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A Study on Effectiveness of Forecasting Techniques to Improve Performance of Manufacturing Processes

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*Abstract*— Forecasting is a basic need to grow any business. Many of the companies depend only on the forecasting data. Customer demand in developing countries and developed countries is increasing due to an increase in the world population. For this, forecasting has become very much necessary. The economy of a country depends on the manufacturing sector. And the manufacturing of a company depends on forecasting. Because forecasting prevents to over and under the stock situation of a company and decided the future production rate. In this paper, some forecasting methods like qualitative and quantitative methods are defined. Improving forecasting for an organization is difficult. In this paper, some of the easy methods are explained so that which organization do not know about the forecasting can use the forecast for his success. And some of the large industries can improve his forecasting method. Forecasting plays an important role in production planning.

Keywords – forecasting, manufacturing, qualitative method, quantitative method.

# INTRODUCTION

T

HE economy of development and developing countries depend largely upon the manufacturing sector. To maintain, manufacturing organizations know market needs. Forecasting is a prediction of a future event. Forecasting is most important for any organization to connect it with the market demand. Effective forecasting is most important for a successful manager in an organization One of the biggest challenges for the manufacturing companies is that to produce products according to market demand and stocks to minimize the loss of products due to its short perishability [9]. The time-based analysis is important for any organization. Many of the forecasting models available in the market. But this is important to determine which model is perfect to grow manufacturing. Forecasting has two purposes first is that to provide information related to demand it is useful to decision making. And second is to anticipate changes so that appropriate action can be taken [12]. Forecasting may be a factor that leads to production efficiency. Demand forecasting accuracy significantly affects safety stock and inventory levels and consumer service level. When demand is high it is important that the accuracy of the forecast can be obtained with the use of an appropriate forecasting model. When the accuracy of a forecast is law or forecast is inaccurate, the obtained production plan will be unreliable, and may result is an over-or under-stock problem. So, to avoid them, a suitable amount of stock maintain by the organization. To solve-above, mentioned problems some of the forecasting methods are mentioned in this paper.

 The researcher who has in this field has developed many forecasting methods and modal which are defined by their complexity and easy to use. The forecasting method can be based on the mathematical data the uses the past data of the company product, previous, forecasting models, consumer review, and planned according to the administrative experience. All of them based on the combination of qualitative and quantitative methods. Forecast error for a company's most important product line ranged from 0.1% to 50% with an average error of 5% [13]. Forecasting is the first step it improves planning. Analysis of part data using quantitative methods and the time- series forecasting is driven force form any production planning. When the production planning is based on the accurate forecasting modals all labors and materials can be utilized more efficiently in any organization [5].

# Proposed demand forecasting and production planning method

Many companies make different types of products that we can categorize into individuals or groups. Some common characteristics are common individual and group products. Forecast the monthly demand of each product using various forecasting methods which are mention in this paper. Collect all data from the market for products and determines the demand for each product. For example, an automobile has different types of products some of the individual products like nuts, bolts, frame, engine, brake, and some of the group like gearbox, complete can, and power transmission. To categorize the demand according to the individual and group product. And after that determines the safety stock of a company. If a stock is greater than the consumer demand, then no more action needed and not necessary to improve production planning and production rate. If the stock is less than the consumer demand. It is compulsory to improve production planning to improve production rate. Make planning by the expert and experienced person and apply it as soon as possible then the company fulfills the demand of the customer [4].

Forecast demand of each product

Determine the demand of each product

Determine the stock

If stock is less than the customer

If stock is greater than the customer demand

Not needed to take any action

Take action and improve and update the production planning and production rate

Fig. 1 - Proposed demand forecasting and production planning method

# Different type of forecasting method

*A.) Quantitative method: -*

a) Simple moving average method:**-**simple moving average method is based on the previous data of the demand. The simple moving average method predicts the demand for the next period using the mathematical formula. The simple moving average method used the values of the previous month and averaging all values to find the next month's demand data. When the new demand is known, the oldest demand (Data) removed from the formulas. Keep N constant. SMA depends on the value of N. If the value of N is increased, it means that the organization uses the more past data for finding the average values. If the value of N is decreased, it means that the organization used only the most recent data for finding the average value of demand [5].

 = Forecast for the upcoming period

N = number of periods to be average

 = Data of past period

Forecasting Method

Based on Method used

Based on time horizon

Short- range forecast

Medium-range forecast

Quantitative method

Qualitative Method

Long-range forecast

Executive opinion

Market research

Time series models

Delphi Method

Regression models

g

Exponential Smoothing

Moving average method

Level

Simple moving average method

Trend

Weighted moving average method

Seasonality

Fig. 2 – Different type of forecasting method

Taking an example, for a manufacturing company, sales and forecast are given as follows. Here we find to forecast product sales for months 4 to 6 using 3 periods.

Table 1.1

|  |  |
| --- | --- |
| Months | Sales |
| 1 | 4 |
| 2 | 6 |
| 3 | 5 |
| 4 |  |
| 5 |  |
| 6 |  |

For month Forecast by SMA =

For month Forecast by SMA =

For month Forecast by SMA =

b.) Weighted moving average method: -This method gives more emphasis to recent data. And a factor used in this method called Weight Factor. Weights factor decrease for the older data and increases for the recent data. Sum of the all factor is equal to 1.

 = Forecast for the upcoming period

N = number of periods to be average

 = Data of past period

 = Weight Factor

Taking previous example again to solve by weight moving average method. Here Weights factor is 3/6, 2/6, 1/6.

Table 1.2

|  |  |
| --- | --- |
| Months | Sales |
| 1 | 4 |
| 2 | 6 |
| 3 | 5 |
| 4 |  |
| 5 |  |
| 6 |  |

For month Forecast by SMA =

For month Forecast by SMA =

For month Forecast by SMA =

c.) Exponential Smoothing: **-**The exponential smoothing method most frequently used method used in any organization because it is easy to use and the minimum amount of data needed in this method. This is also a modified version of the weighted moving average. We need just three values for this method.

Last period’s forecast ()

Last period’s actual values ()

Smoothing Coefficient (α)

Here α is the smoothing factor and the value of α lies between 0.1 and 0.3. If the value of α is unity, then the forecast will simply track the demand and if the value of α is Zero then the forecast will remain at a constant value.

Fig. 3 order smoothing

Table 1.3 yearly data of a company

|  |  |  |
| --- | --- | --- |
| Month | Actual | Forecast |
| January | 100 | 100 |
| February | 105 | 100 |
| March | 110 | 101 |
| April | 95 | 102.8 |
| May | 103 | 99.44 |
| June | 107 | 100.15 |
| July | 112 | 101.52 |
| August | 90 | 103.616 |
| September | 109 | 100.89 |
| October | 104 | 102.511 |
| November | 92 | 102.8 |
| December | 99 | 100.6 |

Fig. 4 Exponential smoothing for a random data set (α = 0.2)

Table 1.4 yearly data of a company

|  |  |  |
| --- | --- | --- |
| Month | Actual | Forecast |
| January | 100 | 100 |
| February | 103 | 100 |
| March | 105 | 100.6 |
| April | 107 | 101.48 |
| May | 109 | 102.58 |
| June | 110 | 105.86 |
| July | 113 | 105.08 |
| August | 115 | 106.664 |
| September | 118 | 108.332 |
| October | 121 | 110.86 |
| November | 123 | 112.88 |
| December | 125 | 114.90 |

Fig. 5 Exponential smoothing for a trend (α = 0.2)

Table 1.5 yearly data of a company

|  |  |  |
| --- | --- | --- |
| Month | Actual | Forecast |
| January | 90 | 90 |
| February | 95 | 90 |
| March | 100 | 91 |
| April | 105 | 92.8 |
| May | 110 | 95.24 |
| June | 105 | 98.2 |
| July | 100 | 99.56 |
| August | 95 | 99.648 |
| September | 90 | 98.708 |
| October | 95 | 97.960 |
| November | 100 | 97.360 |
| December | 105 | 97.900 |

Fig. 5 Exponential smoothing for a seasonal (α = 0.2)

*d.) Second order smoothing: -*In this method we use trend adjustment and forecast data.

1. First calculate the next period of forecasting using the exponential smoothing method
2. Calculate the trend adjustment for the next period.

 = Trend adjustment for the upcoming period

 = Trend adjustment

β = Second order smoothing factor

1. And add the next period forecast to the trend adjustment

Fig. 6 order smoothing

Regression model: - The regression model is a different type of forecasting method related to others. Because in this method we use the two or more variables for the forecasting. Take an example, a company make different types of product and want to know which of his product affect another product during the sale. If one type of product sale is increasing or decrease related to the product.

Table 1.6 yearly data of a company

|  |  |  |
| --- | --- | --- |
| Month | Radio ads | Revenue |
| January | 21 | $8,350.0 |
| February | 180 | $21,629 |
| March | 60 | $12,485 |
| April | 190 | $20,900 |
| May | 92 | $14,800 |
| June | 42 | $11,300 |
| July | 175 | $20,400 |
| August | 130 | $18,720 |
| September | 115 | $16,255 |
| October | 72 | $12,900 |
| November | 105 | $15,925 |
| December | 199 | $26,925 |

Fig. 7 Regression model for a random data set

*B.) Planning based on the time*

a.) Short-range forecasting: **-** short term forecasts highly planning details. For example, a retail organization wants to sell out his stock. But for an effective replenishment retails organization will need to forecast for sales of all stocked products.

b.) Medium-range forecasting:**-** This is less-details forecasting for example an organization wants to introduce his products, so the organization needs to forecast future consumer trends. These forecasts are less detailed.

c.) Long-range forecasting:**-** This forecast system is planned for a long time of period. Taking an example, the organization wants to open new stores in some cities. So, the organization will need to know about consumer behaviour.

*C.) Qualities Method: -*

a.) Executive opinion: - In this type of forecast use when an organization wants to lunch new products in the market. In this method, a group of head and forecasting managers meets for a forecasting discussion. Every person gave their opinion about the best forecasting. But one weakness may happen that one person’s opinion can affect the forecasting.

b.) Market Research: **-**In the market research method organizations conduct many types of surveys to know about the customer's needs and his thinking about the product. The strength of this market research is that organization will know perfectly what the best for the customer preference is. But it can be difficult to develop a good questionnaire.

c.) Delphi Method:**-**Delphi method is used for a long timeforecasting long-term product demand, a group of expert makes many teams. And these teams take the survey from the market. Collect all data from market-related to customer preference and related to product and give their response to team leader. The team leader consults the result for the best forecasting. But this method has one weakness this is a very time-consuming method [12].

# Conclusion

Due to the rapid increase in customer demand, we also must speed up our manufacturing process and production rate. But before that, we must avoid the situation of understock or overstock. For this, forecasting has become important. This paper is only present the different type of forecasting method. Some methods based on mathematical data like simple moving average method and Exponential smoothing method, and some methods based on theoretical data like survey and group discussion.

# References

1. N. de P. Barbosa, E.da S.Christo, and K. A. Costa “Demand forecasting for production planning in a food company” ARPN Journal of Engineering and Applied Sciences 10(16), 7137-7141, 2015
2. Melvin E. Salveson “On a quantitative method in production planning and scheduling” Econometrica Vol.20, No. 4 (Oct. 1952), pp. 554-590
3. Ramaswamy SundararajanErik Anson LindquistNardo B. Catahan, Jr.Shailendra GargMaria Theresa Barnes Leon, “Modeling of forecasting and production planning data”, US patent 7,606,699, 2009
4. Pisal Yenradeea,, Anulark Pinnoib and Amnaj Charoenthavornyingb, “Demand Forecasting and Production Planning for Highly Seasonal Demand Situations: Case Study of a Pressure Container Factory” Science Asia 27 (4), 271-278, 2001
5. Judy L. Miller, Brenda K. Bloss,” food production forecasting with simple time series models” Hospitality Research Journal 14(3), 9-21, 1990
6. Gabirel R Bitran, Elizabeth A Haas, Hirofumi Matsuo, “Production planning of style goods with high setup costs and forecast revisions” Operations Research 34 (2),226-236, 1986
7. Melvin E. Salveson, “On a Quantitative Method in Production Planning and Scheduling”, Econometrica , Vol. 20, No. 4 (Oct., 1952), pp. 554-590
8. Hemalata C. Dandekar, “Some Uses and Potentials of Qualitative Methods in Planning” Journal of planning Education and research 6 (1), 42-49, 1986
9. James T Rothe, “Effective of Sales Forecasting Method”, Industrial Marketing Management 7 (2),114-118, 1978
10. Gabriel R. Bitran, Elizabeth A. Haas, Hirofumi Matsuo, (1986) Production Planning of Style Goods with High Setup Costs and Forecast Revisions. Operations Research 34(2):226-236. <http://dx.doi.org/10.1287/opre.34.2.226>
11. Mitsutaka Matsumoto & Shingo Komatsu, “Demand forecasting for production planning in remanufacturing”, The International Journal of Advanced Manufacturing Technology, 79(1-4), 161–175. doi:10.1007/s00170-015-6787-x
12. David K. Harrison, David J. Petty, “Systems for Planning and Control in Manufacturing”.
13. Rothe, James T., Naidu, 6. M., and Kleimenhagen, A. K., Auditing the Sales Forecasting System, Marketblg: I 776 -1976 and Beyond. 1916 Educators’ Proceedings, Series #39, American Marketing Association, Chicago.
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