# Analysis and Development of an Optimal Order Proposal System at a Retailer

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***Abstract*—Demand planning and forecasting process in retail sector has recognized the critical role of order proposal and inventory replenishment systems. Order proposal systems have evolved from manual order proposal to system generated advanced orders. Retailer is a self-service business-to-business retail store where the ordering system plays a vital role in replenishment of stocks, reduction in inventory and achieving higher levels of customer satisfaction.The primary objective of the project was to analyse the existing ordering system at retailer and to develop an optimal order proposal system.**

**This project follows the methodology starting with the study of the existing order proposal system and identifying the limitations. New parameters and advanced forecasting tools were introduced which led to the development of an optimal order proposal system. Calculations were carried out to find the accurate demand using forecasting tools. The result indicates that in terms of performance, the optimal ordering system makes a significant impact on the order proposal generation process.**

***Keywords—retailer, order proposal system, forecasting, demand, inventory***

## I. INTRODUCTION

Retailing and wholesaling in India is gradually inching its way towards becoming the next boom industry.[1] The whole concept of shopping has changed in terms of format and consumer buying behaviour, ushering in a revolution in shopping in India. [2] Modern retail has entered India as seen in sprawling shopping centres and multi-storied malls that offer shopping, entertainment and food all under one roof to the customers.[3]Order proposal system at wholesalers is necessary during sales order processing. Functions such as monitoring the status of the sales transaction, checking for incomplete data, checking for availability of the products purchased, calculating pricing and taxes, scheduling deliveries and creating printed or electronically transmitted documents can be carried out by the system. [4]

## II. LITERATURE REVIEW

Samuel FossoWamba and Harold Boeck [1] in their research investigate the potential of RFID (Radio-Frequency Identification) technology and the EPC (Electronic Product Code) network as enablers of information flow in a Business-to-Business electronic commerce (B2B e-commerce) context. By focusing on a single open-loop supply chain initiative in the retail industry, their work examines the issues related to the determination, validation and simulation of selected B2B ecommerce issues integrating RFID technology and the EPC network in a research laboratory setting.

Hyunjoo and Kyoung [2] in their research explore how consumers will respond to different price promotions in stores and on online channels during a holiday period.The research focuses on examining whether the extent of price promotions that consumers perceive in online and offline channels and their response to such price promotions influences their spending during holidays in each channel. The study findings support the effectiveness of price promotions during holidays and should develop price promotion programs that are well suited to consumer behaviours in different channels.

Kurt M. Bretthaueret. al [3] researches that retail companies have added online sales channels to their supply chains. The findings of this research include how percentage of sales occurring online plays a vital role in determining the number of sites providing e fulfilment, holding and backorder expenses are the only consideration and an increase in shipping costs does not as a matter of fact indicate that adding online fulfilment locations will reduce total cost. Results from the study illustrate that the model provides good results even when demand is correlated or not normally distributed.

H. van Donselaaret. al [4] in their study on ordering of retail stores in a supermarket chain to characterize changes in ordering and investigate their potential drivers. Using orders, shipments, and POS data for item-store combinations over 5 stores, they found that store managers systematically modify automated order advices by advancing orders from peak to non-peak days. The study shows that order advancement is influenced by hypothesized product characteristics, such as case-pack size relative to average demand per item, net shelf space, product variety, demand uncertainty, and seasonality error.

Lam Martin and JolmFrci [5] have studied that the application of statistics-based methodologies can affect sound, data driven decisions.. Accurate forecasts can be provided by statistics based methodology of time series. The study considered the application of time series analysis to sales of a newly launched product for 1 year in order to forecast the next *6* months of sales. By comparing the time series forecast with the existing forecasting method to actual

sales, in order to determine and compare forecast accuracies, it was found that the time series forecast model reduced excess inventory by 13% of cumulative sales based on the old forecast method to absolute deviations sustained at less than 11% during the 6 month forecast period.

Tong Shuet .al [6] in their study have discussed the supply chain collaborative forecasting methods. The method uses past actual sales data, factors of Spring Festival transportation, shutting down for examinations and repairs and minor repairs are extracted and quantified in different hierarchies and domains. The empirical study carried out indicates that the above mentioned factors play an important part in supply chain sales forecasting. Their application improved the specific and general forecasting accuracy and represents the thought of collaborative forecasting.

The above literature review gave insights into methods adopted by researchers in different scenarios in the study of retail supply chain and ordering.

## III OBJECTIVE

The scope of the project is to investigate the current state of the retailer's order proposing system and develop an optimal order proposing system using advanced forecasting methods and broader parameters to forecast demand. Further, the accuracy of the order proposed by the new system was evaluated.

The main objectives of the project are as follows:

- Study the existing order proposal system
- Development of an efficient and optimal order proposing system.

## IV. METHODOLOGY

The brief methodology followed for the project was, analysis of the existing system, followed by identifying and structuring the problems that exists in the system. This is followed by the collection and classification of the data. Analysis of the data was carried out based on the results obtained from the classification from the rotation class and a new optimal order proposing system was developed. Based on the detailed analysis, advanced forecasting tools were used for demand forecasting. Finally, the implementation of the system was carried out to monitor the performance of the system. Figure 1 illustrates the steps involved in the methodology.

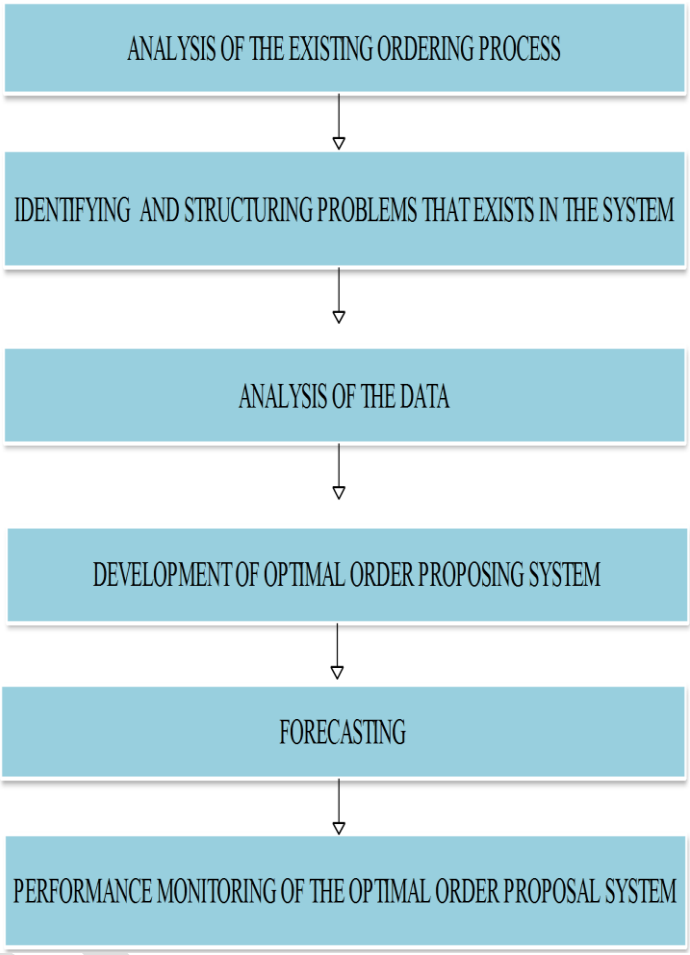


**Figure 1: Steps involved in methodology**

## V. EXISTING ORDER PROPOSAL SYSTEM AT THE RETAILER

The ordering process at the retailer is done by the ordering and reordering team. The process begins with the system generated automated notice to order for a particular stock keeping unit(SKU). This is displayed on the system of the reordering team. The next step involved is based on the order generated by the system and is compared with the current sales of the SKU and then a final order is placed. This final order is then changed manually and then processed into the system and finally an order is generated. This order that is generated is directly sent to the supplier.

The existing system uses the sets of data from the sale of the last sold goods receipts which are the sale dates of the SKU ordered. The system considers the amount of sales quantity that has been sold, the stock that is currently available on the store shelf. The system takes into consideration the minimum order condition that has been set by the supplier about the amount of quantity of the units to be ordered. But the main part of the ordering system lies in the forecasting of the demand. Here, the system uses simple moving average and exponential smoothening methods to forecast all the SKU's demand across all the departments and categories across the store. Moving average/ Exponential smoothing forecasting are used to determine the demand forecasts.

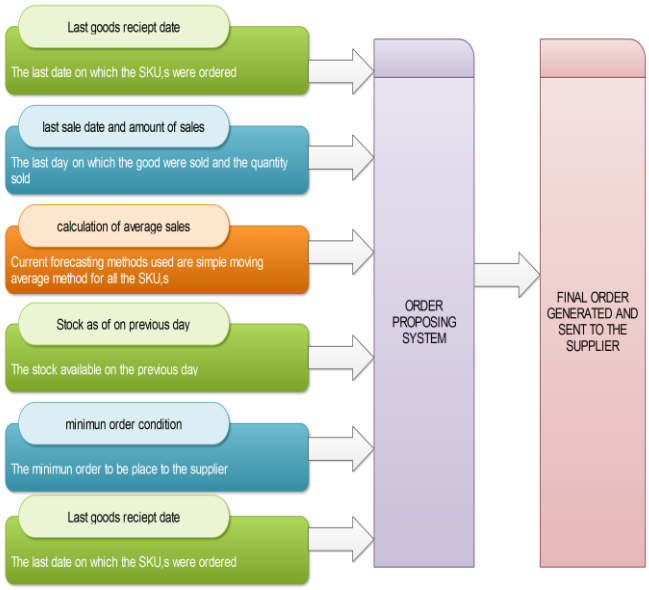


Figure 2: Existing system at retailer

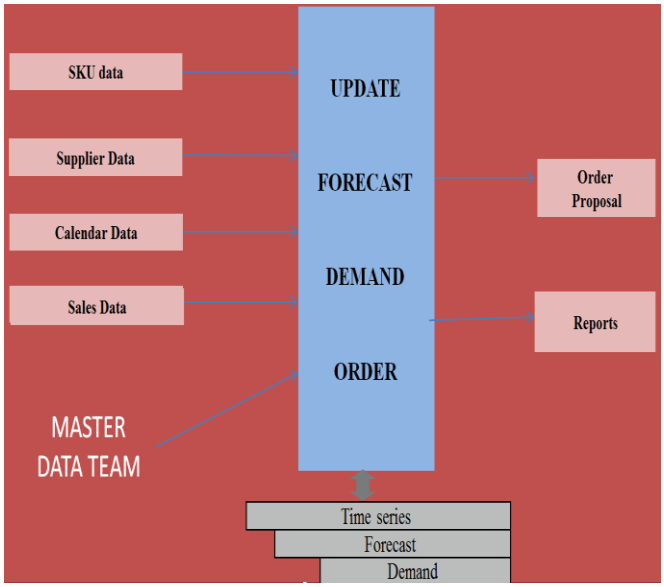


Figure 3: Optimal order proposal system

## VI. DRAW BACKS OF EXISTING ORDER PROPOSAL SYSTEM

The demand forecasting lacks the complexity in choosing parameters for analysis. The forecasting process considers only weekly sales data which is considerably less while ordering for large quantities of products. Using the existing systems in many cases lead to a wrong forecast of demand as one method of forecasting can't be used for all the SKU's. Each product is different and requires different methods of forecasting. The system does not consider any of the better methods of forecasting which exists. Neither does it consider any of the seasonal or festive events into demand forecasting. The system does not have a definitive rotation class defined to handle many products. There are no methods to determine the promotion periods that happen in the store. These drawbacks need to be addressed in order to achieve more accurate order proposals from the system.

## VII. OPTIMAL ORDER PROPOSAL SYSTEM

The system involves the collection of the sales figures from the master data. The supplier data and the list of the calendar events have to be considered in the initial collection of data and they have to be updated into the system. We take into account past two years of sales data, the promotion periods, the calendar events, price of each SKU and the exception handling in case of newly listed articles into the system. The step involves better methods of forecasting using moving average and exponential smoothing methods. Using these methods we can achieve an optimal demand forecast. The next step is the calculation of demand by checking with the stock level, open orders and the delivery schedule of the suppliers. Once these processes are completed by the system, the order is evaluated and then directly mailed to the supplier. Using this we can optimize the complete order proposal process using figure 3.

## VIII. PARAMETERS

New ordering system provides a much accurate order proposal and its behavior is steered through an adjustable Parameter-set. These parameters define the new optimal ordering system [7]. The parameters are:

- Forecasts are based on monthly sales figures. The system is capable of considering 24 months (two years).
- Trends are detected and Superstore reacts dynamically and the most recent history has a higher weight within the forecast calculation.
- Calendar events and seasonal effect are taken into account.
- Promotion periods are recognized.

## IX. CALCULATIONS

The forecasting calculations are based on the formula used directly in the system:

1. Moving average method
2. Exponential smoothing
3. Exponential Winters and Holts Model [8].

*A. Sample 1 calculations using exponential smoothing method:*

In table 1, the average sale/demand for the past two years is 11 units. We choose exponential smoothing method of forecasting as the sales unit per week is 1. Further, exponential smoothing method of forecasting is applied to the sales and the forecast for the next month is predicted. Here, we see that the forecast predicted for the next month of March is 7 units. Then the mean error, mean absolute error, mean absolute % error and mean squared error are calculated.

Table 1: Calculations for sample 1 in units

| Period | Month | DEMAND | FORECAST | ERROR | ABS ERROR | % ERROR | SQ ERROR |
|---|---|---|---|---|---|---|---|
| 1 | 2011/02 Feb | 5 | 25 | -20 | 20 | 4 | 400 |
| 2 | 2011/03 Mar | 20 | 21 | -1 | 1 | 0.05 | 1 |
| 3 | 2011/04 Apr | 15 | 21 | -6 | 6 | 0.4 | 36 |
| 4 | 2011/05 May | 30 | 20 | 10 | 10 | 0.333333 | 100 |
| 5 | 2011/06 Jun | 9 | 22 | -13 | 13 | 1.444444 | 169 |
| 6 | 2011/07 Jul | 34 | 19 | 15 | 15 | 0.441176 | 225 |
| 7 | 2011/08 Aug | 19 | 22 | -3 | 3 | 0.157895 | 9 |
| 8 | 2011/09 Sep | 22 | 21 | 1 | 1 | 0.045455 | 1 |
| 9 | 2011/10 Oct | 19 | 21 | -2 | 2 | 0.105263 | 4 |
| 10 | 2011/11 Nov | 10 | 21 | -11 | 11 | 1.1 | 121 |
| 11 | 2011/12 Dec | 7 | 19 | -12 | 12 | 1.714286 | 144 |
| 12 | 2012/01 Jan | 15 | 17 | -2 | 2 | 0.133333 | 4 |
| 13 | 2012/02 Feb | 4 | 17 | -13 | 13 | 3.25 | 169 |
| 14 | 2012/03 Mar | 16 | 14 | 2 | 2 | 0.125 | 4 |
| 15 | 2012/04 Apr | 8 | 14 | -6 | 6 | 0.75 | 36 |
| 16 | 2012/05 May | 8 | 13 | -5 | 5 | 0.625 | 25 |
| 17 | 2012/06 Jun | 5 | 12 | -7 | 7 | 1.4 | 49 |
| 18 | 2012/07 Jul | 1 | 11 | -10 | 10 | 10 | 100 |
| 19 | 2012/08 Aug | 2 | 9 | -7 | 7 | 3.5 | 49 |
| 20 | 2012/09 Sep | 4 | 8 | -4 | 4 | 1 | 16 |
| 21 | 2012/10 Oct | 6 | 7 | -1 | 1 | 0.166667 | 1 |
| 22 | 2012/11 Nov | 1 | 7 | -6 | 6 | 6 | 36 |
| 23 | 2012/12 Dec | 12 | 6 | 6 | 6 | 0.5 | 36 |
| 24 | 2013/01 Jan | 14 | 7 | 7 | 7 | 0.5 | 49 |
| 25 | 2013/02 Feb | 3 | 8 | -5 | 5 | 1.666667 | 25 |
| 26 | 2013/03 MAR | | 7 | | | | |

The results arrived from the forecasting for sample 1 is illustrated in the figure 4. The smoothing of forecast in relation to the demand using exponential smoothing is seen.

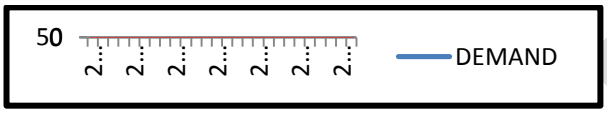


Figure 4: Demand against forecast for sample 1 in units

*B. Sample 2 calculations using moving average method:*

In table 2, the average sale/demand for the past two years is 7 units. We choose moving average method of forecasting as the sales unit per week is 7. Further, moving average method of forecasting is applied to the sales and the forecast for the next month is predicted. Here, we see that the forecast predicted for the next month of March is 2 units. Then the mean error, mean absolute error, mean absolute % error and mean squared error are calculated.

Table 2: Calculations for sample 2 in units

| Period | Month | DEMAND | FORECAST | error | abs error | % error | sq error |
|---|---|---|---|---|---|---|---|
| 1 | 2011/02 Feb | 1 | | 1 | 1 | 100% | 1 |
| 2 | 2011/03 Mar | 7 | | 7 | 7 | 100% | 49 |
| 3 | 2011/04 Apr | 5 | | 5 | 5 | 100% | 25 |
| 4 | 2011/05 May | 4 | | 4 | 4 | 100% | 16 |
| 5 | 2011/06 Jun | 4 | 4 | 0 | 0 | 0% | 0 |
| 6 | 2011/07 Jul | 25 | 5 | 20 | 20 | 80% | 400 |
| 7 | 2011/08 Aug | 5 | 10 | -5 | 5 | 100% | 25 |
| 8 | 2011/09 Sep | 12 | 10 | 2 | 2 | 17% | 4 |
| 9 | 2011/10 Oct | 15 | 12 | 3 | 3 | 20% | 9 |
| 10 | 2011/11 Nov | 21 | 14 | 7 | 7 | 33% | 49 |
| 11 | 2011/12 Dec | 13 | 13 | 0 | 0 | 0% | 0 |
| 12 | 2012/01 Jan | 4 | 15 | -11 | 11 | 275% | 121 |
| 13 | 2012/02 Feb | 2 | 13 | -11 | 11 | 550% | 121 |
| 14 | 2012/03 Mar | 12 | 10 | 2 | 2 | 17% | 4 |
| 15 | 2012/04 Apr | 6 | 8 | -2 | 2 | 33% | 4 |
| 16 | 2012/05 May | 3 | 6 | -3 | 3 | 100% | 9 |
| 17 | 2012/06 Jun | 6 | 6 | 0 | 0 | 0% | 0 |
| 18 | 2012/07 Jul | 1 | 7 | -6 | 6 | 600% | 36 |
| 19 | 2012/08 Aug | 4 | 4 | 0 | 0 | 0% | 0 |
| 20 | 2012/09 Sep | 4 | 4 | 0 | 0 | 0% | 0 |
| 21 | 2012/10 Oct | 1 | 4 | -3 | 3 | 300% | 9 |
| 22 | 2012/11 Nov | | 3 | -3 | 3 | | 9 |
| 23 | 2012/12 Dec | 1 | 3 | -2 | 2 | 200% | 4 |
| 24 | 2013/01 Jan | | 2 | -2 | 2 | | 4 |
| 25 | 2013/02 Feb | 2 | 1 | 1 | 1 | 50% | 1 |
| 26 | 2013/03 MAR | | 2 | | | | |

The results arrived from the forecasting for sample 2 illustrated in figure 5. The demand using moving average method is seen.

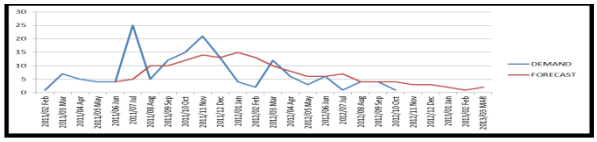


Figure 5: Demand against forecast for sample 2 in units

## CONCLUSIONS

A detailed study was conducted on the retailer to find an efficient and optimal ordering system. Since the existing system had limitations in their ordering system, there was a need to develop an optimal order proposal system, advanced forecasting tool such as exponential smoothing, moving average method, Winters and Holts model were used in the optimal order proposal system.

Based on the study conducted on the samples, it is worth mentioning that the stock availability in the system increased leading to more stocks on the store, the stock day's decreased leading to more accurate order proposals when compared to the data in the existing system. It can be concluded that in terms of achieving the accuracy in ordering, the retailer makes an increasing and significant progress.

## ACKNOWLEDGMENT

I owe my profound gratitude to Ms JyothiMulay, SCM department MCC, India for her creative ideas, valuable suggestions, encouragement and support.

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