Demand forecasting and inventory management as requirements for quality assurance in a bakery company

Previsão de demanda e gerenciamento de inventário como requisitos para garantia de qualidade em uma empresa de panificação

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Abstract

This paper is a case study on the influence of inventory management on the results and profitability of a bakery located in the municipality of Nova Iguaçu, in the state of Rio de Janeiro. As a general objective, this study sought to identify the extent to which demand forecasting influences the inventory management of the bakery studied. To this end, the intermediate objectives were to evaluate how demand forecasting is applied, to verify how information on raw material stock levels is managed at the bakery and, finally, to report on how the adoption of a stock control methodology has a positive impact on the quality of service and the bakery's results. The theoretical reference research used a literature review as

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its methodology, but as far as the case study is concerned, local observations were made and a questionnaire was applied to the operation's manager, comprising ten discursive questions. Based on the analysis of the data collected, the results of the research made it clear how important it is to optimize stocks at the company in order to obtain better results and reduce freight costs, making it financially healthier and, consequently, increasing its profitability. To this end, the need for theoretical and technical knowledge, updating, integration of information, stock management strategy and investment in technologies and tools for stock control and management has become apparent.

**Keywords:** Inventory. Demand Forecasting. Management.

**Introduction**

Stock is considered to be a regulating element for both the production flow and the sales flow. In this way, it ends up becoming an essential resource in the supply chain of
organizations. If it is well managed, stock also becomes an advantage in a highly competitive market as the company is able to promptly deliver a product to the end consumer, in the quantity ordered, excluding failures and delays. Therefore, stock exists so that the supply process can be met, which in turn stems from the demand process. Although supply must be planned in line with demand, ideally there should be perfect synchronization between these two factors to prevent excess or shortage of stock. In other words, with this balance there wouldn't be too much product, to the point of the company making a loss, or too little product, to the point of not being able to meet demand and losing customers. In this way, the stock controller/manager should not work towards a gap between supply and demand, since that would be inevitable, but that this gap should be as short as possible, mitigating the effects of natural variations through careful planning that takes into account all the information that can support the right decisions (Gianesi & Biazzi, 2011).

This research is relevant as it aims to contribute to a reflection on the functionality of communication between the purchasing and sales departments in a bakery in the municipality of Nova Iguaçu, in the Rio de Janeiro lowlands. Stock management is the central object of this study. The role of the two sectors mentioned above will be highlighted with regard to information management.

**Theoretical Referential**

Inventories are accumulations of raw materials, supplies, components, materials in process and finished products that appear at numerous points in companies' production and logistics channels. There is a fundamental economic importance to carefully managing stock levels, since they represent a maintenance cost of 20% to 40% of their value per year, which obviously reflects directly on the organization's bottom line (Ballou, 2006).

Among the challenges of stock management, the main one lies in adjusting the verification and management of stock levels to the reality and needs of the business. In this way, knowing consumer behavior to the point of being able to obtain a certain level of predictability, and having the necessary information to know about the output of each product and the use of each material used in production, is a powerful competitive advantage, since it regulates stock, preventing the loss of resources due to excess, or the loss of customers due to stock-outs. In addition, it is necessary to think strategically about periodic cycles, since consumer behavior can be cyclical or undergo undulations in terms of how much to order and when. To answer these questions, a series of factors must be taken into account, such as the
time and cost of resupply, as well as other relevant factors such as seasonality, speed, intensity and regularity of consumption (Felipe et al., 2013).

Quality is a challenge and needs to be implemented for industrial processes to occur with sustainability to have a real impact on reducing and consequently eliminating environmental damage. Statistics is an essential tool and has been used in several applications and in all areas of human knowledge to improve processes, as decision making and to ensure that the environment is preserved (Cardoso, R.P;Sampaio, N.A.S;Reis, J.S.M;Silva, D.E.W;Barros, 2023; Cardoso et al., 2023; da Silva et al., 2021; Espuny et al., 2022; Fonseca, D;Correa, M.P.O;Santos, R.R;Cardoso, R.P;Reis, J.S.M;Sampaio, 2023; Gomes et al., 2022; Leiroz et al., 2023; Felipe C. Mazza et al., 2023; Felipe Cury Mazza et al., 2022; Moura et al., 2023; Reis et al., 2022; Rezende et al., 2023; Rubert et al., 2023; Sampaio et al., 2022; Yamada et al., 2023)

**Research Method**

### 3.1 Research Classification

According to the classification of research proposed by (Vergara, 1998) the research is characterized as qualitative, since it aims to understand phenomena, study particularities and individual experiences.

Taking into account the author's conclusions, the research is explanatory because it seeks to clarify the factors that contribute to a given phenomenon and descriptive because it exposes characteristic aspects of the problem studied. With regard to the means, the study is characterized as bibliographical research since it was developed using books and articles available in libraries and virtual access, and also as field research, since there is the purpose of practical analysis of reality through the collection of data by means of a questionnaire that was applied.

### 3.2 Data Collection Technique

The current scenario of the bakery under study was surveyed using a questionnaire made up of ten discursive questions addressed to the owner and manager of the business. The aim of the questions is to analyze the main raw materials stored in stock, the number of suppliers per product, delivery times and frequency of purchases, costs, etc. In this way it is possible to assess Demand Forecasting in the management of raw material stocks in the company's supply chain.
3.3 Data Analysis

The data collected was treated in a qualitative way, as it was presented in a structured way and then analyzed. The analysis, based on the literature review, together with the concept of business communication, is also worked on in relation to the methods of using communication and the new information technologies that companies use (Vergara, 1998).

Results and Discussions

The questionnaire sent to the bakery's manager, presented in detail in Appendix 1, enables the company's current stock management situation to be surveyed. From this, it is possible to understand the company's current situation and propose improvements based on the theoretical framework.

4.1 The Bakery's Current Situation

The bakery works with an above-average stock margin due to the fact that the company doesn't adopt a demand flow and purchasing methodology. Control is carried out using electronic spreadsheets linked to the electronic system installed in the company. According to the owner, the system is flawed because practice has more focus than technique. Regarding the management strategy, the fortnightly balance sheet was adopted to analyze production and profits.

As there is no stock control, the company suffered a major loss in a flood where all the stock was lost, including excess material. Although the event was unforeseeable, the loss would have been less if the stock had not been overestimated.

Due to the lack of stock management control, the bakery has difficulties related to the excessive purchase of raw materials without need. Similarly, stock-outs are also indicated as a detrimental factor due to the fact that there is no raw material when needed, thus failing to produce one of the products that are sold. An example of this is the consumption of eggs. According to the manager, this raw material is purchased when needed, and is at the mercy of the supply in nearby small markets.

The manager admits that he always works with stock levels above the average demand because he doesn't have reliable control mechanisms and metrics. In addition, the period of greatest demand is the end of the year due to the Christmas and New Year festivities, when demand for bread increases considerably, requiring more raw materials. The Table 1 shows...
the consumption of the most important raw materials on the company's shopping list, as well as the cost variables based on data collected from December 2022 to February 2023. Based on this data, and that which will be presented in this analysis, it is possible to analyze the real situation of the company's stock and losses due to not adopting stock control.

Table 1: Consumption of raw materials
Source: Authors, 2023

<table>
<thead>
<tr>
<th>POSITION</th>
<th>ITEM</th>
<th>AVERAGE DAILY CONSUMPTION</th>
<th>UNIT COST</th>
<th>AVERAGE DAY COST</th>
<th>AVERAGE CONSUMPTION MONTH</th>
<th>AVERAGE COST MONTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1º</td>
<td>WHEAT FLOUR</td>
<td>250 KG</td>
<td>R$3,00</td>
<td>R$750,00</td>
<td>7500 KG</td>
<td>R$22,500,00</td>
</tr>
<tr>
<td>2º</td>
<td>YEAST</td>
<td>50 TABLETS</td>
<td>R$5,24</td>
<td>R$262,00</td>
<td>1500 TABLETS</td>
<td>R$7,860,00</td>
</tr>
<tr>
<td>3º</td>
<td>SUGAR</td>
<td>30 KG</td>
<td>R$2,45</td>
<td>R$73,50</td>
<td>900 KG</td>
<td>R$2,205,00</td>
</tr>
</tbody>
</table>

Table 2: Current purchasing management (weekly frequency)
Source: Authors, 2023

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM STOCK</th>
<th>MAXIMUM STOCK</th>
<th>REPLACEMENT BATCH</th>
<th>COST OF PURCHASE</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHEAT FLOUR</td>
<td>1750 KG</td>
<td>3625 KG</td>
<td>1875 KG</td>
<td>R$ 5.625</td>
</tr>
<tr>
<td>YEAST</td>
<td>350 TABLETS</td>
<td>725 TABLETS</td>
<td>375 TABLETS</td>
<td>R$ 1.965</td>
</tr>
<tr>
<td>SUGAR</td>
<td>210 KG</td>
<td>435 KG</td>
<td>225 KG</td>
<td>R$ 551,25</td>
</tr>
</tbody>
</table>

Another relevant fact is the means of communication between the company and the supplier. There is no official channel or specialized stock management team, but rather an informal exchange of messages between the manager and the supplier. Freight is CIF and unloading is fully covered by the supplier.

4.2 Basis for Stock Calculation

It is possible to identify that the bakery does not adopt stock management strategies, going back to the period when stock management was based on trial and error. It is worth noting, however, that the error already listed as a presupposition, as it was understood in previously cultivated management models, in the contemporary market, no longer receives
the same tolerance, and, being serious or repeated, can result in the bankruptcy of the business (Souza et al., 2015).

Therefore, adopting one or more stock management strategies is more than advisable, it is necessary, as is automated and computerized data control. Seasonal fluctuations and trends should not be overlooked either, especially when you are not working with a strategy to get closer to the minimum stock. Finally, it is worth associating the idea of stock above demand with the traditional model of stock management, which contemporary authors point out is an obsolete and outdated strategy. Current Asian models tend to minimize overspending, losses and waste (Pozo, 2017).

4.3 Technologies Applied to Stock Management

The manager says that stock control is done using spreadsheets, without any technology or even an integrated system. Again, we see signs of an essentially artisanal management profile, which means that there is no knowledge or updating in terms of the systems available for stock control, especially those that combine and integrate information, as well as other technological resources that can be used.

4.4 Unfavorable Incidents

The manager has had incidents, even to the point of losing all his stock, but he believes that these are inevitable and has not implemented any changes since then.

At this point we return to the implication that, as the just in time system advocates, stocks are synonymous with losses and the biggest bottleneck in the business, and should be minimized or even abolished. Stock that is always above average, as the manager himself said, leads to incidents such as those described, as well as the usual loss of products that are not sold and can spoil. It should be emphasized here that perishing is not unpredictable, nor does it cause inevitable losses. Correct stock control, carried out with the help of technology and fed by constant, consistent and up-to-date information, prevents excess products from being sold out and, when this happens, it is important that this stock is used up within a reasonable time for consumption, in order to reduce losses.
4.5 Overstocking and Stockouts

The manager says he suffers from both problems, mainly as a result of excess stock. At this point, he says that the company's lack of strategy in stock management and the option of always working above the average demand have worsened the results achieved. If losses are recurring and there are losses due to stock-outs, there is a strategic error being systematically made in the management of this business, as well as a lack of planning, since stock is both overstocked and out of stock, and not just in one-off cases.

It is necessary to evaluate the alternatives that are appropriate and applicable to the business, taking into account its processes, demands, problems and budgets. The organization must be able to balance stock inflows and outflows, i.e. sell in and sell out, minimizing stock errors, waste, losses and risks.

4.6 Stock Management Strategies

The manager says he manages stock control by taking stock every two weeks. The lack of strategy and planning goes hand in hand with poor and insufficient control, demonstrating that neglect of the techniques and technologies that could be available leads to negative results and the inability to predict outcomes and circumstances. Furthermore, it is not possible to carry out balanced planning of stock levels.

Based on the consumption data presented, an outline of the raw materials purchasing scenario is shown in Tables 3 to 5. Three purchasing recurrence scenarios are simulated: three times a week, twice a week or once a week. The greater the recurrence, the smaller the replacement batch. The cost of the purchase is only related to the value of the products; there is no calculation for the cost of the order since the bakery lacks information such as the cost of ordering and the cost of storage.

The calculation memories used to arrive at the figures presented in the Tables for the quantities of Minimum Stock (Equation 1), Maximum Stock (Equation 2) and Replacement Lot (Equation 3) (Calixto, 2014).

\[
S_{\text{min}} = DC \times DT \tag{1}
\]
\[
S_{\text{max}} = S_{\text{min}} \times RL \tag{2}
\]
\[
RL = AC/FC \tag{3}
\]

Where:
The purchase unit cost columns show the amount to be invested in the purchase of the raw material corresponding to the term given in the title. In other words, the monthly amount to be spent per item is equal to the frequency of purchase versus the unit cost of the purchase.

### Purchase Management (Purchase Frequency Every Ten Days)

<table>
<thead>
<tr>
<th>ITEM</th>
<th>Minimum Stock</th>
<th>Maximum Stock</th>
<th>Replacement Batch</th>
<th>Cost of Purchase</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHEAT FLOUR</td>
<td>1750 KG</td>
<td>5000 KG</td>
<td>2500 KG</td>
<td>R$ 7.500</td>
</tr>
<tr>
<td>YEAST</td>
<td>350 TABLETS</td>
<td>1000 TABLETS</td>
<td>500 TABLETS</td>
<td>R$ 2.620</td>
</tr>
<tr>
<td>SUGAR</td>
<td>210 KG</td>
<td>600 KG</td>
<td>300 KG</td>
<td>R$ 735</td>
</tr>
</tbody>
</table>

Table 3: Input purchasing management
Source: Authors, 2023

### Purchase Management (Purchase Frequency Per Fortnight)

<table>
<thead>
<tr>
<th>ITEM</th>
<th>Minimum Stock</th>
<th>Maximum Stock</th>
<th>Replacement Batch</th>
<th>Cost of Purchase</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHEAT FLOUR</td>
<td>1750 KG</td>
<td>7500 KG</td>
<td>3750 KG</td>
<td>R$ 11.250</td>
</tr>
<tr>
<td>YEAST</td>
<td>350 TABLETS</td>
<td>1500 KG</td>
<td>750 TABLETS</td>
<td>R$ 3.930</td>
</tr>
<tr>
<td>SUGAR</td>
<td>210 KG</td>
<td>900 KG</td>
<td>450 KG</td>
<td>R$ 1.102,50</td>
</tr>
</tbody>
</table>

Table 4: Weekly purchase management
Source: Authors, 2023

### Purchase Management (Purchase Frequency Per Month)

<table>
<thead>
<tr>
<th>ITEM</th>
<th>Minimum Stock</th>
<th>Maximum Stock</th>
<th>Replacement Batch</th>
<th>Cost of Purchase</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHEAT FLOUR</td>
<td>1750 KG</td>
<td>15000 KG</td>
<td>7500 KG</td>
<td>R$ 22.500,00</td>
</tr>
<tr>
<td>YEAST</td>
<td>350 TABLETS</td>
<td>3000 TABLETS</td>
<td>1500 TABLETS</td>
<td>R$ 7.860,00</td>
</tr>
<tr>
<td>SUGAR</td>
<td>210 KG</td>
<td>1800 KG</td>
<td>900 KG</td>
<td>R$ 2.205,00</td>
</tr>
</tbody>
</table>

Table 5: Monthly purchase management
Source: Authors, 2023

It was found that purchasing the raw material "wheat flour" three times a month, i.e. every 10 days, would enable a 25% reduction in transportation costs. In the current model, as shown in table 2, where the raw material is bought weekly, paying 4 freight charges a month, regardless of demand, the company faces risks related to excess or out of stock and additional freight charges. In addition, the search for new suppliers is seen as a management strategy aimed at improving stock control in the face of expected demand.
Although we are currently unaware of the causal link between strategic errors and problems in the results achieved, it has already been identified that there is a flaw, which we attribute not to management, but to unforeseeable and unavoidable situations. Knowledge and information, when it comes to solid, consistent and successful management, are essential, since empirical foundations are no longer enough to keep a company afloat these days. Table 6 shows the scenarios that were perceived as ideal purchases for each raw material.

### Table 6: Ideal scenario

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM STOCK</th>
<th>MAXIMUM STOCK</th>
<th>REPLACEMENT BATCH</th>
<th>COST OF PURCHASE</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHEAT FLOUR</td>
<td>1750 KG</td>
<td>5000 KG</td>
<td>2500 KG</td>
<td>R$ 7.500</td>
</tr>
<tr>
<td>YEAST</td>
<td>350 TABLETS</td>
<td>3000 TABLETS</td>
<td>1500 TABLETS</td>
<td>R$ 7.860</td>
</tr>
<tr>
<td>SUGAR</td>
<td>210 KG</td>
<td>1800 KG</td>
<td>900 KG</td>
<td>R$ 2.205</td>
</tr>
</tbody>
</table>

Table: Authors, 2023

Bearing in mind that the highest cost is wheat flour, it is understood that by reducing the frequency of purchases from four to three times, as can be seen in Graph 1, more specifically the Ideal Scenario, the supplier's transport cost will be reduced by 25%, equivalent to 1 delivery per week compared to the current scenario, which makes it possible to negotiate better conditions for the bakery and optimize logistics without running any kind of risk of stock-outs.
For the other items, it is understood that the monthly purchase meets the needs of the business at an affordable price and would be well controlled by making it once a month. Obviously there will be inventory control to monitor stock regularly.

### 4.7 Proposals for Improvement

The final Table 7 lists the suggested improvements for the business, in line with what has been studied and explained above. These topics were presented as essential for leveraging and modernizing the bakery's raw material stock management, as well as its evolution in terms of material controls, making it more efficient.

<table>
<thead>
<tr>
<th>CHART OF PROPOSED IMPROVEMENT SUGGESTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOPIC</td>
</tr>
<tr>
<td>Technologies applied to inventory management</td>
</tr>
<tr>
<td>Inventory management strategy</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

*Table 7: Proposals for suggestions for improvement*

Source: Authors, 2023

It can be seen that the advantages highlighted in Table 7 allow the bakery to enjoy factors to optimize its stocks by minimizing the risk of stock-outs, establish a competitive advantage through negotiations to reduce costs and acquire a greater network of partnerships for the organization. These gains are only possible when good use is made of demand forecasting and decisions are made based on solid data consolidated by studies of theoretical literature.
Conclusion

Inventory management is becoming increasingly understood and perceived as a very important strategy for companies. This is due to its significant impact on business, especially on results, expenses and profitability. It requires planning, control and attention, as well as being a way of adding knowledge, strategy and techniques to business management.

Due to the inherent demands of today's highly competitive market, repeated and systematic mistakes made due to negligence or management failures end up being indicated as a negative point, damaging the performance of the company as a whole. In this way, hiring trained staff becomes a necessary management strategy, even if it requires investments in the form of resources, tools and technologies that help to achieve positive results with the consumer public and in cash flow. As a result, the company becomes more competitive, with stock management being the difference between thriving, surviving or failing as a business.

Small companies suffer even more from this scenario, believing that these technologies don't fit into their business, that they don't fit into their budget, and that business can be run as it was in previous generations. All of this demonstrates a lack of knowledge of the current market and of the principles and propositions of inventory management.

In an attempt to answer the problem, the research was able to verify that the lack of a demand forecast, as well as flaws in the information system, end up influencing not only the stock management of the bakery studied, but also its deliveries and the company's financial health.

It was possible, through this work, to see how much the theoretical propositions were proven in practice, by understanding the flaws reported in the business. Stock management has long since ceased to be a matter for the empirical view, since it has become the object of logistics science, and does not need to be based on trial and error, since there are various resources and tools available for this purpose.

References


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