Student Paper Submission.

Title of submission: Assembly line balancing Bimbo's case (Mexico).

Authors:

1) Edgar Vargas Gutierrez edgar.lider@gmail.com
2) Lacayo Castillo Oscar oscar.lacayo88@gmail.com
3) Rodríguez Cariño Vadir. vadrodcar@gmail.com
4) Nila Morales Marco Antonio marco.nila.morales@gmail.com

Primary author name:

Edgar Vargas Gutiérrez.

Email: edgar.lider@gmail.com

Educational Institution

Instituto Tecnológico y de Estudios superiores de monterrey, Campus Estado de México.

APICS Terra Grande – Heartland District Chapter Affiliation

ITESM – CEM, Mexico City Student Chapter.

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1) Edgar Vargas Gutierrez
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3) Rodríguez Cariño Vadir.
4) Nila Morales Marco Antonio

University Affiliation: Instituto Tecnologico y de Estudios Superiores de Monterrey Campus Estado de Mexico.

All the authors are currently students in Industrial and Systems Engineering at Instituto Tecnologico y de Estudios Superiores de Monterry, Campus Estado de Mexico.

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Abstract

The main purpose of the paper is to show a way to balance a production line at Bimbo México, we mention our strategy to balance this line in order to improve the productivity. The importance of solving this problem is that they only have one line for many products, so they spend a lot of money and time changing it. We solve this problem by doing a Master Production Schedule just to arrange the entire production scheduling. We expect to have the best way to control and schedule the entire line in order to have the best utilization and to satisfy the costumers.

Overview of inventory management

An idea of cero inventory is actually false because every step along production line requires raw material or simply work in process in front of the production line (workstation). Today the most important goal inside the area is to minimize actual number of inventory, costs and make more money. In the present case (Bimbo) it is important to know the actual level of inventory and the required in order to satisfy customer needs. Bimbo's case require an excellent schedule in order to satisfy all the customer needs with the minimum possible level inventory.

Assembly Line Balancing (Literature Review)

Since the early of the nineteenth century, the production of almost any kind of product has been changing in order to improve the quality of all the processes involved in the production system. The intention has been to create lean processes, low costs, minimum variation and as Eliyahu Goldratt says, earn money.

First of all, we have to do our own definition of production line. A production line in a company is the sequence of tasks that are grouped into stations, in such a way that you look for a bigger throughput, lower inventory and lower costs. 3

The principal objectives of a production line are to have better quality, faster processes and to diminish all kinds of costs. The main problem when we have a production line is that in most of the cases it is not balanced. One of the processes to balance a production line, which we will not discuss in the work, is the "heuristic method from Helgeson and Birnie (1961) known as the ranked positional weight technique. The method places a weight on each task based on the total time required by all of the succeeding tasks. Tasks are assigned sequentially to stations based on these weights". (Nahmias, 2001)

Another way to create or generate balance in a production line is by using the knowledge that Eliyahu Goldratt developed. He said that if a company wants to have a good production system, they have to follow what he called "Goldratt's Rules of Production Scheduling":

1. Do not balance capacity, balance the flow.
2. The level of utilization of a nonbottleneck resource is determined bot by its own potential but by some other constraint in the system.
3. Utilization and activation of a resource are not the same.
4. An hour lost at a bottleneck is an hour lost for the entire system.
5. An hour saved at a nonbottleneck is a mirage.
6. Bottlenecks govern both throughtput and inventory in the system.
7. The transfer batch may not and many times should be equal to the process batch.
8. A process batch should be variable both along its route and in time.
9. Priorities can be set only by examining the system's constraints. Lead time is a derivative of the schedule.

These were the first points that Goldratt propose to have a good and balanced production system, but the principal ideas that he had, are found in the "Theory of Constraints", which is another way to chase balance in a production line. The main idea of this theory is that you must help the station that is having more work to do; the station that has the larger queue or the one that has more utilization.

Goldratt pointed out the next steps in order to follow his theory of constraints:

1. Identify the system contraints. (No improvement is possible unless the constraint or weakest link is found.)
2. Decide how to exploit the system constraints. (Make the constraints ass effective as possible.)
3. Subordinate everything else to that decision. (Align every other part of the system to support the constraints even if this reduces the efficiency of nonconstraints resources.)
4. Elevate the system constraints. (If output is still inadequate, acquire more of this resource so it no longer is a constraint.)

5. If, in the previous step, the constraint have been broken, go back to step 1, but do not let inertia become the system constraints.

He establish that a company must has some measurements in order to know if they are going good in their principal objective that is to make money. He pointed out two kinds of measurements, the financial and operational.

The financial has the following measures:

- Net profit
- Return on investment
- Cash flow

And the operational measure has the following:

- Throughput
- Inventory
- Operating expenses

The throughput has to increase in order to generate money, inventory has to diminish in order to create more throughput and eliminate money stocked at the system, and the operation expenses has to be also diminish.

Another important thing we have to take care when balancing a line is the batch size. "Larger process batch sizes require fewer setups and therefore can generate more processing time and more output. For bottleneck resources, larger batch sizes are desirable. For nonbottleneck resources, smaller process batch sizes are desirable, thereby reducing work-in-process inventory." (Chase, 2006)

So far we have not mention the mathematical part, when we have a production line there must be some descriptors or values in order to really now if we are going good. Hopp and Spearman establish the next three parameters in order to know how good are production line is.

- Bottleneck (r_b): "The bottleneck rate of the line, r_b, is the rate (parts per unit time or jobs per unit time) of the workstation having the highest long-term utilization."(Hopp, 2001)
- Raw process time (T_0): "The raw process time of the line, T_0, is the sum of the

long-term average process times of each workstation in the line. Alternatively, we can define raw process time as the average time it takes a single job to traverse the empty line". (Hopp, 2001)

- Critical WIP (W_0): "The critical WIP of the line, W_0, is the WIP level for which a line with given values of r_b and T_0 but having no variability achieves maximum throughput (that is, r_b) with minimum cycle time (that is, T_0). We show below that critical WIP is defined by the bottleneck rate and raw process time by the following relationship:
  - $W_0 = T_0 \times r_b$

If our line is balanced, the value of W_0 will always be equal to the number of machines in the line, if not, the value of W_0 will be less.

PROBLEM DESCRIPTION

Based on information provided by Bimbo, about Panquelería production line, on the ground of Azcapotzalco, corresponding to 20 products, which provides the following information:

• Product Name

• Number of packages per hour produced

• Mass Packet Number

• Changing Times Online

Besides, the Plan includes Order of 2 weeks to 19 branches for the next 2 weeks, day by day.

Based on this information, it is making a production plan that optimizes the use of time, in order to fulfill orders based on reducing the time for line cleaning.

MOTIVATION

Bimbo is one of the ten largest companies worldwide within the food industry through the hard work that all who were and are part of this company. But to keep growing and moving forward on behalf of their clients, a key part of the philosophy of Bimbo, the company must keep abreast of the latest methodologies and techniques of production, administration, logistics and other areas that form to remain a leader.

One of the most important lines for this company is Panquelería line, so this will be our object of study in this project that aims to bring those responsible for this line as a joint Bimbo and the latest techniques, information and knowledge management of the supply chain of the manufacturing chain.

METHOLOGY TO SOLVE THE PROBLEM.

In order to solve the problem of making a making a production plan that optimizes the use of time, in order to fulfill orders based on reducing the time for line cleaning, we must consider all the factors involved in the production line, such as rate (which is variable), the demand of every agency, the times involved on operation (such as clean the line), the wastes generated, and the customer service level.

The methology consist in satisfy all the dairy demand of five different products that are fabricated at this line:

- Panque Marmol 300g BIM
- Panque Pasas 285g BIM
- Panque Nuez 270g BIM
- Panquecitos Gotas Panera 10p 700g MTA BIM
- Mantecadas ME 8p 250g BIM

For each product, the demand is different each day at each agency (customer), so, in general we have a total demand of each product diary, the goal is to determine the number of hours in which each product will be "cooked" taking in consider the variability of the processing time, and other times; this by satisfying all the demand (customer service =100%) and by having the minimum waste (0%)

MODEL (ANALYTIC)

The program.

"Project_APICS_ProdMngmt_BIMBO_Vargas_Lacayo_Rodríguez_Nila" works as follows:

Fabrication Base gives the general information of the process, Total Demand sums all the orders of the agencies focusing on the five products early mentioned.

The schedule is programmed in such a way that the hour of production gives the exact time for the production line to produce certain product, in order to fulfill the demand at 100% with no wastes.

The Decission Maker is the principal tool for the program, in this section, the Schedule is repeated 100 times for each product for each day, giving different solutions because the randomness of the process. By having 100 different solutions, the program calculates an average for each day, this average should be the hours planned at the production line for each product every day.

MPS gives the final result, taking in consider the decision made at the previous step, in this section the levels of customer service are around the 100% and the wastes around 0. This section also shows the total throughput and the total cycle-time for each day.

Finally, the benchmarking section provides a quick evaluation of the assembly line giving the decision made for each day, in this section the comparison point are the actual cycle-time, throughput and rate.

RESULTS AND ANALYSIS

The results provide an acceptable solution for each day, this results change constantly because the relationship of decision making with the variability of the process, for example:

Code	Product_Name												
1064	Panque Marmol 300g BIM	Week 1						Week 2					
		07-JAN-10	08-JAN-10	09-JAN-10	11-JAN-10	12-JAN-10	13-JAN-10	14-JAN-10	15-JAN-10	16-JAN-10	18-JAN-10	19-JAN-10	20-JAN-10
	Production Hours:	1.779	2.144	1.732	1.696	1.603	2.662	2.497	2.082	2.197	1.898	1.731	1.584
	DEMAND	17004	20028	16284	16104	15048	24984	23508	19656	20688	17748	16428	15036
	Processing time	9397.644183	10018.3235	10166.711	9105.51144	9053.96006	9606.90183	8174.12582	9628.9487	9691.58689	8797.95958	9693.20517	9584.70457
	Total jobs	16713.9842	21474.4073	17610.6829	15442.552	14511.2917	25572.8503	20407.6985	20044.0182	21297.1536	16701.3635	16775.8043	15185.9725
	"Shakes" needed	19.89799819	25.5652819	20.965518	18.3843581	17.2756928	30.4444783	24.295365	23.8624036	25.3542614	19.8829732	19.9715951	18.0789002
	Cleaning time	0.004139851	0.35599396	0.00758393	0.214175	0.03456357	0.00949596	0.08758523	0.08023833	0.21239741	0.1521351	0.03156643	0.01540363
	Total Cycle time	1.78266901	2.49950702	1.73977469	1.91013157	1.63731988	2.67142076	2.58420675	2.16187972	2.40988621	2.05045747	1.76224313	1.59980014
	Wastes)	0	1446.40	1326.68	0	0	588.850	0	388.018	609.153	0	347.804	149.972

		728	289			3		165	614		329	458
Missing products	290.0158013	0	0	661.448025	536.708308	0	3100.30153	0	0	1046.63651	0	0
Customer Service Level	98%	100%	100%	96%	96%	100%	97%	100%	100%	94%	100%	100%
Waste Level	0%	7%	8%	0%	0%	2%	0%	2%	3%	0%	2%	1%

The Customer service level of this solution is acceptable at every day and the waste level is low. To fulfill every demand each day, the optimal solution is given at the Schedule section of the program, this solution is proposed considering the unexpected variability of the process.

Also the total cycle time for every product gives the total number of hours the production line must be working; this is very helpful to establish work schedule and operators needed.

CONCLUSIONS

The line balancing problems, and production scheduling for a variable process are very common, almost imperative, at every process line, independent of the product made, for this the appropriate usage of models and methods to fulfill the market requirements are very useful. In this problem, the solution provided is made in order to simulates reality, in which the uncertain processing time is the principal enemy. In reality is almost impossible to fulfill the requirements of the customers at a 100%, so this model is very practical to a real decision.

In general, the process schedule is demanding in time and compression of the line behavior, also the constant schedule can ensure a high customer satisfaction level, this is obtained by the repetitive labor of schedule each product offered each day.

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