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Use of dashboard service for optimization and measurement of Key Performance Indicators

An IT decision tool at Cross Docking of a Retail company

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***Abstract*— In the era of knowledge and information technologies, we need to identify strategies for the appropriate use of information and data extraction that allow us to be efficient in the operation of the supply chain. Several authors [4] refer to opportunities and challenges in data analysis, such as listening to data and measuring information.**

The present paper consists of a data analysis for the optimization of information within the operational area. The consolidation of this information was carried out within the processes that make up Cross Docking in a Distribution Center of a Retail company, to subsequently obtain the necessary Key performance Indicators (KPI'S) to identify the merchandise rotation.

A report was developed through the Looker Studio platform (Dashboard Platform), which will provide information in real time, graphically and easily accessible, seeking the ease of showing the indicators for each of the areas, which will support inventory rotation, optimization of times and movements and communication within the areas. We conclude that general performance indicators already exist for the control of the retail supply chain; However, the calculation of performance indicators and dashboard visualization should aim to control the supply chain process.

Keywords- dashboard, retail, cross docking, inventory

I. Introduction

In 2023 a retail company showed deficiencies in inventory rotation because the average minimum storage time of merchandise is two days, this to meet the needs of store supply and transportation use.

However, the information on the status and volume of parts to be distributed is fragmented throughout the Cross Docking process, which is why the information is sought to be consolidated, to have a structured and updated analysis of the Stock that is held in the Distribution Center.

The same data analysis will allow us to build and structure the KPI's to locate the improvement times to which we must focus for inventory turnover and reduce the age time of the pieces in Stock, the same areas of opportunity that will help us meet customer service goals, since the store will have an optimal supply, avoiding shortages and improving the shopping experience.

In the next part of the document, we will describe definition and classification of retail trade; definition of dashboards, methodology for constructing a dashboard and its evaluation; finally, a case study of the use of the dashboard service as a technological decision tool in the cross docking of a retail company.

II. DAshboard context

Dashboard provides a means for managers to monitor, analyze, and perform planning and budgeting. Decision makers use a dashboard to visualize, analyze and compare historical behavior with budgets, and forecasts. And later follow up, through dashboard updates, they could analyze trends and variations of the real conditions [14].

A. Dashboard classification

We can find the follow dashboard classification:

If we are talking about the planning definition [14], there are strategic, tactical, and operational dashboards.

1. Strategic dashboards, which support organizational alignment with strategic goals.
2. Tactical dashboards, which support the measuring of progress in key projects or initiatives.
3. Operational dashboards, which support the monitoring of specific business activities.

If we are talking about KPI control decisions, there are short- and long-range dashboards.

1. Short-range dashboard, it is a dashboard that displays daily information. It is typically used to monitor week, month, quarter, or year progressions. This type of data is frequently displayed in operational dashboards.
2. Long-range dashboard, it is a dashboard that contains a longer time range is usually called a strategic dashboard. Such a dashboard would contain higher-level calculations and key performance indicators (KPIs).

B. Methodology for constructing a dashboard

1. Pre-Modeling activity

- Characterize the environment: To build a dashboard, it is important to focus on the environment where your analysis will be based, to identify the areas in which you will focus on the search for data information and cover only those that are involved.
- Map under study: Once you have considered your environment and focused on the areas of analysis, you must build an object map, where the areas will be studied to determine the important information for the analysis.
- Select the process entities of interest and formalize the measurement objectives: When localized areas of improvement opportunities are found, it is important to analyze what the measurement objectives will be that will help us in analysis and decision making. For this it is important to know the area, what its threats and strengths are.
- Ask measurable questions that address measurement objectives: By formulating quantifiable questions that address the objectives, it helps us know the analysis approach as well as the information we need to collect to address the answers.
- Identify indicators that answer quantifiable questions: With the help of methodologies focused on process analysis and improvement, we can identify those indicators that will help us answer quantifiable questions, so it is important to take the objectives into account when carrying out any improvement analysis.
- Conceptualize the scorecard: At this point we seek to focus the objectives within the area as well as define the indicators focused on decision making within the areas of opportunity to work on.
- To keep in mind to avoid errors: the problem of dashboard design, which is extremely important in the areas of data analysis and decision making. To avoid misleading business users, managers, and other stakeholders through inappropriately designed dashboards, which may contain inappropriate visualization charts and graphs that do not fit the data sets considered.

2. Modeling activity

- Identify the data elements to collect: Having conceptualized the scorecard, the data to be collected will focus on satisfying the information necessary to carry out the improvement analysis for the process or area, which allows focusing on the objectives established at the beginning.
- Collect data, implement, and refine the dashboard: This approach is based on the transformation of the data mart or data warehouse from the star schema, an extremely popular and simple data structure, into the flat data set, suitable for selection and projection operations that must be used to produce subsets of data. data. The dashboard design alternatives obtained can be chosen by analysts for later use or as proofs of concept for demonstration to business users.
- Model validation: The purpose of this stage is to verify that there is no lack of information and to evaluate the organization and representation of the format.

3. Post-modeling activity

- Continuous improvement, adaptability, integrate information from the areas: When the dashboards are finished, the update, as well as the maintenance, lend themselves to continuous improvements over time, which is important to consider to implement improvements, whether visual, graphic or information, to have a greater scope of analysis, On the other hand, this allows for adaptability throughout use over time, allowing for the integration of valuable information for decision-making.
- Changes to other elements of the dashboard model, such as breadcrumbs, and access control, are as simple

as updating the corresponding models, making dashboard maintenance an easy and manageable task.

III. RETAIL CONTEXT

Retail is the activity of selling goods to the public, usually in shops. It is a largely high-volume business, it has greater volume consolidation, and better purchasing conditions. In business management, the tasks of retail commerce are a) determine the needs of its market and b) satisfying more effectively than its competitors [18].

The retail sector includes the marketing of retail products and has two distribution channels: traditional and modern. This sector is important because it is a source of investment, job creation (especially in the modern channel) and tax revenue.

C. *Use of dashboard in retail*

Since 2014, Yesudas, M. et Al. have been documenting dynamic data analysis to create operational reports for retail companies. whose objective was to establish strategic business reports [19].

A. Gunawan described specific applications of using commercial panels for automobile sales [6]. The use of dashboards and business intelligence is documented in the online retail industry [1].

In 2023, different technological platforms have been used to create retail dashboards whose objective has been to reveal trends and evaluate business performance. These platforms are Power Bi [9], Tag Helpers [2] and Apache Superset [15].

The data analysis uses a panel that has the double objective of offering information on the best-selling products [9]. As well as customer segmentation with a recency, frequency and monetary (RFM) approach where the frequency and purchase amount per customer is evaluated, to suggest a classification of customers: loyal, promising and in need of attention, all this through K-Means algorithm [7].

Table 1 shows the dashboard development software documented in the literature review for monitoring the operation of retail companies.

1. TABLE. DASHBOARD DEVELOPMENT SOFTWARE

No.	Literature review	
	Autor	*Software*
1	Yesudas et Al. (2014)	IBM Sterling Order Management System
2	Gunawan(2020), Tungare, N. R.; Jha, D. G. (2023)	Mobile application (R and SQL)
3	Al-Omoush et. Al. (2022), Hilmy F. M. et. Al. (2023)	Python
4	Kanagaraj, K.; Venkatesh, R. (2023)	Power BI
5	Bataieneh et. Al. (2023)	Tag Helpers in ASP.NET
6	Soares, G. H.; Brito, M. A. (2023)	Apache Superset

a. Source: own elaboration.

D. *Retail dashboard Key performance indicator*

Mirabel et Al. describes a conceptual framework for a supply chain analysis. They establish three characteristics of visibility as automation, information, and transformational organization of consolidated reports [11]. They also establish the follow performance indicators:

1. A stockout rate (leading) is when items are not available upon the requested need date.
2. A gross inventory value (lagging) is an average inventory value.
3. An inventory turnover (leading) is the rate of how many times a company can replace the inventories it has sold in a given period.
4. An inventory day of supply (leading) is how many days it will take for the stock to run out if sales continue at the same rate as recent sales.

Natvig and Wienhofena establishes performance indicators for the construction of transportation dashboards, prototype performance indicators are described after area of interest [13].

- Routes: provides status for all routes/trucks (foreseen delays, available capacities, etc.)
- Truck-in/out: supports follow up of transport operations by providing truck status (foreseen arrivals, delays, faulty deliveries, temperature, etc.)
- Warehouse-in: supports cargo receptions and cross-docking
- Warehouse-out: support goods expeditions from warehouse
- Shops: supports goods receptions in shops.

The next part of the paper describes the process to build a dashboard for a retail company, the necessary performance indicator for the company's stakeholders and the feedback process must be identified.

IV. DASHBOARD DEVELOPMENT FOR A SERVICE AT RETAIL COMPANY

The transportation of Cross Docking merchandise to the different stores was carried out by observing the occupied capacity of the spaces assigned to each store. This information was controlled visually directly in the warehouse.

When the analysis of the database begins, it is identified that the replenishment of merchandise by store had an area of opportunity as seen in Figure 1. In which it is observed that there are stores with unstocked inventory for eight or more days. (visually you can see the bars shaded in yellow and red).

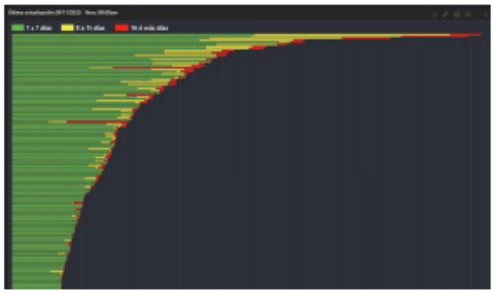

Figure 1. Number of merchandises at warehouse, Source: own elaboration.

Therefore, the replenishment strategy is changed to schedule the supply of those stores that had the longest inventory of unstocked parts, this is greater than eight days old.

A. Objective

Prioritize routing to stores, through the total Cross Docking process, to optimize inventory rotation and meet the company's objective of only retaining merchandise for a period of no more than one week.

By identifying all the questions that interested parties may have, the information to be presented on the dashboard can be determined. The relevant information that needs to be included in the dashboard is divided into the categories of:

B. Pre Modeling activity for study case

1. Situation: For the analysis of the stay time and average times of each process within the Cross Docking until its average Lead Time, the project was carried out since the month of September giving us an approximate average stay time of 5.33 days for a piece in the distribution center independent of its destination, as can be seen in figure 3. As well as a total Lead time of around 9.07 days, which reflects how low its inventory turnover was and the importance of having an indicator meter to prioritize destinations and pieces to send. Logistics: evaluation of available resources
2. Cartography: Monitor the 187 stores that are supplied in the interior of the Mexican Republic,
3. Activities: Download information on the number of units available in warehouses to supply stores in the interior of the republic via Cross Docking, daily. Generate the available inventory update and make the lead time heat map.
4. Communication: Share available inventory and heat map on the internal Google-locker studio portal.
5. Anticipation: The transportation area establishes priorities to carry out the routing and programming of units by size and type of load.

C. Modeling activity for study case

- Identify the data elements to collect: To carry out each of the control panels, information was collected from the logistics process area around the entire distribution center, in addition to the transportation area to be able to manage the replenishment frequency of the stores.
- Collect data, implement, and refine the dashboard: Database work was carried out to create a database that was fed daily to obtain both historical and real-time information. Measurement times were also implemented to regulate the age of parts in the

distribution center and the resupply of each one. Of the stores.

- Model validation: It is divided into three evaluations.

1. The first evaluation allows those involved to begin to familiarize themselves with the tool. For the analysis of the dwell time and average times of each process within the Cross Docking to its average Lead Time. The project has been running since September, giving us an approximate average time of 5.33 days for a part to remain in the distribution center regardless of its destination. As well as a total lead time of around 9.07 days, which reflects how low their inventory turnover was and the importance of having an indicator meter to prioritize the destinations and parts to be sent.

The results of October and November were updated to the date of the analysis that was carried out to reduce times within the merchandise transit zone; as well as reception time, which were prioritized to reduce the average Cross Docking time and Lead Time (see Figure 2).

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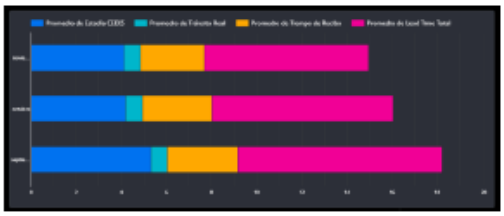

Figure 2. Traceability of lead time reduction within the warehouse. Source: own elaboration.

2. The second evaluation refers to the information in the interface according to their needs. At the figure 3 we can see the scale at the store level, to identify the destinations that should be prioritized. And measure the times that can be maintained or improved, which will allow us to provide a better restocking service and thus keep possible sales and always needs within the customer's reach.

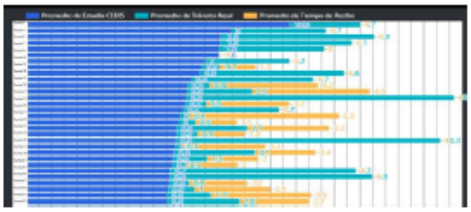

Figure 3. Stay, transit and in-store receipt. Source: own elaboration.

3. The third evaluation is a summary of historical data, this to be able to contrast the totals month by month, which helps us to measure them partially for the next few days or months.

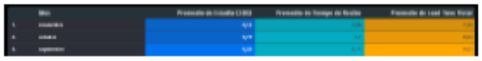

Figure 4. Stay, receipt and lead time in store. Source: own elaboration.

Subsequently, problems were found in measuring store visits for each of the units. We did not have a measurement parameter that would provide us with information on the frequency of refills in stores in the republic. This caused shortages in stores that were located on the borders of the national territory, as they were the least frequented, and their growth was unknown. For this reason, store visit indicators were established to measure replenishment and improve commercial and logistics planning.

Figure 5 shows each of the stores and the number of times they are supplied is differentiated by color. This creates a heat map, which provides us with graphical and summary information about the status of each store. The heat map has filters to obtain information clearly, concisely, and quickly, in addition to allowing managers and the logistics area to interact with the information. Once the information is observed, action plans can be developed for those stores that fall within the red parameterization, which indicates one visit or less per month to the store.

Figure 5. Store visit frequency dashboard. Source: own elaboration.

In addition to the above, a summary of the logistics area was carried out (see figure 6), which provides us with information segmented by the type of stores to be able to visualize the visits where we can concentrate.

Other KPIs are shown in Figure 6 as percentage of target by month, total number of store visits; top 10 stores with the most visits (4 or more visits with a green color block) and stores with the least visits (with a red color block).

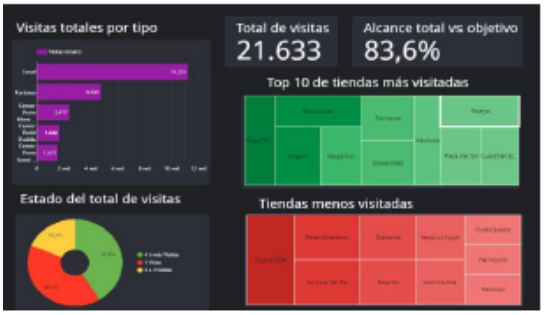

Figure 6. Top 10 visit frequency dashboard. Source: own elaboration.

D. *Post-modeling activity for study case*

Complementing the previous report, Irregularities were found for the assortment regarding imported merchandise, as it is a different merchandise from the national one, there is a different assortment and shipping process than the national product, which is why we seek to have control in the imported merchandise, as shown in figure 7, an analysis and dynamic dashboard was carried out regarding the stock held in CEDIS, particularly Import, in order to keep control.

Figure 7. Import in stock inventory dashboard. Source: own elaboration.

Each dashboard handles specific analyses, depending on the needs that arise throughout the interaction and joint work of each of the areas to be controlled.

It is important to see how each of the developed dashboards converge and support more than one area, this with the purpose of maintaining information communication, which supports decision making to optimize and streamline the cross docking of all the merchandise.

The logistics area is in a different state of change, which is why adaptability and updating is important daily, so the control boards continue to be improved, seeking to combine the information from each of the areas to have all the information in the decision making.

V. Results and Conclusions

Through the boards there has been greater control in each of the areas that make up the logistics of a retail company.

Based on the visibility of the data in the Cross Docking and Lead Time, as well as the age of the parts in the available stock, it has been possible to take an action plan to have a greater inventory rotation and greater profitability in transport. optimizing resources and allowing constant replenishment in each of the company's stores.

Figure 8. Traceability of lead time reduction within the warehouse. Source: own elaboration.

Figure 8 shows how it is made possible to optimize times and movements within the assortment and shipping processes throughout the cross docking of products, allowing for better inventory rotation within the warehouse, around the months of August, September, and October.

Product availability within each of the company's 187 stores plays an important role in meeting customer needs, since the construction of the transportation area dashboard, there has been a higher replenishment frequency to the stores than the previous month (see figure 9). Allowing us to monitor stores less or more frequently for optimal transportation routing.

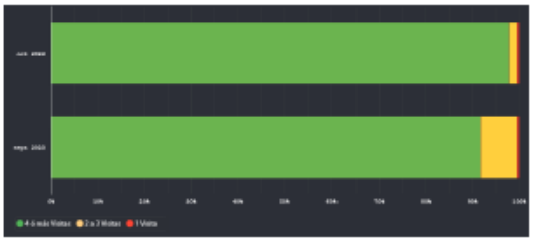

Figure 9. Recharge frequency for the months of October and September. Source: own elaboration.

In the literature review, general performance indicators for retail supply chain control are documented; However, the calculation of the performance indicator should aim to control the analysis process. Table 2 shows the performance indicators that provided a solution to the objective of the problem presented in warehouse of the retailer.

2. TABLE. COMPARISON OF PERFORMANCE INDICATORS

No.	Performance Indicators			
	KPI	*Mirabel et Al. [11]*	*Natvig et Al. [13]*	*Documented case*
1	Stockout rate	✓	●	✓
2	Gross inventory value	✓	●	●
3	Inventory turnover	✓	✓	✓
4	Inventory day of supply	✓	●	✓
5	Available capacities	●	✓	✓
6	Cross-docking support goods	●	✓	✓
7	Expeditions from warehouse	●	✓	●
8	Supports goods receptions in shops	●	✓	✓

a. Source: own elaboration.

Dashboards are a very useful tool for decision making because they provide us with important information thanks to the visual ease with which the data can be read. Likewise, updating or consulting it allows you to interconnect several areas, considering each of the data within your line of business.

That is why a dashboard will allow you to optimize information, connect areas and make decisions in real time.

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