

Supply management and improvement opportunities: a case study at a medical & dental equipment manufacturing company

Gestão de suprimentos e oportunidades de melhoria: estudo de caso em uma empresa fabricante de equipamentos médico-odontológicos

Sergio Alexandre Baptista¹
Edemilson Nogueira¹
Alceu Gomes Alves Filho¹

Abstract: Supply management is recognized as an area of importance to a company's success, as well-managed supply operations can significantly contribute to the generation of profits. This article aims to analyze the supply management of a medical-dental equipment manufacturing company, and to propose, based on the literature, possible improvements in its management policies and practices. To achieve this goal, we performed a case study at a large company of the sector, using interviews, document analysis, and direct observation for data collection. The comparison of the company's practices with those found in the literature substantiated the proposal of a new way of segmenting the company's suppliers, in order to guide the formulation of policies and practices specific and appropriate to each segment.

Keywords: Supply management; Medical-dental equipment industry; Improvement proposals.

Resumo: A gestão de suprimentos é reconhecida como uma área que tem impacto significativo no sucesso da empresa, pois operações de suprimentos bem gerenciadas podem contribuir significativamente para a geração de lucros. Este trabalho tem como objetivo analisar a gestão de suprimentos de uma empresa que fabrica equipamentos médico-odontológicos e propor, com base na literatura, possíveis melhorias em suas políticas e práticas de gestão. Para atingir esse objetivo, realizou-se um estudo de caso em uma grande empresa do setor, utilizando entrevistas, análise de documentos e observação direta para coleta de dados. A comparação das práticas da empresa com a literatura de gestão de suprimentos considerada neste trabalho permitiu a proposição de uma nova maneira de segmentar os fornecedores da empresa que pode orientar a formulação de políticas e práticas específicas e adequadas a cada segmento.

Palavras-chave: Gestão de suprimentos; Indústria de equipamentos médico-odontológicos; Propostas de melhoria.

1 Introduction

The purchasing and supply management area has been recognized for some time as an important competitive resource, since direct materials and services represent about 60% of the total costs for a manufacturing company (Baily et al., 2000; Krause et al., 2001). For this reason, the purchasing function has played a central role in companies' operations strategy (Krause et al., 2001; Prahinski & Benton, 2004; Yang et al., 2013; Rebolledo & Jobin, 2013), contributing to reduce transaction costs and increase final profit margins.

It can thus be assumed that effective and efficient practices in supply management, which entail cost reduction, quality improvement, and greater agility in deliveries, can bring significant benefits to companies. According to Slack et al. (2002), such benefits include the acquisition of products and services of the right quality, and delivery at the right time, at the right quantity and price. Hartmann et al. (2012), in a survey involving 306 companies from eight industrial sectors, indicate that the implementation of advanced practices in the area called Purchasing

¹Universidade Federal de São Carlos – UFSCar, Rodovia Washington Luís, Km 235, CEP 13565-905, São Carlos, SP, Brasil, e-mail: serpira@hotmail.com; edn@dep.ufscar.br; alceu@power.ufscar.br

Received Dec. 06, 2017 - Accepted May 18, 2018

Financial support: None.

and Supply Management (PSM) contributed to the improvement of the results of the area itself, and indirectly, to increased success of the companies.

Spina et al. (2013) argue that there is little doubt about the increased relevance of the PSM area in companies in many industries, including manufacturing and services. The intensification of outsourcing, globalization, and e-commerce has generated rapid changes in the external and internal environments of organizations, confronting PSM professionals with new challenges and making this function more strategic and complex. PSM is important in industry in general, and in the medical and dental industry specifically.

The medical dental technology sector in Brazil has been little studied, despite being an important production segment, while other industrial segments such as automotive and white goods have had some of their supply chains analyzed (Martins, 1999; Salerno et al., 2003; Di Serio et al., 2007; Calife et al., 2010; Cerra et al., 2014). The Brazilian medical-dental industry has characteristics that differentiate it to some extent from the rest of the goods-producing field, according to data from the Brazilian Association of the Medical, Dental, Hospital and Laboratory Equipment Industry (ABIMO, 2014). Some notable characteristics are:

- The Brazilian market is dominated by companies with national capital, accounting for about 65% of the market;
- The industry's production is enough to meet 80% of the national market;
- The industry has as its main customer base a specific segment, the estimated 200,000 dental surgeons practicing in Brazil.

This paper analyzes the supply management of a company that manufactures medical-dental equipment, with the purpose of proposing, based on the related literature, possible improvements in its management policies and practices.

This work is structured in 5 sections. Section 2 reviews the literature about some of the key concepts and practices of supply management. Section 3 presents the research method used in this work. Section 4 describes and analyzes the supply management practices that have been adopted by a medical-dental equipment assembler, also characterizing the activities performed to manage relationships with suppliers. Next, some proposals for improvements to the company's current practices are presented and justified. Finally, in the final considerations, the main conclusions of this work

are summarized, some limitations of the research are noted, and possible future studies are proposed.

2 Supply management

The process of acquiring goods and services in manufacturing firms is considered important for a number of reasons—as will become clear—but its role in reducing total company costs should be highlighted first. According to Lambert (2008), the cost of materials accounts for approximately 53% of sales income, across all types of manufacturing companies in the United States. Thus, any improvement promoted in the acquisition process may imply significant cost reduction.

Baily et al. (2000) state that the purchasing field went through a process of evolution, moving beyond the role of simply converting requests into supplies. The field has achieved a strategic position within companies, involving the development of partnerships and alliances with suppliers; improvement of profile and technical preparation of the supplier base; and a number of improvements in the supply chain. During this process, many companies changed the name of the “Purchasing” function to “Supply Management”.

2.1 Activities of the supply management function

The supply management function, in this scenario where it is expanded and more highly valued, starts to deal with the interface between the operation (production) and its supply markets (Slack et al., 2009). Ballou (2006) indicates that activities associated with supplies include: selecting and qualifying suppliers; evaluating the performance of suppliers; negotiating contracts; comparing prices, quality, and services; researching goods and services; scheduling purchases; establishing the terms of sales; evaluating the value received; measuring the quality received (when it is not included under the quality control responsibilities); predicting changes in prices, services, and sometimes availability; and specifying the form in which the products are to be received. This set of activities highlights the importance of supply management for the good performance of operations (production), and the organization as a whole.

In this sense, Watts et al. (1995) consider that the central role of the purchasing (supply) area is to support the production and operation activities with an uninterrupted flow of materials and services, so therefore the purchasing and production strategies must be consistent with each other and capable of contributing to the company's competitive strategy.

Skinner (1969), in his pioneering work on production strategy, points out that a company's production

system must be designed to accomplish the tasks demanded by the strategic plan. Hence, integration between competitive and production strategies is accomplished by establishing competitive priorities or production objectives.

Since PSM and production functions must be consistent, and should support the company's competitive strategy, the supply area must also be guided by the competitive priorities determined. Krause et al. (2001) propose a way to evaluate the competitive priorities for the purchasing area, based on the strategic relevance of the purchasing function and on the importance of supplier selection and retention tasks. According to the authors, the operationalization of this assessment can be accomplished by measuring the priorities of quality, delivery, costs, and innovation as follows:

- **Quality** - measured in terms of suppliers' ability to provide reliable, durable supplies that comply with the purchasing company's specifications;
- **Delivery** - can be measured in the following dimensions: supplier's ability to fulfill an order; vendor's delivery times; time needed to develop a new component; ability to act on JIT (Just in Time); and ability to deliver on scheduled dates and locations;
- **Cost** - assessment based on total cost, and vendor's ability and willingness to share cost data
- **Flexibility** - can be measured from the vendor's ability and willingness to make changes in the volume and variety of items contained in orders;
- **Innovation** - evaluates the supplier's level of technological capacity, willingness to share technological information, and ability to develop new products and promote changes in existing ones.

If the PSM team can achieve priorities or objectives measured against established improvement values and defined deadlines, they can confirm the relevance of the area to the business as a whole.

In addition to guiding its activities to reach strategic objectives, the adequate choice of governance structures in relation to suppliers is of paramount importance for the performance of the supply area.

2.2 Governance structures in supply management

According to Gereffi et al. (2005), a theory of value chain governance can be constructed based on three factors:

- a) The complexity of information and the transfer of knowledge to maintain a specific transaction, particularly with respect to product and process specifications;
- b) The extent to which such information and knowledge can be encoded, and subsequently transmitted efficiently, without specific transaction investments between the parties involved; and
- c) The capabilities of current and potential suppliers to meet the requirements of the transaction.

Gereffi et al. (2005) also assert that the three factors combined, each classified either as high or low, define the five types of governance structure, as presented in Table 1. Three of the possible combinations were discarded by the authors because they were practically unfeasible.

In "market" governance, transactions are easily coded, product specifications are simple, and suppliers have the ability to produce products, and establish specifications and prices, without participation from buyers: "Because the complexity of the information exchanged is relatively low, transactions can be governed with little explicit coordination [...]" (Gereffi et al., 2005, p. 86).

The "modular" type can occur when the ability to encode specifications extends to complex products. This can happen when the product architecture is modular and there are few variations of the components:

Because of codification, complex information can be exchanged with little explicit coordination, and so, like simple market exchange, the cost of switching to new partners remains low (Gereffi et al., 2005, p. 86).

The "relational" governance type is most appropriate when product specifications cannot be codified, transactions are complex, and vendor skills are high. The exchange of complex and unspoken information tends to occur through personal interactions between buyers and suppliers, and is governed by high levels of explicit coordination, which makes the cost of switching to new partners high.

In a situation where the codifying capacity and complexity of product specifications are high, but supplier capabilities are low, value chain governance will tend to be "captive". This is because the low capacity of the suppliers requires frequent interventions and a high level of control by the purchasing company.

Finally, the "hierarchy" governance type occurs when product specifications cannot be codified, products are complex, and competent suppliers are not found. This situation induces companies to develop and manufacture products internally.

Table 1. Key determinants of global value chain governance.

Governance type	Complexity of transactions	Ability to codify transactions	Capabilities in the supply-base	Degree of explicit coordination and power asymmetry
Market	Low	High	High	LOW
Modular	High	High	High	
Relational	High	Low	High	
Captive	High	High	Low	
Hierarchy	High	Low	Low	

Source: Gereffi et al. (2005).

Ashenbaum et al. (2009) found that surveys of buyer-supplier relationships most often focus on trust and commitment to the relationship. The authors add that the research models in this area could be improved by considering the complexity of the transaction or perceptions about the capabilities of the suppliers as moderating or contextual variables—as was partially contemplated by the proposition of Gereffi et al. (2005).

When considering the governance structure of the value chain, managers have an initial way of assessing the company’s supply network, and if desired, of specifying the configuration of governance types and supplier relationships to be adopted. In different sectors and at different times, this knowledge can be useful for making decisions about the supply structure.

2.3 Supplier segmentation

According to Lambert & Schwieterman (2012), two widely used criteria for segmenting suppliers in manufacturing companies are the complexity of the article, and the volume of expenses with products purchased from suppliers. Items identified as being of low complexity and low spending volume are considered “routine,” and those generating high volumes of spending but are not complex or strategic to the business are known as “leverage”. The objectives for these types entail price negotiation based on minimizing total costs and service improvement by reducing delivery time.

Bottleneck items are those where manufacturing companies have low spending volumes, but products are considered complex, whereas “strategic” items are those that are both high in complexity and expenditure in the annual budget. The suppliers of these two types of products should be viewed as potential partners in development (Lambert et al., 2008).

Lambert (2008) also posited that once the key suppliers to the business are identified, companies and suppliers can work on revenue raising and

cost reduction initiatives to improve the financial performance of both companies.

2.4 Supply management strategies, policies, and plans

In planning and structuring the GSB area, it is still necessary to address some strategic decisions. According to Martins (1999), the term “strategy” refers to a pattern of decisions made by the company, including:

- The determination and communication of objectives and targets;
- The main policies and plans to achieve these goals;
- The definition of the scope of business that the company intends to achieve; and
- The benefits and results provided to shareholders, customers, and the community.

Martins (1999) also stresses that the decision to buy should be considered as a way to increase the company’s competence, and consequently enhance its competitive capacity. Supply management in this situation should develop its own strategic priorities, taking into account the company’s competitive and production strategies, and seeking to ensure that suppliers have or develop sufficient capacity to contribute to the achievement of priorities for cost, quality, delivery time, flexibility, or innovation.

Martins (1999) adds that once the supply strategy and priorities are defined, the next step in purchasing management is to formulate the policies and actions that will underpin the strategy. Here we discuss some of the main sets of decisions, related to: vertical integration level; negotiation plans; definition of the number of supply sources (one or two); local or international source definition; specification changes

in conjunction with engineering; and rationalization of the supplier base. These sets are presented next.

2.4.1 Vertical integration

Vertical integration occurs when a company decides to produce a product, process, or service internally, no longer purchasing it from an external supplier (Balakrishnan & Cheng, 2005).

For Slack et al. (2002), the main criterion used for the decision to make or buy is financial. If a company can produce with lower costs and better quality than those offered on the market, it is likely to do so.

Martins & Alt (2001) cite some advantages of de-verticalization, such as focusing on the main business, reducing investment costs in industrial facilities, and flexibility in changing production volume. The potential drawbacks of de-verticalization would be the loss of technological control, greater exposure to market changes, and greater interdependence among firms in the production chain.

Gerbl et al. (2016) add that the decision about de-verticalization involves other factors besides labor and infrastructure costs, such as the organization's competitive strength in the process under consideration; the outsourcing potential of transactions associated with each location option of the unit; and the organization's own experience with outsourcing.

2.4.2 Negotiation plans

According to Lewicki et al. (2000), the negotiation situation arises when there is a dispute, disagreement, or conflict between two groups, in this case between companies in the supply chain. The negotiation literature presents two approaches that can be used, distributive and integrative.

The distributive bargaining strategy is used by negotiators who believe that they and their counterparts have fundamentally opposing interests. As a result, negotiations can essentially be described as win-lose situations, where one party would try to argue intensively in order to convince the other that, for example, it should reduce prices or accept certain conditions (Lewicki et al., 2000).

Integrative negotiations seek to reconcile the divergent interests of the parties and provide both with joint benefits from the specific negotiation. As such, the approach values "win-win" relationships. The integrative approach has been adopted in strategic partnerships, although empirical evidence in its favor is still virtually nonexistent (Lewicki et al., 2000).

2.4.3 Single source or multiple sourcing

Quayle (2001) found that the buyer's decision about single or multiple sourcing depends on the analysis of several factors, such as economy, geography, organizational politics, culture, quality and trust, protection of the source of supply, competition for prices, and the buyer's inertia.

Quayle (2001) developed a model for decision-making on a single or multiple source of supply. He combines, in three groups, eight variables identified in the literature that can affect the decision about the form of supply. In the first group, called "contingencies", the following variables are combined: individuals, products, organization, and markets. In the second group are the "criteria": economic, power, risk, and social. The third group, called "sourcing form", includes single or multiple source. Hence, the contingencies influence the criteria, which in turn influence the forms of supply. Figure 1 illustrates the proposed model.

2.4.4 Local or international source

According to Slack et al. (2009), a recent change related to the supply chain has been the expansion of the proportion of products and (occasionally) of services purchased outside the country. These authors point out several reasons for this:

- Trade bloc formation in different parts of the world, which has had the effect of lowering tariff barriers, at least within these blocs;
- Transport infrastructures, which are considerably more sophisticated and cheaper than before; and
- Fierce global competition, which has forced companies to reduce their overall costs.

However, Slack et al. (2009) also see problems with global purchases, and caution that the risks of increasing complexity and distance need to be carefully managed.

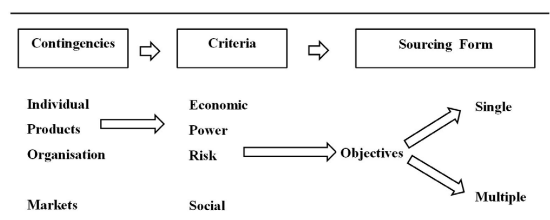


Figure 1. Analytical framework about single-source or multiple-source decision. Source: Adapted from Quayle (2001).

Sourcing products from China and other low-cost countries is common among companies nowadays. The desired benefits of this move include greater efficiency, greater flexibility, reduced investments, and market access and lower costs (Fredriksson & Jonsson (2009).

2.4.5 Changing products specifications

According to Arthur D. Little (2008), cost and quality improvements in the production system can be achieved by continually focusing on identified key customer, design, production, and supply issues. This approach can result in improvements of 16% in product performance, on average, and 10% in complexity (quotient between quantity and variety of parts).

Arthur D. Little (2008) argues that excessive product costs typically result from a failure to consider the implications of product design for manufacturing, assembly, and after-sales service. These failures include:

- Excessive functionality for products and variants, for which customers are not willing to pay (over-engineered products);
- Invalid specifications held over from prior or non-relevant products;
- Product engineering that fails to consider manufacturing and assembly issues; and
- Lack of standardization of purchased parts, leading to high acquisition costs.

Arthur D. Little (2008) presents a methodology for optimization of specifications called “Design to Customer Value”, shown in Figure 2, which incorporates the above-mentioned strategies and covers a series of activities, such as the analysis of market and customer requirements, product cost and technical analysis, and the development of new product concepts.

2.4.6 Supplier base rationalization

Yang et al. (2013) assert that determining the appropriate number of suppliers is the main impetus to rationalize the supply base. Such a decision can strengthen effective supplier selection, volume consolidation, and the assembly of parts (modularization), which in turn contribute to cost reduction and quality improvement.

Yang et al. (2013) suggest that commercial procurement software (e-procurement) can be a tool to rationalize the supplier base, since it allows the execution of electronic purchases that include a greater quantity and quality of information. This reduces the uncertainty in the supply activities, and promotes faster processing in procurement activities.

This section discussed some of the main topics related to supply management, such as roles and activities, governance structure, supplier segmentation and strategies, policies, and work plans. The study of these topics, all considered important in the literature, allowed the survey of some variables for a structured analysis of a company’s supply management, and consequently, the proposal of improvements when possible. The themes and variables mentioned in the literature review are presented schematically in

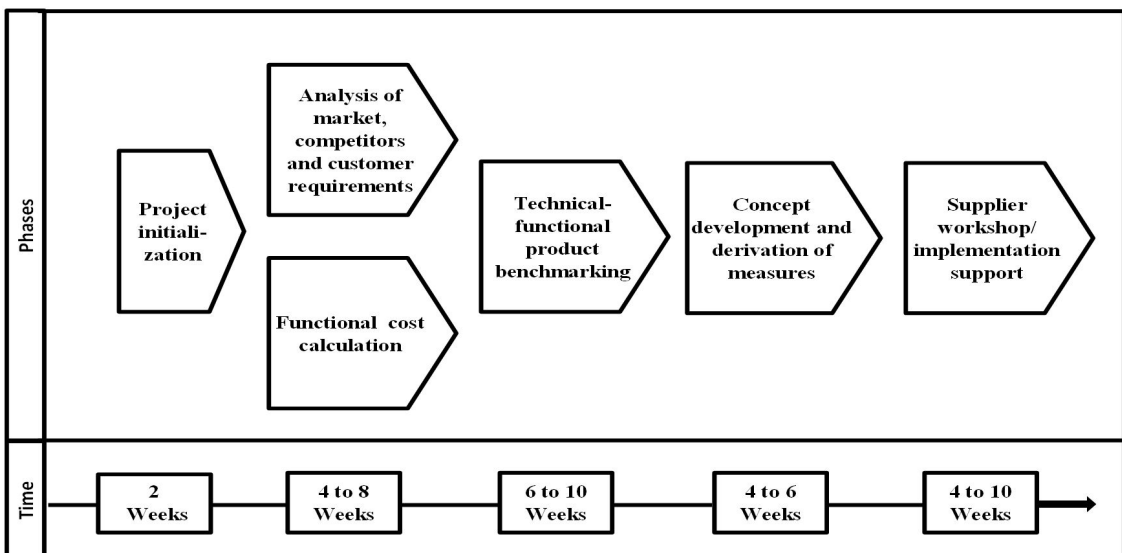


Figure 2. Main activities structured over time. Source: Adapted from Arthur D. Little (2008).

Table 2: they guided the field research that will be reported in section 4. The next section addresses the methodological aspects considered in the field research: a case study of a company in the medical-dental equipment sector.

3 Research methodology

The present study developed an exploratory research, since the objective is to comprehensively analyze the supply management of a medical-dental equipment assembler, aiming to propose improvement in the practices used, and thereby provide an improvement in the performance of this important function in the company studied.

To this end, a qualitative approach was used, since the study aims to provide a deep understanding of the company's supply management. This required that one of the researchers be attached to the company for prolonged periods, and meet frequently with company professionals. The case study research method was used.

The choice of the company for the case study, here referred to as Alpha, was due to its importance in the Brazilian medical-dental technology industry, since it is currently the sales leader in the national market.

In order to obtain information and conduct interviews, managers and supply coordinators of the device assembling company were selected according to the nature of the information sought by the researchers, and also because these individuals are directly responsible for the decisions that occur in the area of supplies.

Data collection was performed using three sources of evidence: interviews, document analysis, and direct observation. The interviews, the main source of data collection, were carried out through the application of a script containing open-ended questions. The document analysis was done through consultations in management reports and in the company's information system. Finally, direct observation was carried out through visits to the factory. Here researchers observed the introduction of new machines acquired for the internalization of manufacturing processes; and the most recent examples of cost reduction projects, through the development of new sources of supply, alteration of items with the support of engineering, and the acquisition of items in the foreign market.

This approach made it possible to understand the supply management of the manufacturer studied, and then propose improvements to the practices in place.

4 Alpha's supply management

Alpha is a large private national company operating throughout Brazil and abroad. It manufactures and distributes, directly or through its dealers, a wide portfolio of equipment under different brands, with the main ones being well recognized in the market.

The company offers the market a complete line of medical and dental equipment and is concerned with leading in the innovations of its segment, offering differentiated products with superior quality. In addition, the company also stands out for its agility in launching new products that meet the needs of consumers.

Table 2. Synthesis of Section 2.

SUPPLY MANAGEMENT	
Activities	Purchase of products and services
Competitive production priorities	Cost
	Quality
	Delivery
	Flexibility
	Innovation
Governance type	Market
	Modular
	Relational
	Captive
Supply segmentation	Hierarchical
	Supplier segmentation criteria
Strategies, policies, and plans	Vertical integration
	Negotiation
	Single source x Multiple sources
	Local x International sources
	Joint engineering and supply specifications changes
	Rationalization of the supply base

The Brazilian market is dominated by five major companies, including Alpha, which together account for more than 80% of the sector's sales. Small businesses also participate in the market, in the most popular product segments. Alpha's main market is the national one, where 85-90% of its total production is directed. Defining export products, models, and volumes is a highly complex strategic issue for Alpha, involving cost analyses, exchange contracts, geographical strategies, and forms of differentiation.

The Alpha downstream supply chain is made up of exclusive regional dealers and sales subsidiaries of the company itself, as well as the final consumer. Upstream, the main focus of this work, the chain is formed mainly by two types of suppliers: suppliers of raw material and suppliers of components.

Alpha's direct material suppliers base is composed of approximately 540 companies, of which 13 are international. Alpha has a highly diversified base of suppliers, which account for, in monetary terms, 36% of the company's total annual sales volume. These numbers highlight the relevance of good supply management and continuous efforts to improve the company studied.

4.1 Supply function activities at Alpha

The activities associated with supply management, divided among the three coordinates of supplies of Alpha, according to Ballou's classification (2006), are distributed as follows:

- a) **“Strategic Supply” Coordination:** to select suppliers; classify supplier performance; negotiate contracts; compare prices, quality, and services; research products and services; and forecast prices and services;
- b) **“Supplier Management” Coordination:** to determine when to buy; set sales deadlines; and evaluate the value received;
- c) **“Supply Quality” Coordination:** to qualify suppliers; evaluate the value received; measure the quality of the input (if this does not fall under the responsibility of the quality control sector); and specify the way in which the products will be received.

Alpha's demand forecasting activities are the responsibility of the production planning and control (PPC) coordination, which in turn is subordinated to operations management.

4.2 Strategic Objectives of supply management at Alpha

The strategic objectives of the activities associated with supply management—considered in this work as competitive priorities—divided among Alpha's three types of supply coordination, are distributed as detailed below:

- a) **“Strategic Supply Coordination”:**
 - **Cost:** the effort to reduce the prices of purchased items, because the greater the proportion of material costs in relation to total costs, the greater the impact of material cost reduction on profitability. An important job for Alpha's supply team, with an impact on company costs, is the average payment term for suppliers. The team works to extend the payment term of the entire supply base, and hence improve the company's operating cycle, by balancing the amounts of the accounts payable and accounts receivable areas each month.
- b) **“Supplier Management” Coordination:**
 - **Delivery:** efforts to ensure that suppliers deliver the articles on the date requested in the order. In addition to establishing the supply period, suppliers are informed about Alpha's current and future needs, in order to facilitate their scheduling. Delays in deliveries can lead to sales losses, production losses, and customer dissatisfaction.
- c) **“Supplier Quality” Coordination:**
 - **Quality:** the joint effort with the supplier to improve the quality of components, ensuring that the material purchased meets the specifications and is not rejected at the receipt inspection. In this way, suppliers must be partners in the quality management process.

The objectives of “flexibility” and “innovation” are approached informally at Alpha, but their importance is felt in the daily operations with suppliers.

Flexibility refers to the supplier's ability to make changes to orders in terms of volume and variety, aiming at the adjustments necessary due to fluctuations in demand for various products. If suppliers do not develop capabilities to satisfactorily deal with contingencies, they will receive a negative rating from Alpha.

Innovation, which considers the supplier's level of technological capability, its interest in sharing

technological information, and its ability to design new products or make changes to existing products, is an important factor in supplier selection and evaluation, since Alpha values those that keep in touch with new developments. Alpha's quantity-related objectives, as cited by Martins (1999), are the responsibility of production planning and control coordination (PPC), and imply considering the trade-off between cost reduction and material availability.

An improvement opportunity is identified here, which is to include formal indicators for the "flexibility" and "innovation" objectives in Alpha's supply management, and assess their usefulness for at least one year before deciding whether or not to definitely incorporate them in the management process.

4.3 Governance structures in Alpha's supply management

According to Ashenbaum et al. (2009), the area of supply management has not been the subject of studies to consider the types of governance structure that characterize the relationships with suppliers.

As a proposal for improvement, following the approach applied by Ashenbaum et al. (2009), we will consider the complexity of the transactions and the perceptions about the suppliers' capabilities to characterize the relations that the company must maintain with them.

We evaluated the governance of the relationship between Alpha and each of its 540 active suppliers, based on the factors "transaction complexity", "ability to codify transactions", and "supply chain capability", each ranked high or low. Next, the entire supplier base was distributed across the five types of governance structure, as proposed by Gereffi et al. (2005). The results of this distribution can be seen in Table 3.

This classification, developed during the course of this study, can serve as a guide for Alpha's adoption of a governance structure more appropriate to the characteristics of its supplier base.

Once the types of governance are defined, important decisions can be made, for example about project

supply, relationship management, and the definition of the most suitable measures to optimize the supply base, among other actions presented in the continuity of the present work.

4.4 Alpha's supply segmentation

Alpha targets its suppliers by using a tool called "supplier ranking", by which it monitors the volume of expenses of the products purchased, ranking them in order of importance from highest to lowest value, called "total buy". Based on this information, Alpha's supply management defines as strategic suppliers the top thirty in the "supplier ranking", which provides complex products. These suppliers are characterized as strategic because they require three to six months of development, should the company decide to obtain a new source of supply.

As a proposal to improve this process, Alpha could group its suppliers according to the characterization of the types of governance (market, modular, relational, captive, and hierarchy) proposed by Gereffi et al. (2005), and the methodology cited by Lambert & Schwieterman (2012), which considers the complexity of products and the volume of expenses with products purchased from suppliers.

Items identified as being of low complexity and low volume of spending are considered "routine", while items with a high volume of spending but low complexity or importance to the business are known as "leverage". "Bottleneck" items are those on which manufacturing companies have a low volume of spending, but are considered complex. On the other hand, "strategic" items are considered of high complexity and high volume of expenses within the annual budget.

The amount considered borderline between high and low volume of expenses is R\$50,000.00/year. The items classified as "market" or "modular" governance are of low complexity. Items classified as "relational" are considered to be highly complex. "Captive" items, which involve capital investment by the buyer, do not exist on the current basis of Alpha. The items with governance type "hierarchy", due

Table 3. Quantity of Alpha suppliers in each type of governance.

Governance type	Number of suppliers	Total participation (%)	Transactions complexity	Ability to codify transactions	Capabilities in the supply-base
Market	244	45	Low	High	High
Modular	154	29	High	High	High
Relational	135	25	High	Low	High
Captive	0	0	High	High	Low
Hierarchy	7	1	High	Low	Low
Total	540	100			

to the prediction of verticalization over time, were disregarded in the matrix. Table 4 presents the result of the proposed segmentation for Alpha.

According to Lambert (2008), by identifying the key suppliers to a business, companies and suppliers can work on initiatives aimed at increasing revenue and reducing costs to improve the financial performance of both companies. In addition, segmentation enables a better definition of the business objectives for each segment, as well as the expected results after achieving the objectives, as will be presented below.

4.5 Alpha’s supply management strategies, policies, and plans

Alpha’s supply strategy is the continuous search for cost reductions in its supply base, without adversely affecting the rest of its indicators, such as component quality or delivery time. According to this concept, the main policies and plans to support such a strategy derive from decisions related to: vertical integration (own manufacturing or outsourcing); negotiation plans; one or two sources of supply; local or international sourcing; and specification changes together with engineering.

As a proposal for improvement, Alpha can also use a policy of streamlining the supplier base by reducing the number of suppliers of similar items. This should realize gains in scale in negotiations (“bargaining power”, since higher volumes of materials or components in the negotiations bring better prices);

gains in logistics operation and management (freight, inventory, optimized routes, etc.); and better supplier relationship management (contract negotiation and administration).

The following sections describe how each of the policies and plans are used by Alpha, as well as the improvement proposals identified from this study.

4.5.1 Vertical integration at Alpha

Alpha currently has internal manufacturing processes for cutting, bending, and welding metals; and for machining, painting, and assembling sub-assemblies and their final products. Other components, such as 2D and 3D sensors, x-ray ampoules, and motor reducers, are purchased from national and international suppliers.

The definition of what is to be manufactured internally and what is to be bought involves strategic decisions by the company managers, who evaluate a set of variables for decision-making, including cost, complexity of the operation, availability of capacity, availability of investments, technological specialization, and quality. All these factors are evaluated through a business study that involves the areas of supplies, manufacturing, engineering, and controlling.

As a proposal for improvement, it is suggested that Alpha structure a plan to study vertical integration using the proposal of segmentation of suppliers presented in Table 4, based on the types of governance, but only for the 57 “leverage-modular” suppliers. These are the only group with the combination of

Table 4. Proposed segmentation of Alpha suppliers.

Supplier segment	Governance type	Number of suppliers	Total participation (%)	ALPHA suppliers (portfolios)	Volume spent/Year (R\$)
Strategic	Relational	52	10	2D and 3D sensors, x-ray ampoules, gear motors, motors, resistors, compressors, stabilizers.	13,031,000
Leverage	Market, Modular	95	18	Electronic boards, electric wire harness, plastic injection, welded metal, hoses, processed rubber, electronic components, indirect materials, plastic and metallic raw material.	21,567,000
Bottleneck	Relational	83	15	Ceramic tablets, pressure switches, counters, stepper motors.	1,070,000
Routine	Market, Modular	303	56	Electronic boards, electric wire harness, plastic injection, welded metal, hoses, processed rubber, electronic components, indirect materials, plastic and metallic raw material.	2,897,000
Vertical Integration	Hierarchy	7	1	Polyurethane injection, laser cutting of metal, tubes, levers, bases.	2,240,000
TOTAL		540	100		40,805,000

complexity of operation, technological specialization, and volume of expenses that would justify this approach (not applicable to the rest of the suppliers) according to Table 5.

4.5.2 Negotiation plans

Alpha uses negotiation to achieve its strategic objective of reducing costs, addressing its supplier base with distributive negotiation strategies (opposing interests), in which, according to Lewicki et al. (2000), buyers use arguments in order to convince suppliers that prices should fall.

Alpha does not have a well-defined negotiation plan, addressing its suppliers, for different reasons, at random. For example, negotiation opportunities arise when there is a need for meetings due to supply and quality problems, when a proposal for another source of supply with lower prices is received, or when the supplier requests price adjustments. The result of this procedure is the realization of generally smaller gains than a consistent trading policy could bring.

As a proposal for improvement, Alpha must structure a negotiation plan, using the segmentation of suppliers presented in Table 4, and defining a feasible percentage for each supply portfolio as a cost reduction goal. Such an initiative could be implemented first with the 38 “market leverage” suppliers, who represent a high volume of spending for Alpha and are more likely to accept the request because of substitution risk. Subsequently, it could be extended to “routine” suppliers, who represent a lower earning potential due to the low purchase volume. Table 5 shows the priority order for these initiatives.

4.5.3 Single source or multiple sources (Dual Sourcing) at Alpha

Maintaining, where possible, at least two suppliers for each material or component lessens dependence between the assembler and supplier, and increases the buyer’s bargaining power. The existence of a single supplier for a particular material may lead to shortages due to supplier bankruptcy, legal problems, factory labor problems, accidents, etc. When seeking a new supply source, Alpha prioritizes replacing suppliers with supply and quality problems, which request and implement price adjustments frequently and do not present a structured plan for this action.

As a proposal for improvement, Alpha should structure a plan for developing new sources of supply, using the proposal of segmentation of suppliers based on type of governance, and making an “effort x impact” analysis that verifies the complexity of the components and the volume of expenses, prioritizing the most indicated, according to Table 5.

4.5.4 Local source or international source at Alpha

Alpha needs to seek international suppliers due to two main factors: the need for high-tech components that do not exist in Brazil, such as the 3D sensors produced in the United States and the 2D sensors produced in Finland; and the search for lower-priced components in countries with lower taxation and labor costs, especially Asian countries such as China and South Korea. Table 6 presents characteristics of some of Alpha’s suppliers abroad.

As a proposal for improvement, Alpha could use the same plan for the development of new sources of supply already recommended for national suppliers. The only difference would be to not consider the portfolio of “market-leverage” vendors, because they market items with little technology involved and do not employ relatively large amounts of labor in manufacturing processes, making it unlikely to find competitive international suppliers, according to Table 5.

4.5.5 Products specifications changes

Alpha uses engineering-supply specification changes as a policy to achieve its strategic goal of cost reduction. An example mentioned by one of the interviewees was the replacement of several items required for internal assembly of the lift system of one of the Alpha products, with a lifting subsystem that is supplied ready-made by an international supplier. This replacement resulted in a total cost reduction of 30%, and also in higher quality.

The above-mentioned policy does not involve a methodology and plan for prospecting and executing new projects; rather, it is implemented from engineering’s identification of quality improvement projects, and proposals from suppliers that come in contact with Alpha to offer new products.

As an improvement, it is suggested that Alpha use the methodology proposed by Arthur D. Little (2008) for optimization of specifications, and structure a plan for prospecting and executing new product improvement projects, considering the proposed new supplier segmentation in this study and the degree of complexity of the components and the corresponding volumes of expenditure, as indicated in Table 5.

4.5.6 Rationalization of the supplier base at Alpha

Alpha has not implemented a policy of rationalization of its supplier base aimed at the strategic objective of reducing costs. This can be observed in the excessive number of suppliers classified in the category of

Table 5. Prioritization of policies and plans for each Alpha supplier segment.

Supplier segment	Governance type	Number of suppliers	Priority order	Negotiation (plan)	Dual sourcing (local)	Dual sourcing (internat.)	Changes specs engineering supply	Base rationalization	Vertical integration
Leverage	Market	38	1	1 st	2 nd	Not applicable	Not applicable	Not applicable	Not applicable
Leverage	Modular	57	↓	1 st	3 rd	2 nd	4 th	Not applicable	5 th
Strategic	Relational	52		1 st	4 th	3 rd	2 nd	Not applicable	Not applicable
Bottleneck	Relational	83		1 st	Not applicable	Not applicable	2 nd	Not applicable	Not applicable
Routine	Market, Modular	303		2 nd	Not applicable	Not applicable	Not applicable	1 st	Not applicable
Vertical Integration	Hierarchy	7	6	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	1 st
Total		540							

Priority order of the policies for each segment/governance type – 1st to 5th

Table 6. Characteristics of Alpha's international suppliers.

Motivation factor	ALPHA's suppliers (portfolio)	Countries	Number of suppliers	Supplier segment	Governance type	Volume expenses/Year (R\$)
High technology	2D and 3D sensors, micromotors, intraoral sensors and cameras, radiographic printers and x-ray ampoules.	US, Switzerland, Finland, Germany, Japan .	8	Strategic	Relational	3,464,000
Costs	Ceramic ingots and bearings, fountains, photopolymerizers, batteries, nozzle tips, reflection mirrors, x-ray ampoules.	China, South Korea	5	Leverage Strategic	Modular Relational	1,282,000
TOTAL			13			4,746,000

“routine” items with “market or modular” type of governance (see Table 4), i.e. providers of products without high technological complexity.

As a proposal for improvement, Alpha should structure a plan to rationalize its supplier base, using the proposed segmentation of suppliers based on the type of governance. The main focus would be to analyze the entire base of “routine” suppliers in order to group each of the items supplied by these 303 companies with the group of 237 suppliers belonging to the other segments. This action, if done well, could reduce the number of existing “routine” suppliers by 50%, due to the similarity of these items to those belonging to the “leverage” suppliers segment, according to Table 5.

Working in a structured way, Alpha will be able to achieve better mid- and long-term results in its continuous search strategy for cost reductions, without adversely affecting the rest of its indicators.

A summary of key policy proposals and plans for Alpha to achieve its strategic objectives is presented in Table 5.

This summary table can serve as a guide for the team formed by Alpha's coordinators and purchasing and supply manager to implement a new supply policy. It also indicates the priority to assign the actions to be performed in each of the dimensions of the supply policy examined in this study. In this way, Alpha will be able to optimize the efforts and the time dedicated to reaching its competitive priorities related to the area of purchases and supplies.

5 Final considerations

The objective of this work was to analyze the supply management of an assembler of medical-dental equipment, aiming to propose improvements in its current practices. To this end, we observed:

- The activities of the supply function in the assembler are consistently distributed among the members of the team, who have well-defined responsibilities, with no need for changes and proposition of improvements;
- The supply team has four defined objectives: cost reduction, improvement of payment term, quality, and deadline; however, two more objectives related to “flexibility” and “innovation” could be added and evaluated during the period of a year, to understand if they can really bring positive results to the assembler;
- As in most companies, according to Ashenbaum et al. (2009), Alpha does not consider the types of governance structure that govern its relationship with its suppliers, but should do so. The segmentation of suppliers according to the types of governance: “market”, “modular”, “relational”, “captive”, and “hierarchy”, as proposed by Gereffi et al. (2005), allows each segment to be managed according to the characteristics of the suppliers that compose it, bringing significant benefits to the company;
- Combined with the segmentation proposed in the item above, the company should use the Lambert & Schwieterman (2012) methodology to subdivide the supplier base into four groups: “Strategic”, “Leverage”, “Bottleneck”, and “Routine”. This would be implemented in place of a policy based solely on the spending with each supplier, and could generate a number of improvements in the company's procurement and supply management practices. The proposed segmentation also makes it possible to prioritize

actions in the area as a function of the relative importance of the identified segments;

- To achieve its strategic goal of cost reduction, Alpha uses policies of “vertical integration”, “negotiation plans”, “single source or multiple sources”, “local source or international source”, and “engineering and supply changing specs”, but it could also adopt a policy of supplier base rationalization, since the reduction in the number of suppliers of similar items could provide gains in scale in its negotiations, improvements in supply management, and also enhancements in the logistics operations.

It can be concluded that the analysis made in this study indicates a series of opportunities for improving the management of the purchasing and supplies area of the Alpha company.

Although the present research contributes to the area, this paper is limited to the study of a single company in the medical-dental equipment industry, which does not permit generalization of the information and results presented here. The study, however, suggests a method and criteria for the definition of supply management policies.

As pointed out in the introduction to this paper, one of the objectives of an exploratory study such as this is to formulate more precise problems that may suggest future work. For example, a broader study could be carried out on a sample of companies from the industry studied, and also from other industries, with the objective of mapping and analyzing supply management policies. Another suggestion would be to conduct a study of a company which has implemented the policy of supply management delineated in this work, based on the current situation found at Alpha.

References

- Arthur D. Little. (2008). Design to Customer Value - how to develop products that fulfill customers needs at the lowest possible cost. USA: Engineering & Manufacturing Insight. Recuperado em 2 de junho de 2014, de <http://www.adlittle.com>
- Ashenbaum, B., Maltz, A., Ellram, L., & Barratt, M. A. (2009). Organizational alignment and supply chain governance structure: Introduction and construction validation. *International Journal of Logistics Management*, 20(2), 169-186. <http://dx.doi.org/10.1108/09574090910981279>.
- Associação Brasileira da Indústria de Artigos e Equipamentos Médicos, Odontológicos, Hospitalares e de Laboratórios – ABIMO. (2014). *Dados econômicos*. São Paulo: ABIMO. Recuperado em 5 de maio de 2014, de <http://www.abimo.org.br>
- Baily, P., Farmes, D., Jessop, D., & Jones, D. (2000). *Compras: princípios e administração*. São Paulo: Atlas.
- Balakrishnan, J., & Cheng, C. H. (2005). The theory of constraints and the make-or-buy decision: an update and review. *The Journal of Supply Chain Management*, 41(1), 40-47. <http://dx.doi.org/10.1111/j.1745-493X.2005.tb00183.x>.
- Ballou, R. H. (2006). *Gerenciamento da cadeia de suprimentos/ logística empresarial* (5a ed.). Porto Alegre: Bookman.
- Calife, N. F. S., Nogueira, E., & Alves, A. G., Fo. (2010). Empresas do setor de linha branca e suas estratégias competitivas e de produção. *Produção Online*, 10(2), 274-296. <http://dx.doi.org/10.14488/1676-1901.v10i2.293>.
- Cerra, A. L., Maia, J. L., Alves, A. G., Fo., & Nogueira, E. (2014). Cadeias de suprimentos de montadoras dos setores automotivo e de linha branca: uma análise comparativa por meio de estudos de caso. *Gestão & Produção*, 21(3), 635-647. <http://dx.doi.org/10.1590/0104-530X193/12>.
- Di Serio, L. C., Sampaio, M., & Pereira, S. C. F. (2007). A evolução dos conceitos de logística: um estudo na cadeia automobilística no Brasil. *Revista de Administração e Inovação*, 4(1), 125-141. <http://dx.doi.org/10.5585/rai.v4i1.73>.
- Fredriksson, A., & Jonsson, P. (2009). Assessing consequences of low-cost sourcing in China. *International Journal of Physical Distribution & Logistics Management*, 39(3), 227-249. <http://dx.doi.org/10.1108/09600030910951719>.
- Gerbl, M., Mcivor, R., & Humphreys, P. (2016). Making the business process outsourcing decision: why distance matters. *International Journal of Operations & Production Management*, 36(9), 1037-1064. <http://dx.doi.org/10.1108/IJOPM-04-2014-0192>.
- Gereffi, G., Humphrey, J., & Sturgeon, T. J. (2005). The governance of global value chains. *Review of International Political Economy*, 12(1), 78-104. <http://dx.doi.org/10.1080/09692290500049805>.
- Hartmann, E., Kerkfeld, D., & Henke, M. (2012). Top and bottom line relevance of purchasing and supply management. *Journal of Purchasing and Supply Management*, 18(1), 22-34. <http://dx.doi.org/10.1016/j.pursup.2011.12.001>.
- Krause, D. R., Pagell, M., & Curkovic, S. (2001). Towards a measure of competitive priorities for purchasing. *Journal of Operations Management*, 19(4), 497-512. [http://dx.doi.org/10.1016/S0272-6963\(01\)00047-X](http://dx.doi.org/10.1016/S0272-6963(01)00047-X).
- Lambert, D. M. (2008). *Supply Chain Management: processes, partnerships, performance* (3rd ed.). Florida: Supply Chain Management Institute.
- Lambert, D. M., & Schwieterman, M. A. (2012). Supplier relationship management as a macro business process. *Supply Chain Management*, 17(3), 337-352. <http://dx.doi.org/10.1108/13598541211227153>.

- Lambert, D. M., Knemeyer, M. A., & Gardner, J. T. (2008). Developing and Implementing Partnerships in the Supply Chain. In Lambert, D. M. (Eds.), *Supply Chain Management: processes, partnerships, performance* (3rd ed, pp. 255-282). Florida: Supply Chain Management Institute.
- Lewicki, R. J., Saunders, D. M., & Minton, J. W. (2000). *Essentials of negotiation*. Boston: McGraw-Hill.
- Martins, M. F. (1999). *Análise da função suprimentos nas empresas de manufatura: o caso das empresas da indústria de linha branca* (Tese de doutorado). Escola de Engenharia de São Carlos, Universidade de São Paulo, São Carlos.
- Martins, P. G., & Alt, P. R. C. (2001). *Administração de materiais e recursos patrimoniais*. São Paulo: Saraiva.
- Prahinski, C., & Benton, W. (2004). Supplier evaluations: communication strategies to improve supplier performance. *Journal of Operations Management*, 22(1), 39-62. <http://dx.doi.org/10.1016/j.jom.2003.12.005>.
- Quayle, M. (2001). Purchasing in the UK and Switzerland: an empirical study of sourcing decision. *European Business Review*, 13(1), 42-59. <http://dx.doi.org/10.1108/095553401110380646>.
- Rebolledo, C., & Jobin, M. H. (2013). Manufacturing and supply alignment: Are different manufacturing strategies linked to different purchasing practices? *International Journal of Production Economics*, 146(1), 219-226. <http://dx.doi.org/10.1016/j.ijpe.2013.06.027>.
- Salerno, M. S., Marx, R., & Zilbovicius, M. (2003). A nova configuração da cadeia de fornecimento na indústria automobilística no Brasil. *Revista de Administração da Universidade de São Paulo*, 38(3), 192-204.
- Skinner, W. (1969). Manufacturing – missing link in corporate strategy. *Harvard Business Review*, 47(3), 136-145.
- Slack, N., Chambers, S., & Johnston, R. (2002). *Administração da produção* (2a ed.). São Paulo: Atlas.
- Slack, N., Chambers, S., & Johnston, R. (2009). *Administração da produção* (3a ed.). São Paulo: Atlas.
- Spina, G., Caniato, F., Luzzini, D., & Ronchi, S. (2013). Past, present and future trends of purchasing and supply management: an extensive literature review. *Industrial Marketing Management*, 42(8), 1202-1212. <http://dx.doi.org/10.1016/j.indmarman.2013.04.001>.
- Watts, C. A., Kim, K. Y., & Hahn, C. K. (1995). Linking purchasing to corporate competitive strategy. *International Journal of Purchasing and Materials Management*, 31(1), 2-8. <http://dx.doi.org/10.1111/j.1745-493X.1995.tb00197.x>.
- Yang, C.-L., Lin, R.-J., Krumwiede, D., Stickel, E., & Sheu, C. (2013). Efficacy of purchasing activities and strategic involvement: an international comparison. *International Journal of Operations & Production Management*, 33(1), 49-68. <http://dx.doi.org/10.1108/01443571311288048>.