Competitors' Collaboration

- A System Dynamics Perspective on the Collaboration Profit Model

Bowon Kim

(Associate Professor Graduate School of Management KAIST/bwkim@kgsm.kaist.ac.kr)

―| **Abstract** |―

　본 논문을 통하여 인터넷 환경의 B2B 마켓플레이스에서 경쟁 기업들 간에 왜 그리고 어떻게 협력(Collaboration)이 가능한지 살펴본다. 시스템 다이나믹스 시뮬레이션을 활용하여 잠정적으로 도달한 결론은 경쟁 기업들의 그러한 협력이 시장 수요의 증가를 가져오고 이를 통해 증대된 이윤을 실현할 수 있을 때 그와 같은 관계가 가능하다는 것이다. 즉, 경쟁기업간 협력이 지속가능하기 위해서는 기업간 협력이 시장 수요를 확대하고 그 결과로 개별 기업이 (비록 시장 점유율이 하락하는 경우가 있을지라도) 더 많은 절대적인 이윤을 얻을 수 있어야 한다. 경우에 따라서는 파이를 분배하기 전에 파이의 절대적인 크기를 키우는 것이 좋다는 것과 유사한 논리이다.

Keywords: e-business, 협력(Collaboration)

I. Introduction

The recent, quite rapid, rise and fall of the Internet business made people wonder whether it had a sound business model in the first place: for instance, as of early 2001, the online business-to-consumer (B2C) market suffered from almost 98% decrease in the market valuation from its peak less than a year ago (Economist 2001). Even the B2B marketplace failed to materialize its full potential many experts expected as one of the most promising. As the confusion surrounding the Internet became subsiding, however, people started to think about what is the true value of e-business transformation. One consensus reached is that the Internet enables firms to collaborate with each other to create more value. Phillips and Meeker (2000) suggested that collaboration should be the primary sources of sustainable revenues for the B2B marketplace. Mandel and Hof (2001) also pointed out that collaboration could speed up product development as part of such collaboration.

There are real world examples of B2B marketplaces that try to capitalize on the concept of collaboration. One such example is found in the automobile industry. Covisint is the B2B marketplace, founded by global carmakers such as Ford, GM, Daimler-Chrysler, Renault, and Nissan. One of Covisint's claimed goals is to facilitate collaborative information exchange and work processes between business partners: examples like Covisint are also found in other industries such as aerospace industry (Exostar). In effect, the whole idea of Covisint itself is based on collaboration. Although sounding appealing, it is not clear how such collaboration could create value for the partners involved. More specifically, why do the fierce competitors collaborate to create a common marketplace and under what circumstances?

The primary motivation of this research is to answer the question. This paper is structured as follows. In Section 2, we define e-collaboration more concretely and suggest a conceptual typology by looking into two dimensions, intra versus inter-firm and horizontal versus vertical collaboration. In the section, we also posit two fundamental conditions, i.e., Pareto optimal improvement, for sustainable e-collaboration. Section 3 presents system dynamics models from simpler to more sophisticated and complicated ones. In Section 4, we describe simulation results and explain how the results support our propositions. Finally, we conclude this paper by

considering managerial implications and directions for future research.

II. Collaboration - Typology and Theoretical Model

In the literature on supply chain management, 'coordination' has long been regarded as one of the key success factors (Raman 1995). Kim (2000) suggested that in order to have a sustainable supply chain strategy, there should exist long-term strategic relationship, which in turn relies on coordination between participants in the supply chain management: see also Sox, et al. (1997) and Whang (1995). Previous research is diverse in associating such supply chain coordination with specific operations benefits: for instance, operations performance improvement related with quality and cost (Lau and Lau 1994, Ingene and Parry 1995), lead-time performance (Hartley, et al. 1997), delivery and control of quality (Reyniers and Tapiero 1995), product development performance (Clark 1989, Cooper 1994), bullwhip effect reduction (Sterman, et al. 1997, Lee, et al. 1997), so on.

Although collaboration is synonymous with coordination in many aspects, we would like to highlight the intricate relation between collaboration and the Internet (or the Internet-based technology) by using the term 'e-collaboration.' As in more traditional (i.e., pre e-business environment) supply chain management, we expect e-collaboration to be sources of operations improvement and performance enhancement.

1. Typology of E-collaboration

We define e-collaboration as encompassing all forms of collaborative activities, e.g., value chain activities, within a company and/or among companies using the Internet-based technology.

That is, there are 2 dimensions when categorizing the e-collaboration: one related with whether the collaboration is intra-firm or inter-firm in nature, and the other with the types of value chain activities for which the collaboration is pursued. If different departments (or, divisions) in the same company collaborate, we call it intra-firm collaboration. If the collaboration is between different companies, it is

inter-firm collaboration. Regarding the second dimension, we consider horizontal versus vertical collaboration. Horizontal collaboration implies that similar value chain activities are collaborated. For instance, if business unit A (or, company A) and business unit B (or, company B) are collaborating with each other for marketing function, we call it horizontal collaboration. On the contrary, if the partners, either intra or inter-firm, collaborate for different value chain activities, we call it vertical collaboration. For example, manufacturing company and its supplier could collaborate for new product introduction.

Figure 1 shows the typology of e-collaboration using the two critical dimensions. Regarding this typology, an important research question arises "what kinds of mechanisms or systems are more appropriate, e.g., effective, for each of the cells in the typology?" Although we are not specifically focused on that question, understanding the relevance of the question is still important for us to rigorously investigate the issues in point.

	Horizontal	Vertical
Inter-firm		
Intra-firm		

⟨Figure 1⟩ Typology of e-collaboration
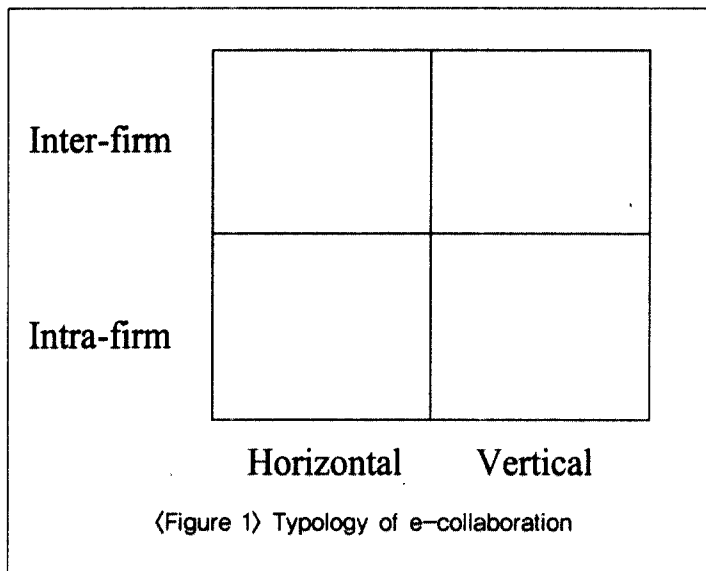
2. Fundamental Conditions – Pareto optimal improvement

In order for the collaboration between/among the partners (either intra or

inter-firm) to sustain, two fundamental conditions should be satisfied. In essence, satisfying these two conditions simultaneously means Pareto optimal improvement (Iyer and Bergen 1997). The conditions are as follows:
1st condition - total sum of 'e-collaboration' profit should be larger than or at least equal to the sum of the non-collaboration profit,
2nd condition - for each of the e-collaboration partners, the e-collaboration profit should be larger than or at least equal to the non-collaboration profit. When e-collaboration satisfies these two conditions, it is improving the welfare of all of the participants in the collaborating activity in a Pareto optimal sense. That is, every participant gains more than or at least equal to what it used to gain before such collaboration, and one or more of the participants should gain strictly more than before.

<Table 1> Notation

$i : i = 1, 2$ E-collaboration partners,

$p_i : i$ Profit without e-collaboration for partner

$\tilde{p}_i : i$ Profit with e-collaboration for partner

$\pi : \pi = p_1 + p_2$ Total profit without e-collaboration, i.e.,

$\tilde{\pi} : \tilde{\pi} = \tilde{p}_1 + \tilde{p}_2$ Total profit with e-collaboration, i.e.,

We can express the conditions in an algebraic manner. Consider a case where two partners e-collaborate. Table 1 describes the relevant notation. With the notation, we restate the two conditions:
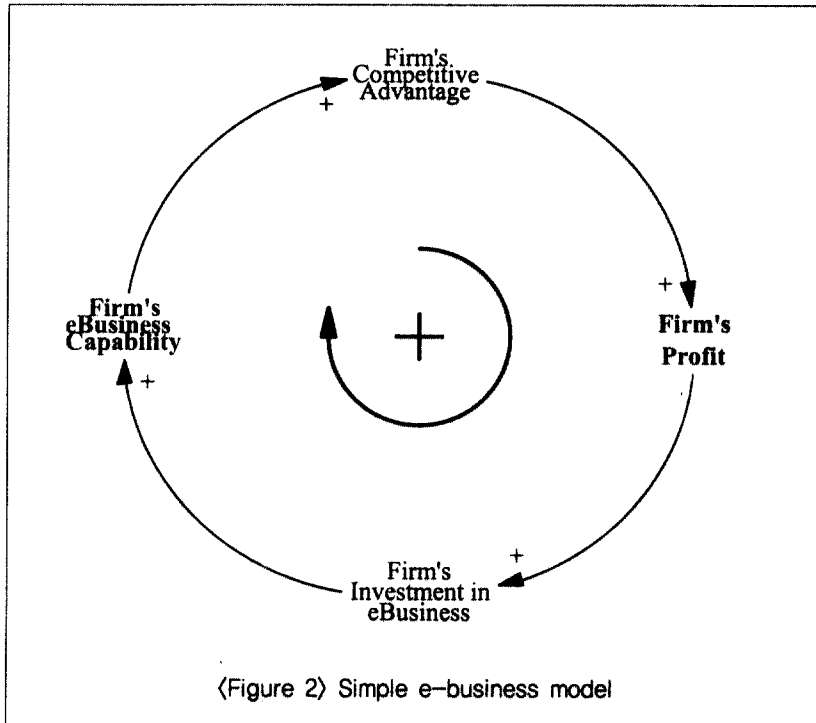
1 $\pi \le \tilde{\pi}$,st condition for e-collaboration:

2nd co $p_i \le \tilde{p}_i$ $i = 1, 2$ .for each ndition for e-collaboration:
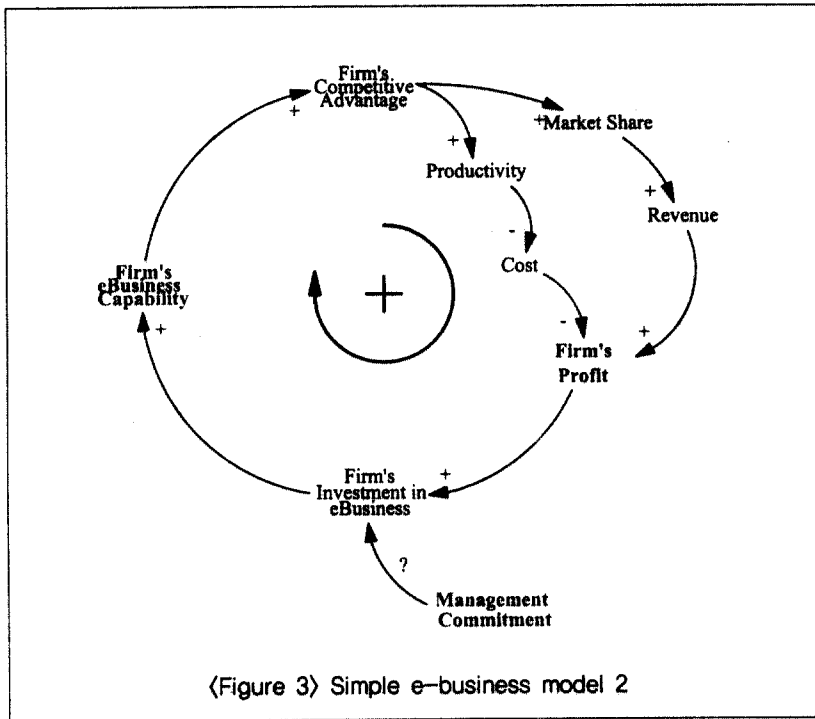

III. A System Dynamics Model for Collaboration

Given that a sustainable collaboration is possible only when the two fundamental conditions are met, we need to show that there indeed can be

a situation where the two conditions are satisfied concurrently. That is, for the purpose of our research, it suffices to show that such a situation could exist. There may be different approaches to accomplish the objective. In this paper, we employ a system dynamics simulation.

In order to prove our proposition, we develop several system dynamics models from simpler one to more complicated ones. Figure 2 presents the simplest e-business model. As the firm invests more in its e-business activity, its e-business capability improves, and so does its competitive advantage in the market. This series of improvements enables the firm to reap more profit eventually.

<Figure 2> Simple e-business model

〈Figure 3〉 Simple e-business model 2

The e-business model in Figure 3 is a slight improvement over that in Figure 2: it considers 2 different ways for the firm's competitive advantage to contribute to enhancing the firm's profit, one internal and the other external. First, the internal path is associated with the firm's cost reduction due to its productivity improvement, which in turn is triggered by the enhanced competitive advantage. The other one, i.e., the external path, relates to increased revenue due to the firm's market share growth, which is also expected because of the firm's heightened competitive advantage.

The two models in Figure 2 and 3 illustrate the basic dynamics of the e-business. But, they are incomplete at best because they ignore a very important element in competition, i.e., the firm's competitors.
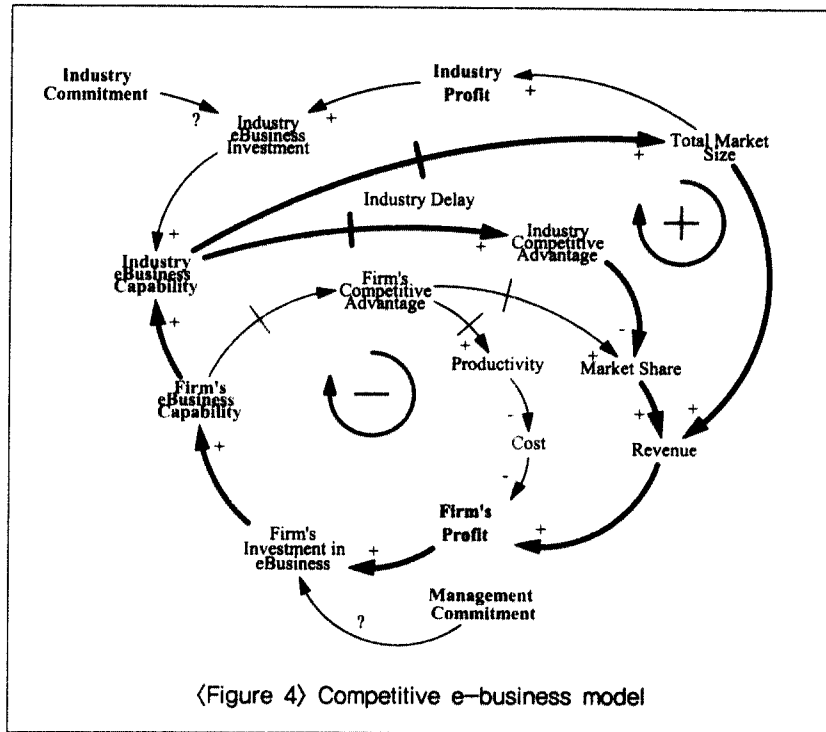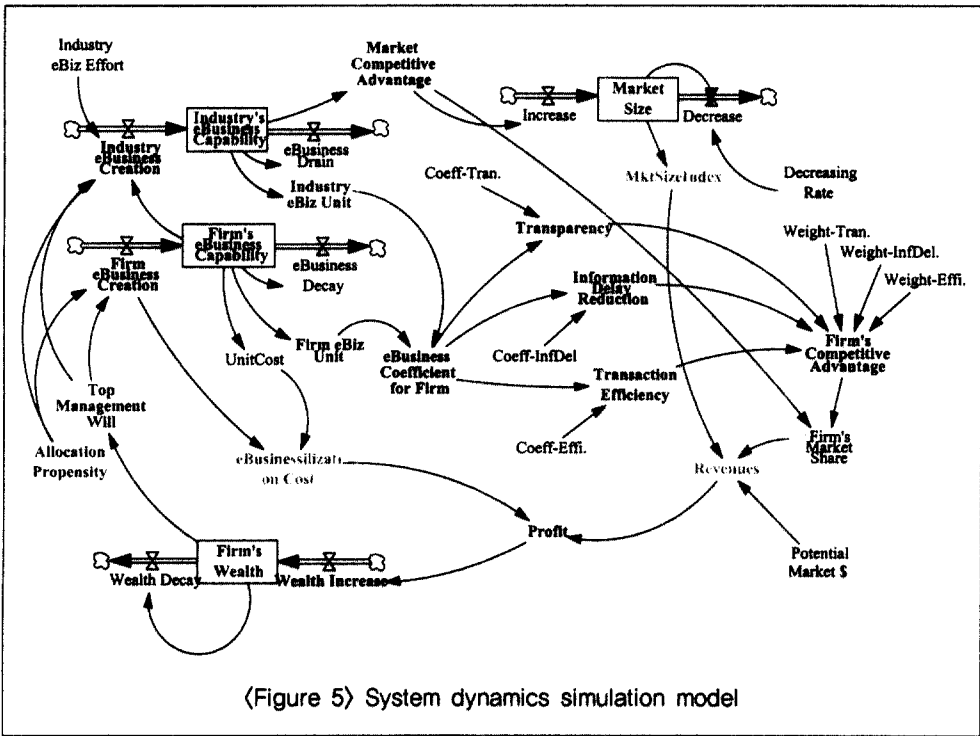
〈Figure 4〉 Competitive e-business model

Figure 4 depicts a model, which specifically incorporates the competition into the analysis. There are several important features deserving more explanation.

First, rather than including individual competitors separately, the model treats them as the holistic competitor. Thus, there are only two competitors considered in the market, the firm itself and the others represented by 'industry' as a whole except the firm.

Second, the firm now has two options regarding e-business investment. It can invest either for its own e-business improvement or the e-business improvement at the industry level. In reality, the firm's investment in improving the industry's e-business capability is expressed in a monetary term. But, in this model, the influence diagram indicates that the firm's capability directly affects the industry's e-business capability, which eventually enhances the industry's competitive advantage as a whole. This is just for the purpose of easier visualization, and any potential

problem due to this is rectified in the actual simulation as in Figure 5.

In Figure 4, there are two feedback loops associated with the industry's e-business capability, each of which counters each other. A negative feedback loop exists: as the industry's e-business capability improves, it is likely for the firm to suffer in the market because it might lose its market share. On the other hand, if the increased industry's e-business capability better serves the customer in the market as a whole, and thus eventually enlarges the total market size, the likelihood that the firm could benefit from the expanded market will be also increased. Consequently, it is not straightforward to see whether the firm's investment in enhancing the other competitors' e-business capability would result in ameliorating or deteriorating the firm's own profitability.
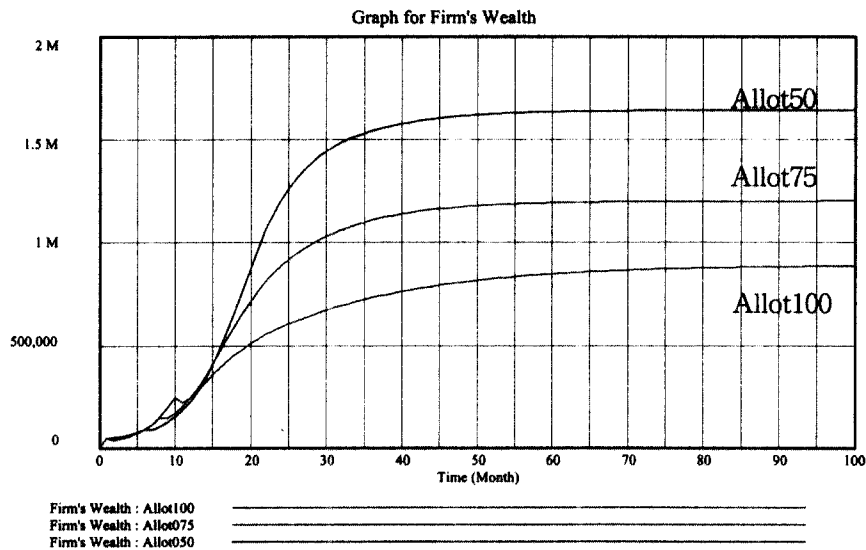

〈Figure 5〉 System dynamics simulation model

As we alluded already, Figure 5 is the actual system dynamics model used for simulation. It is important to note that the primary objective of this simulation is not to suggest a complete e-business model, but to show that

it is possible for a Pareto improving e-collaboration to exist in the real situation. Consequently, the specific numerical formulations of the simulation model were not developed quite rigorously: for instance, we used dimensionless variables in order to just highlight the structural relationships among the key variables/factors. We also tried to make sure that the dynamic relationships were formulated following models in the literature in order to retain generalizability. More detailed explanations about the dynamic cause-and-effect relationships along with key assumptions of the simulation are in the appendix.

Ⅳ. Simulation Results

Using the system dynamics simulation model in Figure 5, we derive results that support our proposition.

Graph for Firm's Wealth

Firm's Wealth : Allot100
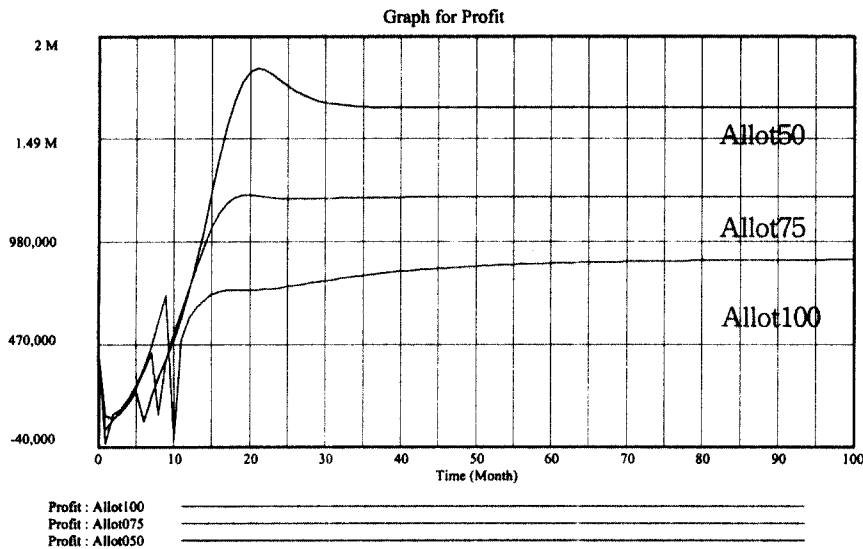Firm's Wealth : Allot075
Firm's Wealth : Allot050

〈Figure 6〉 Simulation result: firms wealth

Figure 6 shows how the firm's wealth grows as the firm chooses different e-collaboration strategies, while Figure 7 displays the firm's profit growth. In the figures, we consider three e-collaboration strategies:

·   Exclusive e-business strategy ‐ If the firm adopts this strategy, it allocates all of its resources (available for e-business development) to its own e-business capability building only. That is, the firm's focus is solely on its own e-business capability building. In the figures, this case is marked by 'Allot100,' which implies "allocating 100% resources to the firm's own e-business capability building."

·   Collaborative e-business strategy ‐ When the firm adopts a collaborative e-business strategy, it invests not only in its own, but also the industry's e-business capability building. In the figures, we consider 2 such cases. 'Allot075' can be regarded as 'moderately collaborative' since the firm allocates 75% of its resources for its own e-business capability building with only 25% for the industry's e-business capability building. A more proactive participation in the e-collaboration is represented by 'Allot050,' where the firm spends 50% of its resources for industry's e-business capability building.

Graph for Profit

〈Figure 7〉 Simulation result: firms profit

From the system dynamics simulation results in Figure 6 and 7, we conclude that e-collaboration pays off in the long run. In the figures, we see that during the initial period, say time from 0 to about 15, it is hard to

tell whether the collaborative strategy is better than the exclusive one: one even can say that during that period, the exclusive strategy seems better. Should we extend our decision time horizon, it seems unambiguous that the collaborative e-business strategy is much better than the exclusive one.

Why are these results observed from the simulation? In short, the collaborative strategy has helped the industry as a whole to increase the total market size, with which the individual participant, i.e., each firm, is able to gain more profit, even when its relative market share is down a little bit.

Ⅴ. Managerial Implications

The primary objective of this paper is to explore whether it is possible for competitors to collaborate under the Internet-based technology environment, and if possible, under what circumstances. In order to answer the research questions, we utilize the system dynamics simulation, and derive results that show that it is indeed making sense for competing firms to collaborate. But, such collaboration requires a certain condition that the collaboration should increase the total market size. In other words, if the collaboration fails to expand the market demand, competitors would not have an incentive to collaborate. This observation is consistent with Kim (2000)' s, which deals with coordinating innovation in a supply chain: Kim (2000) showed that the supplier would have an incentive to coordinate with the manufacturer only when the market demand function is sensitive to the price changes caused by the innovation, i.e., the total market demand increases due to the coordination between suppliers and manufacturer.

Adopting the definition of e-collaboration, we propose that the Internet-based technology enabled the firms to collaborate more efficiently and effectively. That is, although the collaboration or coordination is not a new concept, certainly it is true to say that the Internet technology made such collaborative activities be performed with far less cost, but far more efficiently than before. Since the Internet technology becomes more and more ubiquitous in management, it is strategically imperative for a firm to seriously look at the issues of e-collaboration now. This is why the subject in this paper should be

regarded as critical in the e-business era.

However, it should be noted that what is proved in this paper is just a possibility for competing firms to collaborate. That is, we neither do nor can assert that such collaboration should or could exist in the real situation. There are key issues that should be resolved first before any e-collaboration is realized. First, it is not enough to increase the total market size alone, each of the participants in the collaboration should gain more compared with 'before e-collaboration.' Using the terminology introduced earlier, we state that the second fundamental condition for e-collaboration is more difficult than the first one. Much research is needed in studying 'workable' models or schemes to make sure that the two fundamental conditions should be satisfied simultaneously. There are emerging efforts to encourage collaboration among companies at the industry level, using some 'standardizing technology' : for example, see XML, RosettaNet, and CPFR. In the literature, it has been demonstrated that developing such models/schemes acceptable to all the parties in the collaboration is much more difficult than proving such models/schemes would lead the firms to collaborate.

[REFERENCE]

Clark, K. B. (1989). Project scope and project performance: the effect of parts strategy and supplier involvement on product development. *Management Science, 35*, 1247-1263.

Cooper, R. (1994). Komatsu, Ltd. (A): target costing system. *Harvard Business School Case*, No. 9-194-237.

Economist (2001). Internet Pioneers: We have lift-off. Economist (February 3   9, 2001), 73-75.

Hartley, J. L., B. J. Zirger, and R. R. Kamath (1997). Managing the buyer-supplier interface for on-time performance in product development. *Journal of Operations Management, 15*, 57-70.

Ingene, C. A. and M. E. Parry (1995). Channel coordination when retailers compete. *Marketing Science, 14*, 360-377.

Iyer, A. V. and M. E. Bergen (1997). Quick response in manufacturer-retailer channels. *Management Science, 43* (4), 559-570.

Kim, B. (2000). Coordinating an innovation in supply chain management. *European Journal of Operational Research, 123*, 568-584.

Lau, H. and A. H. Lau (1994). Coordinating two suppliers with offsetting lead time and price performance. *Journal of Operations Management, 11*, 327-337.

Lee, H. L., V. Padmanabhan, and S. Whang (1997). Information distortion in a supply chain: the bullwhip effect. *Management Science, 43*, 546-558.

Mandel, M. J. and R. D. Hof (2001). Rethinking the Internet. *BusinessWeek* (Asian Edition, March 26, 2001), 43-48.

Phillips, C. and M. Meeker (2000). *The B2B Internet Report: Collaborative Commerce.* Morgan Stanley Dean Witter, Equity Research, North America (April 2000).

Raman, A. (1995). Coordination: An Overview. *Harvard Business School Case*, No. 696-001.

Reyniers, D. J. and C. S. Tapiero (1995). The delivery and control of quality in supplier-producer contracts. *Management Science, 41*, 1581-1589.

Sox, C. R., L. J. Thomas, and J. O. McClain (1997). Coordinating production and inventory to improve service. *Management Science, 43* (9), 1189-1197.

Sterman, J. D., N. P. Repenning, and F. Kofman (1997). Unanticipated side effects of successful quality programs: exploring a paradox of organizational improvement. *Management Science, 43*, 503-521.

Whang, S. (1995). Coordination in operations: a taxonomy. *Journal of Operations Management, 12*, 413-422.

Covisint (www.covisint.com)

Exostar (www.exostar.com)

XML (www.xml.com)

RosettaNet (www.rosettanet.org)

Collaborative Planning, Forecasting and Replenishment (CPFR) Committee (www.cpfr.org)

\<Appendix I\> Model Assumptions - Key Variables

- #### E-business capability dynamics

We assume that the firm's eBusiness capability is a function of two variables: 'Firm eBusiness Creation' is the firm's eBusiness capability increase due to its own active efforts, and 'eBusiness Decay' represents the natural decaying of the firm's eBusiness capability. The initial eBusiness capability level is set at 100.

- #### E-business coefficient

We assume that the firm's eBusiness capability influences three variables: information delay reduction, transaction efficiency, and transparency. That is, the firm's competitive advantage is affected by these three factors, which are in turn advanced by the firm's eBusiness capability. For each of these factors, the larger the eBusiness coefficient, the better for the firm's competitive advantage.

'eBusiness Coefficient for Firm' is assumed to be dependent not only on the firm's own eBusiness capability (via 'Firm eBiz Unit'), but also on the industry's eBusiness capability (via 'Industry eBiz Unit'). Another complication is incorporated so that there is a sort of threshold level for the industry's eBusiness capability, beyond which the impact of the firm's own eBusiness capability on its competitive advantage (via 'eBusiness Coefficient for Firm) multiplies sharply. In the model, the threshold level is set at 0.5.

- #### Market share determination

The firm's market share is determined by the ratio between firm's competitive advantage and the competitors' overall competitive advantage (i.e., 'Market

Competitive Advantage). A scaling coefficient is added.

- **Market size determination**

The total market size increases as the 'Market Competitive Advantage' enlarges. There is also a decaying factor involved. In order to make the calculation simple, we normalize the 'Market Size' so that the market size index (MktSizeIndex) is between 0 and 1.

- **Top Management Will**

This is the actual amount of resources available for the firm's eBusiness efforts. We initially assume that the firm reserves about 0.1% of its wealth for eBusiness capability improvement.

- **Allocation Propensity**

This is the ratio of resources the firm allocates for its own eBusiness capability building. Thus, "(1-allocation propensity)*available resources for eBusiness" are invested in the industry-wide eBusiness capability building. In this paper, we used 3 levels of 'Allocation Propensity' : 1.00, 0.75, and 0.50.

- **Other coefficients and parameters**

Other coefficients and parameters are not critical in determining the overall dynamics of the simulation, and simple assumptions are used for them.