

## Partner Risk Management System Considering Supply Chain in Construction Project

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**Abstract:** Construction project needs many stakeholders, so, the role of appropriate stakeholders is very important and project success depends on ability of those stakeholders. Only the top 1% construction companies operate an electronic procurement system to select their stakeholders while the remaining cannot have it. Therefore, this study demonstrated supply network collaboration system for small and medium construction companies in selecting appropriate stakeholders and showed a matching algorithm for supply network system based on credit, technology, performance, information and recommendations. This research proposed the supply network system including matching algorithm with suppliers and subcontractors. The proposed system had a following advantage: establishment of a risk management-oriented collaboration system (web/mobile); development of mutual sharing company pool and mutual evaluation algorithm; soundness analysis based on outsourcing partner search and matching service and; supply networking web system and mobile app. that can provide web 3.0 based optimization information. The proposed system can make economic and social positive effects. Efficient project management including partner (partner) management; business risk reduction: Recommendation of excellent suppliers and real-time monitoring function to remove dangerous; promotion of advanced Information Communication Technology (ICT) convergence technology development: Promotion and activation of related industrial technology development.

**Key words:** Supply chain, matching system, partner, risk management, construction project, promotion

### INTRODUCTION

Construction project needs many stakeholders such as subcontractors, suppliers, equipment companies, so, the role of appropriate stakeholders is very important and project success depends on ability of those stakeholders. In the construction project, more than 80% of the total construction cost is spent on the network supply chain between the first and second suppliers as shown in Fig. 1 (Vrijhoef and Koskela, 1999). About top 1% construction companies operate an electronic procurement system to select their stakeholders while the remaining 99% depend on manual work (Eom *et al.*, 2015).

Due to the last economic downturn and the restructuring of the construction industry, the debt-to-equity ratio has risen sharply from 149% in 2004 to 219% in South Korea. The risk of default by small and medium-sized construction companies is higher than ever. Therefore, it is very important to select an excellent partner for the success of a construction project.

In order to succeed in the project, it is imperative to maintain continuous status management such as selecting

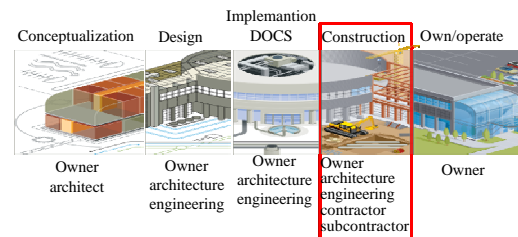


Fig. 1: The needs of supply network service

excellent suppliers. Therefore, this study demonstrated supply network collaboration system for small and medium construction companies. And this system contained matching algorithm for partners based on credit, technology, performance, information and recommendations.

### Literature review

**Related technology:** Since, Project Management Information System (PMIS) has been put into practical use since, the mid-1990's, the technology of domestic companies has international competitiveness and it is

currently being converted from client/server to web-based (Eom *et al.*, 2008). The initial project management information system was designed as a function to report to the management (or the client) but now it is supplementing the functions that support the work in the field. Although, it is widely used in construction projects and Information Technology (IT) projects which are generally, project-managed businesses, most of the functions are centered on social network functions for exchanging information with partner companies and they are not able to reach active management levels such as inquiry, recommendation, monitoring and contracting.

In the case of large corporations, the supply chain network is established through its own electronic procurement system, and partner selection and management are underway. However, most small and medium-sized enterprises depend on manual work and experience for partner selection and management. And it is difficult to select a company having excellent technology and management status. In the case of the construction industry, the scale of the market is expanding, and the importance of management of partner companies is increasing as a way to secure competitiveness of Small and Medium-sized (SMEs) construction companies. However, companies that manage information systems by themselves are limited to large contractors. In addition, it is difficult to evaluate the technical capability of suppliers and the reliability of the selection process is deteriorating due to the financial stability evaluation based on financial data a year ago, and the secondary damage caused by bankruptcy during the performance of the business is serious.

Also, since the late 1990s, there have been a number of companies developing and distributing web-based construction work solutions in the United States, connecting each department (public works, construction, design and management) in the field first with a LAN, A

solution has been developed that is a common collaboration between the Internet and other subcontractors and suppliers. Among the major collaboration solutions companies in the US, Citadon, Buzzsaw, Primavera, Meredian and Buildpoint are among the leading companies. They focus on ASP (Application Service Provider) and Project Web-Hosting. Project extranet, a construction management program that enables the smooth communication between project team members through the internet, webcams that can live on the construction site and programs for storing and managing construction related documents. It is contributing to e-Commerce among companies through subcontractors and supplier bidding programs (Rankin *et al.*, 2006) and providing information on the suppliers of materials (Anonymous, 2017).

**Supply chain matching system:** SNS (Social Networking Service) of existing Facebook, Google+, etc. is focused on individual-individual, Enterprise Social (Enterprise 2.0) is divided into Enterprise 2.0 (Social Networking Service) Yammer, Chatter, etc.) and in the long term, it is expected to be linked to social networks from employees, partners, and customers (Makkonen and Virtanen, 2015). In the enterprise business, many related companies are interconnected in the form of subcontractors as Fig. 2.

The supply chain means a system that includes all the organizations, people, technologies, information and resources for providing products or services between suppliers and consumers (Kim and Kim, 2014). The core of the next-generation corporate network lies in the selection and ongoing management of connected suppliers based on immediate communication (Sangchul and Tae-Hwa, 2016; Veeramani *et al.*, 2002). For this, a matching system based on the technology and financial credibility of the partner (e.g., supplier) is essential.

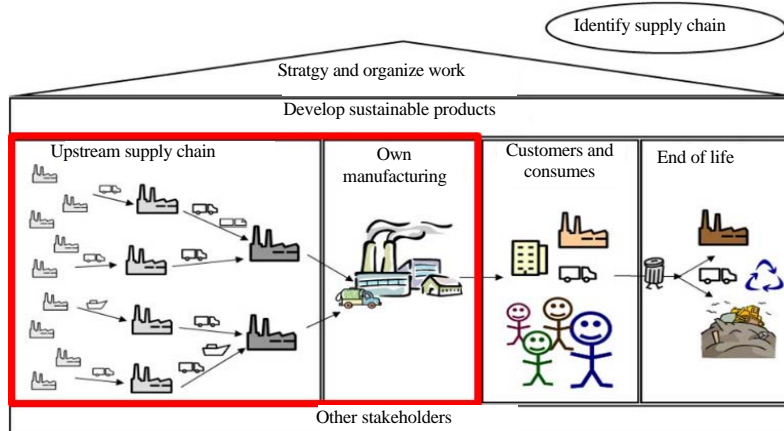


Fig. 2: Supply chain network

Efficiency within the construction industry can be significantly improved by adopting e-Business methods and solutions (Rankin *et al.*, 2006). e-Business can be defined as all business transactions (exchange of information) conducted electronically. Potential e-Commerce technology applications in the construction industry include e-Marketing, e-Selling, e-Procurement of goods and services, e-Collaboration, e-Finance and e-Customer services and relations (Veeramani *et al.*, 2002). Although, e-Commerce technology is an important tool in the development of main contractor-subcontractor partnerships, almost no research has been conducted in related fields. Rankin *et al.* (2006) identified and explored Architecture, Engineering and Construction (AEC) industry stakeholder issues relating to e-Procurement, including the advantages and disadvantages, barriers, challenges and solutions. Zou and Seo (2006) examined e-Commerce technologies currently being applied in the construction supply chain and provided recommendations for future improvement and better use of e-Commerce (Zou and Seo, 2006). Eom *et al.* (2015) explored a paradigm shift within main contractor-subcontractor partnerships from the main contractor's perspective. They also suggests development of a framework for an e-Procurement system that applies a strategic-partnership philosophy to improve the subcontracting process and enhance main contractor-subcontractor relationships overall (Eom *et al.*, 2015).

**MATERIALS AND METHODS**

**Proposed system**

**System architecture:** The most important factors in creating a supply network system are named "SIREN":

- SMEs; Target users include small and medium-sized businesses with bidirectional default alarm check function
- Integration; Integrate credit information and EW (early warning) information in supply chain and use it as a procurement system for SMEs
- Rank excellent vendors recommend the best company rankings by inquiry by work and region
- Easy to use; Simplify credit rating by applying traffic light system, easily view use and manage
- Intercompany networks; Establish a linkage network diagram between companies to take into consideration the chain default risk as shown in Fig. 3.

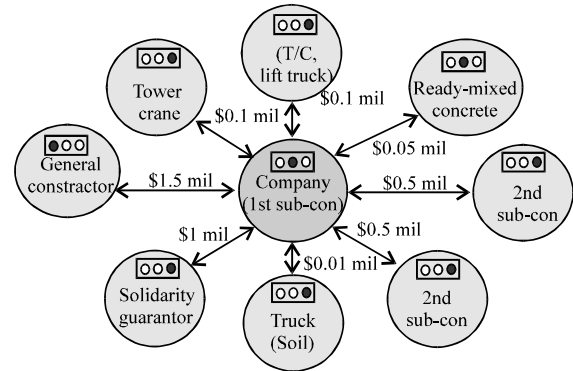


Fig. 3: System architecture

And in order to build SIREN as shown in Fig. 4, the steps were taken as follows:

- Analyzing the project management information System (PMIS) process and visualizing the process step-by-step business model in the project management area such as sales, order, quote, process, schedule, quality and safety management
- Model integrated information object data by benchmarking existing construction project management system
- Analysis of partner search and automatic matching process based on specific process model of construction collaboration management system
- Supply chain implement integrated collaboration management process across all fields, review integrated development plan, propose process standard

**SIREN Model:** The research team built a web/mobile-based vendor inquiry/registration/management and transaction risk monitoring system that can be easily used by SMEs. The core credit evaluation module aims to provide the integrated transaction risk indicator and the recommendation function of excellent companies by constructing a chain of default indicators (network) based on Korea Enterprise Data (KED) credit rating information. Through SIREN, the information of KED credit rating information plus chain bankruptcy indicator (network) could suggest integrated transaction risk indicator. The major functions of SIREN were abstracted in 3 items) Retrieve company) Business network and) Monitoring as in Fig. 5.

**Retrieve company:**

- According to the category of construction industry sector

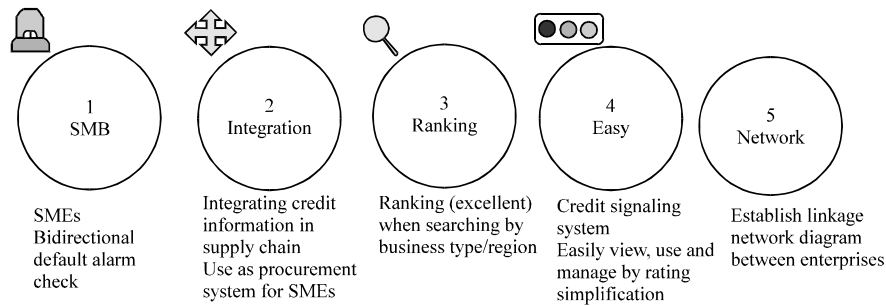


Fig. 4: The concept of SIREN

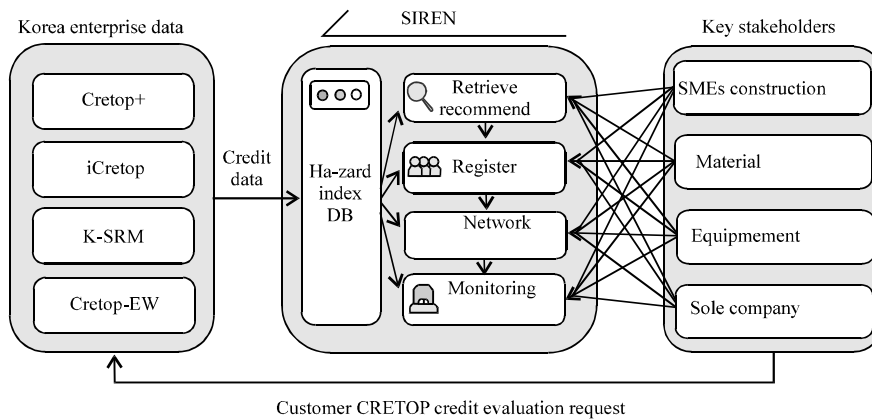


Fig. 5: SIREN Model

- Paying for existing accounts and checking for default risk
- Build a company evaluation model based on credit, technology and performance information DataBase (DB)

**Business network:**

- Network diagram displaying linking businesses by company
- Notification on network when risk increases such as chain breakdown of affiliated companies
- Detailed view when clicking network diagram company

**Monitoring**

- Save the list of suppliers and view credit rating changes
- Short Message Service (SMS), SNS connection and alarm for real-time customer monitoring
- Situation management for business customers

**RESULTS AND DISCUSSION**

**Main functions description**

**Partner search:** The partner search screen is divided into basic search and detailed search. You can search by entering key information such as company name, representative name and business number. In addition, users can select basic and detailed categories, so that they can search by category and can search by inputting search terms. In detail search, category classification is available.

**Partner details screen:** In the details view, users can see your partner’s network risk index and can see detailed information on the right. Next, users can check the license information and the evaluation table for the contact information company. Users can register your partner as a user by clicking register my partner.

**Partner registration screen:** Users can check the number of partners currently registered as a partner. Users can also check the list of companies by category by clicking

on the partner by registering the partner by category of group by group management function. Users can also select and delete registered partners and also provide basic search functions.

**Partner overdue notification page:** The research team have searched the target of the report month, entered the information to be reported and registered or canceled it.

## CONCLUSION

Construction project needs many stakeholders such as subcontractors, suppliers, equipment companies, so the role of appropriate stakeholders is very important and project success depends on ability of those stakeholders. Subcontractors play an important role in the successful completion of construction projects. Recent changes in the business environment have made contractors more likely to have a partnering philosophy when procuring subcontractors. Until now, e-Procurement systems are not being applied to enhance subcontracting efficiency, more focused on major contractor's view and a little big company only use systematic e-Procurement system to select their partners. Therefore, this study demonstrated supply network collaboration system for small and medium construction companies in selecting appropriate stakeholders and showed a matching algorithm for supply network system based on credit, technology, performance, information and recommendations.

This study proposed an improved Supply Network System (SIREN) for SMEs construction companies. Those SMEs could not have enough resources such as manpower, money and information, they always faced risk of contracting inappropriate suppliers. Therefore, this research proposed the supply network system including matching algorithm with suppliers and subcontractors. The proposed system had a following advantage. (Establishment of a risk management-oriented collaboration system (web/mobile)). Development of mutual sharing company pool and mutual evaluation algorithm). Soundness analysis based on outsourcing partner search and matching service and). Supply Networking web system and mobile app that can provide web 3.0 based optimization information. Additionally, the proposed system can make economic and social positive effects). Efficient project management including partner (partner) management). Business risk reduction: Recommendation of excellent suppliers and real-time monitoring function to remove dangerous). Promotion of advanced Information Communication Technology (ICT) convergence technology development: Promotion and activation of related industrial technology development.

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