Case Study on the Application of Postponement Strategy and Managerial Insights

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Abstract

Postponement is an organizational concept whereby some of the activities in the supply chain are not performed until customer order is received. Postponement is increasingly drawing the attention of companies, which not only allows companies to maintain cost effectiveness and economies of scale but also increases the flexibility of the operating system and the timeliness of delivery. In China, companies are not very familiar with this concept, and the application of postponement is still in its initial stage. We developed case studies in Wuhan district, which aimed to investigate the situation of the application of postponement in Chinese enterprise circumstances, to summarize the experiences of the application and make some contributions to the theory and application of postponement strategy. Based on the results collected from some companies investigated, we achieved in-depth insights on the application of postponement in the companies and drew some conclusions on the following respects: drivers and inhibitors for the application, initially select appropriate postponement strategy, the framework for the application, main challenges for the successful application, other findings, and so on, which will benefit companies to reap more progresses in the application of postponement.

Keywords: Application; Case study; Mass customization; Postponement; Supply chain

1. Introduction

Today’s market is characterized by the facts that customer need is more uncertain, product life cycle is becoming shorter, demand for service level of delivery and lead time of product are much improved. To serve the market and customer needs better, companies segment the market much more detailed, competition among companies is switched toward customer-based competition. It is becoming a trend for modern companies pursuing new competitive advantages to provide the customer with customized product, to fully satisfy the customer in all aspects. And companies intend to seek kinds of strategies to alleviate competitive pressure from market and end-customer, to strengthen its core competence. During the process of seeking new strategies, postponement emerges after years of negligence by academics and companies, and catches their eyes, with the development of manufacturing technology and methodology of management. The concept of postponement is about delaying activities (all kinds involved in the whole supply chain) until exact attributes of demand can be identified.

Postponement is taken as a vital element in any agile strategy and a powerful strategy to reduce and control demand variability (Christopher, 2000); it enhances the ability of company to compete on time while remaining cost competitive. “Postponement increases the company’s flexibility responding to changes in the mix of demands from different market segments. The company can improve its responsiveness to orders or reduce its investment in inventory (Lee and Billington, 1993).” Companies have improved their performances by applying postponement strategy. The success of the application of postponement returns to advocate its advantages and accelerate the studies on it and its application. It seems the prosperity of postponement has come. Based on a survey of 3693 companies a decade ago, the Council of Logistics Management indicated that a shift towards postponement was taking place in the international business world (Council of Logistics Management, 1995). More than 40 per cent of North American and almost 50 per cent of European respondents had employed postponement strategies more often than five years before. Only 24.4 per cent and 16.2 per cent of respondents, respectively, indicated that their uses of these strategies had not increased. Morehouse and Bowersox (1995) in their book forecasted that by 2005 more than half of all inventory in food supply chains would be retained in semi-processed state at manufacturing locations, waiting for final manufacturing or packaging to meet customer’s specifications. An increasing num-

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ber of European industrial companies are implementing postponed manufacturing systems. Generally speaking, in these systems, three areas of postponement are combined: the semi-finished products are customized into final products according to a specific customer need (Form Postponement) when an order from customer arrives (Time Postponement), then these final products flow into downstream distribution systems, and ordinarily are delivered into retailers or end customer directly (Place Postponement).

For the application of postponement strategy, the success of Hewlett-Packard is a famous case. A low cost thermal inkjet printer manufactured by Hewlett-Packard Co., comes with different materials enclosed in the package, depending on the market. The manual has to be written in the local language, for example, the power supply is packed separately to match the local voltage supply easy. Yet the generic printer is same everywhere. HP sells over two dozens country-localized versions of printer. At one time, products were completely assembled for every market at the factory. Then, after careful analysis, the process is changed. Generic printer is now shipped to regional distribution centers, where workers combine printer with the right power cord and manual to meet demands in places as different as Jakarta, Helsinki, and Minneapolis. Product differentiation is postponed from the factory. Product localization is assigned at the warehouse. In the case of the HP DeskJet, no change is made to the existing product design. But substantial process change—relocating the box kitting process from factory to distribution center—leads to many benefits. For example, inventory requirement is greatly reduced, which results in a substantial cost saving. One large stock of generic printers replaces its more costly predecessor, multiple large stocks of printers kitted for sale in England, France, Germany, and other countries. This benefit, which comes from risk pooling, motivates many postponement decisions.

The successful case is not just only HP inkjet, Benetton is another well known example (Yeh and Yang, 2003). The application of postponement has never stopped its steps to go forward. More and more companies are joining the array of the application of postponement. It is easy to make a long name list of companies which have been applying postponement strategies: Wal-Mart, Bally Engineered Structure, Federal Express, National Semiconductor, Measurably Better, Dell Computer Corporation, Intel, Hitachi, Mitsubishi, Panasonic, France Telecom, Toyota Motor Company, and IBM Rochester…

Apparently, we notice that these cases all come from the U.S or Europe. Postponement is not an unfamiliar concept there, while it is still some new in China, which motivates and encourages us to explore the following problems: in the present Chinese market, to what extent, Chinese companies understand the concept of postponement? How does a company apply the strategy of postponement? What is the status of the application of postponement for the company? What are the main factors will drive or inhibit the application of postponement for the company? To answer these interesting problems, in 2003, we took a basic investigation to some companies in Wuhan, furthermore, we applied a supplementary one in the winter of 2004. Based on all the results obtained, we analyzed them and achieved some insights on the application of postponement and draw some conclusions. We believe that what we did will help company enhance its understanding the essence of postponement and improve the performance of the application.

The paper is arranged as follows: section 2, the history of postponement and background are introduced, section 3 and section 4 explain the investigation, the method applied, delineate the results we achieve, and analyze the results, the last section, section 5, conclusion is drawn, and the research limitation and future study is analyzed.

2. Literature Review

To offer high product customization without incurring immense costs, as first recommended by Alderson in 1950, producer should add options or make differentiating changes to the product close to the time of purchase by end customer. The approach is referred to as postponement, that is, the extent to which production and distribution are delayed. Alderson’s recognized that offering product options to customer was inherently beneficial because it allowed a company to meet customer needs more closely. He argued that cost would be reduced by postponing a necessary stage to produce different final versions of the product. However, he did not address other issues associated with postponement such as the potential of losing customers or the impacts on various costs.

When a company postpones some manufacturing activities, customer may have to wait longer for the product and switch to its competitor’s product. Also, there is a risk of not being able to fulfill a customer’s order at the time quoted. Consequently, without effective supply chain management, the more postponement is used, the less certain the quoted delivery date is.

Then research on postponement dates back to Bucklin (1965), whose rigorous analysis of postponement made it a more useful concept. He viewed postponement as a means by which a supplier may shift risk to the buyer. He made a distinction between postponement and speculation: postponement involved delaying value-adding activities until a customer order was received, and speculation involved adding value before the order was received. After 1965, few papers were published on postponement until 1988, when Zinn and Bowersox (1988) presented a framework to suggest conditions in which postponement was justified. The most important of these conditions were: (1) high unit value of the product; (2) high sales fluctuations in the industry; (3) a company with a large number of distribution
warehouses; and (4) a company that offered several versions of the product (i.e., high product customization).

Lee et al. (1993) demonstrated to the case of Hewlett-Packard with using the term of design for localization. In fact, the strategy Hewlett-Packard applied could be treated as postponement. In that paper, Lee et al. just used a famous case to explicate the term ‘design for localization’. Later, Feitzinger and Lee (1997) again restricted their attention to the case of Hewlett-Packard, they explicated the Hewlett-Packard application of postponement to realize mass customization. The concept of postponement was closely related to that of mass customization, “the key to mass customization effectively is postponing the task of differentiating a product for a specific customer until the latest possible point in the supply network (a company’s supply, manufacturing, and distribution chain)”. They presented three organizational-design principles to form the basic building blocks of an effective mass customization program: (1) modular product design; (2) modular process design; (3) agile supply networks which were the methods of postponement and at the same time, effective ways to achieve mass customization. Brown, Lee and Petrakian (2000) introduced the experience of Xilinx Firm which had improved its semiconductor supply chain by using product and process postponement. This semiconductor firm used two different postponement strategies: product postponement and process postponement. In product postponement, the product was designed so that the product’s specific functionality was not set until after the customer received it. So, Xilinx’ product was designed to be programmable, permitting customer to fully configure the function of the integrated circuit using software. In process postponement, generic parts (component commonality, for example: Jack C. P. Su et al., 2004) were created in the initial stages of the manufacturing, while in the later stages, semi-finished products from the initial stages were customized into final products according to specific customer needs. Xilinx manufactured a small number of generic parts and held them in inventory. The use of these generic parts allowed Xilinx to hold less inventories in form of final products. And for some final products, Xilinx can perform the customization steps quickly enough to allow them to build-to-order.

Pagh and Cooper (1998) identified four generic supply chain postponement/speculation strategies by using the Postponement/Speculation Matrix, and cited some empirical examples; proposed important postponement/speculation determinants; finally presented a descriptive and normative tool (the Profile Analysis) for selecting the most appropriate supply chain postponement/speculation strategy. Van Hoek et al. (1998, 1999) made great contributions to the application of postponement. They provided an in-depth analysis of experiences of four companies in managing the change process associated with the application of postponement strategies. They also identified operating and organizational characteristics to assess the attractiveness of postponement in their specific business settings. They found, in particular, an organization’s administrative heritage and the lack of an overall supply chain vision could be major bottlenecks in managing the change process. To apply postponement strategy successfully, companies should establish the appropriate mix of standardization and customization in the supply chain. They pointed out that difference in the internal organization and external demands for product specificity would require different postponement strategies. Furthermore, Van Hoek et al. (1999) developed a survey of postponement application and carried it out with the Dutch national bureau of statistics aiming to measure the following questions: (1) the formation of strategies capabilities that were needed to realize a mass customization strategy; (2) the application of postponement; (3) the extent to which companies with varying organizational heritage had different strategic capabilities and levels of postponement to realize mass customization. The results showed mass customization related capabilities had been developing increasingly in the past five years. In line with the results, changes happened in operating environment; the degree of the application of postponement grew, though in most cases it was still restricted to the end of the value chain. They analyzed that American companies with high scores on mass customization related capabilities performed worse on postponement and for European companies, enhancing scale effects deserved priority.

Chiou et al. (2002) empirically examined four types of form postponement proposed by Zinn and Bowersox through 102 IT firms in Taiwan and explored the factors affecting the adoption of different form postponement strategies. Huang et al. (2003) took a case study in Taiwan’s PC industry who was seeking a new supply chain structure “virtual manufacturing alliance” that was through global logistics strategy combination the modularity and postponement concepts to configure the supply chain.

All the literatures mentioned above, actually do less deep analyze: how a company applies postponement in an organizational level; what kinds of problems are involved during the application of postponement; what is the framework for the application of postponement strategy.

3. Case Studies

3.1 Research Method

In order to answer the questions put forward in section 1 and 2, case study was intermittently carried out in two stages: from September to December of 2003 and from November to December of 2004, in Wuhan district, China. In the first stage we focused on collecting the basic information of companies and their applications of postponement, while in the second stage we centered to get the information on their progresses and problems during their applications. Six companies were deliberately selected as
our cases from our initial comprehension on Wuhan’s enterprise environment. Basically, the following reasons drove us to take the specific companies as our cases in Wuhan: (1) Wuhan is the centre of China and one of the bases of manufacturing industry, whose advanced companies applied postponement strategy could, in some extent, reflect the application level in manufacturing industry of China; (2) the companies selected were five Joint-Venture ones and an IT firm, which had more incentive to apply an advanced management method or theory if it really did help them, and actually had applied or tended to apply postponement strategy through our introduction to postponement during our first stage investigation, and were distinguished from most of companies that had not any idea or plan on postponement; (3) the companies lie in the upstream, midstream and downstream supply chain, whose applications owned their characteristics and from which some managerial insights could be derived and concluded; and (4) the cases contributed to the knowledge of the relevant management change processes associated with the implementation of postponement strategies.

We visited six companies selected: five Sino-European Joint Ventures and a famous IT company, in Wuhan district and besides our visits, we contacted them times and had them clarify some questions. During two stages of our investigation, no strict interview protocol was developed. We paid more efforts in the first stage than in the second one, for introducing and discussing the method of applying postponement with the companies. As we mentioned before, postponement was still a bit new for Chinese enterprises, and some of employees of companies were not familiar with the concepts (impression achieved by our previous experience with them). So in our first stage investigation, we deliberately developed a questionnaire based upon the work of Pagh and Cooper (1998), Van Hoek (1998). Beside taking the questionnaire as a cue in first stage, in both stages we used a set of questions on postponement, not included in the questionnaire, based on our experiences and the relevant references, to assure all the information we need were collected. Through getting an effective communication with them, we could understand their applications of postponement in depth. In fact, all companies collaborated with us in all respects, including answering questions in detail, showing us around their work floors, etc.

All cases were grounded on similar information collection and analysis procedure. Information was gathered through company visits, shop floor observations and semi-structured interviews with some employees of the companies we visited.

3.2 Basic Information of the Companies and Investigation Results

The case companies are briefly introduced and basic investigation results collecting through two stage investigation are described as follows:

Company A

Company A is the grand Sino-France auto-making joint venture and the important project of the Eighth Five-year Plan of State economy, founded in May, 1992. The production scale of the company is to be 300,000 cars and 400,000 engines annually based on the development strategy of constructing one project through two phases. At present, the company has more than 5,000 employees with its capacity of producing 150,000 cars and 200,000 engines annually, mainly Fukang series and Xsara Picasso.

The company always attaches great importance to the development of the new products, applying itself to providing Chinese customers with cars of good performance and low price. In addition to introducing new products, the company has stayed at the leading technological process and assimilated managerial methodologies from its mother companies, which has helped establishing the scientific management system and the management policy of Market-oriented, Quality-based, Management-driven and Profit-oriented in the company.

By the time we visited the company, it had employed the assembly and manufacturing postponement strategies in some areas intuitively. The interviewee believed that, if the company could intentionally apply postponement strategy and redesign its processes and supply chain, it would achieve better performance. He expressed his views for the application of postponement: (1) the employees should have a clear picture on postponement, and the company also should make more efforts to advocate the postponement strategy and train its employees. After all, application of an advanced strategy or management methodology was a challenge to traditional method; (2) when postponement strategy was applied, relevant adjustments to the organization and human resource, improvement on management system and optimization on management information system would be needed; (3) the company should try its best to establish flexible management system (FMS) to support and collaborate the application of postponement; (4) in the aspect of production, some shortages did exist. The company should always keep track of production processes; (5) production department and sales department should be integrated seamlessly. The two departments need form a relationship of closely collaboration based upon their own definite assignments within an effective management system; and (6) currently, it was difficult for the company to realize entirely design postponement, because of limitation of supply chain and its capability.

Company B

Company B is a high-tech cooperation dedicated to the manufacturing, research and development of optical fiber and cable products, which is the largest one of the kind in China at present. Being equipped with the state-of-
the-art technologies, the company is able to offer customers various a complete stock of fiber and cable products.

The company has modern plant buildings and equipment and adopts the advanced fiber and cable technologies and modernized management method and system. In 2001, the company successfully enlarged the annual fiber capacity to 10 million kilometers and the annual cable capacity to 7 million fiber-km.

The company is producing all kinds of fiber performs with the Plasma Activated Chemical Vapor Deposition (PCVD) process. Integrating production experiences, improvements and innovations, it has accumulated its own wealth of cable production technologies, which represents the world class. As the largest cable maker in China, the company can supply the latest and the most competitive cable products on the access network market.

To produce fiber and optical cable, glass tube should be made at the first stage of production then the basic attributes of fiber have been determined. The optical cable is made of fiber and its production accords to order. The company had applied first stage manufacturing postponement, our interviewee argued, in term of the characteristics of fiber and optical cable, it was not suitable to apply any other type of manufacturing and assemble postponement strategy during its manufacturing and distribution processes. He also addressed that the application lacked of enough top management commitment.

Company C

Company C is a small-sized company, founded in 1991. The range of products gradually evolved and expanded as the science of commercial vehicle construction went through rapid changes. Now the products include a complete range of component for articulated vehicle equipment, semi-trailers: fifth-wheel couplings, mounting plates and telescopic landing gears etc. The company only owns one shop floor with several computer-controlled production processes.

The customer need fluctuates periodically which drives the company applying manufacturing postponement. The interviewees talked about the problems they were confronting: (1) operational problems caused by product proliferation, (2) increased workload of management, (3) the trend of lengthening lead times. According to what they said, during the process of production, the company should provide different types of products in line with specific customer need, and in terms of these products, the company should also update the engineering files, inspection files and package files, reorganize production in batches, inspect the quality of products strictly.

The company was equipped advanced information infrastructure, such as: Internet, Local Area Net. The company had installed CAD, Project 2003 and a Chinese accounting software.

Company D

Company D is an auto electric manufacturing company who is jointly invested by foreign and domestic corporations and its business scope ranges from designing, manufacturing, and selling electric appliance to providing relevant auto components and the main business concentrates on electric wire harness for some famous automobile companies.

In order to provide the customer and car owner with superior quality and cost products and services in China and world export market, the company has improved its performance by means of implementing its world standard quality management systems, advanced technologies and employee training, utilizing China developing local industrial strength and abundant human talents to control internal forces and adjust external influences.

The company had applied postponement strategy intuitively. In our visit, according to the question: how it applied postponement strategy, the interviewee answered: first, analyzing all processes, redesigning them, separating the generic processes from the specific ones, next, finding out most common part of processes, pushing product differentiation near the end of manufacturing stage in order to realize postponement. As far as the benefits of the application of postponement were concerned, she concluded: (1) more rapid reaction to customer needs, (2) reduction on inventory, including semi-finished products and final products.

Company E

Company E is a joint-venture company and its main business is to produce subsidiary plastic products for automobile, cooperating with automobile manufacturer in China. The company employs ISO9002 quality management system and its production control is excellent with only 1% scrap. The production is relatively simple, only has several processes. Its main customers are big automobile companies.

The company adopts JIT mode to organize its production, purchasing its raw materials throughout the world. It has established logistics department, integrating part of functions of purchasing and sales department into logistics department. For the company’s product proliferation and its number of products, logistics department could optimize the whole flow of material and information.

Interviewees said they had applied manufacturing postponement strategy, and it was entirely necessary to implement postponement, which could benefit the company: (1) reducing raw material, components and final products’ inventory; (2) meeting the customer need timely and exactly. When discussing the problems of the application, they argued that problems were: (1) sales uncertainty and fluctuation caused complexity of production; (2) sales department sometimes failed to understand the customer
demand and to deliver orders to manufacturing department in time. They thought the company had better increase the proportion of standard processes.

Company F

Company F is a high-tech joint-stock enterprise engaging in researching, developing, designing, manufacturing, marketing and service of telecommunication terminal equipments and relevant management systems. Within ten years since foundation, the company has developed into a national key new and high technology enterprise possessing many independent intelligence property rights. Its main products—Public Phone Bill Meter and its management system occupy 80% of the market share throughout our country. IC Card Payphone series and management systems take the leading place in technical design and solution of the same trade. Besides, the company provides the whole set of intelligent public payphone solution based on intelligent platform and Public Internet Access Terminal (short as PIAT) and its management system based on advanced embedded operation system. Centering on the demand of customer, the company sets up an efficient market and service network including 28 agencies in China.

Before applying postponement strategy, the company didn’t have a holistic planning on materials, semi-finished products and final products. To keep high service level for the customer, the company needed maintain high inventory, because sales men deliberately expanded the customer need, when they putting forward their sales plan. During our first stage of investigation, the company was on its pilot stage of the application of postponement.

Enabler factors for implementing postponement strategy are the following: (1) product proliferation, generally, the company introduces new or enhanced versions of products before present products reach the end of their life cycles. The average manufacturing lead times of products are short (about 3-4 work day); (2) characteristics of market. The demand of market is turbulent and customers most of time have their own individual needs. The company has employed some measures for the application of postponement, such as: (1) training and advocating postponement; (2) adopting Assembly-to-Order (ATO) mode for production.

Table 1 summarizes the basic information of products and operations characteristics we collected from the companies.

<table>
<thead>
<tr>
<th>Product Characteristics</th>
<th>Company A</th>
<th>Company B</th>
<th>Company C</th>
<th>Company D</th>
<th>Company E</th>
<th>Company F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage of Product Life Cycle</td>
<td>Maturation</td>
<td>Maturation</td>
<td>Maturation</td>
<td>Maturation</td>
<td>Maturation</td>
<td>All Stages</td>
</tr>
<tr>
<td>Product Type</td>
<td>Moderate</td>
<td>Standard</td>
<td>Moderate</td>
<td>Standard</td>
<td>Customized</td>
<td>Moderate</td>
</tr>
<tr>
<td>Product Range</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Wide</td>
<td>Wide</td>
</tr>
<tr>
<td>Value Profile</td>
<td>Initial Stage</td>
<td>Initial Stage</td>
<td>Middle Stage</td>
<td>Initial Stage</td>
<td>Middle Stage</td>
<td>Final Stage</td>
</tr>
<tr>
<td>Specific Formulation of Products</td>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>Moderate</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Specific Peripherals</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Commonality of Component</td>
<td>Moderate</td>
<td>Low</td>
<td>Moderate</td>
<td>Low</td>
<td>Moderate</td>
<td>High</td>
</tr>
<tr>
<td>Value Density of Products</td>
<td>High</td>
<td>High</td>
<td>Moderate</td>
<td>Low</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Technology and Process</td>
<td>Moderate</td>
<td>High</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
<td>High</td>
</tr>
<tr>
<td>Decoupling Feasible?</td>
<td>Some can</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Complexity of Customization</td>
<td>Moderate</td>
<td>High</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
<td>High</td>
</tr>
<tr>
<td>Modular Product Design</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Sourcing from Multiple Locations?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Economic of Scale</td>
<td>Moderate</td>
<td>Large</td>
<td>Moderate</td>
<td>Small</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Market</td>
<td>Life Cycle</td>
<td>3-5 years</td>
<td>2 years</td>
<td>3-7 years</td>
<td>1.5 years</td>
<td>3-5 years</td>
</tr>
<tr>
<td>Required Lead Time</td>
<td>2 weeks</td>
<td>High</td>
<td>Moderate</td>
<td>High</td>
<td>Moderate</td>
<td>High</td>
</tr>
<tr>
<td>Delivery Frequency</td>
<td>High</td>
<td>High</td>
<td>Moderate</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Price Competition</td>
<td>Yes, seriously</td>
<td>Yes, seriously</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Varied Markets and Customers</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Special Knowledge and Capacity</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
4. Further Investigation Results, Result Analysis and Managerial Insights

This sector is the cross-case analysis of the results. Based on the further investigation results and our analysis on them, we achieve some managerial insights, such as: the drivers and inhibitors for the application, the initial selection of postponement strategy, a framework for the application, key challenges for the successful application of postponement and other findings should be emphasized.

4.1 Drivers and Inhibitors for the Application of Postponement

The word ‘turbulent’ is often used to describe the market in some academic papers and generally the market is becoming more uncertain than before. We investigate six companies, four of them can be classified into automobile industry, and the left two belong to IT industry. The customer demands to the two industries are much more fickle and complex than to others. Our investigation results show the companies (e.g., Company A, B, F) are characterized by high demand uncertainty and enduring the frustration that traditional forecasting methods for the markets are not always reliable. Demand uncertainty could be easily concluded as one key driver. China is still in its elementary phase of market economy, for companies, price is an effective way to compete in the market. Apparently, the companies in automobile and IT industries are facing the fierce price competition from the markets, which is another key driver.

In present market environment, customer demand to products and services is more individual than years before. Demand for customization is a trend, which is a consensus for the companies investigated and often leads to product proliferation. While demanding for customization, customer often requires short lead time. Then in order to follow the pace of developing the product serials and keep the competence, companies have to shorten their product lead times. Companies which are demanded for customization and short lead time would benefit from appropriate postponement strategy. Especially delaying differentiation closer to customer will reduce the lead time of products. As illustrated in the table 1, Company D’s product lead time is merely one and a half days, the average product lead time of six companies’ is less than 1.5 weeks.

In sum, key drivers for the application of postponement are: (1) demand uncertainty, (2) price competition, (3) demand for customization, and (4) short lead time.

Quick response to customer demand is the primary aim company pursuing. ‘Postponement’, as a concept, is counter-intuitive, which has company leave inventory in a less finished condition. By virtue of our detailed introduction for postponement strategy in our first stage investigation, the companies got their deeper understanding on postponement and its application. Company A, and D had applied postponement intuitively based on their managerial exploration, they still benefited from our communication, according to their response. Our investigation findings show lack of deep understanding on postponement and its application as a key inhibitor limits the company’s initial passions on it. Further, when companies intend to apply postponement, they are often confused by lack of the methodology and experiences to analyze operations and select an appropriate postponement strategy. In fact, even in academic field, research achievements on postponement less contribute to a mature and practicable methodology for selecting appropriate postponement. A postponement implementation involves fundamental changes not only to a company’s manufacturing processes or internal operations, but also to external operation and collaboration with its strategic partners within the supply chain. Basically to apply postponement strategy, a company requires a flexible, just-in-time production model, and its supply chain partners must respond by gearing supply and production accordingly. ‘But in China, generally poor performance of supply chain also limits for companies to apply postponement’, the interviewee of company E said. Chinese enterprises more focus on their internal operations solely based on their own enterprise environment.

Thus, we also can summarize the key inhibitors are: (1) lack of deep understanding on postponement and its application, (2) little knowledge of methodology, and (3) limitation of Supply Chain.

4.2 The Initial Selection of Postponement Strategy

According to the basic characteristics of companies, from our first sight, what kind of postponement is suitable for them? This is an important problem for any company who prepares to apply postponement strategy. Pagh and cooper (1998) introduced a method, so-called profile analysis, to select appropriate postponement strategy. They divided the whole supply chain operations into two parts: manufacturing processes and logistic operations, on which, according to the speculation or postponement strategy applied, forms four generic supply chain P/S strategies. Though the four P/S strategies, to some extent, are relative ‘coarse’ for companies in China, the scope of decision determinants and analysis to P/S strategies in profile analysis present us an important foundation for postponement selection. In this part we intend to generalize a table (see Table 2) to help manager initially evaluate what type of postponement is justified.

At our first stage of investigation, we deliberately collected some data from six companies which were primarily aimed at determining the characteristics that favored postponement. Furthermore, we discussed with our interviewees and justified our views on this issue, the process of discussion contributed to design the following Table 2 based on Pagh and Cooper’s work. Frankly, the Table 2
### Table 2. Characteristics Impacting the Selection of Postponement Strategy

<table>
<thead>
<tr>
<th>Operations Characteristics</th>
<th>Company’s Focus</th>
<th>Effect and Influence of Postponement</th>
<th>Possible Postponement Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Life Cycle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction</td>
<td>Customer service</td>
<td>Keep logistic efficiency</td>
<td>Final manufacturing, assembly postponement</td>
</tr>
<tr>
<td>Growth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maturity</td>
<td>Cost and demand stability</td>
<td>Reduce cost, minimize risk and demand uncertainty</td>
<td>Manufacturing postponement</td>
</tr>
<tr>
<td>Decline</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Product Type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td>Cost, service</td>
<td>Keep economy of scale</td>
<td></td>
</tr>
<tr>
<td>Customized</td>
<td>Specific customer demand</td>
<td>Own customization competence</td>
<td>Design, engineering or manufacturing postponement</td>
</tr>
<tr>
<td>Value Profile</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial Stage</td>
<td>Inventory cost</td>
<td>Avoid high inventory cost</td>
<td>Design or engineering postponement</td>
</tr>
<tr>
<td>Final Stage</td>
<td></td>
<td></td>
<td>Final manufacturing postponement</td>
</tr>
<tr>
<td>Specific Formulation</td>
<td>yes</td>
<td>Meet demand</td>
<td>Improve customization</td>
</tr>
<tr>
<td>Specific Peripherals</td>
<td>Yes</td>
<td>Meet demand</td>
<td>Improve customization</td>
</tr>
<tr>
<td>Value Density</td>
<td>High</td>
<td>Inventory cost</td>
<td>Reduce cost</td>
</tr>
<tr>
<td><strong>Technology and Process</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decoupling Feasible?</td>
<td>Yes</td>
<td>The prerequisite for postponement</td>
<td>Manufacturing postponement</td>
</tr>
<tr>
<td>Complexity of Customization</td>
<td>Yes</td>
<td>Cost, meet demand</td>
<td>Limited loss scale of economy</td>
</tr>
<tr>
<td>Modular Design</td>
<td>Yes</td>
<td>Customization</td>
<td>Favor customization competence</td>
</tr>
<tr>
<td>Sourcing from Multiple Locations?</td>
<td>Yes</td>
<td>Cost</td>
<td>Reduce transportation cost</td>
</tr>
<tr>
<td>Required Lead Time</td>
<td>short</td>
<td>Meet demand</td>
<td>Short lead time</td>
</tr>
<tr>
<td>Delivery Frequency</td>
<td>Yes</td>
<td>Meet demand</td>
<td>Keep high service level</td>
</tr>
<tr>
<td>Demand Uncertainty</td>
<td>Yes</td>
<td>Risk of lost sale, obsolescence, inventory cost</td>
<td>Reduce uncertainty</td>
</tr>
<tr>
<td>Price Competition</td>
<td>Yes</td>
<td>Cost</td>
<td>Reduce cost</td>
</tr>
<tr>
<td>Varied Markets and Customers</td>
<td>Yes</td>
<td>Market segment, product position involved</td>
<td>Satisfy customer demand better</td>
</tr>
</tbody>
</table>

Note: We classify labeling and packaging postponement into final manufacturing postponement just gives us a rationale for initially selecting a postponement. We are sure there is a welter of complex technology, process, product and management issues surrounding postponement, and probably no hard rules for right postponement decision-making.

### 4.3 A framework for the Application of Postponement

As mentioned above, at the first stage of investigation, some companies improved the understanding on postponement and passionately planned the application of postponement. After one year of their applications, at the second stage, we discussed the processes of applying postponement with our interviewees from all companies we visited. From our understanding on postponement, practices and experiences from the companies, we generalize a framework for the application of manufacturing postponement: (1) vision, (2) design and plan, (3) execution, and (4) review.

Generally, to implement postponement strategy, one company may set up a leading team to implement the strategy. The leading team should consist of one or two staff members from top management (e.g., a vice general manager in charge of production), production manager, inventory or logistic manager, and some other members from work floor, design, engineering, or finance department.

1. **Vision**

   In the first step, the leading group needs to elucidate the reasons for the application of postponement and depict a whole picture for the company’s application which embodies the company’s perception on benefits and wishes by implementing the postponement. The vision here is similar to the ‘vision’ in strategy management, but
closer to the meaning of 'target' for the application, e.g.: company E’s vision: Restructuring a quick responsive production system, and reducing 20% inventory. Basically, the vision is achieved based upon expectation on postponement, the analyses of competency and weakness of supply chain, strategic preference and the characteristics of operations, etc. After all, different company has different targets.

(2) Design and Plan

For the second step, the leading team synthetically consider and balance all dominant factors involved (at a tactic and operational level), such as cost, customer requirement, responsive time, service level etc., so that the supply chain and business processes can be best designed and organized to realize the vision. As postponement can be applied along the entire supply chain, not merely in logistics or in manufacturing, in this step, the key is to decide what form of postponement is suitable and where the customer order decoupling point (CODP) is set in the operational processes. One way is to build detailed spreadsheet models to weigh the factors under the vision. This process may need all of company’s business functions—R&D, marketing, manufacturing, and finance—contribute to these models. Postponement design includes not only restructuring existing operations through adding new operations or repositioning activities, but also devising the performance measurement and responsibilities in corresponding position for company’s employee and other respects. Applying postponement almost inevitably involves changing positions and criteria of employees. Therefore, the change management plan should be practically designed to meet human criteria as well as the economic rational considerations.

Obviously, if the restructuring or reengineering process is complicated, it may give rise to the change of organization. At last, the team should make the detailed scheme for the application.

(3) Execution

The third step concerns smoothly applying the postponement design according to the plan made in former step. In the phase, the team especially needs to identify and tackle potential bottlenecks and focuses on the change brought to the people. Some activities in this step may be necessary, e.g., an extended period of preparation and training may be executed prior to the formal application of postponement embodying considerable uncertainty; similarly, prior to implementation of a process change, extensive simulation tests may help reduce either the possibility or the extent of production disruption.

Substantially, the step is closely related to the process of change management. If we appropriately tackle the change, with the prerequisite of detailed design and plan, the difficulty will be under control (But in recent literatures, the difficulty of applying postponement intends to be enlarged or aggrandized by academic researchers).

(4) Review

Step four aims to review the effectiveness of the changed operation system versus the vision and targets after applying postponement strategy and to evaluate the application process in accordance with the plan and design, then make adjustment to the application processes, or even on the former three steps. The important work in the step is to utilize the right and reasonable performance indexes for review and evaluation, for example, company A took the following indexes: inventory, responsive time and cost.

We should point out that the four steps interact on each other and form a close loop.

4.4 Key Challenges for the Successful Application of Postponement

In literatures on postponement, few failure cases on application can be found, and lessons or problems on it are less presented either. When a company loses guide by the lessons or experiences, its application may be frustrated with lower productivity, excessive equipment downtime, and deterioration in quality, etc.

Both the application of postponement and its problems vary from companies. We present some primary problems digesting from the companies investigated, with the purpose of contribution to future applications (shown in table 3).

All the problems can be divided into two categories: problems in each step and those existing in whole process of the application. We start from discussing the problems in each step, then to those common ones in whole application.

‘Unreasonable targets’ is the first factor to cause trouble for the application of postponement in step of vision. A company realizes successful application of postponement possibly brings it many benefits: decreasing lead time, improving order fill rate, reducing inventory cost, minimizing the costs of production, quick responding to change in demand, etc., when it gives high expectation on the application of postponement, it may set high targets for the application, e.g., company A had set one target: reducing inventory 30%, which was proven to be very difficult for it. If a company fails to clearly know what the postponement can afford, its application of postponement may go wrong direction. If a company intends to improve the targets which do not match the strength of postponement selected, the application can not completely reach the targets it sets. Company A, C employed manufacturing postponement strategy, which was difficult to contribute to reduce the lead time sharply.
Lack of supply chain perspective is a common problem for companies in China. When a company’s condition changes, the company tends to focus on those changes within its own environment rather than pay much attention to how to collaborate and integrate the supplier and distributor into its new supply chain.

There are no sufficient analytical models and tools supporting companies to implement postponement strategy. When the staff members in the companies do not understand the postponement in depth, they can not achieve the best use of postponement. And while keeping the pace of progress, they can not tackle the problems properly, which might result from poor resources for analysis. The interviewees from Company B, C, D had ever complained to us that they were hard to get the references on the models and tools for the application of postponement.

Company C and D were limited by their financial status, they laid tight budgets for the application. Some problems appeared in later steps of their applications of postponement, e.g.: resource allocation, shop-floor worker resistance, which partly attributed to the companies’ tight budgets.

Sometimes, the application of postponement is constrained by technology. Company B intended to apply final manufacturing postponement, but its production line could not be separated in its downstream manufacturing processes, thus, technology limitation became an inhibitor. Postponement implementation is generally involved in decoupling processes.

Timing also is an important factor. Suitable change speed can keep a right rhythm for applying postponement. At a certain time, introducing a scale of change that is too great to absorb causes severe problems, can mismatch the original plan of the application and impede actual production schedules.

Due to a lack of understanding of what constitutes a comprehensive set of postponement practices, most companies probably neglect or underestimate the disruption during the change process.

Pilot implementation can show the company an example, and demonstration of the success of precisely targeted pilot program conduces to reduction of risk in later steps. But in our investigation, relative companies: Company C, D, E, in order to save costs, or limited by their budgets, omitted the pilot implementation. A large company can more easily invest in pilot production lines for experimentation and test and thereby reduce uncertainty regarding the extent of disruption from process change, such as company A, F. As introduced before, company C, D, E are relative small ones, but company C, E achieved good results without any pilot program because of their simple technology changes, while, company D resulted in production disruption for no pilot program.

Organization align ensures shifts, teams, departments can synergically work together according to their tight-coupled responsibilities. Deficient organization align cannot not burden the need and pressure of postponement which is often involved in fundamental changes for business processes. In later phase of the application, Company A, B often found functional conflicts existed and no department was responsible for some problems.

A company stresses on IT support by using Internet, Intranet, EDI and Email information technology to form a framework of integrated information system to share information which is often helpful to postponement decision-making and its application. Company D, E didn’t integrate information because of less IT support, so, they were more difficulty to decide where the CODP should be. Actually, full of IT support contributes to many aspects of production, beside the application of postponement, for example, a software upgrade that increases the flexibility of a production line may enable the firm to expand the set of products manufactured, and software employed to monitor various aspects of a manufacturing process may reduce yield loss or result in lower costs due to equipment failure.

A period of training is imperative prior to or during
the early stage of execution. The training can be combined with the pilot implementation. No or less training directly impacts workers to fast master the procedure changed and to detect potential uncertainty while actual postponement is employed company-wide. Company B, C, D paid very limited efforts on training which had caused temporarily disruption on production in their work floors respectively. Pisano (1996) found that “learning-before-doing” contributed significantly to the success of process development projects.

Performance measure, insufficient incentive and worker resistance are related and performance measure is in dominant position among three of them. Postponement brings a company changes involved in inventory, design, engineering, production, distribution, and so on. The performance measure on these departments should be rightly adjusted in accordance with the changes brought by the application. On the contrary, inappropriate performance measure gives rise to insufficient incentive, and insufficient incentive is one of reasons resulting in worker resistance, which is Company E, F’s problem existed during the stage of execution. Worker resistance is not only from insufficient incentive, but also from heavy workload (e.g., company B), strict operation procedure, new work environment (e.g., company C), etc. However, the extent of worker resistance that occurs in response to changes is often difficult to gauge prior to implementation. In this condition, a company should guide management to perceive the tendency of worker resistance and tackle it timely.

External collaboration with suppliers, distributors and customers is critical. Companies need to collaborate closely with their partners to ensure that they fully understand the postponement strategy and are managing the inventory process accordingly. If not, there's a risk of excess, insufficient, or obsolete inventory—all of which add costs, increase lead times and negate the benefits of postponement. The problem of external collaboration partly resulted from lack of supply chain perspective which is commonly in the companies we investigated and trust (Tejader, 2004) rooted in members. Company A, F, involved extensive alignment with supplier specialized in performing specific elements of the value adding process. During the step of execution, they might need to reselect individual suppliers and were tired of communicating with the suppliers to provide corresponding components and services. Company C, E, had similar problems, though they had fewer suppliers comparing with Company A, F.

But Company B, E did not review their application. By that time, Company B was on the middle of the stage of execution, and Company E regarded it unnecessary due to its relative simple application process. For no review or unreasonable method to review, Company A, C, E all confronted frustration during their later applications.

Lack of top management sponsorship and support, no enough synergy and collaboration are common problems which often last the whole process of the application. For example, Company B failed to get its full top management sponsorship and commitment throughout the whole process of the application, which is a salient feature impeding itself to glean the most benefits of postponement. Company F succeeded in its application of postponement, the planner had ever said: “I am fortunate to get the back of our vice general manager”. One interviewee from company D, expressed whether postponement would be implemented in the company or not, and whether the application of postponement would succeed, were decided by the decision and support of top management.

The problem of no enough synergy and collaboration was obvious in such big Company A, B, during their applications. To realize the vision for postponement within a company, all functional departments are involved: design, engineering, purchasing, production, logistics, should closely collaborate with each other, set the reasonable vision, make right postponement design, and properly execute the design and plan of postponement.

From the lessons or problems happened to the companies, it is much easier for us to foresee a picture of successful application: when a company begins to apply postponement, at first, it may deliberately build an environment for the application and advocate its benefits, at this step, it should show a clear and reasonable vision (or targets) for its staff members. Secondly, the company proceeds with detailed analysis and design for postponement and its application under the guide of methods and experiences. Thirdly, it executes the application of postponement, often should pay more attentions to: implementing pilot application, quality control procedure, technical risk, performance and incitement system adjustment or performance criteria, collaboration among functional departments, between company and outside partners, and so on. Last, the company should not neglect the step of review, from which it summarizes the experiences, improves on the applications.

4.5 Other Findings on the Application of Postponement

Through our investigation, in combination with secondary research, the following points should be stressed:

1. A company may have more than one appropriate postponement strategy;
2. Delaying product differentiation at a point closer to the customer is not always true or reasonable;
3. CODP could be in any place of operation processes, its place depends on the company’s vision on postponement;
4. A company’s starting point and its administrative heritage, have great impact on the application of postponement in Europe. However, the two points don’t have much influence on the companies we visited.

A company may have several appropriate postponement strategies. First, a postponement strategy is often applied to a product line or a product group, but when the company has several product lines or product groups, it could be members of supply chains and applied several postponement strategies (Chiou et al., 2002). So, under this condition, a company produces different product groups, it may apply types of postponement strategies in its same operations system or different ones. For example, Company F, had applied assembly postponement for IC card payphone series in its assembly workshop, and implemented manufacturing postponement for phone bill meter wireless. Second, if an operating system for a product series is complicated enough, possibility exists for a company applying two or more (though seldom happened) postponement strategies on it, if the company is pursuing specific portfolios of targets.

With the HP example’s dispersion, postponement, known as "delayed differentiation," is a supply chain strategy that delays product differentiation at a point closer to the customer as possible. But it is not always true or reasonable. If a company only aims to increase the flexibility in responding to changes in customer demand, it is right to set differentiation point (CODP) closer to the customer. Actually, most often postponement is applied in the distribution channel or final manufacturing, in order to be close to the customer and allow for rapid delivery of customized products. Postponement can benefit company to minimize the cost of production, realize mass customization, reduce inventory cost, improve service level, etc., and might result in differentiation point not closer to the customer. Further, there are many types of postponement strategies existing: design postponement, engineering postponement, purchasing postponement, assembly postponement, etc. All rightly deduces item 3: CODP can be in any place of operations. If systematically concerning the vision for postponement, Hau (1997) presented a model to illustrate it.

Van Hoek et al. (1998, 1999) discussed the bottlenecks in the application of postponement, executed case study research in Holland. They concluded a company’s starting point and its heritage or history of an organization, were bottlenecks influencing the application of postponement. According to our investigation, all companies have not been founded for a long time, and at the outset of their establishments, they organized their structures and functions in line with modern management methodology. So, two factors: a company’s starting point and the administrative heritage, having great impact on the application of postponement in Europe, however, have not much affected the applications of the companies.

5. Conclusion, Research Limitation and Future Studies

5.1 Conclusion

Postponement means delaying activities in the supply chain until customer orders are received with the intention of customizing products, as opposed to performing those activities in anticipation of future orders. The concept of postponement is increasingly drawing the attention of researchers and enterprises, whose application not only allows company to maintain cost effectiveness based on lowered inventory levels and economies of scale in upstream, forecast-driven, primary manufacturing, but also increases the flexibility of the operating system, the timeliness of delivery.

As mentioned before, postponement is not new in U.S or Europe. But in China, enterprises are not very familiar with this concept, and the application of postponement is still on its initial stage. We developed case studies in Wuhan district, which aimed to investigate the situation of the application of postponement in Chinese enterprise circumstance, to summarize the experiences of the application and make some contributions to the theory and application of postponement strategy. Based on the results collecting from the companies investigated, we achieved managerial insights on the application of postponement and drew some conclusions on the following respects: drivers and inhibitors for the application, initially select appropriate postponement strategy, the framework for the application, main challenges for the successful application, other findings, and so on. We believe what we achieve in this paper will benefit companies to reap more progresses in the application of postponement.

5.2 Research Limitation and Future Studies

For our investigation we chose six companies in Wuhan district, with the purpose of contributing the knowledge of the application of postponement. Obviously, our case study is not a survey, and can’t afford us the picture of the universal application of postponement in China. On the one hand, cases from different industries in different districts may provide us more perspectives and managerial insights. Future research may employ similar investigation with data from different industries and districts combining with the support of a survey in China. On the other hand, differences and similarities in the applications of postponement strategies among up-stream, mid-stream, down-stream producer, or between firms with their own retail channels and those without, should be examined. This could shed more light on the benefits and costs of adopting postponement strategies.

In our investigation, the analysis is more based on qualitative data. In future study, we may capture the whole
concept of the application through combining qualitative data with quantitative analysis and applying suitable mathematical modeling. And we will perform more in-depth analysis on dominant details, e.g., postponement analysis method, methodology for what type of postponement strategies matches with company, achieve more insights on financial effects of postponement on operating costs and on the role of specific operating characteristics.

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