Supply chain management:
survey in the Brazilian pharmaceutical industry

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Abstract: This research analyses the supply chain management performance of the pharmaceutical industry in Brazil, from the SCOR (Supply Chain Operations Reference) Model point of view, taking five business processes in consideration: planning, supplying, producing and distributing. A survey was conducted in ten pharmaceutical companies located in Goiás, in the country Centre. The results indicates competition takes place between companies and not between supply chains, very little integration occurs between their links (partners), but wrapped in operational information such as quantity and time, than in relation to strategic issues such as planning along the chain. The industries have a great concern about the quality of their products, because this is an essential aspect of competition in the sector. They are far more shrouded with issues of internal improvements than improving the performance of the supply chain as a whole.

Keywords: Supply chain management, SCOR model, Brazilian pharmaceutical industry.

1 Introduction

Supply Chain Management stand out in the Brazilian business scenario as a major source for generating a competitive advantage. The management of the supply chain is founded on the focus turned to the real needs of customers, timing of the operations in all their extension, establishment of networks of collaborative relationships and management of information flow and products. Just the management of internal activities in an organization is not enough to guarantee success. Competition takes place not only among firms, taking on a broader conception of supply chains. It is in this context that the present study is part of, with the goal of verifying the way that eighteen companies that shape the pharmaceutical industry of the state of Goiás in Brazil manage their supply chain.

There are many factors that hinder competition in the pharmaceutical industry such as high cost and time in developing new products, information asymmetries between production and demand, consumer decision, that is not only from the consumer but also depends on the medical decision, and inelasticity of demand and prices, among other influencing factors.

Discussing every variable in regards to a production chain goes through a comprehensive broad sense, which goes beyond the purpose of this research. Thus, it is necessary to define a supply chain reference model, to focus on the variables considered critical. This research adopted the Supply Chain Operations Reference (SCOR) proposed by the Supply Chain Council as a basic conceptual model.

Based on the issues previously presented and on the recommendation of the SCOR model, the research was guided by the following general question: How do pharmaceutical companies in Brazil (in the state of Goiás) manage their supply chains?

The general research question was deployed and specific issues have emerged, such as:

- How is demand planning, supply and infrastructure along the SC?
- How is the procurement process done in terms of reliability, quality, cost and time?
- How do pharmaceutical companies manage the production, implementation and infrastructure requirements, in order to attend quality and service regulatory standards?
- What is the delivery process, considering work distribution channels, order management, storage, time to deliver, service completeness, reliability, cost and flexibility?
- How do the revenues occur in the supply chain?

In order to answer the broad research problem, five hypotheses were formulated:

- Hypothesis 1 (Planning): The demand planning, supply and infrastructure along the SC occurs in isolation, with each company planning on its own;
- Hypothesis 2 (Supplying): The supply is made to meet the requisites of reliability, quality, cost and time;
- Hypothesis 3 (Manufacturing): The management and production infrastructure inside the companies meet quality requirements and compliance with regulatory standards;
- Hypothesis 4 (Distribution): The distribution process meets the requisites of deadlines, completeness, reliability, cost and flexibility;
- Hypothesis 5 (Return): The returns of products in the supply chain occur quickly and easily.

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2 Supply chain operations reference model - SCOR

The SCOR model provides the standard language to describe the performance, configuration, activities, practices and workforce assets of the supply chain. The model was developed by the Supply Chain Council as a tool to address, improve, communicate and evaluate the performance of SC. It describes the business activities of the SC in order to meet customer demand, from the simplest to the most complex, covering many different industries and projects (SUPPLY CHAIN COUNCIL, 2012). The technical community of the Supply Chain Council, in order to perpetuate the use of SCOR published ten subsequent versions of the original, updating analysis dimensions related to performance (used to describe the performance of SC), processes (explain how the SC is configured), practices (seen unique ways to configure the SC processes) and people (assessing needs, and availability of skills gaps in the workforce SC). The research was based on the 9.0 version of SCOR model, which has a structure consisting of five categories of processes: planning, procurement, manufacturing, distribution and return. The model encompasses all customer interactions - from order to the payment of the bill, all material transactions - from the first suppliers to the last customers, and all interactions with the marketplace - from prediction of aggregate demand to the fulfillment of each request. The SCOR model was structured in four levels of detailing.

At the first level categories of SCOR processes and competitive performance goals are defined. The processes of planning, procurement, manufacturing, distribution and return allow the model to represent any supply chain. In the Table 1 it is presented the definitions of activities related to the processes of the SCOR model:

Table 1: Activities and processes of the SCOR model

Process	Definition	Activities
Planning	Processes designed to match the demands with the resources and materials available, with plans of supply, production and distribution	Develop guidelines and formulate goals. Integrate best solutions in the areas of inventory, purchasing, production, distribution and return. Align such aspects with financial and marketing plans of the organization
Procurement	Procedures for identifying sources for obtaining materials required for execution of production plans	Schedule inventories and deliveries of products and services that will meet the demands of a company. Monitor supply sources through performance indicators and contract management.
Manufacturing	Manufacturing and assembly processes to produce as demanded by production plans	Schedule and provide production. Convert raw materials, inspecting and packing them in ways that meets the company's consumers
Distribution	Products delivery processes to meet the demands	Managing customer orders, logistics storage, separation, billing, shipping and distribution of products
Return	Processes associated with returning of products that do not meet specifications	Perform reverse logistics of products sold to customers, and returns of materials for use in internal business processes

Source: Supply Chain Council (2012).

Level 2 deals with categories of processes. The five types of processes must be adjusted to the reality of their organizations that adopt the SCOR model, especially regarding to the purpose of production: for storage (Make-to-Stock - MTS), to meet demand (Make-to-Order - MTO), and to meet customized demand (Engineering-to-Order - ETO). At this level of detail of the SCOR model, the categories of processes include planning, preparation and execution, as described in Table 2:

The level 3 deals with the processes decomposition, i.e., the detailed information of the features of the process for each process category de-

fined on level 2. At this level, the elements of the processes, the metrics for measuring the performance of processes, the benchmarking and best practices, and the capabilities of systems (software) to ensure the desired performance are defined. Also, at this level, the companies can adjust their operations strategies.

Table 2: Categories of processes of the SCOR model

Process	Peculiarities
Planning	Balancing aggregate demand and supply. Consider a consistent planning term. Fix occurrences at regular periods. May contribute to the reduction of response time in the SC.
Preparation	Scheduling. Processing the product and / or moving the product to the next process. May contribute to reducing service time of the request.
Execution	Prepares and retains information management or relationships with the planning and execution of reliable processes

Source: Adapted from Stephens (2009).

According to Hammer (2006, p. 82-83), five performance attributes are identified by the SCOR model at this level:

(1) Reliability - the performance of the supply chain to deliver the right product in the right place, at the right time, in appropriate settings and packaging, in the correct quantity, with the correct documentation, to the correct consumer;

(2) Responsiveness - the speed at which a supply chain delivers products to the consumer;

(3) Flexibility - the agility of a supply chain to respond to market changes to gain or maintain competitive advantage;

(4) Costs - costs associated with the operation of the supply chain;

(5) Assets - effectiveness of an organization to managing assets.

Level 4 is designed to implement the practices established to achieve competitive advantage and to adapt to changing business conditions, focusing on the improvement of the actions (PIRES, 2007; RODRIGUES ET AL., 2006, p. 7).

According to Stewart (1997, p. 64), as the changes are unique to each company, the specific elements of this level are not defined within a standard model, and must be revised to the specificities of each organization.

Broadly, to use the SCOR reference model within its limits and scope of work represents an interesting tool and a great step towards systemizing, integrate, communicate and manage the key processes along a supply chain.

3 The brazilian pharmaceutical industry supply chain

Two distinct moments have marked the recent history of the pharmaceutical industry in Brazil: the former was characterized by absolute dominance of large multinational companies and lasted until the end of the 90th decade, and the second is marked by the growth of Brazilian companies of generic drugs that reached sales leadership in less than ten years (MESQUITA & SANTORO, 2004, p. 68).

According to the research conducted by All Consulting (2009) the pharmaceutical industry is going through a time of repositioning throughout its value chain, including its internal structure and business model, investments in research and development, and aspects related to external features, taking into account the greater intervention of regulatory authorities on their products.

The same research also shows that despite the good prospects for the sector, especially related to the current global economic environment, which has impelled companies to seek out low-cost production nations, the pharmaceutical industry in Brazil still has problems which inhibit better re-

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sults, for example, logistical bottlenecks and the high dependence on foreign inputs, since the country does not produce most of them, generating a high trade balance deficit in this economic sector.

The increases in the domestic and international marketplace encourage pharmaceutical companies to intensify their investments in research and development, contributing to the considerable development of the industry in Brazil (ALL CONSULTING, 2009).

According to Caliari & Ruiz (2010), the structure of the Brazilian pharmaceutical industry is characterized by increasing imports with a low growth of exports, acquisition of domestic companies by foreign enterprises, significant increase in prices, deverticalization and productive specialization and, stagnation of domestic production or even contraction of production in some segments.

The pharmaceutical industry in Goiás, according to data released by the Department of Planning of this state (SEPLAN, 2011), has "… the second largest amount of employees in Brazil, with high technology enterprises and production focused on generic drugs. The pharmaceutical cluster located in Anapolis Industrial and Agricultural District is composed by pharmaceutical companies, inputs suppliers, service providers and public and private institutions.

The arrangement of the Brazilian pharmaceutical supply chain, as shown in Figure 1, was shaped by local and international suppliers of inputs, pharmaceutical companies, distributors, pharmacies (or networks), hospitals (public and private), customers and patients.

Brazilian supply chain pharmacies are the main delivering channel of medicines for the population. According to the institute IMS Health, Brazil is the country with the highest proportionate number of pharmacies per capita in the world (FERREIRA, DIVINO and CORREA, 2009).

The main suppliers of the Brazilian pharmaceutical supply chain are mostly located abroad and are responsible for active ingredients. The manufacture is on account of the pharmaceutical companies, which are subjected to stringent quality standards established by ANVISA - National Agency for Sanitary Surveillance (FORTUNA & MESQUITA, 2003). Also according to Fortuna and Mesquita (2003), pharmaceuticals distributors are the main sales channels and deal with nearby 70% of the total volume traded. Other channels of direct sales to pharmacies and hospitals, respectively, represent the volume of 13 % and 17% of the drugs commercialized in the Brazilian market.
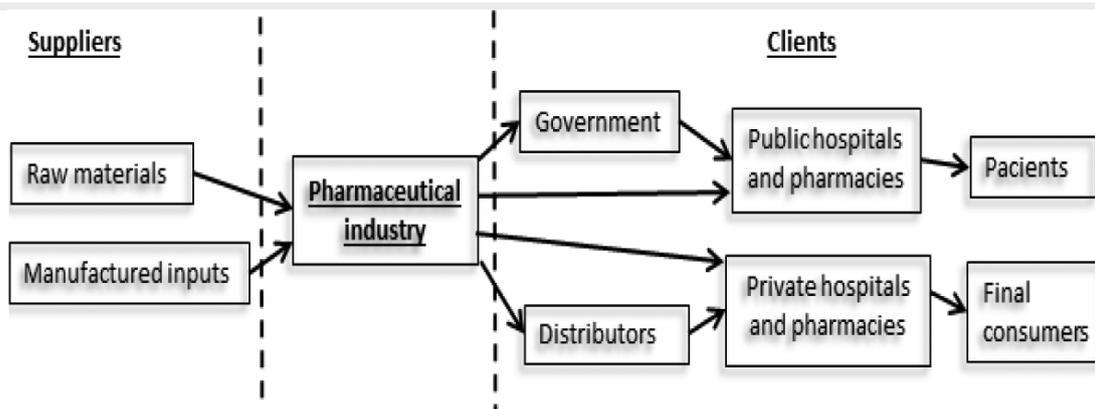

Figure 1: Brazilian pharmaceutical supply chain (adapted from Mesquita & Santoro, 2004)

4   Research design

This research is characterized by a survey quantitative study. According to the American Statistical Association (2009) survey research is the method of data collection from a sample or part of a population, conducted through structured questionnaires in which the size and representativeness of the sample must ensure statistically reliable results. According to Forza (2002), in general, a survey research involves the collection of information from individuals about themselves or about social units to which they belong. Babbie (2009, p. 269) affirms that survey research is probably the best known research method nowadays widely used in the social sciences and, because of its wide acceptance, it has increasingly widespread application in other areas of knowledge. This description refers to the focus of this research, concerning the organizations in the pharmaceutical industry, seeking to obtain scientifically reliable data to allow comparisons and generalizations in light of the theoretical model referenced. According to Babbie (2009, p. 270), the features of scientific survey research consists in being logical, deterministic, general, parsimonious and specific.

According to Forza (2002), survey research design includes all of activities that precede data collection. Also, it is necessary planning all of the future activities in a detailed way and defining documents to keep track of decisions made and activities completed to prevent subsequent problems.

The population of this research was composed of pharmaceutical companies that make up the cluster pharmacist of Goiás, which according to SEPLAN (2011) consisted of 18 industries.

The main research instrument used was a standardized and self-administered questionnaire. According to Malhotra (2009) "… a standardized questionnaire will ensure comparability of data, increase the speed and accuracy of registration and facilitate data processing". The questionnaires were applied former through preliminary contact (in person or by telephone), clarifying the purpose of the research, and later by sending the form by e-mail and making personal contact in cases of necessity of delivery of printed questionnaires.

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4.1   Profile of the respondents

The respondents invited to participate in the research were considered in terms of their position held, age and education. In relation to the position they hold in the company, 20% of respondents were directors, 60% were managers, 10% were supervisors and 10% were coordinators. Regarding their level of education, 30% did not respond, 20% had higher education, 30% were specialist and 20% held a master degree. Regarding the age of the respondents 50% are in the range of up to 30 years old and 50% of 31 to 40 years old. There was no one older than 41.

4.2   Supply Chain Management theoretical model used in this research

Forza (2002) affirms that before starting theory testing survey research, the researcher has to establish a conceptual model. Following this statement, after conducting a bibliographical research relating to the pharmaceutical industry and technical visits to two companies, an operational SCM model was chosen, close to the features found in these preliminary find-

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ings. Therefore, the theoretical model used in the survey research was the SCOR. This model was chosen, in view of its advantages that, according to Stewart (1997, p. 63) are:

- - Quick modelling and understanding of SC;
- - Easy configuration of the internal and external company´s SC, illustrating the current configuration and the ideal situation;
- - Better evaluation, comparison, and more effective communication of business processes;
- - Use of benchmarking data and best practices to prioritize activities and quantify the potential benefits;
- - Identifying of software that is better adapted to the specific needs of processes.

According to Ribeiro (2003), the SCOR model was developed in this quest "... of the standards-setting processes, common metrics and presentation of best practices, to enable and encourage continuous improvement in the supply chain". The processes are, as already discussed, planning, supplying, manufacturing, delivering and returning (SUPPLY CHAIN COUNCIL, 2012). Activities that compose these processes are specified in Table 3.

Table 3: Description of the SCOR model macro processes

Process	Definitions
Planning	Permeates all the others processes and is considered the development of guidelines to ensure the availability of resources
Supplying	Schedule deliveries, receive, verify, and transfer payment
Manufacturing	Execution of production, availability of necessary inputs, production, assembly and packaging
Delivering	Requesting process, setting delivery, transportation planning among others
Returning	Return shipping and return of materials and products that do not meet specifications

Source: Adapted from Supply Chain Council (2012).

5 Presentations and analysis of data

Data collection has embraced the following procedures: preliminary verbal contact, in person or by telephone, with 18 pharmaceutical companies, with exposition of the purpose and relevance of research; sending of a questionnaire via e-mail or in person; after 8 days (waiting for return), respondents who hadn´t answered, received the questionnaires for a second time, reinforcing the importance of participation to ensure the representativeness of the population.

According to Babbie (2009, p. 253), while the literature shows extensive acceptable rates of response according to the type of survey, there are some basic rules: a response rate of 50% is generally considered adequate, 60% is considered good and 70% is very good. The return rate for this survey was 56%, therefore, it is considered appropriate. Eighteen pharmaceutical companies that represent the population of interest were invited to the research, and ten answered the questionnaires. Results of the survey were analyzed using descriptive statistics, since it consists in a method that provides quantitative descriptions so manageable (BABBIE, 2009, p. 246).

5.1 Companies Profile

Five parameters were considered in the survey for description of profiles of the pharmaceutical companies studied: annual sales, number of employees, product portfolio, supply chain configuration and types of production system.

It was found that the yearly budget of the companies was as follows: 10% made up to one million dollars, 10% between 5 and 10 million dollars, 10% between 10 to 100 million dollars and 30% made over 100 million dollars a year. There was no billing company in the range from 1 to 5 million.

Regarding the number of employees, it was observed that among the companies: 20% of them had up to 50 employees, 10% had from 51 to 150 employees, 30% had from 151 to 500 employees, 40% had from 501 to 5000 employees and no company had over 5000 employees.

It was found that 90% of the companies were producing solid drugs, 60% of them produced semisolid drugs, 80% were producing liquid drugs, 40% produced injectable drugs and 20% were producing other types of products such as aerosols, lotions and antibiotics.

Regarding the arrangement of the supply chain three different configurations were detected as shown in Figure 2 The setting of type 1 was represented by the supply chain of 6 companies, the type 2 was presented in 3 and the type 1 was presented in just one.

Regarding the industries types of production system it was found that 80% of them were working with pushing system, 10% of them were using the pulled system and 10% had both production systems. Also 80% of the companies studied produced for inventory, 10% produced based on order and 10% produced based both on custom order and order.

5.2 SCOR Model Processes Analysis

Five processes were analyzed as follows:

5.2.1 Planning Process

In the analysis of data relevant to the planning process, 100% of the companies reported that to accomplish it, they had considered some kind of structured and systematized information on demand; 80% considered information on pre-
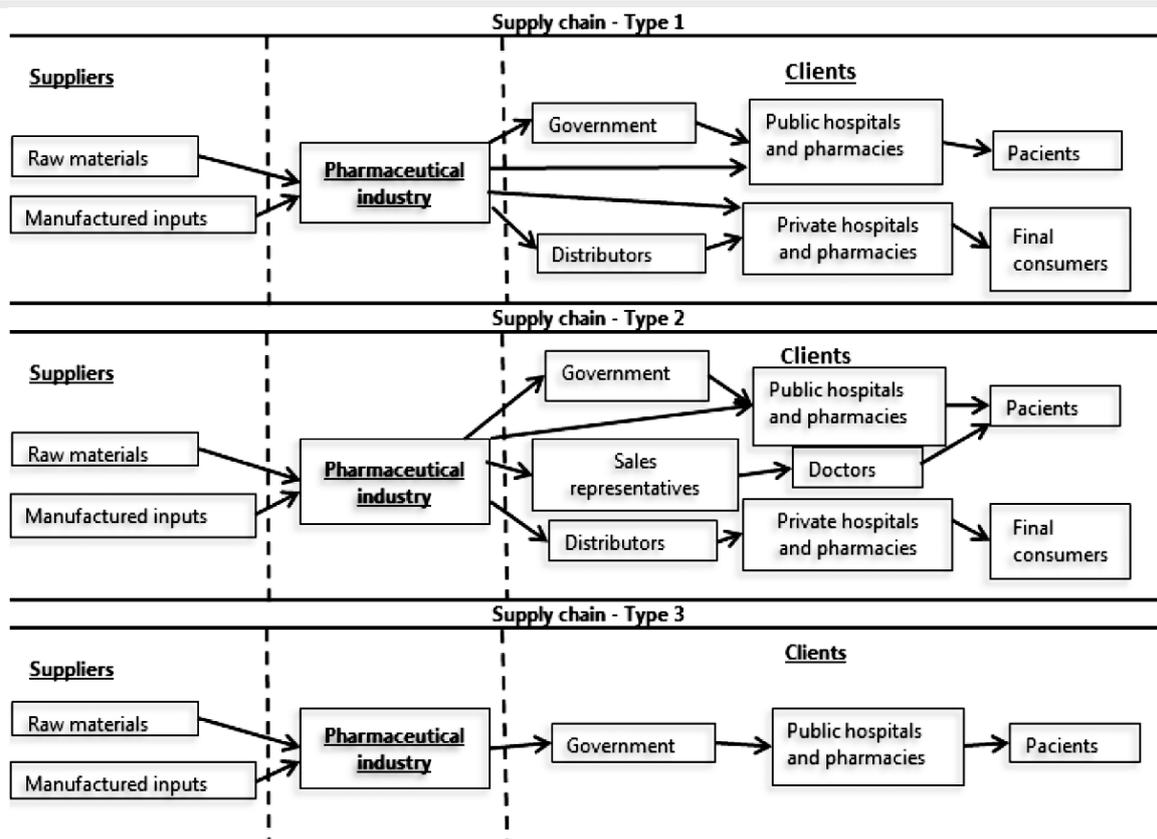

Figure 2: Configuration of the supply chain of the companies studied

vious sales; 70% considered the seasonality of the product; 60% worked with current orders, and 40% used some other type of information (sales forecasting, marketing expansion, etc.).

Regarding the periodicity of demand forecasts, 20% of the industries performed with fortnightly frequencies, 50% monthly and 10% quarterly. The time horizon of the forecast was monthly in 20% of the companies studied, 30% of them worked with quarterly horizon, 20% worked with semester, 10% worked for 5 months. All the companies made annual forecast.

To perform the calculation of demand forecasts 50% of the companies use some mathematical method, and they do it by using some software.

One of the most important topics of planning is defining, sharing and aligning sales goals regarding production along the supply chain. This topic is especially important to evaluate the hypothesis of this research related to planning. It was found that 90% of the companies have defined their sales goals aligned with internal production, but only 30% disclose it to all the company's employees, in 30% of them just the high dome have knowledge about the plans and in 40% of the companies studied only the production and marketing departments know of them.

It was found that 70 % of the companies don´t allow the participation and access to their knowledge about targets by their partners (chain links), 20% share with its suppliers and customers and 10% share only with their key suppliers.

When companies were asked about inventory planning, the following answers were obtained: to determine the amount of finished products in stock 10% of the companies did sales forecasts in relation to production, 10% determined them by the difference between inventory and sales average, 30% used the minimum stock calculation, 20% used software (ERP and MRP), 10% did not store anything and 20% did not answer the ques-

tion; and to determine the amount of supplies in stock 10% of the companies used sales forecasts in relation to production, 10% determined them by the difference between inventory and consumption, 40% used the calculation of the minimum inventory, 20% used software (ERP and MRP) and 20% did not answer the question.

5.2.2 Procurement Process

Regarding the degree of dependence (bargaining power in negotiating) with suppliers it was found that 10% of companies had very high dependency, 40% had high dependency and 50% had moderate dependence.

About transparency of negotiations with suppliers it was discovered that 20% of the companies used to deal with them in a very high level, 70% had a level of transparency considered moderated and 10% had high level of transparency.

In sharing of information dimension 20% of the companies have answered that sharing was very high, 40% of the companies answered that it was high, in 30% it was moderate, and in 10% it was low.

For the variable quality of the delivered products the following answers were obtained: 20% of the companies stated that the quality was very high, 60% was high and 20% was moderate.

Regarding the timeliness of delivery by suppliers, the following performance was found: 50% of industries reported that delivery times were mostly met by suppliers, and 50% partially comply.

Regarding the comprehensiveness of the lots delivered by suppliers, 80% of industries reported that their suppliers always deliver lots completely, and 20% reported that they deliver incompletely.

The attributes used to describe the current transportation system used by the companies were analyzed in light of the cost and reliability of deliveries. It was found that 50% of the industries studied reported that the cost was high, 40% said it was

moderate, and 10% affirmed it was low. None of them showed the cost as too high or too low.

The transportation system evaluated on the attribute of reliability was considered by 30% of industries with very high reliability, 20% of them considered it high, 40% related it was moderate, 10% affirmed it was low and none were assessed as very low.

5.2.3 Manufacturing Process

In relation to the manufacturing process issues such as alignment between planning and production scheduling, efficient management of productive resources, process flexibility in the face of contingencies, scraps, set-ups, service quality and regulatory standards in the industry were evaluated.

It was found that the planning process is done without participation of partners. Information was gathered on the existence of timing and balance between what was planned and what was scheduled for production. The findings showed that for 20% of the industries, the timing and balancing of production is very high, 50% is high, 30% is moderate, and there were no records of businesses with low or very low level of balancing.

On the issue of the efficiency in management of productive resources 30% of the industries reported it to be very high, 20% high, 50% moderate and no company pointed performance as being low or very low.

The analysis of the flexibility in the production process to meet contingency changes found that 10% of the industries reported it to be very high, 40% moderate and 50% high.

For exchange losses (scraps) during production, 40% of the companies reported that they are moderate and 60 % informed they are low; no company pointed it out as being too high, too low or high.

On the subject of the setup time to exchange (tool, software, equipment) of a running process by booting the next production process, results showed that 10% consider it very high, 50% moderate and 20% consider low. No company pointed it out as high or too low.

On the issue of quality of production processes, 70% of the industries related as very high and 30% high. No one answered moderate, low or very low.

Finally, it was evaluated the compliance with regulatory requirements, in which 80% of the industries considered very high, 20% high performance and no company pointed it out as moderate, low or very low.

5.2.4 Distribution Process

Concerning the process of distribution the subjects evaluated were deadline, completeness, reliability, damages in the cargo, cost and flexibility.

In the dimension of compliance deadlines for delivery by the pharmaceutical industry, 80% responded that they are mostly accomplished and 20% are partially completed, and none responded that they are concluded in their minority.

In relation to the completeness of the loads delivered by pharmaceutical companies, 50% reported that they always completely deliver and 50% partially delivered and no one informed never delivering.

On the issue of cargo damage, 30% of industries reported moderate breakdown occurrences, 50% informed low damages and 20% too low. No answers pointed high or very high.

About the flexibility in the delivery system to meet demands contingency, 10% of the companies showed that it was very high, 80% related it was high and 10% pointed it out as low. No one of the companies indicated moderate to very low.

It was also evaluated the property of the transportation system and 40% of industries

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reported that they partially outsource deliveries and 60% outsource completely. No company pointed out that it had its own vehicles to transport their goods.

On the issue of transportation costs, 10% of the industries considered it as too high, 50% high, 30% moderate, 10% low and none considered it as very low cost.

And finally, this process of distribution assessed the reliability of delivery, where 20% consider it very high, 50% high, 30% moderate and none considered it low or very low.

5.2.5 Process Return

In the SCOR model the analysis of return investigated if it was occurring rapidly and facilitated. The reusing of waste, environmental preservation, returning items and programs for assessing levels of customer satisfaction (feedbacks) was evaluated.

On the reuse of waste, 80% of industries reported the existence of recycling pro-grams and 20% did not. Most industries related that they send products for recycling. Some have a water reuse system and only incinerate waste that is not suitable for recycling.

In relation to environmental preservation programs, 60% reported owning, 20% didn´t own and 20% didn´t report anything. The preservation programs most mentioned were: recycling, effluent treatment plants, maintenance of environmental reserves, reforestation and wastewater treatment.

In assessing the return of the items the subjects considered were return of sales and return of packages. About easiness of return sales, 40% identified it as high and 60% as moderate, and none pointed it out as too high, low or very low. On the issue of return of packaging only 60% of companies responded no return, and 20% indicated that the ease of the process of return is high,

20% moderate and 20% too low, none showed very high and low.

On the existence of programs to assess the level of consumer satisfaction, 50% indicated that they have one and 50% do not. Among those companies that reported the existence of programs to evaluate the level of customer satisfaction, sources such as after-sales, telemarketing or SAC representatives and reports were identified.

6   Concluding remarks

This research aimed to diagnose the pharmaceutical industry of Brazil in Goiás, considering the theoretical assumptions of the SCOR model. The competition was observed between companies instead of their supply chains. Very little integration occurred between the links (partners) inside the supply chain. The companies had a great concern about the quality of their products, because it was a compulsory request, and they were much more concerned about questions of internal improvements, than improving the performance of the supply chain as a whole. Finally, this diagnosis showed a gap between the supply chain management model practiced by the pharmaceutical industry in Brazil and the SCOR reference model. This result must be considered as an alert about how much the Brazilian pharmaceutical industry can be improved to become more competitive globally.

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