EVIDENCE OF THE BULLWHIP EFFECT IN TANZANIAN SUPPLY CHAIN – A CASE STUDY OF SUGAR INDUSTRY

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Abstract

The study sought to examine the symptoms that represent the bullwhip effect (orders variation) along the supply chain. It was conducted using sugar suppliers in Morogoro and Dodoma using a descriptive survey design. A total of 50 respondents constituted the study sample and they were all members of sugar supply chain including the manufacturer, agents, wholesalers and retailers. The study found out that, the order variations do exist and are signified by the longer lead times, high stock shortages or many order cancellations, poor quality of customer service, uncertain production or purchase planning, and high overtime expenses. In other words, the study confirms presence of the bullwhip effect within the chain. The study recommends that the supply chain operators need to be aware of the early warning signs of the bullwhip effect and supply chain managers should use more effective inventory policies, sophisticated forecasting techniques, and effective information systems to counteract the effect at its earliest stages.

Key Words

Supply chain, supply chain management, bullwhip effect, order variability

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1.0 INTRODUCTION

Supply chains exist to support the flow of demand, supply, and cash (Taylor, 2004). Supply chain in business includes the stages, which were built to fulfill the demand of the customers. A typical supply chain usually includes raw material suppliers, manufacturers, wholesalers, retailers, and end customers. In supply chains, the variability of order quantity may considerably increase relative to the variability of the end customer demand. In practical operation of any supply chain, the downstream members of the chain observe the demand and transmit it to the upstream members by the replenishment orders. The bullwhip effect occurs when the demand order variations in the supply chain are amplified as they move up the supply chain (Peter, 2007). According to Peter (2007), increasing global competition in the world market today makes the supply chain management more critical. The quality of a company's supply chain performance can mean the difference between business prosperity and failure (Gattorna, 1998). Actually, it is well known that the objective of supply chain management is to provide a high velocity flow of high quality, relevant information that will enable suppliers to provide an uninterrupted and precisely timed flow of materials to customers. However, unplanned demand oscillations, including those caused by stock outs, in the supply chain execution process creates distortions which can wreck havoc up and down the supply chain (Donovan, 2002). The term "Bullwhip Effect" is a logistical effect that shows how small changes at the demand end of a supply chain are progressively amplified up the supply chain (Buchmeister, 2008).

Generally, bullwhip effect occurs when the demand order variations in the supply chain are amplified as they move up the supply chain. Acknowledging this, Peter (2007) asserts that there are five major causes for the bullwhip effect: (1) forecasting, (2) non-zero lead-time, (3) order batching, (4) supply shortages, and (5) price fluctuations. As stated by Disney and Lambrecht (2008), the bullwhip effect can be quite exasperating for companies; they invest in extra capacity, extra inventory, work over-time one week and stand idle the next, whilst at the retail store the shelves of popular products are empty, and the shelves with non-selling products are full. Specifically, as put forward by Agaran, et al, (2007), the bullwhip effect is a major concern for many manufacturers, distributors and retailers.

Lee, et al, (1997a), state the symptoms of the bullwhip effect to include excessive inventory, poor product forecasts, insufficient or excessive capacities, poor customer service, uncertain production planning and high costs. This is supported by Swamidass (2000) who puts that, the common symptoms of the bullwhip effect include delayed new product development, constant shortages and backorders, frequent order cancellations and returns, excessive pipeline inventory, erratic production scheduling and chronic ever-capacity problems.

It is reported that manufacturing industries waste millions of money each year because they are not able to match production to demand (Sengupta et al., 2006). Tremendous variability in orders along the supply chain can plague companies trying to eliminate excess inventory, forecast product demand, and simply make their supply chain more effective (Lee, et al, 1997a,b). A major cause of supply chain inefficiency is actually the "bullwhip effect" (Sengupta et al., 2006) which is the uncertainty caused from distorted information flowing up and down the supply chain, where companies upstream do not have information on actual consumer demand. As a result, these companies have their ordering decisions based on incoming orders from the next downstream company. This leads to amplified order variability: demand coming in from a downstream company has a lower variability than demand to an upstream company.

According to Lee, et al, (1997a), there are several causes ascribing the bullwhip effect, including factors such as demand signal processing, rationing game, order batching and price variations. Moreover, as lead times increase, variability also increases. For the firms to avoid such inefficiencies, there must be specific efforts to coordinate the overall supply chain system. However, such efforts are useless unless there is a clear identification of the presence of the bullwhip effect in the supply chain of the industry.

One of the most fruitful research sub-areas in the studying of supply chain management is the bullwhip-effect: a relatively new phase to describe the demand amplification phenomenon which was already well known at Procter and Gamble as long ago as 1919 (Towill, et al, 2007). Because it is a relatively new phenomenon in Tanzania, this study's focus of the bullwhip effect is an important study that deals with the underpinning of bullwhip effect. A study on bullwhip-effect has been carried out by the USAID Deliver Project in 2008 on the contraceptive supply chain in Tanzania. However, it was based on non-for-profit and not for commercial perspective.

In general, symptoms of bullwhip effect are presented as excessive inventory, poor product forecasts, insufficient or excessive capacities, poor customer service, uncertain production planning and high costs (Lee, et al, 1997a). To find evidence on the existence of the bullwhip effect, the researcher needs to investigate the presence of these symptoms in the industry.

This study was therefore executed in order to investigate whether there is evidence to suggest that the bullwhip effect exists in the supply chain of the sugar industry in Tanzania. The industry has been found worth studying due to its common mismatch between demand and supply in the country apart from the possibility of tracing the product through a supply chain. It was hoped that this study would stimulate further research on the causes and impact of the bullwhip-effect on the supply chain. In its attempt to bring to light the bullwhip effect, the study aimed by and large at substantiating the existence of the effect in the sugar supply chain, and exclusively at clarifying on identification of its symptoms based on the common descriptive factors as presented by Lee, et al, (1997a). Thus, specifically, the study intended to meet the following objectives.

1) To establish whether there is coexistence between length of lead times and degree of variability of orders along the supply chain;
2) To ascertain whether there is any association of quality of product forecasts with degree of orders' variability along the supply chain;
3) To establish whether there is association between customer service level and orders' variability along the supply chain;
4) To establish whether a level of certainty in production planning represents the degree in which orders vary along the supply chain, and;
5) To understand if the levels of overtime expenses are an indication of the existence of order's variability along the supply chain.

2.0 MATERIALS AND METHODS

This study employed a cross-sectional descriptive survey design to discover the current situation of the bullwhip effect in the supply chain of sugar in Tanzania. The study was carried out in Morogoro and Dodoma regions. Morogoro is where the Mtibwa Sugar Company, the biggest manufacturer of sugar in Tanzania is based. On the other hand, Dodoma served as one of the

major markets in the nearest proximity of the producer; it is also the most appropriate place where all other key supply chain players, namely, sugar agents, wholesalers and retailers are found collectively and conveniently. The Mtibwa Sugar Company was selected for the study basically due to two reasons. First, sugar is one of the products which have high demand in Tanzania to the extent of using local product as well as imported one. In connection to this, initial exploration confirmed the firm's readiness to participate in the study. The second reason was the proximity of the firm and the easiness and convenience of tracing the product through a supply chain.

The population of this study included all supply chain key players of sugar including the manufacturer, distributors/agents, wholesalers and retailers within the study area. Altogether, the study involved 50 participants classified as presented in the Table below. The sample size of 50 was found adequate for analysis and reporting purposes.

Table 1: Composition of Participants by Cadre

Type of Respondents	**Frequency**
Retailers	42
Wholesale Shop Owners/Operators	5
Agents	2
Operations Manager of Mtibwa Sugar Company	1
Total	**50**

This study called for the use of snowball sampling as the primary technique to be applied in the selection of respondents. This was the case because to be able to study the bullwhip effect in a supply chain, the product needs to be traced along the supply chain as it moves from one channel member to another. So, the researchers made initial contact with the manufacturer of sugar and then used the information availed to establish contact with their distributors who in turn led the researcher to contact wholesalers. It was not easy for the wholesalers to remember their retailers' customers as they do not keep proper records about their physical location. Once again, snowball sampling had to be used to identify the retailers.

This study applied both primary as well as secondary data. The primary data was collected from key persons in the supply chain organizations using a questionnaire which collected both qualitative and quantitative data. On the other hand, secondary data was sought from documentary review. Before full scale data collection was made, the instrument was pretested in order to improve both validity and reliability. With respect to data analysis, the study employed both qualitative and quantitative methods. Quantitatively, data were analyzed mostly using tables, frequencies and percentages. Qualitatively, analysis methods used included; matching of data and information from the various units of analysis, using comparisons and application of explanation building.

3.0 RESULTS AND DISCUSSION

This section presents results obtained from the study which are followed by discussion.

Results

3.1 Length of Lead Times and Variability of Orders along the Supply Chain

In order to establish whether there was any coexistence between length of lead times and degree of variability of orders along the supply chain, the study looked at three important items namely; length of lead times, frequency of stock shortages and frequency of order cancellations.

3.1.1 Length of Lead Times

Table 2 below reports the length of lead times among supply chain members.

Table 2 : Length of Lead Times among Supply Chain Members

LENGTH OF LEAD TIMES	More than 4 days	Exactly 4 days	Less than 4 days	TOTAL
MANUFACTURER	1	0	0	**1**
AGENTS	2	0	0	**2**
WHOLESALERS	4	1	0	**5**
RETAILERS	0	5	37	**42**
TOTAL NUMBER	7	6	37	**50**

PERCENTAGE	14.0	12.0	74.0	**100**

Source: Field data, 2011

As depicted from Table 2, most upper level supply chain members, comprising of the sugar manufacturer, two agents and four wholesalers reported to have longer lead times (more than 4 days), compared to many lower level supply chain members, that is 37 retailers who claimed to having experienced shorter lead times (less than 4 days).

3.1.2 Frequency of Stock Shortages

Table 3 below presents the frequency of stock shortages among supply chain members

Table 3: Frequency of Stock Shortages among Supply Chain Members

FREQUENCY OF STOCK SHORTAGES	Many times	Sometimes	Never	**TOTAL**
MANUFACTURER	1	0	0	**1**
AGENTS	1	1	0	**2**
WHOLESALERS	4	1	0	**5**
RETAILERS	22	4	16	**42**
TOTAL NUMBER	28	6	16	**50**
PERCENTAGE	**56.0**	**12.0**	**32.0**	**100**

Source: Field data, 2011

Table 3 above shows that the largest portion of supply chain members, that is 56% reported to have experienced stock shortages many times. This includes the sugar manufacturer, an agent, four wholesalers and 22 retailers. On the other hand, a relatively smaller percentage (32%) of the members (16 retailers) claimed to have never experienced stock shortages, whereas the rest (12%) of the members (including four retailers, an agent and a wholesaler), experienced stock shortages only sometimes.

3.1.3 Frequency of Order Cancellations

Table 4 below depicts the frequency of order cancellations to the supply chain members

Table 4: Frequency of Order Cancellations to Supply Chain Members

FREQUENCY OF ORDERS CANCELLATIONS	Many times	Sometimes	Never	TOTAL
MANUFACTURER	1	0	0	**1**
AGENTS	2	0	0	**2**
WHOLESALERS	4	1	0	**5**
RETAILERS	6	13	23	**42**
TOTAL NUMBER	13	14	23	**50**
PERCENTAGE	26.0	28.0	46.0	**100**

Source: Field data, 2011

As seen from Table 4 above, there was a portion of supply chain members who experienced order cancellations many times and those who never experienced order cancellations at all. Those who experienced order cancellations (26%) included the manufacturer, two agents, four wholesalers and six retailers, while those who had never experienced order cancellations (46%) included 23 retailers. The rest of the sample (28%) had experienced order cancellations only sometimes.

Discussion

Generally, a larger proportion of the supply chain members (86%), most of whom were retailers, claimed to have experienced shorter lead times in their supply of sugar. As Steven, a retail shop owner manager puts it;

"I don't receive any prior orders to my sugar selling. Customers come to my shop, ask for sugar and I sell to them right away. I do not need even an hour to sell a customer the sugar…"

On the other hand, a relatively small proportion of the supply chain members (14%), consisting of the manufacturer, agents and wholesalers experienced longer lead times in their selling of the sugar. This was a statement by one of the agents:

"…when a customer orders, we normally need to process all the paperwork necessary before we actually deliver the sugar to them. This normally takes five to six days…So the customer has to make sure to order from us a week prior to his delivery date…"

Longer lead times have an implication because they cause customer's replenishment planning systems to change and very often create false demand for future supply coverage. This new surge in demand often causes decisions to be made that increase capacity unnecessarily as the demand ultimately dissipates. This situation was reported by Donovan, (2002) as a source for bullwhip effect.

For the case of stock shortages, a larger proportion of the supply chain members (68%) claimed to have experienced stock shortages at least once, and out of this, as large as 56% of the supply chain members experienced the stock shortages more frequently while the other 12% experienced it less so. The sugar shortages have an implication as they lead to customers' overreaction such that the customers' orders give the supplier little information on the product's real demand (Lee, et al, 1997a) and hence cause order variability from the customers to the producers of sugar.

The findings furthermore stipulate that generally, a relatively larger proportion of the supply chain members (54%) claimed to have experienced last minute order cancellations at least once, and out of this, as large as 26% of the members experienced the order cancellations more frequently while the other 28% experienced it less so. The extent of the order cancellations, according to Lee et al (1997a), implies that when the product is in short supply, customers exaggerate their real needs when they order. Later, when demand cools, orders will suddenly disappear and cancellations pour in. In general, the frequent stock shortages and order cancellations signify that there is order variability along the supply chain of sugar.

Thus, based on the first objective of this study, there is the coexistence between the length of lead times and the degree of the variability of orders along the supply chain. This was as shown by the findings, whereby apart from retailers (whose business process is instant) who had only short lead times, most of the upper level supply chain members had experienced longer lead times (hence excess stock) as well as order variations (which were signified by frequent order cancellations).

3.2 Product Forecasts and the Variability of Orders

The second objective of this study was to establish whether there was any association of quality of product forecasts and the degree of orders' variability along the supply chain. Results for the investigations show that a large proportion of the supply chain members (58%) claimed to base their product's forecasts on past sales data while the other 42% claimed to never use any forecasting method, instead they just choose to sell the exact amount of sugar as they have always been selling. None of the supply chain member claimed to have used any sophisticated forecasting technique. The findings on the investigation are as tabulated in Table 5 below:

Table 5: Quality of Product's Forecasts among the Supply Chain Members

FORECAST METHOD USED	Based on past sales data	Sell the same amount	Sophisticated methods	**TOTAL**
MANUFACTURER	1	0	0	**1**
AGENTS	2	0	0	**2**
WHOLESALERS	4	1	0	**5**
RETAILERS	22	20	0	**42**
TOTAL NUMBER	29	21	0	**50**
PERCENTAGE	58.0	42.0	0	**100**

Source: Field data, 2011

Discussion

Generally, a larger proportion of the supply chain members (58%) claimed to base their sugar sales forecasts on the amount of orders they have been receiving from their customers in the past, while 42% of them do not forecast at all and instead they supply a fixed amount of sugar. As Kimaro, a wholesale shop owner manager put it:

"…if I want to know how much sugar supply I should get, I greatly considered how much of the sugar my customers have been ordering from me…'

These findings imply that the supply chain members rely on poor product forecasts. According to Lee, et al (1997a), when a downstream operation places an order, the upstream manager

processes that piece of information as a signal about future product demand. Based on this signal, the upstream manager re-adjusts his or her demand forecasts. Since, it is already stipulated earlier that the orders from the downstream operations are normally overstated for various reasons, the upstream manager finds himself with excess stock. The result is that, the fluctuations in the order quantities over time can be much greater than those in the demand data, thus, causing order variability among the suppliers in the supply chain.

Hence, most supply chain members relied on poor product forecasts (i.e. those that are based on past purchases figures from customers and which are always misstated). At the same time, almost an equal proportion of such supply chain members are the ones who had reported to experience stock shortages and order cancellations, which signify that, they experience variability in orders. Therefore, the supply chain members' reliance on poor product forecasts is another factor which is experienced in association with the orders variability.

3.3 Customer Service Level and the Variability of Orders

The third objective of this study was to establish whether there was any association of quality of customer service with degree of orders' variability along the supply chain. With this regard, it has been found out that the largest portion of supply chain members, that is 48% reported to have experienced many customer complaints on stock shortages several times. On the other hand, a relatively smaller percentage (38%) of the members claimed to have never experienced customer complaints due to stock shortages, whereas the rest (14% of the members) experienced the complaints only sometimes. This is summarized in Table 6 below.

Table 6: Frequency of Customer Complaints (resulting from stock outs)

FREQUENCY OF CUSTOMER COMPLAINTS	Many times	Sometimes	Never	**TOTAL**
MANUFACTURER	1	0	0	**1**
AGENTS	1	1	0	**2**
WHOLESALERS	4	1	0	**5**

RETAILERS	18	5	19	**42**
TOTAL NUMBER	24	7	19	**50**
PERCENTAGE	**48.0**	**14.0**	**38.0**	**100**

Source: Field data, 2011

Discussion

Generally, almost all the supply chain members (58% in Table 3) who reported to have experienced stock shortages also reported that their customers complained about the stock outs (62% in Table 6). This signifies that there is order variability among the suppliers of the sugar, as one sugar agent puts it:

"…we are doing our best to ensure that we never run out of stock, because if we do, then we lose a lot of our customers. At times of shortages, prices tend to increase and so some customers shy away from purchasing at the higher prices".

The measure of the quality of customer service is limited to the fact that there are stock outs which cause customers to complain about the availability of sugar from the suppliers. Therefore, the findings conclude that there is an association of quality of customer service with degree of orders' variability along the supply chain. This can be shown by having supply chain members who experienced stock outs, and hence customer complaints, also reporting to having experienced the variability of orders along their supply chain of sugar.

3.4 Level of Certainty in Production Planning and the Variability of Orders

The fourth objective of this study was to establish whether the level of certainty in production planning represents the degree in which orders vary along the supply chain. This section presents frequency of sudden orders received by the supply chain members and rate of responses to sudden order increases. Table 7 below presents the rate of sudden increase in orders received by the supply chain members.

Table 7: Rate of Sudden Order Increases

SUDDEN ORDER INCREASES	Always	Sometimes	Never	TOTAL
MANUFACTURER	1	0	0	**1**
AGENTS	2	0	0	**2**
WHOLESALERS	3	2	0	**5**
RETAILERS	27	11	4	**42**
TOTAL NUMBER	33	13	4	**50**
PERCENTAGE	66.0	26.0	8.0	**100**

Source: Field Data, 2011

The presented data indicate that the largest portion (92%) of the respondents claimed to have received sudden increased orders from their customers. Yet still, an equally larger portion of such members (66%) claimed to have received the sudden orders more frequently, while the rest (26%) claimed to have received the orders less frequently. In addition, Table 8 presented below depicts the rate of responses to sudden order increases by the supply chain members.

Table 8: Rate of Filling Sudden Order Increases

RATE OF FILLING SUDDEN ORDER INCREASES	Always	Sometimes	Never	TOTAL
MANUFACTURER	1	0	0	**1**
AGENTS	2	0	0	**2**
WHOLESALERS	4	1	0	**5**
RETAILERS	35	3	4	**42**
TOTAL NUMBER	42	4	4	**50**
PERCENTAGE	**84.0**	**8.0**	**8.0**	**100**

Source: Field Data, 2011

The data indicates that the largest portion (92%) of the respondents filled the sudden order increases from their customers. Yet still, an even larger portion among such members (84%)

claimed to have filled in the sudden orders more frequently, while the rest (8%) claimed to have filled in the orders less frequently.

Discussion

Generally, the data stipulated that most of the supply chain members (92%) experienced sudden order increases from their customers and most of them responded by filling such orders more frequently. The frequently sudden increases in orders, along with the frequent efforts of filling in these sudden orders by the supply chain members, have an implication that these supply chain members have an uncertain production or purchase plans which lead them to repurchase or revisit production suddenly in order to fill such orders. According to Lee, et al (1997a), one of the common symptoms of the order variations along the supply chain is uncertain production planning (i.e., excessive revisions).

3.5 Level of Overtime Expenses and the Variability of Orders

The fifth and last objective of this study was to show that the levels of overtime expenses are an indication of the existence of order's variability along the supply chain. This section presents rate of overtime storage costs and rate of overtime transportation costs.

To start with, Table 9 below presents rate of overtime storage costs faced by the supply chain members. From the Table, it can be observed that the largest portion (84%) of the respondents claimed to have never incurred any overtime storage expenses due to sudden increased orders from their customers. This proportion consisted of respondents who are all retailers of sugar. However, 16% of the respondents claimed to have incurred overtime storage expenses due to the sudden increased orders from customers. Out of this proportion of the members, (12%) claimed to have incurred the overtime storage expenses more frequently; while the rest (4%) claimed to have the overtime storage costs less frequently.

Table 9: Frequency of Overtime Storage Costs among the Supply Chain Members

FREQUENCY OF OVERTIME STORAGE COSTS	Always	Sometimes	Never	**TOTAL**
MANUFACTURER	1	0	0	**1**

AGENTS	2	0	0	**2**
WHOLESALERS	3	2	0	**5**
RETAILERS	0	0	42	**42**
TOTAL NUMBER	6	2	42	**50**
PERCENTAGE	12.0	4.0	84.0	**100**

Source: Field Data, 2011

In connection to that, Table 10 below depicts frequency of overtime transport costs to the supply chain members.

Table 10: Frequency of Overtime Transport Costs to the Supply Chain Members

FREQUENCY OF OVERTIME TRANSPORTATION COSTS	Always	Sometimes	Never	**TOTAL**
MANUFACTURER	1	0	0	**1**
AGENTS	2	0	0	**2**
WHOLESALERS	4	1	0	**5**
RETAILERS	31	7	4	**42**
TOTAL NUMBER	38	8	4	**50**
PERCENTAGE	76.0	16.0	8.0	**100**

Source: Field Data, 2011

As depicted in Table 10 above, the data indicates that all the respondents (92.0% - refer to table 8) who reported to have received sudden increased orders from their customers also incurred overtime transport costs of carrying the sugar (or its raw materials in case of the manufacturer) from their source of supply to their selling points. It is interesting to note that, the whole portion of the supply chain members who reported to have incurred overtime transport costs more frequently (76%) are among those who claimed to have received the sudden orders more frequently (84.0% - refer to Table 8). The same applies for those who claimed to have received the orders less frequently who also experience the overtime storage costs less frequently.

Discussion

Generally, the data stipulated that for those supply chain members who experienced sudden order increases from their customers and then responded to fill such orders, most of them (92%) also incurred overtime transportation costs. According to Lee, et al (1997a), the frequent overtime transportation costs have an implication that the supply chain members, due to their uncertain production or purchase plans experience high costs of transportation in filling the sudden order increases from their customers. Accordingly, another common symptom of the order variations along the supply chain is high costs for corrections, such as for expedited shipments and overtime. Thus, the findings conclude that the higher the level of the overtime expenses experienced by the supply chain members, the more the variability of orders along the supply chain.

4.0 CONCLUSION AND RECOMMENDATIONS

This section provides conclusion and recommendations that serve as the way forward towards improving the management of the sugar supply chain in the country.

4.1 Conclusion

The Tanzanian sugar supply chain is suffering from the bullwhip effect (order variations). In order to save it, knowledge is needed on the phenomenon of the bullwhip effect. Basically, the symptoms of the bullwhip effect are manifested in longer lead times, high stock shortages or many order cancellations, poor quality of customer service, uncertain production or purchase planning, and high overtime expenses which have all been uncovered in this investigation.

The order variations are more signified by high stock shortages and many order cancellations, than they are by longer lead times. Poor customer service comprises of customer complaints as a result of stock outs. However, customers in this case not only complain about the un-availability of the sugar (stocks) but also on the high prices of the sugar during the shortages.

Frequent deviations from the production or purchase planning also signify order variability and this situation arises mostly from last-minute, sudden increases in customers' orders in such a way that the supplier of the sugar fails to resist to serve them as promptly. In attempt to fulfill the sudden increases in customers' orders, the suppliers are faced with high costs of transportation

and storage. This also signifies that the orders had deviated from the time of the first production or purchase of the sugar, forcing the suppliers to incur more costs when they have to revisit the production or purchasing later on. All these situations have been confirmed to exist in this study hence the presence of bullwhip effect in the sugar supply chain.

4.2 Recommendations

This study provides recommendations in two areas, which are; theory recommendations and managerial recommendations.

4.2.1 Theory recommendations

There is need to have deeper understanding of bullwhip effect as a fertile area research to further knowledge of practitioners as well as managers of firms. Advance knowledge and practice is required into better measuring approaches and best practices in the management of the bullwhip effect in the Tanzanian context.

4.2.2 Managerial recommendations

1) The supply chain operators, including those in manufacturing, distribution, wholesaling and retailing, who are directly responsible for selling the product to the customers should focus on learning the early warning signs of the bullwhip effect, that is, order cancellations, stock shortages, poor quality of customer service, uncertain production or purchase planning, and high overtime expenses. Thereafter, they need to take appropriate measures to improve management of the sugar supply chain. It often happens in the country that, sugar is in short supply to the end users but the reality is some members in the sugar supply chain have piles of stocks in their warehouses. This is due to poor management of the chain.

2) Managers in the organizations within the supply chain should focus on applying effective inventory policies within their organizations to avoid the problems of stock shortages and high levels of obsolete inventory. They should also employ effective and sophisticated forecasting techniques to avoid inefficient and excessive production, which result into the bullwhip effect. Further, they should introduce application of up-to-date and effective information systems in order to communicate demand and supply information effectively, timely, and accurately in order to avoid the situation of order variability due to information gap within the supply chain.

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