



# The critical factors in managing relationships in international engineering, procurement, and construction (IEPC) projects of Chinese organizations

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## Abstract

In International Engineering, Procurement, and Construction (IEPC) projects the main contractor carries out the work at distant sites for the project owner with support from multiple suppliers and/or subcontractors. Managing relationships with suppliers and/or subcontractors in such projects is even more critical due to additional dependency on them to complete the job. Yet it is not clear which factors influence such relationships in IEPC projects. This study intends to close this gap in the extant literature. Data has been collected from professionals involved in IEPC projects and it has been investigated how various aspects of relationship with suppliers and/or subcontractors may influence project outcomes. Logistic regression and neural networks have been used to analyze the data and subsequently identify four critical factors: *service provided by suppliers and/or subcontractors*, *continuous improvement*, *supplier and/or subcontractor delivery reliability*, and *effective problem solving*, which impact IEPC project success to the greatest extent. The findings suggest that the main contractors should pay particular attention to these aspects of relationship management.

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## 1. Introduction

The construction industry is one of the largest industries and its contribution to GDP is one of the highest in most countries (Cheng et al., 2010). In spite of its size and impact on the economy, the construction industry as a whole is slow to adopt supply chain management (SCM) best practices (Akintoye et al., 2000; Gadde and Dubois, 2010). While there have been a few studies that championed implementation of basic supply chain (SC) principles to improve traditional construction

project outcomes, the International Engineering Procurement Construction (IEPC) projects remain almost unexplored.

Compared to traditional design-bid-build contract model where the project owners provide the engineering design and the contractors solely carry out the construction activities, under EPC contract model the main contractors are responsible for all of the activities ranging from engineering, procurement, to constructions based on basic specifications provided. In EPC projects the main contractors need to come up and evaluate more innovative combinations of design and procurement options to find the right balance between profit margin and inherent risk, and overcome greater logistical difficulties in purchasing and transporting materials and equipment cost effectively (Dainty et al., 2001a; Vrijhoef and Koskela, 2000).

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If project site is abroad the main contractors face greater challenges in negotiating and managing often unpredictable durations of work carried out by multiple subcontractors, obtaining approval from higher number of authorities, dealing with fluctuations in currency exchange rate, synchronizing and coordinating international equipment and materials procurement with longer lead times and higher delivery uncertainty (Yeo and Ning, 2002). Clearly, the underlying complexities pose additional challenges and justify the importance of managing relationships with suppliers and/or subcontractors for success of such International Engineering Procurement Construction (IEPC) projects.

Many such EPC projects are plagued with strained relationships among project owners, main contractors, and suppliers and/or subcontractors; often resulting in delayed completion, budget overrun, poor quality, and subsequent barrage of claims and counter claims (Yeo and Ning, 2002). However, the potential for improvement could be substantial as some of the past studies on traditional construction projects (Beach et al., 2005; Larson, 1995) had demonstrated that significant cost reduction, superior technical performance, and higher level of customer satisfaction might be achieved by improving supply chain relationships between main contractors and suppliers and/or subcontractors. An extensive review over 91 published SCM research articles by Gosling and Naim (2009) pointed out the overall lack of coverage of the engineering-to-order (ETO) sector in which all construction projects belong to. Meng (2010) is a notable exception that proposed a framework with eight assessment criteria to study supply chain relationship in traditional construction industry. However, it remains to be verified if those criteria are relevant for managing relationships in IEPC projects which are inherently more complex in nature.

In addition, the current literature mostly deal with the relationships between the project owners and the main contractors in construction projects (Briscoe and Dainty, 2005; Kadefors et al., 2007). Based on extensive review of 38 published works as well as survey and expert interviews Jelodar et al. (2016, 2017) conceptualized relationship quality among project owners, contractors and consultants in construction procurements and subsequently advocated seven strategies. They found trust, commitment, collaborations, and communications to be crucial attributes for building quality relationship. While trust, communication, commitment, mutual objectives, and continuous improvement were often found among the critical factors for successful partnering relationships between project owners and main contractors in construction (Black et al., 2000; Cheng and Li, 2002; Ng et al., 2002), other factors, such as team/joint work, risk allocation and problem solving were reported to play important roles in managing relationships between main contractors and suppliers and/or subcontractors (Beach et al., 2005; Humphreys et al., 2003; Meng, 2012). These findings suggest that in construction sector the critical factors affecting relationships between main contractors and suppliers and/or subcontractors may differ from the ones between clients and main contractors. Also, a review of 50 published studies by Bemelmans et al. (2012) reveals that existing studies focused mostly on partnering characteristics, barriers, procurement

process, selection criteria and performance, and points to an overall scarcity of research (with few exceptions such as Dainty et al. (2001b) and Eom et al. (2008), etc.) in applying the best practices of managing supply chain relationships between main contractor and suppliers and/or subcontractors in traditional construction as well as EPC projects.

The EPC projects at international locations have seen significant growth in recent times. Hence, it is important to explore how the IEPC projects may benefit from the best practices in supply chain relationship management and project management. This study is motivated to fill the void in the current literature by empirically exploring the critical factors in managing relationships between main contractors and suppliers and/or subcontractors that affect the IEPC project performance. The objectives of the study are of two folds. First, in the context of IEPC projects the significance of the factors and performance indicators that were deemed relevant in traditional construction projects are assessed. Second, relative impact of these factors on the IEPC project performance is evaluated and factors that may be more important than others are identified.

In the next section, the success factors and project performance measures that have been commonly used in the literature are discussed. Then, the research methodology and details of data collection are presented. In the subsequent sections, findings and contributions of this study, limitations of this research, and future research directions are discussed.

## 2. Literature review

In the traditional construction sector there have been limited but interesting studies that explored how different factors of supply chain relationships either between project owners and main contractors or between main contractors and suppliers and/or subcontractors affected project performance (Beach et al., 2005; Black et al., 2000; Chen and Chen, 2007; Humphreys et al., 2003; Meng, 2012). However, we did not find any study dealing specifically with IEPC projects. We looked into construction, general project management, and supply chain management literature to understand how certain aspects and capabilities of suppliers and/or subcontractors possibly may influence their working relationship with the main contractor and ultimately impact project success. Subsequently, they were categorized as potential success factors. Based on the literature review it is conjectured how these different factors of managing relationship may potentially play key roles in establishing and maintaining effective dealings between the main contractors and suppliers and/or subcontractors in IEPC projects. Subsequently, relative effectiveness of these factors is tested by analyzing the data collected and relevance of these factors is discussed based on the current literature.

### 2.1. Co-operational/Collaborative relationship

Grounded on the theory of competition and cooperation (Deutsch, 1980), it has been observed that supply chain partners/entities may exhibit cooperative, competitive or indifferent

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