Reconfiguration of the production levels through world´s economy changes

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Abstract

For the manufacturers, the production is everything. Actually, the rate of production is calculated from baseline of future sales. However, the market volatility, decrease the sales and increasing the inventory cost. Hence, we propose analysis this issue, from a forecasting and planning production models that considers the economy changes like a rate.

Keywords: Reconfiguration, Production levels, Global Economy, Rates of production

Introduction

Nowadays, the companies try to investigate how to do more certainly their forecasting, because for the constantly economics changes reducing the displacement of finished products inventory. This is one effect´s of the variation in the purchasing power of the population.

In this meaning, the scientific of the corporation studies the movements of economy every day with the aim to incorporate more variables and estimate the forecasting involved to reality of the actual economy. Nonetheless, the economies volatility make more difficulties this process. First, we have to know the real meaning of forecasting, discussions about this, has concluded that forecasting is numerical estimates by date of the future that can be achieved with a specific level of support (Carroll, 2005). The goal in forecasting is to have a good forecast performance on the average over the time, although we have to consider the accuracy of the data because frequently affect the planning and results of the forecaster. Data that have a high percent of variation over the time present the future tends be more variable. At the same time, forecast is more accurate for groups of items rather than for individual items because group data tends to be less variable (Swamidass, 2000).

Also, it´s important to know the horizon of the forecast, the horizons are the time require for forecast, depend the necessities of the companies. When a company wants to make new investment, the horizon may be four to twenty years. For aggregate production planning the horizon may be one to two years, and finally, for short term production

scheduling, the horizons may be each quarter or between one to four months. This essay is focus on the forecast analysis for aggregate production planning. Forecasting methods are classified in two groups: quantitative and qualitative models, the first are methods bases on mathematical or statistical models. On other hand, the second are based on judgment, institution, experience and personal knowledge. In this meaning, the most appropriate model for the manufacturing management is the quantities models. The Quantitative forecasting methods have two divisions: Time-series methods and explanatory or causal models. Finally, the selection of the method to use, depend on: observation, time horizons, the MAD observed and the complexity. (Forecasting Methods, 2006).

Also, when you construct their forecast, you have to apply some practical empirical advice of forecasting, built to the experience along the time, these are; 1. Forecast probably is wrong, 2. The correct forecast is not proof that the forecast method is correct, 3. All trends eventually end, IV. Complicated forecast methodologies can be dangerous, anything is the same. V. The underlying data in the forecast is nearly always wrong to some degree, VI. Data that has not been regularly used is almost useless for forecasting, VII. Most forecasts are biased in some way- usually accidentally. VIII. Technology will not make up for a bad forecasting strategy, IX. Adding sophisticated technology to a bad model makes is worse, X. Large numbers are easier to forecast than small ones (practicalforecasting, 2007).

Therefore, it´s convenient to analyzing the environment before selecting a practice to forecast sales and production. Every day the companies fight to be more competitive and more profitable in a volatile market, trying to anticipate to what the demands need. For this reason, the major part of the industries based their forecast in horizons of one or two years, because comprehend the constant variation of the market, but, through the global economy recession, find to equilibrate their scheduling and be more profitable. Models with macro factors are more accurate in and around recession period. Actually the structure of the forecast is the following.
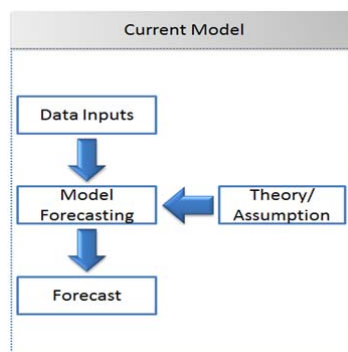

Fig.1. Structure of forecast, Source: Practical forecasting, 2007.

Methods Proposed
Due to the production planning model depends directly of forecast, requires includes in this study. The production planning represents the mainstay of the manufacturing. By definition, production planning it's the administrative process that consist in making sure that sufficient

raw materials, staff and other necessary inputs to produce according to the schedule specified (Kluwer Academic, 2000). Different types of model to planning the production including Job Methods, Batch methods, Flow methods, process methods, Mass production method and others, permit have a visual of the quantities of product to manufacturing,

Actually, the system not includes macro factor, directly affecting the levels of finished product inventory. The macro economics' factors are all indicator of variation economic that indicate the increase or decrease of one country economy and can be seen in the increase or decrease of future demand (JM Fanelli, R Frenkel, 1994). One of this macro factors, and the focus of this research, is the growth economy variation such an important variable that affect level of sales and inventory of the companies. Consequently, this research aims to present empirical options to diminish the high level of inventory in crisis time. The proposal consist in analysis the variation of the macroeconomic factor called "Growth Domestic Product" to include the variation as a multiplier to calculating the forecast. This element may be used to forecasting or in the moment to planning the production.

Also, the model proposal focus on foretells the trend of the future demand and thereby produces the required amounts for sale, saving considerable costs of maintaining inventories, increasing the velocity of displacement of the inventories and profitability. This model may apply for emergent economies for their unstable economy condition.
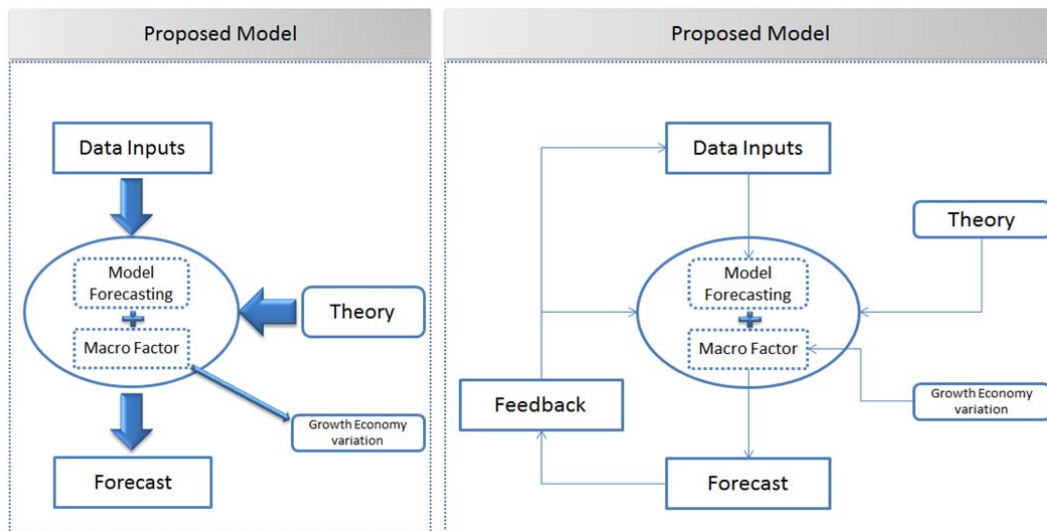

Fig. 2. Graphic model of forecasting including the macro factor

The graphic model shows the participation of the new variable called "percent of growth economy variation" that in combination with the result of the model of forecasting, feedback about the changes in the global economy along the process and show to the companies the levels of production to satisfy market needs and be more effective the production planning process.

We present the model from mathematical simple point of view and based on the model of time-series forecast seasonal, to after replicate to the other mathematical model. Also, we developed and stated the most basic optimization model for production planning for the following context.

Y = Forecasting production value
x = Sales
P_1 = Percent of growth of the company (planned)
G_V = Growth economy variation
N = period

$$Y = (a + bX) * (P_1) * (G_V) \tag{1}$$

$$a = (\frac{\sum x^2 \sum y - \sum x \sum xy}{n\sum x^2 - (\sum(x))^2})(P_1 * G_V) \tag{2}$$

$$b = (\frac{\sum xy - \sum x \sum y}{n\sum x^2 - (\sum(x))^2})(P_1 * G_V) \tag{3}$$

The range of the forecast in a simple model would be:

$$S_{yx} = \sqrt{\frac{\sum y^2 - a\sum y - b\sum xy}{n-2}} \tag{4}$$

Also, we adapted a proposed model by Stephen C. Graves of the Massachusetts Institute of Technology to development and state the most basic optimization model for production planning adding the macro economy factor, for the following context:

Decision variables

1. Pit production of item i during time period t
2. Qit inventory of item i at end of time period t

Parameters

The letters T, I, K are number of time periods and resources, respectively
1. a_{ik} amount of resource k required per unit of production of item i
2. b_{kt} amount of resource k available in period t
3. d_{it} demand for item i in period t
4. cp_{it} unit variable cost of production for item i in time period t
5. cq_{it} unit inventory holding cost for item i in time period t
6. P_1 percent of growth of the company
7. G_v Growth economy variation

$$X_1: Min(\sum_{t=1}^{T} \sum_{i=1}^{I} cp_{it} p_{it} + cq_{it} cq_{it}) * (P_1 * G_v) \tag{5}$$

The aims of this function (5) is to minimize the variable production cost plus the inventory holding cost for all item over planning horizons of T period, and with the multiplication of this equation with the macro economy factor give us more data accuracy to schedule the production and diminish the risk to high level of inventory.

At the same time, the companies have problems when isn´t know all future demand in their variation on each time period, in this meaning we have other planning problem that added to the variation of growth economy are necessary to know, for this case present de following adapted equation.

Decision variables

1. U_{it} unmet demand of item i during time period t

Parameters
1. r_{it} unit revenue for item i in period t
2. cu_{it} unit cost of not meeting demand for item i in time period t
3. P_1 percent of growth of the company
4. G_v Growth economy variation

$$X_2: Max(\sum_{t=1}^{T} \sum_{i=1}^{I} (r_{it}(d_{it-} u_{it}) - cp_{it} p_{it} - cq_{it} q_{it} - cu_{it} u_{it}) * (P_1 * G_v) \tag{6}$$

This function (6) has been modified to include revenue as well as the cost of lost sales. In this case, we can consider that like a cost minimization problem, where the cost of lost sales includes the lost revenue (Graves, 1999). The different with the original equation is the variation of the economy as a determinant factor in the model to production planning.

In resume, the calculation is based on the following statement "Data production*forecasting model*variation of growth of the companies*(1+-economy growth variation)". This is simply test to analyze and then replicate in the other mathematical forecasting model.

Conclusion

The inclusion of the economic variations on the forecasting allows to adequate the production levels and avoids the high maintenance inventory costs. Therefore, in times where the economy is highly volatile and vulnerable, results to be fundamentally important the inclusion of variations like the economic growth by giving more accuracy to the forecast.

The aims of this function 5 and 6 in this paper is to minimizes the variable production cost plus the inventory holding cost for all item over planning horizons of T period, and with the multiplication of this equation with the macro economy factor give us more data accuracy to schedule the production and reduce the risk to high level of inventory. Similarly, has been

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References

Carroll, N. (2005). Practical Guide to Business Forecasters. En J. M. Chaman L. Jain, *Practical Guide to Business Forecasting* (pág. 475). United State of America : Graceway Publishing Company.

Forecasting Methods. (20 de 02 de 2006). Recuperado el 02 de 20 de 2013, de http://www.poms.ucl.ac.be/etudes/notes/prod2100/cours/Part%206-Forecast.pdf

Graves, S. C. (November de 1999). *Manufacturing Planning and Control.* Massachusetts : Massachusetts Institute of Technology.

JM Fanelli, R Frenkel. (1994). *Latin American Council of Economic and Social Science.* Recuperado el 17 de 02 de 2013, de http://biblioteca.clacso.edu.ar//clacso/otros/20111211112359/frenkel2doc.pdf

Kluwer Academic. (2000). *Encyclopedia of Production and Manufacturing Management.* Massachusett: Kluwer Academic Publishers.

practicalforecasting. (2007). *practicalforecasting*. Recuperado el 2013 de 02 de 19, de Searching for Better Forecasting Methods?: http://www.practicalforecasting.com/laws-of-forecasting.html

Swamidass, P. M. (2000). Follow the Leader, Capacity Expansion Strategy. En P. M. Swamidass, *Encyclopedia of Production and Manufacturing Management* (pág. 953). Massachusetts, USA: Kluwer Academic Publisher .