INNOVATIVE PRACTICES IN SUPPLY CHAIN MANAGEMENT AND THEIR CONTRIBUTIONS TO REDUCE THE ENVIRONMENTAL IMPACT

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ABSTRACT

The objective of the present study was to identify the main innovative practices that have been used in Supply Chain Management. To achieve it was adopted in the Phase 1 as a methodological approach a systematic literature review, based on a content analysis of 58 articles that were published in periodicals, qualified by CAPES between 2008 and 2016. For Phase 2, it was sought to identify through a web research which of the established innovations on Phase 1 were used in some of the greatest Supply Chains, ranked by Gartner (2016). After the data collect of Phase 1, the findings were classified according to Ohio Model, innovation type and they received the attribution of the sustainable practice impact. In relation to Phase 2, the collected data were categorized into their respective organizations, as well they received the proper identification of the practices listed by Innovations Model, established by the authors. As a result of Phase 1, the Innovations Model was proposed, the data found indicated that most of the innovations are Incremental. For Phase 2, it was possible to admit that, compared to the Innovations Model, the organizations presented an average of 6.67 innovations stipulated in the construct.

Keywords: Supply Chain Management; Innovation; Ohio Model; Sustainable Practices; Gartner Top 25.

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INTRODUCTION

The innovation arises as a solution for the organizations that are facing the challenges of the current scenario. According to Anthony (2012), the innovation is defined as something that causes impact, and this means to obtain a result that could be measurable, such as profitability, improvement of a process, effect on a person's life, or something completely different.

Inside the context of organizational innovation, Bessant (2003) reveals that companies develop relationships with other enterprises and generate networks where they share since resources until the knowledge for the development of a new product or service, in other words, the innovation has become the directive that guides a group of organizations.

Due to the relationship between organizations, the Supply Chain Management (SCM) is a theme that has gained popularity and importance both in academy and corporative environments (NASLUND and WILLIAMSON, 2010). It happens because SCM is a set of approaches that are used to integrate suppliers, manufactures and warehouses in order to correctly deliver the products (SIMCHI-LEVI et al. 2003), and because of this obtain competitive advantage and the improvement of performance (LI et al., 2006).

In this sense, the present study aims to answer the research question: What are the main innovations those have been used in the SCM and what are their impacts in the corporate sustainability? To respond this question, the general objective was to identify the main innovative practices that have been employed in SCM. Specifically it was proposed to map the articles that are related to the theme, to identify the principal innovative practices, to classify the innovation type between Incremental and Radical, to categorize the practices according to the key business processes of Ohio Model and to recognize the impacts on corporate sustainability.

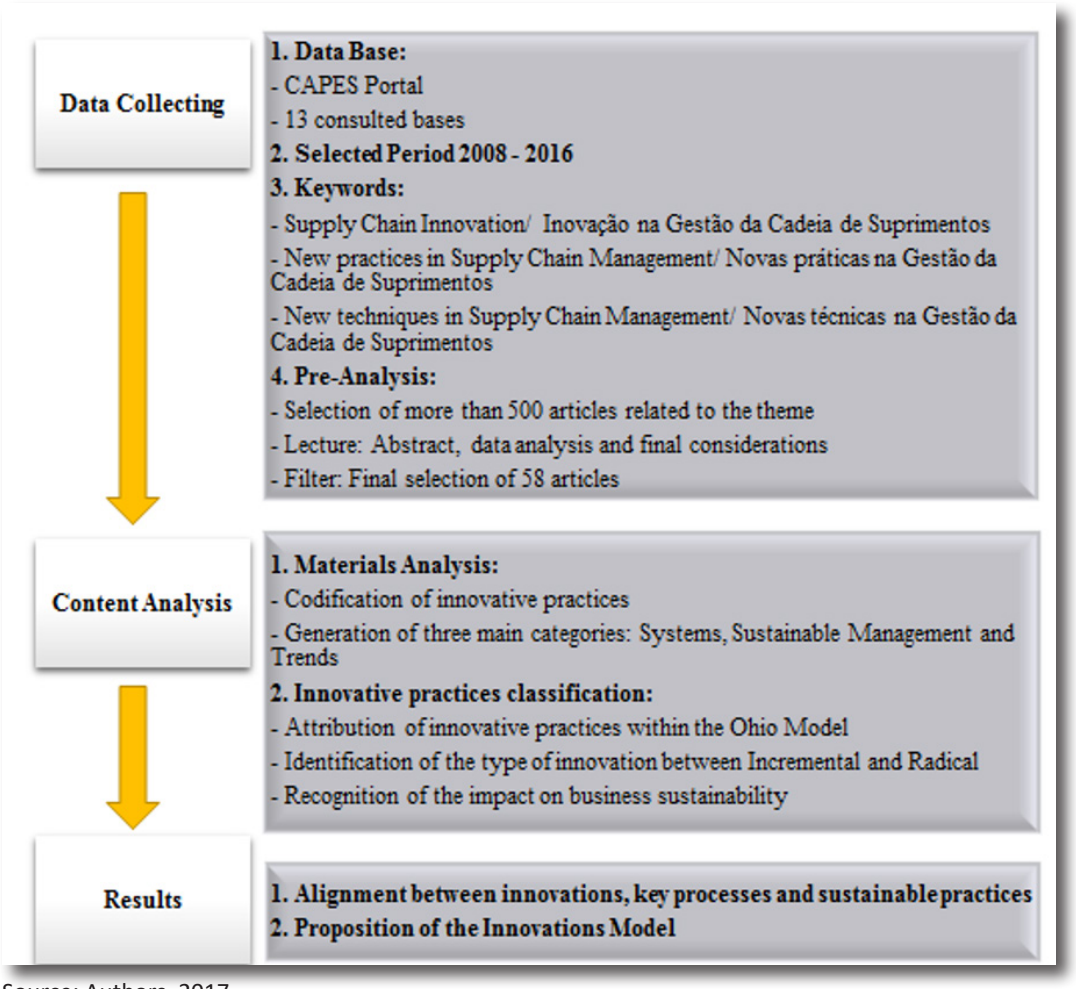
In the second moment, we tried to establish a comparison between the configured model by the authors and the innovations that have been applied within the scope of the major Supply Chains ranked by Gartner (2016), which is one of the leading companies in terms of research and consulting in the world.

This research was structured in five sections, the first is the introduction, followed by the methodology which describes the two phases of the data collection, after that there is a theoretical background of the study and in sequence the data analysis was divided in two different topics in order to contemplate the phases analysis more integrally, and finally occupying the last section the final considerations are presented.

1 RESEARCH METHODOLOGY

In relation to the delimitation of research, it is possible to characterize it as a study predominantly qualitative, in opinion of Gammelgaard and Flint (2012), this method allows more research questions and helps to reveal more about the complexity of SCM. To achieve the objectives, two different phases were established for the methodology. The first one is a systematic literature review, based on a content analysis of 58 articles (final selection), it presents a cross sectional period from 2008 to 2016, the research was realized through the CAPES portal, in periodicals from Qualis B1. The Figure 1 demonstrates the steps of the methodological processes that were applied to construct Phase 1.

Figure 1 – Methodological processes – Phase 1

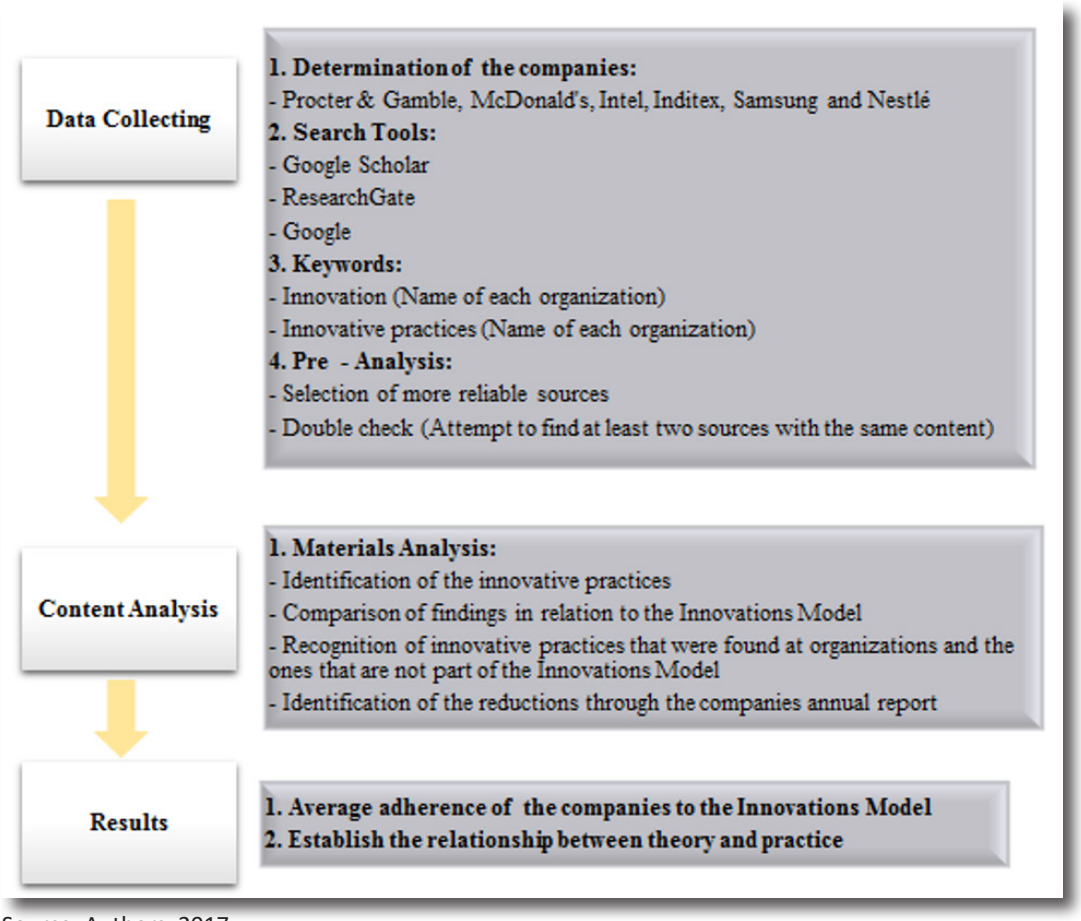


Source: Authors, 2017

For the second phase of this study, six companies were selected, they obtained prominent positions in the ranking fixed by Gartner (2016) – Top 25 Supply Chains 2016. The selected are: Procter & Gamble, McDonald's, Intel, Inditex, Samsung and Nestlé.

Subsequent to the selection, it was realized the data collecting by web research (research of published materials at the internet) about these organizations in order to verify if they apply the innovations that were found by the authors and compare them with the Innovations Model. According to Duffy (2002), web research enables the access to specific populations and hard to find, increases the speed of obtaining information and reduces costs in data collection. The Figure 2 demonstrates the methodological processes that were used in the second phase.

Figure 2 – Methodological processes Phase 2



Source: Authors, 2017

2 THEORETICAL BACKGROUND

The theoretical background was divided in two sections. The first one is an overview about SCM, considering definition, implementation and integration models. The second section describes the main practices that have been used in SCM.

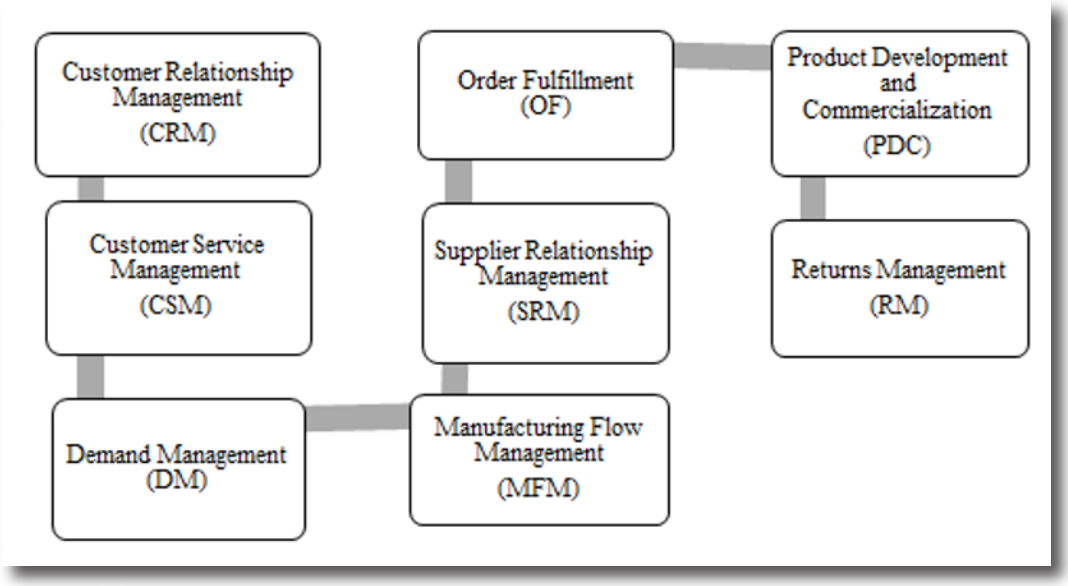
2.1 SUPPLY CHAIN MANAGEMENT

There are several definitions for the term SCM. In opinion of Pires (2004), this represents a collaborative model that pursuits the integration of the major activities of business along the Supply Chain (SC), looking for attend the customer needs with the lowest cost. The enterprises, which intend begin to manage their SC, could find support in literature models.

Lambert et al. (2005) realized a study related to the various proposed models for implementation and integration, the authors found five main different frameworks – Ohio Model (proposed by Cooper, Lambert and Pagh), SCOR Model, Srisvastava, Shervani and Fahey Model, Bowersox, Closs and Stank Model and Mentzer Model.

In order to fulfill the objective of this work, we opted to use the Ohio Model (COOPER et al., 1997; SIMON, 2005; SIMON et al. 2015), because among the structures listed, the models Ohio and SCOR provide more information (LAMBERT et al., 2005). The Ohio Model covers eight key business processes (described in Figure 3), and because this reason, Simon et al. (2015) indicated this configuration as the most appropriate to didactic and academic base.

Figure 3 – Key Business Processes



Source: Adapted from Cooper et al. 1997

2.2 INNOVATION IN SCM

The advancement of technology has enabled many innovations within the SCM. In this sense, the evolution of Information Technology (IT) was the precursor that allowed the implementation of new systems. In this context, the principal findings are Electronic Data Interchange (TAN et al., 2010; DUBEY et al., 2012) and Electronic Supply Chain Management (GIMÉNEZ and LOURENÇO, 2008; WU and CHANG, 2011).

Another department that had been impacted is warehouse, where new dispositive, such as Warehouse Management System, (MACHADO and SELLITTO, 2012; HÉKIS et al., 2014) has been used to generate more efficiency in the operations. Digital Warehouse Management System (WANG et al., 2010), Collaborative Planning, Forecasting and Replenishment (GIMÉNEZ and LOUREÇO, 2008; DU et al., 2009), Vendor Managed Inventory (TALEIZADEH et al., 2014; UGARTE et al., 2016) and their respective variants Vendor Managed Inventory with Consignment Stock (BAZAN et al., 2015) and Green Vendor Managed Inventory (JIANG et al., 2015) obtained prominent positions in this area.

In reference to the transportation, the findings are Transport Management System (OLIVEIRA and FERRAZ, 2013; MEHAR et al., 2015), Sustainable Transportation Management System (MEHAR et al., 2015) and Global Positioning System (HE et al., 2009; AREBEY et al., 2010). In relation to innovative practices in this modality, it is possible to cite Hub and Spoke (DUBEY et al., 2012; LIU et al., 2012), Cross-Docking (GALBRETH et al., 2008; AGUSTINA et al., 2014), Milk-Run (NEMOTO et al., 2010; WONG et al., 2011) and Reverse Cross-Docking (KHEIRKHAH e REZAEI, 2015; ZULUAGA et al., 2016) too.

In the ambit of sustainable management, the main innovations are Green Supply Chain Management (SARKIS et al., 2011; DROHOMERETSKI, 2014) and the novelties related to products, such as Green Products (KHOR and UDIN, 2013; TOMASIN et al., 2013), Eco-Design (SANTOLARIA et al., 2011; GONTIJO and DIAS, 2014) and Low Carbon Eco-Innovation Products (JABBOUR et al., 2015).

Finally, some innovations as Radio Frequency Identity (RFID) (HE et al., 2009; AREBEY et al., 2010) and their respective variants 3D Scanning (CHOI et al., 2015) and RFID Digital Warehouse Management System (WANG et al., 2010) have been applied in SCM, but also they are related to the future trends. In this group of trends, it is possible to indicate Additive Manufacturing – 3D Printer (MARCHESE et al., 2015; SASSON and CHANDLER, 2015), Cloud Computing (SUBRAMANIAN et al., 2014; XING et al., 2016), Knowledge Management (PIETROSEMOLI and MONROY, 2013; PATIL and KANT, 2014) and Nanotechnology (BOWLES and LU, 2013a; BOWLES and LU, 2014) as potentials for the future.

3 DATA ANALYSIS

This section was divided in two topics and presents the data analysis of the different phases of data collecting. The first topic is about Phase 1, and it is a result of the methodological approach that was established in Figure 1. The second topic describes the product of the data collecting of Phase 2.

3.1 DATA ANALYSIS PHASE 1

This section has as purpose to demonstrate the data analysis of Phase 1, as well the configured model by the authors through the classification of the main innovations employed in SCM at the key business processes of Ohio Model (codifications of the key business processes were presented in Figure 3 at the third section), followed by the identification of the innovation type between Incremental (I) and Radical (R) (ROTHWELL, 1992; CHANDY and PRABHU, 2011; NORMAN and VERGANTI, 2012) and the recognition of the impact in corporate sustainability. As a result we obtained Table 1, which is composed by twenty seven innovations.

Table 1 – Innovations Model

continue

KEY BUSINESS PROCESSES	INNOVATIONS	TYPE	AUTHORS	SUSTAINABLE PRACTICES
DM MFM PDC	Additive Manufacturing - 3D Printer	R	Marchese et al. (2015); Sasson and Chandler (2015)	Prototypes and lighter raw materials
CSM SRM	Cloud Computing (CC)	R	Subramanian et al. (2014); Yan et al. (2014); Xing et al. (2016)	Reductions of paper, energy and polluting gases
CSM DG SRM	Collaborative Planning, Replenishment and Forecasting (CPFR)	I	Giménez and Lourenço (2008); Du et al. (2009); Hudnurkar and Rathod (2012)	Decrease of waste and reduction of polluting gases
CSM DG OF MFM	Cross-Docking	I	Galbreth et al. (2008); Agustina et al. (2014); Dadhich et al. (2015); Kheirkhah and Rezaei (2015)	Reduction of polluting gases and reverse logistics
MFM	Digital Warehouse Management (DWMS)	I	Wang et al. (2010)	Reductions of paper and energy
CRM PDC RM	Eco-Design	I	Santolaria et al. (2011); Lee et al. (2014); Gontijo and Dias (2014)	Reduction of raw material and focus on repair, reuse and dismantling

Table 1 – Innovations Model

continue

KEY BUSINESS PROCESSES	INNOVATIONS	TYPE	AUTHORS	SUSTAINABLE PRACTICES
CSM DM SRM MFM	Electronic Data Interchange (EDI)	I	Tan et al. (2010); Dubey et al. (2012); Musawa and Wahab (2012)	Reductions of paper and energy
OF SRM	Eletronic Supply Chain Management System (E-SCM)	R	Giménez and Lourenço (2008); Wu and Chang (2011); Barutçu and Tunca (2012); Valverde and Saadé (2015)	Reductions of paper and energy
CRM CSM OF SRM RM	Global Positioning System (GPS)	I	He et al. (2009); Arebey et al. (2010); Michaelides et al. (2010)	Decrease of polluting gases
CRM PDC RM	Green Products	I	Khor and Udin (2013); Tomasin et al. (2013); Chen et al. (2010)	Reduction of raw material and focus on repair, reuse and dismantling
MFM RM	Green Supply Chain Management (GSCM)	R	Sarkis et al. (2011); Drohomeretski (2014); Lee et al. (2014)	Policies defined for the Triple Bottom Line
CSM RM SRM	Green Vendor Managed Inventory (GVMI)	I	Jiang et al. (2015)	Decrease of waste and reduction of polluting gases
OF SRM	Hub and Spoke	I	Dubey et al. (2012); Liu et al. (2012); Roni et al. (2016)	Decrease of waste and reduction of polluting gases
SRM	Knowledge Management	R	Samuel et al., 2011); Pietrosemoli and Monroy (2013); Patil and Kant (2014); Cerchione e Esposito (2016)	Solutions for the Triple Bottom Line
PDC RM	Low Carbon Eco-Innovations Products	I	Jabbour et al. (2015)	Reduction of raw material and focus on repair, reuse and dismantling
CSM OF SRM MFM	Milk Run	I	Nemoto et al. (2010); Wong et al. (2011); Dubey et al. (2012)	Decrease of polluting gases
CSM PDC RM	Nanotechnology	R	Bowles and Lu (2013a); Bowles and Lu (2013b); Bowles and Lu (2014)	Improvement of production and identification of items in poor condition

Table 1 – Innovations Model

conclusion

KEY BUSINESS PROCESSES	INNOVATIONS	TYPE	AUTHORS	SUSTAINABLE PRACTICES
DM MFM PDC	Postponement	I	Drohomeretski et al. (2008); Wong et al. (2010); Dubey et al. (2012); Ugarte et al. (2016)	Reduction of waste
DM OF SRM MFM RM	Radio Frequency Identity (RFID)	R	He et al. (2010); Arebey et al. (2010); Wang et al. (2010); Nativi e Lee (2012); Chen et al. (2013); Choi et al. (2015); Khan et al. (2016)	Reduction of waste and control of the returns
MFM	Radio Frequency Identity+Digital Warehouse Management System (RFID+DWMS)	I	Wang et al. (2010)	Reduction of waste and control of the returns
RM	Reverse Cross-Docking	I	Kheirkhah and Rezaei (2015); Zuluaga et al. (2016)	Reduction of waste and control of the returns
OF	Sustainable Transportation Management System (STMS)	I	Mehar et al. (2015)	Sustainable transport
CSM OF	Transport Management System (TMS)	I	Mehar et al. (2015); Oliveira and Ferraz (2013)	Decrease of polluting gases
CSM DM SRM	Vendor Managed Inventory (VMI)	I	Giménez and Lourenço (2008); Dubey et al. (2012);); Hudnurkar and Rathod (2012); Taleizadeh et al. (2014); Ugarte et al. (2016)	Decrease of waste and reduction of polluting gases
CSM RM SRM	Vendor Managed Inventory with Consignment Stock (VMI-CI)	I	Bazan et al. (2015)	Decrease of waste and reduction of polluting gases
CSM RM MFM	Warehouse Management System (WMS)	I	Ribeiro and Freitas (2011); Machado and Sellitto (2012); Hékis et al. (2013)	Reductions of paper, energy and polluting gases
MFM	3D Scanning	I	Choi et al. 2015	Reductions of paper and energy

Source: Authors (2017)

The results indicated that RFID is the innovation with more quantity of listed studies (totalizing seven works), followed by the practices of VMI, Cross-Docking and Postponement. On the other hand, with minor amount are: DWMS, GVMI, Low Carbon Eco-Inoovations Products, RFID+DWMS, STMS and 3D Scanning. In the case of innovations with less number of works, it is necessary to emphasize Nanotechnology, because only three works were found and the authors are the same.

Considering each key business processes of Ohio Model individually, it's possible to affirm that the processes CSM and SRM are the ones which obtained the largest quantity of innovations, totalizing twelve of the twenty seven listed for each. In the opposite way, the process CRM obtained the smaller amount, counting only with Eco-Design, Green Products and GPS.

In relation to the corporate sustainability, the findings mostly result in reductions of paper, energy, waste and decrease of pollutant gases, which is aligned to the works published by Srivastana (2007). Beyond the benefits generated by the reductions, Kuçukoglu and Pinar (2015) revealed that when innovations related to green practices are adopted, the organization not only reduces the environmental impact, but also leverages the enterprise to a better competitive position.

3.2 DATA ANALYSIS PHASE 2

In the second phase, the collecting data occurred according to the description of Figure 2, and as a consequence of this it generated the Table 2, where are listed the innovations found in the six organizations ranked by Gartner (2016) – Procter & Gamble, McDonald's, Intel, Inditex, Samsung and Nestlé, as well as their respective references. The items in blue color are different of the established at the Table 1.

Table 2 – Selected companies and their innovations continue

COMPANY	INNOVATIONS	REFERENCES	ANNUAL REPORT
Procter & Gamble (P&G)	• Additive Manufacturing – 3D Printer • CC • CPFR • Cross – Docking • EDI • Nanotechnology • RFID • TMS • VMI • Control Tower + Business Sphere • Distributor Connect • Global Data Synchronization • Re-Ordering System	RFID Journal (2003); Industry Week Advancing the Business of Manufacturing (2006); RFID Solutins online (2006); O'Donnell (2006); Songini (2007); Mckellar (2010); Gilmore (2011); Procter & Gamble (2011); Luongo (2012); Kamalapur and Houshyar (2013); SCM Supply Chain Movement (2013); Supply & Demand Chain Executive (2013); Banker (2015a); Banker (2015b); Morgan (2015a); Morgan (2015b); Edicom Connecting Business (2017a); Grean (2017); Kim and Mahoney (2017); Krassenstein (2017); Nano Werk (2017); Powley (2017); Sitecore (2017); Urban (2017)	Reductions: (Compared to 2010) -11% of Energy; -10% of Greenhouse gas; -75% of Waste; -16% of Water Increment: +9,6% of Renewable energy
McDonald's	• Additive Manufacturing – 3D Printer • CC • Eco-Design • EDI • Hub and Spoke • RFID	Gallon e Beuren (2011); The Operations & Supply Chain, IIM RAIPUR (2011); Kzobek (2012); McDonald's (2012); Sharma (2013); Vitasek (2016); Clarke (2017); Contract Logix (2017); McDonald's (2016); Swedberg (2017a); Swedberg, (2017b); Trefis Team (2017)	Reductions: (Compared to previous year) -5,8% of Electricity; -3,6% of Gas; -12% of Greenhouse gas
	• Just in Time • Lean Management • Supplier Performance Index		

Table 2 – Selected companies and their innovations

continue

COMPANY	INNOVATIONS	REFERENCES	ANNUAL REPORT
Intel	• CC • Green Products • Knowledge Management • Nanotechnology • RFID • In – Memory Data Platform • Security Development Lifecycle • Technology Roadmap	Kanellos (2004); Intel IT (2012); Hesseldahl (2014); Chvatal et al. (2016); Intel (2016); Collins (2017); Hardy (2017); Intel (2017a); Intel (2017b); Intel Corporation (2017); National Institute of Standards and Technology (2017); Supply Chainopz (2017)	Reductions -60% of Carbon emissions; -78% of Hazardous Waste; -82% of Non-hazardous Waste; Increment: +80% of Water - Treated and returnable
Inditex	• CC • CPFR • Cross- Docking • EDI • Postponement • RFID • WMS • Eco – Efficient Store • Environmentally – Friendly Products • Just in Time • Manufacturer Management System • Reverse Milk Run	Inditex (2004); Mossinkoff and Stockert (2008); Sheffi (2012); Masvoz (2013); Mcbeath (2014); Indian Textile Journal (2014); Inditex Annual Report (2014); Closa (2015); Violino (2015); Inditex (2016); Global Brands (2017); Gomes and Rodriguez (2017); Inditex (2017a); Inditex (2017b); Inditex (2017c)	Reductions -20% of Electricity; -40% of Water; -75% of Waste Increment: +30% of Energy from clean sources
Samsung	• CPFR • Eco – Design • EDI • Knowledge Management • Nanotechnology • RFID • TMS • WMS • Eco-Friendly packaging • Eco – Partner Certification Program • Eco – Products • Delivery Time Promise System	Samsung (2004); Nystedt (2007); Inovis (2008); The Korea Herald (2013); Kablian (2014); Samsung Newsroom (2014a); Samsung Newsroom (2014b); Kinaxis (2016); Brighton School of Business and Management (2017); Getright (2017); Samsung (2017a); Samsung (2017b); Samsung (2017c); Samsung (2017d)	Reductions: -49% of Gas emissions (Compared to 2008); -93% of Waste Increment: +100% of EHS Management System Certification

Table 2 – Selected companies and their innovations conclusion

COMPANY	INNOVATIONS	REFERENCES	ANNUAL REPORT
Nestlé	• CC • EcodEX (Eco-Design) • EDI • Nanotechnology • RFID • VMI • WMS	Watson (2005); Consumer Goods Technology (2009); Ponce and Dourado (2009); Consumer Goods Technology (2011); Kohn (2012); RFIDBr Portal Brasileiro sobre RFID (2013); Nestlé (2016); Edicom Connecting Business (2017b); Nestlé (2017); Oracle (2017); Packaging Gateway (2017); The Project on Emerging Nanotechnologies (2017)	Reductions: -39% of Gas emissions (since 2006); -25% of Water (since 2010); -77% of Waste
	• Vehicle Management System		Increment: +17% of Renewable energy; +34.9% of the Packaging materials are made from renewable materials

Source: Authors (2017)

The findings demonstrate that the companies in average apply 6.67 of the twenty seven innovations described by Table 1, and the six enterprises presented the average of 3.67 different innovations of the Innovations Model. Between the innovations that were listed in the proposed model by the authors, the RFID is the one that most affects the organizations, it was found in 100% of the six companies, followed by Cloud Computing and EDI that were adopted by five of the six selected.

In the spotlight, it is possible to cite Procter & Gamble. According to Gartner (2016), this company belongs to the exclusive category called Master (occurs when an organization remains in the Top 5 for at least seven years in the last ten years), and it presented de larger amount of innovations, listed in Innovations Model, beyond it, were identified four different innovations – Control Tower + Business Sphere, Distributor Connect, Global Data Synchronization and Re-Ordering System in this company. In the other hand, Nestlé was the one that had the smaller quantity of different innovation, counting only with Vehicle Management System as a differential. In this sense, Samsung applied the greatest amount of different innovations.

Two of the enterprises presented the smaller quantity of innovations in relation to the model, Intel and Inditex, both achieved five of the innovations listed at Table 1, however both showed different innovations, five and three, respectively.

About the corporate sustainability, five of the selected companies presented innovations linked to sustainable initiatives (McDonald's, Intel, Inditex, Samsung and Nestlé), only Procter & Gamble didn't present a specific innovation related to sustainability.

The use of innovations listed in Table 1 plus the different innovations, guaranteed places for Intel, Samsung and Nestlé at the rank proposed by Corporate Knights (100 World's Most Sustainable Corporations 2016), this fact proved that the founds about the sustainable impact caused by adoption of innovartions are effective. Another fact that could prove this theory is listed in the annual report present by each of these companies, in other words, the reports presented the quantity of reduction of gas emissions, water and waste that truly happened in these organizations. It's also possible to admit that comperad with Table 1 - Column 5 the founds described at Table 2 – Column 4 are almost equal.

FINAL CONSIDERATIONS

The objective of this article was to identify the main innovative practices that have been used in SCM in the last years, through systematic literature review. By means of the analyzed articles, it was possible to found twenty seven innovations, and three of them presented variations (RFIS, VMI and WMS).

The Table 1 is the final construct elaborated by the authors at Phase 1, and according to Innovations Model it is possible to admit that innovations don't affect only one key process, in other words, the application of a new system or a new practice could cause positive impact in various key business processes. Other relevant contribution in this study is that few innovations were classified as Radicals (only 25, 93% approximately). In this sense, we admit that the current innovative practices are linked to continuous improvement/ enhancements.

Concerning about Phase 2 of this article, it's feasible to admit that, as well as Table 1, the Table 2 presented the RFID as a highlight within organizations, thus, liking theory with practice, because academy demonstrates a special interest about this theme and the practice consecrates this as an element of high relevance inside the researched Supply Chains.

Inside this context, some of the selected companies exhibited different innovations those are related to the issues of corporate sustainability, such as Eco-Efficient Store, Environmentally-friendly Products, Eco-products, Eco-Partner Certification Program, and Eco-friendly packaging, and it meets one of the specifics objectives of this work that was developed in Table 1. In this sense, it's feasible to affirm that organizations, which adopted innovative practices in order to improve quality, reduce costs and enhance the performance, also generated positive environmental impact.

The present study presented limitations, as the data colleting exclusively secondary in the phases, and the established period (2008 – 2016). In this sense, the selected interval had as justification the intent to secure the highest degree of innovation, but we also believe that a smaller quantity of years could generate lesser amount of innovations.

For future works, we suggest the use of Innovations Model proposed by the authors, as a base for a case study or for a survey, to find out if the findings of theory are effectives in practice, especially at small and medium sized enterprises, and through this way it would be possible to recognize which practices could be adopt both by large, small and medium organizations.

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