"Medium and short-term production planning in the San Luis Dairy Industry"

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Abstract.

This research was carried out in "San Luis" Dairy Industry, by the necessary to improve the Production Planning System for a medium and short term, through the implementation of appropriate tools, which are described in the different bibliographies.

To make a diagnosis of the Production System, management indicators such as: reaction capacity, flexibility and reliability were analyzed and the current state of the company was demonstrated mathematically and the main problems and causes that effect the inadequate Production Planning were also detected. analyzed. In addition, the main problems and causes that influenced the inadequate planning were detected of the production.

The prediction is the main input for the Production Planning, so, it was developed for QF-01, QF-02, QM -03 and QM-04 (short term) products family for the QF and QM (medium term). Once it was obtained, the Aggregate Plan was developed for each product family (QF and QM) and subsequently, it was disaggregated in the Production Master Plan the for each product (QF-01, QF-02, QM-03 and QM-04), and finally the Gantt's charters of the sequencing of activities with their respective duration. Were elaborated SPSS version 21.0, Microsoft Excel version 2010, Minitab 17 and Forecast Pro were used as computer tools that facilitated the mathematical and statistical processing of the information, it should be mentioned that the forecast 2016 was not known by the company

At the end of this work, it was demonstrated the feasibility applying the selected tools, it facilitates making decisions in the Production Planning process in medium and short term and the impact on the indicators of Customer Service Level and frequency.

Keywords

Production Planning - Forecast Pro-Aggregate Plan-MPS-Programming

1. Introducción

Within the Ecuadorian productive sectors as a fundamental axis in the change of the productive matrix is the Dairy Industry and its derivatives, whose consumption is projected an increase of around 100 liters per capita per year, as a result of the higher income in the families Ecuadorians.

In the last eight years the per capita consumption of cheese has doubled, from 0.75 kilos in 2006 to 1.57 kilos last year. It is in this sector where the Ecuadorian government seeks to increase exports, through increased productivity, quality and intensive production in innovation, technology and knowledge.

The Dairy Industry in the Cayambe Canton processes 5.8 million liters per day, of which more than a third goes to cheese production. The sales of this cheese industry grew 3.4 times between 2005 and 2014, and is expected to grow 12.1% this year. Large and medium-sized companies have developed technology and supply the main markets of the country; And the small companies that produce in artisan form supply to the towns where they are located. That is why it is intended that small companies come to change their production systems in such a way that allows them to grow in the market, improve the productivity of the industry and be competitive in both price and quality.

It is from this need that plans to plan production in the medium and short term in the Dairy Industry San Luis

Since its beginnings, the industry has produced craftsmanship, this form has served for a long time. In the last years and due to the expansion of its market, it has been facing some problems that affect the good development of the execution of the production, as well as, the fulfillment of the orders of the clients. Within these problems the following are highlighted.

- ✓ Failure to comply with the delivery dates of the orders, which has caused the loss of customers.
- ✓ Lack of knowledge of the characteristics of the demand, which means that 4000 liters of milk are always processed.
- ✓ Loss of small customers, especially at the local level, because it gives higher priority to the markets with greater demand.
- ✓ Inventories are registered with more than two days, which is a problem given the perishable nature of their products.
- ✓ Ignorance of their star product since they produce all the cheeses in equal amounts.
- ✓ Ignorance of the amount of inputs needed for the development of their productions.
- ✓ Production planning is done empirically by the manager of the company, and is not based on scientific tools.

The above mentioned is the problematic situation of the present investigation in the San Luis Dairy Industry, which is concretized in the lack of a medium and short term production planning system, and based on scientifically argued tools, that allows taking Decisions within the production planning process. All of which constitutes the technical problem to be solved.

2. Materials and Methods

Characterization and diagnosis of the Production System

General characterization of the company

In order to carry out the general characterization of the industry, it was based on internal factors: mission, vision, raw material, organizational structure and product range; And later external factors: main suppliers and customers, within the latter of which stands out the chain of supermarkets Santa Maria to which more than 70% of the total production is destined.

According to the level of flexibility the system was classified as a batch production with low product nomenclature and medium volumes of production.

But also according to Acevedo the system is classified:

Element to be analyzed	**Classification variant**				
Production-consumption ratio	**Direct delivery**				Against stock
	Covered in the delivery cycle		**No coverage in the delivery cycle**		
How the production process is executed	By pace	By programs			**By order**
		Fixed Frequency	Fixed quantity	Irregular	
Element to optimize	**Ciclo de producción**	Work force	Means of work	**Work object**	Others

Finally describes the production process for each of your product family.

Analysis of technical-organizational requirements

Reaction Capacity: The probability that the actual reaction capacity is greater than the planned reaction capacity is 35.99%, a percentage not quite satisfactory.

Flexibility: The work force that works in the company is considered highly flexible, with a level of flexibility close to 100%. All the workers execute all the operations immersed in the system of production, due to the lack of complexity in the productive process, that is to say, it only requires the addition of additives and the processing of the products in each one of the operations.

Reliability: The company is unreliable, with a 16.32% probability of meeting orders within the deadline and without claims for problems in quantity, which is synonymous with the level of Customer Service. This low result specifically affects the 40.40% probability that the orders have problems of fulfillment of the deadline and 59.59% that they have problems for not fulfilling the promised amount.

Analysis of the Principles of Production

Proportionality: the process of this company is characterized in that not all the productive links work at par and the workers alternate in the different operations throughout the working day. Hence this principle does not make much sense be analyzed.

Continuity: the analysis of this principle is also due to the characteristics of the production process. The sequential displacement of the work object favors the continuity of work of the operations, giving the fret with a high

continuity of the means of work within the processing of the lot.
As part of the sequential displacement, the low flow continuity of the work object is deduced, resulting from the batch-to-batch movement between operations. In the case of the continuity of the labor force, the high levels of labor were found to exist, and this principle should behave favorably.

Precision and enrichment of the problems that affect the productive system

Problems:

A. Lack of adequate inventory level of both inputs and finished product.
B. They have no record of company data, such as cost of production, storage cost, productivity level, production planning and forecasting.
C. Lack of motivation and training to the workers, that is, to commit to the company.
D. Failure to comply with the date and quantity of customer orders, affecting the company's image.
E. Lack of standardization of the production process that leads to the ignorance of all its associated indicators, such as standard times, production capacity, cycle times, production rate, among others.
Figure 1 shows that the three main problems affecting organizational performance are those related to production planning.

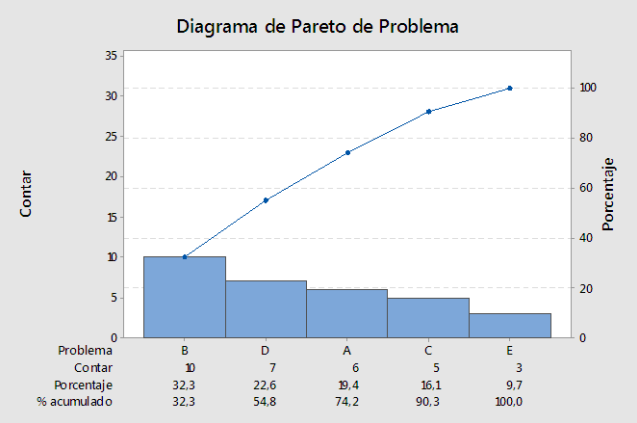


Figure 1 Pareto diagram of major problems

3. Results

Production Planning was developed in the medium and short term, the main input for this process is the forecast

Forecasts

Figure 2 shows the prognosis report for a product. It should be mentioned that the prognosis was performed by family of products (QF and QM) and by each product (QF-01, QF-02, QM-03, QM-04).

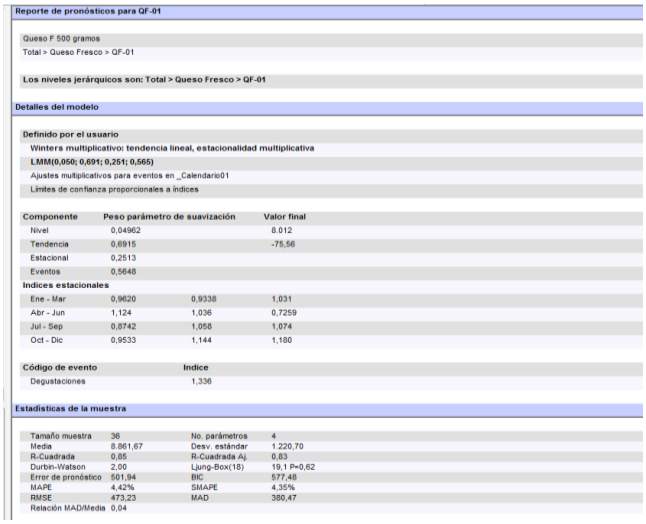


Figure 2 Statistical Forecast Report

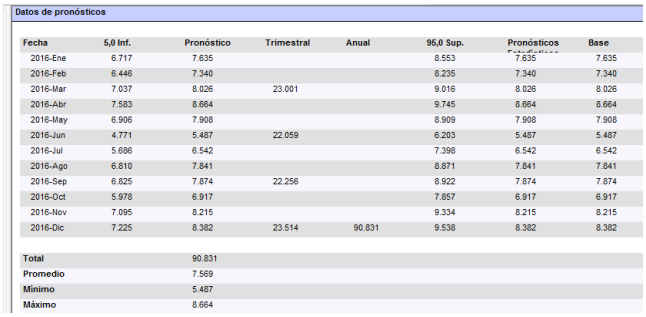


Figure 3 2016 Predictions

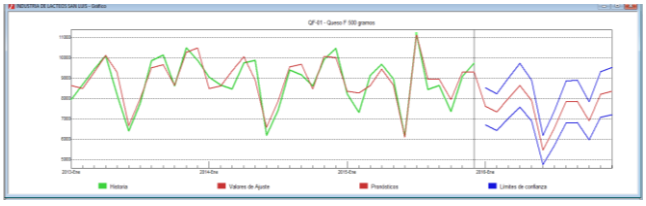


Figure 4 Forecast report graph

Table 1 shows the Aggregate Plan for QF, it should be mentioned that it was also elaborated for the QM family.

Table 1 Added QF family plan

PLAN AGREGADO INDUSTRIA DE LACTEOS SAN LUIS QUESO FRESCO													
	Enero	Febrero	Marzo	Abril	Mayo	Junio	Julio	Agosto	Septiembre	Octubre	Noviembre	Diciembre	Costo Total
Inventario Inicial (unidades/mes)	0	0	0	0	0	0	0	0	0	0	0	0	
Días Hábiles por mes (días/mes)	21	21	23	21	22	22	21	23	22	21	22	22	
Horas de producción disponibles (horas/mes)	525	525	575	525	550	550	525	575	550	525	550	550	
Producción Total (unidades/mes)	10815	10815	11845	10815	11330	11330	10815	11845	11330	10815	11330	11330	
Pronóstico de la Demanda (unidades/mes)	11455	11348	12267	13084	11012	8796	10222	11538	12329	11196	12608	12954	
Producción de Turno Regular (unidades/mes)	10815	10815	11845	10815	11012	8796	10222	11538	11330	10815	11330	11330	
Horas Totales de Turno Regular (horas/mes)	525	525	575	525	535	427	496	560	550	525	550	550	
Unidades disponibles antes del tiempo extra (unidades/mes)	-640	-533	-422	-2269	0	0	0	0	-999	-381	-1278	-1624	
Unidades producidas en tiempo extra (unidades/mes)	640	533	422	1575	0	0	0	0	999	381	1260	1575	
Inventario Final (unidades/mes)	0	0	0	-694	0	0	0	0	0	0	-18	-49	
Costos de tiempo regular ($/mes)	1252	1252	1252	1252	1252	1252	1252	1252	1252	1252	1252	1252	$ 15.022
Costo del tiempo extra ($/mes)	122	102	80	300	0	0	0	0	191	73	240	300	$ 1.409
Costos de Escasez ($/mes)	0	0	0	1457	0	0	0	0	0	0	38	105	$ 1.598
												Costo Total	$ 18.029

Table 2 shows the Master Production Plan for the month of October.

Table 2 Production Master Plan

PLAN MAESTRO DE PRODUCCIÓN INDUSTRIA DE LÁCTEOS SAN LUIS

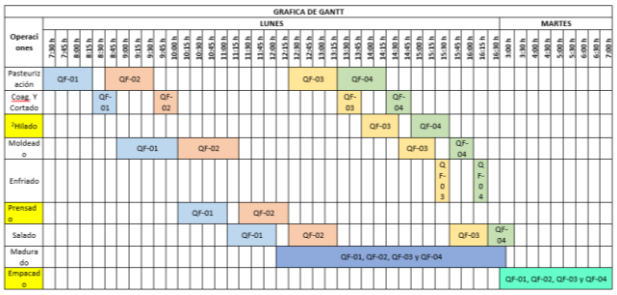
Producto: QF-01 **Política de Pedidos:** 315, 393 o 472 unidades **Tiempo de Espera:** 1 día

Cantidad Disponible: 0	Octubre																									
	3	4	5	6	7	8	10	11	12	13	14	15	17	18	19	20	21	22	24	25	26	27	28	29	31
Pronóstico		329	329	329	329	329		329	329	329	329	329		329	329	329	329	329		329	329	329	329	329	
Pedidos de los clientes (registrados)	0	300	280	380	205	550	0	280	130	450	265	605	0	310	105	420	283	662	0	291	309	345	215	629	0
Inventario disponible proyectado	0	15	50	142	252	17	0	35	220	242	292	2	0	5	215	267	299	30	0	24	30	157	257	21	0
Cantidad del MPS	0	315	315	472	315	315	0	315	315	472	315	315	0	315	315	472	315	393	0	315	315	472	315	393	0
Inicio del MPS	315	315	472	315	315		315	315	472	315	315		315	315	472	315	393		315	315	472	315	393		315
Inventario disponible para promesa	50		252		17		220		292		2		215		299		30		30		257		21		235

The Production Master Plan was prepared for the last quarter of the year (October, November and December) and for each product (QF-01, QF-02, QM-03 and QM-04).

Table 3 shows the schedule of activities on Monday of the first week of October.

Tabla 3 Schedule of activities



Final analysis

The feasibility of applying the process of Production Planning developed is evidenced, on the one hand, from a methodological point of view, and on the other from the analysis of the level of customer service and Ritmicity. For the analysis of these last two indicators, the months of December of 2015 are compared with the one of 2016 as shown in Annex 27. It is valid to clarify that the work does not directly affect an increase of the productivity of the company.

From the methodological perspective, it can be said that the present work provides the company with the methodological procedures in the literature for the development of Aggregate Planning and the Master Production Plan.

Regarding the forecast can be said that the company has its forecasts for 2016 and can collaborate with the corresponding for 2017 by means of Forecast Pro, that is to say, it has the database of the demand for each of its products and in A format consistent with this software. In addition, the main features of historical time series are provided for all products.

The Aggregate Plan elaborated clarifies to the company the strategy of planning to follow, that is to say, leveling of the labor force with extra time and the total approximate costs and associated with this strategy in each one of its families of products. This plan and its total costs, in conjunction with forecasts made as the projection of total revenues, allows the company to project its decision making for the year that is planned.

The Production Master Plan allows you to have more accurate control of the available inventories, the amounts to be released each day and the inventories available for pledge. With this plan, there is a positive impact on the indicators of Customer Service Level and Production Ritmicity, that is, the differences between the committed amounts and the amounts actually satisfied are minimized by controlling the inventories available for promise and with This the claims for lack of quality.

The production scheduling using the Gantt chart allows you to know the duration of each activity and the progress of a production batch, ie in a given time, you can see if the programmed is being fulfilled or see which activity is Delayed In addition, it allows you to distribute the work on different machines.

Level of customer service

The analysis of the Customer Service Level is determined taking into account two aspects: quantity of orders claimed for problems of quantity and quantity of orders claimed for breach of delivery deadline. The results are the following:

$$NSC_{12/2015}=\left[1-\frac{42}{80}\right]*\left[1-\frac{18}{80}\right]=0{,}475*0{,}775$$

$$NSC_{12/2015}=0{,}3681$$

From this result it can be said that the orders claimed for quantity problems have a probability of 52.5% and are those that lead to a greater extent to the misconduct of the reliability of the system of 36.81%.

$$\text{NSC}_{\frac{12}{2016}}=\left[1-\frac{0}{77}\right]*\left[1-\frac{0}{77}\right]$$

$$\text{NSC}_{12/2016}=1$$

$$\Delta\text{NSC}=0{,}6619$$

For an increase in the Customer Service Level of 66, 19%.

Rythmic Production

For the calculation of the Ritmicidad of the Production the requested amounts are considered as the sales planned and the quantities delivered as the actual sales. The calculations are as follows:

$$Kr_{12/2015}=\frac{18318}{18922}=0{,}9680$$

$$Kr_{12/2016}=\frac{17417}{17417}=1$$

For an improvement from the point of fulfillment of the sales plans.

4. Conclusions

The compilation of the theoretical bases around the scientific problem raised allows to confirm the broad conceptual base on each one of the subjects treated. The above, together with the hierarchical approach treated allows to organize this process of a better way in each one of the horizons of planning.

The tool used in the diagnosis of the object of study effectively enabled this activity, since it allowed to characterize and classify the production system properly. A low Customer Service Level of 16.32% was detected and a high probability of not complying with the delivery deadlines of 40,40%.

The process of Production Planning developed brought significant improvements to management. On the one hand, it contributed to elaborate the historical series of the demand from the year 2013 to the 2016, which serves as base for the development of future forecasts through the Forecast Pro; And on the other hand, the company is given the methodological procedures in the literature for the development of its planning process.

The developed Aggregate Plan and Production Master Plan helped to estimate the total costs associated with a strategy of leveling the workforce and overtime, better control of inventories and better control of available orders for pledge, respectively. Both plans led to raising the Customer Service Level by 66, 99% and to increase the fulfillment of the Production Plan to 100%.

The scheduling of the production helped to know the duration of each activity and to keep track of the work progress of a production batch, in a given time can observe if the programmed is being fulfilled or see which activity is delayed.

Gratitude

To God for giving me life and giving me every day a new opportunity to live.

To my family for being the people I love the most and for supporting me unconditionally.

To the Technical University of the North, and to all the teachers who train professionals of quality.

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