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Virtual organization for supply chain integration: Two cases in the textile and fashion retailing industry

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ABSTRACT

A supply chain is an alternative form with competitive entity consisting of a group of companies in the business environment. Some supply chain projects are initiated by associated firms while some are started by the head office of multinational enterprises in order to integrate the diversified subordinates. This study focuses on the investigation on the supply chain structures within the boundaries of two multinational textile enterprises, respectively. One enterprise tries to integrate the market side by merging a brand owner. The other seeks an integration solution to compensate from its loss of control of sub-manufacturing sites which during corporate expansion were registered as independent firms. Both enterprises have initiated their global logistics management projects in order to balance the demand and supply. By participating in the two projects, our research indicates the different barriers of integrating toward the upstream and downstream supply chains and provides a mutual solution by building up the e-Fashion global supply chains. Similarities and dissimilarities of both cases towards the virtual organization approach are also addressed in this paper.

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1. Introduction

Supply chain management (SCM) is a popular research topic for both the practitioners and the academia over the last two decades. Stevens (1989) defined supply chain as a “connected series of activities which is concerned with planning, coordinating and controlling materials, parts and finished goods from supplier to customer”. Beamon (1998) defined SCM as “a set of relationships among suppliers, manufacturers, distributors, and retailers that facilitates the transformation of raw materials into final products”. These definitions indicate that managing supply chains is a complicated task. This is because a supply chain usually consists of a number of members which come from various geographical locations, and

belong to the organizations with different interests. This barrier is especially awkward for supply chains which involve inter-organizational cooperation because the existence of self-interest of different companies is inevitable (Hult et al., 2007). To a certain extent, the problem in managing such supply chains would be easier if the members of a supply chain are owned by a single authority. A central controller, in principle, could dominate the decision makings for the activities of the supply chain based on all information that could be gathered from its subordinates. Unfortunately, most supply chains consist of companies from different organizations and each has its own sets of core competences. This implies that integration, be it temporary or permanent, is required in order to managing the supply chains well to achieve a particular set of goals during a particular time period.

It is believed that future business competition will be between supply chain networks, rather than between companies (De Souza et al., 2000; Min and Zhou, 2002). In

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this connection, there is a need to research for new organization structures for supply chains to accommodate the necessity of coordination and information flow among the supply chain members. This leads to the evolution of virtual organizations.

A virtual organization is defined as “a collection of geographically distributed, functionally and/or culturally diverse entities that are linked by electronic forms of communication and rely on lateral, dynamic relationships for coordination” (DeSanctis and Monge, 1999). From this definition, it is not surprising that virtual organizations are usually linked with information technology or information system. Virtual organizations are sometimes referred to as virtual enterprises. Tuma (1998) defined a virtual enterprise as a “production system with mainly independent enterprises as single elements, which can be dynamically insourced or outsourced depending on the market demands”. Both definitions are similar and hence virtual organizations and virtual enterprise are found interchangeably in the literature.

This paper aims to reveal two case studies in the textile industry that involve integration in the context of virtual organization. The two cases share some similarities but the efforts and barriers in relation to forming virtual organization are different. One of the studies involves downstream integration, while the other is concerned with upstream integration. Nevertheless, a virtual organization approach provides a mutual solution for both cases. It can also avoid the conflicts between the newly merged business units and headquarters. Consequently, integration of the supply chain is possible. The authors are part of the consultant teams, particularly in the business process reengineering phases. The authors have participated in enacting the context of virtual organization for each of the two cases including organization charts, operation functions, and key performance indicator (KPIs).

The rest of this paper is organized as follows. Firstly, related literature is reviewed in Section 2. Then, Section 3 presents the background and integration barriers of the two cases. It is not our intention to present a comprehensive analysis of the related inter-organization information systems, which is too technical and not quite relevant to the scope of this paper. Instead, a brief description of the integration towards virtual organization approach, reflections and discussions which are drawn from the cases in relation to the formation of virtual organization are included in Section 4. Finally, Section 5 concludes this paper.

2. Literature review

2.1. SCM and supply chain structure

Traditional supply chains are viewed as simple sequential or serial systems, like a flow line. Input (i.e. raw materials) enters from one end and transforms to output (e.g. semi-finished or finished goods) that leaves at the other end. This configuration is quite static in nature and is applicable for products which are changing less frequently and are produced efficiently by mass production in the last

few decades. However, advances in information technology have changed the supply chain configuration in the last decade (Ahuja and Carley, 1999; Black and Edwards, 2000; Lin and Lu, 2005; Chan and Chan, 2005; Boyle et al., 2008). One of the phenomenal changes is globalization (Lee et al., 2006), and the other one is the concept of mass customization (van der Vlist et al., 1997; Aydin and Güngör, 2005). The former leads to the increase in the number of outsourcing activities and thus supply chains have been transforming from the said serial structure to network (Ahuja and Carley, 1999; Chan and Chan, 2005). The latter requires a system with greater flexibility and responsiveness (van der Vlist et al., 1997). Therefore, supply chains are now more dispersed and dynamic in nature than ever before, with most supply chain members separated geographically (Mowshowitz, 1997; Ahuja and Carley, 1999), like the two case studies in this paper. In this connection, coordination, which is the management of dependencies between the activities (Malone and Crowston, 1994), among supply chain members, plays an imperative role in SCM.

Networked organization is not new in industry. In the past, however, networked organizations seem to be found only within their respective firms (Khalil and Wang, 2002). In other words, only intra-organization networks were common. That is the reasons why they are not called virtual organization because they are physically belonging to a single enterprise. Nowadays, inter-organization communication is possible with the help of advanced information technology. Inter-organization networks, or virtual organizations, will probably become an emerging organization structure in the future. Such structures are characterized by flexibility, fast responsiveness, and high efficiency (Hughes et al., 2001; Khalil and Wang, 2002; Lin and Lu, 2005).

However, traditional mass production systems, or vertical integration approaches, cannot meet the demand of such flexibility and responsiveness (van der Vlist et al., 1997). Good cooperation among the members in the virtual organization is of vital importance to make the project a success (Martinez et al., 2001). Each entity of the virtual organization is proficient in a specific task and has possession of a particular core competence with respect to the supply chain or virtual organization. A collection of these core competences would result in a synergistic effect (Cunha and Putnik, 2006). Higher productivity and lower transaction costs are the expected consequences of adopting a virtual organization approach (Tuma, 1998; Khalil and Wang, 2002). In the next section, details of the virtual organization approach will be discussed.

2.2. Virtual organization

A virtual organization approach is dedicated for management activities which are changing dynamically in essence, and to improve the efficiency and effectiveness of such activities by handling them in a flexible manner (Mowshowitz, 1997). A virtual organization approach is feasible partly due to the advances in information technology (Ahuja and Carley, 1999; Black and Edwards,

2000; Lin and Lu, 2005). In an empirical study, Lin and Lu (2005) survey more than 300 electronics manufacturers who were asked the degree to which the company had undertaken virtual organizational structuring that was enabled by information technologies. The survey result indicates that information technologies can provide the potential means to implement virtual organization, which they regard as a form of structural innovation. More specifically, they also found that employees' on-the-job training, organization age, and the level of process management implementation all positively influence the adoption of virtual organization. With the help of information and communication technology, members in a virtual organization can achieve their common goal by flexible allocation of resources (Hughes et al., 2001).

Information technology is definitely a major ingredient in transforming a set of organizations to a virtual organization (Koh et al., 2008). Members in a virtual organization can exchange information through, say, email or electronic data exchange, and can meet with each others using video conferencing, for example. However, using information technology alone is not a sufficient condition to form a virtual organization successfully. Information technology is merely an enabler for adopting virtual organization. On the other hand, virtual organization is not free from implementation barriers. Among them, trust among members is the biggest challenge to be addressed (Larsen and McInerney, 2002; McCarter and Northcraft, 2007). Hughes et al. (2001) also suggest some problems with respect to the virtual organization in the retail bank industry. Although their study is more specific to that industry, it is still a good reference regarding the potential problems that could occur during implementation of virtual organizations.

Virtual organizations are seldom formed from the scratch. Most likely, they have to be converted from their legacy systems. For example, Boersma and Kingma (2005) present a case study in the vehicle manufacturing sector in relation to the reformation of an enterprise resource planning (ERP) system, subject to the context of virtual organization. The resulting system is, what Boersma and Kingma (2005) claim, a hybrid logistical system which is a combination between a virtual ERP system and other materials control systems. This example shows that restructuring to a virtual organization involves business process reengineering (BPR). This requires throughout understanding of the processes to be reengineered, or unrealistically high expectation of the results of the BPR would be generated (Chan and Choi, 1997). In addition, BPR demands a good understanding of the projects objectives so that only proper and necessary changes should be made (Chan and Choi, 1997).

With respect to the objectives of virtual organization formation, Martinez et al. (2001) define four possible options that could be set up: (i) Maximize flexibility and adaptability to environment changes; (ii) Development of a pool of competencies and resources; (iii) Reaching a critical size to be in accordance with market constraints; and (iv) Optimization of the global supply chain. Another possible reason for forming a virtual organization is due to strategic alliance among the members (Talluri et al., 1999; McCarter

and Northcraft, 2007), although the terms of alliance may be temporal, i.e. for a particular time period only. As quoted in Talluri et al. (1999), "Apple Computer and Sony Corporation engaged in a similar temporary alliance to manufacture PowerBook notebooks. ... Similarly, IBM, Apple Computer, and Motorola have become involved in an interfirm alliance to develop an operating system and microprocessor for a new generation of computers". It is obvious that strategic alliance is also a driving force for forming virtual organizations. Through strategic alliance, the problem of trust issues as discussed above may become minimal because the parties involved in the virtual organization have a clear and well defined objective. Although the relationship would be temporal in some cases, the participating parties can cooperate with each other well (e.g. by sharing essential information) in order to achieve the joint inter-organizational objectives. Another empirical study, Chang (2003) found that a good inter-organization cooperation would result in positive innovation performance in an empirical study that involves biotechnology and integrated circuits industry in Taiwan and the UK. In other words, a firm's networking ability is directly, and positively, related to its technological innovation.

In conclusion, forming a virtual organization may originate from strategic alliance, and may involve a series of BPR. In this connection, this study compares the two different case studies in the same industry which have recently adopted the virtual organization approach in order to improve the performance of the respective supply chain by balancing the demand and supply. This could be done by forming a virtual organization that includes both the players in the market side (demand side) and the manufacturing side (supply side). The two cases in this paper are forming virtual organization with the background of a series of merges and acquisitions, which is a kind of strategic alliance. However, the scope of the two cases is different in the sense that one involves upstream integration while the other one involves downstream integration. It is interesting to conclude from these two cases how virtual organization approach could be a mutual solution to the two contrasting scenarios. Details are discussed in the following sections. In addition, the barriers to implementing virtual organization from the two cases will be summarized in a later section.

3. The two cases in the textile industry

In the discussion of previous literature, we have identified that the driving forces of forming virtual organization are related to the supply chain structure and its control mechanism toward the pursuing market competency by the supply chain members. The two firms presented in the following case studies correspond to the statements of Martinez et al. (2001) as they are trying to increase the flexibility to environment changes in order to fulfill the market demand in time in a global setting. More specifically, the target firm in the second case seeks the opportunities of developing new markets to break through the growth constraints by integrating the downstream brand owner of consuming products.

3.1. Upstream integration—Firm C

Established in the 1970s, Firm C has been successfully one of the leading manufacturers and fabric suppliers in the global fashion industry. It focuses mainly on the business customers which are brand owners of the clothing industry and the market distributors, by providing the fabric design, manufacturing, reproduction, and trading services. Due to the drastic change of external environment, however, Firm C has faced a series of challenges in sustaining its global competency.

First, one fountainhead of the fashion supply chain is the petrochemistry industry that has been growing prosperously as well as the consuming markets in the end of this supply chain. Such situation diminishes the bargaining power of the fabric manufacturers at the time when they need to invest more capital in upgrading the production technologies or facilities in order to satisfy the new requirements of product quality. Second, new competitors have been arising in China with cheaper labor forces and consequently they gradually attract the European and American buyers. These new entrants in China have step by step broken the existing fashion value chain in Taiwan and formed several industrial districts. Similar to other enterprises in Taiwan, Firm C has built several production sites in China and South-East Asia in order to reduce the manufacturing costs and the strength of rapid innovation and product design has kept certain competitive advantage and international sales of Firm C. However, like most subordinates of the Taiwanese firms, the headquarters does not have full control over the manufacturing sites regarding the production scheduling, inventory control, information sharing, and sales planning. In addition, Firm C only produces 7 types of the 10 key fabrics which dominate the main portion of the existing business market. The other 3 types are bundled by subcontracting to IH Firm to the customers but sometimes this subcontractor is also competing with Firm C by selling its products to the customers directly.

Hence, Firm C has to adjust its previous business model in order to shorten the time-to-market by integrating internal and external resources. In other words, Firm C looks forward to solidifying its position in binding the relationships with existing business customers and expanding the capability to fulfill the dynamic market demand.

Two actions have been taken by Firm C with the above corporate strategy in integrating its supply chains. An acquisition of Firm IH to Firm C was made including its manufacturing sites in Taiwan and China. Accompanied with the acquisition, Firm C initiated a supply chain integration project for the newly expanded supply enterprise territory. Fig. 1 depicts the simplified supply chain structure before adoption of the integration project. Accordingly, it indicates that business flows between Firm IH and Firm C have some confictions as they both sell products to the same customers without cooperation. Moreover, the situation of separated sourcing occurred in each individual manufacturing site leads to weak bargain power toward the suppliers. A supply integration project was then kicked off in the middle of year 2004. It aims to use a commonly shared information systems platform hosted by the headquarter of Firm C so as to coordinate the activities of product design, sales, manufacturing, and logistics planning among its subordinates and Firm IH.

The project was initially planned by the project team including the managers of Firm C, the consultants of an information system vendor, and the government auditors (as this project was initiated as part of a funding program approved by the government to support leading companies to strengthen the overall performance of the textile industry in Taiwan), and the authors acted as the business process reengineering (BPR) consultants. The project implementation follows the sequence: the preliminary analysis, BPR, existing systems analysis, and finally the design and adoption of the enterprise-wide supply chain system which encompasses three levels of internet-based network connection to the subordinates and the newly acquired Firm IH. As shown on Fig. 2, the development of

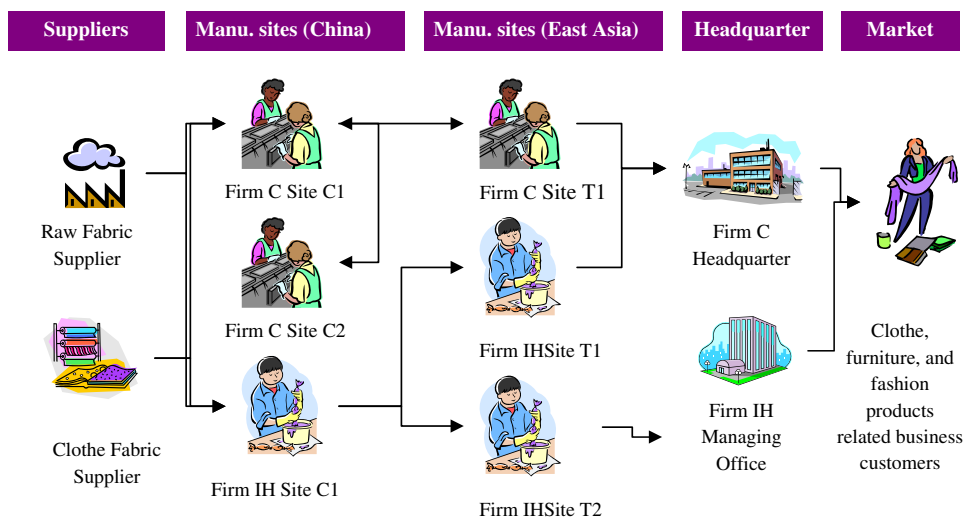


Fig. 1. The supply chain entities associated with firm C (Pre-Project).

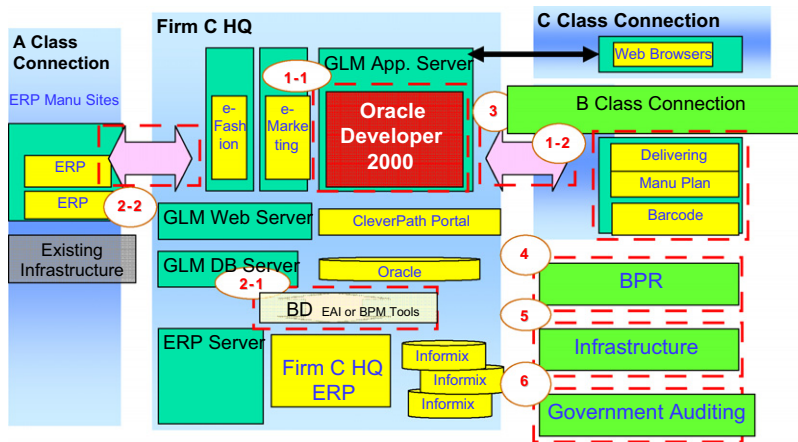


Fig. 2. The project scope of supply chain integration firm C.

Table 1
Scope and implementing sequence of Global Logistics Management Project with respect to Fig. 2.

No.	Title	Content
1-1	HQ App. server	Plan and design an app. server to host the information gathered from Fashion design and Marketing. This server also serves as the platform to serve the information request from C class connection.
1-2	GLM Business Intelligence	Enhance current ERP systems in the manufacturing sites, including the plan on delivering and manufacturing, and amend the limitations of existing Barcode systems.
2-1	GLM DB Server	Plan and design the core server to host the global information including sales orders, estimated and exact procurements, inventories, and etc. among different sites.
2-2	A Class Connection	Plan the connection among ERP systems within the separated manufacturing sites and logistics hubs, the development of mid-ware systems is needed in a few sites.
3	B Class Connection	Plan the connection among the separated manufacturing sites and logistics hubs. It focuses on the advanced information for the decision-makings by top managers on order dispatching, delivery coordinating, and capacity planning in a global context.
4	BPR	Business Process Reengineering and organization context adjusting to fit the new business model in supply chain integration.
5	Infrastructure	Procuring and Implementing the hardware/software after the planning. It includes the staff on-site training and after adoption maintenance.
6	Government Auditing	Auditing conducted by the experts from the government and universities to ensure the correct expenditure and project outcome.

an application and a database server of global logistic management is to be designed within the headquarter of Firm C, that it links to the enterprise resources planning (ERP) systems of the supply chain members through A class connection, to the expanded modules of business intelligence system through B class connection, and to the customers and suppliers by Web interfaces and enterprise portal through C class connection.

Table 1 elaborates the tasks as shown in Fig. 2 further. It is based on the case of Firm C and S, to be discussed in the following section, has a similar scope. The numbers do not represent the exact sequence of project implementing since some of the steps are adopted in a parallel mode. More specifically, C Class Connection is a minor section which exists before the project kick-off. Within the project scope, it has been strengthened to link to the GLM App. Server.

Beside the system design, this project covers the procurement of hardware and software packages, a preliminary analysis by BPR to examine the organizational adaptability to the new system, and government auditing processes. It is expected that after the systems will have been implemented, Firm C will be able to receive the complete information of customer demand, control over the production capability of subordinates, and satisfy the quality requirement and emergent orders by reallocating the orders to available production lines of the manufacturing sites.

3.2. Downstream integration—Firm S

In the current study, another project is associated with Firm S which is the focal company of the manufacturers

for consuming fabric products along the supply chain. Inaugurated in the early 1960s, Firm S has been successful in the presence of producing artificial fabric such as bedding and batting fibers, to cater for the industrial needs. Firm S has been successfully increasing the number of its production bases and the total sales volume to over one hundred million US dollars until recently. In order to break through the barrier before another growth, it adopted the strategy of reaching closely to the consumers' markets by integrating its supply chain with the market side. The project for Firm S aims to consolidate the entire supply chain so as to enter the fashion industry. Firm S used to play on the role of chemical fiber supply. It targets the more profitable segments of the supply chain by providing to the consumer market.

One of the efforts is to make the acquisition of an American brand owner, Firm A, in the furniture industry with fabric made products. Similar actions are expected to be taken in the European and Asian markets to fulfill the corporate vision of being a global brand owner. The actions of the merger in early 2004 created the need to unify all the areas of activity within the supply chain scope including the subordinates of Firm S and to collaborate with the suppliers and the wholesalers. There were new ERP introduced into Firm S two years before the Supply Chain Integration project. However, due to the failure of customization and staff training, much information and operation procedures were still pending on paper work. There was a lack of information visibility among manufacturing sites that leads to unnecessary costs and waste due to the unbalanced inventory level and demands. Furthermore, the information of KPIs was not well maintained and updated. In particular, there was a need to set up KPIs for supply chain operations.

Like the previous case, strategic process redesign began that influenced every entity of the Firm S's consuming

products supply chain. Among these we can cite the following:

- (1) It was known that within a few years the main wholesale customers would enter the emerging competitive areas such as Latin America, India, and China.
- (2) The growing market globalization involved both the need to be competitive at the regional level and to position Firm S itself in developing markets. The acquisition of Firm A and the associated supply chain integration therefore becomes a pioneer pattern of its future global supply chain system.
- (3) There was a short order-to-deliver time of 14 days requested by the wholesalers in the American market. Hence, more accurate forecasting is needed in order to reduce the manufacturing cost as shifting a major portion of Firm A's productions to Asia had increased shipping time. Similar challenges are also going to take place in other markets.
- (4) Based on the analysis of supply chain entities, Firm S has no control over the supply decision to fulfill the US market. Hence, Firm S decides to gain power by the acquisition of Firm A and reallocate some of the orders from Firm A's manufacturing sites to factory No. 2 in China and keep some Work-in Process (WIP) stocks for the final step of product assembly in the United States as shown in Fig. 3. The reason for leaving some of the assembly procedures in the factory No. 1 is due to the consideration of shipping costs calculated by product volume and preparation as the safety stocks.

In summary, Firm S is a company which, historically having had a captive market in artificial fabric materials, needs to face the challenge to centralize its power and coordinate the sales, manufacturing, sourcing, and distribution activities among the supply chain entities; in short, transforming the enterprise legions. Similar to the

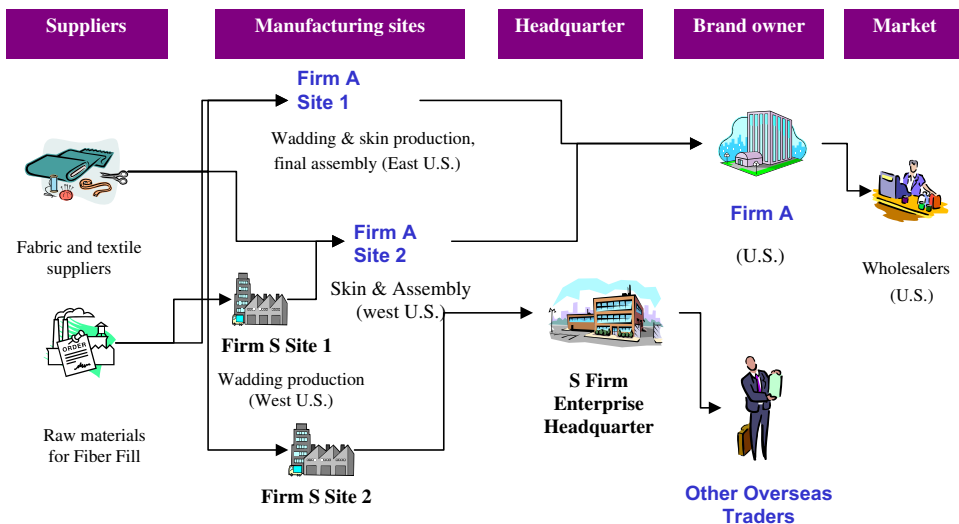


Fig. 3. Supply chain entities associated with firm S (Pre-Project).

system design portrayed in the previous case, Firm S plans to set up a global logistics database and an enterprise portal for inter- and intra-organizational information exchange and storage. The post-integrated value chain of Firm S is similar to Fig. 2 for Firm C.

3.3. Integration barriers

These supply chain integration projects commenced almost at the same time after the government had approved the funding to support leading Taiwanese companies in order to strengthen the overall performance of the textile industry in Taiwan. Firm C and S were selected to share the funds because of their leading role in the industrial sector on textile fashion products. Based on the background study, the common issues for them were identified:

- (1) there are corporate merges occurring along the supply chain;
- (2) the focal firms, which is the initiator of a supply chain integration project or the headquarter of a group of subordinates (definition can be seen in Banerji and Sambharya (1998) and Wang and Heng (2002)), are multinational companies with similar running scales in the industry;
- (3) in order to fulfill the customer demand and reduce the inventory holding cost, they intend to increase the portion of Make-to-Order productions that it partially relies on their subcontractors;
- (4) there are existing non-integrated information systems platforms among different sites that hinders the development of a centralized logistics database.

On the other hand, there are a number of different attributes between the two integration projects. Some of them are listed in Table 2 below.

As discussed before, the major difference between the two integration projects is the scope of integration: one involves upstream integration while the other one is concerned with downstream integration, although both cases occur in the textile industry. In this regard, control of

order dispatching is also different for the two cases. Firm C used to control the order dispatching but there is a lack of information visibility regarding the factories side, but Firm S, which has full access of production information, has less control on this.

In Firm C's integration project, it aims to integrate the capacities of multiple production sites particularly certain level of business autonomy exists at each of the diversified manufacturing sites and it hinders the headquarter planning for order dispatching and production scheduling in an efficient way. In contrast, Firm S's core competence is on production and has little market intelligence. In order to expand the business, the firm has chosen to acquire Firm A in order to integrate the whole supply chain by incorporating the demand information into production planning activities. However, imbalance in bargaining power between Firm S and Firm A has to be resolved.

Another dimension that makes the two projects different is the availability of past performance measurements. Since the fast expansion of Firm S in the last five years, some important KPIs have not been recorded and hence the effectiveness of the integration project may not be able to be measured accurately. This also affects the formulation of the new structure because no basis can be referenced to. However, this is not the same for Firm C because previous KPIs are well documented.

Furthermore, due to the differences in the two cases, the implementation efforts are different as well. Firm C's project involves setting up a common interface for inter-firms (or inter-site) communication. Less effort has been spent on the ERP systems. In contrast with Firm C's project, Firm S's project deal with the ERP systems in some subordinates which involve restructuring the database format of different firms.

A minor attribute of the two integration projects is the cultural issue. Firm C's project involves firms in the Asian countries only and hence cultural and language problems are minimal. In the contrary, Firm S's project involves cross-countries integration and thus cultural issues have to be taken into consideration as well. This cultural problem should not be overlooked during the course of the reformation towards virtual organizations.

Table 2
Comparison of the two projects of supply chain integration.

Issues	Firm C	Firm S
Main goal	Integration of manufacturing capacity	Integration of new market channel
Acquisition	Firm IH, an OEM manufacturer	Firm A, a US brand owner
Region	Asia (Chinese culture area)	Cross-continent (multi-cultural)
Existing confliction	Occur in the manufacturing sites because of autonomy	Power transferring between Firm S and A
Industrial sector	Upstream of the clothing supply chain	Middle to down stream of the textile furniture supply chain
Order dispatching	Controlled in the headquarter but lack of information visibility of the factories	Controlled in Firm A before the integration project. Firm S has less visibility of the market demand
Item coding	Unified coding policy	Different codes for the same item among different sites
Performance measurement	KPIs retrievable but new policy needed for new corporate territory	Pervious KPI not recorded regularly because of fast expansion over the past 5 years
Action taken	Building up a common interface for site communication and implementing organization restructuring with virtual organization	Establishing ERP in some subordinates and modifying existing database of Firm A and restructuring the item master database. Implementing virtual organization

4. Virtual organization approach

4.1. The mutual solution—virtual organization

In the end of the BPR section, the consultant team has realized the need of setting up virtual organizations for the two cases in order to empower the integration objectives of centralizing the decision makings and increasing visibility for both upstream and downstream supply chain. With the commitments of project participants and stakeholders, there are a number of mission-based units established. They spread across the entire corporate territories of Firm C and S except the profit dispatching centre and the supply chain balancing unit which have the full-time staff specifically appointed for the operations.

As illustrated in Fig. 4, the sales staff of each subordinate who are assigned as the member of *unified sales centre* should record the orders and forecast information in the ERP systems which link to a global logistics database and update the change in a daily basis. There is a unit leader and assistants appointed in the headquarters to coordinate this operation and monitor the performances of different sites. Such matrix structure ensures that the communication and information

exchange occur on time. Similar to the *unified sales centre*, the *procurement planning centre* adopts the same structure such that members are recruited from the procurement purchasing department of different subordinates. They report the demand of key items to the headquarters of the respective virtual organization where the data are gathered and analyzed for passing to the *supply chain balancing unit*. The *supply chain balancing unit* plays the central role in supply chain integration, by controlling the production planning management of each manufacturing site. The production manager is in charge of gathering the information of sales quantities, production capacity, and the procurement requirements, and then estimating the balanced figures for sourcing, manufacturing, and delivering in time. In addition, this unit maintains the categorized KPI for supply chain effectiveness which affects the evaluation of all participants within the mission-based virtual organization. Notably, a *profit dispatching unit* is designed innovatively for both cases. There are two reasons for creating this unit. First, many subordinates are registered as legal entities and it means that there are necessary paper works of quoting, selling and delivering activities even between the supply chain entities within the corporate boundary. A factory manager may attempt to remain the profit in

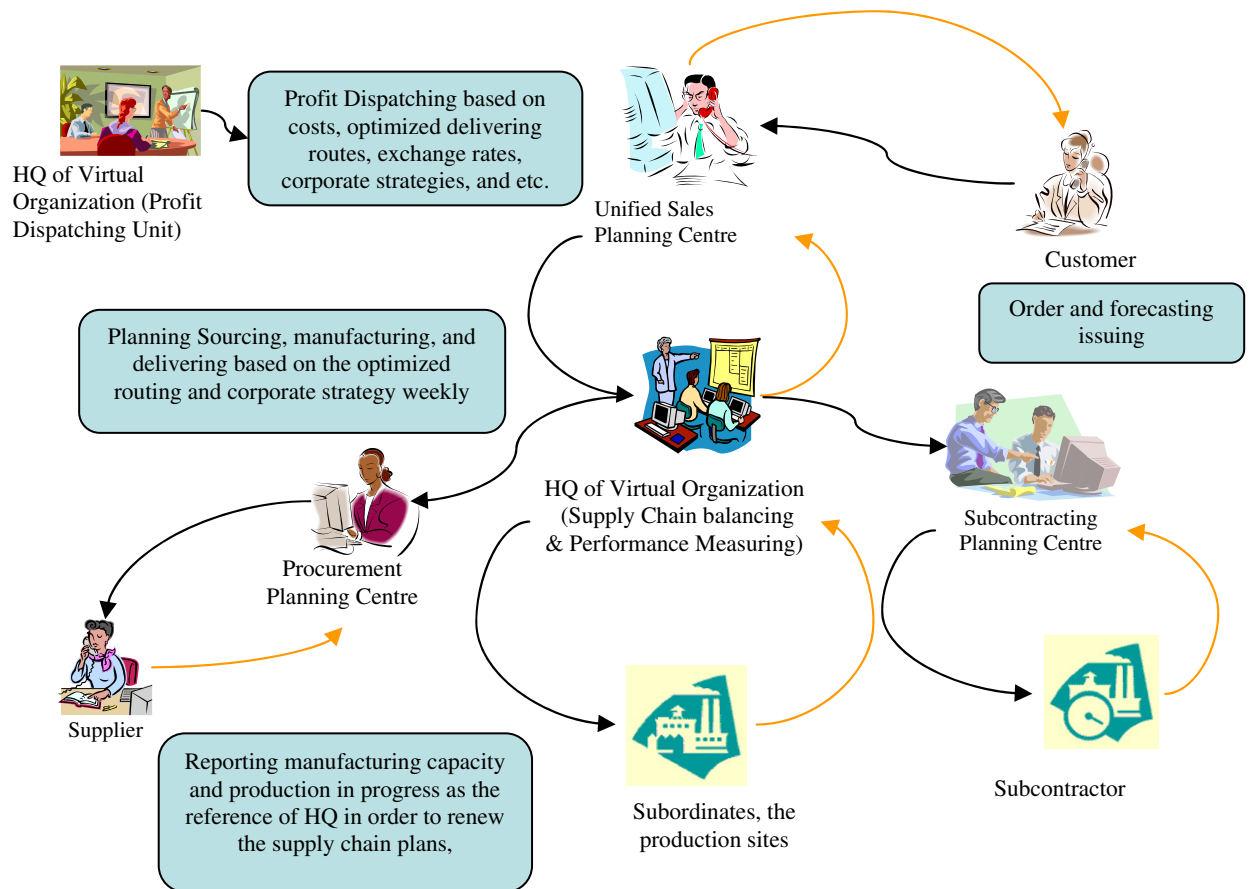


Fig. 4. Operation functions of virtual organization.

his/her own site in order to gain the better figure of annual revenue. However, it is conflictive to the corporate interest since it may be added up to be an unreasonable price in the end segment of the enterprise supply chain. Second, there are different tax rates and dynamic currency exchange rates. It would be better to have a centralized planning unit to control the pricing policy among different sites in order to maximize the enterprise benefits and avoid losing money because of the change of exchange rate.

4.2. Reflection and discussion

As discussed in Section 4.1, virtual organization approach provides a mutual solution to the two cases in this study. By adopting such an approach, information across the whole supply chain (or virtual organization) is shared properly through the dedicated information platform. In this connection, it is found that the responsiveness of the two supply chains have been improved as they have successfully shortened the order-to-market lead time. The virtual organization approach delivers the expected consequences promptly. However, implementations of virtual organization of these two cases are not risk free and are discussed below.

Regarding Firm C, there is a potential risk of inner competition between its multi-sites production facilities. The rationale behind this is due to the fact that the manufacturing processes in the production sites (i.e. the subordinates of the focal firm) are parallel to Firm C in terms of production and sourcing activities. In other words, they are independent of each other and there is a need to balance the self-interests of different production sites. In this connection, an integrated sourcing, production, and delivery program may be needed in order to satisfy the common sales goal(s). This issue has not been addressed in the above-mentioned implementation of the new virtual organization structure primarily due to the fact that this involves the decision-making processes of the whole supply chain and is a separate issue to forming the virtual organization. However, the newly developed virtual organization structure can assist the decision-making processes because information can flow among the members easier and more accurately than before.

For Firm S, the above issue is less significant because of good control on the production and sourcing activities. However, lack of control over the demand information and order allocation is the major potential risk that Firm S is facing now. The decision of order dispatching and the demand forecasting are not passed to Firm S. However, it is impossible to take over the two functions within such a short time period after the acquisition since there are concerns of generating tensions between the employees among the two enterprises, even though Firm A has been acquired by Firm S. This is because Firm A, as a brand owner maintains strong bargaining power on the said issues regarding the market information. This is a socio-technical problem and it will require time for the staff in Firm A to work with Firm S in a cooperative manner (Thatcher et al., 2007). A temporary remedy is to fostering

new staff in Firm A from Firm S directly so that Firm S can gain possession of the control of the management activities immediately. However, in order to conquer the root cause of this problem, Firm S has to establish a mutual vision with the top management of Firm A, and then penetrate the vision to the staff through corporate strategy so that they can fully understand why cooperation between the two firms is beneficial to everyone in both companies. In addition, some cross-company KPIs for supply chain performance can be setup so that Firm A is not isolated as a single entity in the newly formed virtual organization.

4.3. Initial benefits

The sales volume of fashion products by Firm S increased by approximately 33% after the project had launched. The rationale behind this may due to the fact that virtual organization functions avoid the direct conflicts between Firm S and Firm A. For the case in Firm C, it is able to have control over the subordinates and overall reduction in 25% of the costs in manufacturing and operation procedures are recorded. In other words, the virtual organization approach provided a solution to both Firm C and S that avoids the conflicts between the newly merged subordinate, and the headquarter. This distinctive feature makes supply chain integration possible. Most importantly, they present the case that virtual organization can be feasibly and practically adopted when an enterprise extends its operations by integrating or merging the other segments of supply chains.

5. Conclusion

This study presents two cases in the textile industry to exemplify how the focal firms make use of virtual organization approach to integrate their activities in order to balance the demand from market side and supply from the manufacturing side. After the integration, the responsiveness of the supply chains has improved, and flexibility in response to the market demand is satisfactory. A major success factor in forming the virtual organizations, not surprisingly, is the application of information technology. However, the major contribution of this study is to demonstrate how virtual organization approach can help the focal firms of the two cases, which are dissimilar in nature, in achieving the virtual organization paradigm, and to show why virtual organization approach could be a mutual solution for both cases.

One limitation of this paper is that it does not address the decision support systems of the related virtual organizations as discussed in Section 4. Development of associated decision-making tools in order to further improve the performance of the virtual organizations could be regarded as a future research direction of this paper. From the literature it is seen that a multi-agent system would be a good modeling technique for virtual organization in order to aid decision-making in virtual organizations (Petersen et al., 2001; Ouzizi et al., 2006; Chan and Chan, 2009). Therefore, a future research

direction to extend the present study could include an agent-based coordination approach to the case companies in order to make higher level decisions regarding the production, sourcing, inventory planning activities. In addition, a number of other factors, such as organizational issues and the behavioral issues (such as inner competition as discussed above) could influence the efficacy of the virtual organization approach. A multi-disciplinary approach may be adopted in future study to further analysis the moderating effects of the aforementioned factors.

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