Statistical improvements to the Advanced Planner & Optimizer Module of a Food Production Company

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Abstract

Objectives: An analysis of the SAP-APO demand forecasting system of a food company is carried out, describing how the demand-planning process is carried out from start to finish, with emphasis on the Demand Planning (DP) tool, Found in the system, which is responsible for generating demand proposals for future months.

Methods/Statistical analysis: It was divided into definition of the information system, collection of historical data, analysis of demand forecasting, adjustment of model parameters and implementation of improvements.

Findings: Redefining the parameters of the statistical models of the SAP-APO demand module

Application/Improvements: The percentage of products to be manually adjusted decreased by 12.58%, compared to the previous level of care. This translates into an increase in the utility of the system of more than 85%.

Keywords: SAP, Modulo Advanced Planner & Optimizer, statistics, Food Company, inventory management.

I. INTRODUCTION

The SAP APO tool offers the possibility of adopting an optimized demand planning methodology, which, in general terms, consists in the use of mathematical models that, under well-defined parameters, lead to an optimal forecast and then be used in the Areas of Logistics, Marketing, Finance and Sales. Based on this procedure, the tool, through the Demand Planning functionality "Demand Planning", is able to carry out a process of logistic decision making for the generation of feasible forecasts that at the same time contemplate the priorities of the Business and ensure a rational use of resources¹.

The company under study is one of the main food producers and distributors in Latin America, which has its headquarters in Venezuela and Colombia. Currently, the statistical forecasts generated by its optimization and advanced planning system (SAP-APO); are not adjusted to the volumes that the Business needs. The statistical model that chooses the system is not the most appropriate for each product since the forecasts have very high deviations or equal proposals for all months, so it must be adjusted manually.

The research consists of proposing improvements to the SAP-APO system through the analysis and adjustment of its statistical models and parameters to the sales behavior for various product categories.

II. GROUNDWORK

Today businesses depend largely on your environment, which, is influenced by events or situations of nature: cultural, technological, political, economic, ecological, demographic, etc. or combination of these ones and interactions.

Similarly, global competition, volatile demand, the specific needs of customers and cycles ever shorter product life, along with other factors determine profound changes in the way of conducting relations between manufacturers, suppliers, distributors, customers and consumers ²

Business success depends on continuous and systematize co process of adaptation and adjustment to their environment and finding a strategic position in the market to ensure the profitability of its operations.

In this vein, companies should focus their abilities and skills to properly manage their resources and ensure efficient supply chain and thus meet the needs of its customers ³

Such satisfaction is not only based exclusive you in product quality; so are "the when" and "where" it is essential to ensure product availability when and where the customer requires.

The use of a technology platform that allows them to make accurate decisions in real time and with elements of business intelligence specializing in the optimization of the Planning supply chain is essential ⁴

In order to improve the management of the supply chain the internship project, conducted in a beverage company consumer, which showed the need to maintain and ensure the balance of returnable materials within the chain emerges supplies of the organization.

The project is to design and implement a model processes to estimate the recovery of returnable materials market using the advanced planning SAP Advanced Planner & Optimizer (APO), and thereby estimate a procurement plan associated with the existence inventory and recovery ⁵

This project is part of an initiative that includes the implementation of the aforementioned tool, to support all processes PLANNING ng supply a major beverage company.

III. METHODOLOGY

The first stage of the methodology is intended to understand the process of generating the statistical forecast of the company under study.

Once the forecasting process of the selected products has been defined, the next stage comprises a detailed analysis of all the elements related to that process. For this reason, the number of products to be studied to establish and the current situation of the process, and how they behave, are defined. This is done by obtaining data that determine the process as they are: the forecasts generated in the last month; The statistical models with their parameters, existing in the planning module of (APO); The sales averages of the last three (3) months and the classification of SKUs chosen by history time and stage in the life cycle.

Subsequently, the analysis of the information collected previously is carried out, starting with the revision of the history of each product, identifying possible values that make it fluctuate and behave atypically influencing and generating inconsistency when calculating the forecast. It is the percentage of products that present constant forecasts for the following months, as well as those that do not reflect a figure according to the levels of sales in previous months. Then the calculation of the trace signal is developed, which provides a graph through which it will be possible to determine if the process of generating the Statistical Forecast is or is not under control. From this data you can see the state in which the Demand Planning (APO) module is located. Then the diagnosis is made, which is based on identifying the constraints found in the process and the root causes of it ^{5,6,7, 8, 9, 10,11, 12,13}.

A synthesis of Weaknesses, Opportunities, Strengths and Threats (DOFA) is then elaborated to evaluate the APO forecasting system, analyzing internal and external factors, positive and negative, that influence the situation and can be used to improve Results of this planning. From this analysis we derive a series of strategies to follow to improve the aspects that affect the performance of the process. This analysis allows a clear approach to the project so as to know where to concentrate the efforts to achieve the improvements through the proposals of adjustments of the module of demand planning of (APO).

The first activity in the fourth phase is the ABC Segmentation Analysis, which establishes the weight that each SKU has in terms of profits within the organization, that is, how important and representative it is for the company. In this way it is recognized which are those products considered fundamental for the organization and which of these turn out to be complementary so as to consider a greater care and proper management in the planning as the case may be.

Then, proposals for improvements in the Demand Planning process are generated (APO), according to the diagnosis presented by the previous phase, so as to solve the problems encountered in the process. Finally, once the proposals for improvements are reviewed by the management of "Demand Planning and Master Data", the proposals are implemented.

IV. RESULTS AND DISCUSSION

The results per stage are described as follows

Phase I: Definition

Following are the steps for generating the statistical forecast of demand using the historical values and statistical methods described below:

- **Historical Data Collection:** This activity executes the job that loads the sales history in the transaction code SDP94 (Interactive Demand Planning) of each of the products in the portfolio.
- **History validation:** the history settings to be used (number of months) are activated for the calculation of statistical forecasts.
- **Calculation of Forecast:** First, through the corresponding job (code APC1DPGP34), the calculation of orders corrected for previous months, that is, orders of the month less the unsatisfied demand of the previous month is executed. Then, the products are automatically segmented to run the forecast in the corresponding chain according to three, six or twelve months (time to take history for each product).
- **Forecast Review:** it analyzes the cases where the statistical model of automatic selection is not the best, based on the comparison of the forecast generated for the month following the course with the average sales of the last three (3) months for each Product, setting a tolerance margin of 5%. Those exceptions are adjusted manually. This step is performed between the third and fourth day of the month and once adjusted the figures are passed to the Marketing area no later than day five (5) to continue with the process of obtaining the dynamic plan.

Phase II: Collection of Information

A sample of 108 products of the categories of flour, detergents and soaps were analyzed. Then, their forecasts were collected, released in July 2012 and containing the forecasts for the next twelve (12) months. By observing the data generated by the system, we can divide the products into three (3) large groups, these are:

- **Constant forecasts:** products that present equal proposals for the next twelve (12) months.
- **Forecasts outside the tolerance range:** products that present proposals that, when compared to their average sales of the last three (3) months, differ by more than 5%.
- **Forecasts that need to be adjusted manually:** products that have constant forecasts, out of range or both.

Phase III: Analysis and Diagnosis

The sales averages were obtained for each of the products of the sample to be studied (last three (3) months), so once the forecasts have been obtained a comparison can be made between the two (2) figures through the margin of established tolerance and see how accurate the forecasts are in relation to the average sales, being the most reliable figure, which will later act as a historical for future forecasts.

Of the sample studied, most of the products moved away from the established tolerance range (5%) either because it was higher or lower than this. This indicates that the concern that the system throws unadjusted forecasts not only falls on the fact that it proposes equal numbers for all the months, but also the figures differ enormously of the kilos that are invoiced in previous months, that is of its history of sales. This requires attention since depending on the product the deviation can be such that it would affect the planning of production and of materials, causing losses and mismatch in the company^{14, 15, 16, 17, 18, 19, 20, 21, 22}.

Statistical models used for the generation of forecasts

The advantages and disadvantages, as well as some characteristics present in the models found in the SAP-APO DP module used by the company are highlighted below.

Model 1 Constant with alpha adaptation: this model is ideal for those seasonal or trend data. The system through a regression analysis locates where there is an important tendency pattern and in turn eliminates those data that leave the regression and only contribute deviations to the forecast. If no pattern is detected a

continuous forecast will be run. Among the advantages of this model is that it is easy to understand and has the functionality to smooth small fluctuations, is most useful when making short-term forecasts. Another very important advantage is that it presents alpha parameter, to give importance to the most recent data of history and can be modified according to the needs for obtaining better forecasts. As a disadvantage, this model requires a large amount of historical data for the generation of sales forecasts and produces very high errors when the data present many fluctuations.

Model 2 Moving average: this model calculates the average of the values of a time series within the horizon. This excludes the irregularities of the pattern of the historical series and all its values have the same weight for the average. The only parameter you handle is the number of periods. One of its disadvantages is that it is not easy to determine the number of periods required to obtain a good forecast and that if there is a tendency or seasonality does not adapt quickly to these changes in level.

Model 3 Weighted Moving Average: calculates the weighted average of the values of a time series within the horizon. It gives more weight to the most recent history for calculating the future. One of its advantages is that it reacts quickly to changes in trend or seasonality. As a disadvantage, it depends on the proper selection of weights for good accuracy.

Model 4 Seasonality Test: This model uses first-order exponential smoothing where the most recent sales have more weight in the forecasting calculation, while sales of earlier periods decreases an exponential rate. Among its advantages is the good precision it has in short-term forecasts. As a disadvantage, if recent sales have large fluctuations, the forecast will present greater error and is not recommended for medium- and long-term forecasts.

Model 5 Adaptive Forecast: it has the same principle of the weighted moving average, the system has a weight factor that assigns to the data as the user program, for example this factor can be defined giving more weight to the most recent data instead of to the oldest. This model works well with stable sales products but extensive research may be needed to find the right parameters to produce a good forecast.

Generic Profile: The generic profile is programmed with the linear regression strategy, which is a mathematical method that models the relationship between two variables, a dependent variable and other independent variables. Among its advantages is that it provides accuracy in short, medium and long term forecasts. As a disadvantage, the accuracy of the forecast will depend on the consistent relationship between the variables.

After studying the models that were chosen in APC for the generation of sales statistical forecasts, it is established that there is at least one model of each type among the existing ones for the calculation of forecasts through statistical tools, that is, models Linear regression, moving averages, exponential smoothing, among others, so there is a great variety. Once established these models and considering them apt for the calculation of the sales forecast will have to modify its parameters since it resides in them the lack of fidelity that they can have because these determine the final result and depending on the fluctuation and the time that is thrown The constant forecasts that are not useful for the business.

Phase IV: Proposal for Improvements and Implementation Results

Once the constraints are identified, proposals for improvements are generated. The first of these consists of a redefinition of the parameters of the statistical models of the SAP-APO demand module. This is done through successive tests on a sample taken from all the products of the portfolio of the company under study. Another of the improvement proposals is to change one of the statistical models of adaptive average that was not useful, for one that previously measured the seasonality and trend of historical data of each product and based on this will generate a behavioral forecast thereof. Finally, the third proposal is to categorize the products according to a segmentation analysis to assign a different tolerance range to each one when comparing their demand forecasts with sales in the past months, in this way they would be focused and would give greater attention to those who represent the strength of the Business.

These improvement proposals were reviewed by the "Demand Planning and Master Data Management"

and after approval, the implementation process began. Once implemented, a continuous monitoring of the results of the demand proposals generated by the system and the percentage of forecasts that did not fit the previously established requirements was carried out. It was observed that thanks to the changes made in the PD module "Demand Planning", the percentage of products to be manually adjusted decreased to 12.58%, compared to the previous level of attention. This decrease of attention, results in an increase in the utility of the system of more than 85%.

To keep the process under control, two (2) precision indicators were generated, with the objective of continuously evaluating the demand planning process. One of these, the trace signal indicator, to establish if the process is under control according to previously established limits. The second, to analyze the degree of attention required by the system based on the accuracy of the forecasts generated.

V. CONCLUSION

After performing the corresponding tests in which the parameters of each model were varied as well as the values of the past period to be taken into account as a history for the calculation of demand forecasts and once established which were the ones that provided a better result in As for precision in comparison with actual sales, a large drop in constant forecasts can be observed, one of the concerns of the Demand Planning and Data Master Coordination since the dynamic plan that must generate each month should not be Equal due to the difference of working days between them as well as the difference in behavior of each product. Looking at the forecast generated in July 2012 shows 54.63% of products with constant forecasts, compared to 5.56% by varying the parameters of the models and replacing the model 5 of adaptive average by a model Of trend evaluation and seasonality through a linear regression. This indicates that 59 SKUs of the sample had constant forecasts whereas in August 2012 only 6 SKUs had constant forecasts, this implies a decrease in the number of products that would have to adjust the forecast manually.

Similarly, in July 2012 75.93% of the products were outside the tolerance range established for their forecasts, then in August 2012 after the changes decrease to 21, 30%, that is, more than half. Similarly from July to August 2012 the percentage of products requiring a manual adjustment decreased from 97 SKUs to 27, representing a 76% reduction in manual labor.

It is observed how the accuracy of demand forecasts increased when adjusting and defining new parameters and models. Likewise, the same analysis was performed after categorizing categories, further reducing the number of products out of range compared to the averages of sales, which would indicate that from 21.30% to only 9.07% Products that are out of range with new values set for the evaluation of their difference with actual sales. This means that only 12.58% of the sample products will need to be manually adjusted, reducing the manual work that was initially carried out to more than 85%..

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