Bullwhip effect Phenomenon and Mitigation in Logistic firm's Supply chain: Adaptive approach by Transborder Agency, Canada

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***Abstract*— This case study explores the bullwhip effect phenomenon and mitigation in supply chain process at Transborder Logistic Canada.**

Despite being one of the largest logistic chains of Canada, Transborder for two years was facing challenges and problem in shape of bullwhip effects. To add further to the firm's problem there is no owned-warehouse to manage its inventories. The theoretical framework for present case study is based on the theory of Lee (1977) to overcome the problems in the supply chain process. Moreover, the steps of Hussain and Drake (2011) are considered to overcome the bullwhip effects, challenges of cost control, response time, risk management, and effective warehouse management.

"Realism" is the research philosophy undertaken to develop a cross-sectional research design to investigate the research problem at hand. Hypothetico-inductive-deductive model is used to explore research variables. Moreover, researcher used mixed method approach by circulating matrix based semi-structured survey questionnaire in different interlinked departments of Transborder Agency. The questionnaire is based on LIKERT Scale (1-to5) rating. In addition to that, open-ended interviews with the head and subordinates of various departments were commenced to explore qualitative aspects related to research problem.

Results revealed that logistic firm rely heavily on demand-forecasting information through customers. There was fluctuation in demand order along with order batching, demand forecast updating, rationing and shortage game, and price fluctuation. The Polar diamond approach is considered by Transborder to effectively and efficiently deal with problem at hand and challenges that are hindering the supply chain process. Moreover, VMI, EDI, and POS are tools and techniques used to resolve different types of challenges and find a long term proper rational solution to bullwhip effect (problem at hand).

Moreover, findings revealed that However, there is still need for effective warehouse management which can be done through developing strategic alliance with various partners across the globe and undertaking the software inventory system to manage things in correct manner.

Logistic supply chain inefficiency is mainly caused by bullwhip effect. The rational adoption of model can assist supply chain managers to be proactive in approach. Moreover, the rational decision can help in identification of problem at early stage and help the firm to efficiently overcome the problem.

Keywords*— *Logistic Industry; Supply Chain Management; Bullwhip Effect; Polar Diamond Model

1. Introduction

1.1 Introduction

The focus of logistic business entities has been significantly on their respective supply chain due to cut-throat competition in global market. Furthermore, customers' high expectations and short life span of products and services have urged businesses to invest wisely in supply chain activities. Supply chain has given competitive edge over rivals to various enterprises including; Toyota, P&G, Nike, Apple, Samsung, and Intel [1]. SCM concept in modern day business is, "A set of methods developed to appropriately assimilate manufacturers, suppliers, stores, and warehouses efficiently, so that commodities are formed and dispensed at right time to right location with the correct magnitudes, in order to be cost-effective while considering risk and maintaining required level of satisfaction" [2]. Although, SCM is considered as potential asset of organisation and enables firm in attaining competitive advantage but it is one of most critical and perplexed activity, relying on intricacy of product and size of business [3].

1.2 Company Overview

Transborder is a Canadian logistic company that mainly functions at Canada and USA but airlines gives this contracting agency freights all over the world. The organisation has grown over the 28 years work by now being present in five continents and stationed at 90 countries [4]. "To be the Future of Transport Logistics by bringing tomorrow's supply chain technologies and best practices to our customers today" is mission of the organisation [4]. Transborder uses "Customer Centric" approach in order to maintain adequate balance through expert logistics at domestic, international and distribution services at cross-discipline has made company to be one of the finest in logistic business as it values its clients all across the globe [4]. However, the company shares warehouse as it does not own its own warehouse due to company's policy of not investing excessively in non-current assets. Furthermore, I.T system is based in London [4].

1.3 Transborder Global Strategic Objectives:

The Annual Report of company clearly indicates that vision of the organisation is attained through well-defined global strategic objectives. These objectives are as following:

- Main target is to expand and grow competitively in international market.
- Supply chain competitive expansion by following 24 hours service delivery model.
- New strategic innovation in supply chain process through strategic alliance with supply participants working mainly at; London, NY, and TO.
- Maintain a steady focus on global knowledge management strategy to work in swift manner with local and international partners.

At Toronto (CA) outlet, there are four staff members while 35 individuals in warehouse. Furthermore, at Montreal (CA) office, total 35 employees are working whereas in JKF, (USA) 10 individual forms office staff and approximately 150 at warehouse. The interline partners constitute by 1500 in Vitran while 150 Cargo Express.

1.4 Problem

In order-to-delivery cycle, bullwhip effect is frequently occurring unavoidable part as if it occurs, it creates negative influence on performances of supply chain [5]. In present case, researchers are investigating the critical issues arouse with passage of time and what attempts has been made by the firm to overcome it. The problem was incurring during supply chain process due to deviation in demand order in supply chain as there was amplification. Ref. [6] suggests that bullwhip effect occurs due to variation in the demand calculation at different stages of supply chain. No-owned warehouse strategy of Transborder is additional contributing factor towards problem as there is still fluctuation in demand and surplus or shortage is not handled in effective way. The preliminary research has shown that there still exist communication gap between partners involved in supply chain.

Transborder faces situation for future purchases estimation as unpredictable due to offering price discounts and special promotions to buyers who stock in large quantities in future and fluctuation in prices bring potential loss. Critical obstacles in supply chain process have been created by bullwhip effect as these had not been adequately managed at early stages. At Transborder, it is evident that bullwhip effect has influenced SC by diminished availability of level of products, inclination in labour cost, delay in distributions and dispatches.

2. Literature Review

2.1 Introduction

There is no one common definition that has been agreed by scholars and authors regarding logistic supply chain management (SCM) and management control system (MCS). Therefore, extensive literature is presented by various schools of thoughts in relation to MCS and logistic SCM. Hence, it is essential to construct an adequate understanding towards aforementioned concepts. Ref. [7] has provided a broader view of MCS by including almost entire company's organization. Such broader view indicate "management of everything inside the organisation" thus to narrow it down, a definition proposed by Simons that is widely agreed by scholars including references; [8, 9, 10, & 11] are included in this study. *''Management Control System are the formal, information-based routines and procedures managers use to maintain or alter patterns in organizational activities''* [12].

Thus, these procedures and routines are linked with controls and various scholars have explained it differently, such as cultural control, results control, and action control [10]. It is a boundary belief system, interactive controls, and diagnostic controls [12]. Therefore, these controls are defined and explained as per own understanding.

According to Ref. [13], various stages in vertical structure of supply chain has many distinct authorities. In logistic business, the main structure contains shipments and freights, supplies and deliveries, and stocks and warehousing. The business mainly deals with consignments, beginning with receiving orders or parcels, their effective storage and timely deliveries. This leads to various challenges as identified earlier along with problems rising at different stages. When there are different ownerships at different stages, there arises a challenge of coordination [14].

Ref. [15] emphasized on the notion that, "*when there is ineffective coordination or lack of clear communication, this leads to develop bullwhip effect*" (P. 88). Interestingly, Ref. [14] have credited the lack of coordination to each authority responsible in supply chain process who observes it only with his/her own objective rather than considering the entire chain being affected by it (P. 49). Ref. [16] has strongly suggested that the supply chain network cannot accomplish its task without having effective communication and high level of coordination. Ref. [16] also stated that, bullwhip effect is resultant of lack of coordination in the supply chain network.

2.2 Bullwhip Effect

Ref. [17] have explained that, a variable magnification is regarded as bullwhip effect phenomenon when there is degree of variation at two extreme nodes (customers and producers) in supply chain. The variation can be of any degree and could be resulting from even a slight change in estimation. In other words, if supply pattern is not aligned with demand pattern then on different stages the gap between supply and demand enhances leading to cause either excessive stocking or shortages in inventories.

Ref. [18] explained the bullwhip effect phenomenon as "*a small disturbance in the flow of orders generated by customers that produces successively larger disturbances at each upstream stage in the supply chain"* (P. 225). On the other hand, Ref. [19] stated that *"Phantom demand or fictional demand can create a problem of bullwhip which will lead to produce challenges of delay in response time, inclined cost, and excessive stocking for a firm"* (P. 532). Thus, a slightest variation in supply or demand can have impact on supply chain.

Ref. [20] provided an example of bullwhip effect phenomenon that demand variation from customers can start when supplier estimate more than required and eventually same estimation keep inclining from wholesalers, suppliers, and manufacturers' perspective. It disturbs the entire process of supply chain.

The above empirical findings conclude to the notion that small change in demand or fictional demand can lead to replenish following order in supply chain.

2.3 Demand forecast updating

In supply chain process, due to usage of statistical forecasting methods the natural consequences (bullwhip effect) starts [21]. Ref. [14] further explained occurring of bullwhip effect is due to unreal customer demand leads to over estimation in forecasting. However, the demand forecasting could also be due to improper communication between different departments in supply chain. The time lead uncertainty increases when there is poor demand data and thus supplying firm has a burden to carry excessive inventories in stock. Moreover, the lead-time inclination further increases when there is no demand from customers. Not only lead time but the costs for firm increase which further affect the response time and storage of inventories. The bullwhip effect can lead to certain situation where firms have to start downsizing staff and sell assets if stocks pile up and costs goes out of control [19].

In addition to that, Ref. [22] states that *"forecasts that are manually developed are susceptible to the 'recency' effect – an effect that further amplifies volatility when forecasts are updated"* (P. 88). Here, the recency reflects that an event that has recently occurred and individuals overreact to it. While demand forecasting is being done, this recency-effect is evident as humans naturally response to market's changing conditions by over-adjusting the supply with shifts in demand.

2.4 Bullwhip Effect - Causes

Bullwhip effect is first being published by ref. [21] and there is extensive research conducted by same researchers on this topic. Ref. [21] stated that four important parts of supply chain; partners in supply chain's demand forecasting updates, order batching to gain benefit of transportation economics; rationing, and price fluctuation causes either separately or combined with one another to create bullwhip effect. The detailed analysis of Ref. [21] study showed that challenges like costs, response time, lead-time, and inadequate communication are linked strongly with bullwhip effect.

The above theoretical framework and background information of case study has enabled researchers to identify different types of challenges and problems faced during supply chain process. In the light of available literature and preliminary research, researchers have examined and explained these distinctive challenges and problems.

2.5 Challenges

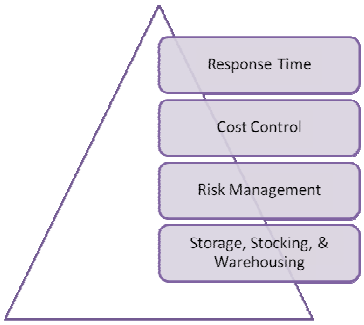

Figure 1: Challenges pyramid constructed by researchers through preliminary research

For over two years period there were various challenges that company faced due to its multi-dimensional business model. The pyramid shown above indicates the nature of most and least serious challenges for Transborder. There was a problem of communication error that had incurred quite frequently over a time and given birth to various types of challenges. One of the challenges that case study faced was "Response time". Since, company has complex and long supply chain involving various partners, buyers, and suppliers therefore leads to complicated communication process. The diversification has enhanced distinct stakeholders' expectations to respond quickly. Rapid response is required due to quick increase or decrease in demand [2]. Furthermore, cost control was another challenge that was constantly faced by Transborder as freight prices mounted, leading to technological advancement, rapid increase in global customers, healthcare cost along with increased commodity prices. These all had brought operating cost under pressure. Since the chain participants are operating in different part of the world thus aforementioned factors and operating cost developed a critical scenario.

Risk management and planning was another critical challenge that organisation was facing as slight loophole in management could result into serious delays. Moreover, there is still no owned-warehouse by organisation as it share local warehouse to manage its stocks and deliveries. Since organisation involves different participants in chain and at all stages require proper management of stocks therefore it was critical challenge to manage in correct manner all functioning related to Supply chain. This indicates that rethinking of managerial role and skills are essential to manage business operating in the global market [23].

2.6 Theory and Approach

Bullwhip theory by Ref. [21] is main consideration in the present study to deal with problem at hand. Ref. [24] state that, rather than actual sales, variance in order may exceed and leads to develop the bullwhip effect, that in itself is the distortion in upstream. Moreover, inconsistency in the information sharing leads to create bullwhip effect that mainly cause error in communication that eventually lead to influence negatively the entire supply chain process. Since the present problem is identified in the available managerial literature therefore the approach is considered by exploring the work of Ref. [25] and the actual scenario experienced by Transborder. Approach mainly focuses on the effective management of bullwhip effect through global management strategy of maintaining lead time, effective response time, and adequate tools [25]. Furthermore, present approach as well theory is similar to the work of Ref. [23] that considers cultural friction as a reason for diversity as well obstacles in the global context.

3. Research Methodology

3.1 Research Philosophy and Design

In this research, researchers used realism philosophy to investigate research problem by opting a

Hypothetico-Inductive-Deductive model. The study has been completed within three months therefore this exploratory study is cross-sectional in design.

3.2 Research Instrument and Sampling

Open-ended interviews through snow-ball sampling technique was conducted from management while based on interview findings, identified variables were asked from employees working in different parts of supply chain of Transborder through semi-structured degree-based close-ended questionnaire. Researchers used convenience sampling technique for interviews as well survey questionnaire. To ensure majority is approached in all outlets thus more than 60% of respondents were targeted. Hence, 45 from Canada while 96 from USA were considered however, the interline partners and Cargo Express were not included as these partners were not directly involve in supply chain process. Total 15 interviews with management were conducted during July 25, 2015 to August 05, 2015 whereas 126 participants from warehouse were involved in survey from August 06, 2015 to August 20, 2015. The LIKERT Scale (1-to5) is used to evaluate responses from participants.

3.3 Treatment of Data

The ordinal scale is use to evaluate responses from participants. The frequencies of responses were converted into percentages to understand the majority's views and expressions. Furthermore, researchers used coding to record interview responses.

Table

1	*2*	*3*	*4*	*5*
Strongly Agree	***Agree***	***Neutral***	***Disagree***	***Strongly Disagree***

4. Results

The interview with the management revealed that deviation previously in demand was due to amplification. Order at factory inclined per week despite there were teams working in USA and Canada to check oscillation and amplification. The inventories were to stock at warehouse for long time increasing administrative and general expenses for the company. The interviews with management also revealed that there was serious communication barrier between different departments of supply chain. All different factors; order batching, price fluctuation, demand forecasting updating, shortage game, and rationing were previously contributing factor towards obstacle in supply chain are identified in interview responses. Furthermore, it was also confirmed that most of clients made bulk orders to have minimal order processing cost which led to spreading demand cycles to providers and order batching result in to weak and inappropriate forecasting.

The interviews with the management revealed that previously inaccuracies in demand forecasting had created unrealistic expectations among different partners in supply chain. The surplus and shortage along with stocking was due to communication error as there was no unity of command in the organisation. The orders from JFK were usually coming with US market perspective while in Canada market perspective is different. Moreover, the interline partners and Cargo Express had their own view of their respective markets. Therefore, there was fluctuation in demand forecasting. Interviews also concluded that still there is no own-warehouse because Transborder find it a cost-effective way to manage inventories.

The discounts and special promotions identified in the preliminary research have been established in interviews further confirming that the fluctuation in prices previously as well now causing problem for Transborder. The interviews also revealed that delay in distribution and dispatches are problem present at Transborder. The availability of products in timely manner and increasing cost of labour are additional problems that firm was facing. Order-delivery-time is being confirmed as a problem that firm was facing while ago.

Based on the findings from interviews, the survey questionnaire was circulated among participants. Results showed that 72% respondents clearly considered that there was lack of coordination and communication between partners in supply chain process. Moreover, 67% agreed to certain extent that response time is still the biggest challenge firm is facing at present. However, the preliminary research considered cost as second most critical challenge but through survey findings stocking, storage, and warehousing still is second critical factor affecting the supply chain process at Transborder as 80.9% agreed to it. Moreover, cost fluctuation, price variations, and risk related to inventory time delivery

are also confirmed to certain extent. Though interviews showed that special offers and promotions have led to increase problems for the firm but survey findings did not find it as a significant contributor towards bullwhip effect.

5. Discussions

The results showed that Transborder logistic company was facing a serious issue of bullwhip effect that has given birth to various challenges over the time period of almost two years. Moreover, there was no own-warehouse that has further added to the problem. Though still there is no own-warehouse but this has not a direct linkage with bullwhip effect. However, the management has taken steps to ensure that warehouse stocking and management is done in adequate manner. Response time, cost control, and risk management are some of the prominent challenges that were faced by firm. After few years of struggle, eventually, firm developed a strategy to overcome the shortfalls.VMI, EDI, and POS are tools and techniques used to manage bullwhip effect. In addition to that, firm used polar diamond diagram to strategies its plan in order to manage supply chain logistic in global perspective. The findings revealed that Polar-model adaption is part of company's approach to overcome the serious effects arising from bullwhip in supply chain process.

5.1 Solution

The part of case study discusses how the management of Transborder find a way to overcome the challenges and threats it was facing for certain time period. Though there are still communication gap that has been confirmed through primary findings but the management and authorities have taken constructive steps to overcome the potential threats caused by bullwhip effect. Transborder's approaches to overcome challenges and problems are explained through polar diagram as this diamond indicates five main areas of focus for the firm to reduce bullwhip effect throughout the supply chain process.

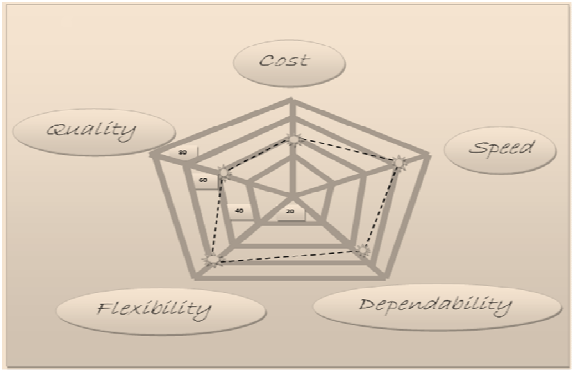

Figure 2: Polar diamond

It is essential for Transborder to manage and prevent bullwhip effect in effective and efficient manner at the early stages of supply chain so that risks, potential threats, and cost related issues are reduced to adequate level in rational way. Ref. [26] suggests that information sharing help firms in reducing bullwhip effect to large extent. However, Transborder opted for multi-dimensional approaches to overcome bullwhip effects that were being concern for almost two years period. For this purpose, one dimension includes sharing information and knowledge in adequate manner is a way that Transborder considered as this helped in improving communication among different stakeholders (Appendix A). Moreover, it helped firm in predicting and forecasting products with precise response time due to improved communication at various stages of supply chain (Appendix A).

Bullwhip effect can be reduced by delaying elimination in order to reduce order-to-delivery time as it can cut down fluctuations in supply chain process [26]. This approach has been considered too by the organisation by combining speed, quality, and flexibility in its supply chain process. However, in order to overcome aforementioned challenges, Transborder used polar diamond approach by combining distinctive attributes of diamond (Appendix A). Speed is a factor that has been considered to overcome the uncertainties. Effective information and knowledge sharing diminishes uncertainties as comprehensive information regarding customer's demand is availed which helps in accurate forecasting. This is now done through focusing on Vendor-Managed-Inventories (VMI), Point-Of-Sale (POS), and Electronic-Data-Interchange (EDI) respectively (Appendix A). Through aforementioned techniques that falls under dependability attribute of polar diagram, there is now significant decrease in

errors in downstream communication that further leads to reduction in uncertainties.

To deal with challenges of variation in price and order-time-delivery, cost and flexibility are the two attributes that is the focus of the organisation from polar diamond (Appendix A). Reduction in price promotion can reduce the inaccuracies in customer demand process. The price strategy is considered by firm on consistent bases (Appendix A). One well-defined and precisely calculated price at low rate is offered in all seasons in order to avoid irregular price promotion strategies each week (Appendix A). As per Ref. [27], demand fluctuations can be largely prevented by opting to the approach of maintaining fixed and stable prices as it enables firm in preventing price fluctuation especially in case of over-purchases when price is being offered at low than routine rates. Similar approach is undertaken by present case study to manage bullwhip effect (Appendix A).

Quality, Cost, and Speed are three attributes combined together from polar diagram by Transborder to manage lead-time challenge (Appendix A). Lean dispatching and manufacturing approach help firm in overcoming demand fluctuations and order batch costing (Appendix A). To ensure Transborder's supply chain is working as per management's plan EDI is considered as it helps in saving and storing information in adequate manner (Appendix A). As per Ref. [28], computerised system of maintaining orders helps organisation in reducing lead time. Thus, this is a solution undertaken by Transborder to manage supply chain process (Appendix A).

According to Ref. [27], *"Strategic partnership helps firm in distribution and preservation through vendor-managed-inventories"*. In order to overcome the bullwhip effect, Transborder also used Vendor-Managed-Inventories (VMI) by forming strategic alliance with various partners operating in different parts across the globe (Appendix A). The accurate account is maintained that how much inventories should be used and how much to be preserved for certain time duration and how to distribute it according to the demand of customers (Appendix A).

6. Conclusion

6.1 Findings

It is evident that amplification has caused demand deviation. Furthermore, there is inefficiency in teamwork for constantly monitoring amplification and oscillation. The mismanagement of inventories is linked with inclined administrative cost. The one of reasons behind aforementioned inefficiencies is barriers in communication within departments functioning in supply chain. In addition to that, obstacles in operations were due to other factors including; price fluctuation, rationing, demand forecasting updates, order batching, and short game. The study showed that unrealistic expectations are develop among partners involved in supply chain due to inaccurate demand forecasting. The unity of command is not evident that creates barriers in communication because the orders do not come from one source. Moreover, the market structure in US and Canada has variation which gives birth to fluctuation. Furthermore, there is conflict of views among stakeholders involved in the supply chain process. On time delivery and dispatching was affected due to inadequate planning and increasing cost of labour for increasing.

The prime concern for the firm is effective communication and coordination at different levels and different departments. This has led to increase the response time which is being minimized through adaptive approach undertaken by the organisation through Polar-Diamond.

6.2 Contribution of the paper

The present research contributes to dynamic field of supply chain through providing new insight dimension of bullwhip effect in logistic business and enhancing the body of knowledge. The results could facilitate logistic supply chain's parties to avoid similar type of problems so that competitiveness is enhanced. Moreover, it contributes towards empirical research as there is very limited work available on Canada's logistic industry.

The study has significant implications on both; theoretical and practical side. On theoretical side, it contributes to the journal by describing the adaptive approach taken by logistic firm in order to overcome bullwhip effect by considering different interlinked variables in system as mediating variables. All

previous included studies are longitudinal thus this cross sectional data collection serve grounds for combining simulation with adaptive approach to measure and manage bullwhip effects. The management's perspective is additional value included in this study to assess order batching. This contribution primarily emphasises on the notion that strategic value related to ordering policy is due to accurate management of demand forces.

The study offers valuable suggestions to improve networking collaboration through polar diamond, which reflects a new model to increase operational efficiency in supply chain. Thus, this paper provides a theoretical framework for polar diamond in practical settings. Furthermore, the managerial literature enriches by adding new dimension to mitigate research area.

The study include HR functioning to some extent which means that this research provide a platform to investigate supply chain management in relation with human resource practices.

On practical side, this study explored the causes and consequences of bullwhip effect in logistic firm due to various interlinked functioning in Canada. The exploratory study brings in the fact that adaptive approach in actual settings enhances the effective and efficient operations. Since study is conducted on logistic firms that has benefited from the approach therefore study is significant for logistic firms experiencing similar problem to mitigate bullwhip effects. Thus, this paper brings practical diversification and solution to increase understanding about supply chain management.

6.3 Recommendations

Since the company does not own its own warehouse which has added earlier to the increased challenges and problems therefore Transborder should developed a plan of warehouse management by investing with strategic partners to share the responsibility to manage contract warehouse in different regions to store and preserve inventories in effective and efficient way. According to Ref. [29], warehouse management enables firms in reducing the cost and increasing customer services via enhanced time utility for the products through increased time availability for potential customers.

Transborder should use computerised software to maintain the record in the information system of all the stocks that are at hand, location, and amount received and issued against all the transactions. This software will help in the effective warehouse management as previously there was no software to manage stocks. Furthermore, bullwhip effect will further decline by amalgamating with strategic partners to use their sources, potential assets, and investment plans to overcome warehouse issues. In addition to that, it is recommended that organisation should consider the matrix programme where employees working at lower management must be linked with strategic objectives.

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