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Effective Supply Chain Configurations in the Business Context of China

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Abstract

Increasingly, global Flat Panel Display (FPD) manufacturers for computer, monitor and TV face growing business opportunities with an expanding global market. At the same time, with the continuous influx of competitors the overall prices of computer and TV have showed downward trends. In this environment it is critical for FPD manufacturers to manage efficiencies in terms of cost, delivery, and quality.

The realistic options for overall cost reduction in the value chains are: (1) manufacturing productivity enhancement through workers' learning curve; (2) product process improvement through better operational systems; (3) effective outsourcing for the back-end assembly and logistical processes.

This paper examined the strategic and operational issues related to efficient supply chain configurations between set-makers and back-end suppliers. For this purpose, this paper analyzed specific issues related to FPD manufacturers that operate in China according to the Chinese government rules and operational constraints. Specifically, we have examined supply chain integration practices through Low Cost Module strategy which includes the movement of its production facilities in China and integration of upstream and downstream suppliers. In this way, case firm has achieved the geographical integration with its suppliers.

We also list key strategic challenges for supply chain configuration with suppliers in this industry and their practical options for their competitive advantages.

Key Words: Flat Panel Display manufacturers, Supply Chain Configurations; Set-Makers and Back-End Suppliers; Business Context of China

Effective Supply Chain Configurations in the Business Context of China

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Effective Supply Chain Configurations in the Business Context of China

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1. Introduction

Korea-based multi-national corporations are demonstrating their positional strengths in global market (including South East Asian countries) through the effective combinations of their global marketing strategy, premium product image, localization initiatives, rational pricing policy, outstanding quality and design. One of the representative products is Liquid Crystal Display (LCD) product. LCD is used a variety of applications that require high quality display--from mobile technologies to large TV. After 40 years of experiences with CRT (Cathode Ray Tube) TV customers are now rapidly switching to LCD. Although early display technologies started in USA and Europe, Japanese firms such as Sharp have attained its commercialization success. Korean firms, with their relative late entry, adopted aggressive strategy and successfully caught up with Japanese forerunners. Korean LCD industry, represented by Samsung Electronics Co., Ltd and LG Display Co., Ltd (from LG.Philips LCD Co., Ltd in Feb 2008) began their production in 1995. Within four short years Korean LCD panel makers now lead the global market (Shintaku et al., 2007). By 1998 Samsung's global market share is No. 1 and by 1999 LG follows as close No. 2. In this way Korean firms have positioned as global market leaders with their sustainable competitive advantages over Japanese rivals (Shintaku et al., 2008).

However, LCD industry is experiencing rapid LCD panel price reductions in keeping up with the downward price movement of the final finished products. In particular, global Flat Panel Display (FPD) manufacturers for computer, monitor and TV face growing business opportunities with an expanding global market. At the same time, with the continuous influx of competitors the overall prices of computer and TV have shown downward trends. In this environment it is critical for FPD manufacturers to manage efficiencies in terms of cost, delivery, and quality.

In these circumstances, a critical challenge for LCD panel firms is how to improve efficiencies of module assembly processes. The realistic options for overall cost reduction in the value chains are: (1) manufacturing productivity enhancement through workers' learning curve; (2) product process improvement through better operational systems; (3) effective outsourcing for the back-end assembly and logistical processes. This paper examines the strategic and operational issues related to efficient supply chain configurations between set-makers and back-end suppliers in LCD industry.

LCD industry has three processes which are array and cell process (i.e., the front core process) and module process (i.e., the backend process) (Shintaku et al., 2007; Shintaku et al., 2008). Most of LCD firms including Korean firms handle the array and cell processes in their domestic plants and module process in oversea plants. This paper focuses on relationships between the OEMs that assemble parts of module process and the suppliers in China that produce Driver IC and Back Light Unit (BLU) in the form of modular processes of LCD panels. Our study examines how Korean multi-corporations transfer these operations from Korea to China through vertical integration with the suppliers according to the Chinese government rules and operational constraints.

In contrast to the dynamic market activities of Korean LCD industry in global market, hardly any research paper is available in this area. This paper focuses on aggressive global market strategy of two Korean firms and examines their supply chain practices. Their global market strategy both involves panel operational process (i.e., frontend process) in Korea and LCD module process (backend process) outside of Korea. Yet, the difference is the strategic alliance details with their suppliers. This research shows that these Korean firms, although in the same industry from the same country, adopt different manufacturing processes depending on their customer characteristics (i.e., either internal or external customers).

The literature review describes the unique competitive circumstances of this industry, prior research of collaborative patterns between set-makers and component suppliers, and emerging issues related to government regulations and competitive requirements. The research model depicts the specific challenges from the standpoint of supply chain management of this industry. This research model identifies how FPD manufacturers achieve the premium value-added under the above mentioned business conditions and constraints.

2. Literature Review

2.1 Supply Chain Integration and Product Architecture Theory

Many researches are available on offshore production of multinational companies (MNC). Classical international business approaches such as corporate advantage theory (Hymer, 1960), product cycle theory (Vernon, 1966), and OLI (Ownership, Location, and Internalization) approach (Dunning, 1979) explain the patterns of how MNCs expand their operations in the oversea market.

First of all, we approach the MNCs' foreign expansion from the perspective of theory of comparative advantages. Transactions of information intensive management resources (IIMR) or intermediate goods across the national borders are possible because of three economic advantage factors (Hasegawa, 1998; Hasegawa, 2002). First, economies of multi-plant suggest that the value of IIMR does not diminish with the use in multi-plants. Therefore, the common use of IIMR in multiple plants instead reduces its overall average cost. Second, joint ownership of IIMR may enhance the economies of scope and therefore realize additional profit potentials in the form of brand recognition, customers' trust and an extended distribution channel. Third, economies of specialization may also achieve a great level of overall network system productivity when diverse sets of upstream/downstream processes within value chain are allocated to many countries

according to the differences in factor costs and economies of scale. The relationship between upstream and downstream processes is also quite interactive. For example, outputs of upstream processes are usually added into downstream processes. At the same time, information and knowledge from downstream processes are reversely put into use through the information feedback mechanisms and change the nature of upstream process characteristics. In this way, dynamic flows of intermediate goods and IIMR occur in the international value network. From the standpoint of supply chain integration it might be desirable to locate upstream and downstream processes in the same location. However, the theory of comparative advantages recognizes the values of utilizing the differences of factor costs and economies of scale through international transactional arrangements.

In this sense, Shintaku's product architecture theory (2006) that explains the catch-up model of Asian firms is receiving an increasing research attention. He points out that cellular phones adopt modular product architecture which allows easy entry of competitors to the market. It is quite challenging to maintain competitive advantages in cellular phone industry which experiences an intense price competition and rapid changes in product design. Naturally, the speed of production transfer from leading nation to following nation is relatively fast. Theories such as the development theory of flying geese pattern (Akamatsu, 1962) and product cycle (Vernon, 1966) explain the patterns of production mode transfer from leading nations to following nations but not the speed of such transfers. One contribution of product architecture theory is to give the traditional theories with the axis of technology transfer speed in the change of product architecture. That is the theory of product architecture articulate why and how changes in product architecture accelerate the production transfers from USA to Japan, Japan to other Asian nations in case of products that adopt modular, not integral, architecture (Shintaku et al., 2006; Fujimoto, 2006; Shintaku et al., 2008). It is observed even in case of the identical products that integral component products are from advanced countries and modular components from developing nations. Figure 1 shows how past catch-up model has changed to catch-up model based on product architecture and that modular products are easily transferred to the developing countries because of easy knowledge transfer on the production of equipment and component parts (Fujimoto, 2006; Shintaku et al., 2007; Shintaku et al., 2008).

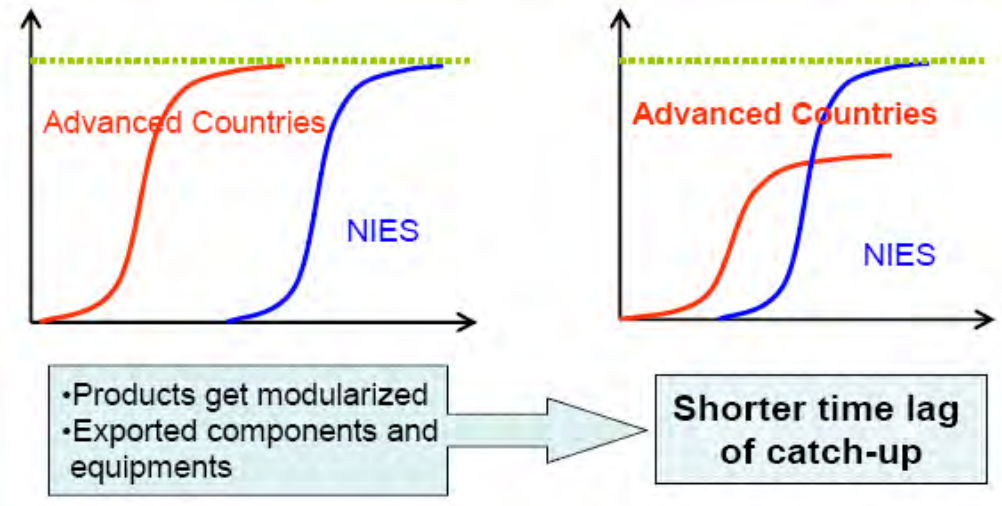

Figure 1: Foreign production transfer model by the theory of product architecture
Source：Shintaku et al.(2006)

The other contribution of product arichitecture theory is to give a systemic view to see the integration and division of production processes of targeted products. Architectures are formed by different levels. Even though the final product layer is modular architecture, the component layer could be integral one. For example, PCs are representative products with modular architecture, whereas HDDs are products with integral architecture, where their sub-components are highly integrated each other.

Let us examine the product architecture of LCD TVs and panels which are the main products of this paper. LCD related products have three levels of architecture: upstream component parts, LCD panels in the middle and downstream LCD TVs (Shintaku et al., 2007; 2008). There are also three processes of LCD panels which are array and cell process (i.e., the front core process) and module process (i.e., the backend process) (Shintaku et al., 2007; Park et al., 2008). Figure 2 shows the three processes of LCD panel from the perspective of product architecture. Most of LCD firms including Korean firms handle the array and cell processes in their domestic plants and module process in oversea plants. Here, the array and cell processes of LCD panel are close to integral architectecture in that these processes are complex and hidden (i.e., black box mode). On the other hand, the module processes are easy to transfer to foreign plants because they adopt modular architecture.

However, in the 2000s, as competition became severe, panel firms in LCD industry tried to push the integration of downstream component manufacturers as well as the upstream components suppliers. Integration of backend processes of LCD panels is about combining Driver IC and Back Light Unit (BLU). Korean LCD industry focused on assembly and finished products in economies of scale and therefore there is very little room for technological differentiation other than cost reduction (LG Economic Institute, 2007). Particularly, module processes of the back end are mainly simple component assembly operations and therefore the cost pressures on them are enormously high. How to deal with the problems of vertical integration or disintegration of back end processes in foreign production sites under the competitive pressure of cost reduction and volume change is the main issue of this paper.

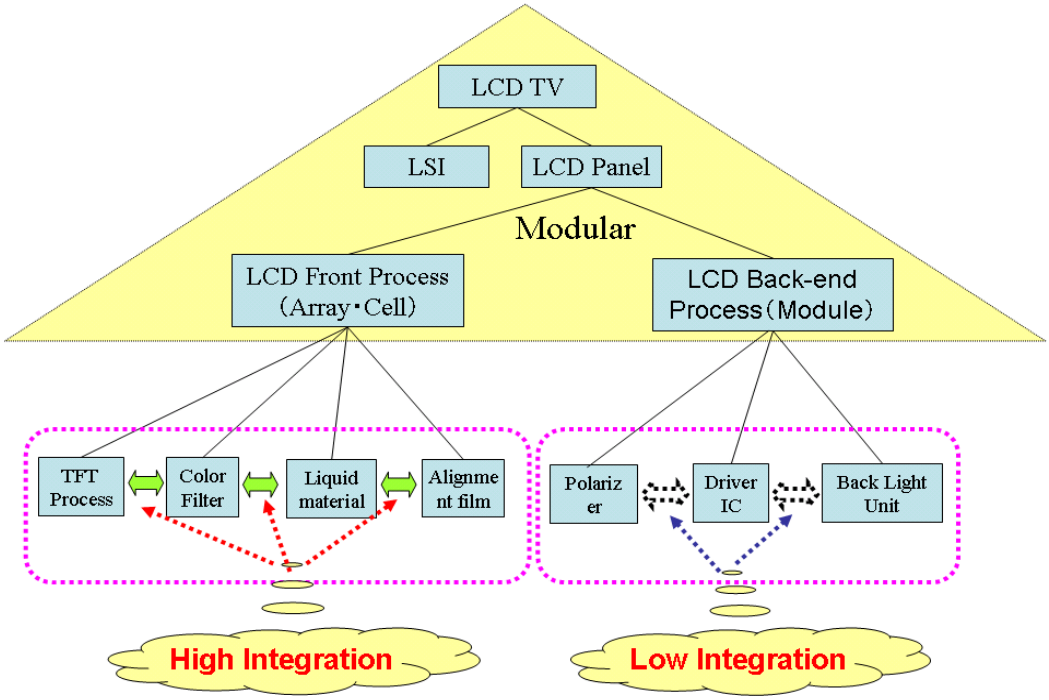

Figure 2 Front end and back end modules of LCD panels

Source: Park et al.(2008)

2.2 Research Model

In this paper, our analysis is centered on module processes, one of the three LCD panels' processes mentioned above, which the foreign plant operations mostly adopt. Since array and cell processes are mostly classified as integral architecture because the process details are kept in "black box", the domestic plants handle them. On the other hand, module processes are close to modular architecture and they are easy to transfer to overseas plants. As stated above, LCD back-end sub-processes could be integrated to form one module. However whether oversea factories integrated these processes or not is an issue to be explored. We will see the internalization decision of Back Light Unit (BLU) by the oversea plants.

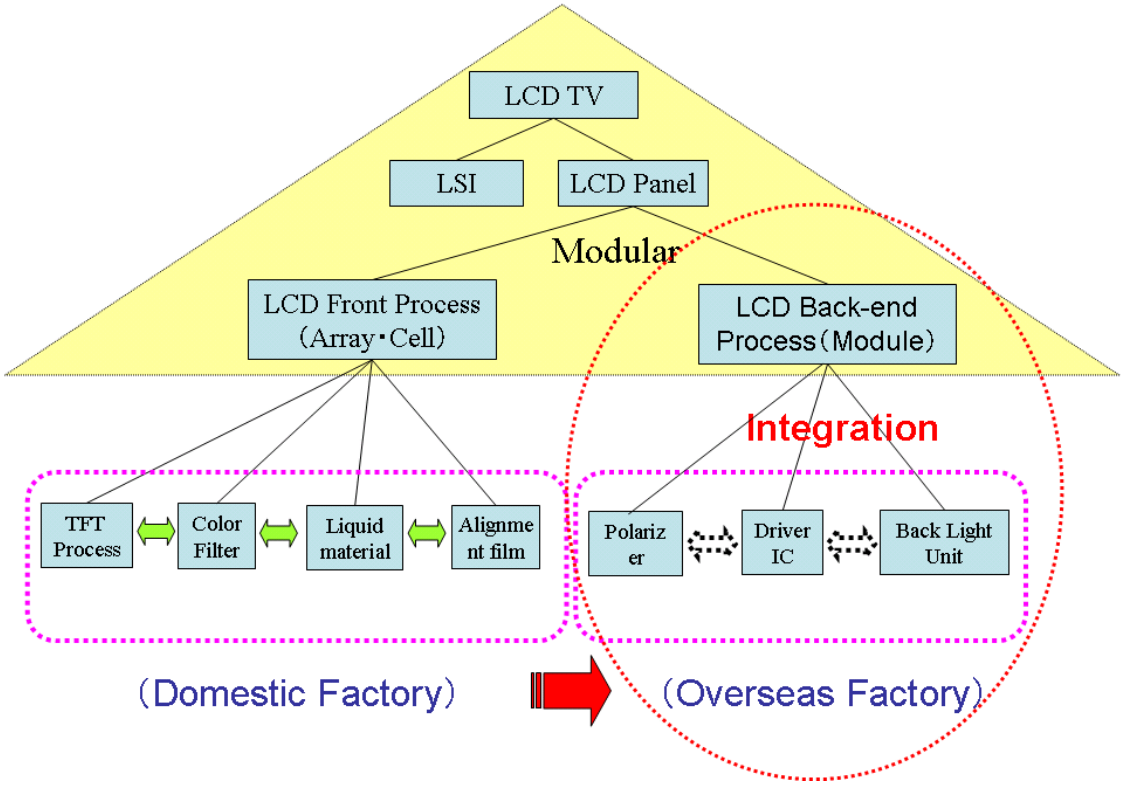

Figure 3 Domestic and overseas factory of LCD panel production

We think whether the oversea plants integrate the upstream process (BLU) or not depends upon their downstream strategies. Since China is “factories of the world”, the downstream product demands tend to fluctuate more than in other countries. Therefore how to respond to the wide demand fluctuation and how to prepare the flexibility of local supply chains for it are major subjects for factories in China. There are two opposite strategies at this issue. One is mitigating the demand fluctuation, and the other is adapting to it. Depending on them, we could hypothesize different models of value chain.

The first strategy is straightly adapting to the demand fluctuation of major products. In this strategy, firms focus on large market segments and a few customers (sometimes internal customers, downstream integration) of major products. Since the markets fluctuate widely and customers demand low cost and large volume, firms tend to outsorce some of the upstream modules. In this situation, it is risky for firms to internalize all processes, considering low cost and large volume with wide fluctuation. Therefore firms seek for the ways to make vertical disintegration with upstream suppliers. How to move suppliers in home country to places close to the local factory in the same industrial clusters is essential to respond to the fluctuation of product demands. We will examine this model in Firm-A.

The second strategy is to mitigate the demand fluctuation as much as possible by making market and/or customer portfolios. To do this, firms make a mixture of markets and customers and create the capabilities to deal with the demand diversity and complexity in local supply chains. In this strategy, the flexibility is related with the demand diversity and complexity rather than quantitative fluctuation itself. Therefor Firms will deal with external customers more aggressively (i.e., downstream

disintegration) and try to create these internal capabilities mainly inside the local factory and related firms (i.e., upstream integration). Forming the cohesive organizational capabilities based on multi-task trained employees is one way to tackle the demand diversity. We will see this model in Firm-B.

Firm	Customers (Downstream)	Local Supply Chains (Upstream)
Firm-A	A few large customers, including internal ones (vertical integration)	Vertical disintegration with major suppliers, using the external capabilities
Firm-B	A variety of customers, including external ones (vertical disintegration)	Vertical integration and creating the internal organizational capabilities

Figure 4: Local Supply Chains: Upstream and Downstream

Thinking about Firm-A model, which subsets could be outsorced to external suppliers depends upon the process architecture of LCD panels (in this case, the architecture of LCD module processes). Since we focus on production activities of overseas LCD panel plants, we analyze supply chain process configuration of LCD module processes from standpoint of process architecture. Process architecture is also classified into the two types—modular or integral[1]. If the manufacturing processes are close to modular architecture, then it is quite feasible to divide the entire process into different subsets and thus firms move certain processes to other countries or use outsourcing instead. It is shown that standardised components can be outsourced to unspecific suppliers, because simple parts are often produced with specific technologies (Hatani, 2009).

For example, even in case of automobile, a representative integral architecture, standardized or specific components such as sheets, harnesses, and micro-chips could be outsourced. On the other hand, the focal company does not necessarily choose outsourcing for the components contributing the premium value enhancement since technological excellence affects the user's life and value components (Nolan, 2001). Or in that case, the focal company will choose the technological alliances with those suppliers.

We could introduce the architecture theory to interpret the local value chains of LCD modules in Korean multinational corporations in China. In vertical supply chains, integration or internalization could be formed when the architectural integrity is necessary, and disintegration or externalization could be found when the arichitectural modularity is necessary. For example, in case of Firm-A, they will choose the downstream integration because the architectural integrity is necessary in their product strategies, and will choose the upstream disintegration because the modularity of their product architectures allows it. In case of Firm-B, they will choose the downstream disintegration because they utilize the modularity of LCD modules, and will choose the upstream integration because they stress the importance of organizational integrity for

[1] The former resembles one-to-one relationships such as the relationships among the function, structure, and process of a system, while the integral type indicates complex relationships between (1) the function and structure of a system, (2) the structure and process of a system, (3) the function, structure, and process of a system, (4) and the function and process of a system (Tomita, Park, & Hong, 2011).

tackling the demand diversity and complexity. These are our main hypotheses in our case studies.

The paper focuses on the factories and suppliers in China that produce Driver IC and Back Light Unit in the form of modular processes of LCD panels. Our study examines how Korean multinational corporations transfer these operations from Korea to China and what type of local supply chains they form through the vertical integration/disintegration with customers and suppliers according to local operational constraints and Chinese government rules.

3. Case Study

3.1 Methodology

Over the years manufacturing firms have experienced process architectural changes in LCD panel productions. The focus of our qualitative study is to examine (1) the oversea transfer process of manufacturing plants, (2) backend production processes in China, and (3) operations management and customer responsiveness.

Emerging economies such as China are an attractive market and is currently one of the most important targets for direct investment (Li and Zhou, 2010). China provides a rich context for research on supply chain such as outsourcing management given that China is the most important recipient of direct investment by MNCs among emerging economies (Li, 2011).

We adopted field-study methods and conducted in-depth executive interviews in the period between December 2007 and March 2010. Appendix shows the interview schedule details. For Firm A, the total three plants visits (both Korea and China) involved ten hours of interviews with the executives. For Firm-B the total seven times of plant visits that took 22 hours of actual executive interviews. The interview participants were managers, all the key functional directors that include production, HR, finance, purchasing, R & D, and plant.

3.2. Case Firm Descriptions

3.2.1 Firm-A

Firm A first completed the cell processes of panels in Korea and then move them to Chinese plants via sea and air transport. In Chinese plants Firm A engages backend assembly processes. Firm A's major products are notebook PC and mid-sized TV panels. Recently, it increases the module production volume of large LCDTV. The production position in China belongs to the same cluster with its other affiliated firms that produce notebook PC lines for the upstream integration of the final products. Such production position is based on the unique nature of notebook PC industry market. The majority of its production is primarily to serve its internal customers.

3.2.2 Firm-B

Firm B transports most of cell-completed panels from Korea via ship and does backend module assembly processes of LCD panels in Chinese plants. Similar to Firm A, Firm B also produces notebook PC and monitor-based panels. Firm B's module production volume of large LCDTV in China is fairly small. Firm B's LCD monitor and TV assembly plants are in the same industry cluster. However, notebook PC panel has very small portion of internal customers and instead it has large external customer base.

3.3 Case Analysis

3.3.1 Local production system in China

3.3.1.1 Firm A's Local Production System

A-Firm started Chinese operation in 2002. Upon completion of the cell process for the panel components they are brought to China via sea or air transportation. This Chinese plant is responsible for the back-end processes of the panel components. The major product items are medium size panels for notebook PC and monitor. Recently, LCD TV modules are added. For the downstream integration of the final products, notebook PC business is in the same cluster. The primary mission of Chinese operation is SCM integration for Chinese customers.

Firm A's effort to achieve additional production efficiency for cost reduction has reached its limit. For integration purpose it outsources some of module processes (e.g., BLU assembly, final inspection and packing) to the external suppliers. In the past Firm A handled all the production processes within its plants with the BLU that its suppliers provided. From the second half of 2007, Firm A adopts low cost module by selecting three suppliers which are entrusted for assembly process, final inspection and packing process. In the future, Firm A intends to strengthen its LCM strategy further by expanding BLU integration of upstream, achieves production cost reduction and stable component parts supply through BLU supplier integration. Firm A's internal operation focuses on high premium value processes (i.e., from PAD clearing to Driver IC).

3.3.1.2 Firm B's local production system

However, Firm B is moving toward internalization of BLU within its plants instead of implementing LCM strategy. Thus, it is doing more or less assembly of LED for LED TV in the second floor of the plant. In this respect, Firm A and Firm B shows difference in externalization and internalization of BLU assembly processes.

3.3.2 Insourcing and outsourcing Flexibility for the integration with their customers

3.3.2.1 Firm A's Outsourcing: Integration efforts with BLU business operations

Figure 4 shows the flow of the module processes of LCD panels in China. This includes PAD Cleaning (or Polarizer attachment), OLB Process (PCB bonding), Assembly Process (B/L inspection and BLU assembly), Aging Process, Final test Process, and Packing Process. A-Firm is in the process of complete component parts localization. The sourcing percentages of component parts in China are very high.

A-Firm has formed a cluster in China (i.e., A-Firm China) for the simultaneous market entry with the downstream notebook business. In view of the crowding market condition, A-Firm has been aggressively seeking the diversification strategy of customer segmentations. Over the years A-Firm China's operation is closely related to other final notebook PC makers and monitor manufacturers. Through the integration with notebook PC's downstream business, A-Firm China currently supplies panel components to about 85% of notebook panel manufacturers in the same industrial complex.

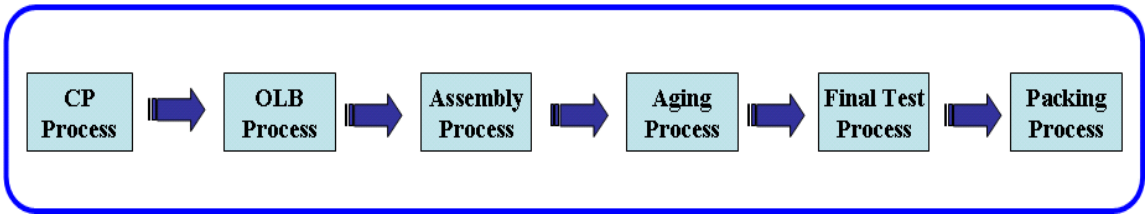

Figure 4: Flow of Module Processes

A-Firm China has now exhausted all the production improvement efforts for any further cost reduction. The SCM integration efforts include outsourcing some of module processes such as BLU assembly, Aging process, Final test process and packing process to external suppliers. Previously, A-Firm China received BLU from Chinese local suppliers and then processed them through its manufacturing assembly operations. From the second half of 2007, A-Firm China chooses three BLU suppliers and arranges them to take care of all these assembly processes after BLU. This so called LCM (Low Cost Module) enabled A-Firm China to achieve more than 30% of cost reduction. For the reliable product quality A-Firm China sends its own inspection team to BLU suppliers regularly. In this way, the tasks of managing external suppliers are becoming quite important as much as ensuring excellence for its own internal operations.

Table 2: A-Firm's LCM Production Model and Integration Period with Suppliers

A-Firm's LCM Production Model	BLU Integration Suppliers	Time Distance Between A-Firm and BLU Supplier	Integration Time
One millions	Supplier C-Firm	15 Minutes	July 2007
	Supplier D-Firm	40Minutes	January 2008
	Supplier E-Firm	40Minutes	July, 2008

A-Firm China intends to strengthen LCM strategy further by expanding the integration efforts to the upstream BLU as well. Thus, A-Firm China expects to achieve continuous production cost reductions and reliable supply of BLU component parts. A-Firm China then focuses its front operations such as CP Process and OLB (Outer Lead Bonding) Process which has greater premium values than the assembly operations that are outsourced.

On the other hand, from the integration perspective both Firm A and Firm C maintain clusters with their downstream customers and yet their operational responsive patterns for their key products are somewhat different. Firm A is in the same cluster with notebook

PC firms while Firm B is in the same cluster with the firms that assemble TV and monitors. Firm A diversifies its customer base with its increasing market saturation and yet it is still in the same cluster with its customers that supply notebook PC panels.

3.3.2.2 B-Firm's Insourcing: Internal production of BLU parts

For Firm B, the main products are LCD panel for note PC, the downstream firms in the same cluster target external customers by with their assembly focus of LCDTV and monitor. Therefore, Firm B (compared to Firm A) achieved better integration with downstream products and thus its downstream customer base is more stable. Recently, Firm B increases production volumes of monitor and TV panels as well as panels for notebook PC. For securing their stable customer base, Firm B's responses are quite flexible to its downstream customer demands. For example, its customer (Firm T), a TV manufacturer, is originally TV OEM assembler. From five years ago, it operates some of modular production lines similar to those of Firm B and thus demands a few additional options for module assembly in their backend processes. Thus, Firm B offers three assembly options to Firm T.

Firm B, therefore, takes care of the subsequent process of the panels that are completed in Korean plant and provides one of the three following options in response to the customer requirements: (1) Panels from Korea + Flat Panel Display (FPD) assembly products (2) Panels from Korea + Flat Panel Display (FPD) + products up to Driver IC Assembly(30 Panels from Korea + Flat Panel Display (FPD) + Driver IC + From BLU Assembly to Packaging. On examining the integration with downstream customers, Firm A and Firm B show differences in their strategic division of key operational processes. Figure 3 summarizes the key differences of these two firms.

Integration between Upstream and Downstream industry

	UpStream	DownStream
Firm A	(LCM Strategy)	Internal customer requirements
Firm B	(Insourcing of BLU)	Flexible Response to the external Customer Requirements

Figure 3: Integration of Upstream and Downstream Industry

3.3.3 Constraints of LCM (Low Cost Module) Strategy

Unexpected issues arose in the course of A-Firm's supplier integration processes. The key issue is about passing through Chinese government customs. As shown in Table 2, this case analysis focuses on integration process with B-Firm which happens to be the closest among the three suppliers. B-Firm is the most reliable among the three BLU suppliers. Since 2004 it prepared for local production and by 2006 the plant was

completed to fulfill A-Firm China's localization goals. From July 2007 in keeping up with LCM(Low Cost Module) strategy, the core of A-Firm China's supply chain integration strategy, B-Firm produces 500,000 units and supplies to the final product manufacturers (i.e., notebook and monitor makers) after passing Chinese government custom and completing BLU back-end assembly processes of the component parts from the front-end of panel module processes. By time distance, it is no more than fifteen minutes between A-Firm China and B-Firm. However, the passing processes (i.e., check the weight and inspect the products) of Chinese government custom takes more than five hours firm. Thus, lead time is being extended. Undesirable inventory problems add the overall production costs. The panel semi-completed products may leave A-Firm China in the early morning and then they arrive in the late afternoon at B-Firm. For example, during this process the inventory level goes up from a desirable level of 5,000 to an undesirable level of 15,000.

If the customer process is delayed, then the component parts may arrive by 5:00 P.M., not 1:00 P.M. Then, the total inventory level easily increases up to 20,000 per day. Two days of inventory then becomes more than 40,000. With the wage differences between A-Firm China and B-Firm, 30% of production cost reduction was possible. It is a critical business challenge to overcome excessive inventory problems with the custom processes.

4. Discussion

In this paper, we have examined A/B-Firm's supply chain integration practices through LCM (Low Cost Module) strategy which includes the movement of its production facilities in China and integration of upstream and downstream suppliers.
The concluding remark is briefly summarized in Figure 5. Firm-A's internal customer focus requires cost efficiency in operations and thus use outsourcing strategy. On the other hand, Firm B with its heavy focus on external customers adopts insourcing strategy in order to respond to the customer requirements with their organizational capabilities.

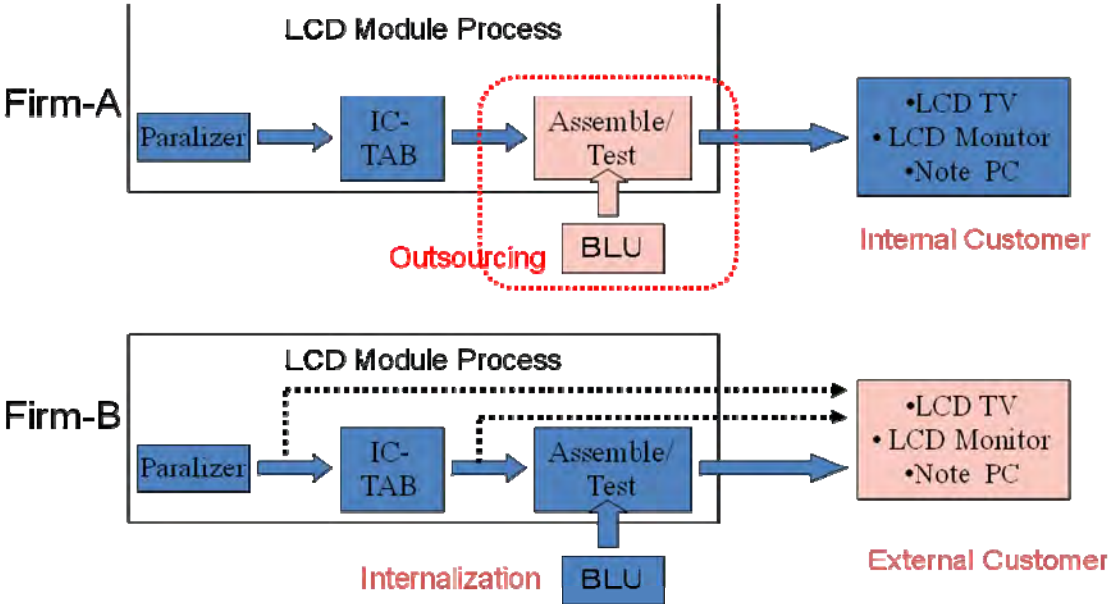

Figure 5: Comparison of Firm A and B Operational Process Analysis

In this way, A-Firm China has achieved the geographical integration with its suppliers. Figure 6 shows how supply chain configurations of A-firm with BLU suppliers have changed.

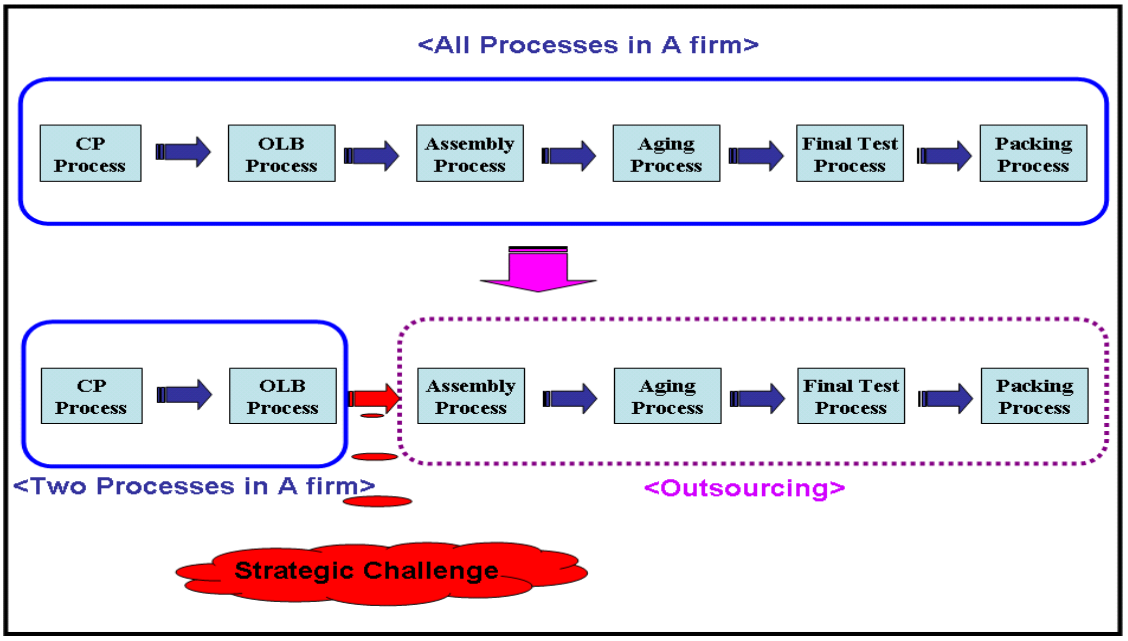

Figure 6: Change of supply chain configurations of A-firm with BLU suppliers

However, Chinese custom issue raises some difficult operational challenges.
Chinese cultural characteristics, the country's regulation system, and increasingly intense market competition make it difficult for firms to achieve strategic goals in the Chinese

market (Kang et al., 2011; Bao et al., 2011). One central challenge for foreign firms engaging in business activities within China is managing Chinese outsource providers in a dynamic environment (Li, 2011). Social control as a governance mechanism can be "generally understood to include people or social based mechanisms that enhance open communication and the sharing of information, trust, dependence, and cooperation" (Hoetker and Mellewigt, 2009).

For these challenges, DELL Computer's effective handling of Chinese customer issues might be worthy to study for Firm-A China (Tanikaga et al., 2004). In November 2000 Dell Computer built plants which are 800 meters away from Dakasaki Airport in Fújiàn Shěng of Southern China. DELL's business model is zero inventory management through production-on-demand. However, it takes at least ten days from the point of order receipt to Chinese government custom processes that include evaluation of Overseas Economic and Trade Commission (OETC), custom registration (CR) and operation document permission (ODP). Chinese government applied new custom system to support DELL's business operations. It is to link customer management system (i.e., finished goods export management system and electronic custom inspection system) and DELL"s management system (order receipt and fulfillment system) through IT infrastructure.

With this arrangement the above mentioned customer processes (i.e., OETC, CR and ODP) are simplified with electronic management system. DELL also shared the list of their component parts with Chinese Custom Authority and the time required for custom processes was greatly reduced. Chinese custom also applied F custom system to DELL. F Custom refers to fast custom process. Firm's custom information is handled via electronic evaluation, not by custom personnel manually. Therefore, export and import approval is done electronically. Through this fast custom process, DELL China could fulfill orders from nearby Japan within 4-7 days.

DELL also requires its suppliers JIT delivery. One supplier that provides up to 70% of component parts arranged its operation in tax free industrial complex. The custom process in this area adopts so called "Concentration Custom" which allows order fulfillment within two hours from order receipt from DELL's plant. Concentration Custom is about custom process for the global firm operations in China (i.e., sole, joint investment and partnership arrangement) and the component manufacturers (component parts assembly, compensation trade) for which export invoice is adequate for custom evaluation decisions. Different from DELL, Firm-A and Firm-B experience custom issues because semi-completed products are delivered to suppliers for manufacturing and assembly operations for finished goods. This is a new form of supply chain issues. Therefore, it is critical for Firm A to promote understanding and support of Chinese government to facilitate the custom process with great efficiency. Future research may explore further through case studies how intermediate products are effectively transferred to the suppliers that assemble and market the finished products.

Appendix: Interview Participants List

Date	Firm	Department	Position	Time-required (hours)
12/10/2007	Firm-A	Korea LCD Fab.	Assistant Procurement Manager	3
12/11/2007	Firm-B	Korea LCD Fab.	Production Director, HR Director, Purchasing Director, Plant Director	3
11/7/2008	Firm-B	Korea LCD Fab.	Production Director, HR Director, Purchasing Director	2
3/25/2009	Firm-A	China LCD Fab.	President, Production Director, Purchasing Director, Plant Director	4
9/3/2009	Firm-B	China TV Fab.	President, Production Director, HR Director, Finance Director, R & D Director, Purchasing Director, Plant Director	3.5
9/3/2009	Firm-B	China LCD Fab.	President, Production Director, HR Director, Finance Director Purchasing Director, Plant Director	3.5
9/4/2009	Firm-A	China LCD Fab.	President, Production Director, HR Director, Plant Director	3
11/4/2009	Firm-B	Korea TV Fab.	Production Director, HR Director, Plant Director	4
3/24/2010	Firm-B	Korea TV Fab.	Production Director	3
3/25/2010	Firm-B	Korea LCD Fab.	Assistant HR Director, Purchasing Director	3

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