CRITICAL SUCCESS FACTORS FOR CONSTRUCTION PROJECTS

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The literature demonstrates a lack of consensus and consistency to identify critical succes factors (CSFs) for different construction operations. Therefore, the objectives of the study are to: (1) identify and categorize CSFs from literature; (2) examine the limitations of the current practices; and (3) recommend future studies. CSFs from the existing literature were categorized according to their emphasis on project outcomes, delivery methods, project types, and partnering processes. Upper management support, commitment, constructability reviews, teamwork, communication, and building trusts emerged as the shared key elements of success in most construction activities. Previous studies' major limitation lays in the emphasis on experts' subjective prioritization of CSFs and the limited number of empirical studies. The results of the study also demonstrate that there is a great potential for investigating CSFs for emerging delivery methods, and for exploring the causality relationships between CSFs and project success.

Keywords: *Success Factors; Project Delivery Methods; Partnering*

FACTORES CRÍTICOS DE ÉXITO PARA PROYECTOS DE CONSTRUCCIÓN

La literatura existente demuestra que existe una falta de consenso y consistencia para identificar los factores críticos de éxito (CSFs) de diferentes actividades de la construcción. Por lo tanto, los objetivos de este estudio son: (1) identificar y categorizar CSFs de la literatura; (2) examinar las limitaciones de las prácticas existentes; y (3) recomendar futuros estudios. Se categorizan los CSFs obtenidos de la literatura según los resultados del proyecto, estrategias de contratación, tipos de proyectos, y procesos de colaboración. El apoyo del personal directivo, el compromiso, la constructibilidad, el trabajo en equipo, la comunicación y la generación de confianza emergen como los elementos compartidos de éxito en la mayoría de las actividades de la construcción. Las mayores limitaciones de los estudios previos se encuentran en la priorización subjetiva de los CSFs y en el limitado número de estudios empíricos. Los resultados del estudio también demuestran que hay un gran potencial para investigar los CSFs relativos a las nuevas estrategias de contratación colaborativa, así como para explorar las relaciones causales entre CSFs y el éxito del proyecto.

Palabras clave: *Factores Críticos; Métodos de Contratación; Colaboración*

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1. Introduction

Critical success factors (CSFs) in the context of project management were first defined by Rockart (1982) as the limited number of factors that should be satisfied to ensure successful completion of a project. Since then, a considerable amount of research has been focused on exploring CSFs for construction projects (e.g. Belassi & Tukel, 1996; Li et al., 2005). These studies gained attention, because identifying CSFs helps practitioners allocate their limited resources to a manageable number of factors that contribute to project success. Although researchers often develop metrics for CSFs -such as mutual trust, effective communication, and adequacy of resource-, there is lack of consensus among researchers regarding the most critical factors, and there is little consistency in their definition and use of language.

Therefore, exploring the evolution pattern of CSFs in the construction literature and predicting the future trajectories would be rewarding. To answer this knowledge gap, the current literature study was conducted to: (1) identify and categorize CSFs according to different project outcomes, delivery methods, project types, and partnering processes; (2) examine the limitations of the current practices; and (3) provide suggestions for future potential studies. To achieve these objectives, a large number of research papers were reviewed; their salient results are summarized in the following sections. The results of the study are the first step towards developing universal CSFs for construction projects to help practitioners create high performance teams.

2. CSF for Different Project Outcomes

Each project team member might pursue different or even contradictory objectives in a project. For example, a contractor may consider construction speed and profitability as the most important measures of success, while an owner may emphasize on-budget completion or quality of construction. These conflicting views of success can result in poor overall project performance if expectations are not communicated. In response to these divergent priorities, most of the previous literature identified CSFs for shared objectives among different team members; these factors included cost, time, and quality.

In one of the early studies, Jaselskis and Ashley (1991) investigated different key success factors that assist project managers to allocate their limited resources in such a way as to achieve a high level of construction performance. After analyzing data from 75 construction projects, they found that the following factors improve the likelihood of achieving outstanding project performance: reducing team turnover, providing a constructability program for contractor organization, and increasing number of construction control meetings for the contractor organization. Furthermore, they found that the success factors affected project outcomes differently. For instance, “reducing team turnover” had more impact on improving budget performance than emphasizing schedule or overall project performance.

In another study, Chua et al. (1999) identified CSFs for different project objectives, including budget, schedule, and quality. They identified sixty-seven factors and grouped them into four main classes: project characteristics, contractual agreements, project participants, and interactive processes. Chua et al. (1999) then distributed a survey questionnaire among experienced practitioners to make pairwise comparisons and determine the relative importance of the various CSFs. They found that regardless of project objective, adequacy of plans, specifications, and constructability are the most important factors characterizing successful projects.

In one of the empirical studies, Cooke-Davies (2002) conducted a detailed analysis on 136 projects executed between 1994 and 2000 and identified 12 factors that were critical to project success. They found that although in some cases schedule delay and cost escalation correlated in an individual project, only a small amount of the cost escalation was accounted

for by schedule delay. Their results indicated that the following practices correlate with on-time performance: adequacy of company-wide education on the concepts of risk management; maturity of an organization's processes for assigning ownership of risks; adequacy with which a visible risk registers is maintained; adequacy of an up-to-date risk management plan; adequacy of documentation regarding organizational responsibilities on the project; and keeping the project (or project stage duration) less than 3 years, with benefits evident among projects closer to 1 year in length. On the other hand, the following practices correlate with on-cost performance: only allowing changes to scope through an established scope-change control process; and maintaining the integrity of the performance measurement baseline. In addition to the above factors that contributed to project management success, the existence of an effective benefits delivery and management process involving the mutual co-operation of project management and line management functions were critical for overall project success.

3. CSFs for Different Project Delivery Methods

Project delivery systems determine the sequencing of design, procurement, and construction, and define the roles and responsibilities of the parties involved in a project. Common delivery methods include design-bid-build (DBB), construction management at risk (CMR), design-build (DB). However, some governments' financial constraints paved the way for innovative methods of development and the financing of public facilities and services via the private sector. Two prominent examples of such methods that have been adopted extensively across the globe are build-operate-transfer (BOT), and public-private-partnership (PPP). A summary of CSFs for different project delivery methods is provided below.

3.1. Common Delivery Methods (DBB, CMR, and DB)

DBB is the traditional project delivery method in the US characterized by two separate contracts for design and construction (Bearup et al., 2007). In this method, the owner hires a designer to provide complete design documents and then selects a contractor based upon a fixed price bid to build the project according to the completed drawings (Touran et al,. 2009). One of the disadvantages of this delivery method is that the owner has to contract two different entities, and the construction cannot be started until the design is complete. To answer this limitation, CMR evolved from the traditional project delivery system as a method to obtain significant constructability input during the design phase of the project by overlapping the design and construction phases (Bearup et al. 2007). While the CMR approach provides some benefits for overlapping design and construction, the owner still has to manage two separate contracts. To answer this limitation, DB delivery system was introduced to help the owner contract a single entity. In fact, any delivery method in which one party is held responsible for the design and construction services is called DB (Songer, 1992).

Due to its numerous advantageous, DB became a popular delivery method in the past decades, with several studies conducted to facilitate successful completion of these projects. For example, Chan et al. (2001) investigated public sectors DB projects to identify a set of project success factors and to determine their relative importance. They analyzed survey responses from 53 participants using multiple statistical techniques, such as factor analysis, stepwise multiple regression, two independent sample t-test, and bivariate correlation. Six project success factors were extracted, including project team commitment, contractors' competencies, risk and reliability assessment, client's competencies, end-users' needs, and constraints imposed by end-users. They found that project team commitment, and contractor's and client's competencies are the most influential factors for project success. The results of the study suggested practitioners focus on team work and partnering to make a project successful.

In another study, Ling et al. (2004) collected empirical data from 87 DBB and DB projects to search for explanatory variables that significantly affect project performance. They catalogued 59 potential factors affecting project performance (e.g. cost growth) and conducted multivariate data analysis to investigate their underlying relationship. It was found that construction speed of DBB projects is determined by gross floor area and the adequacy of contractor's plant and equipment; however, for DB projects, the extent to which contract period is allowed to vary during bid evaluation is more crucial. In a similar study, Lam et al. (2008) investigated determinants of successful DB projects to set a benchmark for comparing project performance. They developed a project success index and distributed a questionnaire among DB participants in the Hong Kong construction industry to investigate the casual relationship between the project success index and the key project performance indicators of time, cost, quality, and functionality. Then, factor analysis and multiple regressions were used to analyze data; they found that the project's nature, the effective project management action, and the adoption of innovative management approaches are the most critical success factors for DB projects. It is important to note that the nature of the project is determined by the extent of contractor's input, attractiveness of the project, and the complexity of the project. On the other hand, project management actions can be described by up-front planning efforts, effectiveness of communication, control and management systems, and organizational structure. Furthermore, it was suggested that adopting innovative management approaches -such as value management and partnering- can increase the chance of success in a DB project.

3.2. Build-Operate-Transfer (BOT)

In a BOT contract, the private sector is financing the project and furnishing design and build. More importantly, after completion of project, the private sector manages and operates the facility for a specified concession period and then transfers the asset to the host government. While, the BOT model of project development provided tremendous opportunities for both governments and contractors, winning a BOT contract is not easy and the negotiation process is complex, time-consuming, and expensive business (Tiong, 1996). Therefore, several studies conducted to shed light on the road to winning a BOT contract. For example, Tiong et al. (1992) conducted an in-depth analysis of nine major BOT projects and interviewed their entrepreneurs, project sponsors, and government officials. They identified six CSFs in winning BOT contracts: entrepreneurship and leadership, right project identification, strength of the consortium, technical solution advantage, financial package differentiation; and differentiation in guarantees. In a follow up study, Tiong (1996) quantified the relative importance of different factors and found that the strength of consortium and financial package differentiation are the most important factors in winning a BOT tender.

3.3. Public-Private-Partnership (PPP)

PPP, or P3, is defined as a contractual agreement between the public agency and private entity that enables the private sector to finance and deliver public projects (Ke et al., 2009). Some of the perceived benefits of PPP projects for public sector are: enhanced government capacity; innovation in delivering project services; reduction in time and cost of project delivery; and transferring the majority of the risk to a private party to secure taxpayers' value (Li et al., 2005). Based on the allocation of resources, risks, and rewards, different types of PPP projects have emerged (Li et al., 2005). As PPP projects are characterized with a broad range of risks, uncertainties, and the involvement of multiple participants, it is important to develop an efficient procurement protocol to improve practices in these projects (Zhang, 2005).

In one of the prominent studies, Li et al. (2005), identified 18 CSFs for PPPs and evaluated their relative significance in the United Kingdom. By obtaining the ranking of perceived

importance of different CSFs, the following factors emerged as being the most important considerations: (1) a strong private consortium; (2) appropriate risk allocation; and (3) the available financial market. They also conducted factor analysis and grouped CSFs into effective procurement, project implementability, government guarantee, and favorable economic conditions. Likewise, Zhang (2005) identified 47 critical success factors for PPPs and categorized them into five groups: favorable investment environment, economic viability, reliable concessionaire consortium with strong technical strength, sound financial package, and appropriate risk allocation via reliable contractual arrangements. He also measured the relative significance of sub factors by distributing a worldwide questionnaire survey. A summary of CSFs different project delivery methods is shown in Table 1.

While the growing market of construction projects in China absorbed large number of international firms, there was no robust method for predicting the outcome of these projects. To answer this gap in knowledge, Ling et al. (2008) conducted a study to predict project success in China based upon the project management practices implemented by the company. They obtained data from 33 projects to identify different project management (PM) practices as explanatory variables of each project's performance. They also used multiple linear regressions to develop five models to predict the probability of project success. The results indicated that a firm's response to perceived change orders is the most important PM practice. In addition, they found that the overall project performance was largely affected by upstream activities, such as managing project scope. The main contribution of the model is to help project personnel to predict project success potential based upon the project management practices used. Lu et al. (2008) used a similar approach to identify CSFs for competitiveness of contractors in China. The relative importance of factors was also obtained thorough survey and questionnaire. The top three factors proved to be bidding strategy, an explicit competitive strategy, and relationships with government departments.

4. CSFs for Partnering Process

A construction project typically requires collaboration between multiple parties with diverse organizational objectives and culture. It is proven that a clash of values and the existence of complex relationships between team members have an impact on project performance (Anvuur & Kumaraswamy, 2007). For example, little cooperation, lack of trust, and inefficient communication can cause adversarial relationships between parties and lead to project delays, difficulty in resolving claims, cost overruns, litigation, and a win-lose climate (Moore et al., 1992). One of the widely practiced management strategies that is intended to improve interorganizational relations is partnering.

Table 1: Summary of CSFs for different project delivery methods

CATEGORIES	CRITICAL SUCCESS FACTORS	
Common Delivery Methods (DBB, DB and CMR)	Ling et al. (2004)	• Adequacy of contractor's plant and equipment
	Chan et al. (2001)	• Project team commitment • Contractor's competencies • Risk and reliability assessment • Client's competencies • End-users' needs • Constraints imposed by end-users
	Ling et al. (2004)	• The extent to which contract period is allowed to varied during bid evaluation
	Lam et al. (2008)	• Project nature • Effective project management action • Adoption of innovative management approaches
Build-Operate-Transfer (BOT)	Tiong et al. (1992), and Tiong (1996)	• Entrepreneurship and leadership • Right project identification • Strength of the consortium • Technical solution advantage • Financial package differentiation • Differentiation in guarantees
Public-Private-Partnership (PPP)	Li et al. (2005)	• A strong private consortium • Appropriate risk allocation • Available financial market
	Zhang (2005)	• Favorable investment environment • Economic viability • Reliable concessionaire consortium with strong technical strength • Sound financial package • Appropriate risk allocation via contractual arrangements

Partnering is defined as cooperative strategy that aims to bridge organizational boundaries and create an environment in which team members can openly interact and perform (Crowley & Karim, 1995). The fundamental principles of partnering are commitment, trust, respect, communication, employee involvement, and equality (Construction Industry Institute [CII], 1991; Cowan et al., 1992; Sanders & Moore, 1992; Uher, 1999). Indeed, the partnering process is designed in a way to transform the traditional and adversarial approach into a highly communicated network of construction parties (Cheng & Li, 2002). It provides several benefits to a project and team members, such as effective framework for conflict resolution, improved communications, reduced litigation, lower risk of cost overruns and delays, and increased opportunities for innovation (Abudayyeh, 1994; Harback et al., 1994; De Vilbiss & Leonard, 2000; Black et al., 2000). Partnering makes all of these possible by re-orientating project participants toward a ‘‘win-win’’ approach and by fostering a teamwork environment.

Several studies examined the best way of implementing partnering. For example, Cheng et al. (2000) developed a framework to identify CSFs that contribute to the successful use of partnering in projects. The authors claimed that to have an effective partnering, there should be specific management skills and contextual characteristics. While management skills are necessary to initiate, form, and facilitate interorganizational relationships, one should prepare a favorable context before starting the partnering process. After reviewing literature, effective communication and conflict resolution were considered as the critical management skills, and adequate resources, management support, mutual trust, long term commitment, coordination, and creativity were classified as critical contextual factors. They also suggested a list of measures to monitor and control partnering performance by targeting both short- and long-term objectives. Short-term objectives—such as cost variation and the rejection of work—were mainly related to an individual project while long-term goals were concerned with the perceived satisfaction of partners' expectations.

Black et al. (2000) analyzed several companies with and without partnering experience to investigate the importance of CSFs toward partnering success. They obtained the opinion of clients, consultants, and contractors in the UK regarding the success factors and benefits of partnering. They found that the following requirements should be met to implement partnering successfully: trust, communication, commitment, a clear understanding of roles, and consistency and flexible attitude. The results also indicated that clients and contractors are more supportive towards the partnering process than consultants.

Cheng and Li (2002) took a different approach by identifying CSFs for different stages of partnering: formation, application, and reactivation. The factors were prioritized using an analytical hierarchy process. The results indicated that some of the CSFs influence the whole partnering process, while there are some CSFs for individual process stages. The common CSFs for whole partnering process are top management support, open communication, effective coordination, and mutual trust; CSFs at the stage of partnering formation are team building, facilitator, and partnering agreement; CSFs of partnering application are joint problem solving, adequate resources, and partnering goals' achievement. Finally, partnering experience, continuous improvement, learning climate, and long-term commitment are important in the partnering reactivation phase. The study is creative in developing a customized CSFs model; however, due to the low number of responses (9 filled-in questionnaires), it should be considered as an exploratory study.

One of the issues that can affect the partnering process is cultural differences (Cheng & Li, 2002). Therefore, as adopting partnering becomes a common practice across the world, researchers attempt to identify partnering CSFs based upon local characteristics for a specific country. For example, to understand the ingredients of successful partnering in the Hong Kong construction industry, Chan et al. (2004) identified critical success factors for partnering projects by obtaining the opinions of various parties, such as clients, contractors and consultants. They used factor analysis and multiple regressions to investigate the relationship between the perception of partnering success and a set of success factors. The results showed the following requirements are necessary for successful partnering: the establishment and communication of a conflict resolution strategy, a willingness to share resources among project participants, a clear definition of responsibilities, a commitment to a win-win attitude, and regular monitoring of partnering process.

A summary of CSFs for the partnering process is provided in Table 2. One should note that only papers that focused on critical factors contributing to successful implementation of partnering were reviewed. There are several studies that examined the impact of partnering on projects success (e.g. Larson, 1997) that are out of scope of this study.

Table 2: Summary of CSFs for partnering process

Studies	Critical Success Factors		
Cheng et al. (2000)	*Management skills:* • Effective communication • Conflict resolution	*Contextual factors:* • Adequate resources • Management support • Mutual trust	• Long term commitment • Coordination • Creativity
Black et al. (2000)	• Trust • Communication • Commitment, a clear understanding of roles • Consistency and flexible attitude		
Cheng and Li (2002)	*Formation:* • Top management support • Mutual trust • Open communication • Effective coordination • Facilitator • Team building • Partnering agreement	*Application*: • Top management support • Mutual trust • Open communication • Effective coordination • Joint problem solving • Partnering goals' achievement • Adequate resources • Creativity • Workshops	*Reactivation*: • Top management support • Mutual trust • Open communication • Effective coordination • Long-term commitment • Continuous improvement • Learning climate • Partnering experience • Joint problem solving • Adequate resources • Workshops
Chan et al. (2004)	• Establishment and communication of a conflict resolution strategy • A willingness to share resources among project participants • A clear definition of responsibilities • A commitment to a win-win attitude • Regular monitoring of partnering process		

5. Conclusions

Success in a construction project is repeatable, and there is a great value in developing a protocol to improve practices in construction activities. The identification of CSFs can furnish project participants with an indicator to attain success in delivering a project or implementing a process. Moreover, CSFs can provide participants with a focus of what they should be aware of in order to ensure the success of a project. Such an improved understanding can

be exploited by project managers to select efficient strategies to alleviate the root causes of poor performance.

To shed light on current practices, this study conducted a comprehensive investigation of literature on CSFs. The results of this study contribute to the practice by providing a list of CSFs for various construction operations, and academia can benefit from identifying the potential topics for future studies. It was found that upper management support, commitment, constructability reviews, teamwork, communication, and building trust are the key elements of success in most construction projects. While the contribution of previous studies in the area of CSFs is significant, there are several limitations related to these studies. First, most of the previous studies rely on obtaining ratings from experts; providing empirical evidence based upon completed projects is rare. Since experts' judgment is subjected to various cognitive biases, the results can be misleading (Tversky & Kahneman, 1974). Second, most of CSFs identified in previous literature (e.g. trust) are subjective, and it is very difficult to measure them during a real construction operation.

There are several research topics related to CSFs that can be further investigated. For example, new project delivery systems, such as integrated project delivery (IPD), are gaining traction in recent years, and determining CSFs for them is rewarding. Kent and Becerik-Gerber (2010) described the common principals of IPD, including a multiparty agreement, shared risk and rewards, and early involvement of all parties. Establishing these principles is not an easy task, and finding a concise number of factors that should be given special and continued attention to increase the chances of a successful outcome is important. Furthermore, one may explore the casual relationships between CSFs and project success based upon empirical evidence.

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