insufficient data for all variables, especially those involving management methods. This itself is an indication of the extent to which the proposed ideal project delivery system is innovative.
As it happens, this finding of statistically significant correlation between organizational integration and performance filled a gap in the literature. Previous studies have shown the correlation between project performance and both alignment of interests and managing-by-means, but not between organizational integration and project performance.

Analysis of the CII benchmarking database also showed a positive and statistically significant correlation between teamwork and safety. In more than 95 percent of projects, safety increased as teamwork level increased.

Case study data were then gathered from RT271 team members for further correlation analyses. Ultimately, data were collected on 20 projects, of which RT271 team members contributed 18.

For analysis of the cases, two indexes were generated: the challenge index (CI) and the performance index (PI). The challenge index was created from the average of complexity, uncertainty, and speed ratings in each case study. The performance index was created from the average of the indicators measuring project success and quality of relationships.

Figure 5 includes mean scores for alignment of interests (AI), organizational integration (OI), and management by means (MBM) for case studies by quadrant. To move from quadrants 1 and 2 to quadrants 3 and 4, a shift that represents an increase in project performance, there must be an increase in levels of OI, AI, and MBM. In
other words, application of OI, AI, and MBM accompanies an increase in project performance. Low-performing projects (with a PI score lower than an average of 4) are projects on which at least one—and in most cases two—of the three measures of OI, AI, and MBM are performing low. This implies the importance of the connection between OI, AI, and MBM.

The research team also performed a qualitative analysis of the case study data. Most of the findings align with the research hypothesis that organizational integration, alignment of interests, and management by means are increasingly necessary for project success as projects increase in complexity, uncertainty, and speed. The following are the findings from the qualitative analysis:

1. The relatively high levels of organizational integration were achieved through involvement of all parties in decision making processes, starting from the early phases of project development.
2. One project team achieved a high level of alignment of interests, even though it did not use any contractual tool adapted for that purpose. Instead, all project team members fully understood the project objectives and their importance to the owner. The project illustrates how a high level of alignment of interests can be achieved through non-contractual methods. (The small sample size prohibited evaluation of the probability that such an approach would be generally effective.)
3. One project was completed successfully on an emergency basis. Emergency projects appear to have many if not all the characteristics of the ideal.
4. On one healthcare project, lean methods and building information modeling (BIM) worked in harmony with culture toward integrated project delivery. The interviewees reported that the use of the tools were often more effective in the integrated approach.

Figure 5. CI-PI diagram

The research team also performed a qualitative analysis of the case study data. Most of the findings align with the research hypothesis that organizational integration, alignment of interests, and management by means are increasingly necessary for project success as projects increase in complexity, uncertainty, and speed. The following are the findings from the qualitative analysis:

1. The relatively high levels of organizational integration were achieved through involvement of all parties in decision making processes, starting from the early phases of project development.
2. One project team achieved a high level of alignment of interests, even though it did not use any contractual tool adapted for that purpose. Instead, all project team members fully understood the project objectives and their importance to the owner. The project illustrates how a high level of alignment of interests can be achieved through non-contractual methods. (The small sample size prohibited evaluation of the probability that such an approach would be generally effective.)
3. One project was completed successfully on an emergency basis. Emergency projects appear to have many if not all the characteristics of the ideal.
4. On one healthcare project, lean methods and building information modeling (BIM) worked in harmony with culture toward integrated project delivery. The interviewees reported that the use of the tools were often more effective in the integrated approach.

Figure 5. CI-PI diagram
5. When asked what they would do differently if given the chance, the respondents from the unsuccessful projects agreed on the need for stronger leadership and more integration to achieve the project goals. Moreover, some projects pointed to needing better communication and more careful selection of contractors. This response suggests that cultural alignment and project leadership are as critical as contractual arrangements to forming integrated team and achieving project success.

CONCLUSION

This research hypothesized that “Complex, uncertain, and quick projects perform better when designed and managed in accordance with alignment of interests, organizational integration, and management by means (lean) methods.”. Hypotheses can be disproven but not proven, only more or less strongly supported. In this research, the hypothesis was supported, but that support could be strengthened with additional and better data. However, the hypothesis is intuitively plausible. With the level of support developed in this research, it should be taken very seriously.

The implications of the research are substantive and important: superior project performance can be achieved by breaking existing paradigms that govern thinking and action. The RT271 team urges the industry and its customers, under the leadership of CII, to proactively create the conditions in which the ideal can be realized. It is in the interest of the industry and its recurrent customers to act together to reduce obstacles to realizing the ideal project delivery system. This can be accomplished by revealing the current paradigms to be obstacles to improvement, changing regulations, developing capabilities, and providing incentives for risk taking and experimentation. CII is well positioned to be a leader of this initiative, the key steps of which appear to be the following:

- Form a coalition of owners and contractors dedicated to the objective.
- Develop and agree upon a strategy for change: the desired future, obstacles to be overcome, and strategies for overcoming the obstacles.
- Implement the strategy for change.

ACKNOWLEDGEMENT

The paper is an outcome of a Construction Industry Institute (CII)-funded research. We would like to sincerely appreciate the CII and the contributions of research team 271.

REFERENCES


LCI (2009). Introduction to Lean Construction, St. Louis, MO


