Chapter 76
Risk Evaluation of EPC Supply Chain Based on SCOR and Multi-Level Grey Model: A Case Study of China's Waste Incineration Plant Project

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ABSTRACT

With the development of China's economy, large-scale engineering and complex engineering are emerging. The Engineering Procurement Construction (EPC) project general contracting model is widely used in civil engineering, water conservancy, railway, water treatment, waste incineration plants and other large engineering area. The increasing complexity of construction technology and the risks are facing overwhelming and fragile supply chain. Based on the deep analysis of supply chain operation reference (SCOR) model, which is widely used in various fields of industry, this article puts forward the preliminary index system of supply chain risk of EPC project by analytic hierarchy process (AHP). The risk index system of waste incineration project including 5 first-level risk indicators and 27 second-level risk indicators has been established and determined. The multi-level grey model is used to evaluate the risk index, calculate the grey evaluation coefficient and the grey evaluation weight vector as well as the weight matrix, draw the specific risk evaluation value of the project, and sort the first level index. Finally, an EPC example of a waste incineration in Hubei Province is used to verify the feasibility and reliability of the method.

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INTRODUCTION

Changes in technology and globalization of products and services have intensely resulted in dynamic markets and greater uncertainty in worldwide competition and demand (Srinivasan, 2014). The pressure led to an increased emphasis on internal business processes and collaborative relationship between customers and suppliers. This can better integrate planning and operations throughout the supply chain and thus can be used as a mean to reduce costs and improve services (Shailendrakumar, 2007). Business success and survival in fast-changing markets depends heavily on an efficient supply chain (Bayraktar et al., 2007; Wunder et al., 2012). Supply chain management (SCM) has become popular during the past decades. Since 1990s, many SCM models have been held to overcome the challenges of organizing and managing the procurement process. For example, they implemented global procurement and production, sought a single source of supply, integrated facilities, outsourced non-core technology, and used JIT (just-in-time) technologies to improve benefits. On the other hand, they also made the supply chain more complex and fragile. The complexity of construction technology, such as a big amount of funds, the long-term construction period, and the uncertain construction environment increase the risk of the supply chain.

Given intensifying global competition as well as structural and contextual disadvantages against developed economies (Buckley, 2009), small- and medium-sized enterprises from emerging countries face the challenge of gaining sustained competitive advantage. Despite research of supply chain integration (Prajogo and Olhager, 2012), which shows its importance to a firm's success (Flynn et al., 2010), ambiguity still remains in supply chain integration (Fabbe-Costes et al., 2008; Autry et al., 2014). Research on integration and coordination of different functional units take the phrase *Supply Chain Management* (SCM) in 1982 (Oliver and Webber, 1982). Specific supply chain management, both in process-based production management and in project-based construction management (Aloini et al., 2012), caused the development of construction supply chain management (CSCM).

The construction industry has become a pillar industry of the national economy. With the development of China's economy, large-scale engineering and complex engineering are emerging. The Engineering Procurement Construction (EPC) project model is widely used in civil engineering, water conservancy, railway, water treatment, waste incineration plants and other large engineering area. EPC project is a turnkey or one-of-a-kind model, made up of a large number of interconnected subsystems and components, requiring considerable human efforts and management creation.

Some main contractors prefer to apply conventional procurement strategies to let materials and equipment enter a project site earlier and stock them to avoid suspension and delay, but it increases the cost of reallocation, inventory, nature loss and depreciation. A series of concepts and modeling frameworks have been developed to improve the problem supply chain performance is facing. The characteristics of supply chain performance should be analyzed in order to understand the mechanics and processes.

At present, researchers mainly focus on the risk of construction supply chain and have achieved many constructive results. Tahet al. (2001) defines a language description system based on the risk hierarchy structure, which lays the foundation for the method of CSCM. Achard et al. (2008) analyzes the risk of supply chain for infrastructure construction projects. It is apparent that risk identification is the basis of risk management. The risk of construction supply chain mainly includes strategic target risk, key factor risk, environment and stakeholder risk, key performance indicators risk. And he put forward the strategy to deal with these risks. Xiao et al. (2011) applies the fuzzy mathematics theory to the risk evaluation of CSCM, by establishing a two-level fuzzy comprehensive model. The model uses the entropy weight