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Flexible Supply Capability Driving Total Inventory Reduction: An Analysis of Omron Healthcare

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In conclusion, we clarify that companies need successful supply chain integration in order to achieve reduction of the total inventory. Requisites for such integration include goal sharing among parties and mix-up of the production systems based on a high level of production capability. Most importantly, we suggest that the flexibility of the supply capability of upstream influences the activities (i.e. order policy) in downstream.

Keywords reduction of total inventory, flexibility of the supply capability, supply chain integration, goal sharing

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1. Introduction

Firms are still facing a critical problem in inventory reduction nowadays. They want to reduce inventory but do not want to lose customers because of inventory shortage. Previous researches point out that effective supply chain management can alleviate managers concern. However, while the final consumer's demand rate stays steady, the demand orders become variable as they move to upstream in supply chain, a phenomenon called the Bullwhip Effect (Lee, Padmanabhan & Whang, 1997). The main causes of the Bullwhip Effect have been identified as demand forecast updating and mistrust among parties (i.e. sales and production departments).

The empirical studies in the field have examined information sharing or IT tools implementation would facilitate the interdepartmental cooperation, and therefore reduce the inventory and contribute to the firm's performance (Lee & Billington, 1992; Kahn1996; Stank, Daugherty, & Ellinger, 1999a; Ellinger Daugherty, & Keller, 2000; Frohlich & Westbrook, 2001; Vereecke & Muylle, 2006; Croson & Donouhue, 2006; Akiike & Park, 2013). However, most studies have not realized the fundamental issues, such as where precisely the

excessive inventory exists and how to reduce the inventory over all? The excessive inventory may happen only at distributor (dealer)'s site, but not at production site. That is to say, a crucial piece missing from the previous studies is the focus on the reduction of total inventory, which can be attained via observation from upstream of component suppliers to downstream of retailers. The purpose of our study is to investigate how to reduce the total inventory by utilizing multi-stage observation.

In this paper, we first provide the theoretical background and point out the necessity of a case study. Then, we introduce the research design and the case. Finally, the last part of this paper is the result and discussion.

2. Research on the Integration of Supply Chain

According to the extant literatures, SCM is defined as 1. the process which manages a series product information flow from upstream (raw materials purchasing) to downstream (distributor); 2. progress in the integration through information sharing among departments and organizations; 3. dealing with total cost reduction and meeting high level of products/service requirement at the same time (Simchi-Levi, Kaminsky, & Simchi-Levi, 2000; Frohlich & Westbrook, 2001; Rosenzweig, Roth, & Dean, 2003).

There is a considerable amount of theoretical and empirical support for the assertion that effective supply chain is important for inventory reduction, a smooth information flow and a firm's financial performance. Many scholars have focused on logistics department's effort (Morash, Droge, & Vickery, 1996), arguing that informal routes for information sharing contribute to the performance more than the formal routes (Stank, Daugherty, & Ellinger, 1999a; Ellinger Daugherty, & Keller, 2000).

Moreover, inter-firm activity attracts scholars' interests. Frohlich & Westbrook (2001) suggests that suppliers and distributors' cooperation contributes the most to the firm performance, and strong business relationship either with the suppliers or the distributors is not the best policy. Kim (2006) states that only for large firms do supply chain integration have effective impact on their competitiveness based on Frohlich & Westbrook (2001)'s assertion. Gimenez & Ventura (2005) prove that integration with retailers contributes to the customer service enhancement as much as interdepartmental collaboration does. There are considerable studies have focused on automobile industry, which have been more likely influenced by Toyota's collaboration with its suppliers (Vereecke & Mulle, 2006). They have

carefully considered the cooperative relationships and emphasized "frequent, closer communication" and "long-term relationship" with the suppliers for Toyota's success.

Toyota Production System (TPS) along with the close supplier relationship has significant effect on inventory reduction and short lead time. Holweg & Pil (2004) pointed out that Make-to-Stock (MTS) manufacturing system has remained in many automobile firms nowadays. But compared with other famous automobile firms, Toyota's pull system by downstream parties or customer was more effective to meet various customer needs in 21st century and avoid overproduction. They stated most researches emphasized TPS's effect between Toyota and the suppliers, not as the whole system across the firm. According to Tomino, Park, Hong & Roh (2009), we have to notice that TPS does not absolutely depend on the pull system. Toyota actually mixes the stable Make-to-Stock (MTS) production plan (push system) and Make-to-Order (MTO) manufacturing (pull system) together to meet flexible market needs. Toyota makes annual/monthly/ten-day production plan based on its own forecasting and sales information from the dealers. The models sold inside of Japan allow some minor changes basically in the section of ten-day production plan, such as color change and minor interior change can be done in a few days. Based on MTS, Toyota well integrates changing demand information to the production plan and cooperates with its suppliers. Another point we have to notice is that automobile industry's distribution channel is different from those of other industries. Car dealer is basically the key channel to sell the cars and collect customer information. In electronics or consumer goods industry, the wholesalers, distributors and retail shops exist between manufacturing firm and customers. In some ways, automobile firms have an easier access to directly get customer's information. Therefore, inventory reduction in other industries may be more complex than in automobile industry because of information variability.

In summary, previous empirical studies inform us that "information sharing" among departments and firms has been the center of the discussion. They examined a wide range of factor signification to firm performance and supply chain integration, such as "information sharing frequency" or "presence of shared database" or "utilization level of information sharing network". They do tell us the universal but partial fact: "information sharing is important". A big pitfall is that extent researches tend to focus on inventory problem at production site, such as helping upstream parties better prepare for viabilities in inventory demand downstream (Croson & Donouhue, 2006). However, they often lack focus on the

total inventory reduction, that is to say, multi-stage observation for the total inventory reduction is needed. A case study here will help us obtain a useful insight into the issue.

3. Omron Healthcare Case Study

3.1 Research Methodology

As a reference from the existing work, we identify two processes by which we observe cooperation among all parties inside/outside the firm: “Collaboration”, which means qualitative or substantive activity, and “Interaction”, means quantitative or structural form or system (Kahn, 1996; Vereecke & Muylle,2006; Akiike & Park, 2013). We cite the definitions from Kahn (1996) as they are close to our thought.

Collaboration is defined as “an affective, volitional, mutual/shared process where two or more departments work together, have mutual understanding, have a common vision, share resources, and achieve collective goals.” Interaction represents the activities formally coordinated among the parties, including “routine meetings, planned teleconferencing, routine conference calls, memoranda, and the flow of standard documentation.” Kahn (1996) drops a hint that early collaboration (sharing common goal and promoting mutual understanding) contributes more to the effective supply chain integration.

3.2 Why Omron Healthcare?

Omron Healthcare Co., Ltd. is one of the major healthcare equipment and machine firms in the world. Corporate/individual customers are familiar with its products, such as blood pressure monitors, digital thermometers, body composition monitors, pedometers, and electric toothbrushes. Omron Healthcare employs 4,492 workers, of which 3,689 are overseas, earns 62.4 billion Yen in revenue (as of 2012), and runs eight domestic offices, twelve overseas offices, one R&D center in the headquarter, and three production sites in Matsuzaka of Japan, Dalian of China and Binh Duong of Vietnam.

Omron Healthcare has been working on its own production activities that are based on the Toyota Production System (TPS) for over twenty years. Although its effort on production and collaboration with the suppliers has been achieved the improvements of productivity and flexibility and reduced production lead time, it still faced the serious problem related to inventory shortage and excessive inventory by products. To solve this problem, Omron Healthcare made a new attempt which was called Make-to-Availability (MTA) system

from 2010. The cooperation involved all the parties concerned, such as sales departments, suppliers, and distributors, and enabled Omron Healthcare to have remarkable achievement on inventory management in two years. The reason we choose Omron Healthcare is that we can deeply observe what it did and how it did to reduce the total inventory before/after the change.

3.3 Research Procedure

This research is mainly based on several fieldworks and interviews with people in charge of production department, sales department, and the supplier. Secondary data and prior research are used to the analysis as well. Fieldwork detail is described as below.

The first-round interview was in August, 2012. The authors visited Omron Healthcare Dalian, China production site and its first-tier supplier A. We have conducted five-hour interview with the president, two Japanese employees from the management team, one local staff from Omron Healthcare, and three consultants from Consulting company B which helped Omron Healthcare implement MTA and daily operation. In supplier A, we were able to interview two Japanese expatriates and four local managers for an hour.

The second-round interview was about three hours in September, 2012. We went to Omron Healthcare's Tokyo Office and interviewed two persons in charge of sales department about cooperation with the production sites and the distributors.

Other than the two interviews above, we also visited a consultant from Consulting company B, who was previously working in Omron Healthcare for several times. Formal and informal interviews were total in five hours. We also used emails and face-to-face meeting to ensure the content's objectivity and appropriateness.

3.4 Omron Healthcare Production History

Omron Healthcare implemented an innovative production system called ONPS (Omron New Production System) in Matsuzaka factory (Japan) in 1982. ONPS is basically the same production concept as TPS. Kanban system is utilized for implementing the pull-production. ONPS contributed the drastic reduction of inventory in process and increase of inventory turnover rate. Main production site was moved from Japan to China after their Dalian factory (China) was started in 1993. The reform of supply chain in Dalian was started in 2005.

Two phases of reform activities in Dalian are observed. As illustrated in Figure. 1, in the

first phases for production reform, Omron Healthcare focused on the production capability building and the cooperation with the supplier. In the second phase, Omron Healthcare paid much attention on a wider range of cooperation, which involved more departments and parties to make information flow traveling through them.

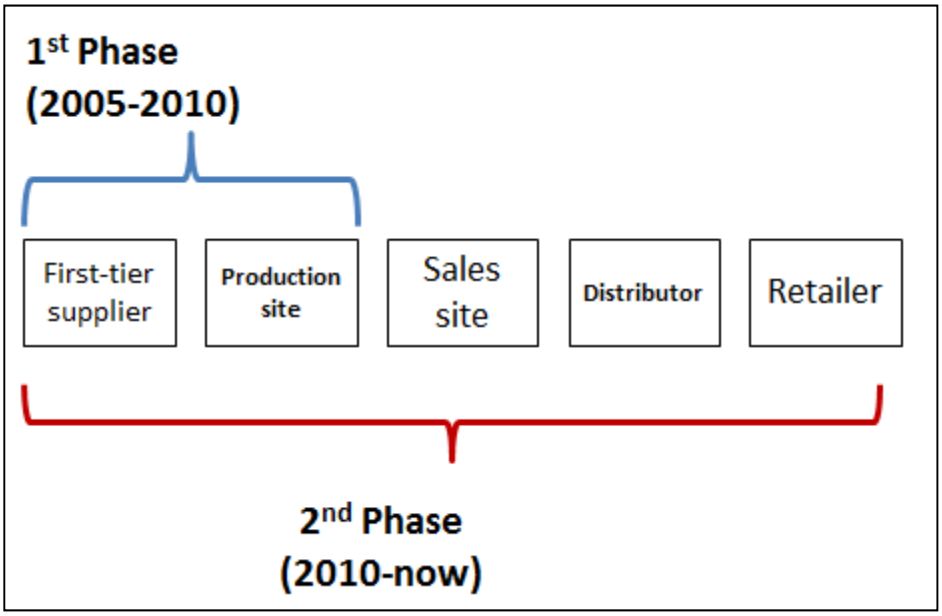


Figure. 1 Omron Healthcare production history

(1)Introduction of DNPS from 2005 to 2010

As production activities in Dalian factory were increasingly important to Omron Healthcare, it brought ONPS to Dalian in 2005 and rename the system DNPS (Dalian New Production System). DNPS actually performed remarkably on inventory reduction and productivity improvement. For example, the pump[1] inventory was reduced from 30,000 in 2003 to 2000 in 2007. Production planning cycle was shortened from monthly to weekly.

However, sales person of Omron Healthcare were required to forecast the demand 15 weeks before production week. They can change their order volume till 5 weeks before production in the limited range. Production plan was based on the forecast of sales department. Flexible production capability was built to respond not to market demand but to sales forecast.

In 2010, the inventory level at the sales warehouse in Japan was still unstable. The inventory temporarily fell down and went up soon without noticed. Some products were

[1] One of the parts for blood pressure monitors, which is to feed air into arm band.

even short of inventory although the factory worked very hard on manufacturing them. One of the main causes of the problem was that the irregular bulk orders disturbed regular production plan.

The production site also knew nothing about sales department's policy and plans, except basic order information such as order items and their numbers. Besides, production site and sales site did not dare to try to share detailed information together. It means production site's effort only contributed the local optimization (good impact only inside of production site), and went along with sales site's order information that mix up with regular order and bulk order. The firm needed all parties involved to work together in order to solve the companywide inventory problem.

(2)MTA from 2010

To solve the problem, Omron Healthcare started working on a new initiative called Make to Availability (MTA) in 2010. MTA is based on Theory of Constraints (TOC) advocated by Goldratt, which is to focus on removing the bottleneck and improving the companywide product information flow in order to link the activities to profit. We will explain the detail of MTA at later section of this paper. On this occasion, each department/party shall not focus on optimizing its own department/party but instead shall consider how to generate a smooth flow of information for the entire firm.

In the following, we describe how Omron Healthcare made every department, suppliers and distributors work together from "collaboration" and "interaction" perspectives (Kahn, 1996).

3.5 Interdepartmental Integration

Collaboration within the firm

Omron Healthcare recognized it was important that all involved department managers understand the system in order to make the new system work. In March, 2010, six-day workshop was held for sharing the common goal by all members. All managers from production, logistics, product development and sales departments were gathered. They were required full commitment to the workshop during the six days. Consulting company B explained their TOC's concept and the importance of total optimization instead of sum of local optimization. Before this workshop, DNPS was perceived as the system not for total inventory control but for the inventory control at production site. Sales department did not

utilize DNPS for the control of their distribution inventory.

Other than learning the new system, managers also did in-depth discussion on what would be the problems after system implementation. Managers shared their own situation and subjects, and truly deepened mutual understanding for the first time. At the workshop, involving the sales team was especially important because all customer information and order information came from the salespersons. Sales site tended to pass the orders to production side with more amount than the one of actual demand because it did not want to have inventory shortage and fail to response to its customer (i.e. distributor). Moreover their fluctuation of production volume was amplified since sales site has passed the order information that mixed up with regular order and bulk order for special campaign. That fluctuation brought the inventory shortage problem at production side. Therefore, sales site could not completely trust production site and kept to order more than the actual demand to prevent opportunity loss until this workshop.

Based on this background, the workshop provided each department with an opportunity to clear away each party's mistrust and misunderstanding and make actual demand information is shared well. If sales manager could not fully understand the whole concept, the way the members of the firm pass information would not be any different from the past. At the end of the workshop, Omron Healthcare decided to give MTA a shot and started the implementation around August, 2010, a trial on five kinds of products and aimed to integrate management between production department and sales department. Now it implements the MTA with 170 items.

Interaction within the firm

According to Omron Healthcare, MTA is a production system that links shipping inventory at sales site and market demand. It replenishes sales stock according to downstream demand information (source from the market or distributor or sales site). MTA means that they manufacture in order to guarantee availability of their products for distributors. Basement for production planning was changed from the order from sales department to the sales shipping inventory. Sales persons basically do not need to order to production department based on their sales forecast.

We would like to clarify the difference among MTA, MTS, and MTO. MTO is a manufacturing system which takes place only after a customer's order is received. On the

other hand, MTS is a manufacturing system based on demand forecast. Since it will prevent opportunity loss and minimize excess inventory, the issue is how to forecast demands as accurately as possible. In order to have an accurate forecast, it is also important to predict the future demand based on the demand fluctuation cycle of the past.

MTA is a type of MTS because the system is based on demand forecast. However, Omron Healthcare distinguish MTA from MTS. MTA is the system based on the forecast by customers (distributors) while MTO is the system based on the forecast by their sale persons. Information from customers transmits directly to the production department through sales department.

Dynamic Buffer Management (DBM)

DBM is an important inventory management method to support MTA. DBM visualize which item should be given the priority of production and how volume should be manufactured. First, it calculates the maximum amount of inventory for each item as a buffer to cope with demand fluctuation. The initial maximum amount of inventory is defined as the maximum demand during supply lead time. Supply lead time is the sum of order lead time, production lead time and delivery lead time. The maximum demand is basically the past maximum sales at the time when the product was the best seller in the item. Then, item's inventory is divided to three zones: green, yellow and red. The supply priority is dynamically adjusted by an easy rule. Red zone means the inventory is ready to short. Those products in red zone should be manufactured as first priority. Yellow zone is the ideal level of inventory and those products should be manufactures as second priority. Green zone means quite sufficient inventory, and the supply is not in a hurry at that time. Present inventory is the sum of the inventory amount in shipping warehouse in Japan, the amount on transportation, the amount in warehouse in Dalian and the amount in manufacturing process in Dalian factory. The amount of supply to be manufactured is subtraction of the present inventory from the maximum inventory.

Also, the maximum amount of inventory is dynamically changeable to a proper inventory level according to the recent sales trend of the each item. The maximum amount of inventory is increased by one-third of the original amount if the items inventory level stagnated in red zone for a while. This situation occurred when sales of these items were increasing. On the contrary, the maximum amount of inventory is decreased by one-third of

the original amount if the items inventory level stagnated in green zone for a while. This situation means that sales of these items are decreasing or these items are approaching to the end of life.

For the regular order, salesmen do not need to make an order, and people on production side do not need to work hard on controlling the inventory level anymore. Information system help two departments share information of inventory amount, products/parts location and factories' circumstances at any time. All actual information is visualized on the information system and shared between production and sales departments.

Make-to Order (MTO) and Make-to Stock (MTS)

Production site treats the bulk order from sales site as a special order, and makes another production plans (MTO and MTS) separately from the MTA which deals with the regular order. People in charge of production attend the formal meeting in sales department and information sharing becomes denser than before. Production site wanted the sales site to pass the bulk order information as early as possible because it has been hard to response to all the huge volume order in a short notice. Sales site wanted to know the accurate delivery time in order to response to the customers as soon as possible. With close collaboration and interaction between two departments, production site is able to know information about big changes in production volume in advance. Production site adopts MTO to respond to the bulk order. The bulk orders can be operated in MTA if the amount of orders is allowed by the MTA standard. Additionally, production site adopts MTS as for the new products. It is necessary to prepare enough inventories before the introduction of new product to the market. The amounts of those advance inventories are set according to the sales and promotion plans by sales department. Production people understand actual sales are often below those plans or forecasts since no one knows whether it is going to be a blockbuster or not.

In 2012 summer, the inventory in the warehouse located in Osaka is reduced about 30% to 40% compared to it before the implementation of MTA. The inventory in Dalian factory is reduced about 40%, which is thought as a big figure in Omron Healthcare. The inventory problem has not completely disappeared after MTA implementation, yet monthly meetings and other communications between two departments enable actual demand information of regular order and sales policy (bulk order for campaign and the new product debut) to be visible for each department.

3.6 Inter-firm Integration

Collaboration with the Supplier

Omron Healthcare held a meeting with people from 140 suppliers when trying to implement MTA to the first-tier suppliers[2]. Omron Healthcare earned suppliers' cooperation by reaching a consensus to build a win-win relationship together, and not to force Omron Healthcare's own thought on the suppliers.

For example, plastic parts supplier A in Dalian with 471 employees agreed to implement MTA in 2011 summer. Before running the MTA, supplier A's plastic parts and electronic parts were facing a serious inventory shortage, in which the shortage ratio was 81.7% in total. At the kick-off meeting, Omron Healthcare and supplier A exchanged their own opinions and concerns about the new system and made a common goal to meet market demand, therefore, the smooth information flow must be carried between two firms as well as among departments within.

Interaction with the Supplier

Supplier A utilizes DBM for the regular order as well and shares the parts inventory information with Omron Healthcare Dalian factory every day. The production plan in supplier A puts red-zone parts to top manufacturing priority, which is based on its own inventory information and Omron Healthcare Dalian's parts inventory information. To ensure that the supplier fully acquires the concept of TOC, Omron Healthcare Dalian factory send one employee to help. The supplier also cooperates closely with Omron Healthcare and gives the status report meeting on weekends, which sum up to a total ten days from 2012 May to August. What is more, the supplier also receives shipping status from Omron Healthcare warehouse in Japan.

As for the response to bulk order such as campaign or new product debut, Supplier A agrees to keep certain amount of the inventory, while Omron Healthcare Dalian factory gives the responsibility to take over those parts inventory. Nine months after starting MTA, supplier A successfully reduced its plastic parts inventory to three-day amount, comparably smaller than the one-week amount at the very beginning.

[2] Although not all suppliers agreed to accept the new system.

Collaboration with the distributor

In Japan, products of Omron Healthcare are first delivered to the distributor, and from there the products go to three kinds of retailers. The first type is the large electronics stores (such as Yodobashi Camera in Japan). Half of the products are sold at this kind of stores. The second type is the drug stores that constitute 30% of the total. The last 20% of the products go to the channel called non-store or special channel. The customer for this type of channel is the corporations that do not hold stores such as TV shopping companies and health insurance associations.

People in charge of sales in Omron Healthcare attended the meeting in distributor Y in June, 2010 to reach a consensus on making the distribution channel simple enough among itself, distributor and major drug store X as implementing MTA. It gave the presentation about MTA implementation in front of distributor's top and middle management teams, explained how much the MTA was effective in order to acquire distributor's understanding, and suggested the distributor's warehouse better be involved as well. The implementation of MTA started from October, 2010 with a few kinds of products. The idea is that when it comes to Omron Healthcare's products, distributor Y that has transactions with many drug stores only sells the products to drug store X. And when Omron Healthcare wants its products to be sold in drug store X, the products are only delivered to distributor Y. Thus, Omron Healthcare, the distributor, and the retailer have one-to-one relationship. Generally, the distributor responses to several retailers, and it tends to inevitably make a large amount of inventory in order to constantly meet the demand of the retailer customer (drug stores). So far, this one-to-one relationship is only implemented among Omron Healthcare, distributor Y and drug store X (retailer) on a trial basis, but it seems to benefit every party.

The point is that the smooth demand information through the simple distribution channel makes the demand of downstream more visible for Omron Healthcare, and alleviates the distributor and the retailer's concern about excessive inventory and inventory shortage. Omron Healthcare expects to implement the MTA to more products and more distributors than now because the MTA has made it achieve a significant performance on total inventory reduction.

Interaction with the distributor

The distributor took Omron Healthcare's suggestion about the MTA implementation, shared information over the IT system and made some basic rules with Omron Healthcare. For example, despite being the only distributor, it has the branches all over the country and sometimes receives orders from seven or eight branches in one day. To be responsive to massive orders every day, Omron Healthcare does daily delivery basically from Osaka warehouse after the distributor confirms the orders. Two parties are running the order-delivery circle every day except for the weekends, when there are no orders. As a result, although the distributor has given a try only on some kinds of the products, the average stock level of those products is already reduced to less than half the previous level, so far. The distributor said it would be delighted to do the same for other products as much as possible.

4. Results and Discussion

4.1 Results

Based on the case above, we can draw a few key points about the total inventory reduction through a multi-stage observation. Omron Healthcare's effort required collaboration (goal sharing, mutual understanding) and interaction (IT system implementation, meetings) with departments inside and related organizations outside the firm.

First, we found that supply chain integration from upstream to downstream was a critical point. To achieve a successful integration, goal sharing and mutual understanding/trust was the primary requisites. Without actual goal sharing and mutual understanding ahead, the departments would only care about their own thoughts and plans, and this would prevent the total inventory reduction. The upstream production capability and mix-up of three production systems were also the basic factors to support the successful integration.

When Omron Healthcare started to work on MTA, all managers from each department were gathered at the very beginning and reached consensus of what they will be doing after understanding each other's situation. For the first time, production, sales, logistics and other departments for operation shared a same goal which is to create a smooth product information flow, prevent inventory shortage and improve the inventory turnover. Since involved departments had a common objective, a series of activities was done smoothly; for example, new IT systems were implemented into some departments, and people from production site attended the meetings on sale's site. We have to notice that if the production site had not

accumulated production capability for the past twenty years, it would have been difficult for Omron Healthcare to operate the new system. With production site's high level of production capability, Omron Healthcare mixes well the MTA (for regular order), the MTS (for new products debut), and the MTO (for bulk order) to deal with the market demand. With the well-done integration, all departments know where the products are and what product is sold, and so forth what they have to manufacture at prompt. Production side does not only have interest on manufacturing but also start to pay attention to the market movement. After such changes, the inventory problem has been alleviated at the multi-stage.

With the suppliers and the distributor, Omron Healthcare did the same process it conducted internally. Omron Healthcare explained MTA to the suppliers and distributors in order to gain their understanding and have goal sharing among them. Then, Omron Healthcare implemented the new system among those parties and had meetings with them constantly.

Second, Omron Healthcare had certain steps to integrate all parties. This was another critical point. Regardless of the amount of effort Omron Healthcare put for building a smooth information flow with suppliers or other firms, it would not be effective if the internal side is not well organized. As a result, Omron Healthcare achieved success on inventory turnover improvement and a big drop in inventory shortage rate in two years.

4.2 Discussion

In contrast to most of the existing studies based on large-scale survey, our research give the readers a detailed insight of the total inventory reduction from a multi-stage observation.

First of all, "goal sharing" is one of the main topics in management study (Lawrence and Lorsch, 1967a; Bourgeois, 1980; Collins and Pollas, 2002), however, it played a less important role in SCM. Gimenez and Ventura(2003, 2005) set the extent of integration as a single variable to measure whether the goal is shared between departments or firms. Kahn(1996) indicates that having collaboration (goal sharing and mutual understanding) done first will contribute more to the firm's performance. It means that goal sharing or vision sharing or mutual understanding among involved parties is significantly more important than only having formal interaction such as emails, phone calls, and meetings. Our finding is consistent with those researches. Besides, we use a case study to provide readers with the activities' detail for goal sharing. This research possibly leads to a hypothesis and illustrate

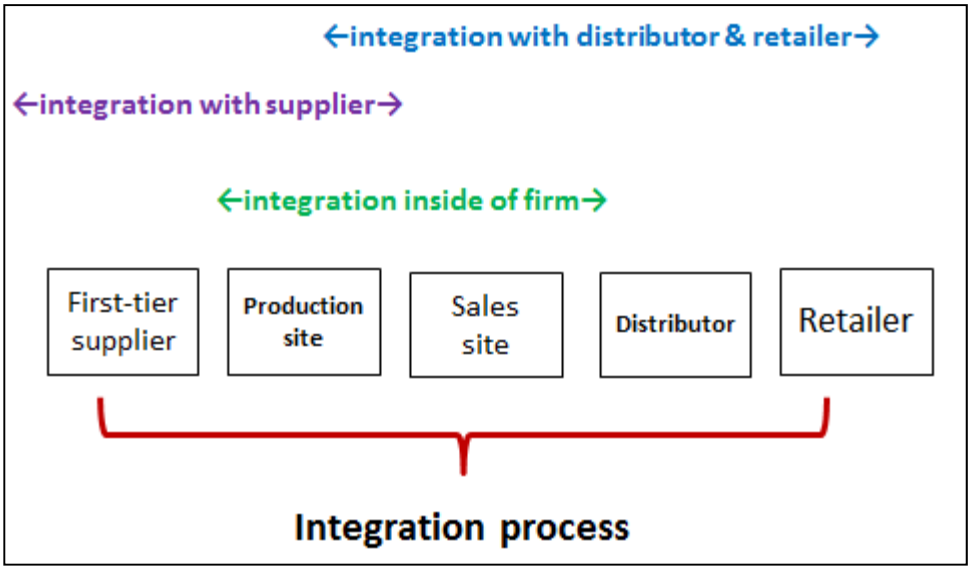
an effective guide line to practitioners as well.

Second, let us discuss the difference from previous studies about TPS. We observe a wide range of integration beyond *keiretsu*[3] , and suggest trust in upstream affects the activity at downstream. In other words, the capability of upstream as flexible supply capability facilitates the total inventory reduction. We notice that if Omron Healthcare had never worked on TPS to improve its production capability, it would not have been able to understand and implement the new system smoothly. Many literatures specially focus on TPS's strong production capability and close relationship with the suppliers. Omron Healthcare has accumulated such production capability for years, and when it was time for to implementing the MTA, it actually took advantage of TPS (named ONPS/DNPS) rather than taking the place of it. Sale's site in Omron Healthcare trusted the production site and knew that it had a high level of production capability, which made parties in downstream easier to mix-up different production systems. TPS studies address that upstream activity depends on demand information from downstream (Holweg & Pil, 2004; Tomino, Park, Hong & Roh, 2009). Our argument is that the capability of upstream to provide a flexible supply influences activities (i.e. inventory management or order policy) in downstream.

Finally, observation of certain processes for integration is important. Tomino (2012) discusses that TPS has adaptation capability to the market because it follows a stable production plan on the one hand, and is able to make minor-change to meet customer needs on the other hand. However, our research did not focus on the completed system but rather on a system that was in the building processes. Omron Healthcare case is not the only form of integration (figure. 2), but nevertheless, the case implies that in order to effectively deal with the downstream, a firm should first integrate the production and sale sectors within. Our contribution is to expand discussion by focusing on integration processes.

Figure. 2 Integration process

[3] Keiretsu is a group of companies with close business relationship. It is the key element of the auto mobile industry in Japan.



In conclusion, manufacturing firms nowadays respond to diverse and complex customer needs on the one hand, and need to solve a plenty of problems such as lead-time improvement and quality improvement on the other hand. Management team should realize that, without flexible supply capability, the firm will be exhausted to deal with various issues at hand, even though building competency is obviously a much harder task.

For the future research, multiple cases are needed to give a general implication. Additionally, whether our finding can be applied to other industries is an intriguing topic as well. Industry differences might give us a different wisdom.

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