

Perishable Economic Order Quantity with A Short Receipt Lag Framework for MSMES In Zimbabwe

Stanley Murairwa

Africa University, College of Business and Management Sciences, Box 1320, Mutare, Zimbabwe

Corresponding author

Stanley Murairwa, Africa University, College of Business and Management Sciences, Box 1320, Mutare, Zimbabwe.

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ABSTRACT

Purpose: The study investigates the application of the Economic Order Quantity (EOQ) framework in handling perishable stocks for Micro, Small, and Medium Enterprises (MSMEs) in Zimbabwe, incorporating a Short Receipt Lag (SRL) time. The study optimises stock management decisions for perishable items, minimising losses and maximising profitability for Zimbabwean MSMEs.

Design/Methodology/Approach: An exploratory mixed methods approach was employed with survey data from 34 volunteered Zimbabwean MSMEs with mathematical modeling.

Findings: The study suggested a Perishable Economic Order Quantity with a Short Receipt Lag (PEOQSRL) framework and determined the order quantity that minimises the stock management costs. The results show that implementing the PEOQSRL framework significantly reduces understocking, overstocking, and waste of perishable stocks. The study reveals that the Zimbabwean MSMEs can reduce costs associated with perishable stock losses through this framework. Several perishable stock management strategies were evaluated that can be implemented by the Zimbabwean MSMEs. The most preferred perishable stock management strategies were First-In-First-Out (80.56%), Regular Stock Counts and Reconciliation (58.33%), Temperature Controlled Storage (58.33%), and Training Staff on Proper Handling Techniques (52.78%). The popular perishable stock disposal strategy by Zimbabwean MSMEs is to discard them immediately (61%).

Research Practical and Social Implications: The enforcement or implementation of the PEOQSRL framework can have practical implications for MSMEs in Zimbabwe, such as enhanced stock management, reduced waste, and increased profitability. The PEOQSRL framework can contribute to job creation, economic growth, and food security, eventually improving the livelihoods of MSMEs in Zimbabwe. This study contributes to effective perishable stock management models and methods for the Zimbabwean MSMEs and similar emerging economies, enhancing their resilience and competitiveness in supply chain uncertainties.

Originality/Value: Besides the developed Perishable Economic Order Quantity with a Short Receipt Lag (PEOQSRL) framework, the utilisation of case-based data in developing the PEOQSRL framework brings novel adaptive and sustainable ideas to the stock management discipline.

Keywords: Perishable Economic Order Quantity with Short Receipt Lag, Perishable Stock Management, Micro Small and Medium Enterprises (MSMEs), Small and Medium Enterprises (SMEs), Perishable Stock Management Strategies

Introduction

Most Micro, Small, and Medium Enterprises (MSMEs) face challenges in managing perishable stock, which loses value after a period. The period could be infinite or finite resulting in infinite and finite perishable stock categories. The MSMEs are widely acknowledged for their contribution to the economic development of Zimbabwe [1]. According to Musabayana,

Mutambara, and Gwenya, there are 73 603 registered SMEs in Zimbabwe as of 2020. According to Jenkins, perishable stock consists of products or services that lose value after a while and become worthless [2,3]. The period “after a while” which this study terms a lag may be gradual or instantaneous, like market studies, seats on a bus, flowers, or pharmaceuticals. This is the aspect that Shaabani adopted to classify literature studies as strictly fixed lifetime, non-strict fixed lifetime, random shelf life, and gradual deterioration over time [4]. Researchers often use the terms perishable “stock” and “inventory” interchangeably. However, the difference is subtle but important. The former refers to items (finished products and materials) sold to customers,

while the latter refers to items, materials, and equipment used to make them. In general, inventory includes stocks. This research focuses on the management of perishable stocks. The perishable stocks can be classified into two groups: stocked perishable items, such as finished products (bread), and non-stocked items, such as services booked (hotel night reservations). The management of perishable stocks uses similar models to non-perishable stock management models but differs in that the former requires extra considerations.

Several models have been proposed to procure and manage perishable stock and non-perishable items, such as the Economic Order Quantity (EOQ), Production Lot Size (PSM), and Single Period models. The Single-Period model, also known as the News Vendor method, was developed to procure and manage perishable stock for the business [5]. The Single-period model does not allow ordering during production or consumption. A penalty is incurred in breach of the policy. This study adjusted this model to accommodate demand fluctuation in the purchasing period. Behret and Kahraman studied the discrete demand under a fuzzy environment in single-period stock models [6]. The major challenges for MSMEs with perishable stocks are poor market demand forecast, product expiring, overstocking, and inefficient tracking. According to Munro, the challenges of managing perishable stocks are waste, packaging, pest and grime control, and logistics [5]. However, the benefits of efficient and effective perishable stock management are maintaining accurate records, identifying business inefficiencies, improving customer retention, enhancing compliance, cutting costs, and monitoring performance over time of the business [5]. Disck.com and Munro discussed First-In-First-Out (FIFO), First-Expired-First-Out (FEFO), inventory tracking systems, supplier management, specialised inventory software, safety stocks, and reorder points as strategies for managing perishable stock [5,7].

Perishable stock management poses challenges in monitoring levels, transportation status, and storage conditions of the perishable items [8]. The leftover stock items by the close of the business are valueless. These items include the stock for newspaper vending, canteen operations, seasonal goods, florists, seasonal clothes, and magazines. Managing food procurement presents problems and opportunities for saving funds in the hospitality industry [9]. Several stock management models were proposed, but the perishable stock-out concept was not considered. Most stock management models hardly consider the perishable of the items [10]. Damgaard, Nguyen, Hvolby, and Steger-Jensen recommended further research on the perishable stock models and their parameters [10]. Due to customer's increasing demand for fresh foods, effective and efficient management of perishable stock is required [11]. The perishable stock items require an accurate control model capable of handling the backlog and opportunity cost [12]. According to Chaudhary, Kulshrestha, and Routroy, future perishable stock studies should focus on stochastic modelling [13]. The arguments highlight the need for more studies of perishable stock management models with opportunity cost. Since the leftovers are valueless, the question is "What is the quantity of the perishable stock that maximises profit, minimises costs, and reduces waste?" Therefore, the research objectives were to

a) examine the current expired perishable stock disposal procedures by MSMEs in Zimbabwe,

- b) assess the challenges faced by the MSMEs in Zimbabwe in the management of perishable stocks,
- c) evaluate the strategies for optimising perishable stock management by the MSMEs Zimbabwe, and
- d) suggest an enhanced perishable stock management framework to mitigate waste.

Literature Review

Shaabani investigated the perishable inventory routing problem. Several studies consider stochastic shelf life and demand processes and consider a constant order lead time [13]. Few studies integrate uncertainty lead time into the supply chain and inventory control. Perishable stocks are modeled in a model with a fixed or random shelf life [14]. The base-stock and constant order policies are the commonly used traditional stock-level dependent policies for perishable stocks [15]. Gong, Lian, and Xiao applied the known continuous review stock policy. While the perishable stock replenishment policy is important in optimising perishable stock waste, the pricing policy contributes immensely to its success [16]. Rathod and Jenkins discussed the strategies for managing perishable stock that include reducing perishability, diversifying supply-chain, building supplier relationships, utilising technology, creating safety stocks, forecasting demand, stock auditing, and tracking, First In, First Out (FIFO), and First Expiring, First Out (FEFO) [4,17]. Most people come up with grocery lists and meal plans knowingly or unknowingly with the perishability of some foods (Byrne, 2022). Jenkins (2022) discussed the twenty common challenges and possible solutions for managing perishable stock [4,18]. Osman, Xu, Akufu, and Paul discussed eight perishable stock management challenges and recommended eight possible solutions to mitigate them [19]. So, the stock perishability affects the households' grocery purchasing behaviour which could be classified as a Micro, Small and Medium Enterprise (MSME) perishable stock management system. Therefore, the questions are

- What major challenges do the MSMEs face in managing perishable stocks in Zimbabwe? How does a short receipt lag impact the Economic Order Quantity (EOQ) framework for perishable stock management in the MSMEs in Zimbabwe?
- What are the current perishable stock management models used by the MSMEs in Zimbabwe?

According to Foodcircle, seven steps constitute the procurement process. In these steps, the company must identify the goods to be offered and suppliers, negotiate a contract, order (placing, receipting, and receiving), and maintain inventory [20]. The perishable stock costs can be optimised in these steps. The challenges the MSMEs face in managing perishable stocks in Zimbabwe are grouped according to these steps. However, there is a need to establish strong supplier relationships [5]. Cost is the biggest challenge in the hospitality industry's inefficient procurement process [21]. These challenges include supply chain issues, sustainability reporting, pricing, sourcing suppliers, quality monitoring and control, seasonality and perishability, compliance with regulations, waste, ordering systems, consumer trends and preferences, and competition. There is an increase in perishable stocks' waste and quality concerns with minimal studies focusing on the issues [19]. According to Damgaard, Nguyen, Hvolby, and Steger-Jensen, many perishable stock models do not consider the items' perishability [10]. More

studies should be conducted on the problems associated with managing perishable stock [10]. Therefore, the questions are

- What could be done to minimise the costs of managing perishable stock?
- What are the optimum order quantities and frequencies for perishable stock in the MSMEs in Zimbabwe considering a short receipt lag?

The MSMEs can dispose of perishable stocks by selling, destroying, or keeping them. The useful strategies for managing perishable stocks are batch tracking, demand forecasting, diverse supply chain, FEFO, FIFO, inventory auditing, inventory management software, reorder points, safety stock, single-period inventory management, and temperature and humidity monitoring [5].

Research Gap

The reasons for more waste in perishable stocks have been studied, but what has attracted researchers' interest is the lack of waste perishable stock reduction strategies [16]. This study responds to the call for more studies on effective and efficient perishable stock models by Osman, Xu, Akufu, and Paul, Macías-López, Cárdenas-Barrón, Peimbert-García, and Mandal, Patriarca, Di Gravio, Costantino, and Tronci, Chaudhary, Kulshrestha, and Routroy, and Damgaard, Nguyen, Hvolby, and Steger-Jensen [11-13,19].

Research Methodology

Type of research: The research conducted an exploratory mixed methods study to understand the MSMEs' strategies for handling perishable stock.

Variables of the Research: The research collected data from volunteered MSMEs in Zimbabwe on the type of perishable product, average monthly volume, storage methods and temperature, inspection frequency, staff training, tracking and disposal, and mistakes and ways of managing perishable stocks. Figure 1 presents the research conceptual framework.

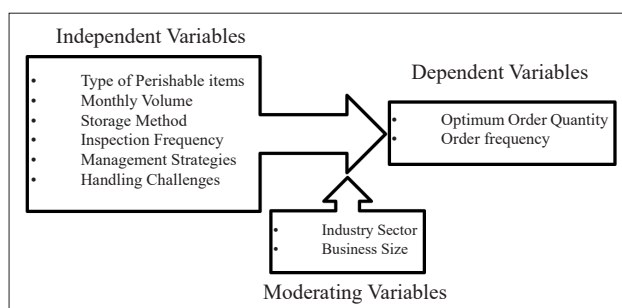


Figure 1: Research Conceptual Framework

Figure 1 presents the independent, dependent and moderating variables of this study. The moderating variables are not examined in this study. The dependent variables optimise the perishable stocks and determine the order frequency. The independent variables are the type of perishable stocks, monthly volume, storage method, inspection frequency, management strategies, and handling challenges.

Population, Sample, and Sampling

In 2020, there were 73 603 registered SMEs in Zimbabwe [2]. The target group of the research was the Micro, Small and Medium Enterprises (MSMEs) in Zimbabwe that had internet access. The Voluntary sampling design was used to select the MSMEs in Zimbabwe that completed the questionnaires [22]. An intent to conduct a study was written and attached to the Google Forms questionnaire. The respondent was supposed to give concern before completing the data collection instrument. The data was collected from 34 volunteer MSMEs in Zimbabwe that were managing perishable stocks daily. The data was collected over five working days from Monday 30 September 2024 to 4 October 2024.

Data Gathering Method

The researcher designed a Google Forms questionnaire to collect data from MSMEs in Zimbabwe. The research collected primary data from MSME owners who volunteered to participate in the study.

Data Gathering Instrument

A Google Forms questionnaire was designed, and the link was shared with 43 volunteered MSMEs to complete [23]. The questionnaire composed of closed questions and two open-ended questions was distributed to MSMEs in Zimbabwe. A good response rate for an online data collection instrument is between 5% and 30% responses [24].

Data Analysis Tools and Procedures: The data was analysed in real-time by Google Forms and later in SPSS using descriptive and inferential statistics. The mean score was computed with

$$\bar{x}_s = \frac{\sum_{i=1}^n x_i}{n} \quad (1)$$

where n is the sample size and x is the data value. The ranks were allocated according to Murairwa [25,26]. The percentage scores were computed with

$$P_s = \frac{x_i}{n} \quad (2)$$

where x_i is the i th number of responses and n is the sample size. The difference of two proportions test was implemented to test at a 5% level of significance the hypothesis that H_0 Two proportions are the same versus H_1 Two proportions are not the same. The Z-test value was computed with

$$Z = \frac{p_1 - p_2 - (\pi_1 - \pi_2)}{\sqrt{\hat{p}(1-p)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} \quad (3)$$

where $p_1 = \frac{x_1}{n_1}$, $p_2 = \frac{x_2}{n_2}$, $\hat{p} = \frac{x_1 + x_2}{n_1 + n_2}$ is the pooled proportion, $p_1 + p_2 = 1$, $p_2 + p_1 = 1$ is the first sample proportion, p_2 is the second sample proportion, π_1 is the first population proportion, π_2 is the second population proportion, n_1 is the size of the first sample and n_2 is the size of the second sample. The p-value was computed with

$$p\text{-value} = 2 \times \min(p, 1-p), \quad (4)$$

The larger the p-value the more it supports H_0 . If $\alpha > p\text{-value}$, H_0 is rejected, otherwise it is not rejected. The research applied the Effect Size to test the significance of the magnitude of the difference between the two proportions. The results are presented in different graphs for visual depiction.

Ethical Issues: This study involves the collection of human views and opinions. However, the participation was voluntary. The Google Forms questionnaire was accompanied by a consent statement that participation was voluntary. At any point, the respondent was free to abandon the process. However, completing the questionnaire was voluntary, and the data provided would be used only for research purposes. The views and opinions were analysed and used only for this study. The extract from the cover letter that accompanied the questionnaire is as follows:

“.....The questionnaire collects data for research on perishable stock management by MSMEs in Zimbabwe. By completing the questionnaire, you have volunteered to participate in the study as a respondent. By completing the questionnaire, you have consented to participation in the study.”

Results and Discussions

The response rate was 79.07%. This is very high because the Voluntary sampling design was used to select the respondents [24]. Figure 2 presents the distribution of respondents by type of MSME perishable stocks.

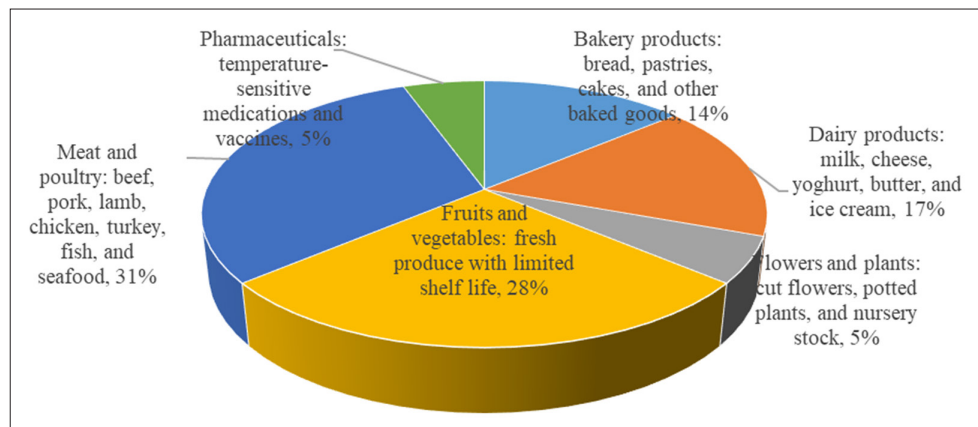


Figure 2: MSMEs by Type of Perishable Stocks in Zimbabwe

Figure 2 shows that most of the MSMEs in Zimbabwe that participated in this study were from Meat and Poultry (31%), Fruits and Vegetables (28%), Dairy Products (17%), and Bakery Products (14%). The least participants came from the Pharmaceuticals (5%), and Flowers and Plants (5%). The results in Figure 2 show that most MSMEs in Zimbabwe are in meat, poultry, fruits, vegetables, dairy, and bakery businesses. However, the proportions of the MSMEs Trained (52.80%) against those Not Trained (47.20%) are statistically the same as supported by the results, $z = 0.4752$, $p = 0.63122$. The difference between the two proportions is not significant at $\alpha = 0.05$. This means the two proportions are statistically the same. So almost half of the MSMEs in Zimbabwe require training on managing perishable stocks of their businesses. Figure 3 presents the MSMEs in Zimbabwe's perishable stock quantities.

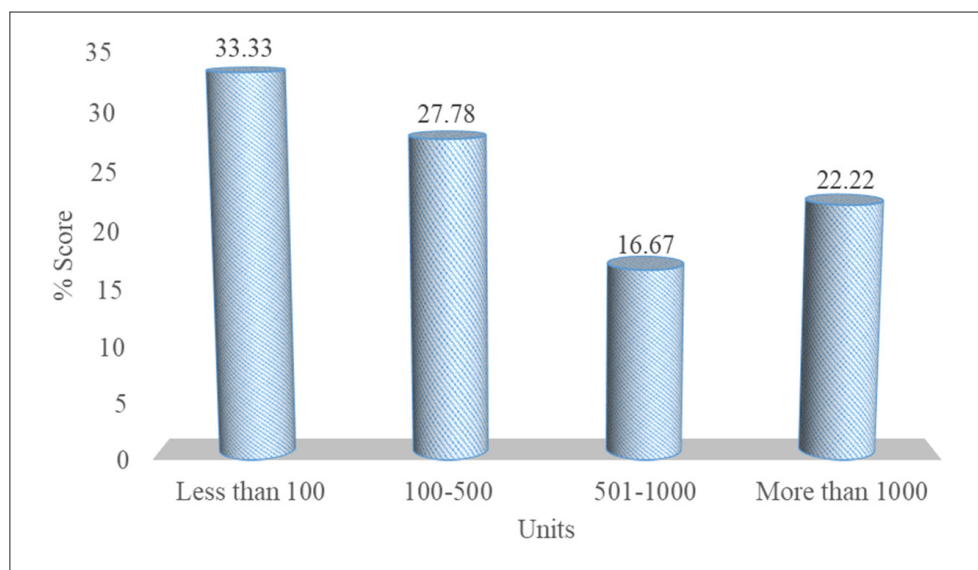


Figure 3: MSMEs Quantity of Perishable Stock in Zimbabwe

Figure 3 shows that less than 100 perishable stocks were handled by 33.33% of the MSMEs in Zimbabwe, while 27.78% managed 100 to 500 perishable items. This, therefore, means that more than 61.11% of the MSMEs in Zimbabwe were managing less than 500 units of perishable stocks. About 16.67% of MSMEs in Zimbabwe managed 501–1000 perishable stocks. The quantity distribution of the perishable stocks can be analysed using the management techniques Rathod used to optimise the stock management process [17]. The study investigated the procedures for disposing of expired perishable stocks and presented the results in Figure 4.

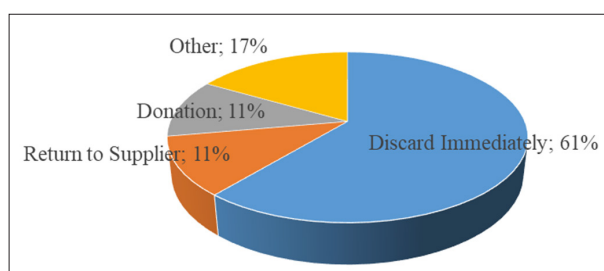


Figure 4: MSMEs Procedures for Disposing of Expired Perishable Stocks in Zimbabwe

Figure 4 presents the favourable perishable stock disposal strategies by the MSMEs in Zimbabwe. Most MSMEs in Zimbabwe preferred to Discard Immediately (61%) of perishable

stocks. Donation (11%) and Return to Supplier (11%) are the least preferred perishable stock disposal methods. The results confirm the discussions in VSG. The research investigated whether disposing of expired perishable stocks is the same for MSMEs in Zimbabwe at a 5% significance level and presented the results in Table 1.

Table 1: Procedure for Disposing of Expired Stocks

	Test Statistics
Chi-Square(a)	25.333
Df	3
Asymp. Sig.	0.000

(a) 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 9.0.

Table 1 shows a Chi-square test value = 25.333, p-value = 0.0001, and degrees of freedom = 3. Since $\alpha=0.05 > p\text{-value}=0.0001$, the null hypothesis is rejected. There is a difference in the disposal of expired or spoiled perishable stocks by the MSMEs in Zimbabwe. These results suggest a strong preference for Discard Immediately (61%) as an expired perishable stock disposal strategy among the MSMEs in Zimbabwe. The research assessed the challenges faced by MSMEs in Zimbabwe and presented the results in Figure 5.

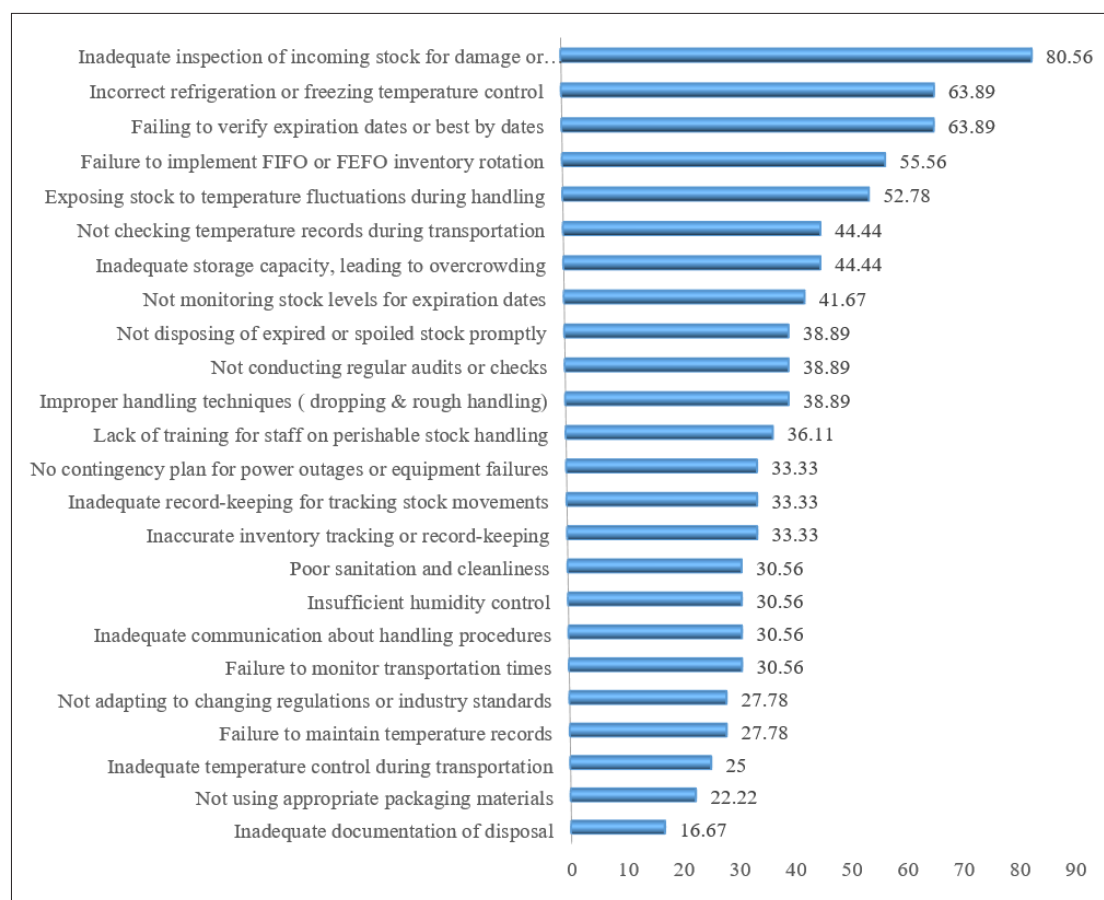


Figure 5: Perishable Stock Management Challenges Faced by MSMEs in Zimbabwe

Figure 5 presents the challenges that MSMEs in Zimbabwe face in managing their businesses' perishable stocks. Figure 5 shows that 80.56% of the MSMEs in Zimbabwe inadequately inspect incoming perishable stocks for damages, spoilage or expiry. The MSMEs in Zimbabwe incorrectly control refrigeration and freezing temperatures (63.89%) and verify the perishable stock expiring date (63.89%). The results agree with the discussions in Rathod, Osman, Xu, Akuful, and Paul and Jenkins [3,17,19]. The results show a lack of training of the MSMEs in Zimbabwe on mitigating the perishable stock management challenges. The research investigated the frequency of reviewing and updating perishable stock management procedures in MSMEs in Zimbabwe and presented the results in Figure 6.

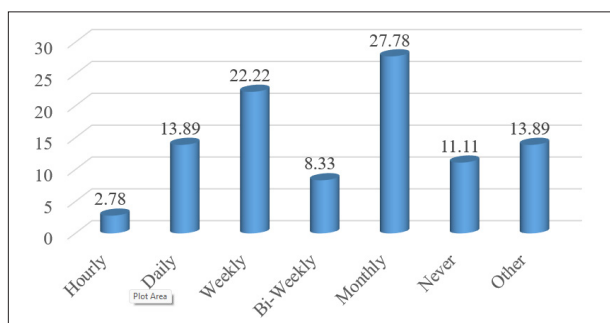


Figure 6: Frequency of Reviewing and Updating Perishable Stock Management Procedures

The results in Figure 6 show that most MSMEs in Zimbabwe prefer Monthly (27.78%) and weekly (22.22%) intervals for reviewing and updating management processes of perishable stocks. Generally, there are no fixed rules on how and when to review and update the perishable stock management procedures. However, the results in Figure 6 suggest why most MSMEs in Zimbabwe that manage perishable stocks fail. The research expected continuous short-term reviewing and updating of stock management procedures similar to what was discussed in Gong, Lian, and Xiao [27]. The weekly and monthly reviewing and updating lead to high operations costs from disposal, donation, and retention of perishable stocks. The study collected the participants' views on the strategies to improve the management of perishable stock and presented the results in Table 2.

Table 2: MSMEs Strategies for Managing Perishable Stock in Zimbabwe

Strategy	% Score	Rank
First-In-First-Out (FIFO) Inventory Rotation	80.56	1
Regular Stock Counts and Reconciliation	58.33	2
Temperature-Controlled Storage (Refrigeration & Freezing)	58.33	2
Train Staff on Proper Handling Techniques	52.78	4
Verify Expiration Dates and Best By Dates	47.22	5
Automated Inventory Management Software	44.44	6
Real-Time Tracking and Monitoring	44.44	6

Comply With Regulatory Requirements	41.67	8
Follow Industry Standards	36.11	9
Sanitation and Cleanliness Protocols	33.33	10
Conduct Thorough Inspections Upon Receipt	30.56	11
Check Temperature Records During Transportation	30.56	11
Regular Training Sessions	30.56	11
Use Appropriate Packaging Materials	27.78	14
Maintain Accurate and Detailed Records	27.78	14
Monitor Temperature Records	27.78	14
Identify and Address Bottlenecks	27.78	14
Continuously Review and Refine Procedures	27.78	14
Temperature-Controlled Transportation	25.00	19
Track Stock Movements and Transactions	25.00	19
Proper Ventilation	22.22	21
Clear Procedures and Guidelines	22.22	21
Monitor Transportation Times	19.44	23
Power Outage and Equipment Failure Procedures	19.44	23
Business Continuity Planning	19.44	23
Implement Sustainable Practices	19.44	23
Humidity Control	16.67	27
Schedule Regular Inventory Audits	16.67	27
Monitor Temperature and Humidity Levels	16.67	27
Performance Monitoring and Feedback	13.89	30
Internet of Things (IoT) Sensors for Temperature Monitoring	11.11	31
Implement Lot Tracking and Traceability	8.33	32
Emergency Stock Disposal Plans	8.33	32
Conduct Mock Recalls	8.33	32
Implement Vendor Verification Programmes	5.56	35
Automated Alerts and Notifications	5.56	35
Mobile Applications for Inventory Management	5.56	35
Analyse Inventory Turnover and Shrinkage	5.56	35

Table 2 shows that the MSMEs in Zimbabwe prefer First-In-First-Out (FIFO) Inventory Rotation (80.56%) to manage perishable stocks. The First-Expired-First-Out (FEFO) inventory rotation applies for shelf-life controlled stocks. However, more than half of the participants prefer Regular Stock Counts and Reconciliation (58.33%) and Temperature-Controlled Storage (Refrigeration & Freezing) (58.33%). The results in Table 2 confirm the discussions in Disk.com (2024), Munro (2024), Rathod (2024), Osman, Xu, Akuful and Paul (2023), and Jenkins (2022). The MSMEs in Zimbabwe also highly preferred to use databases for perishable stock management as supported by Automated Inventory Management Software (44.44%) and

Real-Time Tracking and Monitoring (44.44%). Table 2 results show the need for MSMEs in Zimbabwe to adopt and leverage new technologies in managing perishable stocks as evidenced by the low preference percentages on the last eight strategies that capture the roles of Internet of Things (IoT) sensors, automated alerts and notifications, and mobile applications technologies. The research analysed the data from the literature and proposed a procurement model presented in Figure 7.

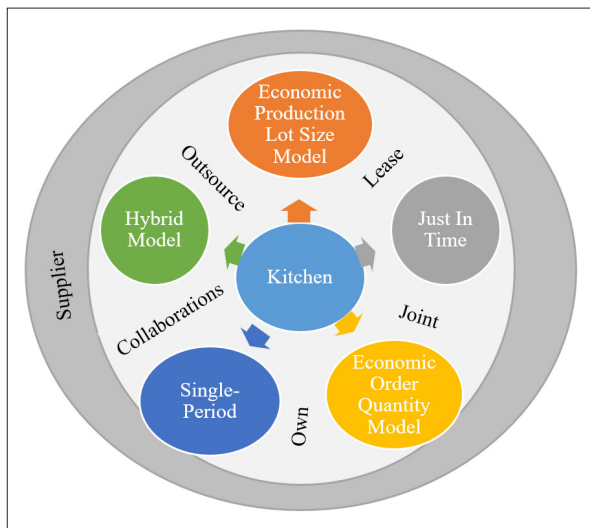


Figure 7: Perishable Stock Procurement Processes

Figure 7 shows that the MSMEs in Zimbabwe cannot adopt a single procurement model because of the different types and values of the perishable stocks. The hybrid stock management model is appropriate for all MSMEs in Zimbabwe that handle perishable items. Figure 7 shows the strategies that MSMEs in Zimbabwe can adopt to optimise perishable stock management. The MSMEs in Zimbabwe can determine the procurement model by categorising the value of the inventory using the ABC analysis model (Rathod, 2024). The high-value perishable stocks are highly perishable and valuable in monetary terms but with a low frequency of demand. If the stock is highly perishable, the best procurement model will be to own, lease, or collaborate with the suppliers, and apply the Just-In-Time (JIT) model to the Economic Order Quantity (EOQ) model. This is a hybrid procurement model. The company owns the company that produces stocks in the economic production lot size (EPLS) model. The moderate-value perishable stocks are managed with moderate attention, but their review and replenishment are less frequent than the high-value perishable stocks. The low-value perishable stocks are of the least monetary value but are in high demand. The items are of low cost. The items contribute a minimal amount to the overall inventory value of the MSMEs in Zimbabwe.

The category of the ABC analysis must have an effective and efficient perishable stock management model. Researchers should develop category-specific models. It may be inappropriate to have a single stock management model for managing the three stock categories of the ABC analysis. Thus, researchers must be guided by the ABC analysis when developing stock management models. The one-size-fits-all stock management model is ineffective and inefficient. By understanding the demand patterns of each stock category, companies can optimise

the quantity kept in their warehouses. The research determined the perishable stock quantity that can be purchased every time an order is placed, taking into consideration the ABC analysis model.

The Perishable Economic Order Quantity with a Short Receipt Lag (PEOQSRL) framework: To accommodate the three types of stocks, the research proposes the Perishable Economic Order Quantity with a Short Receipt Lag (PEOQSRL) model for perishable stocks such as those for the canteen. The model hedges against delay in receiving inventory by ordering buffer stock every time an order is placed after the short production lag or procuring. The model accommodates perishable stocks by reducing the order quantity according to demand. The model has two periods of receiving orders. This reduces opportunity costs, such as stock-out, overstocking, and backorder costs. The model assumes that the order received is the buffer stock. Thus, the receipt order is the buffer stock. The current buffer stock is the production items. The diagram of the PEOQSRL is presented in Figure 8.

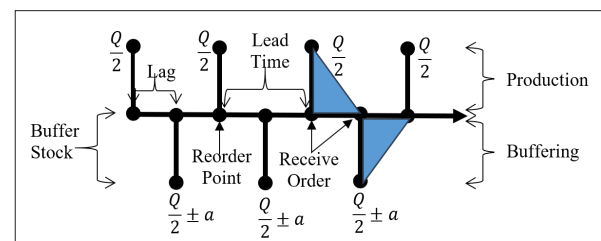


Figure 8: Perishable Economic Order Quantity with a Short Receipt Lag Framework

Figure 8 shows that a short receipt lag is when a company consumes the available stocks while waiting for the second part of the order to arrive. During the short receipt lag, the MSME can analyse the demand and adjust the quantity of the order of the buffer stock. That is why there is a need for collaboration within the supply chain as presented in Figure 7. A Q-quantity order is placed by the company at any given time. However, the company receives half of the orders for production and consumption. The second half of the order comes in during the cycle time and becomes the buffer stock for the remaining period of production time. The cycle time is the same as the lead-time. The PEOQSRL model can handle stocks that go bad quickly and stocks that go bad slowly.

Notation

Let,

- “Q” is the quantity of items per order;
- “ C_h ” is the monthly holding cost of an item;
- “ C_o ” is the ordering cost per order of the items;
- “M” is the monthly demand for the product; and
- “C” is the unit cost of each item.
- “a” is the minimum stock added to or subtracted from “Q*”.

The Assumptions of The PEOQSRL Framework

- The general assumptions of the Economic Order Quantity (EOQ) model apply.
- The stock order is received twice and used once during the cycle time as a batch.
- The demand is for one month.
- Half of the stock is charged holding cost.

The Quantity That Minimises Costs of The PEOQSRL Framework

The Total Cost = Ordering Cost (OC) + Holding Cost (HC) + Purchase Cost (PC)

$$OC = \frac{Mc_o}{\frac{Q}{2} + \left(\frac{Q \pm a}{2}\right)} = \frac{Mc_o}{Q \pm a}$$

$$HC = \frac{c_h}{2} \left[\frac{Q}{2} + \left(\frac{Q \pm a}{2}\right) \right] = \frac{c_h}{2} (Q \pm a)$$

$$PC = MC$$

$$TC = \frac{Mc_o}{\frac{Q}{2} + \left(\frac{Q \pm a}{2}\right)} + \frac{c_h}{2} \left[\frac{Q}{2} + \left(\frac{Q \pm a}{2}\right) \right] + MC$$

$$= \frac{Mc_o}{Q \pm a} + \frac{c_h}{2} (Q \pm a) + MC$$

Using Partial Derivative

Ordering Cost; $\frac{\partial}{\partial Q} \left[\frac{Mc_o}{\frac{Q}{2} + \left(\frac{Q \pm a}{2}\right)} \right]$

$\frac{\partial}{\partial Q} \left[\frac{Mc_o}{\frac{Q}{2} + \left(\frac{Q}{2} + a\right)} \right]$	$\frac{\partial}{\partial Q} \left[\frac{Mc_o}{\frac{Q}{2} + \left(\frac{Q}{2} - a\right)} \right]$
$= Mc_o \frac{\partial}{\partial Q} \left[\frac{1}{Q + a} \right]$	$= Mc_o \frac{\partial}{\partial Q} \left[\frac{1}{Q - a} \right]$
$= -Mc_o \frac{\frac{\partial}{\partial Q} [Q + a]}{(Q + a)^2}$	$= -Mc_o \frac{\frac{\partial}{\partial Q} [Q - a]}{(Q - a)^2}$
$= -\frac{Mc_o \left(\frac{\partial}{\partial Q} [Q] + \frac{\partial}{\partial Q} [a] \right)}{(Q + a)^2}$	$= -\frac{Mc_o \left(\frac{\partial}{\partial Q} [Q] + \frac{\partial}{\partial Q} [-a] \right)}{(Q - a)^2}$
$= -\frac{Mc_o (1 + 0)}{(Q + a)^2}$	$= -\frac{Mc_o (1 + 0)}{(Q - a)^2}$
$= -\frac{Mc_o}{(Q + a)^2}$	$= -\frac{Mc_o}{(Q - a)^2}$

Holding Cost; $\frac{\partial}{\partial Q} \left\{ \frac{c_h}{2} \left[\frac{Q}{2} + \left(\frac{Q \pm a}{2}\right) \right] \right\}$

$\frac{\partial}{\partial Q} \left\{ \frac{c_h}{2} \left[\frac{Q}{2} + \left(\frac{Q}{2} + a\right) \right] \right\}$	$\frac{\partial}{\partial Q} \left\{ \frac{c_h}{2} \left[\frac{Q}{2} + \left(\frac{Q}{2} - a\right) \right] \right\}$
$= \frac{\partial}{\partial Q} \left\{ \frac{c_h (Q + a)}{2} \right\}$	$= \frac{\partial}{\partial Q} \left\{ \frac{c_h (Q - a)}{2} \right\}$
$= \frac{c_h}{2} \left(\frac{\partial}{\partial Q} (Q) \right) + \frac{\partial}{\partial Q} (a)$	$= \frac{c_h}{2} \left(\frac{\partial}{\partial Q} (Q) \right) + \frac{\partial}{\partial Q} (-a)$
$= \frac{(1 + 0) c_h}{2}$	$= \frac{(1 + 0) c_h}{2}$
$= \frac{c_h}{2}$	$= \frac{c_h}{2}$

$$\frac{\partial TC}{\partial Q} = -\frac{Mc_o}{(Q \pm a)^2} + \frac{c_h}{2} + 0$$

But $\frac{\partial TC}{\partial Q} = 0$

$$\Rightarrow -\frac{Mc_o}{(Q + a)^2} + \frac{c_h}{2} = 0 \quad (1)$$

$$\Rightarrow -\frac{Mc_o}{(Q - a)^2} + \frac{c_h}{2} = 0 \quad (2)$$

From Equation 1	From Equation 2
$\frac{c_h}{2} = \frac{Mc_o}{(Q + a)^2}$	$\frac{c_h}{2} = \frac{Mc_o}{(Q - a)^2}$
$\Rightarrow (Q + a)^2 c_h = 2Mc_o$	$\Rightarrow (Q - a)^2 c_h = 2Mc_o$
$\Rightarrow (Q + a)^2 = \frac{2Mc_o}{c_h}$	$\Rightarrow (Q - a)^2 = \frac{2Mc_o}{c_h}$
$\Rightarrow Q + a = \sqrt{\frac{2Mc_o}{c_h}}$	$\Rightarrow Q - a = \sqrt{\frac{2Mc_o}{c_h}}$
$\Rightarrow Q^* = \sqrt{\frac{2Mc_o}{c_h}} - a$	$\Rightarrow Q^* = \sqrt{\frac{2Mc_o}{c_h}} + a$

Therefore,

$$Q^* = \sqrt{\frac{2Mc_o}{c_h}} \pm a \quad (3)$$

Equation 3 is the quantity that optimises the management of perishable stocks of quantity Q^* . Thus Q^* is the perishable stock quantity that can be ordered considering a short receipt lag. If the finite perishable stock demand decreases, the perishable stock management optimising quantity is $Q^* = \sqrt{\frac{2Mc_o}{c_h}} - a$. If the finite perishable stock demand remains constant, the perishable stock management optimising quantity is $Q^* = \sqrt{\frac{2Mc_o}{c_h}}$. This is the general economic order quantity (EOQ). If the demand for the finite

perishable stock increases, the perishable stock management optimising quantity is $Q^* = \sqrt{\frac{2Mc_o}{c_h}} + a$ the model reduces the storage costs and the costs of ordering more or less than demand as the short receipt lag period allows the MSMEs to order demand-driven stock. This is similar to a back-order, with the difference being that during the brief lag period, the quantity to be received is adjusted to meet the remaining demand during the second phase of the cycle. The model provides an opportunity to align supply to prevailing demand using the experience in the first half of the production period. The MSMEs can forecast and model demand to determine the “ $\pm a$ ” stock quantity.

Conclusion And Recommendations

The Perishable Economic Order Quantity (PEOQ) framework with a short receipt lag is an important instrument for MSMEs in Zimbabwe, to enable businesses to optimise their stock management and minimise losses due to waste, particularly through perishable. By adopting the Perishable Economic Order Quantity with a Short Receipt Lag (PEOQSRL) framework, MSMEs can improve their businesses' supply chain resilience and responsiveness to changing global market demands in the disruptive VUCA environment.

The Perishable Economic Order Quantity with a Short Receipt Lag (PEOQSRL) framework, offers a tailored solution to optimise stock management. The key benefits include reduced waste (minimises perishable stock losses and enhances profitability), improved supply chain efficiency (streamlines ordering and replenishment processes), enhanced decision-making (provides data-driven insights for informed stock management), increased business competitiveness (enables MSMEs to respond swiftly to market demands), and economic growth (contributes to Zimbabwe's economic development by supporting MSMEs). The MSMEs in Zimbabwe can navigate perishable stock management challenges, ensuring sustainable business growth and improved customer satisfaction by implementing the PEOQSRL framework.

To optimise the perishable stock, the MSMEs in Zimbabwe should adopt the PEOQSRL framework, invest in inventory management systems by utilising technologies for real-time monitoring and automated ordering, develop supplier relationships to foster collaborative partnerships for reliable and just-in-time deliveries, staff training to enhance inventory management skills and knowledge, continuous monitoring and evaluation to regularly assess and refine inventory management strategies, government support, and research and development to explore integrating artificial intelligence, and data analytics for enhanced decision-making.

The successful implementation of the PEOQSRL framework promises to have far-reaching benefits for MSMEs in Zimbabwe and the economy at large, including increased food security, improved livelihoods for rural communities, and enhanced business competitiveness for MSMEs in the global market. Thus, the PEOQSRL framework has the potential to contribute significantly to the development and growth of Zimbabwe's economy.

Future Research Areas

Future research could investigate the impact of factors such as supply chain disruptions, climate change, and technology

on perishable stock management. The researchers could also develop a heuristic approach, integrate technological innovations and sector-specific applications, explore alternative inventory models, assess the environmental impacts of optimised inventory management, and investigate scalability for larger enterprises.

Conflict of Interest

The author declares no conflict of interest regarding the publication of this article.

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Author Contribution

Stanley Murairwa conceptualised, formulated the methodology, investigated, wrote the original draft, and reviewed, and edited the article manuscript.

Data Availability

The data backing the findings of this study can be accessed from the corresponding author upon reasonable request. The information was gathered via an online questionnaire created on Google Forms and has been securely stored in compliance with relevant data protection laws. This journal adheres to the Taylor & Francis Share Upon Reasonable Request policy.

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