SME Supply Chain Collaboration Innovation Using an Online Hub: Introduction of a Case in Korea

Yongma Moon[1], Dongmin Shin[2], Sungho Lee[1]
1 College of Business Administration, University of Seoul, Korea, 130-743
2 Industrial and Management Engineering Department, Hanyang University, ERICA Campus, Korea
(E-mail: yongma@uos.ac.kr, dmshin@hanyang.ac.kr, shlee@uos.ac.kr)

Abstract: This paper describes how Korean small and medium enterprises (SME) have been collaborating to improve their performance on a supply chain network using a web-based information hub, called i-Manufacturing. Recent dynamically changing business environments have imposed new challenges on managing supply chains in terms of flexible and rapid collaboration among business partners. To enable firms to actively adapt their operations to changing economies and circumstances, enhancing flexibility of organizations and effective information sharing among business partners are key strategies for successful enterprises. Although much effort has been undertaken to meet these requirement, and a variety of tools have been devised, those kinds of competitiveness could not be easily accomplished because of lack of capitals or other resources in case of small and medium sized firms. For the purpose of assisting SMEs interact and collaborate in an effective and efficient way, Korean government establishes a consortium and developed an on-line collaboration hub for SMEs. This paper describes the current status of the online hub and discusses future directions of the hub for a better supply chain collaboration environment.
Key words: Supply chain collaboration; SME; Online hub

1 Introduction

It is well known that effective collaboration in a supply chain helps business partners share their information and plan interactively, which can contribute to the increase of efficiency in operations management. Recent studies have shown that collaboration improved supply chain performance in many different core areas, such as sales, forecasting, cost reduction, inventory management, and production planning (Stank et al., 1999, Simatupang and Sridharan, 2002, Barratt and Oliveira, 2001, Simatupang and Sridharan, 2005).

While there have been several approaches for integrating supply chain activities for large sized enterprises, this paper discuss the collaborative achievement especially for SMEs. However, as described in Dainty et al., 2001, collaboration among SMEs has not received much attention. Vaaland and Heide, 2007 pointed out that SMEs usually tend to be less optimistic about the future economic requirements and less concerned with supporting supply chain management from various perspectives. For these reasons, limited effort to exploit advanced technologies for supply chain management system for SMEs has been undertaken. As such, only a small number of SMEs have gained benefits through alternative technological approaches such as e-ordering and e-invoicing through a web intermediary, which is reported to be successful (Pramatari, 2007).

Small and medium sized enterprises (SMEs) in Korea, which have limited human and information technology (IT) resources, have difficulty in constructing IT-based infrastructures or systems to achieve the competitive advantages or synergies. To relieve this problem, a consortium initiated by Korea Institute of Industrial Technology (KITECH) and several academic institutes was established with the support from Korea government in 2005. Since its establishment, the consortium has been successful in supporting SMEs to improve their operations management in supply chains by providing a collaboration support system equipped with practical and technological functionalities

This paper presents the supply chain collaboration system for small and medium enterprises in Korea, called i-Manufacturing collaboration hub. Section 2 describes the framework of i-Manufacturing collaboration hub. In Section 3, a part of functions provided by i-Manufacturing system are presented followed by current issues and future directions in Section 4 and 5.

2 Framework of the i-Manufacturing Collaboration Hub

In the manufacturing industry sector, high expenses and technological barriers of proprietary information systems have prevented SMEs from developing and operating their own collaboration support systems for supply chain management. This situation has impeded enhancement of

competitiveness of SMEs, which plays a crucial role in a nation's manufacturing economy.

To address this problem, an effort has been made to develop a collaboration supply chain system for small medium manufacturing partners from product planning to development, design, purchase, production, and services since 2005 (http://www.i-Manufacturing.com/). As an instance of benefits, unlike the past, when clients and vendors needed to have face-to-face meetings to order to discuss their engineering design drawings, the newly constructed collaboration network system for manufacturing partners in a supply chain, i.e., online conference system equipped with CAD software functionality, has removed this need, leading to operational efficiency with regard to operating cost and time savings. More than 600 manufacturers are currently connected by the system, and they have achieved cost reduction and productivity increase (Ryu et al., 2008). The detailed framework of the manufacturing collaboration infrastructure is illustrated in Figure 1 (Jung et al., 2011).

2.1 Interfaces

The online collaboration system was operated in differently manner depending on firms' specific types of collaboration until 2010. From 2011, the system provides richer functionalities in order to support a wider range of firms regardless of their collaboration types. In the early phase of designing i-Manufacturing hub, the functionalities it provides was separated in such a way that Design Hub, Blow Hub, Production Hub, Engineering Hub, Automold Hub, Press Hub, and Automobile Hub are isolated as shown in Figure 2. This implementation of functionalities without considering different characteristics of manufacturing sectors incurs a problem that some functions are widely used in some industry but others are not, resulting in inefficiency in using the collaboration system from an overall perspective. To cater for individual firm's characteristics in supply chains, the system, i-Manufacturing hub system is being updated to a customizable application service provider type of system (ASP type). This improvement is expected to resolve the past problem that a firm in one hub could not collaborate with other firms in a different hub because collaborations are supported only in a limited range of industry sectors. As a result of this effort, a more generalized and flexible function-oriented system is developed. In this system, all firms are allowed to collaborate with any partners involved in i-Manufacturing hub system.

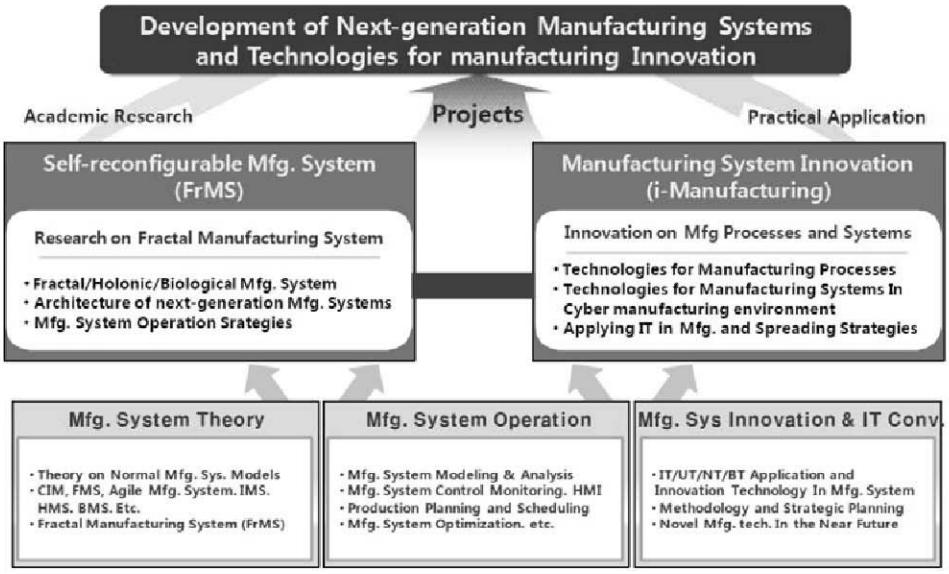


Figure 1 Framework and Direction for Collaboration System (Jung et al., 2011)

Figure 2 i-Manufacturing Online Interface

The enhanced system which can be customized according to the types of collaboration achieved better performance in a supply chain. As shown in Figure 3, the performance of the system showed significant improvement in a supply chain. In average, the achieved performance improvement drawn in a red bar increases from 7.1% to 63.3% for delivery time reduction and from 6.2% to 15.9% for cost saving. Note that the increased performance is much higher than had been expected drawn in blue color.

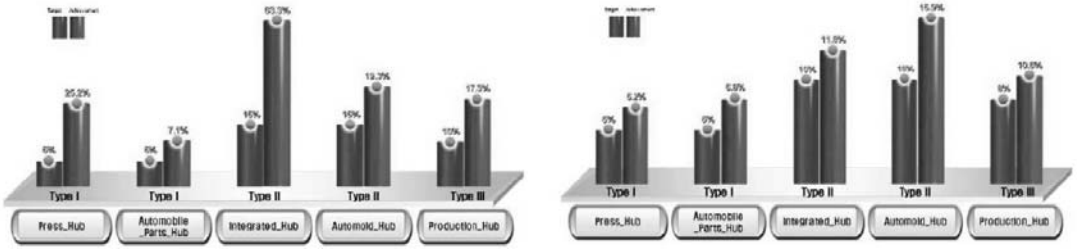


Figure 3 Performance of Collaboration System (i-Manufacturing) in 2007 for Delivery Time Reduction (left) and Cost Savings (right) (Ryu et al., 2008)

2.2 System structure of i-Manufacturing

As aforementioned in 2.1, i-Manufacturing has been updated to an ASP type system. i-Manufacturing hub system provides four different types of basic services, and each firm can add optional function features in addition to the basic service as per their need. The basic types are divided into Basic collaboration (A-type), Design collaboration (B-type), Design collaboration(C-type), and Manufacturing collaboration (D-type). It has put focus on four key needs from the manufacturing industry: information innovation, manufacturing process innovation, manufacturing system innovation, and new product development innovation. In the basic collaboration type, each collaborating partner can use online resources provided by i-Manufacturing hub system for their collaboration tasks. For example, employees in a firm can store and retrieve their documents, emails, contact information, and other data using i-Manufacturing hub system. Online communication with its collaborating partners is also supported in real-time. Besides, if a firm adds some optional function such as a 2D drawing viewer, it can retrieve and read CAD drawing online without purchasing drawing software. In this manner, product designing engineers do not need to bring up their CAD files in their memory to look into drawings with process engineers in collaborating partner firms regardless of CAD software installation status of the partner firms. Design collaboration type services provide basic functions that are required in the process of new product development. As a part of new product development process, project management such as scheduling of each project and monitoring and reporting of changes in projects is crucial to remove operational inefficiency. For this reason, project management functions are available for the design collaboration type, and for more advanced and sophisticated types of designing collaboration, resource handling functions such as MRP could be selected. The final type of collaboration hub provides services for process planning for each worker, outsourcing, and reporting to monitor their own status regarding manufacturing process in addition the previous functions.

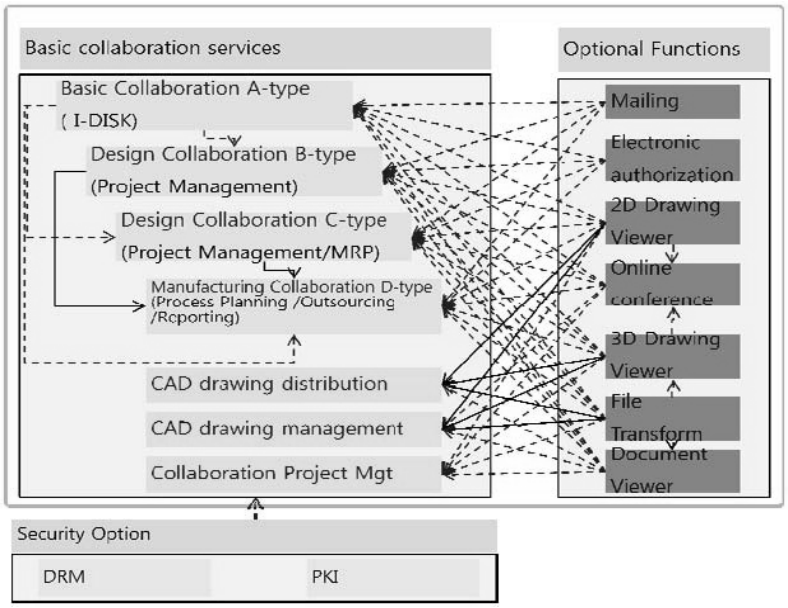


Figure 4 Structure of New i-Manufacturing (ASP type)

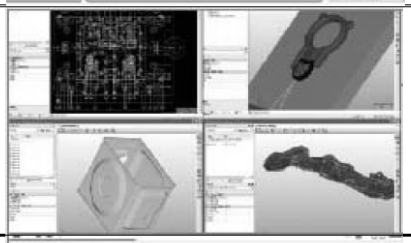
3 Services Provided by I-Manufacturing

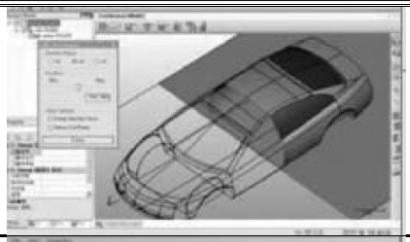
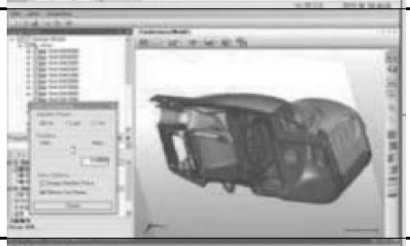
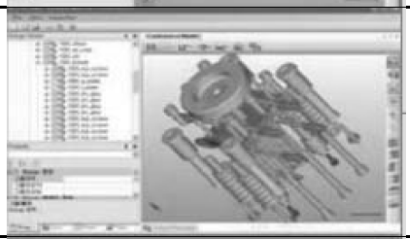
Basic functions which are provided by i-Manufacturing hub system are presented in Figure 5. These basic functions are implemented to obtain efficiency of information flow, communication, visualization, and productivity. All functions are operated online and some service functions such as CAD viewer are delivered in a manner of cloud computing.

4 Current Issues on i-Manufacturing

4.1 Evaluation of i-Manufacturing

The implemented system was evaluated for its effectiveness in supporting collaboration in 2007. However, at this point of a leaping stage, it is necessary to assess the updated system in more quantitatively analytic manner for its evolvement along with dynamically changing business environment through continuous improvement. For this reason, a framework of specific causes and their effect has been developed for i-Manufacturing. Many factors could be sources of performance improvement. For example, the current position of a firm in a supply chain could be a significantly important factor which could affect the system effectiveness and, depending on the position like 1^{st} tier vendor and 2^{nd} tier vendor, the extent to which a firm can gain benefits by using the system might be different. Thus, we have set several hypotheses, as shown in Figure 6, regarding financial status, process structure such as make-to-order and make-to-stock and relationship, strategic environment, competition, objectives, functional purposes, motivation of involvement over quality, flexibility, time and cost. At this point of time, the validation process is being undertaken.

Category	Function	Description	Figure
Information	Engineering	Increase quality of molds by pre-reviewing product design through CAE, sheets interpretation and three-dimensional measuring	
	Monitoring	Support you to forecast period of delivery by monitoring progress conditions in terms of parts, products and process	
	Reporting	Provide information helping plan works like management information(cost, sales) and production information(process forecasts, optimization of process)	
	Knowledge research	Systematically manage know-how needed to develop new products to decrease errors and reduce production cycle	
	Online conference	Offer real-time online conference with variety engineering data(CAS, CAD, CAE, CAI), so you can communicate with customers who far from your place	
	Data management & sharing	Integrated management of data supports sharing data precisely between users	

Communication	Distributing drawing & settlement	All drawings can be distributed to the person in charge and through online settlement, work's speed, quality and secure is going well process	
	Correlation with customer	Sharing outputs(technology data, 2D/3D model) with customers, increase company's reliability by securing clarity	
	message	When work progressing or change occur, workers can monitor the conditions in real time by using e-mail, SMS, message	
Visualization	CAS visualization	Enable to monitor diverse information(2D rendering images, 3D rendering models) produced via software like MAYA, 3D MAX, CATIA	
	CAD visualization	Enable to monitor 2D/3D plan information and reviewing drawings produced via software like UG, CATIA, Pro/Engineer	
	Mockup	Enable to systematically manage assembling information of interference check and assembly degree	

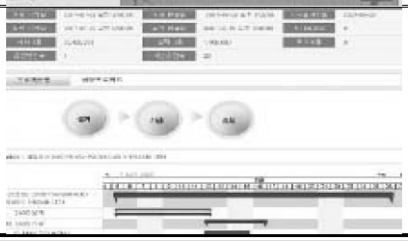
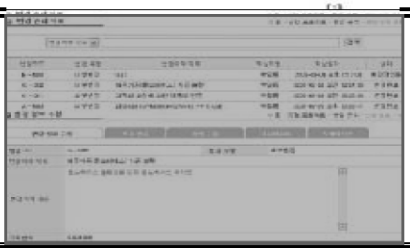
	CAE visualization	Enable to monitor and analyze information produced via software like Moldflow, ANSYS, CAPA	
	CAI visualization	Enable to monitor and analyze design data, measuring data and performance check data measured by three dimension measuring tools like Rapidform and Geomagic	
Productivity	Scheduling	Enable to check current schedule and corresponding information	
	Process management	Support to plan optimized design through simulation applied CAPA and period of delivery	
	Task management	Provide tools that enable workers to manage their tasks	
	Partner management	You can co-work with partners on-line and check delivery time, process and person in charge of outsourcing in real time	
	Change record management	Accumulate data occur through product development to production, so you can reduce errors for precise and quick work	

Figure 5 Representative Functions Provided by I-Manufacturing

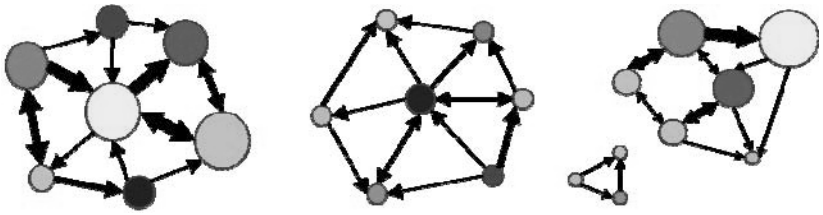


Figure 6 Social Network Analysis

4.2 Social network analysis

To boost more participation of collaborating firms and solicitation of potentially new collaboration partners, the system needs to be investigated how effectively it can support connections among enterprises. Some firm may play a principal role in the collaboration system as a leading firm, and its participation can motivate their partners for more active collaboration.. Besides, depending on the degree of utilization, more or sometimes less involvement occurred. To see this collaboration easily, social network analysis could be applied. For example, path length which is a widely used measure of strength of connectivity needs to be considered. Besides, many other measures can be utilized, for example, centrality, closeness, clustering coefficient.

4.3 Collaborative performance measurement and self-evolving system

One of the key issues in supply chain collaboration is to develop some measurement of performance to check the efficiencies of each firm's current system and the whole supply chain. As described in Simatupang and Sridharan, 2005, the measurement enables each firm to benchmark the best practice or level of best-in-class performer. In addition, relative weakness of a firm in supply chain could be analyzed by the measurement as well. For these reason, i-Manufacturing had developed series of measurement based on supply chain operations reference (SCOR) model which had been devised for evaluating and improving supply chain performance by Stewart, 1997. Within this stream, Jung et al., 2011 introduced collaborative key performance index. In addition to development of measurement for i-Manufacturing, the construction of performance management system is currently planned as shown in Figure 7.

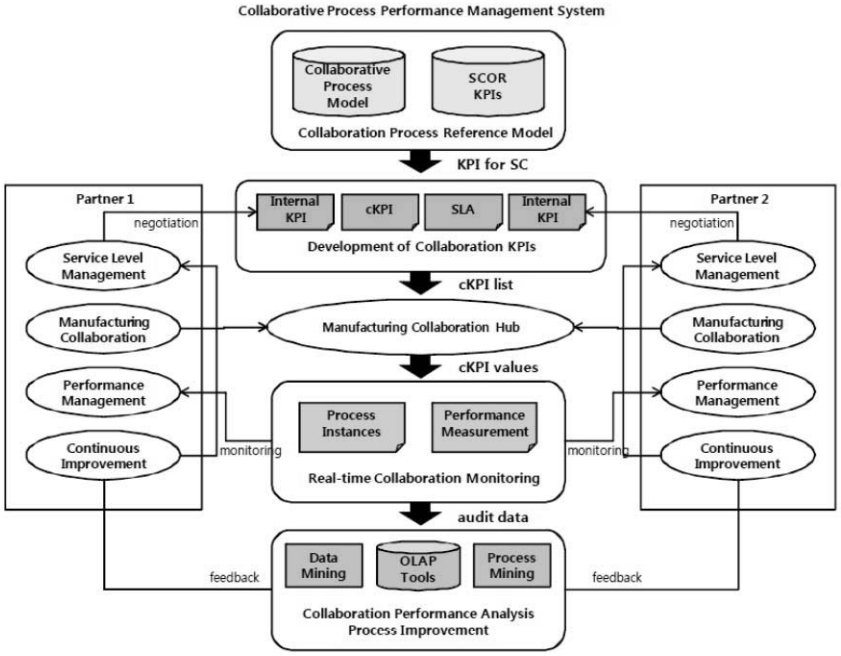


Figure 7 Collaborative Process Performance Management System (Jung et al., 2011)

5 Discussions and Conclusions

This article addressed a case in Korea for a company or government considering development of a collaboration system. While lots of research has studied supply chain collaboration for large size firms, collaboration issue for SME is barely discussed so far, not to say the development of system. However,

this article shows potential that collaboration system could stimulate SMEs in obtaining operational efficiency and financial improvement. Also, this explanatory study shows some guidelines for the collaboration innovation, for example, structure of system, components, functions, consideration factors, utilization of could computing and so on.

Lots of SMEs in Korea are struggling to survive in a competitive market, but limited resources and poor circumstances was critical barrier to their collaboration. Adaptation of innovative process technologies to collaboration system may help them to create values of Korean SMEs. We believe that i-Manufacturing project will be a good way to achieve the innovation in Korea in the near future. To achieve this goal, expanding the application areas of collaboration, driving more participation of potential firms, and more detailed analysis on current system should be prepared. In this sense, this article shows the direction of how to approach to our intrinsic problems.

References

[1] Barratt M., Oliveira A. Exploring the Experiences of Collaborative Planning Initiatives[J]. International Journal of Physical Distribution & Logistics Management, 2001(31): 266-289

[2] Dainty A.R.J., Millett S.J., Briscoe G.H. New Perspectives on Construction Supply Chain Integration[J]. Supply Chain Management: An International Journal, 2001(6): 163-173

[3] Jung J.-Y., Lee J., Jung J.W., Kim S.-k., Shin D. A Methodology for Collaborative Performance Measurement of Manufacturing Collaboration[J]. International Journal of Industrial Engineering: Theory, Applications and Practice (accepted), 2011

[4] Pramatari K. Collaborative Supply Chain Practices and Evolving Technological Approaches[J]. Supply Chain Management: An International Journal, 2007(12): 210-220

[5] Ryu K., Shin J., Lee S., Choi H. i-Manufacturing Project for Collaboration-based Korean Manufacturing Innovation[C]. IEEE, 2008:253-258

[6] Simatupang T.M., Sridharan R. The Collaborative Supply Chain[J]. International Journal of Logistics Management, 2002(13): 15-30

[7] Simatupang T.M., Sridharan R. The Collaboration Index: A Measure for Supply Chain Collaboration[J]. International Journal of Physical Distribution & Logistics Management, 2005(35):44-62

[8] Stank T.P., Daugherty P.J., Autry C.W. 1999. Collaborative Planning: Supporting Automatic Replenishment Programs[J]. Supply Chain Management: An International Journal, 1999(4): 75-85

[9] Stewart G. Supply-chain Operations Reference Model (SCOR): The First Cross-Industry Framework for Integrated Supply-Chain Management[J]. Logistics Information Management, 1997,(10): 62-67

[10] Vaaland T.I., Heide M., 2007. Can the SME Survive the Supply Chain Challenges?[J]. Supply Chain Management: An International Journal, 2007(12): 20-31