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Project Delivery Systems for Healthcare Projects: To Lean or Not to Lean

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Abstract

Question: How can project owners employ the expected impacts of project delivery systems to select between traditional and lean-oriented systems for healthcare projects?

Purpose: The ultimate purposes of this paper are to: (1) understand the characteristics of traditional and lean-oriented project delivery systems used in healthcare projects; (2) identify the key factors that influence the selection of delivery systems for healthcare projects; (3) understand the impacts of delivery system selection on the project performance; and (4) present a logical process that can be used as a basis for selecting project delivery systems for healthcare projects.

Research Method: The research methods include data gathering, along with using structured surveys to healthcare project stakeholders and semi-structured interviews with a randomly selected group of senior experts.

Findings: This paper establishes a novel strategy for project delivery system selection for healthcare projects that takes into account five guiding principles identified by stakeholders.

Limitations: The findings are based on a structured survey within the State of Kuwait, and semi-structured interviews with a selected group of senior experts.

Implications: The strategy for selecting project delivery system focuses on examining the readiness of the owner to accept the risks of scope clarity and budget risks; eradicating the perils of change orders and claims; observing the financial flexibility of the owner; including the owner's preference to project delivery speed; and establishing project responsibility and control.

Value for authors: The novel strategy presented within this study serves as a guide to help owners understand and analyze the underlying dynamics and key factors that should be considered when selecting a project delivery system for healthcare projects.

Keywords: healthcare projects, project delivery systems, design and build

Paper type: Full paper

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Introduction

The proper selection of a project delivery system (PDS) is considered one of the primary determinants of project success as it influences the subsequent relationships among project stakeholders. Over the past decades, a number of project delivery systems have emerged to streamline the execution of public procurements and minimize adversary relationships among the project stakeholders. The available project delivery systems can be generally classified into two broad groups: traditional delivery systems (e.g. design-bid-build, and construction project management) and lean-oriented delivery systems (e.g. lean project delivery system, integrated project delivery, project alliancing, and design-build). Among these delivery methods, design-bid-build has been the most widely used since the 1940s and for the majority of the 20th century (Miller et al., 2000). Construction project management also started to became widespread since the 1960s as a solution to the construction industry's high levels of project inefficiencies (Tatum, 1983). In the 1980s, the concepts of partnering between owners and contractors - a primitive form of lean-oriented projects - became common in the petrochemical construction industry (Loraine, 1994). Later in the 1990s, design-build was introduced and empirical studies showed that it could reduce the cost, speedup the schedule and improve the quality of building projects (Konchar and Sandivo, 1998). Around the same period, the concept of integrated project delivery was incepted as a solution to the construction industry fragmentation problem, and at the turn of the new millennium the lean project delivery system emerged as a viable solution for project delivery from a life-cycle perspective (Fischer et al., 1994; Ballard, 2000).

Despite the existence of these new lean-oriented project delivery methods, which can offer a viable alternative to traditional delivery systems and are considered easier to manage, safer, and of better quality (Abdelhamid et al., 2008), the amount of public procurements using them remains relatively small (Kent and Becerik-Gerber, 2010). One of the explanations for this phenomenon is the unfamiliarity of public agencies with the existence of these alternatives and their impacts on project performance. Accordingly, public agencies can generally be authorized to select among a few delivery systems for the execution of public procurements (McWhirt, 2007). Nevertheless, these agencies are typically confronted with a challenge in selecting among the few available authorized project delivery systems, especially in projects that require advanced specialized knowledge and/or involve design for new technologies such as healthcare projects. For such projects, there is a lack of solid underpinning theories and conceptual methodologies that can guide public agencies in selecting an appropriate project delivery system. As a result the majority of public procurements in the context of healthcare projects are delivered using a traditional delivery approach, which can leave the owner frustrated with the outcomes (Reed, 2008). This is especially true if the project characteristics do not match the delivery system requirements, and typically lead to substantial waste of public funds on redesign, disputes and litigation.

A number of techniques have been proposed in the literature for selecting appropriate delivery systems, including the process of elimination (Gordon, 1994), Parker's judging alternative technique (Alhazmi and McCaffer, 2000), the analytical hierarchy process (Cheung et al., 2001; Mahdi and Alreshaid, 2005), and multi-attribute decision support systems (Mafakheri et al., 2007; Touran et al., 2009; Chih 2010; Mostafavi and Karamouz, 2010). Despite the contributions of these studies and techniques, some existing knowledge gaps need to be addressed and filled:

- In the specific context of healthcare projects, there is a lack of studies that develop conceptual strategies and techniques for selecting the project delivery system, which leads to significant problems during the project design and construction phases (Reed, 2008).
- The link between project characteristics and the appropriate delivery system is not clearly understood in the domain of healthcare projects. In order to select an appropriate project delivery system for such projects, the key factors that influence owner's decision need to be identified and clearly understood. Healthcare projects involve the design of complex, unique, and multifaceted facilities. They are typically developed by not-for-profit organization and thus the budget plays a key role in project delivery. A major concern for owners of healthcare projects is typically about controlling the complexity of design and construction, within the constraints of the budget, service life, and hazard management (Lavy and Fernández-Solis, 2010).
- Due to the scarcity of quantitative data on healthcare projects delivered using new project delivery methods (Bilbo et al., 2015), the impacts of project delivery system is not well understood or commonly considered in project delivery system selection.

Objectives

This study aims to provide hard data and guiding principles that can help owners of healthcare projects select the appropriate delivery method for healthcare projects. To this end, a mixed-methods sequential explanatory design is utilized in order to achieve four main objectives: (1) understand the characteristics of traditional and lean-oriented project delivery systems used in healthcare projects; (2) identify the key factors that influence the owner's decision to select a project delivery system; (3) understand the impacts of delivery system selection on the project outcomes; and (4) provide a logical procedure that can be used as a basis for selecting project delivery systems in the context of healthcare projects. The study is primarily based on collected hard data from healthcare project professionals in Kuwait, but the results could be applicable to other countries with similar characteristics in the gulf region and the Middle East. The following four sections discuss the study objectives in detail.

Characterizing healthcare project delivery systems

In constructing healthcare facilities, project delivery is considered a broad, complex process that includes extensive planning, design, procurement, and construction of a facility that often requires advanced specialized design and installation of new technologies evolving at ever-increasing rates. Within a controlled environment, a healthcare facility typically integrates complex structures and systems that are critical to the staff, employees and visitors, including nuclear, electromagnetic, radiation, and chemical systems (Lavy and Fernández-Solis, 2010). Public agencies, acting as owners of public procurements, typically pay attention to items such as project cost, construction duration, contractor selection, critical complex systems and commissioning, but rarely think about the repercussions of selecting an inappropriate project delivery system. With public agencies' typical limited knowledge of evolving technology requirements and design complexity, the selected project delivery system could be an impediment to completing the project in time, under budget and at the best value; which leaves many owners frustrated with the outcomes (Reed, 2008).

While developing the strategy for healthcare projects, several project delivery systems are available to public agencies, including Design-Bid-Build (DBB), Design-Build (DB), Construction Project Management (CPM), Construction Management at Risk (CMR), Integrated Project Delivery (IPD), Lean Project Delivery System (LPDS), among others (Gould, 2005; Ballard, 2008; Fisk and Reynolds, 2010). The selection strategy can be further complicated, if the agency does not have the capacity to identify clear and sound criteria for selecting the procurement method and contract format. In general, there is a wide variety of common procurement methods, including low bid, qualifications-based, sole source, best value - total cost, best value – fees/qualifications, among others; while typical contract formats may include lump sum, unit price, cost-plus, target price, guaranteed maximum price, among others (Oztas and Okmen, 2004; Kenig, 2011). In addition, the strategy of healthcare PDS selection is further complicated by the various contractual relationships and contracts among the stakeholders, which typically include the owner-architect/engineer (A/E) contract, owner-contractor contract, owner-professional construction manager contract, contractor-subcontractor contracts, among others (Oztas and Okmen, 2004; Fisk and Reynolds, 2010).

Given the aforementioned challenges and project complexity and uniqueness, the owner must decide on and select an appropriate project delivery system before the procurement stage; a challenging decision that several public agencies overlook which can create serious downstream problems. On the whole, project delivery systems for healthcare projects can be categorized into two main broad perspectives: (1) traditional delivery systems (TDSs), and (2) lean-oriented delivery systems (LODSs). There are clear distinctions between the two categories detailed by Mossman (2014) in terms of the ethos, theories, structure, planning, quality, control, risk, and attitude toward waste. Yet, some project delivery methods could have a slight overlap with one of the categories (e.g. Design-Build can be considered a semi-lean delivery method).

TDSs for healthcare facilities

In healthcare projects, a traditional delivery system (TDS) is mainly characterized by the disintegration of the design, procurement, and construction phases. The owner hires a professional architect/engineer (A/E) to develop the design of the project in 4 typical phases: conceptual design, schematic design, developed design and final design. Following the development of the final design, the owner typically requests the designer (or a consultant) to prepare the bid documents in order to seek bids from contractors in a procurement phase that culminates with selecting a contractor (or a number of prime contractors) for constructing the healthcare facility. This philosophy of separating design, procurement and construction is considered a major problem in construction (Ballard and Koskela, 1998).

The most common form of TDSs for healthcare facilities is the Design-Bid-Build (DBB) system, which is known to most private owners and public agencies, especially those who reject new delivery methods (Koskela et al., 1997; Tam et al., 2014). TDSs also include the Construction Project Management (CPM) delivery method and its variants, which are considered offshoots of DBB in which a professional construction management firm is hired to manage the construction phase especially in projects where a number of prime contractors are hired.

A distinctive feature of TDSs for healthcare facilities is that the owner is considered responsible for the design, and the contractor is considered responsible for the execution of the work including project time, cost and quality. These types of arrangements can create substantial problems to the owner if the owner is not familiar with the design requirements for the healthcare facility, unable to establish the project budget, or expects a fast delivery of the facility.

Healthcare TDSs can also present significant challenges to the contractor such as controlling the project costs while delivering value to the owner; managing the negative effects of design deficiencies and poor coordination; and the typical challenge of finishing a complex project on time to avoid liquidated damages. In such complex projects, contractors are commonly vulnerable to losses from design deficiency, if careful attention is not paid to the management of change orders and variation requests in order to compensate losses.

LODSs for healthcare facilities

Lean-oriented delivery systems (LODSs) are based on the life cycle perspective of integrating design and production/construction in order to maximize value to the owner and reduce waste (Ballard and Zabelle, 2000). These delivery systems embed the philosophies of promoting cross-functional team organizations, adoption of lean design processes, and minimizing negative interactions among project stakeholders (Kemmer et al., 2011). The early engagement of key stakeholders in the design phase is a distinctive feature of these delivery systems (Ballard, 2008). The concepts of generating greater value with less waste are important underpinnings of lean construction. Value is understood in terms of what the customer orders; i.e., entirely in terms of the product to be provided (Ballard et al., 2007). Consequently, it is quite natural to focus on eliminating waste, where waste is anything not necessary for delivering value to a customer. The lean ideal is to provide a custom product exactly fit for purpose delivered instantly with no waste and non-value-adding activities (Ballard et al., 2007).

The most recognized lean-oriented project delivery systems for healthcare projects are the Integrated Project Delivery (IPD) system and the Lean Project Delivery System (LPDS). The Integrated Project Delivery system (IPD) is a project delivery approach that aims to integrate people, systems, business structures, and practices into a process that harnesses the talents of all project stakeholders in order to increase value to the owner, reduce waste, and maximize efficiency through all phases of design, fabrication and construction (AIA, 2007). It promotes the concept of collaboration among the entire project stakeholders including the owner, designer, contractor, subcontractors, fabricators, and suppliers.

The Lean Project Delivery System (LPDS) is a project-based delivery system in which the project team collaborate to help owners decide what they want and how to realize their decisions through a process of aligning ends, means and constraints (Ballard, 2008). From the LPDS perspective, a project is regarded as a value-generating process that requires downstream stakeholders to plan and design the project steps through cross-functional teams. A roadmap for lean implementation on capital projects was developed by Ballard et al. (2007) and includes important principles such as structuring the project organization to engage downstream players in upstream processes, aligning project scope, budget and schedule, encouraging thoughtful experimentations, celebrating breakdowns as opportunities for learning, and building quality and safety into projects. Despite the clear value of the IPD and LPDS, they are still not widely used in healthcare projects.

Other project delivery systems can be considered as semi-LODSs, including the Design-Bid (DB), Construction Management at Risk (CMR), and Project Alliancing (PA) delivery systems. These delivery systems provide some features of LODSs such as integrating design and construction processes, enabling collaboration among some of the project stakeholders, reducing constructability problems, and providing value to the owner by reducing potential time waste. However, they lack some features of LODSs. For example, DB and CMR typically put the contractor and the construction management firms in the leading role on the project and are usually not as transparent to the owner as LODSs. Collaboration among project stakeholders is also constrained in DB projects compared to LODSs. While there may be some collaboration in DB projects, the designer is at times constrained by the contractor's preferences and financial priorities which may not necessarily be aligned with the owner's objectives and preferences. Yet, semi-LODSs are more commonly utilized to deliver healthcare projects than IPD and LPDS. Figure 1 summarizes the main characteristics and differences between TDSs and LODSs.

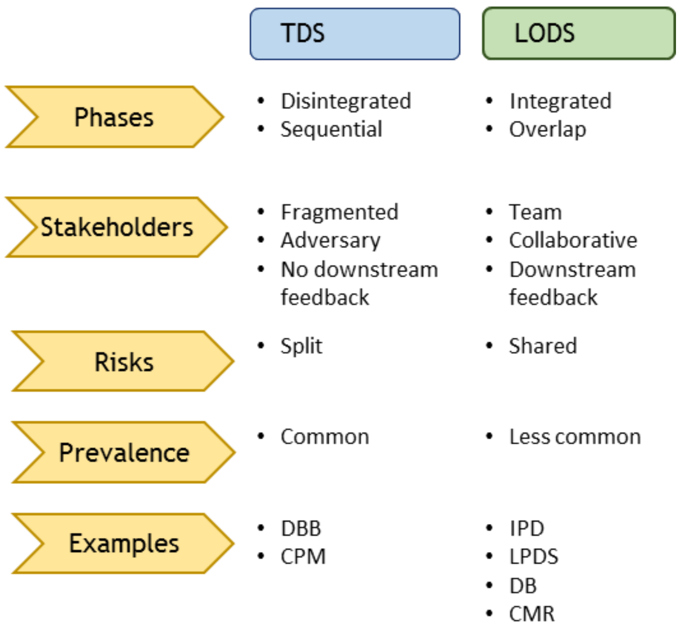

Figure 1: TDS vs LODS for healthcare projects

Factors influencing PDS selection

In order to select an appropriate project delivery system for healthcare projects, private owners and public agencies need to consider a multitude of factors that typically influence the selection. Ignoring the significance of these factors can lead to substantial problems, disputes and litigation among the project stakeholders; especially when owners face difficulties in identifying these factors (El-Sayegh, 2008). As such, it is important to have a clear understanding of the key factors that influence the selection of a delivery system and their impact on healthcare project execution.

Blismas et al. (2004) identified 10 main factors that influence the selection of project delivery systems for multi-project environments: project uniqueness, site geographical disparity, owner indecisiveness, owner's corporate drivers, business volatility/economic environment, legislative processes, property supply, project prototyping, lead times, and third party intervention. Issues such as variations in scope, site uniqueness, poor project definition, and uncertainty surrounding organizations' portfolios were considered major problems that hinder adopting the principles of lean construction to project delivery (Blismas et al., 2004).

According to Mahdi and Alreshaid (2005) there are 34 factors that affect the selection of an appropriate delivery system for a project. These factors can be grouped into seven main groups: project-related characteristics, cost estimation precision, need for project time reduction, tightness of project milestones/deadlines, cost saving needs, project budget risks, and the ability to define the project scope, size and complexity.

El-Sayegh (2008) identified 21 key factors to have a considerable impact on the effectiveness of project delivery, including scope definition, cost reduction requirements, short schedule obligations, handling changes, flexibility requirements, experience-related factors, project complexity, owner's control, among others. These factors were grouped into eight categories: scope, cost, time, quality, risk, owner's organization, funding/cash flow, and project characteristics (El-Sayegh, 2008). Other studies also suggested similar grouping such as the study by Chen et al. (2010) and Li et al. (2015) in which the factors were categorized into: cost, schedule, quality, complexity, scope change, experience, financial guarantee, risk management, uniqueness, and project size.

According to Yoon et al. (2016), the main influencing factors that affect project delivery selection are the owners' experience and capacity, importance of shortening project duration, and importance of project cost reduction. Other factors were also considered important such as the type of construction, complexity, flexibility requirements, need for design and construction integration, market conditions, and uncertainty.

Despite the contributions of the aforementioned studies, they were not conducted in the specific context of healthcare projects and were limited to a small subset of the recognized project delivery systems. It is clear from the literature that theoretical underpinning and criteria for selecting PDS within healthcare projects is needed. To this end, the first phase of this mixed-methods sequential explanatory study involved the design of a survey questionnaire to solicit input from experts in healthcare construction industry about the key factors that affect the selection of an efficient project delivery system. The survey targeted the major stakeholders of healthcare construction projects in Kuwait, as a representative country of the Middle East. The surveyed experts included representatives of owners, engineering/design firms, contractors, construction management firms, and consulting firms. The experts were presented with a list of factors identified from the literature for other types of construction industry sectors, and were asked to select the factors that pertain to healthcare projects and realistically have the greatest impact on healthcare project success. The survey was distributed to 100 experts and 54 responses were received (54% response rate). The respondents were 38% seniors, 52% mid-careers, and 10 % juniors.

The respondents identified several factors to be key in selecting a PDS for healthcare projects, which indicates the complexity of the selection process and advocates the need for methodologies that can aid owners in making the right selection. The factors identified by the experts through the survey can be summarized into three broad groups:

- G1 - Cost-related factors: budget expansion risks/flexibility, capacity for financial guarantees, cost of change orders and delays, requirements for the lowest cost, and financing options.
- G2 - Time-related factors: shortest time requirements, tight project milestones, flexibility of staying on schedule.
- G3 - Project control factors: project complexity and uniqueness, owner's experience and capacity, owner's authority to select PDS, and preference for involvement.

As shown in Table 1, related factors have been sub-grouped into five categories to facilitate the second phase - representing and characterizing their effect on developing the methodology for PDS selection. The table also illustrates the relationship between the identified factors and the literature on PDSs of other types of construction industry sectors.

Table 1: Factors identified to influence selecting the PDS for healthcare projects

Gr.	Cat.	Influencing Factor	A*	B*	C*	D*	E*	F*
G1	Risk	Owner's ability to handle budget risks		✔	✔	✔	✔	✔
		Capacity for financial guarantees	✔	✔		✔	✔	
	Change	Change order handling	✔	✔	✔	✔	✔	✔
		Scope and Quality control	✔	✔	✔	✔	✔	✔
	Budget	Requirements for lowest cost		✔	✔	✔	✔	✔
		Financing/economic environment	✔					✔
G2	Fast Delivery	Shortest time requirements		✔	✔	✔	✔	✔
		Tight milestones	✔	✔		✔	✔	
		Schedule flexibility			✔	✔	✔	✔
G3	Control	Project complexity and uniqueness	✔	✔	✔	✔	✔	✔
		Owners' experience and capacity	✔	✔	✔	✔	✔	
		Owner's authority to select the PDS	✔		✔			
		Owner's preference for involvement		✔	✔	✔	✔	✔

* A: Blismas et al. 2004, B: Mahdi & Alreshaid 2005, C: El-Sayegh 2008, D: Chen et al. 2010, E: Li et al. 2015, F: Yoon et al. 2016

The surveyed experts also pointed out the importance of highlighting the impacts of selecting between a TDS and LODS to the owner before the decision is made. In their opinion, the owner's decision is facilitated if the impacts are identified.

Impact of delivery system on healthcare projects

The impacts of TDSs are represented by data collected from historical case studies conducted on these delivery systems. On the other hand, as there is limited available data on the impacts of LODSs, their perceived impacts can be analyzed through a questionnaire survey distributed to experts in healthcare projects.

TDS reported impacts

TDSs are largely known to create some challenges to project stakeholders such as controlling the project cost, time and quality (Atkinson, 1999; Cooke-Davies, 2002; Hjelmbrekke et al., 2014). In their responses to the survey questionnaire, experts indicated that TDSs usually fail to face the notable challenges of complex healthcare projects. In addition, in these projects, owners are typically challenged with controlling design details, reducing constructability issues, and avoiding change orders and claims.

Several case studies reported considerable cost overruns and disputes when the owner requirements are not well understood and met. In the studied cases, the relationships among the owner, consultant and contractor typically become adversarial (Kumaraswamy and Morris, 2002), and the owner frequently faces variation orders that come with additional project time and cost impacts.

The impacts of the traditional delivery system on project time, cost, quality and productivity have been reported in several research studies focused on building projects. In a case study that surveyed 351 projects, it was reported that the delivery speed of the traditional DBB system is, on average, 30% slower than DB (Konchar and Sanvido, 1998). The study also indicated that the cost of DBB projects is about 13% higher than that of DB.

In a different study, the analysis of 67 global projects from the Construction Industry Institute's database showed that the traditional DBB projects, on average, experience about 6.5% relative change in schedule, while DB projects experience a 7.4% relative change in cost (Ibbs et al., 2003). The same study also pointed out that labor productivity in DBB projects can drop by 10% due to schedule changes. In another recent study, it was estimated that TDSs can result in up to 50% cost overrun, extend project duration by up to 50%, and require up to 35% construction rework (Aziz and Hafez, 2013).

Table 2 summarizes the aforementioned impacts of the traditional delivery system on project performance metrics. The survey questionnaire responses indicate that the construction industry is still facing the same impacts identified through the literature. An explanation of this phenomenon, as detailed by some respondents, is the lack of stakeholder interest in experimenting with new project delivery systems either due to change resistance or due to lack of authority to select new project delivery systems.

LODS perceived impacts

Due to the scarcity of projects delivered through LPDS and IPD, the perceived impacts of LODSs are analyzed through a questionnaire survey distributed to experts in healthcare projects. As many of these experts are not familiar with the LPDS and IPD systems, a hypothesis is made that DB projects provide some features of LODS projects and can be considered semi-LODS projects. The DB system is regarded as one of the oldest better alternatives to the traditional delivery system as it provides many LODS features such as integrating the design and construction processes, enabling collaboration among some of the project stakeholders, and providing value to the owner by reducing potential project time waste. Despite its reported benefits to project stakeholders in general building projects, its positive effects on cost and productivity are debatable (Ibbs et al., 2003). There is also little to no research on the impact of this system in the context of healthcare projects.

Table 2: Impacts of traditional delivery systems on project performance

Metric	Impact
Time	30 - 50% slower[1,3]
Cost	13 - 50% of project cost overrun[1,3]
Rework	35% [3]
Productivity	10 - 60 % drop in labor productivity[2,3]
Safety	3 – 6% additional accident costs[3]
Materials	10% of material is wasted[3]

1 Data from Konchar and Sanvido (1998)
2 Data from Ibbs et al. (2003)
3 Data from Aziz and Hafez (2013)

In order to investigate the perceived impacts of the DB delivery system, the survey questionnaire included questions that solicit input from experts about the positive and negative impacts on healthcare project performance. Other questions were included to characterize their attitude toward PDS selection and verify their experiences.

The collected data revealed that 66% of the respondents have worked before in DB projects; however, there was no consensus on a certain definition for DB. Around 27% defined DB as a delivery system through which the project team complete the design to the Developed Design phase and then proceed with construction, while 25 % indicated that it is a delivery system through which the contractor carries out the design and construction activities in parallel. Other definitions were also reported.

Positive impacts

The responses to the questions on the positive and negative impacts of DB delivery method are summarized in Figures 2 and 3. As shown in the figures, a majority of the experts (66%) considered the reduction of coordination problems as a key positive impact of DB projects. Around 55% indicated that DB helps reduce variation orders, while 53% indicated that it helps reduce the project cost and improve productivity. The majority of experts did not consider DB to have a positive impact on reducing turnover rate, accelerating owner submittal feedback, increasing contractor profit, or increasing the involvement of owner employees in the project. There was also a mixed response as to whether DB can help reduce procurement lead time. Figure 2 ranks the positive impacts of DB by response rate.

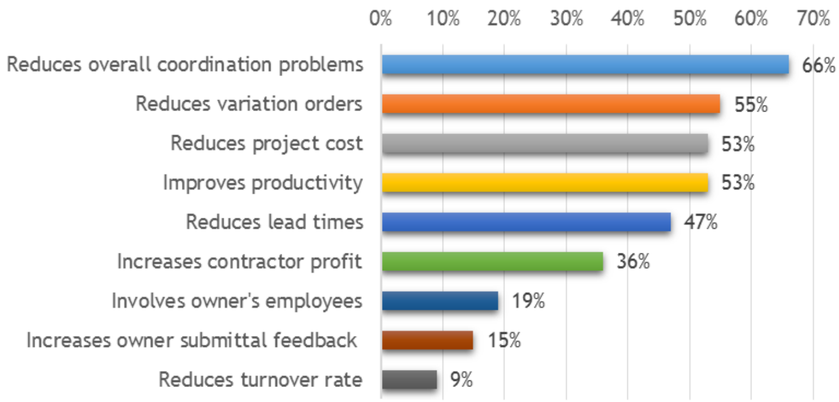

Figure 2: Positive impacts of LODS (DB) for healthcare projects

Negative impacts

The majority of the respondents (67%) considered fast-track design coordination a major negative impact of DB delivery systems. Other negative impacts reported are: lack of clarity in concept design (48%), change order interruptions in advanced design stages caused by the owner (46%), working under tight schedules (39%), lack of design competency/feedback from contractors (33%), and lack of owner's experience to control the quality/value (26%). Figure 3 ranks the negative impacts of DB by the response rate received from the survey.

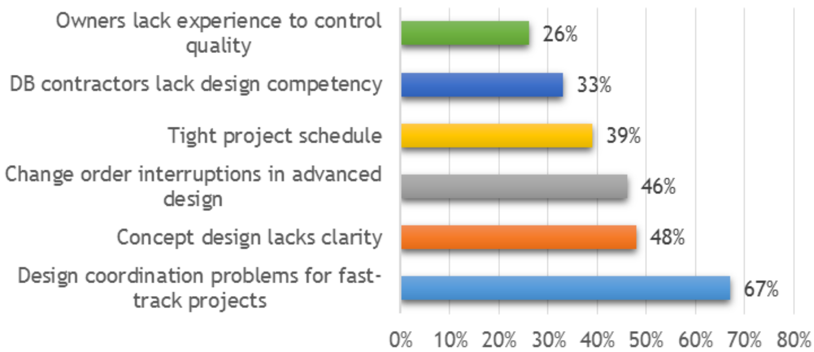

Figure 3: Negative impacts of LODS (DB) for healthcare projects

As indicated by the aforementioned reported and perceived impacts, TDSs and LODSs have their own positive and negative impacts, and given the multitude of factors that need to be taken into account in selecting a PDS there is a critical need for a methodology that can help owners select the appropriate project delivery system for healthcare projects. The following section presents a conceptual methodology that has been designed to aid owners achieve that goal.

Selection of PDS for healthcare projects

The key factors affecting the selection of a PDS and the impacts (positive and negative) were presented to a limited group of randomly-selected senior experts; and they were asked to provide the decision steps for selecting between TDSs and LODSs for healthcare projects based on the aforementioned three groups and five categories of factors. The responses were collected through semi-structured interviews in order to document the logical steps and owner's priority in analyzing PDSs. The majority of experts ordered the three groups of factors as follows: (1) cost-related factors, (2) time-related factors, and (3) project control factors. The cost-related factors include owner's risk acceptance, change handling/management, and owner's capacity to establish additional budget. Figure 4 presents the logical steps identified by the majority of experts in order to select an appropriate PDS for healthcare projects.

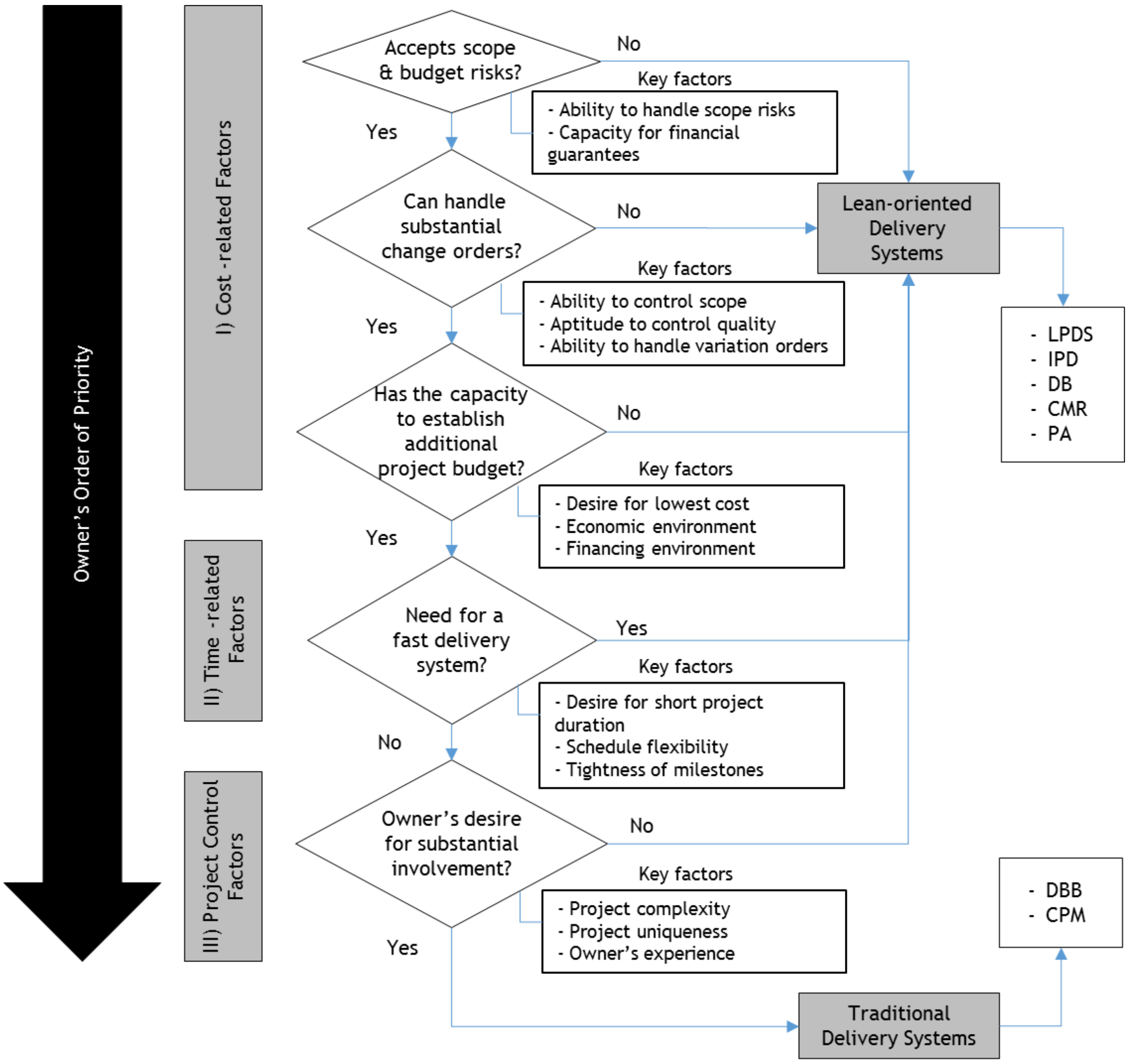

Figure 4: Proposed methodology of PDS selection for healthcare projects

As shown in Figure 4, the presented logical process establishes five guiding principles that should help owners to avoid the pitfalls of selecting a PDS that does not meet the specific needs and challenges of the healthcare project. The first principle encompasses the readiness of the owner to accept the risks of scope clarity and their associated budget repercussions. If the owner is not willing to assume these risks, then the best alternative would be an LODS project. For example, in projects characterized by limited certainty, the owner might not accept the risks of scope clarity and their budget repercussions. However, in other circumstances, if the owner is willing to accept these risks as a tradeoff in order to reduce the construction costs, a traditional project delivery system is the best alternative. For instance, in projects with well-defined scope of work and complete design documents, the owner would be willing to accept such risks. Likewise, if the owner has extensive experience building healthcare facilities, the owner would be willing to accept such risks in order to reduce the project costs. The second principle is based on the first principle – clarity of scope and its risks - and is included to eradicate the perils of change orders and their associated claims and litigation. The third principle embodies the financial flexibility of the owner and its capacity to establish additional budget in case of substantial changes to the scope of work. The fourth and fifth principles include the preference of the owner for project speed and control.

While LODSs are perceived to speed up the project delivery process and reduce the responsibilities on owners, TDSs on the other hand would give owners the added value of cost control through competitive bidding from mainstream contractors. These guiding principles should lay the foundation for theories and tools that help owners select efficient PDSs that fit their project characteristics and needs. These guiding principles could also be integrated into larger decision support systems that encompass several types of projects such as the decision support systems developed by Mahdi and Alreshaid (2005); Mafakheri et al., 2007; Touran et al., 2009; Chih 2010; and Mostafavi and Karamouz, 2010.

Conclusions

This study contributes to the body of knowledge by providing hard data and guiding principles to enable healthcare project owners select an appropriate PDS. First, the study identifies and contrasts the main characteristics of traditional and lean-oriented PDSs for healthcare projects. Second, the study pinpoints the key factors that influence healthcare project owner's decision to select a PDS. Third, the study highlights the impacts of PDS selection on healthcare project outcomes. Fourth, a logical procedure is developed and proposed as a guiding methodology for selecting healthcare PDS. The proposed methodology of selecting a PDS for healthcare projects provides a perspective for understanding and evaluating the impact of key factors that affect PDS selection. The methodology employs five guiding principles that are developed to: (1) examine the readiness of the owner to accept the risks of scope clarity and their associated budget risks; (2) eradicate the perils of change orders and claims; (3) observe the financial flexibility of the owner and its capacity to establish additional budget in case of substantial scope changes; (4) include the owner's preference to project delivery speed; and (5) establish responsibility and control over the project design and execution. The developed methodology is an attempt to fill the gap in the knowledge of existing strategies for selecting healthcare project delivery system, and can facilitate the development of underpinning theories to measure and evaluate the influence of the guiding principles on the effectiveness of project delivery. The proposed methodology can be further explored in comparative analysis studies to contrast the impacts of PDS selection decisions. The results of this study should prove useful to decision makers in the healthcare sector in Kuwait and other Middle East countries with similar nature.

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