How Information Systems Assist the Management of the Supply Chain in an Emerging Country Like Brazil

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Abstract. IT has an important role in the performance of companies, provides a flow of information that makes the supply chain become more robust and resilient, without compromising efficiency. Most companies are applying IT systems, mainly in Supply Chain Management (Supply Chain Management - SCM) to enhance their performance in competitive global markets. The research is important because it will provide a study of what are the IT systems used to manage the supply chain and likely future trends. To achieve the objective of this work was carried out a survey with consultants and professionals in IT and supply chain who work in large companies. To collect the data needed for analysis, we used the exploratory research of a qualitative nature. Thus, we can conclude that the use of IT in the supply chain directly impacts in the areas of planning, manufacturing suppliers, customers and delivery.

Keywords: IT, SCM, information systems.

1   Introduction

Rapid technological change and the need for information are always available to customers and suppliers, practically, is mandatory that all companies involved in any supply chain, use the Information Technology (IT).

Companies seek to adapt to this scenario focusing on performance, seeking to improve the level of service and reduce costs in an attempt to differentiate and increase the perceived value of their customers [1].

IT has an important role in the performance of companies, provides a flow of information that makes the supply chain become more robust and resilient, without compromising efficiency. Most companies are applying IT systems, mainly in Supply Chain Management (Supply Chain Management - SCM) to enhance their performance in competitive global markets [2].

According Prajogo & Olhager [3] IT can assist the SCM in the following aspects. First, it allows companies to increase the volume and complexity of information that needs to be communicated with its trading partners. Secondly, it allows companies to provide real-time information in the supply chain, including inventory levels, delivery status, and production planning and scheduling which enable companies to manage and control their supply chain activities. Third, it also facilitates the alignment of forecasting and scheduling operations between enterprises and suppliers.

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2   Literature Review

SCM has always been a challenge for information integration. The idea is to allow everyone involved in the flow of goods can make decisions based on the latest information and better than all others, both upstream and its downstream. The company manages its supply chain better get your product from point of origin to point of consumption in the shortest amount of time with the lowest cost [4].

According to Patterson et al. [5] a variety of factors can affect the decision of an organization to adopt and implement a technology that provides supply chain. The authors classify them into five broad categories: individual, related to task characteristics related to innovation, organizational and environmental. The authors also suggest that these factors may be important to different degrees, depending on the context or technology.

Information systems (IS) are combinations of technologies and people's activities using that technology to support operations, management, and decision-making [6].

IS provide many different solutions for almost all areas of business, the SCM uses some. Patterson et al. [5], point 18 IT systems applied to SCM. Table 1 shows the description and associated applications of various software, hardware and management systems.

Table 1. IT systems applied to SCM

Technology	Description
Legacy Systems	Legacy Systems are mainframe-based systems that operate at the operational level in only one stage. They are constructed as independent blocks, which hinders their communication with other systems. Systems were first used in SCM.
Barcode	Technology for the allocation of computer readable codes on items, boxes and containers. Employed to improve the data transmission speed and precision of the information. It is used in managing inventory, warehouses, supermarkets and so on.
CAD	Allows the realization of industrial designs on the computer screen that can be stored, manipulated and updated electronically.
BI	Set of applications that organizes and structures the transaction data of an organization, facilitating the analysis in order to benefit the operations and decision support.
EDI	It is the electronic transfer of data between business partners. The data is structured according to standards agreed in advance between the parties. Divided into two categories: traditional EDI, using services of value-added network, and WebEDI with access forms online (Internet).
Fleet tracking	Can be based on satellite transmission or by cell phone for tracking and monitoring of vehicles, being applied to control performance and safe transport. The data generated by this system feeding the TMS and WMS.

Table 1. (*continued*)

AQC	Responsible for monitoring the processes of quality assurance, inspection, specifications and calibration of measuring instruments.
MES	Planning systems that aim to optimize and synchronize their use. Supports the exchange of information between production planning and control of the production process through the monitoring and tracking of raw materials, equipment, personnel, instruction and production facilities.
TMS	Responsible for controlling the transport of loads, determining the modal, freight consolidation managing and coordinating the efforts of transport.
WMS	Optimizes operating activities (material flow) and administrative (information flow) in the process of storage, tracking and controlling the movement of inventory in the warehouse. Its use is restricted to operational decisions, such as: definition of collection routes, addressing products, etc..
CRM	Tool to unify customer information and create a single, centralized interactions and anticipating customer needs. It also provides control of promotional activities and their impact on demand as well as the control of activities of product warranty.
PDM	Manages information related to products, serving as an integration tool that connects different areas of product development.
RF	Facilitates communication, providing essential information on the status of the products. Support tool that automates and improves the management of operations, eliminating human error.
SCP	Assists in the planning, execution and measurement of processes, including modules for demand forecasting, inventory planning and distribution.
DFS	Uses mathematical methods that manipulate historical data and external data to forecast demand for products and services. In general, integrated systems, such as ERP and SCP.
WIS	Facilitates internal and external processes of enterprises, integrating enterprise information systems. In SCM, the WIS more presents are e-procurement and e-market place, which are systems of process automation corporate purchases.
B2B	Electronic marketplaces where suppliers and buyers interact to conduct transactions. It is an e-business, that is, relations between companies.
ERP	Unified system that integrates departments and functions of the company. Improves the flow of information chain in such a degree that it has become a standard operation.

Morais and Tavares [7] highlight several benefits provided by IT systems, as shown in table 2:

Table 2. Benefits of IT systems applied to SCM

Technology	Benefíts
Barcode	- Replaces the process of collecting and exchanging information paper, with risks of error and rework constant. - Rapid deployment, - Easy to use - Compact Equipment
CAD	- Creation of movements in the drawing, allowing testing before production. - Reduced time for product development - Creating better quality drawings to facilitate communication with partners - Greater flexibility and faster responses in the design modifications - Offer data entry for computerized manufacturing
EDI	- Possibility of integration between organizations in applications like accounts payable, inventory control, shipping and production planning.
Fleet tracking	- Contribute to the management of the fleet and cargo and to control the hours of service of drivers
MES	- Flexible manufacturing process and high quality.
TMS	- Reduction of costs. - Efficient management and coordination of freight transportation efforts.
WMS	- Improvement of the distribution process.
CRM	- Satisfaction and Customer Loyalty
RF	Reduction of the costs of distribution warehouses, retail and handling stockouts.
SCP	Obtaining the real data demand, time and inventory.
ERP	Integrating and efficient flow of information in organization and / or between it and its partners.

Other authors reported the following benefits of the integration of IT and SCM:

Sanders et al. [8] showed a direct relationship between the use of technology in SCM and it was reported that organizations use IT more than normal in your industry, to achieve more operational benefits such as reduced costs and cycle times.

Levary [9] suggests that the benefits include: 1. Minimizing the bullwhip effect, 2 . Maximize the efficiency of conducting activities along the supply chain, 3 . Minimize inventory throughout the supply chain, 4 . Minimize cycle times along the supply chain, 5 . Achieve an acceptable level of quality throughout the supply chain.

Dias et al. [10] list the following benefits achieved by the use of IT in SCM: (i) sharing instant information , (ii) sharing programs that increase operational efficiency, (iii) real-time monitoring of the consumer load ; (iv) development of global sales channels (v) reduction of inventories , and (vi) greater flexibility .

These benefits can be obtained as the level of installation and use of IT systems, which directly affects the performance of the supply chain.

3   Methodology

Type of Research

To achieve the objective of this work was carried out a survey with consultants and professionals in IT and supply chain who work in large companies. To collect the data needed for analysis, we used the exploratory research of a qualitative nature.

For Gil [12], the exploratory research aims to provide greater familiarity with the problem in order to make it more explicit .

Zikmund [13] considers that exploratory studies are conducted to clarify ambiguous problems, research is needed to better understand the dimensions of the problems .

The qualitative approach presents a reality that can not be quantified or measured items and involves subjective reality research. You can work with the data without specific statistical treatment, seeking understanding of reality [14] .

The research can be categorized as "survey" as it involves the question directly to respondents, members of a significant sample of the research universe and whose behavior you want to know, because their results can lead to conclusions corresponding to the data collected [11].

Sample and Actors Research

The actors of the research are:

- IT Consultants
- Supply Chain Consultants.
- Employees of companies working with IT and Supply Chain.

Questionnaires were sent to 60 companies and 14 responded and, of these, most opted not to disclose the name or corporate fantasy for strategic reasons.

Research Instrument

For Gil [12] , most cases of exploratory research involves literature review and interviews.

The interview, at Gil [11], is a technique in which the researcher has investigated against him and asks questions, the objective of obtaining the data of interest to research.

The research instrument of this work consists of a questionnaire with closed and open questions. Some of the responses were directed by the interviewer, in the form of performance notes which aim to detect the degree of importance, according to the intensity of perception for that aspect.

4   Analysis of Results

The survey showed that all IT systems reported by Patterson et.al. [3], are used by some of the companies surveyed. The systems that are most commonly used by companies are those that provide greater operational benefits, as Sanders et.al. [8], including:

1) Barcoding and ERP, shown in Figure 01, were the most used systems in 11 of the 14 companies surveyed (78.5%). The companies surveyed confirmed the operational benefits that offer the use of the barcode as ease of use and elimination of paper in data collection and integration and efficiency in the flow of information in the organization and / or between it and its partners in the case of ERP [7].
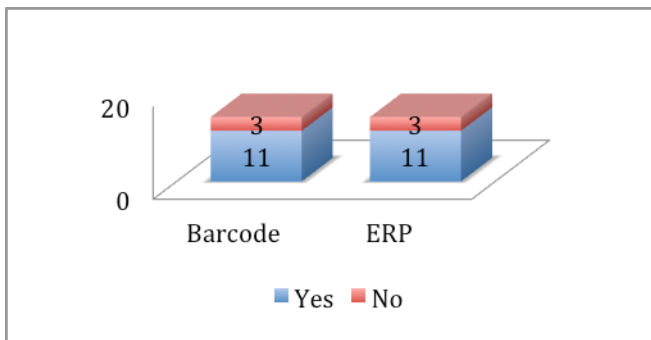

Fig. 1. Use of Barcode and ERP

2) Legacy systems, CAD, BI and WMS, had a use of 11 of the companies surveyed (71.4%) as noted in Figure 02. Legacy systems provide operational benefits as accesses to data and legacy systems, but are still used by companies. The BI organizes and structures the transaction data of an organization, facilitates the analysis in order to benefit the operations and support their decisions. To Morais e Tavares [7], the benefits obtained with CAD are creating movements in design allows testing before production, reduced time for product development, design creation of better quality to

facilitate communication with partners , greater flexibility and faster responses in the design modifications and offer input to the computerized manufacturing, whereas for the WMS, the benefit is the improvement of the distribution process.
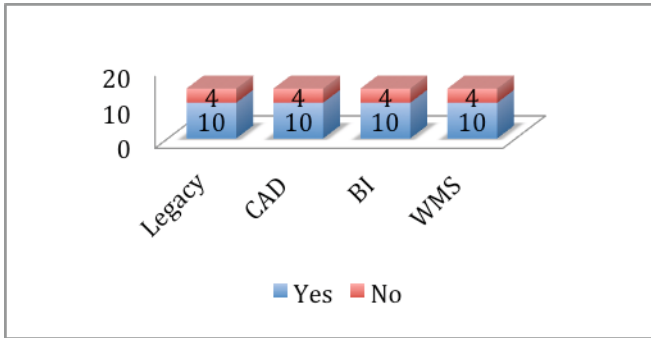

Fig. 2. Use of legacy systems, CAD, BI and WMS

3) The EDI and its use, as demonstrated in Figure 03, was reported by 9 of the 14 companies surveyed (64.2%). The main benefit presented is the possibility of integration between organizations in applications like accounts payable, inventory control, shipping and production planning.
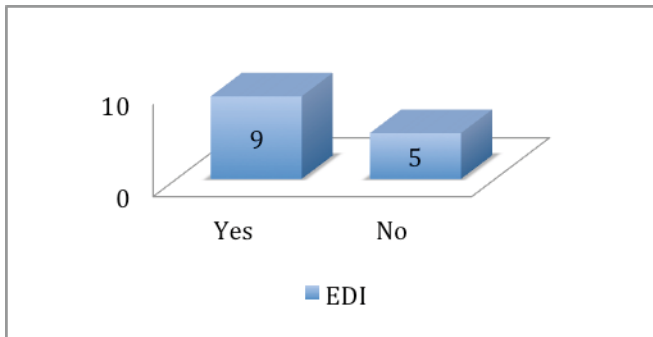

Fig. 3. Use of EDI

4) The use of CRM, DFS and SCP systems, as in Figure 04, are present in half of the companies surveyed (50%). Halves of the companies answered "No", this may indicate that these companies have caution in using these systems, or are not convinced about the benefits that they can provide since some benefits are geared more for planning than for operating as satisfaction and loyalty through CRM, obtaining the real data demand, time and inventory by SCP and forecast demand for products and services obtained from the DFS, as shown Morais and Tavares [7].
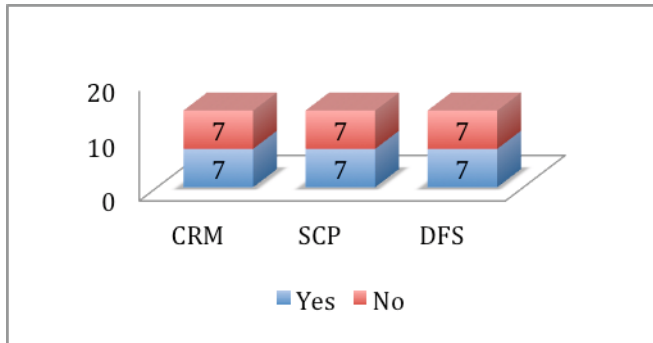
Fig. 4. Use of CRM, SCP and DFS

5) Among the seven fleet tracking systems, AQC, MES, TMS, WIS, PDM and RF, shown in Figure 05, five of the 14 companies surveyed - (35%) - answered "Yes" Tracking fleet, AQC, MES, TMS, WIS and 6 companies (42%) answered "Yes" to PDM and RF. Research has shown that the benefits offered by these systems as fleet management and cargo, flexible manufacturing process and high-quality, cost reduction and efficient management of freight, reducing expenses distribution warehouses, etc., relate to processes and management and not with the operational benefits, which does not make them attractive for use by all companies.
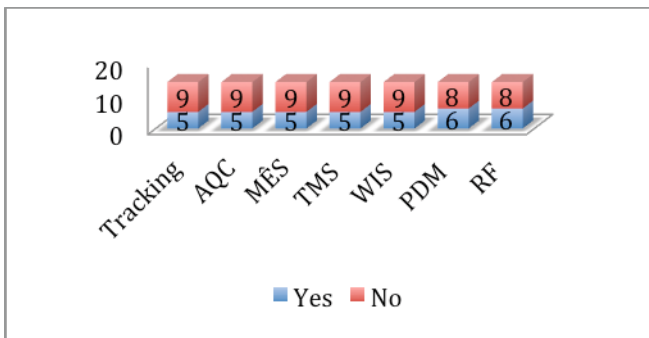

Fig. 5. Use of fleet tracking, AQC, MES, TMS. WIS, PDM and RF

6) In both B2B and RFID systems, shown in Figure 06, we note that the systems were less used by 14 companies surveyed, 4 for B2B companies (28.5%) and 3 companies for RFID (21.5%). It can be deduced that the low utilization is on the point that the two systems need specific equipment for deployment and the benefits are not operational.
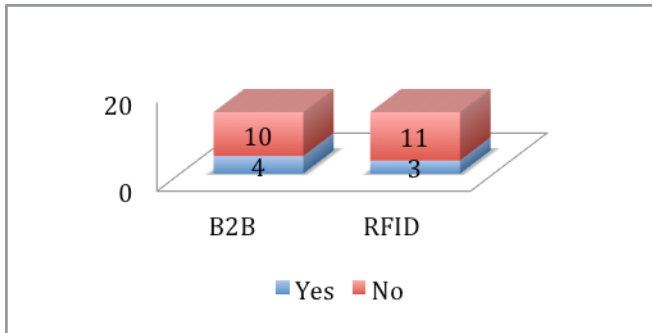
Fig. 6. Use of B2B and RFID

Questioned whether the respondents which would be applied to the IT systems of the future SCM. Two systems were cited VMI (Vendor Managed Inventory) - Stocks Managed by the Provider and ERP version 3.

5   Conclusions

The research achieved the objectives of verifying the main IT systems used in the supply chain and what are the most commonly used by businesses.

All systems surveyed in the literature are used by respondents, and the most used are those that offer operational benefits such as ERP, barcode, legacy systems, CAD , BI and WMS .

New technologies also " scare " companies which leads to them not adopt these technologies more quickly when launched, as found in research with B2B and RFID.

It was noticed that the systems for planning and management of SCM, and their usage in enterprises are increasing.

Thus, we can conclude that the use of IT in the supply chain directly impacts in the areas of planning, manufacturing   suppliers, customers and delivery.

As a future project, expected to use these items for review and creation of indicators in order to measure the level of impact in different areas of the company.

The matter does not end here, is a contribution to future discussions on the subject and quest for improvement of systems analysis of information technology in supply chain management .

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