A Case Study of Inventory Management System for an International Lifestyle Product Retailer in Bolivia

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Abstract

Effective inventory management influences every aspect of a firm's operations. Inventory management in developing countries is a difficult business process because firms do not use basic inventory control concepts and techniques. Moreover, developing countries are characterized by trade imbalances with developed countries due to process inefficiencies, bureaucracy, and communication problems. This leads to longer lead times and supply uncertainty. Consequently, firms attempt to overcome the supply uncertainty by carrying unnecessary amounts of buffer stocks. We analyzed the inventory management system of an international lifestyle product retailer in Bolivia and found that, as the literature predicted, the firm showed no use of basic inventory control techniques. Particularly, it did not make data-driven decisions, lacked an effective inventory management system, or knew which products had higher consumer demand, and thus worked under a high level of supply uncertainty and inventory management illiteracy. Therefore, to reduce supply uncertainty, we developed a new inventory management system based on two strategies: (a) strategies to reduce demand uncertainty; and (b) strategies to reduce process uncertainty. Specifically, we implemented triple exponential smoothing for product demand forecasting, ABC segmentation to identify the most important products in the firm's portfolio, the newsvendor model to determine optimal inventory levels, powers-of-two policies, to optimize reorder times, and Turnover Based Metrics to arrange SKUs in the warehouse. Overall, our results suggest the significance of taking into account the country in which any firm operates. Hence, it should not be a surprise that in developing countries firms show high buffer stocks and generally adopt reactive flexibility practices.

Keywords
Inventory Management, Demand Forecasting, ABC Segmentation, Newsvendor Model, Powers-of-two policies.

1. Introduction

Every business, whether it is a manufacturing or service firm, requires the supply of its inventories to carry out its production and sales activities. Inventories have long been thought of as a necessary evil because they allow firms to respond to fluctuations in demand and supplier's uncertain delivery times. However, high inventory levels should result in higher costs associated with the production of goods and services. This suggests that inventory management is critical to maintaining the required quantity of goods because low inventory levels cause constant interruptions in the manufacturing system and the inability to meet customer demand. On the other hand, high inventory levels lead to higher production costs, which have a significant impact on the firm's profit margin. Inventory management has sparked interest as a research topic, with mathematical models and management policies being used to make decisions about how much and when to issue a supply order. A variety of internal and external organizational factors can influence these decisions, making the results of mathematical models and management policies vulnerable to different contexts. As a result, it is critical to examine inventory management practices taking into account the firm's country context to gain a better understanding of their operations and environment. In particular, the majority of inventory control techniques and concepts currently in use were established in developed countries, primarily to suit that specific industrial environment (Goonatilake 1990). The goal of developing countries' industrialization policies was to establish import-substitution industries. This policy was frequently combined with a protectionist strategy that required a ban on imports to support local industries. However, these policies lead to the development of local monopolies, which in time caused inefficient manufacturing processes characterized by unmet delivery dates or high production and inventory costs. As a consequence, any cost increase that was caused by internal inefficiencies was quickly pushed on to customers, with little risk of sacrificing market share or the firm's profitability, and thus promoting the adoption of weak inventory management practices (Goonatilake 1984). Therefore, in our research, we study the inventory management practices of an international lifestyle product retailer in one of the poorest countries in the Americas: Bolivia. Moreover, based on our findings we propose different strategies to improve supply flexibility.

2. Relevant literature

Firms want to become competitive in any market. However, the country's uncertainty makes it difficult to satisfy consumers. Supply efficiency is necessary to maintain low product costs, but supply flexibility is more important in environments characterized by high uncertainty. In particular, in politically unstable countries satisfying consumer needs is particularly difficult, due to time-varying supply. For example, constant country blockades due to political instability. Moreover, due country's instability consumers will suddenly reduce, cancel or move forward or backward their orders, and thus firms need higher supply flexibility (Angkiriwang et al. 2014). These supply flexibility practices may include changes in capacity levels, change of suppliers, smaller lot sizes, higher inventories, etc. Although many supply practices can be implemented by firms to increase supply flexibility, these practices are costly and cannot be used by all firms under all situations (Merschmann and Thonemann 2011; Stevenson and Spring 2007).

According to Angkiriwang et al. (2014), supply flexibility is characterized as a firm's capacity to react to unanticipated and unforeseen changes caused by uncertain conditions to satisfy a range of consumer demands or requirements while also ensuring customer satisfaction at a low cost. Under this framework, uncertainty is considered an important dimension that causes the need for a firm's supply flexibility. Thus, supply uncertainty is shown by the unpredictability of material sourcing and is revealed by material availability (Angkiriwang et al. 2014), material price (Zhang et al. 2011), alternative procurement availability (Pujawan 2004), and supply lead time (Osman and Demirli 2012). Moreover, according to Angkiriwang et al. (2014), a firm's uncertainty has three dimensions: (a) supply uncertainty (the uncertainty of material's supply); (b) process uncertainty (the probabilistic nature of machine availability and/or processing times); and (c) demand uncertainty (the probabilistic nature of demand quantity, types, timing, and locations). Therefore, where availability is unpredictable, greater flexibility is needed to satisfy consumer demand.

Moreover, flexibility can be reactive or proactive (Koste and Malhotra 1999). Flexibility's reactive nature helps to face internal and external environmental uncertainty, while its pragmatic nature enables a firm to redefine business risks or affect consumers' expectations in a particular industry. Specifically, reactive flexibility is related to a firm's attempt to react to the level of uncertainty, while maintaining its service level or efficiency. On the other hand, proactive flexibility is related to the strategies firms use to increase flexibility through proactively redesigning products, processes, and the supply network, as well as proactively negotiating more effective relationships with trading partners. Due to the high uncertainty and monopolies in developing countries, according to Goonatilake (1984) firms rely on abnormally high buffer stocks and disregard conventional inventory management practices, which

increase production costs. Thus, in developing countries, firm's higher buffer stocks are due to the use of one or a combination of reactive flexibility practices:

- *Higher safety stocks*. Is one of the most popular methods for increasing flexibility when demand and availability are unpredictable. The firm reduces the likelihood of inventory shortage and increases flexibility by keeping higher safety stocks (Van Kampen et al. 2010).
- *Capacity buffer.* Or having flexible capability is one way to deal with uncertainty. However, for certain industries, dynamically adjusting the capacity level is expensive, if not impractical. Rather than keeping inventory buffers, some firms tend to have surge capacity in the form of extra assembly lines that are staffed only when required (Manuj and Sahin 2011).
- *Supplier backups.* It is dangerous to work with a single supplier. Firms can also maintain several suppliers, which ensures supply. However, in most cases, this practice raises costs (Angkiriwang et al. 2014).
- *Safety lead times.* Firms also apply a safety lead time to the actual cycle time when faced with uncertainty. Safety lead time allows firms to increase material availability and thus become more flexible while increasing inventory and adding costs (Angkiriwang et al. 2014).

3. Supply characteristics in Bolivia

The main causes of industrial problems in developed countries have been described as high resource utilization, excess work-in-progress, low efficiency, poor product quality, and high inventories (Goonatilake 1990). Developing countries usually play the role of raw material producers or manufacturers, and face issues that influence the efficiency of their suppliers. These types of countries face different problems such as instability of their governments and policies, corruption, labor-intensive industries, lack of infrastructure, limited access to technology, underemployment, child labor, and a low education level (Akamp and Müller 2013). Moreover, the slow diffusion of innovations from developed to developing countries, due to contextual differences, has been seen as a significant barrier to industrial growth (Da Silveira 2001). However, much of the weaknesses of developing-countries industrialization programs have been due to the low value placed on successful supply management practices (Lehmann and Cordon 2020). Inventory management practices are part of supply management practices, and if this critical function is overlooked, it should result in excessive buffer stocks. Specifically, in developing countries, firms do not often use proper inventory management methods (Goonatilake 1984). Moreover, in developing countries manufacturing and commercial firms are often forced to close due to a lack of raw materials, components, or finished products. Problems in inventory management practices are to blame for a large portion of the shortcomings and bottlenecks of production and commercialization. As a result, new research into the degree to which inventory management practices are used in firms from developing countries is needed.

Bolivia is one the least developed countries in the Americas and its firms suffer many of the management problems mentioned above. Over the years, Bolivia has been characterized by constant political instability and economic inequality (Herbas-Torrico et al. 2021). The Bolivian economy is not industrialized and has few large firms and a significant number of small firms (Morales 2020). In Bolivia, eight out of ten jobs are created in small firms, which contribute 83% of Bolivian employment (Opinión 2017). Due to the size of its informal economy, the Bolivian economy is vulnerable to persistent political instability and exhibits irregular growth patterns (Hussain 2014). Moreover, Bolivia is generally characterized as politically unstable (The Fund for Peace 2020). Furthermore, due to these problems, innovation and entrepreneurship take a backseat precluding any form of competition. For example, to start a formal business in Bolivia, one needs at least 45 days (Del Castillo 2020). These kinds of disincentives, in the form of regulations and administrative procedures, cause higher economic informality, lower productivity, higher costs (Strobel 2010), and thus higher supply uncertainty. Therefore, Bolivia's peculiar characteristics cause supply uncertainty to firms operating in the country and a fertile ground for inventory management research.

4. Case study

We conducted a case study with an international lifestyle product retailer in Bolivia. We chose to do a case study because is an effective research tool for gathering rich scientific evidence and thereby gaining a thorough understanding of supply management practices (Kähkönen 2011). The firm we chose aimed to learn more about supply management practices in Bolivia. Specifically, we wanted to know the practices firms from developing countries use to face supply uncertainty.

4.1. Firm's supply characteristics

The firm we chose is an Asian low-cost franchise of lifestyle product retailers that imports, stocks, distributes, and markets products designed by the company itself. The company's business model aims to capture new demand and become the market leader. This strategy is implemented through the continuous introduction of new products to the market. The franchise operates in Bolivia, in the cities of La Paz, Cochabamba, and Santa Cruz. For the development of our study, we analyzed the franchise's operations in the city of Cochabamba. Moreover, in Cochabamba, the firm has three sales branches and two warehouses (one for products and the other for furniture). The stored products are finished products and, depending on their characteristics, are categorized into different groups and subgroups.

We collected data sales from May 2019 to January 2020, through the firm's invoice system. During this period three orders to the franchise's main supplier were placed. Afterward, the firm received 96,001 products from 1,791 different Stock-Keeping Units (SKU's). In particular, the firm defined the classification of 1,791 SKU's into different groups and sub-groups. Based on the information obtained from the three placed orders, we identified nine product groups and 39 sub-groups. Moreover, we found that only 75.94% of products had consumer demand, and 24.06% were obsolete products (around 146,861.97 U.S. dollars in lost sales). Furthermore, during this period we found that the firm did no calculate any safety stock, and placed orders when the warehouse "*started to look empty*." We also found that the firm used only in extreme situations, as its backup supplier, another franchise in other cities. However, due to contractual reasons, the firm has to place its orders from its main supplier in China. Regarding safety lead times, they had high variability because Bolivian customs procedures were overly bureaucratic and complex. Particularly, any order from the main supplier in China on average took around two months until its reception. However, due to Bolivian customs, some orders were delayed up to 5 months.

At the beginning of the study, the firm was using the same storage space it still uses now. Specifically, the storage space was not properly organized and was characterized by no warehouse slotting and high processing times. These high processing times were due to the absence of inventory management practices. Moreover, the shelves inside the warehouse were numbered randomly. Specifically, the products were stored on shelves randomly, using the availability of space as the only organizational criterion.

The inventory control management practices consisted of recording each order's information in an Excel table. Specifically, this table included the number of products at the time of an order reception, the number of outgoing products to supply the sales branches, and the shelf number on which the product was located. At different times, the same product could be located on different shelves because the received orders were randomly arranged. At the time of receiving the orders, the products were arranged according to the availability of space in the warehouse. Consequently, products were untidy. Also, there were no permanent warehouse personnel or established work schedules. Thus, the firm's investors were in charge of hiring personnel only when it was necessary to place orders for the store branches or to unload received orders.

Additionally, the firm did not know which products had higher demand in the sales branches. Products in high demand were stationary in the warehouse because their market potential was not known and thus not requested by the sales branches. Similarly, when placing orders, product demand was not taken into account. Therefore, the sale of products that could generate greater income for the firm was overlooked. Also, the optimal quantities for each product group were unknown. As a result, orders were oversized for certain types of low-demand products and undersized for high-demand products. This resulted in higher buffer stocks for some products and unsatisfied demand for others.

4.2. Typology of supply uncertainty

Based on the uncertainty typology suggested by Angkiriwang et al. (2014), the data collected, and the Bolivian business environment characteristics, the case study faces highly uncertain demand. Specifically, the firm's high demand uncertainty is related to the inability to forecast what products are needed by the branches and the high product mix of the firm (1,791 SKU's). Moreover, supply-wise, the case study faces highly uncertain supply lead times for most products, due to: (i) overly bureaucratic and complex Bolivian customs procedures, and (ii) high dependence on only one overseas supplier. In terms of operation processes, the case study showed high processing times due to the lack of use of basic inventory management practices. Therefore, this information suggests that the case study operates under a high level of supply uncertainty where much flexibility is needed.

4.3. Flexibility strategies adopted

The approach a firm creates flexibility to handle uncertainty differs from case to case. For our case study, the typology of supply uncertainty suggests that reactive strategies should be used by the firm, and must focus on the use of (a) product forecasting methodologies for its high product mix (1,791 SKU's) to reduce demand uncertainty; and (b) inventory management practices to reduce high processing times. We did not consider flexibility strategies to reduce uncertainty in the supply lead times because: (i) overly bureaucratic and complex customs administrative procedures are determined by the Bolivian government, and (ii) franchise exclusivity contracts determine that the firm can only use the main supplier in China.

5. Results

In the following sections, we present the results from the implementation of the strategies to reduce demand uncertainty and process uncertainty.

5.1. Strategies adopted to reduce demand uncertainty

As we suggested above, the case study did not use any demand forecasting methodology. Thus, we used time-series forecasting to predict demand for each group using data from five weeks of sales (average supply lead time for one order). We found strong seasonality in the data and used triple exponential smoothing. We used the three most common quantitative measures for evaluating the forecasting models we developed: mean absolute deviation (MAD), mean square deviation (MSD), and mean absolute percentage error (MAPE). To select the best model coefficients, we used the optimization tool from Excel (Solver) to search for the model parameters that minimize MAD, MSD, and MAPE (Hopp and Spearman 2011). Due to space limitations, in Figure 1 we only present four out of nine optimized forecasting models with their parameters.

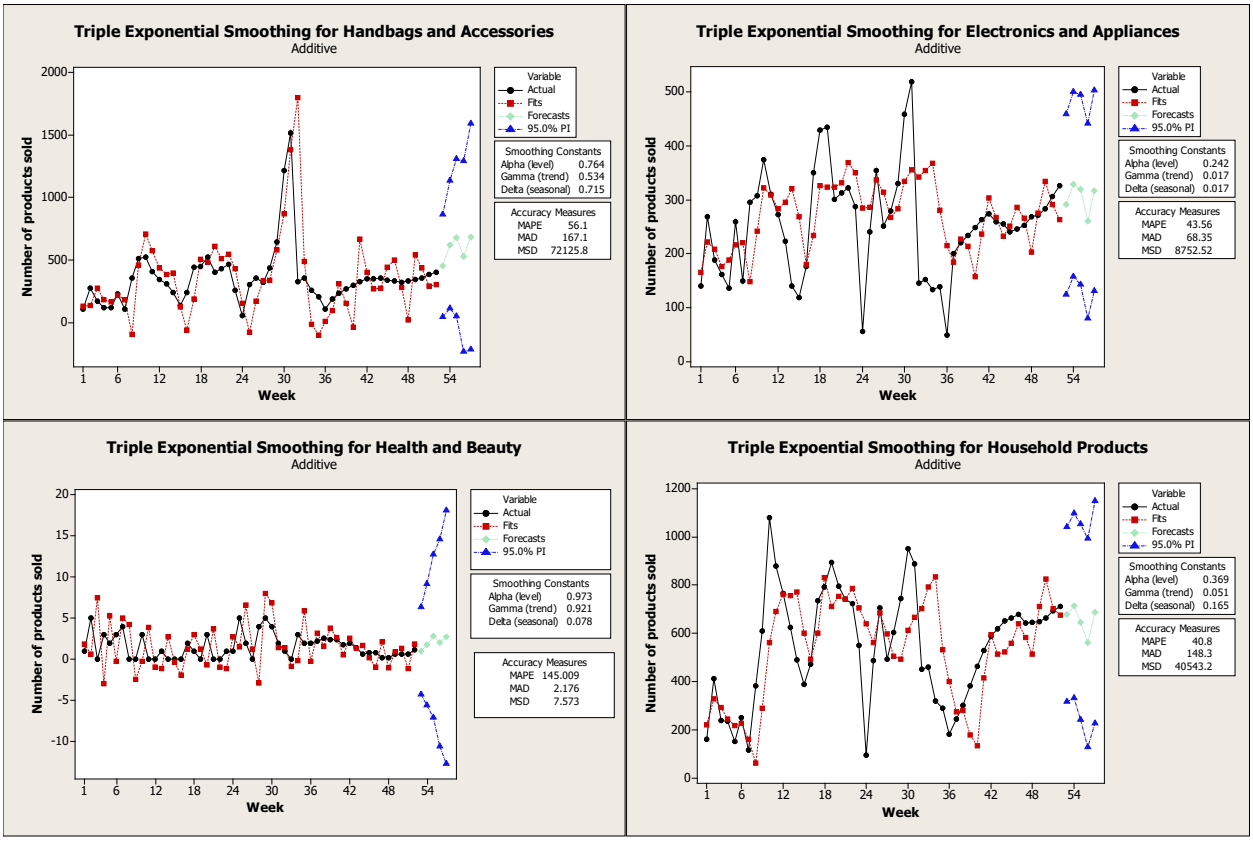

Figure 1. Final forecasting models for four product groups.

Next, to categorize the economic importance of each product group, we used the ABC analysis (Hopp and Spearman 2011). Specifically, products that generate 60% of the sales were classified as A-type products. Moreover, those product groups responsible for making the remaining 40% of sales were divided between B and C-type products. Next,

we estimated the number of products for each product category. As Table 1 shows, (a) accessories and handbags, and electronics and appliances product groups have most A-type products; (b) household products, makeup, scented products, and toy series product groups are B-type products; and (c) health and beauty and textile product groups have most C-type products. In particular, Table 1 suggests that health and beauty products and textile products represent the lowest sales for the firm.

Table 1. Number of products per category within each group

Product Group	A-type	B-type	C-type
Accessories and handbags	118.00	67.00	142.00
Electronics and appliances	100.00	60.00	212.00
Health and beauty	1.00	0.00	0.00
Household products	94.00	107.00	297.00
Makeup	65.00	69.00	125.00
Scented products	4.00	7.00	6.00
Stationery and gifts	11.00	25.00	194.00
Textile	0.00	0.00	2.00
Toy series	18.00	24.00	43.00

Then, to refine the categorization produced by ABC analysis, we compared the inventory value of each product group against its coefficient of variation (CoV). Specifically, this analysis should allow us to determine the importance of product groups when comparing their degree of volatility vs. their economic value. As a consequence, we can enrich ABC analysis with a new dimension (product volatility). Particularly, (i) A-type products should be products with high [low] volatility and with high economic value; (ii) B-type products should be products with high [low] volatility and with medium economic value; and (iii) C-type products, products should be products with high [low] volatility and low economic value. Therefore, as Figure 2 shows: (a) accessories and handbags, household products, and electronics and appliances are A-type products; (b) makeup products are B-type products; and (c) textile, scented products, stationery and gifts, toy series, and health and beauty products are C-type products. These results suggest that the case study should give more importance to the reduction of supply uncertainty in A and B-type product groups (accessories and handbags, household products, electronics and appliances, and makeup)

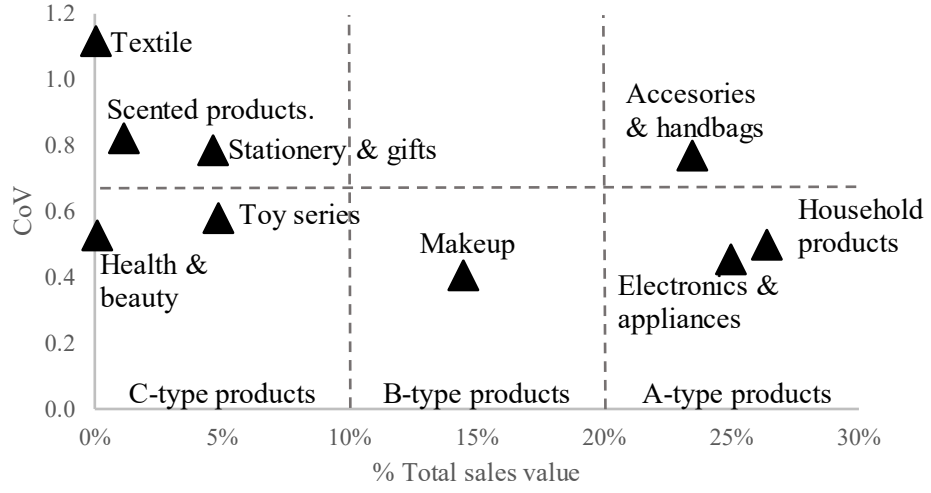

Figure 2. Product groups' degree of volatility vs. its economic value.

As we mentioned before, the firm is a low-cost Asian franchise of lifestyle product retailers that continually imports, stocks, distributes, and markets innovative products designed by the company itself. Due to the firm's low-cost products and the need for high inventory turnover of innovative products we considered the most appropriate inventory model to determine optimal order quantities is the newsvendor model (Hopp and Spearman 2011). Specifically, consider the situation that the case study faces in each order of new products from its main supplier. Due to the product's novelty, demand is random and occurs in such a short burst of time that if inventory is not on the shelves,

sales are lost. Therefore, the newsvendor model is the most appropriate to determine optimal order quantities. Next, using the newsvendor model we considered three different demand scenarios, taking into account the possible demand fluctuations due to the COVID-19 pandemic. According to the World Trade Organization (2020), world trade is expected to plummet between 13% and 32% in 2020 due to the COVID-19. Based on this information: scenario 1 represents no change in demand behavior, scenario 2 represents a drop in 13% of sales, and scenario 3 represents a 32% sales reduction (i.e. worst-case scenario).

5.1.1. Scenario 1

In Table 2, using the previously forecasted demand and the newsvendor model, we calculated the optimal order quantities per product group (Q*) and the optimal reorder time (T*) for two cost settings (minimum cost and maximum profit). Moreover, using the powers-of-two policies (Muckstadt and Sapra 2010) we also calculated the practical reorder time for each product group (T). Particularly, we used powers-of-two policies (PO2), because the newsvendor model calculates a different reorder time for each product group. However, due to the firm's business model, for each order, it should only use a single container with multiple products, and cannot place different orders with different delivery times for different product groups. Hence, the PO2 policies combine orders from many products in a cost-effective way in a single order and give the practical reorder time. As shown in Table 2, we calculated T and we found that, when there is no change in demand, the practical reorder time should be 32 weeks for all product groups in a single container.

Table 2. Scenario 1: Practical reorder times (T) using PO2 policies with no change in demand

Product Group	Minimum Cost				Maximum Profit			
	Q*	%	T*	T	Q*	%	T*	T
Accessories and bags	9.641	19.28%	26.93	32.00	10.587	19.25%	29.57	32.00
Electronics and appliances	6.376	12.75%	25.06	32.00	7.023	12.77%	27.61	32.00
Health and beauty	44	0.09%	28.76	32.00	49	0.09%	31.50	32.00
Domestic products	13.838	27.68%	25.41	32.00	15.233	27.70%	27.97	32.00
Makeup tools	11.397	22.79%	24.84	32.00	12.559	22.83%	27.37	32.00
Scented products	473	0.95%	30.43	32.00	517	0.94%	33.25	32.00
Stationery and gifts	6.337	12.67%	27.67	32.00	6.951	12.64%	30.35	32.00
Textile	48	0.10%	41.29	32.00	52	0.09%	44.67	32.00
Toy series	1.846	3.69%	25.71	32.00	2.031	3.69%	28.28	32.00

Note.- Q*: optimal order quantity; T*: optimal reorder time; %: percentage of a single container; T: practical reorder time

5.1.2. Scenario 2

For scenario 2 we considered a drop in 13% of sales and estimated again Q*, T*, and T (see Table 3). Our results show that under scenario 2, the practical reorder time should also be every 32 weeks for almost all product groups for a single container. However, our results also suggest that textile group products (C-type products) should be reordered every 64 weeks.

Table 3. Scenario 2: Practical reorder times (T) using PO2 policies with 13% drop in demand

Product Group	Minimum Cost				Maximum Profit			
	Q*	%	T*	T	Q*	%	T*	T
Accessories and bags	9.617	19.23%	30.88	32.00	10.561	19.20%	33.91	32.00
Electronics and appliances	6.388	12.78%	28.86	32.00	7.036	12.79%	31.79	32.00
Health and beauty	44	0.09%	32.85	32.00	48	0.09%	35.98	32.00
Domestic products	13.853	27.71%	29.23	32.00	15.248	27.72%	32.18	32.00
Makeup tools	11.426	22.85%	28.62	32.00	12.589	22.89%	31.54	32.00
Scented products	468	0.94%	34.64	32.00	512	0.93%	37.87	32.00
Stationery and Gifts	6.311	12.62%	31.67	32.00	6.923	12.59%	34.74	32.00
Textile	47	0.09%	46.33	64.00	51	0.09%	50.17	64.00
Toy series	1.846	3.69%	29.56	32.00	2.031	3.69%	32.52	32.00

Note.- Q*: optimal order quantity; T*: optimal reorder time; %: percentage of a single container; T: practical reorder time

5.1.3. Scenario 3

In the case of scenario 3, we considered a reduction in 32% of sales, and we also calculated Q*, T*, and T (see Table 4). The results similarly show that under this scenario, the practical reorder time should also be every 32 weeks for 66% of product groups using a single container. However, our results also suggest that 33% of some C-type products (health and beauty, scented products, and textile) should be reordered every 64 weeks for maximum profit.

Table 4. Scenario 3: Practical reorder times (T) using PO2 policies with 32% drop in demand

Product Group	Minimum Cost				Maximum Profit			
	Q*	%	T*	T	Q*	%	T*	T
Accessories and bags	9.577	19.15%	39.34	32.00	10.518	19.12%	43.21	32.00
Electronics and appliances	6.409	12.82%	37.05	32.00	7.058	12.83%	40.80	32.00
Health and beauty	44	0.09%	41.58	32.00	48	0.09%	45.57	64.00
Domestic products	13.877	27.75%	37.47	32.00	15.274	27.77%	41.24	32.00
Makeup tools	11.473	22.95%	36.77	32.00	12.639	22.98%	40.51	32.00
Scented products	461	0.92%	43.63	32.00	504	0.92%	47.72	64.00
Stationery and gifts	6.268	12.54%	40.24	32.00	6.878	12.50%	44.16	32.00
Textile	45	0.09%	56.95	64.00	49	0.09%	61.73	64.00
Toy series	1.847	3.69%	37.84	32.00	2.032	3.70%	41.63	32.00

Note.- Q*: optimal order quantity; T*: optimal reorder time; %: percentage of a single container; T: practical reorder time

In general, our results from the three scenarios suggest that A, B, and two C-type products (stationery and gifts, and toy series) should be reordered every 32 weeks. Additionally, our results also suggest that three C-type products (health and beauty, scented products, and textile) should be ordered every 64 weeks for maximum profit. Therefore, the firm's order plans should consider this information in the orders to be placed to its supplier.

5.2. Strategies adopted to reduce process uncertainty

To reduce process uncertainty (high processing times), we used warehouse slotting. Particularly, we analyzed the results presented above to categorize and organize inventory throughout the warehouse. Moreover, we used a two-stage process to assign each SKU using the results of the ABC analysis (see Figure 2) and afterward assigned each product group to listed storage locations within the warehouse. Specifically, we used slotting by Turnover Based Metrics (Kofler et al. 2014): within each product group, the SKUs were arranged via a simple policy of highest product demand and proximity to the warehouse entrance (see Figure 3).

This layout should be strictly followed when the firm receives its requested orders. Particularly, warehouse workers should always start at the opposite end of the entrance, and thus any changes can be made easily when more space is needed for any new product.

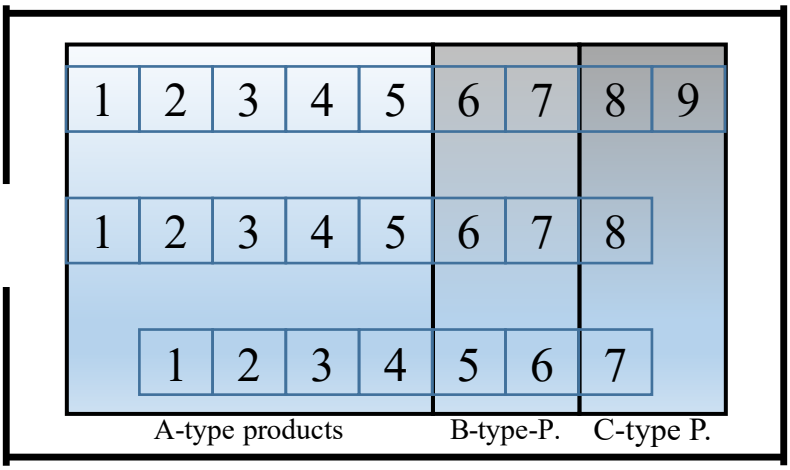

Figure 3. Warehouse layout slotting

6. Discussion and conclusions

In this article, we studied the inventory management practices of an international lifestyle product retailer in Bolivia. Our literature review showed that in developed countries supply efficiency is necessary to maintain low production costs. However, in developing countries supply flexibility is more important due to the environment's high uncertainty. Thus, for developing countries, supply flexibility allows the firm to react to unanticipated and unforeseen changes to satisfy consumers at a lower cost. Firms can choose between using reactive flexibility or proactive flexibility. However, due to characteristic high uncertainty and monopolies in developing countries, firms focus on reactive flexibility in the form of higher buffer stocks and chose to ignore the use of common inventory management practices. Therefore, firms in developing countries use one or a combination of reactive flexibility practices: higher safety stocks, capacity buffers, supplier backups, and safety lead times.

Our study was made in Bolivia: a developing country characterized by persistent political instability and thus high uncertainty. In particular, as a case study, we analyzed the inventory management practices of an Asian lifestyle product retailer. As the literature predicted, the firm did not use any inventory management practices and was characterized by high buffer stocks (in the form of 1,791 SKU's). Moreover, we found that the firm did not make any data-driven decisions. For example, orders were placed when the warehouse *"started to look empty,"* nor management knew which products had higher consumer demand. Therefore, the firm worked under a high level of supply uncertainty and inventory management illiteracy.

Based on the collected information we proposed two types of strategies to reduce supply uncertainty: (a) strategies to reduce demand uncertainty; and (b) strategies to reduce process uncertainty. Initially, the strategies considered to reduce demand uncertainty were related to the use of time series forecasting for the firm's nine product groups. Specifically, we found strong demand seasonality and thus used triple exponential smoothing for our predictive models. As a consequence, we developed nine demand forecasting models with optimized parameters (see Figure 1). Next, we used ABC analysis to categorize product groups according to their economic importance. We found that: (i) accessories and handbags, and electronics and appliances generated 60% of economic value (A-type products); (ii) household products, makeup, scented products, and toy series product groups generated 40% of economic value (B-type products); and (iii) health and beauty, and textile product groups generate 10% of economic value (C-type products). To refine our product categorization, we compared the inventory value of each product group against its CoV. We found matching results, with slight differences (see Figure 2). Specifically, we found that: (a) accessories and handbags, household products, and electronics and appliances were A-type products; (b) makeup products were B-type products; and (c) textile, scented products, stationery, and gifts, toy series, and health and beauty products were

C-type products. These differences are due to ABC analysis assumes the absence of demand volatility in the products under study (Hopp and Spearman 2011). Thus, the introduction of demand volatility in our analyses improves the reliability of our product categorization. Next, to estimate optimal order quantities we used the newsvendor model (Hopp and Spearman 2011) because the firm sells innovative low-cost products and needs high inventory turnover. Using the forecasted demand for each product group into the newsvendor model, we calculated the optimal order quantities for each product group and the optimal reorder times for three consumer demand scenarios (scenario 1, no change in demand; scenario 2, 13% demand reduction; scenario 3, 32% demand reduction). The results from Tables 2, 3, and 4 show the existence of different optimal reorder times for each product group. These results were impractical because for each order the firm should only use a single container with multiple products. Moreover, it cannot place different orders with different lead times for different product groups. Hence, we used PO2 policies (Muckstadt and Sapra 2010) to combine orders from many products, in a cost-effective way, in a single container, and thus estimating practical reorder times (see Tables 2, 3, and 4). Consequently, the three scenarios suggest that A and B-type products should be reordered every 32 weeks. However, C-type products, except stationery and gifts and toy series, should be reordered every 64 weeks. Subsequently, we developed strategies to reduce process uncertainty. Specifically, we aimed to reduce high processing times through warehouse slotting. Specifically, using the results presented above and Turnover Based Metrics (Kofler et al. 2014), within each product group the SKUs were arranged via a simple policy of highest product demand and its proximity to the warehouse entrance (see Figure 3).

Our findings generally indicate the significance of taking account of the context in which any firm operates. Particularly, Bolivia is a developing country and historically has been characterized as a politically unstable country (Herbas-Torrico et al. 2021). Political instability causes constant material supply problems due to protest marches and road blockades (Arce and Rice 2009; Los Tiempos 2020). For example, the political crisis of 2019 caused 150 firms to declare bankruptcy and close down (Pagina Siete 2019). Therefore, as Goonatilake (1984) suggests, Bolivian firms should rely on abnormally high buffer stocks, do not use conventional inventory management practices, and thus have higher production costs. Our case study showed no different behavior to firms from other developing countries. These conditions suggest that firms from developing countries should aim to work on reactive flexibility practices. Moreover, firms should lobby their governments to improve business infrastructure and reduce excessive bureaucratic procedures. In the first case, firms should aim to increase safety stocks, capacity buffers, supplier backups, and safety lead times. For the second case, firms should jointly work with local and federal governments to develop a better business infrastructure.

Finally, our study shows that the implementation of reactive flexibility practices can greatly improve inventory practices. Yet, the limited sample size of our study limits the generalizability of our results. Thus, more studies are needed to confirm our findings. Moreover, the particular business characteristics of our case study limit the capacity to extend forecasting results to other products and industries. However, the framework of strategies used to reduce supply uncertainty can be used in other industries. Furthermore, our article suggests that inventory management practices from developed countries can also be used in developing countries to reduce supply uncertainty. However, as our study found, firms in developing countries do not even use basic inventory management practices. Hence, most management decisions still are subjective in nature, instead of data-driven. Therefore, the intelligent use of demand and inventory information in developing countries has considerable potential for a firm's growth. This information should uncover patterns, unexpected relationships, and market trends, making it possible to reduce buffer stocks, accurately forecast demand, and reduce inventory processing time.

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