European Research Studies Journal
Volume XXIII, Special Issue 1, 2020

pp. 79-88

The Impact of Supply Disruption on the Standing Order System in the FMCG Supply Chain

Submitted 21/08/20, 1st revision 18/09/20, 2nd revision 27/10/20, accepted 05/11/20

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Abstract:

Purpose: *The article aims to present the impact of supply disruption on the FMCG supply chain's standing order system.*
Design/Methodology/Approach: The research methodology used is the inventory control system's indicators with a fixed order quantity and graphic modeling.
Findings: *The system with a fixed order quantity requires the determination of the average annual demand for a given good and the determination of the ordering point, which is important for the FMCG branch.*
Practical Implications: *Delivering goods in the right place and time plays an important role in the supply chain of movable goods. Maintaining a safe level of inventory ensures an effective and smooth flow of inventories through the supply chain's links.*
Originality/value: *This article demonstrates the system with a fixed order quantity allows you to determine the size of the average annual demand for a given good and the point of ordering. It was indicated when logistic companies should use this method.*

Keywords: *Stock management, fixed order quantity, supply chain.*

JEL classification: *G32, M11, P41.*

Paper Type: *Research study.*

Acknowledgement: *Research financed from the NCN research project no. UMO-2012/05 / B / HS4 / 04139.*

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1. Introduction

Inventory control is important due to the specificity of the functioning of enterprises linked in the supply chain of movable goods. Considering today's economic conditions and the importance of inventory in the supply chain, the topic of fixed-order inventory control is still relevant.

The article aims to present the impact of supply disruption on the FMCG supply chain's standing order system. The research methodology used is the inventory control system's indicators with a fixed order quantity and graphic modeling. The system's use will allow us to determine the level of acceptable disturbances in the examined entities and show in which aspect the most effective method of the inventory control system with a fixed order quantity should be applied.

2. Supply Disruption in Branch FMCG

The supply chain is a sequence of processes that adds value to an item as it moves through individual links in the supply chain, starting from raw materials to the final recipient (Tundys, Rzeczycki, and Drobiazgiewicz, 2018). An integrated link that enables the effective flow of products through the supply chain is warehoused (Ripkema, Rossi, and van der Vorst, 2014; Kauf and Bruska, 2011). Moreover, warehouse management has become a key component of the supply chain (De Koster, Le-Duc, and Roodbergen, 2007; Kleindorfer and Saad, 2005).

Disruptions are foreseen or unpredictable events that directly impact the functioning of the entire organization or a particular process in the organization (Kramarz, 2013). The basic element is the disturbance assessment using appropriate tools and methods that analyze and monitor the possibility of a disturbance (Kulińska, 2012).

The industry in which the snowdrift control system is particularly important is the FMCG (Fast Moving Consumer Goods) industry. This is a fast-moving industry. In terms of finished products, warehouses mainly store food. Fast Moving Consumer Goods also includes cosmetics, detergents (Miller, 2016). This industry's supply chains are dynamic (Liczmańska, 2016) and sensitive to the occurrence of supply disruptions between individual links in the supply chain (Rahman, 2017).

The daily turnover of FMCG products in the supply chain is high. Especially in terms of deliveries. With a consistently high volume of deliveries, the possibility of disruption is very likely. Two groups of disruptions in the FMCG supply chains can be distinguished (Giera and Kulińska 2019):

1. The discrepancy between the demand and supply for products,
2. Supply disruptions.

To provide enterprises with adequate protection against the occurrence of disturbances, an appropriate inventory control system should be selected, which will enable the creation of a flexible system preventing the occurrence of disturbances (Giera and Kulińska, 2019).

3. Fixed Order Quantity

Contemporary inventory management problems in the supply chain can be considered taking into account two aspects: the development of market relations and an ineffective management accounting system. The development of market relations and competition, economic conditions, and the necessity to introduce new information technologies are connected with the necessity to use movable goods in the supply chain. The second aspect is an ineffective management accounting system that gives erroneous, fairly generalized information on inventories' demand in a particular supply chain (Grigoriev, 2006).

In a warehouse economy, tangible goods are called stocks. Stocks are needed for a stable flow of goods. They are the material basis for the commodity turnover (James and Douglas, 2005). Inventory is a set of production means held at various production and marketing stages, waiting to be consumed, transported, or sold. Inventories can play both positive and negative roles in an enterprise's economic activity (Gadzhinsky, 2005). The positive role of inventories is to ensure the continuity of the production or consumption process, protection against increases in purchase prices, smoothing out uneven demand, improving production efficiency, customer service, and the reliability of logistics management. The negative role of inventories is the freezing of cash, which slows down the development opportunities of enterprises with large amounts of inventories (Drozdov, 2012).

Inventories play an important role in the rational and efficient functioning of the enterprise. Creating inventories is to create a buffer between consecutive material deliveries and eliminate the need for continuous deliveries. This ensures continuity of production and delivers products in the right quantity and time to all links in the supply chain (Zevakov and Petrov, 2002).

SCS (Stock Control Systems) is the basis for analyzing inventory management by many companies. When managing inventories, one should consider the frequency of deliveries, which will directly affect the operation of enterprises and the entire supply chain. In a fixed order quantity inventory control system, order quantity is the main parameter. Determining the size of the order is the first element that must be specified. In an inventory control system with a fixed order quantity, the quantity of the ordered inventory is strictly fixed, and it is a constant value, which means that any changing conditions in the economy do not affect the quantity of the inventory order (Drozdov, 2012).

Ordering stocks in fixed amounts means periodic replenishment of the product with a specified equal amount each time. In practice, a fixed order quantity is quite often set arbitrarily. In this regard, the policy is conditioned by various factors, taking into account the transport possibilities, the weight of the stock, and the distribution of goods in the trailer.

To calculate the inventory control system's indexes with a fixed order quantity, you need to calculate the optimal order value. The Economic Order Quantity method is defined by the following formula (1):

$$Q_n = \sqrt{\frac{2PD}{U}} \tag{1}$$

where:
Q_n - optimal order quantity, [pcs]
P - product order cost, [zł.]
D - monthly or yearly demand for the product, [pcs]
U - unit storage cost for a month or a year, [zł./pcs]

An order in the system will be placed when the quantity of the current stock drops to the level specified by the order placement point.

4. Research Objects

The research entities are two companies providing warehouse services for the FMCG industry. The logistic audit results that the average annual demand in a particular examined entity is 24500 [pcs / pallet]. The purpose of using economic entities with such an annual demand is to visualize the inventory control system with a fixed-order quantity. The identical average annual demand will allow presenting how other factors affect the surveyed entities' functioning using the fixed order quantity method.

Table 1 shows the surveyed entities' basic parameters to illustrate the enterprises. It is the basis for further calculations.

Table 1. *Data on inventory orders*

Goods	**Yearly demand [pcs/ pallet]**	**Price [zł./pcs]**	**Delivery time [days]**	**Possible delay in deliveries [days]**	**Yearly delivery costs [%]**	**Yearly storage costs [%]**
A_1	24 500	185	3	3	25	5
A_2	24 500	215	1	5	5	5

Source: *Own study based on data from the enterprise.*

In Table 1 the optimal value of a one-off order for goods A_1 is given in equation (2):

$$Q_1 = \sqrt{\frac{2*46{,}25*24500}{9{,}25}} = 494{,}97 = 495\ [pcs] \quad (2)$$

where:
D_1 = 24500 [pcs]
U_1 = 185*0,05= 9,25 [zł./pcs]
P_1 = 185*0,25= 46,25 [zł./pcs]

The optimal value of a one-time order for product A_2 is given in equation (3):

$$Q_2 = \sqrt{\frac{2*10{,}75*24500}{10{,}75}} = 221{,}36 = 222\ [pcs] \quad (3)$$

where:
D_2 - 24500 [pcs]
U_2 - 215*0,05=10,75 [zł./pcs]
P_2 - 215*0,05=10,75 [zł./pcs]

The inventory control system parameters with a fixed order quantity were calculated for two items (A1 and A2) shown in Table 1. The purpose of specifying individual parameters is to present an inventory control system with a fixed order quantity using graphical modeling.

Table 1. *Inventory control system parameters with fixed order quantity*

	Index	**Model**	**Goods**	
			A_1	**A_2**
1	Daily demand [pcs]	[Annual demand / Number of working days in a year (247 days)]	24 500 /247 = 99	24 500 /247 =99
2	Order fulfillment time [days]	[optimal order quantity / Daily demand]	495/99=5	222/99=2,42
3	Expected demand while waiting for delivery [pcs]	[Delivery time * Daily demand]	3*99=297	1*99=99
4	Maximum possible demand during delivery [pcs]	[(Czas dostawy + Możliwe opóźnienie dostawy)*1%]	(3+3)*99=594	(5+1)*99=594
5	Safety stock [pcs]	[Maximum possible demand during delivery - Expected demand during delivery]	594-297= 297	594-99 = 495
6	Ordering point [pcs]	[Safety stock+ Expected demand while waiting for delivery]	297+297=594	495+99=594
7	Maximum stock [pcs]	[Safety stock + optimal order quantity]	297+495=792	495+222=717
8	The period of consumption of	[(Maximum stock – Ordering point) / Daily demand]	[(792-594)/99]=1,96	[(717-594)/99]=1,24

	inventories up to the safety level [days]			

Source: *Own study.*

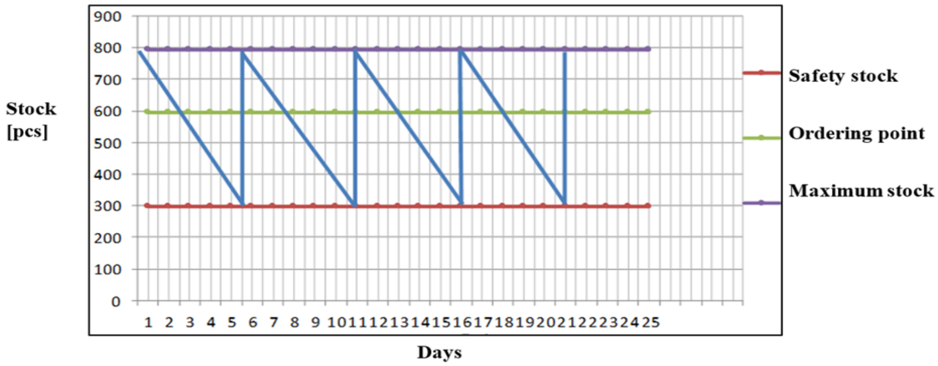
5. Analysis System

Based on the data from Table 2, graphic models were developed - inventory dynamics in Figure 1 to 3 for 3 different cases:

1. No delays in deliveries,
2. The occurrence of a single supply disruption,
3. The occurrence of repeated disruptions in supplies.

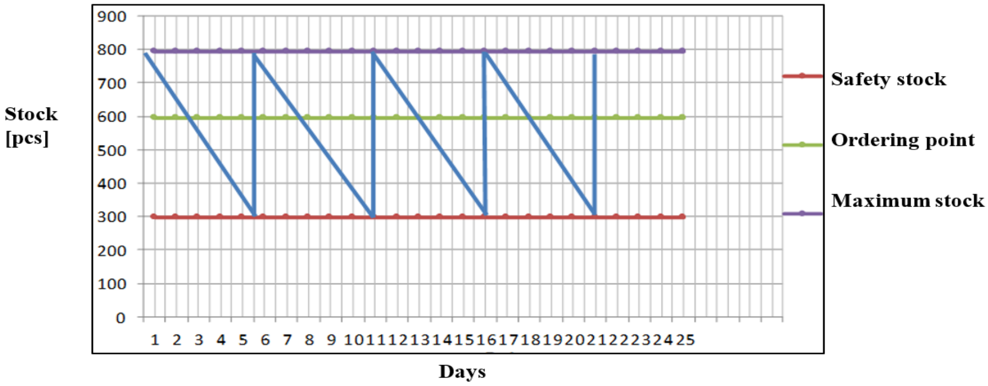
The first Figures show the absence of delivery delays (Figure 1 and Figure 2).

Figure 1. *Fixed order quantity system for A1 goods in the absence of delays in deliveries*



Source: *Own study based on Table 2.*

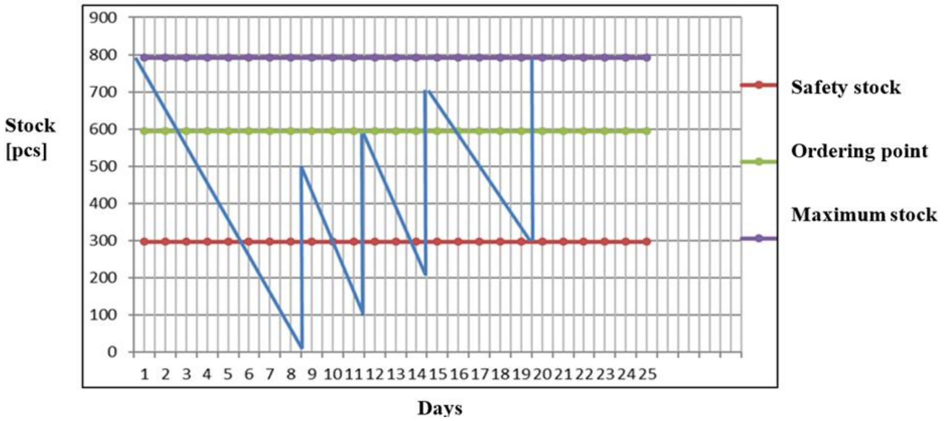
Figure 2. *Fixed order quantity system for A2 goods in the absence of delays in deliveries*



Source: *Own study based on Table 2.*

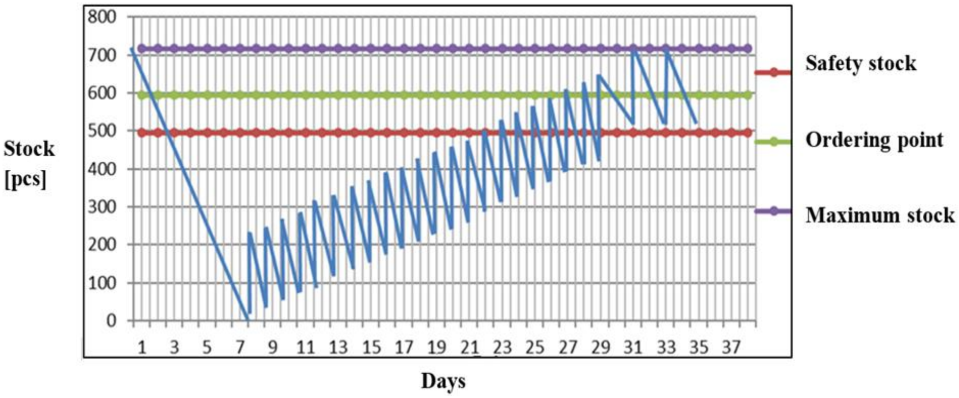
The absence of supply disruption will allow all links in the supply chain to function smoothly. This chart shows a systematic decrease in inventory in facilities and an increase in products after delivery. The charts in Figure 1 and Figure 2 make it possible to determine the frequency of re-ordering of goods, a key element in the FMCG industry. The following graphs (Figure 3 and Figure 4) show the occurrence of a single supply disruption.

Figure 3. *Fixed order quantity system for A1 goods in the event of a single supply disruption*



Source: *Own study based on Table 2.*

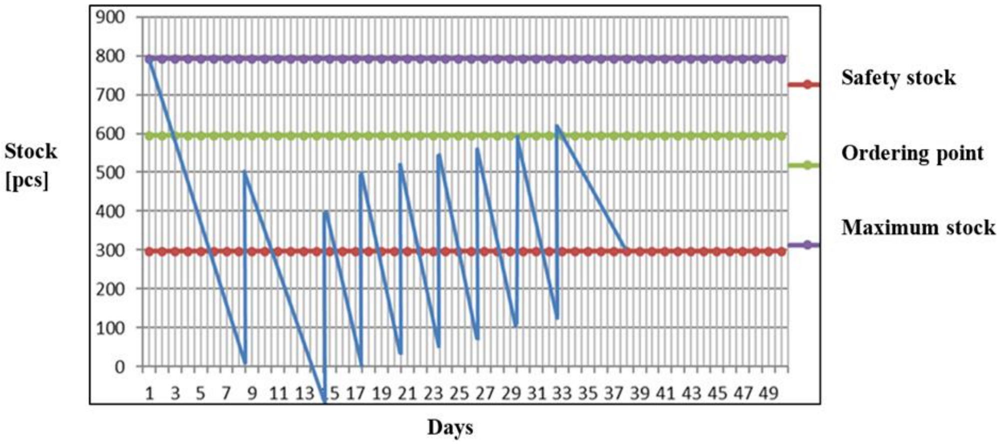
Figure 4. *A system with a fixed order quantity for A2 goods in the event of a single supply disruption*



Source: *Own study based on Table 2.*

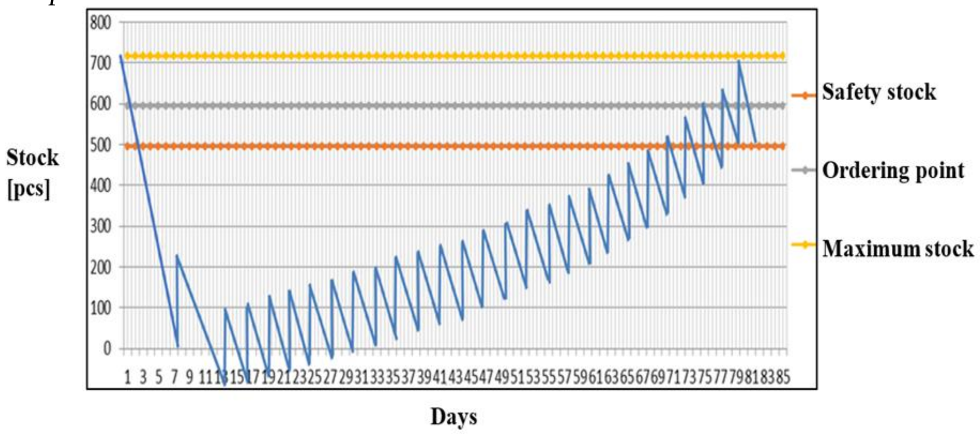
The occurrence of a single disturbance in the examined entities shows that the minimum stock level is not always achieved. This element is particularly visible in the product A2 (Figure 4). The inventory control system with a fixed order size does not consider changing conditions, including delays in deliveries. Therefore the occurrence of a single one disrupts the possibility of shortages in the warehouse. The next two graphs show repeated supply disruptions (Figure 5 and Figure 6).

Figure 5. *Fixed order quantity system for A1 goods in the event of repeated delivery disruptions*



Source: *Own study based on Table 2.*

Figure 6. *Fixed order quantity system for A2 goods in case of repeated supply disruptions*



Source: *Own study based on Table 2.*

The occurrence of repeated disruptions in the surveyed entities' supplies indicates that the safe level of inventory is not achieved in most of the analyzed period in organizations. Delayed delivery of goods to the surveyed entities prevents the surveyed enterprises' proper functioning and subsequent links in the supply chain.

The fixed order inventory control system allows only one disruption to occur so that the supply chain links can continue to function properly. The greater number of supply disruptions causes a deficit of goods for the surveyed entities. The conducted analysis shows that the inventory control system with a fixed-order quantity does not fulfill its function in industries where there are changing conditions for enterprises' functioning, but it does not mean that enterprises should not use this method.

This system enables the determination of the average annual demand for a given good and the ordering point's determination. This element has a key impact in the FMCG industry, where necessities constantly requiring direct access through the supply chain's last link are used.

6. Conclusions

An inventory control system with a fixed order quantity requires the continuous settlement of the current stock in the warehouse, although each order's quantity is constant. This system does not consider the changing economic conditions and the increase or decrease in demand for a given good, as well as the possibility of disruptions in the supply of goods for individual links in the supply chain.

Based on calculations and graphical modeling, the snowdrift control system with a fixed order quantity does not perform its function in the event of disruptions during delivery.

This system allows you to determine the size of the average annual demand for a given good, the point of order, and the number of goods each company should have to achieve a safe level of inventory. Having this information in place by warehouse companies is crucial to ensure constant access to inventory down the supply chain.

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