



Utilization of a cognitive task analysis for integrated project delivery application: Case study of constructing a campus underground parking facility

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Abstract

Integrated Project Delivery (IPD) has the potential to overcome inefficiencies of traditional delivery methods by enhancing collaboration among project participants, and is therefore gaining popularity in the Architecture, Engineering and Construction (AEC) industry. For owners considering an IPD approach and are incapable or unprepared to pursue a “pure” IPD project, an IPD-ish approach could be an alternative option. IPD mode is featured by implementing a range of fundamental principles. However, investigations on application of IPD-ish principles to actual construction projects are highly limited. This research mainly focused on a Cognitive Task Analysis (CTA) of the application of IPD principles to the design and construction of an IPD-ish project, and presenting a case study on an underground campus-parking facility. A case study for CTA was designed in this study: a project progress map was developed, wherein seven project phases were defined; by analyzing the project goals and technical measures in each project phase, six key IPD elements was summarized, and a few specific work measures for addressing these elements were discussed. For owners or participants intending to plan an IPD-ish project, the results of the study provide a few references on the selection and application of IPD principles in each project phase.

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Keywords: Cognitive Task Analysis (CTA); Integrated Project Delivery (IPD); IPD-ish project; IPD principles; Project process

1. Introduction

With the development of the Architecture, Engineering and Construction (AEC) industry, project delivery

methods are simultaneously undergoing continuous evolution (Garcia, Mollaoglu-Korkmaz, & Miller, 2014). Owing to the increasing complexity of construction projects and the demands from the owners of project outcomes, traditional project delivery methods such as Design-Bid-Build (DBB) and Design-Build (DB) do not exhibit the capability to satisfy the requirements of the AEC industry (Franz, Leicht, Molenaar, & Messner, 2017). Thus, the project owners have been seeking new project delivery methods for ensuring faster completion of construction projects, effective cost-control, higher safety, and higher quality, while accelerating the design and construction process (Bilbo, Bigelow, Escamilla, & Lockwood, 2014).

Abbreviations: AEC, Architecture, Engineering and Construction; AGC, Associated General Contractors; AIA, American Institute of Architects; CAR, Construction All Risks; CNY, Chinese Yuan; CTA, Cognitive Task Analysis; DB, Design-Build; DBB, Design-Bid-Build; IPD, Integrated Project Delivery; SJTU, Shanghai Jiao Tong University

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Owing to its emphasis on the principles of trust and cooperation, Integrated Project Delivery (IPD) has been attracting the interest of owners, architects, and the builders in the construction industry (Kent & Becerik-Gerber, 2010). American Institute of Architects (AIA) define IPD as a project delivery approach that integrates people, systems, business structures, and practices into a process that collaboratively harnesses the talents and insights of all the participants to optimize project results, increase value to the owner, reduce waste, and maximize efficiency through all phases of design, fabrication, and construction (AIA, 2007). As defined by AIA, there are a number of levels of collaboration in the IPD; among these, the highest collaborative level is referred to as “IPD as a Delivery Method” and also by numerous other terms including “Pure” IPD and “True” IPD. “IPD as a Delivery Method” is characterized by a multi-party contract between the owner, prime designer, contractor, and/or other key members of the project team, incentivizing collaborative behavior, team risk-sharing, and other IPD principles and practices. On the other hand, the lower collaborative level in IPD occurs when integrated practices or philosophies are applied to certain traditional delivery approaches, it is referred to as “IPD as a Philosophy” and also by numerous other terms including IPD-ish. IPD-ish is characterized by traditional contracts with some limited risk-sharing and some application of IPD principles (AIA, 2010a). The main difference between true IPD and IPD-ish is that whether a project adopt a multi-party contract to address all the IPD principles. The administration of a true IPD contract entails the fulfillment a variety of challenging requirements; moreover, many project contexts do not facilitate the implementation of all IPD principles (Abdulaal, Bouferguene, & Al-Hussein, 2017). Consequently, true IPD has not been generally implemented worldwide. Meanwhile, the implementation of an IPD-ish project is more feasible than true IPD. It is recognized that IPD-ish projects which are incapable for a multi-party contract but implement a major portion of integrated perceptions can still deliver much of the values of IPD (Song & Liang, 2011). Thus for owners considering an IPD approach and are incapable or unprepared to pursue a true IPD project, an IPD-ish approach could be an alternative option. However, investigations on application of IPD principles to actual construction projects are highly limited.

Cognitive Task Analysis (CTA) is an effective tool to identify the concepts, goals and strategies required for task performance. The concept of CTA has implicated for the development of expert systems, job and task design, and decision making (Wei & Salvendy, 2004). The aim of this research is to conduct a CTA case study on the construction of an underground campus-parking facility to explore the effective utilization of IPD principles in IPD-ish projects. To achieve this aim, a project progress map is developed, and the whole project process is divided into seven phases. The case study is analyzed by detailing the seven phases of the IPD-ish project and supplemented with inter-

views of the project participants to explore their approach to work and organization in each project phase to achieve highly effective integration. It is anticipated that a few key IPD principles can be applied to this project to realize “IPD-ish” characteristics.

2. IPD principles

IPD conceptions and similar integrated delivery methods have enjoyed wide recognition by means of publication of several project and owner success stories, such as the Autodesk Headquarters (Bendewald, Franta, & Pradhan, 2010). Several organizations such as AIA and Associated General Contractors (AGC) have also developed and promoted a few standardized contractual documents (AGC, 2011; AIA, 2009). In Jan 2010, AIA released a case study report on IPD projects in the USA (AIA, 2010b). In all these cases, integrated projects were distinguished by their demonstration of highly effective collaboration among participants, and by the extent to which they satisfied or exceeded owners’ expectations with regard to the projects’ schedule, cost, and quality; moreover, a majority of the project participants expressed their interest to continue following the principles of IPD and their expectations from IPD as a project delivery approach. Integration of project participants has yielded enhanced results. The utilization of integrated contract structures has been recognized conceptually in other countries although using dissimilar terminology and marginally varying legal relationships (Franz & Leicht, 2012); this corroborates the assertion that IPD can be applied to a variety of contractual arrangements. Previous research studies in this area explored the introduction of Building Information Modeling and Lean Construction as technologies that support the delivery of projects through more collaborative and integrative means (Dossick, Azari, Kim, & El-Anwar, 2013; Ma, 2014); introduced effective contracting policies or management strategies when conducting IPD contracts (El-adaway, 2010); or developed of multimedia and information tools to implement the new project delivery (Alshawi & Aouad, 1995; Lines, Perrenoud, Sullivan, & Smithwick, 2014).

According to AIA documents (AIA, 2010a; Matsumoto, Stapleton, Glass, & Thorpe, 2005), there are a range of fundamental IPD principles, and any project delivery method may be enhanced through the implementation of these principles. Projects that implement a part of these principles could be IPD-ish ones. The IPD principles summarized from AIA documents are as follows; however, there are relatively less research studies on the systematic implementation of these principles in a project:

- (1) Mutual respect and trust.
- (2) Mutual benefit and reward.
- (3) Collaborative innovation and decision making.
- (4) Early involvement of key participants.
- (5) Early goal definition.

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