

A Study on Collaboration Informatization Level of Supply Chain Process : Korean Automobile Industry Case

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Abstract. Many of manufacturing companies faced to globalization make an effort to obtain a competitiveness of speediness, flexibility, collaboration by using the informatization. It has been operated on enabler to drive creation of performance beyond just playing the role of office automation in the enterprise. According to this importance of informatization in enterprise, it also has been studied roundly to analyze its level. So, in this paper we suggest the conceptual methodology to analyze the level of collaboration informatization between manufacturing companies from the viewpoint of performance on the supply chain process. Also we applied it to automobile industry in order to set out the method. It will contribute to a new perspective analyzing the informatization status in the manufacturing industries.

Keywords: Collaboration, Supply Chain Process, Informatization level

1 Introduction

Currently, manufacturing companies have concentrated on the market changes by using various cooperation systems like a strategic alignment and outsourcing for taking a continuous competitiveness. To maintain a competitive edge, manufactures must make a major shift in strategy to effectively synchronize activities among functionally and geographically disperse groups.

A collaborative manufacturing strategy can help a company maximize the effectiveness of its value chain in order to better control profits and address changing market demands [5],[8]. As being advanced the information technology (IT), particularly, business environment has been changed. It makes over the competition from inter-enterprise to supply chain [18]. Information technology as a tool of collaboration among manufacturers, helps to sharing process. It means to design working process in association with inter-organizations or enterprises. As a result, collaborate informatization could help sharing an enormous amount of information. It also improve the quality of information belonged to companies which have influence on positive results in coordination ability, productivity and others in the company.

From this informatization, the buyer will be increasing power about reducing the stock cost, times and errors [16]. In summarization above, informatization is the useful factor to strengthen the competitiveness in which it realize the performance of supply chain by collaboration inter-enterprise or manufacturers. Many studies are being conducted to analyze the level of informatization to take advantages by using the information systems. Researchers have suggested various method and framework. However, there are some kind of limitations that it could not link the business strategy and performance with IT. In previous researches, they only have focused on the results. This approach is effective to explain the present status. But, it is difficult to address an underlying cause at the issue. Thus, in this paper we will suggest the conceptual methodology to analyze the level of collaboration informatization between manufacturing companies from the viewpoint of performance on the supply chain process. This study has following procedures. First, we will see the relation between collaboration and informatization. Second, consider previous researches about methodology of analysis informatization level. Third, suggest the conceptual analysis method based on supply chain process performance. Finally, applying it to automobile industry, give an account of the way using it.

2 Related Work

2.1 Collaboration and Informatization

The Previous research shows that IT supports the collaboration of inter-enterprises. It could be possible for supplier and buyer to exchange information by using IT. Information technology as a tool of collaboration between manufacturers, helps to sharing process. It means designing work processes in association with inter-organizations or enterprises. It also improve the quality of information belonged to companies which have influence on positive results in coordination ability, productivity and others for the company. Most of the authors pointed out that information technology could make enterprise collaboration. Technology has gained a central role in the design of business model and operation, in the definition of business strategy and relationships among partners, in the design of performance measurement techniques, and in the integration of processes and organization. “It is no longer merely an implementation issue; rather, the exercise of information technology is a critical organization design issue”[12].

2.2 Collaboration and SCM performance

Anthony(2000) insisted that supply chain collaboration occurs when two or more companies share the responsibility of exchanging common planning, management, execution, and performance measurement information [2]. Das and Teng (2003) suggested that the performance between partners could be measured how they accomplish their strategic object by collaboration [9]. Many previous researchers have

concentrated on the way to measure collaboration performance called it “alliance performance”. However, it is difficult for them to consent to suggestions that measures of collaboration performance. Supply chain partnership is longitudinally cooperative relation between buyer-supplier [7]. It is also relation and network in the transaction partners organizing supply chain [11].

Through the following table.1, we could be conjectured that collaboration performance means Supply Chain Management (SCM) performance. SCM is the way to manage the whole processes which connect supplier and customer.

Table 1. Definition of SCM

Researcher	Definition
John and Relev (1985)	Managing the movement of raw materials from supplier to customer
Holcomb (1991)	Constructing the relationship of inter organization on the supply chain to product more valuable services or goods than competitors.
Westbrook (1992)	Controlling the network of production and distribution processes from point of origin to point of consumption

SCM spans integration, coordination and collaboration of inter-organizations to cover a wide scope of supply chain. Considering collaboration of partners belongs to the supply chain process, measuring the performance of collaboration is also comprised in. SCM performance have been widely discussed in related literature and suggested in terms of cost, quality, delivery and flexibility [20], logistics cost reduction, order to delivery lead time, inventory management, sales market, facility efficiency [1], logistics efficiency, cost down on the supply chain, on time delivery [10]. Also, various methods have been developed to measure them: SCOR model, ECR scorecard, EC/SCM scorecard, Logistics scorecard.

In particular, SCOR model is the reference model to provide standardized access route of efficient technology analysis on the process, considering the various factors required to build the SCM system. It also provides the integrated analysis of SCM processes in which are planning, purchasing, supplying and distributing from supplier to buyer [13]. SCC (Supply Chain Council) divided the supply chain performance into supplier and customer through SCOR model. They suggested performance factors of reliability, flexibility and responsiveness in the customer area. Also supplier area has been classified to asset and cost. Based on the SCOR model, we employed such indicators to set out our methodologies.

2.3 IS performance by the process perspective

There have been many studies about Information system assessment. In a broader sense, assessment of informatization level we called in this article pursues their approaches. There are only differences between approaches to analyze the area that they covered. Many studies focused on value of IS investment in the past. However, some problems with this research have been less carefully defined direct effect. Hence, a recently researches are trying to examine the effect by approaches of process view. It is possible to measure the effect which appeared through various working processes,

linking it to business value. Melville and Gurbaxani (2004) insisted that the research of IS and business value is scrutinizing IS influence for the performance of organizations or business process [13]. Baura et al.(1995) and Mooney et al.(1995) defined an underlying value of IS based on the process view [4],[15]. They suggested that IS exert influence on business processes at first, and then it make effect in business performance indirectly. There are weak point in this perspective but, it could be better than other way, since performance by IS has been developed by processes. Mende suggested that the current state of an information system is evaluated at two levels [14].

- the benefits the system creates by supporting a business process
- the technical and functional quality of the system itself

He used a critical success factor (CSF) approach [17] in order to evaluate a system's impact on process performance. On this approach, we could suggest that IS support the business processes, and it would be contributory to business performance. Also it has applied to a basis of conceptual framework linking the IS to business performance in this study.

We researched the T-MODEL to make a analysis framework. It is based on the specific and logical alignment between the IT investment and the business performance, and it takes a role as a framework that can evaluate the Business Competitiveness through IT more reasonably. It classifies the IT system, which is a direct outcome of IT investment, into IT functions, and also classifies the business process, which is a direct driver of business performance, into business activities [6]. There are three methods to produce a level of informatization, IT Dependence Analysis Method, Business Supportiveness Analysis Method, IT Contribution Analysis Method and Economic Analysis Method. The methodology designed based on T-MODEL uses the business Key Performance Indicator (KPI) to analyze the IT Performance linking to business processes [6]. By using two methods on the T-MODEL, we could analyze the collaboration infomratization level. It is the IT Dependence Analysis (ITDA) and the other is Business Supportiveness Analysis (BSA). ITDA could be understood a partial effect of IT in a working process. It means the benefits of the system created by supporting business processes. The level of ITDA represents how much dependent the work to its systems. BSA is the technical and functional quality of the system supporting an activity of the task on the business processes.

3 Analysis Method of Collaboration Informatization level

To identify the area of collaboration between companies, it needs to be looked out over industrial structure. The extent of inter-organizational collaboration is divided into vertical and horizontal collaboration. And vertical collaboration is also broke down into internal and external [3]. It could include collaboration with customers, internally and with suppliers, and horizontal collaboration include with competitors, internally and with non-competitors, e.g. sharing manufacturing capacity. In this

study we have been focused on the vertical collaboration between supplier and customer company, since we assumed that most of collaboration supported IT would be took place on the supply chain in case of manufacturing. Also we guessed that the collaboration performance could be estimated on the manufacturers which make the final product.

3.1 Conceptual model and Analysis process

We approached to the linkage model which provide the view point of relation: performance-process-IT to elicit the actual impacts of systems. To connect the performance with IT, business processes are acted as mediators between them. From this conceptual model, we could make a procedure of analysis method. Linkage in this model could be explained via reliance level of a business process that corresponds to the allied IT systems. Following figure shows the relation between each perspective.

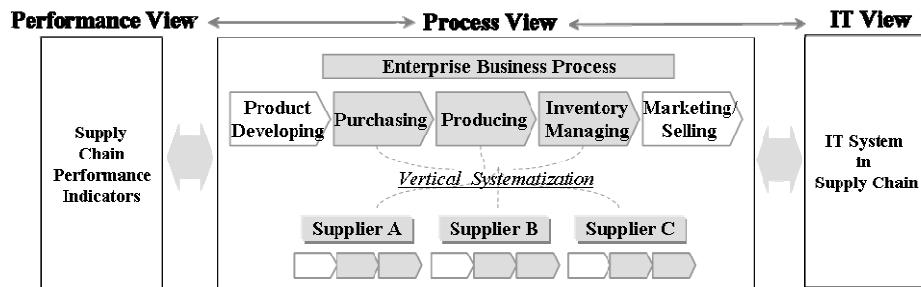


Fig. 1. Conceptual framework of methodology

Supply Chain Performance Indicators are representative of performance and the attainment of its performance could be analyzed based on business processes vertically systemized between buying and supplier companies. This linkage model is grounded upon T-Model, and we could recognize the supporting area of IT systems easily. Based on this logical flow, we proposed the analysis procedure. It is composed of several phases.

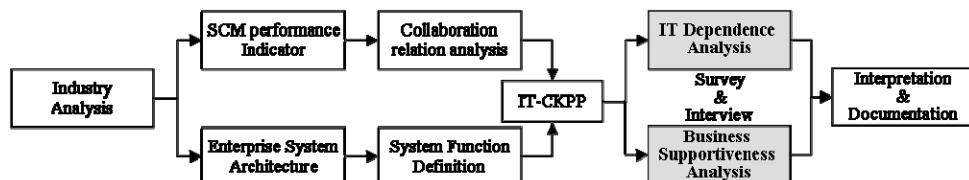


Fig. 2. Procedure of collaboration informatization level analysis

First, we have to know the characteristic of industry that would make going to analyze and define the performance indicators using the SCM's that was introduced in previous research like SCOR model. And then, classify the activities on the processes related the indicators. Those activities work for accomplishing the performance and

the indicators measure the level of it. In the second phase, it is need to collect the information of IT systems in those companies like the system architecture. Using the information, derive the system function and make it overlapped with activities on the processes. After this phase, we could find the IT-CKPP : IT-Collaboration Key Performance Process.

In next phase, we apply the analyzing methods: ITDA, BSA executed by surveying and interviewing. More specific description could be showed following section : case study.

4 Case Study : Automobile Industry in Korea

In this section, we specified the methodology and its contents. Particularly, we have chosen the automobile industry, since there are many cooperative companies so that we could distinguish our interest easily.

It needs to investigate whole companies involved, but we have only to carry out several companies. Following table shows the standard of selecting companies.

Table 2. Selecting criterion of research sample

Classification	Criterion	Sample size
Buying company (LV1)	Market share 80% high rank major automobile manufacturers	3 major enterprise
Supplying Company (LV2)	High weighted supplier delivering the parts of an automobile to buying company	46 supplier company

We set out the companies into two groups. Level 1 group includes automobile companies like Hyundai and General Motors. Companies producing the parts of an automobile are included in the Level 2. They are called partners or collaborated company and almost of them is systemization of the Level 1 enterprises. This case study has been executed for about 3months, including total 49 companies in the survey.

4.1 Application : Production and Logistics processes

Automobile industry requires the various materials or resources so there are many manufacturers making automobiles, parts, and accessories. Particularly, it is necessity to use the IT systems in the area of designing, producing and managing. There are various paths and related partners, therefore, without IT they hardly ever take the competencies against other companies. Collaboration is frequently occurred on the whole supply chain, especially parts of development, purchase, supply and logistics are distinguished. In those area, to reduce the development period and all kind of cost incurred supplying flow, it is important to manage the supply chain more effectively. Considering the characteristics of automobile industry and using the SCOR model, we collected the Key Performance Indicators : KPI. Followings are indicators on the

Production/Logistics processes. SCOR model suggest the four dimension of performance but we have been excepted the “assets”, since it is irrelative with IT.

Table 3. Performance Indicators of SCM

Dimension	Performance Indicators
Reliability	Production L/T, Production Planning L/T, Production Planning Cycle ratio of on-time modification
Responsiveness	Production Planning Consistency Rate, Emergency Order Rate End Products Inventory Turnover, Success ratio of delivery quality Productivity(yield),Inventory Error Rate
Cost	Inventory Holding Rate, Supply Chain IT Cost, Production Cost per Unit, The Number of Inventory Ratio, Error Cost

Next phase, we should analyze the relationships between buying and supplying companies and then derive the processes in which collaboration occurred. In case of the automobile industry, production/logistics area commonly is related a process flow such as production planning, material requirement planning, inventory management, quality inspection, claim management, production, shipping/logistic. Figure 3 shows the collaboration relations analysis in production/logistics domain between level 1 and level 2 companies.

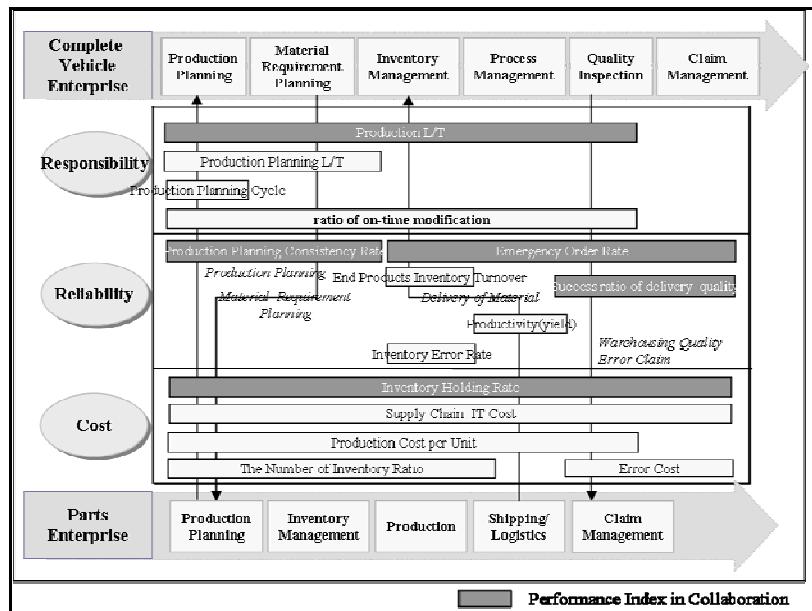


Fig. 3. Collaboration flow analysis in the Production/Logistics domain

In figure 3 (as shown above), shadow areas are the collaboration indicators and their related processes are CKPP. With this result, we could overlap the CKPP with IT systems to figure out the IT-CKPP. And then, considering its relationships, executed

the IT dependence and business supporting analysis. There are several systems supporting business processes, and we conducted survey to conclude the IT support level against Level 1 and Level 2 companies. The questionnaires are consisted of two area, support and usage level. Support level means whether the system has been built for activity on the processes, and usage level indicate the quality of that system.

ITDA is the degree of the activity relying on those systems, it has three dimensional level, importance, use, necessity. First dimension is weight of the IT on the processes, second level is frequency to utilize the systems, last dimension means requirements if there are no systems. Figure 4.5. shows the result of those analyses.

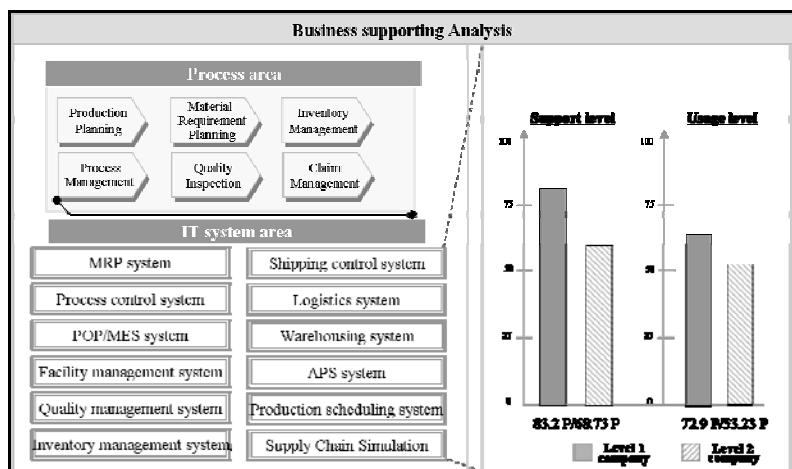


Fig. 4. Result of the Business supporting analysis

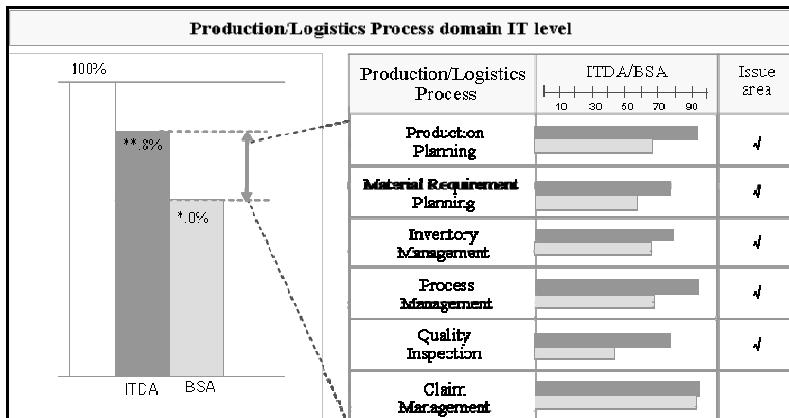


Fig. 5. Result of ITDA and BSA analysis

In the Production/Logistics domain, we could find differentiations between companies. Level 1 group has been revealed high degree of BS against Level 2 group. It could be analogized by scale of IT investment among them. In other words, level 1

group has relatively large amount of budget for IT, but level 2 group is usually not. Another finding with the result is ITDA/BSA. We could the collaboration informatization level by it. In case of that ITDA is higher than BSA, the infomratization level is low, and those processes need to be supported by systems, whether make a new system or maintenance. We could find a result that more systems are required to the production/logistics area except to claim management process. As we find the issue area, we should conduct to interview for finding a factor of the problem.

As a result of conducting interview, we could be known about those problems. One reason of the problem is that the information related to products and inventories is not accuracy so that level 1 group companies have a problem in the operation. Also level 2 companies have a cost problem because of inefficient production processes. These problems could be continuous with incapacity of IT system.

Consequently, to solve the problems, it needs to be complemented to more supply information systems.

5 Conclusions and Future Research

In this paper, we provided collaboration informatization status and methodologies of finding problems in supply-chain process. Furthermore, we applied T-Model that aligns between performance and IT by escaping established analysis methods around indices in process perspective. Applying this concept to automobile industry, we can provide successive flow for analysis method.

However, this methodology has following limitations. First, it is not easy to collect the performance indicators of entire enterprise and define the boundary of collaboration among partners. Second, in case of Information System, there are differences between level 1 and level 2 companies, so it needs to establish standard defining the systems for convenience of research. Finally, since there are many companies to supply the parts of automobile for buying company, we have to consider leveling around enterprises to analyze the collaboration relationships accurately.

Consequently, we need to establish more generalized standard for applying it and future researchers should devise the analysis model that can compensate theses weakness.

References

1. Anderson, C., D.L., Britt, F.E., Favre,D.J.: The seven principles of supply chain management, Supply Chain Management Review,1(1),pp.31-43 (1997)
2. Anthony, T.: "Supply Chain Collaboration: Success in the New Internet Economy", Achieving Supply Chain Excellence Through Technology, Vol.2,pp.41-44 (2000)
3. Barratt, M.: "Understanding the Meaning of Collaboration in the Supply Chain, "Supply Chain Management: An International Journal, Vol.9, No.1,pp.30-42 (2004)
4. Baura,A.,Kriebel,C.H.,Mukhopadhyay,T.: "Information Technologies and Business Value : An Analytic and Empirical Investigation", Information Systems Re-search,6(1),pp.3-23 (1995)

5. Cadence Design Systems : Design Chain Optimization: Competing in the disaggregated electronics industry, White Paper (2003)
6. Choon Seong Leem, Byeong Wan Kim.: "Advances in Concept, Framework and Methodology for Measuring the Business Competitiveness through IT", ICCIT (2007)
7. Christine,M.H.,Lamming,R.C., and Cousins.: "Developing the concept of supply strategy", International Journal of Operations and Production Management, Vol.9,pp.650-674 (1999)
8. Collaborative Manufacturing Explained, A MESA International White Paper (2004)
9. Das, T. K. and B.S.Teng.: "Partner Analysis and Alliance Performance", Scandinavian Journal of Management, Vol.7, 257-267 (2003)
- 10.Gill, P. and Abend,J.: "Wal-Mart : the supply chain heavyweight champ",Supply Chain Management Review, 8-16 (1997)
- 11.Harland,C.M.: "Supply Chain Management : Relationship, Chains,Neworks",British Journal of Management,7(Special Issue),(1996)
- 12.Marco Busi, Umit S. Bititci.: "Collaborative Performance management : Present gaps and future research", International Journal of Productivity and Performance Management, Vol.55 No.1 (2006)
- 13.Melville, N., Kraemer, K., and Gurbaxani, V.: "Review : information technology and organizational performance : an integrative model of IT business value", MIS Quarterly,28(2), pp.283-322 (2004)
- 14.Mende,M., Brecht,L. and Osterlem H.: "Evaluating existing Inromation Systems from a Business Process Perspective", Proceeding of the computer personnel research conference on Reinventing IS : managing information technology in changing organization (1994)
- 15.Mooney, J.G.,Gurbaxani,V. and Kraemer,K.L.: "A Process Oriented Framework for Assessing the Business Value of Information Technology," ACM SIGMIS Da-tabase, Vol.27,No.2,pp.68-81 (1996)
- 16.Nakane, J. & M, Jenkins.: "Electronic Trading Networks : EDI and Beyond", Connference Proceedings, IDATE 91, Motpellier, France, November (1983)
- 17.Rockart, J.: Chief Executives Define Their Own Data Needs, Harvard Business Review, 57(2),pp.81-93 (1979)
- 18.Ronald H. Ballou, Stephen M. Gilbert, Ashok Mukherjee.: "New Managerial Challenges from Supply Chain Opportunities", Industrial Marketing Management 29,7-18 (2000)
- 19.SCC.: "Supply-Chain Operations Reference-model Overview of SCOR Version 6.0" (2003)
- 20.Wheelright, S.C.,Bowen, H.K.: "The Challenge of Manufacturing Advantage", Production and operateions management,Vol.5, No.1, Spring (1996)