ISSN: 2047 - 0398
SPECIAL ISSUE – V|4|N|5|, January | 2015

APPLICATION OF THE RESTRICTIONS THEORY: Productive Analysis In A Food Industry

Msc. Cleunice Zanella
Social and Applied Sciences Area
Universidade Comunitária da Região de Chapecó (Community University from the Region of Chapeco) – UNOCHAPECÓ, av. Atilio Fontana, 591 E – EFAPI, Chapecó – Santa Catarina - Brazil, 89809-000.

Msc. Rodrigo Barichello
Social and Applied Sciences Area
Universidade Comunitária da Região de Chapecó (Community University from the Region of Chapeco) – UNOCHAPECÓ, av. Atilio Fontana, 591 E – EFAPI, Chapecó – Santa Catarina - Brazil, 89809-000.

Msc. Silvana Dalmutt Kruger
Social and Applied Sciences Area
Universidade Comunitária da Região de Chapecó (Community University from the Region of Chapeco) – UNOCHAPECÓ, av. Atilio Fontana, 591 E – EFAPI, Chapecó – Santa Catarina - Brazil, 89809-000.

Paola L. Carre
Social and Applied Sciences Area
Universidade Comunitária da Região de Chapecó (Community University from the Region of Chapeco) – UNOCHAPECÓ, av. sen. Atilio Fontana, 591 E – EFAPI, Chapecó – Santa Catarina - Brasil, 89809-000.

Dr. André Luis Da Silva Leite
Sciences Management Department
Universidade Federal de Santa Catarina (Federal University of Santa Catarina) – UFSC – Bairro Trindade, Florianópolis – Santa Catarina - Brazil, 88040-000.

Dr. Nelson Casarotto Filho
Production Engineering Department
Universidade Federal de Santa Catarina (Federal University of Santa Catarina) – UFSC – Bairro Trindade, Florianópolis – Santa Catarina - Brazil, 88040-000.

ABSTRACT

The study aims to apply the optimization process of the restrictions theory in a food industry located in the west of the State of Santa Catarina, to identify the constraints of the production process of gelatine production line. Methodologically the study is exploratory, developed through a case study with qualitative and quantitative analysis of the processes. Initially identified the flowchart of the production process, then the runtime of activities and problems related to production stoppages. It was identified from the monitoring carried out that the biggest bottleneck of the jellies production of the studied company is on the machines that pack the sachets (primary packaging), which despite having greater capacity than the secondary packaging (Vertopacks) present restriction on production volume due to setups, identified mostly by the exchange and cleaning of teflon, industry organization, adjustment of machines, coil exchange and gymnastics. Overall, the study results show that using the restrictions theory is possible to identify bottlenecks and guide managers in correcting the process restrictions, in order to optimize production.

Key-words: *Restrictions theory. TOC. Productive process. Food industry.*

1 INTRODUCTION

The companies aim to constantly improve their products and processes, seeking competitive prices, in order to stay in front of market scenario. In this context, marked by competition and relentless pursuit of competitiveness, management of resources and of activities is fundamental (Corrêa, 2010).

In this sense the companies use methods and management techniques, in order to reduce losses and hence reduce production costs, in order to correct problems and restrictions that affect their activities. One possibility for business management is the application of Restrictions Theory - TOC, a tool that can be used in the identification, analysis and solution of problems affecting the development of enterprises, enabling the achievement of its goals (COGAN, 2007).

TOC came up with the initial purpose to solve problems inherent to the production processes of plants, to identify the restrictions on production lines. It is currently being put into practice in other environments, as the perception of its effectiveness in continuous improvement processes from the restrictions perceived and identified (Denicol, Cassel, 2013).

The management of restrictions is an approach that recognizes the role that the limiting resource has on the production process. Through knowledge and understanding of the issues involved with the management of the restrictions, companies can realize immediate improvements in the results of their organizations and through a focused approach to continuous improvement, they can plan to also meet the future needs (COX SPENCER, 2002).

The restrictions theory becomes a differential to solve the problems related to the operating procedures of organizations, contributing as a tool to support organizational management (GOLDRATT; COX, 2002). In this regard, earlier studies such as Moellmann et al. (2006); Denicol and Cassel (2013); Zanella et al.(2013); Buzzi, Ribeiro and Carlesso (2013); Ducatti et al. (2013) show the importance of using the restrictions theory in the business environment as a support tool for the management process, the various business segments.

Zanella et al. (2013) stresses the importance of TOC also in the monitoring through accounting controls, which allow managers to identify production costs (direct, indirect, fixed and variable), but also of those costs that represent situations of normal losses, abnormal or idle production processes.

From this context, the study aims at the implementation of the optimization process of the restrictions theory in a food industry in order to improve their business competitiveness through the use of these techniques used by management of production. In this sense, the study aims to answer the following issues: What are the main constraints existing in the jelly production process of a food industry?

The study is justified by the importance of the food industry in the western region of Santa Catarina, both in generating jobs and income, as in general for regional development, and because it can serve as a model for the application of the theory of constraints in other companies in this business segment.

2 THEORETICAL FUNDAMENTATION

This topic covers the key concepts and the context of the restriction theory, as well as related studies that contribute to the studied subject.

2.1 Restrictions theory put in the context and its concepts

The restrictions theory had its development from the 70's when the Israeli physicist Eliyahu Goldratt assisted in the management of a company, using the reasoning process applied to physics, developing software for planning the production of cages for birds. This software gave birth to the Optimized Production Tecnology - OPT, which consisted of a series of principles for production optimization (Noreen, SMITH, MACKEY, 1996); CORBETT NETO, 1997).

The restrictions theory was presented and subsequently disseminated in the book "The goal" (1984), which discusses the techniques to maximize the productive resources of a factory, through the management of the restrictions. TOC claims that any system has at least one restriction, otherwise the outputs would be endless (GOLDRATT, COX, 2002).

The Restrictions Theory is a systematic management approach, which has the active focus the management of restrictions that prevent the company advance towards its goal: profit and maximization (Krajewski, Ritzman, Malhotra, 2009). The production processes to not generate bottlenecks should receive and dispatch in the same amount not to generate accumulation at some stage or sector, in this sense, Cox III and Spencer (2002, p.28) point out "A production system consists of a series of steps successive performed by different resources. All steps or operations should be completed in a specific sequence to obtain the final product."

Restrictions are defined as obstacles or factors that prevent a system to achieve its goal. The "bottlenecks" or "boundary points", can be found in companies due to lack of planning, to identify and solve the lack of capacity in relation to the optimization of production resources and time. Bottleneck is a special type of restriction that

ISSN: 2047 - 0398
SPECIAL ISSUE – V|4|N|5|, January | 2015

relates to the lack of capability of a process and for this reason it is also called, under certain conditions, restrictive use of production capacity (CORBETT NETO, 1997; Krajewski, Ritzman, Malhotra, 2009).

The management of restrictions facilitates the achievement of the objectives pursued by the companies, and they need to follow five steps, which according Corbertt (1997) involve:

(i) **Identify the restrictions of the system -** in this step analyzes the process flow for finding the feature that limits the gain of the entire system. Every system has one or more restrictions, limiting the gain.
(ii) **Explore the restrictions of the system –** according to Guerreiro (1996) exploring the restrictions of the system means taking a whole advantage of it, that is, obtain the best possible result in this condition.
(iii) **Subordinate everything else to the above decision -** All resources should work according to the restrictive resource.
(iv) **Raise the restrictions of the system** - This step values the investment in restrictive use increasing its production capacity.
(v) **If in a previous step the restriction is broken, return to the first step** - from the 4th step go to the to the 1st step, because with the restriction changes the whole system should be reassessed once the process is analysed with base on the restriction, that is, the cycle will continue to get improvements.

There are some concepts related to the restrictions theory and its principles of fundamental importance to understand the study and contribute to the management and improvements in production. Among them are the *lead time* approaches, which Tubino (1999) identifies in waiting time, processing time, inspection time and shipping time.

Measure the capacity demand provides some basic information for capacity planning. The problem is that demand is uncertain. In each case, the volume of production is the most appropriate measure of capacity, because does not change the nature of the product of the operation. For many operations, the capacity setting is not so obvious, especially when a much wider range of products presents requests for the process variable, the production volume measurements are less useful.

In this sense, relating the restrictions theory with the production processes, there is the importance of measuring and managing the productive capacity of the processes. One should have control of all the steps involved in its production process and know exactly how long it takes to perform each activity, and the time lost between stages of production, to identify and correct the problems caused by the restrictions.

2.2 Studies related to the subject of study

Studies related to the studied thematic contribute to discussions about the restrictions theory, as evidenced below.

The Moellmann research et al. (2006) displays and uses the Global Efficiency Ratio Concept equipment combined with the Restrictions Theory and Kaizen techniques such as analysis tools and the choice of improvement actions in production lines. Through a case study applied an automobile company, the results of implementing indicate improvements in net capacity values of machine tools of the engine block machining line, which consequently allowed better gains in overall productivity of the manufacturing line engines, and stresses the importance of the restrictions theory in the management process.

Denicol and Cassel (2013) conducted a systematic review of the academic literature on the restrictions theory (RT) that can be applied in managing the supply chain. Through publications in international databases considering a time period of 10 years, have shown an overview of the knowledge generated in this area. The results highlight the importance of the RT and its application in different organizations, as well as list the categories of results for future research, indicating how most promising categories of RT-TP (Thinking Process) and the RT-SCRS (Supply Chain Replenishment System), considering that the RT-TP helps to identify the problem when extrapolated restrictions factory, while the RT-SCRS considers the client as restriction, but the product is not always available to lose sales.

Zanella's study et al. (2013) identifies the relationship of normal loss, abnormal and idleness with the production costs of a footwear company in the state of Santa Catarina. After identification of the assembly line flow, the authors demonstrate that productivity losses accounted for 22,705 pairs that are no longer produced. The overall results show the importance of productivity controls and monitoring of production costs to optimize the results of the production process.

Buzzi, Ribeiro and Carlesso's study (2013) aimed to identify bottlenecks in the company's production sectors Uniforms 1000 Colors, with reference to the concepts of the RT. The results consider the productive capacity of

ISSN: 2047 - 0398
SPECIAL ISSUE – V|4|N|5|, January | 2015

the industry and the bottlenecks to fill orders on time combined, helping managers to seek improvements to the limiting factors of production capacity.

Ducatti's study et al. (2013) had intended to present a conceptual discussion of the RT contribution to the continuous improvement process (MC). The authors are based on a review of literature on traditional CM and the RT approach to MC. They consider that the RT has a particular view of MC process, and can correct restrictions gradually to improve performance or reduce costs in this respect the authors show that the RT differs from other approaches which see any improvement as positive.

3 METHODOLOGY

This research is characterized as an exploratory case study, from the application of TOC optimization process in a food industry located in Chapecó, in the western region of the State of Santa Catarina. In the matrix, which serves the entire south of the country, has a branch in Araras, state of São Paulo, serving the Southeast and Northeast of Brazil. Generates around 500 direct jobs, in addition to a team of over 140 sales representatives, distributors and wholesalers spread throughout the country.

For the study, delimited the analysis of the restrictions of the production process of gelatine, which is one of the main products of the company object of the study. To collect data, we used the observation of the production process of gelatine production line, considering the steps and the process flow: (i) pre-mix, (ii) mix and (iii) the engine room, and these three essential steps for the company's gelatin production.Subsequently elaborated a spreadsheet that was sent to two people, one of the first and the other the second round. It was up to these people the responsibility to fill in the requested data to monitor the steps of the production process, referring to the period of analysis (01 to 26 October 2013).

Persons selected to contribute in the process notes, are responsible for stopping the treadmill when there is some need or problem related to the processes of this production step. Thus considering that they are responsible for the "stops" identify the reason and the time the activity was interrupted or "stop". Subsequent to this analysis were performed which allowed to identify the note major constraints gelatins production process of the company studied.

There was the flowchart of the production process, the processing time in each step and then, through the collection of the problems observed in the production process, we identified the main constraints that hinder the optimization of the production process, in addition to the main *setups* that occurred during the study period.

4 ANALYSIS OF THE RESEARCH RESULTS

The studied company produces a wide range of items, ranging from colorifics, chocolate, soft drinks and jellies. This topic addresses the production of gelatin process comprising the steps and time of activities, as well as restrictions and *setups* observed in the development of the activities of the production process, as shown in Figure 1.

Looking at Figure 1, the pre-mix includes the weighing of micro ingredients, transferring them to the mixers with capacity of 500 kg, which are added to the macro ingredients. Once the mixture, packets with the raw material is stored temporarily until go to next step, which depends on the approval of Quality Control. Approved, the material is fed to the *"bags"*, kind of bags that store the raw material already mixed and leads to the four sachet machines and Masipack, the same purpose machines.

In the sachet machine, if the product is packed in plastic fractionating sachets ready to be Cartridged boxes in the respective flavor of gelatine. The sachet machine produces 60 sachets / minute, and the quality control carries out periodic inspections and random weight for checking quality parameters. The machine packs the sachets by the operator is called Vertopack and performs the closing sachets 120 / min. After completed the steps the product is packed in cardboard boxes, properly sealed, for shipment.

4.1 Identification of the restrictions of the production process of gelatin

The sachet machines of production capacity was calculated considering the maximum produced by each machine, the effective production time at every turn that in the company is 369 minutes (the time disregards-arrival of officials and preparation for the beginning of activities), total sachet machines, worked days (Monday to Friday) and exceptionally Saturdays (6 days / week), resulting in weekly production, considering the production of two shifts.

The machines that perform the secondary packaging, VPs calls, follow the same parameters, but it was considered a capacity of 146 sachets packaged per minute on two machines running. Thus, in Table 1, there is shown a weekly production capacity of packing machines, which is 221,440 units gelatins and secondary packaging 215 496 finished units.

From the data in Table 1, it appears that there is a difference of 5,904 units / week between the primary packaging capacity (packing machines) for secondary packaging (VP's). Thus, the capacity of the secondary packaging packing machines limited to, introducing a restriction in the gelatin production. However, these data refer to the nominal capacity of the equipment, ie production possible and not necessarily the actual output (effective).

After obtaining the production capacity of the machines involved in the process, could be compared with the actual total production (effective) weeks during the period from 01 to 26 October 2013, and for every week the volumes produced were noted both packing machines as in the VPs, considering both shifts worked, even if Saturday were shown in Table 2.

Whereas there is dependence on activities, ie, the production volume of VP's (secondary packaging) depends on the volume of production of packing machines (primary package), it should be noted that the volume that the process 2 cannot absorb, is stored at processes, and may cause loss of quality. In this case, as shown in Table 2, the second process produced more than one process at weeks 1, 2 and 4 (yellow line), which was due to stock between processes. This is explained by the fact that the actual production process 1b (effective) lower than rated capacity. When we compared the abilities of processes 1 and 2, there is only 2 weeks in the process of production volume 1 was greater than the volume of the production process 2.

Then, after the collection of production data, as shown in Table 2, note that the analysis of the total utilization of production on the capacity of each machine does not occur using the maximum capacity, is PV or packing machines. This percentage difference can be explained by the occurrence of *setups*, identified among three main: exchange and cleaning of the *teflon*, machine regulation and industry organization.

Was observed at week 1 that the use of the total production capacity is only 71% of 5 packing machines machines. This percentage can be analyzed considering a total of 380 minutes *setups* this week. Among the major reasons for these *setups* are: exchange and cleaning of the Teflon (tape to prevent damage to the sachet at the time of sealing), machine regulation and industry organization (includes cleaning the desktop), as shown in Table 2.

In week 2, the capacity utilization of the machines improved, rising to 82%, this percentage resulting from a decrease in total *setups* this week, corresponding to 348 minutes. In this period, in a turn at week 2, were not sachets gelatine produced and the target was not reached in the day due to exchange and cleaning of *teflon*, adjustment of the machine and weight of the packaged gelatin and the gymnastics performed during office hours work. Remember that in week 1 worked on Saturdays and at week 2 only 5 days, Monday to Friday.

In week 3, the capacity utilization of packing machines represented 83%, the best presented index of weeks studied. You can combine this better use of machines to decrease the number of *setups* throughout the week, representing 320 minutes. It appears that the *setups* are restrictions that interfere directly in production, because did not reach the targets in some days of the week 3 and not produce in the second round, the week showed the best productivity index, due to reduction of *setups.* The VP`s machines reached 92%, a rate considered very good by the company. The main reasons given for the *setups* this week were: the exchange and cleaning teflon, machine regulation and industry organization.

At week 4 were worked five days in both packing machines machines as in VP`s, and the first the rate of capacity utilization was 80% and in packaging machines the result was 94%, the best in recent weeks. The reasons of production *setups* did not change much compared to other weeks, remaining the exchange and cleaning *teflon*, machine setting and coil exchange. The gymnastics was also identified.

Given the data presented, it can be identified that the biggest bottleneck of the company gelatin production is the amount of sachets packaged by VP`s because its daily production capacity of 146 und / min, and were lower than packing machines (60 und / min), since they indicate packaging machines and 5 are just two. Significantly, also be deemed to *setups* as factors that help to lower productivity and directly interferes with the actual capacity (effective) of the company's production.

Today the company uses the VP`s at maximum capacity and sometimes works up on weekends, as both packing machines failed to meet weekly demand.

ISSN: 2047 - 0398
SPECIAL ISSUE – V|4|N|5|, January | 2015

From the identification of the processes and comparison with the actual production (effective) weekly parse the index of capacity utilization, and relate it to the programmed *setups* and not programmed that occurred during the period of this study. From this information, the company can take corrective actions to improve their efficiency.

With the identification of the system's restrictions on breakpoints of production from machine setting, you need to identify if the error is due to operator failure, if the problem is related to inadequate planning of the production sequence, resulting exchange product and hence the setting of the machine or if the product requires such constant hit by mechanical problems.

Reducing *setups* times of the machines, as well as the maintenance that are common today and commit to full capacity utilization of the machines. Should be sought to reduce the time used for the organization of the sector, this *setup* identified every week analyzed, the intervals and times of stops as welding adjustment, weight, or the exchange of flavor, these being performed by while the auxiliary operator performs the cleaning and organization of the environment.

As for gymnastics performed, it is suggested take turns working positions in the period in which it is running, generating multi-functionality or performing the activity per cell and does not impair the continuity of production.

In the current situation the company is, the acquisition of a VP in order to secure a meeting demand and prevent the identified bottlenecks, or the replacement of packing machines for increased production capacity and thus constantly feed the VPs is not feasible because in a shopping feasibility study conducted by the company, has been shown to generate a lot of inventory to current demand and the cost per unit oscillate very little of that today is practiced. Thus, the option is to remain with the production using two VP's. It is therefore the company take specific actions in order to reduce the identified setups, contributing to the improvement of process efficiency.

Thus, the overall results of the study corroborate the claim that the OCD becomes a differential in solving problems related to the processes, contributing as a tool to support organizational management, as pointed by Goldratt and Cox (2002), showing the importance of its use as a tool to support the production process, in this case also when applied to the food industry, to identify bottlenecks and fix problems perceived by restrictions in the production process.

5. FINAL CONSIDERATION

From the study and identification of constraints in the production of gelatin process, it is observed that there is not much variability of *setups,* generated mostly by the exchange and cleaning of the *teflon,* industry organization, adjustment of machines, exchange coil and gymnastics. Also appears that the company does not use the possible production capacity of packing machines due to scheduled and unscheduled *setups.*

From this study, it is possible for the company to know the points to be improved by defining what to change and how to make the expected change for the improvement of processes in points of the production line bottlenecks. In general, today the company serves the market demand in the conditions in which they work and the inputs and raw materials available to them, considering also the physical space in which they are installed. Note the constant search for the managers to develop better and more efficient processes that perform through an expansion of the company, new product development, optimization of production activities and best-qualified and well-being of employees.

Finally, before all the content displayed throughout this study we conclude that the RT tools are indispensable and assist in an objective and clear manner, the solution of problems or bottlenecks found in production processes.

REFERENCES

BUZZI, Elisete Maria; RIBEIRO, Mariana Emidio Oliveira; CARLESSO, Roni Ebrson. *Teoria das restrições na identificação de gargalos no setor produtivo: a Indústria Uniformes 1000 Cores.* Revista Eletrônica da Faculdade de Alta Floresta, v. 3, n. 2, p.1-23, 2013.

COGAN, S. *Contabilidade gerencial: uma abordagem da teoria das restrições.* São Paulo: Saraiva. 2007.

CORBETT NETO, Thomas. *Contabilidade de ganhos: a nova contabilidade gerencial de acordo com a teoria das restrições.* São Paulo: Nobel, 1997.

CORRÊA, H. L. *Gestão de redes de suprimento: integrando cadeias de suprimento no mundo globalizado.* São Paulo: Atlas, 2010.

COX III, James F; SPENCER, Michael S. *Manual da Teoria das Restrições.* Porto Alegre: Bookman, 2002.

ISSN: 2047 - 0398
SPECIAL ISSUE – V|4|N|5|, January | 2015

DENICOL, Juliano; CASSEL, Ricardo Augusto. *Teoria das restrições (TOC) para o gerenciamento da cadeia de suprimentos: revisão sistemática da literatura.* In: SIMPEP – Simpósio de Engenharia de produção, 20, Bauru, 2013. Anais eletrônicos... Available on: <http://www.simpep.feb.unesp.br/anais_simpep.php?e=830> Access on june 12, 2013.

DUCATTI , Ana Paula Silva; ROJAS LUIZ, João Victor; ROJAS LUIZ, Octaviano; SOUZA, Fernando Bernardi de. *Contribuições da teoria das restrições para os processos de melhoria contínua: uma análise teórico-conceitual.* In: SIMPEP – Simpósio de Engenharia de produção, 20, Bauru, 2013. Anais eletrônicos... Available on: <http://www.simpep.feb.unesp.br/anais_simpep.php?e=830> Access on june 12, 2013.

GOLDRATT, Eliyahu M., COX, Jeff. *A meta: um processo de melhoria contínua*. 2. ed. São Paulo: Nobel, 2002.

GUERREIRO, Reinaldo. *A meta da empresa: seu alcance sem mistérios.* São Paulo: Atlas, 1996.

KRAJEWSKI, L. J.; RITZMAN, L.; MALHOTRA, M.. *Administração de produção e operações.* São Paulo: Pearson Prentice hall, 2009.

MOELLMANN, Artur Henrique; ALBUQUERQUE, Alexandre Saul; CONTADOR, José Luiz; MARINS, Fernando A. Silva. Aplicação da teoria das restrições e do indicador de eficiência global do equipamento para melhoria de produtividade em uma linha de fabricação. *Revista Gestão Industrial*, v. 6, n. 1, p.90-105, 2006.

NOREEN, Eric; SMITH, Debra; MACKEY, James T. *A teoria das restrições e suas implicações na contabilidade gerencial.* São Paulo: Educator Editora, 1996.

TUBINO, Dalvio Ferrari. *Sistemas de produção: a produtividade no chão de fábrica.* Porto Alegre: Bookman, 1999.

ZANELLA, Cleunice; KRUGER, Silvana D; DEIMLING, Moacir; DENIG, Graciele C. *A relação das perdas normais, anormais e da ociosidade com os custos de produção de uma empresa calçadista do estado de Santa Catarina.* In: SIMPEP – Simpósio de Engenharia de produção, 20, Bauru, 2013. Anais eletrônicos... Available on: <http://www.simpep.feb.unesp.br/anais_simpep.php?e=830> Access on june 12, 2013.

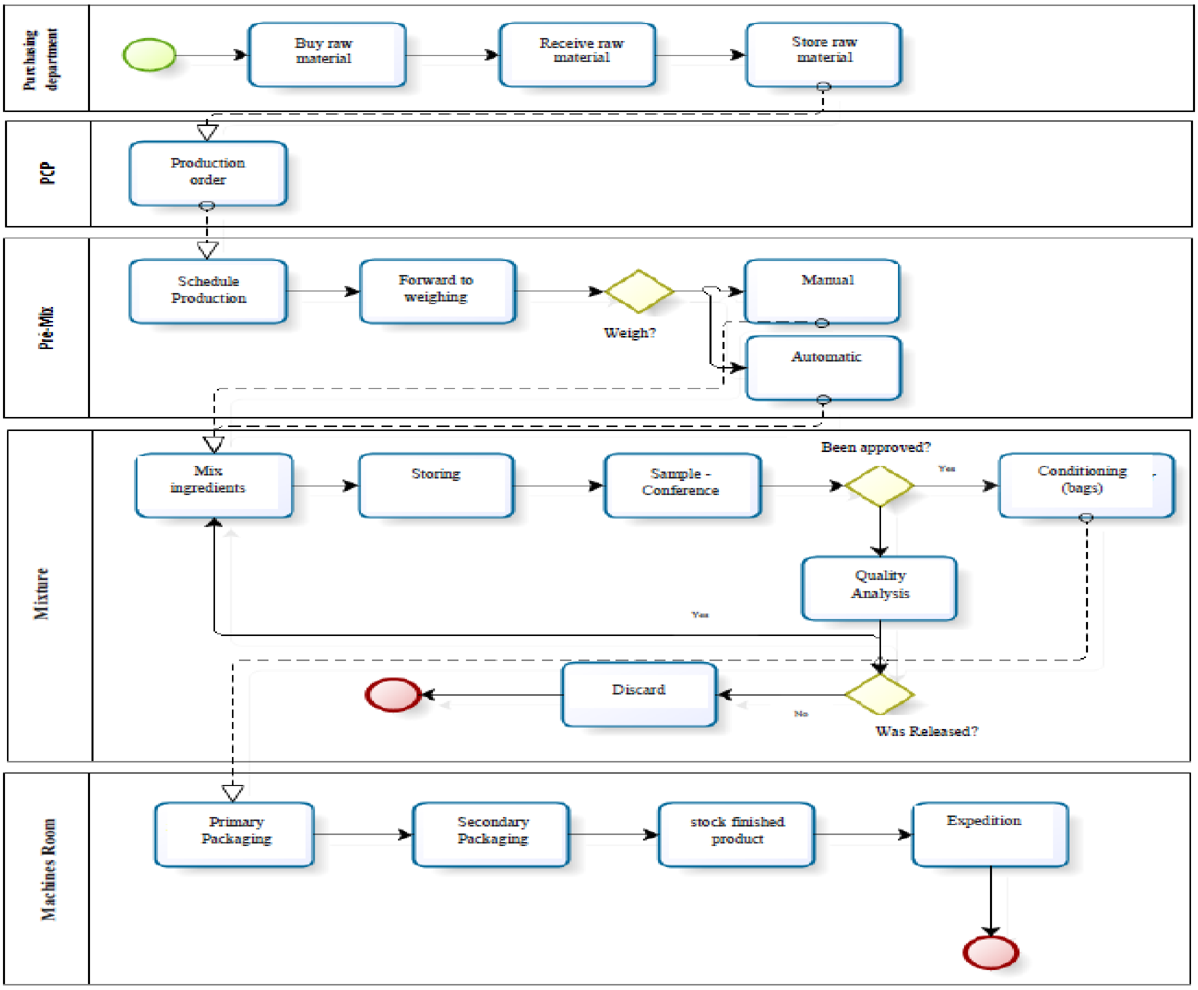

FIGURE 1: Gelatine productive process fluxogram
Source: Elaborated by the authors with data from the research

ISSN: 2047 - 0398
SPECIAL ISSUE – V|4|N|5|, January | 2015

TABLE 1: Productive capacity packing machines and VP's

Production capacity of 5 packing machines					
Sachets/min	Effective time of production (min)	Total of machines	Production/shift (und)	Two shifts production (und)	Worked days
60	369	5	110.700	221.400	5
Production capacity of 2 VPs machines					
Sachets/min	Effective time of production (min)	Total of machines	Production/shift (und)	Two shifts production (und)	Worked days
146	369	2	107.748	215.496	5

Source: Elaborated by the authors with data from the research (October/2013)

Table 2: Production volume (in units)

		WEEKS			
	MACHINES	**1**	**2**	**3**	**4**
PROCESS 1	**MASIPACK**	136.234	189.381	173.456	181.555
	Packing machine 1	205.397	152.129	146.314	153.971
	Packing machine 2	182.307	177.707	138.766	188.870
	Packing machine 3	204.899	203.585	238.293	170.221
	Packing machine 4	218.606		217.553	192.412
	Total Production	947.443	904.747	914.382	887.029
	Production Capacity	1.328.400	1.107.000	1.107.000	1.107.000
	Total Usage (%)	**71**	**82**	**83**	**80**
PROCESS 2	**MACHINES**	**1**	**2**	**3**	**4**
	VP 1	495.106	366.949	573.048	492.081
	VP 2	481.884	480.610	611.800	517.862
	Total Production	976.990	847.559	1.184.848	1.009.943
	Production Capacity	1.077.480	1.077.480	1.292.976	1.077.480
	Total Usage (%)	**91**	**79**	**92**	**94**

Source: Elaborated by the authors with data from the research