

BUSINESS INNOVATION VIA COLLABORATION

e-Manufacturing: Web-based Collaboration Systems for SMEs

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Abstract: Unpredictable challenges from global markets and customers make manufacturers difficult to produce quality products satisfying cost and time constraints. To cope with competitive and dynamically changing internal and external conditions, the manufacturing industry needs to be equipped with advanced technologies including IT as well as substantial infrastructure. "e-Manufacturing" is referred to as a system methodology enabling the integration of manufacturing operations and functional objectives of an enterprise by using intelligent IT technologies such as Internet, tether-free communication methods including wireless networking or web-based connections. The key factor of e-Manufacturing is collaboration. Hence, we have developed four kinds of web-based collaboration systems, referred to as hub systems, while conducting e-Manufacturing project funded by the Korea government. In this paper, therefore, the functions and characteristics of each collaboration hub systems will be introduced. Furthermore a case study of business innovation by applying collaboration systems for SMEs (small and medium sized enterprises). As a result of applying collaboration systems to SMEs, they can get competitiveness because of effective web-based tools for them, and reach business innovation which makes them survive in a global market.

1 INTRODUCTION

The manufacturing industry has been facing with unpredictable challenges brought on mostly by dynamically changing customer demands. To cope with competitive external conditions, the manufacturing enterprises of today should equip advanced technologies based on substantial infrastructure including network facilities, which supports speedy communication and rapid data transactions. Due to widespread availability of the Internet over the past decade, business of the enterprise has been evolving into e-business, which innovates in business processes and systems such as Enterprise Resource Planning (ERP), Supply Chain Management (SCM), Product Lifecycle Management (PLM), Customer Relationship Management (CRM), and so forth. It has aided the acceleration of rapid and smart production in manufacturing systems to fulfill requirements of customer such as short delivery, low cost, and quality products (Lee, 2003).

Although many companies and government have tried to innovate in manufacturing industry, they tend to invest funds only for facilitating partial sections of a whole business such as product or

production technologies, manufacturing process, and business services. Business innovation, however, must occur in all dimensions – product, process, and organization – to improve business performance and competitiveness. Companies are seeking new ways of providing additional value to customers and gaining a competitive edge over their competitors. As a representative way of gaining competitiveness, they are focusing on the collaboration even with their competitors. Today's worldwide economic conditions also call for them to modify their business processes. As a consequence, manufacturing enterprises (especially small and medium sized companies, i.e., SMEs) are focusing on on-line or off-line collaboration to get the power of scale and to manage processes effectively.

When we compare a commitment of manpower during the product lifecycle between global leading companies and most of the Korean SMEs, focal points are definitely different as depicted in Figure 1. Most of Korean SMEs seem to ignore the importance of the initial stage for making products including product design, process planning, etc., thereby they often alter production schedules and force subcontractors to rework changed parts. Hence, they expend a significant amount of manpower later

in dealing with inherent quality errors or claims from customers. Such waste can be prevented by making collaboration in the early stages as done by leading companies. Experts in each process gather and make lots of discussion with each other to reduce errors possibly occurring during and after production. By doing so, they do not encounter many after-sales troubles even though they spent much time and effort in early stages. In short, collaboration in the early stages produces a big difference in quality of final products.

Enterprises must capture, manage, and leverage their intellectual assets to differentiate themselves. The best way is to use the right application which supports collaboration. Collaboration is the most important factor to increase a company's flexibility and agility to respond swiftly to changing market pressures and competitors. Collaboration is being viewed as the next big wave after e-Commerce, digital commerce and several other variants that have emerged over the last decade [4-5]. According to the outcomes of the e-Manufacturing project, as illustrated from the following section, collaboration systems can function as a good extranet as well as intranet especially for SMEs who have insufficient infrastructure or network facilities.

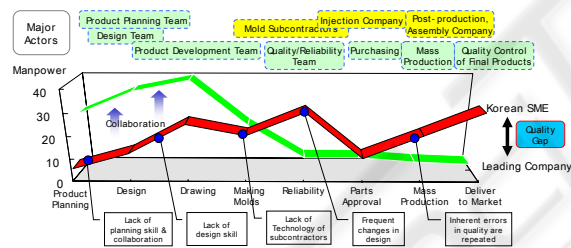


Figure 1: Comparison of product development lifecycle.

2 E-MANUFACTURING

e-Manufacturing can be referred to as a system methodology enabling integration of manufacturing operations and functional objectives of an enterprise by using intelligent IT technologies such as Internet, tether-free communication methods including wireless networking or web-based connections (Ryu *et al.*, 2004). It is a novel concept or paradigm in manufacturing areas used to meet the requirements for the complete integration of all business participants including suppliers, manufacturing elements, and customers through the effective use of web-enabled technologies.

e-Manufacturing does more than just connect the Internet to the shop floor. It provides a fundamental change in a enterprises' strategic value proposition. It is a collection of systems, processes, and technologies supporting and enabling manufacturers to collaborate with others. To effectively embody collaboration, the following tools are developed;

- Tools for data mining, transforming, and transferring to manufacturing facilities via web-enabled applications,
- Intelligent methods and tools for monitoring, predicting, and resolving undesirable events such as deterioration, trend of performance loss, machine faults or failures, etc.,
- Tools for optimizing processes and operations to improve system performance,
- Synchronization tools for integrating systems associated with e-Manufacturing such as MES (Manufacturing Execution System), PLM (Product Lifecycle Management), etc.,
- Tools for satisfying customers by providing qualified services including engineering services, technical assistance, consulting, etc.,
- Collaboration methods and applications enabling companies to cooperate with others amicably by supporting easy sharing of data/information/knowledge.

e-Manufacturing project was launched as a pilot program by both central and regional governments to build up infrastructure to promote collaboration and technology development among companies in 2004. The industrial section where the collaboration system first applied was injection-mold. However, it will be enlarged to other major industrial sections including automobile, machinery, electronics, etc. Furthermore, the application region of the project will be spread out from the metropolitan area to local areas as well as overseas countries. Note that the number of SMEs who participated in the project was 81 in 2005 and it becomes 210 in 2006. The goal, model, and main characteristics of the e-Manufacturing project can be summarized as illustrated in Table 1.

Table 1: Outline of the e-Manufacturing project.

	Description
Goal	To increase industrial competitiveness and added value via collaboration
Model	Business innovation model including both on-line and off-line collaboration
Characteristics	The project develops collaboration systems via cooperation between government and industrial entities

2.1 Collaboration Systems

The collaboration systems have been independently implemented (but are now being integrated) according to their specific objectives. As illustrated in Figure 3, we have developed *Design_Hub*, *Production_Hub*, *Blow_Hub*, and *Engineering_Hub* from 2004 to 2005, and we are now building up a new one referred to as *Automold_Hub*. The *Design_Hub* was first developed among 5 systems to support collaborative design of molds by providing useful tools including CAD conference, 3D drawing visualizer, collaborative project manager, etc. While developing *Design_Hub*, we started to develop *Blow_Hub* which is specialized one according to the product type. That is to say, blow-product can be produced when two types of molds are equipped with (i.e., parison mold and blow mold). At the same time, another collaboration system, namely *Production_Hub* was developed to support collaboration among small companies who have different production skills including machining with CNC, discharge of electricity, try-out, CAM, assembly, etc. In the mean time, for mold companies involved in the e-Manufacturing project, the use of three collaboration systems often got them into trouble because of the inveterate inferiority in the quality of products, parts, modules, and molds. To support them by providing engineering technique and knowledge, *Engineering_Hub* was newly developed in 2005. By utilizing *Engineering_Hub*, mold companies receive benefits from helpful information or service provided by engineering experts when faced with any intricate problem or

need to consult engineering knowledge such as CAE (Computer Aided Engineering) analysis and 3D inspection, etc. Figure 3 illustrates functional areas and topology of aforementioned collaboration systems configured from the process point of view.

All functions of the collaboration systems are provided as a type of ASP (application service provider) so that users can use them at anytime and everywhere. Functions are summarized as follows;

- **Design_Hub**
 - Managing collaboration project information and history of injection molds
 - Managing standard work templates and distributing drawings and documents
 - Online conference with 2D/3D CAD drawings
 - Searching project/data information according to users' permission to access
- **Blow_Hub**
 - Managing collaboration project information and history of blow molds
 - Managing standard business templates
 - Providing part library supporting parametric design of parison and blow molds
 - Same functions supported by the Design_Hub
- **Production_Hub**(Figure 3)
 - Planning and scheduling including outside orders by simulation(with delivery or cost)
 - Distributing specification of parts or modules to the cooperating companies
 - Monitoring production progress of cooperating companies, and reporting it to customers through SMS (short message service)
 - Providing online CAE, inspection services
 - Supporting the calculation of production costs

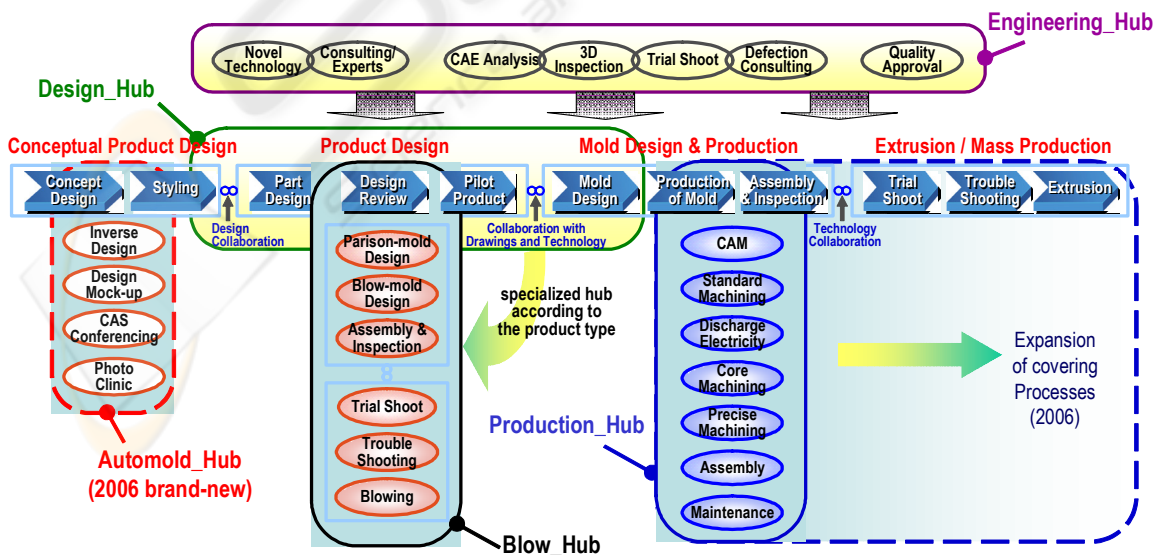


Figure 2: Functional area and topology of each collaboration systems.

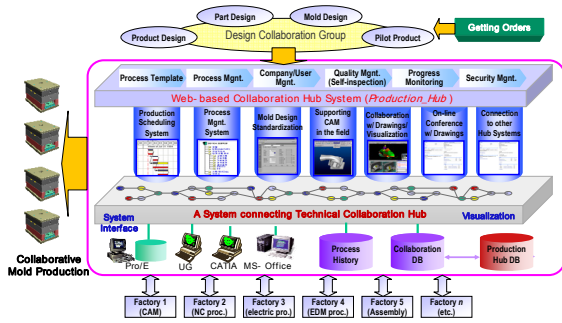


Figure 3: A system model for *Production_Hub*.

- **Engineering_Hub**
 - Online CAD/CAE conference with customers
 - Managing projects and history of eng. services
 - Supporting connection between experts and customers by organizing communities
 - CAI (Computer Aided Inspection) tools for verifying CAD drawings by comparing them with skin data points inspected together
- **Automold_Hub**
 - Managing three types of collaboration projects including styling, inverse design, and parts development
 - Providing collaboration tools such as Photo Clinic (online voting tools/AHP), on-line CAS (Computer Aided Styling) conference, CAI, etc.
 - Supporting web-based tools for making design mock-up of automobile and sharing information with customers

2.2 Case Study of *Production_Hub*

As an illustrative application, a virtual company, referred to as “Moldzone”, accomplished business innovation by applying *Production_Hub*. The consortium utilizing *Production_Hub* consists of 20 mold design/production companies in 2005. Most of them were regarded as poor and small-sized companies before using the collaboration system. Because of their structural limitation, they found it difficult to survive by getting orders requesting them to make a single part/mold, while being responsible for all production costs (e.g., labor cost, electricity, water, etc.). Furthermore, external market conditions push them lower the price of molds because there are so many companies in China, who can do the same job at lower cost.

In the meantime, they apply *Production_Hub* to obtain an effective and efficient way to collaborate with each other. They use the system as the intranet to manage all data and information of each company. They also use it as the extranet to collaborate with

each other. As a consequence, 9 companies reached the consensus that they should migrate at the same place in order to reduce indirect costs by sharing expenses, thereby allowing them to be equipped with competitive power. They redefined the roles, processes, and responsibilities of each company according to their ability to perform in order to use a web-based collaboration system, *Production_Hub*. After applying *Production_Hub*, their business model has been changed from product based model to relation based one.

They are now getting turnkey-typed orders that request multiple molds at once mostly from overseas companies. They have increased mold quality but reduced delivery time and cost. Statistically speaking, they have achieved a 44.2% increase in production quantity, 78.7% increase in revenue, and a 192% increase in their profit. As well, delivery time has been reduced from 90 days to 60 days (33% decrease). Currently, they are operating Moldzone II in order to enlarge their items to produce (mostly big-sized molds for making automobile parts).

3 CONCLUSIONS

The e-Manufacturing project is designed to build up infrastructure as a part of its efforts to promote collaboration and technological development. It is referred to as a scheme designed to promote informatization of the manufacturing sector by innovating and integrating new product development, procurement, production, logistics, after-sales and other manufacturing processes based on Korea’s strong IT infrastructure.

It is our strong belief that developing and providing collaboration infrastructure to manufacturing companies is the best strategy for the innovation in manufacturing industry. By applying IT and web-based technology into the conventional manufacturing industry, manufacturing companies can achieve competitiveness and manufacturing innovation as well.

REFERENCES

- Lee, J., 2003. e-Manufacturing – fundamental, tools, and transformation, *Robotics and Computer Integrated Manufacturing*, 19: 501-507.
- Ryu, K., Choi, H., Lee, S., 2004. Framework of e-Collaborative Engineering Services for Mold Companies in Korea, *IMS Int. Forum, Cernobbio, Italy*, 17 May – 19 May: 1128-1137.