

Segmenting Supply Chain Process for Optimal Performance by Adopting Postponement: A Randomized Trial

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Abstract — Even though extensive technologies have been applied to all stages of a supply-chain, the performance of many supply chains has been quite dismal. One potential cause for failure is the lack of comprehending the nature of the demand and therefore being unable to devise a supply-chain that would better satisfy that demand. A common mistake is to use an efficient supply chain that calls for a responsive supply chain and vice versa. The paper aims to develop the first wave of empirical investigations related to the impact of supply chain design practices on performance. It investigated a supply chain design model that linked efficiency with responsiveness to optimize performance by deploying postponement. An in-depth case study methodology was adopted to uncover the strategies undertaken by one of the Bangladesh's fastest growing cement manufacturers to create a competitive advantage through its management of the supply chain design alignment. The major elements were verified by surveys. Applicability and exploitability of the diagnostic instrument was validated using action research. Generally, the adoption of segmenting the supply chain process by diffusing the postponing style led to an improved performance, which, in turn, positively impact operational performance. Operational performance enhances organizational performance. Just as processes can be broken into parts, so can supply-chain processes be segmented to achieve optimal performance. This paper underpins the under-researched area of action research in supply chain design and practitioners are provided with a framework for assessing the synergistic impact of postponing practices for optimum upshot.

Keywords— *Action Research, Alignment, Efficient, Responsive, Postponement, Optimum, Supply chain design.*

1. Introduction

With businesses going multinational in operations and the corresponding trend is characterized by several challenges whereby cost is the key and customers are expecting lower cost products without compromising on quality [1]. Similar scenario is experienced within the cement industry. Hence, continuous improvement activities such as, Kaizen, lean operations, effective and efficient supply chain are embarked upon by manufacturers to mitigate the rising cost of operation and continuously improve their product cost [2].

A supply chain is a system of facilities that procure raw materials, transform them into intermediate goods and then final products, and finally deliver the products to customers through a distribution system that includes a (probably multi-echelon) inventory system. Thus, it spans procurement, manufacturing, and distribution, with effective inventory management as one key element. To fill orders efficiently, it is necessary to understand the linkages and interrelationships of all the key elements of the supply chain. Ref. [3] argues that majority of product cost is locked in the materials. This explains why efficient supply chain management is important for organizations to attain competitive edge in their business environment. So, operation and supply chain excellence plays a vital role in reducing the product cost. In the same manner, the application of supply-chain best practices from other industries could be used to significantly improve the inefficiencies in the cement industry supply chain [4].

However, it is important to note that prior to the introduction of any change efforts (like supply-chain best practices) in an organization, there is a need to assess the current performance in supply

chain system and develop a suitable performance measurement system specific for the organization.

The term postponement refers to delayed decision-making about a product. It is beneficial to delay commitment to product-specific characteristics as late as possible in order to avoid a mismatch between orders and inventory on hand. The length of delay is specific to a product but the common strategic motivation is to gain better information about customer demand by waiting to customize a product for a particular market or customer. At the point of postponement a standardized module or platform starts to acquire customer or market specific characteristics. Figure-1 shows the spectrum of opportunities for postponement that extends from procurement to distribution. Postponement enables forecasters to make better predictions about end product demand over time since the standard module is built-to-forecast and the finished product is built to a better forecast or even built-to-order. Ref. [14] observes that the shorter the time horizon over which predictions are made, the more accurate the forecast.

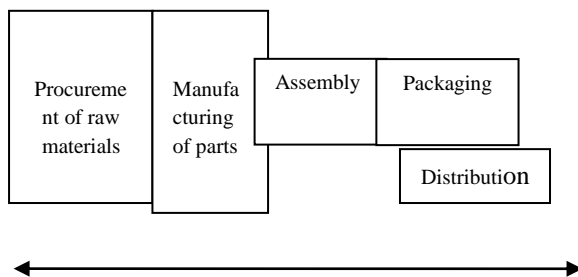


Figure 1. Possible Spectrum of differentiations

This study examines an integrated performance measurement system within a supply chain organization and specifically focuses on the postponement style of supply chain design within the procurement department. At the same time, empirical data is acquired via a case study conducted at a company (which, for purposes of confidentiality, will be referred to as ABC) through interviews, direct observation and data gathering during participatory actions.

Supply chain design performance is needed for various reasons: improving operations, better outsourcing, increasing profits, enhancing customer satisfaction, generating quality outcomes, tackling competitive pressures, increasing globalization, increasing importance of E-commerce, and growing complexity of supply chains.

Segmenting supply chain process for optimal performance by adopting postponement assists the business organization to compete in the dynamic international market. The objective here is to incorporate activities across and within the organizations for providing the customer value. An integrated supply chain involves coordination and information sharing up and down the process among all stakeholders. With technology facilitating information flow, a coordinated supply chain can be designed to meet the strategic, planning, and operating objectives of the educational institutions. It also means establishing effective and feasible relationships both inside and outside the organization [2].

There was a paradigm shift within the management of supply chain lately: One of the most significant changes in paradigm of modern business management is that individual businesses no longer compete as solely autonomous entities, but rather as supply chains. Business management has entered the era of inter-network competition and the ultimate success of a single business will depend on management's ability to integrate the company's intricate network of business relationships. A poor supply-chain performance often is the result of using the wrong supply-chain design and invariably causes havoc to company performance.

1.1 Problem Statement

The purpose of the study is to analyze and evaluate the performance of postponement strategies on supply chain design for optimal gain. The situations in which postponement may be an explicit choice to be made for a supply chain are limited, but may become real options for specific categories of products or sales channels of a company. That is the distinction this paper wants to make it clear – postponement as a business model which then drives the supply chain strategy. If we are looking for an alternate way to design effective supply chains, the answer does not lie in adopting theories in the hope of finding the right answer, but to build supply chain capabilities driven by business strategy. To find this new approach to build effective supply chains, one needs to understand the supply chain sphere of influence, find out what drives the supply chain, and learn about the new design imperative to build supply chain capabilities to support strategy – that would respond to the

current nature of demand by eliminating potential wastes.

This exploratory research reveals the prime forces with the objectives of analyzing the supply chain design practice by means of action research touching on the issue of evolution of supply chain design on performance. Postponement model of supply chain design practices was proposed for initiating optimal performance.

2. Literature Review

Sources date the idea of postponement as far back as the 1920s and the first use of postponement as a manufacturing strategy as early as the 1950s [5]. Early mention of postponement suggested that costs due to risk and uncertainty were a function of variety and that an efficient means of producing a product is to “postpone changes in form and identity to the latest point in the marketing flow and postpone changes in inventory location to the latest point in time” [6]. In 1965, Ref. [7] recognized that little had been done in the area of postponement despite its tremendous potential for cost savings. He defined total cost as the sum of inventory holding cost and delivery cost, both of which are a function of delivery time. He argued that “a speculative inventory will appear at each point in a distribution channel whenever its costs are less than the net savings to both buyer and seller from postponement”. In other words, postponement is not cost effective when there is sufficient information about demand to produce finished goods in mass and store them in inventory. For some products it makes sense to postpone the finishing process by introducing a finishing cost and increasing the delivery time because the product is not readily available from stock.

According to Ref [8], manufacturing postponement occurs when parts are shipped to the finishing center from more than one supplier. Manufacturing postponement has the greatest potential for cost savings in inventory because the value of the product increases through the addition of each successive component. Manufacturing postponement usually results in higher production costs. The increase is due to the capital cost of switching machinery between different types of variety and shipping them to different finishing facilities. Time postponement occurs when finished products are shipped to centralized warehouses

closer to the customer than the manufacturing location. The motivation is to increase customer service levels by decreasing customer lead time and to respond quickly to orders by placing inventories closer to the customer without committing to an individual order. The final outcome of their research is a framework which serves to assist managers in determining what type of postponement is best for a given product or supply chain structure.

Ref. [9] go further and identify the factors which influence the costs and benefits of postponement as market factors, process factors, and product factors. Market factors refer to characteristics of demand and uncertainty. Process factors refer to characteristics of operating policy within the firm as well as the external supply chain, such as managerial support and the location of and relationship with suppliers. Product factors refer to the design and characteristics of an individual product such as integral versus modular and inventory carrying cost. They also highlight enablers of postponement such as process standardization, process re-sequencing (redesigning the assembly process to move value-added processes closer to the customer), and component standardization. Redesigning products with these characteristics makes postponement possible and reduces the risk to the manufacturer by eliminating redundant processes and designing products to be modular and component interfaces to have standard ports for easy assembly.

Performance measurement is defined as the process of quantifying the level of efficiency and effectiveness of an activity into a measured value [2]. Performance measurement is a process of assessing the progress of work towards the goals and objectives that have been defined previously. The measurement of supply chain performance becomes the main concern. For supply chain actors, performance measurement can be used as a basis to improve its performance. All this time, performance measurements by supply chain actors are conducted separately. It causes inefficiency, as well as obstructs both parties in understanding the effectiveness of each respective performance [4].

Until recently, there has been no agreement of researchers which model is most flattering to be used and which key indicator that important to be maintained [10]. Recent models demonstrate its

complex performance measurement due to wide range of supply chain that becomes cause of weaknesses. The complexity will put management in difficulties for selecting the most important key indicator to be maintained. The existing models could not yet be employed for best performance management since it has not been based on optimization model [11].

Recent research studies done by Edwin et al have identified four common postponement strategies, namely pull, logistics, form and price postponement [12]. The former three postponement strategies are linked to production and manufacturing, while the last one is a pure pricing strategy. They aim at balancing the costs and benefits of mass production and mass customization. Practical examples of postponement can be found in the high-tech industry, food industry and other industries that require high differentiation. Ref. [13] proposed a framework for implementing postponement by classifying products according to two factors; product complexity - the number of product varieties, and speed - the time from customer order to delivery.

Action Research is implemented to solve a problem and bring about improvement. Thus, 'research is seen as an agent of change' as outlined by Ref. [18]. Ref. [17]. argued that despite its potential benefits and relevance to the industry, there is a lack of reported AR studies. There is a need to adopt AR study more, as a methodology for research in operations management.

However, So far, no research has discussed the impact of postponement supply chain design for optimal performance. Therefore, an efficient and effective integrated model of performance measurement by supply chain actors is required. The motivation for this research is to determine which companies are using postponement and categorize the type of products that are ideal candidates for postponement. Because postponement is a widely known, yet underutilized, strategy it is important to understand strategic motivations and operational consequences that can help aid in future research.

3. Research Questions

More specifically, the research asks the following questions:

- Why do firms choose to adopt supply chain design practice to devise a strategy that would better satisfy demand?
- How do firms integrate supply chain design activities to achieve optimal performance?

4. Methodology

An in-depth case study methodology was adopted to uncover the strategies undertaken by one of the Bangladesh's fastest growing cement manufacturers to create a competitive advantage through its management of the supply chain design alignment. The area of study was generally on its supply chain department with focus being given to procurement department performance and their relationship with their suppliers. An array of methods was used – interviews, field notes, observations and content analysis with case study as the dominant method.

In this proposed study, the primary source of data collection was done through the use of semi structured in-depth interviews and survey questionnaires. Supporting data had been collected through workplace observations in which the researcher acted as a non-participant observer as opined by Punch [15]. Two streams of primary research were executed for this study. The results from these surveys, in combination with secondary research, formed the basis for the findings highlighted in this report.

An internet-based survey

- Sent to some industry practitioners
- Survey timeframe: Three weeks in February 2017

A detailed in-person survey

- Questions were geared toward gaining an in-depth understanding of postponement's catalysts, inhibitors, enablers, critical success factors, and benefits.
- Respondents were experienced supply chain executives, practitioners.

Nearly half of the survey respondents were employed with the supply chain/logistics and distribution area within their organization. More than half of the survey respondents worked in departmental management, and almost 10% were involved in senior management. The major

elements were verified by surveys. Applicability and exploitability of the diagnostic instrument was validated using action research.

Action research was adopted in this particular circumstance over other methods such as, Triangulation, SEM or empirical analysis because of its applicability fitness to real-life and to be able to provide practitioners with a framework for assessing the synergistic impact of postponing practices on supply chain design performance. An AR project can therefore be said to have two parallel objectives: an improvement objective to solve a specific problem and a research objective to contribute to the generation of new knowledge [16].

A major strength of an AR project is context bound and strongly linked to practical problem solving [17]. Thus, local knowledge is contrasted with research-based knowledge, and the theoretic understanding that is developed is evaluated on its ability to make sense of the situation at hand, ensuring that theory has the capacity to explain the phenomena under study. The results of an AR project are immediately visible, proving the workability of the implemented solutions, and are as such the true test that something works in practice and not just theory – as Ref. [17] coined the phrase “Nothing is as practical as a good theory”.

A well structured Questionnaire in a five point Likert Scale (1=Very Dissatisfied, 2 = Dissatisfied, 3 = Neither Satisfied nor Dissatisfied, 4 = Satisfied, 5 = Very Satisfied) was used. Data were converted into numerical codes and the details of these coding were recorded in a code book to help establish the proposed concept.

5. Findings & Analysis

Push or pull – efficient or responsive supply chain design? That is a question every supply chain needs to answer. It also changes the question from push or pull to a question of where the inflection should occur. The case study gave detailed information about a company pseudo named ‘ABC’ that has adopted postponement in some capacity. It is worth noticing the motivation and risks that they incurred in order to figure out whether their product is a candidate for postponement. The data analysis provides background on the company and the

product that is postponed, a description of the supply chain before and after the postponement was adopted, the decoupling point between intermediary product and finished goods. Afterwards, it touches on the issue of creating a supply chain that is purpose built to take advantage of postponement model.

The plant of ABC, which is located in Chhatak, Sunamganj, Bangladesh is the only fully integrated dry process cement plant in Bangladesh where high premium quality clinker (a semi finished product needed to produce cement) and cement are produced utilizing sophisticated and state-of-the-art machineries and processes. The Company’s ability to produce its own clinker under its strict quality supervision and the presence of an international standard Quality Control and Monitoring Lab ensures the same consistent premium quality in each and every bag. By supplying clinker to other cement producers in the market and through import substitution of clinker, ABC helps the country save USD 65-70 million worth of foreign currency per year [21].

ABC’s products are high value with a challenging demand forecasting owing to long buying cycles ranging anywhere from six months to two years. Forecasts are generally compiled from sales representatives’ predictions. Because of the high cost of the products, the decision making process and financial constraints of the customers, it is somewhat difficult to know when products will be ordered. As a result, ABC was plagued with less than optimum service levels for few products and higher than planned inventories for others. All of these conditions were catalysts for a postponement strategy, which became even more important as a result of an industry-wide directive.

The first postponement strategy involved designing Economic Order Quantity (EOQ) for holding inventory into the Minimum order Quantity (MOQ) that ABC designed and produced. Originally traditional method of make-to-stock was in place. To optimally manage inventories, ABC collaborated with an external supplier to replace the EOQ module with a cost saving MOQ. During the redesign phase engineers were able to develop the universal module at a lower cost because of advanced strategy which deployed both the push and pull strategy depending upon the nature of the demand to better respond with low wastage.

Shortly after, ABC initiated another postponement strategy in their product line. This next strategy was to redesign the product so that it could be configured-to-order at the end of the assembly process. There are currently two variations of the Series. Through a carefully designed manufacturing process, ABC is able to manufacture to a specific model as soon as that specific model is shipped to fill a customer order. This strategy involved the redesign of the manufacturing process so that the product could be configured-to-order at the end of the assembly process. This meant that all of the commonalities between the two different variations of each model would be combined into an intermediate product that would be produced to a forecast, stored as intermediate inventory, and configured-to-order once an order was received. The redesign phase took a team of engineers six months to make changes and train workers on the assembly line. The supply chain became vastly more efficient and service levels increased dramatically. Figure 2 is a representation of the supply chain after postponement.

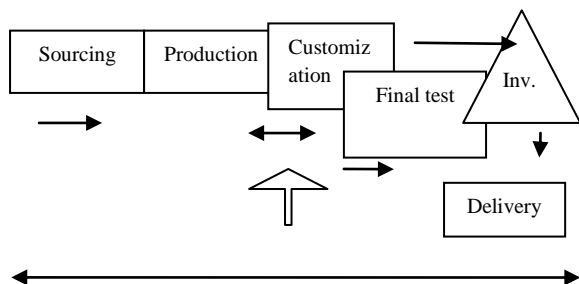


Figure 2. ABC supply chain – Postponement point

At the point of postponement, an intermediate job is held in inventory awaiting a customer order. This allows ABC to reduce customer lead time from roughly 20 days to four hours plus test and delivery time. Before delivery, the product is placed in buffer inventory waiting for shipment. The shipment of an instrument is a trigger for the replacement of that configuration in buffer inventory. Customer service levels improved and inventory was significantly reduced by eliminating the need to store high value finished goods.

This is a classic example of the benefits of the successful implementation of postponement. Because of this success, ABC was able to continue developing postponement in other lines. Today,

more than 85 percent of the production at ABC involves some form of postponement compared to less than five percent five years ago. By redesigning the supply chain to be easily adaptable for configuration, ABC realized that the product could also be easily de-configured back to the intermediate stage to support the secondary market for the commodity.

6. Results & Discussions

Conventional wisdom holds that the best way to improve responsiveness and cost savings in the supply chain is to “go direct” and “eliminate the middleman” [19]. However, the migration to demand driven supply networks is leading many to reconsider the use of middlemen in the supply chain as in, the case of this particular action research on ABC company.

By keeping product as generic for as long as possible the impacts of forecast inaccuracies was minimized and the optimum performance level was achieved. Once postponement has been deployed, the ABC company was able to streamline its workflow as efficiently as it is depicted in the below illustration. It further shows how those ‘bullwhips’ have been downsized to make it run smooth while eliminating potential wastages.

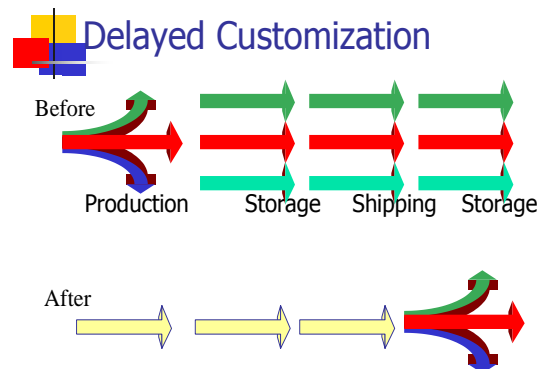


Figure 3. Effect of delayed customization [20]

The switch to postponement strategy by company ABC was deemed successful for wide variety of reasons. The intriguing strategic motivation for starting postponement was to improve service level and, at the same time, to cut down inventory holding cost.

It started with the goal of minimizing of one metric, in that particular case of ‘ABC’ – a shift from EOQ to MOQ, and resulted in improvement in other areas. Figure shows a list of primary drivers of postponement for ABC Company and the associated benefits. Another key factor for successful implementation was product modularity.

As ABC realized that they had to reengineer their traditional procurement process (Push) to take advantage of logistic postponement using a common platform.

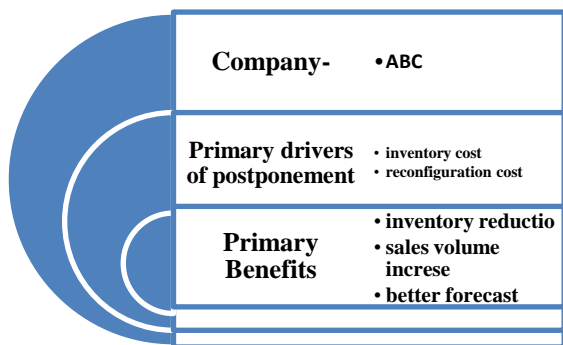


Figure 4. Primary drivers & benefits of postponement

As such, postponement - the optimal strategy with the appropriate mix- proved to be a cost-effective solution as it reduced redundant stock and saved the amount of rework. Essentially, the decision made by ABC was at the product level according to the specific metric measuring demand, inventory cost, turnover and lead time constraints.

A truly robust framework of this nature was possible as ABC had an ERP- enabled system in place and high level of commitment from the individuals at the top. The following inferences have been drawn to initiate the action research model for deploying postponement to achieve optimal performance.

Action Research

Table 1 a. Steps to Action Research

<i>Summary of findings</i>	<i>Recommended actions targeted to findings</i>	<i>Who is responsible for action</i>	<i>Who needs to be consulted</i>	<i>Resource required (soft)</i>
<i>Research Question#1</i>	<i>keeping product as generic for as long as possible</i>	<i>procurement department</i>	<i>purchase manager</i>	<i>commitment</i>
<i>Why do firms choose to adopt supply chain design practice to devise a strategy that would better satisfy demand?</i>	<i>instigate product modularity</i>	<i>logistics team members</i>	<i>supply chain inbound logistic</i>	<i>alignment</i>
<i>Finding#1</i>	<i>To improve service level and, at the same time, to cut down inventory holding cost.</i>		<i>top level management</i>	<i>paradigm shift</i>
<i>Finding#2</i>	<i>To be a cost-effective solution</i>			<i>participation</i>

Source: Developed by the author from the action research

Table 1 b. Steps to Action Research

<i>Summary of findings</i>	<i>Recommended actions targeted to findings</i>	<i>Who is responsible for action</i>	<i>Who needs to be consulted</i>	<i>Resources required (soft)</i>
<i>Research Question#2</i>	<i>- ERP-enabled system</i>	<i>commitment of the top level</i>	<i>channel member</i>	<i>commitment</i>
<i>How do firms integrate supply chain design activities to achieve optimal performance?</i>	<i>High level of commitment from the individuals at the top.</i>	<i>management procurement department</i>		<i>alignment</i>
<i>Finding#1</i>				<i>paradigm shift</i>
<i>By keeping product as generic for as long as possible the impacts of forecast inaccuracies can be minimized and the optimum performance level can be achieved</i>		<i>postponement channel supplier</i>	<i>end-users</i>	<i>participation</i>
<i>Finding#2</i>				
<i>Reengineering traditional procurement process (Push) to take advantage of logistic postponement using a common platform.</i>				

7. Future Work

The case study based action research would assist any organization, especially the SCM team to effectively manage suppliers and measure the department and supplier performance. As majority of spending in any organization involved in material purchases, hence, having effective management system will save the organization money and time which will help them in long term sustainability. The limitation of this study is that the sample is limited to Supply chain of functional products, thus it is required consideration and prudent to generalize the results to apply to supply chain of innovative product.

As technologies, customer expectations and supply chain management is rapidly evolving and more and more new strategies will emerge in future. Therefore, it would be wise for the organization to constantly monitor the progress and keep adapting to evolving theories, strategies and technologies.

8. Conclusion

In order to have an effective supply chain performance, organization must employ strategies for measuring and improving the performance of supply network participants. Strategies combined with effective measuring tools and supported by effective supply chain design such as, the proposed postponement model, will help any organization to excel in their daily routine work. Commitment from management is deemed vital as some of the infrastructure requires considerable overhaul in terms of style adaptation. All measurement systems should be diligently measured and senior management team get involved in reviewing the performance.

This paper encompasses the evolution of SCM in terms of time frame. In addition, this research represents the first large scale empirical study that systematically investigate input, output and process of the supply chain design performance through redesigned postponement model. The study proposes the model of a supply chain design alignment for finding the right balance between supply and demand and to be able to reduce the waste substantially while optimizing the workflow.

From a managerial point of view, this research provides a novel approach to developing and assessing supply chain management application in the academia as well as for the practitioners.

Finally, a successful postponement will call for a tight integration between a manufacturer and a third party logistics provider. An ERP application is supposed to be installed to facilitate the process as well. However, substantial ROI is achieved over a longer term by minimizing waste and excess inventory. Soon, it will no longer be a question of whether postponement is the right strategy, but rather how the supply chain will take benefits from cost saving strategies as in postponement.

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