

Counterfeiting in Supply Chains: A Literature Review and Future Research Directions

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Abstract

The purpose of this paper is to present an overview of the research carried out in the Supply Chain Management (SCM) area into counterfeiting, hence increasing understanding about which perspectives were studied, and the risks and threats to the operations of companies and their supply chains. A structured literature review was conducted based on 81 articles taken from journals on the ABS list, which analyzed the perspectives of counterfeiting and approaches to the subject. The evolution over the last five years in the discussions on the subject and the need to prepare mitigation plans and take strategic decisions in the fight against counterfeiting are highlighted as the results. Based on a structured review of multiple studies, this paper classifies several elements that have been discussed with regard to counterfeiting over time and puts forward proposals for new studies, proposing future research directions.

Keywords: Counterfeiting, Operations Management, Strategy Decisions, Risk Management.

Introduction

Companies experience many problems and risks in their operations, such as supplier failures, inaccurate demand information, process management problems, oscillations, and others (Christopher and Lee, 2004). As a consequence, strategic management needs to map out those vulnerabilities that may have a negative impact on the company.

Among these events, counterfeiting risks can have an influence on the consumer market (Jütner *et al.*, 2003; Engebø, *et al.*, 2016) and affect the company negatively. Counterfeiting is related to fraudulent or illicit practices, and copyright (Bamossy and Scammon, 1985) or trademark infringement (Grossman and Shapiro, 1988).

Anti-counterfeiting actions to mitigate negative consequences for business should be developed by way of strategic decisions and control mechanisms (Tang, 2006). Strategy development in the area of Supply Chain Management (SCM), therefore, is important for the company, since it considers decisions, competitive priorities, best practices and strategic direction (Schroeder *et al.*, 1986). Clearly, these authors strengthen Skinner's (1969) view on the strategic role of the production function in companies. Lastly, Wowak *et al.* (2016) also note the relevance of product control and traceability in supply chains, as way of providing managers with guidance and their operational strategy.

We can find different risks in supply chain literature review, studies such as Fratochi *et al.* (2016) deal with the importance of in-house production, which can guarantee the quality and originality of the product. Already authors such as Mehrejerdi (2013), Papert *et al.* (2016) and Dwivedi *et al.* (2017), structure their studies in technology tools to ensure the traceability of the product. However, information about the magnitude of the problem is unclear, or there is no uniformity in the type and quality of the information, since many studies tend to analyze only one product or market niche.

Bak (2018) identified four categories of risks in the supply chain; design continuum, relationship continuum, process continuum and economic continuum. In this study, we will appropriate the process continuum and relationship continuum categories, direct our efforts in reviewing the risks of counterfeiting in the supply chain.

Therefore, those studies that explore how companies manage their SCM decisions when counterfeiting is a threat can help researchers, managers and others involved in counterfeiting issues. Anand and Gray (2017) emphasized their concern with this new phenomenon and called for interdisciplinary discussions to begin to elicit new contributions to this topic.

In order to explore the available information on the subject and knowing its importance for preventing and mitigating counterfeiting, this study will be structured by way of a literature review, which will be an initial guide to new insights related to counterfeiting and SCM.

In order for the mapping out to be carried out in a consistent manner, we established a main objective; to explore the contributions and content of previous research, by identifying the sources of information on counterfeiting, the industrial sector involved, the established research networks, and the theories and practices that supported those studies. In addition to a thematic analysis on the elements that were also used in this context.

The expected results from this study will contribute to studies into counterfeiting, particularly in the area of SCM, where the subject is still at an initial stage.

In this paper we first present various issues related to the counterfeit market, followed by an overview of some previous topics from the literature. We will then discuss how we collected and analyzed the data and present a short step-by-step schema. The subsequent sections of our study discuss the findings and the relationships obtained, thus exploring the research objective. The contributions of this research and future research implications follow the discussion.

The Counterfeit Market

Companies currently face a myriad of risks. These risks include counterfeiting, which involves several types of product, and while the phenomenon is not recent, it has only been studied in recent decades (Eisend and Schuchert-Güler, 2006). The smuggling also has a negative affect on a company's operations and its proposed goals (Svensson, 2002; Christopher and Lee, 2004).

According to Harvey (1987), counterfeit products used to be associated with substandard products sold only by "money-opportunists", but over time they evolved into copies of luxury goods. Brands such as Rolex, Cartier, Chanel, Dior, and others were quickly affected by this market (Harvey, 1987; Dubois and Duquesne, 1993; Bian and Moutinho, 2011).

In the medicine area, the WHO (1999) defines a counterfeit medicine as one that is "deliberately and fraudulently mislabeled with respect to identity and/or source". This counterfeiting may relate to the ingredients that go to make up the product, or its packaging, regardless of whether the product is a branded or generic product. The large amount of counterfeit drugs circulating in the United States may cause irreparable harms especially to the health of the population and to the US economy. Report presented in 2016 by the Drug Enforcement Administration (DEA) showed hundreds of thousands of counterfeit pills, some containing deadly doses of *fentanyl*s. Between 2013 and 2016, there were more than 700 deaths related to *fentanyl*s.

The largest volumes of products seized each year on European borders because of counterfeiting are related to sports footwear (17%), handbag / watches / bracelets (15%) and clothing (14%) (EUIPO, 2017). China is still by far the largest supplier of counterfeit goods. According to data from the WCO (2016), taken from 59 customs authorities worldwide, the 4,475 seizures of goods in 2016 that in some way or another infringed intellectual property

rights in textiles, personal hygiene, cosmetics and electronics were an increase of 22.8% over 2015.

In other emerging economies counterfeiting is also a relevant problem. According to the IDESF (2015), activities on the border between Brazil and Paraguay result in an annual turnover in smuggled goods, such as cigarettes, medicines, glasses, watches, and other items, in excess of R\$ 20 billion, which has a direct impact on the legal market.

In 2016, sales in the Brazilian pharmaceutical market amounted to around R\$ 85.35 billion, making it the eighth largest market in the world currently (Interfarma, 2017). As a result, the illicit medicines trade is seen as a source of profit for organized crime, which causes concern in several areas; business, the police and the medical profession, and not just because of the health of the population, but also because of financial and public safety issues. Machado and Bandeira-de-Mello (2013) discussed the strategic management process of companies in the pharmaceutical sector, where they identify the need to develop specific competencies for dealing with the issue of counterfeiting.

Data provided by customs authorities indicate that counterfeit goods accounted for US\$ 461 billion in trade worldwide in 2013, representing 2.5 percent of all that was marketed in that year (OECD, 2016). Automotive parts, many pharmaceutical goods and computer programs are examples of goods that suffer from counterfeit activities, which are now moving away from the high value-added markets and beginning to operate also with a variety of other, less-known brands (Berman, 2008).

Another aspect that draws attention in the studies is the conscious consumption of counterfeit products and satisfaction with them (Bavar *et al.*, 2017). Berman (2008) reveals that some people consciously buy counterfeit goods because of ease of access to them and because of how relatively cheap they are in the informal market. Those who act in this way, however, harm the company whose goods are being counterfeited and sold irregularly, since the losses in terms of revenue are genuine.

Therefore, the counterfeit industry is a globalized industry and not one that is limited to emerging countries, like China in particular, or regions like East Asia; there are factories in several countries and parts, medicines, shoes, watches, and other items are distributed internationally (Grenoble *et al.*, 2014, OECD, 2016). World trade is dynamic and organized structures operate on many fronts in the illicit trade. Such trade has been facilitated by the advance of e-commerce, which allows small quantities to be delivered directly to the end customers via a country's normal postal service. Environments that are subject to counterfeiting tend to be dynamic, since the manufacturing strategies, sales and distribution of these illicit products need organization and permanent change (Berman, 2008; Wilcock and Boys, 2014).

Finally, counterfeiting generates expenditure on the operations put in place for reducing smuggling, reduces the tax paid, and damages the reputation, quality and finances of companies whose brands are involved in smuggling (Stevenson and Busby, 2015). Berman (2008) also stated that those companies that own the original products become vulnerable to a reduction in their sales, since in many cases it is difficult to distinguish the legal product from the illegal product, and their image in the market is damaged (Grossman and Shapiro, 1988), since those that make illegal products have no concerns for the original product brand.

The scenario of counterfeiting in the world is intense and should be a warning for companies, for the authorities that supervise the entry of products into their countries, and finally for the end consumer, who often can be affected by the situation (Berkeley, 2008), since a product

may be marketed as an illegal copy and sold as an original product (Chakraborty *et al.*, 1997) in order to deceive others (Baize, 1999).

Risk and Strategy Management

It is important for firms to identify and understand the sources of the risks affecting their supply chains. They need to do so in order to be able to take strategic decisions and decide what actions can be taken for mitigating these risks in this context, since the complexity of supply chains has been openly discussed in the last decade, which makes them more vulnerable to various risk (Wagner and Bode, 2008).

Sanders and Wagner (2011) recognized that this increased complexity made traceability a challenge for global supply chains. Machado *et al.*, (2018) also point out that companies that are subject to counterfeiting seek to develop mitigation capabilities that are specific to their markets. Bak (2018) noted a lack of tools for risk assessment in supply chains.

There are risks involved in the process of formulating company strategy and even in product and market development, such as events generated by internal or external environments (Christopher and Peck, 2004; Tummala and Schoenherr, 2011). Internal risks may be related to information technology (Lee, 2002), no supply service (Christopher and Lee, 2004), performance issues (Jüttner *et al.*, 2003), and others. Also relevant are external risks due to climate change and natural disasters (Chopra and Sodhi, 2004), global financial crises (Jüttner and Maklan, 2011), counterfeit products, brand reputation and the growth in the illicit market (Grossman and Shapiro, 1988, Berman, 2008, Grenoble *et al.*, 2014, Stevenson and Busby, 2015).

Uncertainty generated by ignorance (Zsidisi, 2003) can lead to negative events and impacts for the company and also to the supply chain it is part of (Christopher and Lee, 2004; Tang, 2006). For Wagner and Bode (2008), risk can be characterized as an unplanned event, which originates from an anomaly that materializes, resulting in significant threats to the normal operations of the companies. In this case Risk Management (RM) allows for a constant evaluation of hypothetical events and their consequences, including sources and likely causes (Jüttner *et al.*, 2003).

Much of the research into counterfeiting addresses questions about the characteristics of counterfeit products, the market, human health risks, impacts on the firm and buyer perceptions (Berman, 2008; Bian and Moutinho, 2011; Ames and Sousa, 2012; Machado and Bandeira-de-Mello, 2013; Grenoble *et al.* 2014; Hurtado and Lasmar, 2014). Hence, it is assumed that there is wide ranging impact in the supply chain, starting from the raw material supplier to the end customer. Bak (2018) argues the impacts will differ in each supply chain and their complexity, having four consistent themes for risk (figure 1).

From the themes studied by Bak (2018), our literature review will go through the process continuum category, which is closely related to processes that involve the supply chain, i.e.: integration and processes, systems and technological tools of risk management and potential risk analysis, and the theme of relationship continuum, being more directed to the relationship between the partners of the supply chain, contractual relations, among others.

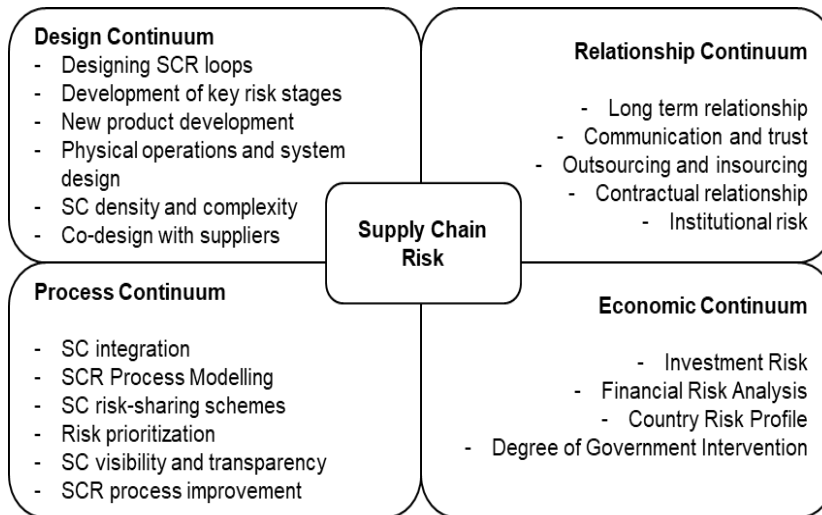


Figure 1 – Supply Chain Risk categories based on continuous themes
Source: Adapted Bak (2018)

Following this review of the literature on counterfeiting, the next section will address the methodological procedure followed in this study.

Method

According to Webster and Watson (2002), there are two types of literature review, the first deals with a mature topic when the authors conduct a thorough review of the literature and propose a model that synthesizes the research that will lead to it being broadened. The second type deals with an emerging issue in the area, giving researchers the opportunity to develop new conceptual models and research suggestions. As a new topic under discussion for the area of SCM, it is necessary to map out the discussions that have already been held and to suggest new research opportunities. Reviewing the literature on the subject, mapping out the main discussions and putting forward a proposal for future research directions are, therefore, of relevance. According to Kitchenham (2004), a systematic literature review should be “*identifying, evaluating and interpreting all available research relevant to a particular research question, or topic area, or phenomenon of interest*”, or often a contemporary phenomenon (Ridley, 2008). As a result, this research uses a descriptive approach based on analytical mapping (Vosgerau and Romanowski, 2014).

The literature review used as its basis leading journals in OM and SCM according to the ABS Guide (Academic Journal Guide), which is considered to be a quality indicator and accepted in the academic world. This guide provides a wide coverage of journals, besides collaborating with researchers from various business area (Morris *et al.*, 2009) and is an excellent starting point for academic research (Hussain, 2010). Webster and Watson (2002) recommend a structured approach that focuses on the main journals and academic databases, which can speed up the identification of relevant papers.

The ABS Guide is also frequently used as a basis for publications that help with decisions about the destination of research papers, jobs, promotions and the assessment of research programs (Mingers and Liying, 2017).

Considering that these journals publish the results of research that has a high degree of excellence, new discussions often appear in other academic databases, so our research will use the ABS Guide 2015, with journals rated between 2 and 4*.

Keywords that emphasize the phenomenon were used in the research (Ridley, 2008) with Boolean connectors (for example, AND, OR) using a combination for a full-text search (Table 1). The time horizon for locating studies was kept open, so minimizing time bias in the searches (Kitchenham, 2004).

The selection criteria indicated by Kitchenham (2004) emphasize the importance of refining the inclusion and exclusion criteria of the research, which will form part of the literature review. To validate this topic therefore, we decided to read each of the papers.

Keywords	Search strings	Academic Journal - ABS List	Rating 2015
Counterfeit	TX (e.g.: counterfeit* OR pirate OR piracy)	Journal of Operations Management	4*
Counterfeiting		Inter Journal of Operations and Production Management	4
Pirate		Production and Operations Management	4
Piracy		Inter Journal of Production Economics	3
Falsification		Inter Journal of Production Research	3
Smuggled		Journal of Supply Chain Management	3
Smuggling		Manufacturing and Service Operations Management	3
		Production Planning and Control	3
		Supply Chain Management an International Journal	3
		Business Process Management Journal	2
		Inter Journal of Physical Distribution and Logistics Managem	2
		Inter Journal of Quality and Reability Management	2
		Journal of Business Logistics	2
		Journal of Purchasing and Supply Management	2
		Total Quality Management and Business Excellence	2

Note: TX = All text

Table 1 - ABS Guide and Keywords

The sequence of this process was maintained by way of explicit selection criteria that were used for assessing the studies, with a total of 281 documents being screened in the first stage. The abstracts were then reviewed and articles that did not meet the inclusion criteria were considered to be irrelevant to the topic and excluded, while the 153 articles remaining were identified as potential candidates for inclusion in the review process. In this step the articles in the list were assessed by reading the introduction and conclusion of each paper to further assess their relevance. Following this screening, 63 papers were excluded because they were not relevant to the topic. Finally, each paper was read in full and analyzed. This examination indicated that there were 81 papers that should be included in the literature review.

The purpose behind the final reading of the papers was to apply a fine filter in order to eliminate those that were not suitable for inclusion, something that may not have been apparent in the previous phases. We carried out an analysis that involved tabulating the papers in an MS-Excel spreadsheet, in which each study was ranked according to its approach. In the process of analyzing the data and building up the map of topics, we considered the main authors, the method applied, but mainly the sources of information that were used.

The following section provides the findings from all the selected studies, and what is known and not known about the current state of studies in counterfeiting.

Findings

Having discussed the methodological procedures that we used in the study in the previous section, it is now time to present the results obtained by way of data collection. We discuss below the number of articles that have appeared over time, the academic journals in which

these articles were published, and their epistemological orientation. We also include a section showing the elements most widely used to support the topic of counterfeiting.

Descriptive analysis

General trends in the literature

In order to check the extent of the coverage of the analyzed subject in SCM, as described in the methodological section, after the 81 papers that were defined for inclusion in this study had been selected, we found there to be no great dispersion in the research carried out during the analysis. The International Journal of Production Economics (20% of the papers) and International Journal of Physical Distribution and Logistics Management (15% of the papers) are used most by the authors for disclosing their research into Counterfeiting and SCM, while the articles published in other academic journals are more widely dispersed between them.

First of all, the search period in the databases was not limited, which allowed for as wide a range of papers as possible to be included. There is an evolution over the years included in the research into the issue of counterfeiting, with most of the studies analyzing supply chains. The complexity of supply chains has provided this opportunity for including further studies on several fronts; although the risk of counterfeiting is not a recent phenomenon, it has proved to be of greater interest in research terms (Eisend and Schuchert-Güler, 2006).

Although we collected data for a long period of time, we found few studies into counterfeiting in the initial years, although since 2014 there has been a comparatively significant evolution in the number of studies carried out, which probably indicates the concern that SCM researchers have with regard to the effects of counterfeiting (Anand and Gray, 2017). Studies in other areas of knowledge have already pointed to the negative effects of counterfeiting on firms and product brands (Harvey, 1987).

Research Method

We then analyzed the methodologies used in the articles we collected. The five methodologies most frequently used and that occur in almost 80% of the 63 articles that were reviewed are: survey (18); modelling/simulation (18); multiple case study (12); theoretical essay (10); and single case study (5). The remainder used other qualitative methodologies. As counterfeiting is a complex and multidisciplinary research subject, a mix of methods can be used.

The use of Survey and Modelling/Simulation in these studies into counterfeiting enshrines a historic emphasis by the SCM field on working with quantitative research. Furthermore, because this is an issue that is still under development, generating models, hypotheses and scales are fundamental requirements for going into the subject in greater depth and building up knowledge.

Industry Sector Analysis

With regard to the sectors analyzed, we observed that the issue of counterfeiting has been discussed by researchers in several sectors. Therefore, 15% of the studies carried out relate to the manufacturing sector, followed by retail with 13%, the pharmaceutical sector with 8%, and 6% to food industry. They have different characteristics, however, depending on the supply chain and the product, as Grenoble *et al.*, 2014 pointed out, and they cause different impacts on each consumer (Berman, 2008). Most of the discussions on the subject are still in the exploratory stage for all industries.

Decentralization into sectors can be explained by the evolution of the subjects that are discussed in existing studies and that range from corporate governance, the use of tracking systems and risk management, to resilience and risk mitigation.

One difficult aspect of the sectors we analyzed were the modeling and survey studies, which frequently did not indicate the sector itself, but sought to analyze counterfeiting across several sectors, indicating that the process of knowledge building in the SCM area is ongoing.

Thematic Analysis: Elements supporting a discussion of counterfeiting

Throughout our review of the literature we noted that researchers discussed several elements in support of the discussion of counterfeiting, as can be seen in Figure 2. Over the last two decades theoretical approaches such as the Transaction Cost Theory (TCT) and Resource-based View (RBV) have been fundamental for building up knowledge about counterfeiting in the SCM area. Management practices have also contributed towards mitigating counterfeiting actions and increasing company resilience as is showed in the figure.

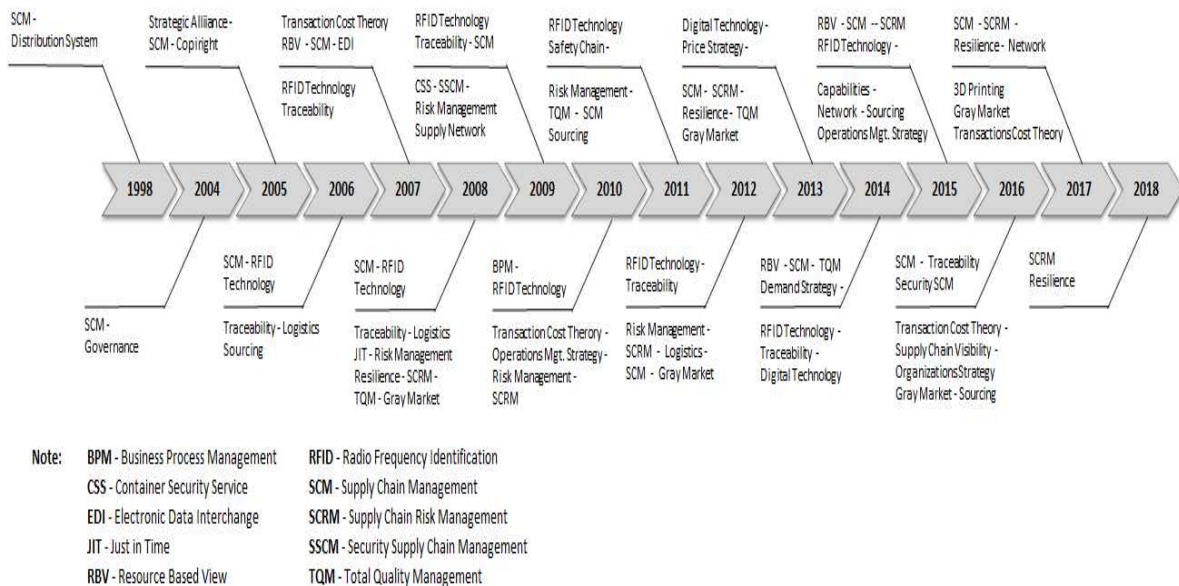


Figure 2 – Elements supporting counterfeiting discuss

In addition, it can be noted, also, that the elements identified are aligned with two categories of proposals by Bak (2018), relationship continuum and process continuum. Consolidating the importance of understanding the processes established in the supply chains and in the relationships between the partners.

Applying Theory

Studies in supply chain risk management (SCRM), resilience and OM are beginning to be discussed in order to structure a new strategic vision in companies. As Mintzberg (1983) mentioned, changing environments compel managers to adjust company strategies for operating with uncertain conditions (Zsidisi, 2003). This aspect may negatively affect their operations (Tang, 2006).

As we have seen, the counterfeiting industry is profitable and globalized, with counterfeiters seeking to create market gains and strengthen their resources. Stevenson and Busby (2015) indicate that counterfeiters use products that already have a structured base, are trusted in the consumer market, enjoy quality and intellectual property resources and have built up a recognized reputation. Such aspects are the traditional resources identified by the Resource Based View (RBV) and widely discussed in studies, like those by Barney *et al.* (2001) and Helfat and Peteraf (2003).

In the study by Zailani *et al.* (2015) the authors state that the prospect of using supply chain security features, copyright protection in negotiations, and reviewing outsourced service providers can increase the performance of the companies involved in the process, hence, integrating the pillars of RBV as a business strategy for SCRM. Fratocchi *et al.* (2016) emphasize the importance of the company having valuable resources and capabilities for constructing superior performance. The authors stated that the internalization of operations is based on better transaction costs, anti-counterfeiting actions, protecting brand and assets, and generating reliability, which consequently result in superior performance.

Past studies have addressed transaction costs and the feasibility of using new technology projects against counterfeiting, piracy and in other situations, while seeking to preserve the *status quo* of the relationship between the buyer and suppliers. Skowronski and Benton Jr (2018) highlighted the importance of copyright protection in transactional relationships with suppliers located in countries that have weak counterfeiting and piracy laws. Stranieri *et al.* (2017), in turn, analyzed the use of traceability systems and the transaction costs involved in the food supply chain for mitigating the risks involved.

Elements	Highlights and Trends	Authors
RBV	<ul style="list-style-type: none"> * Counterfeiting strategies and how companies competitive resources are achieved. * Improvements in the management of the supply chain and the strategic resources that companies have. * Internal knowledge has been one of the strategic resources that companies are using to compete and apply reshoring, while companies still seek advantages in offshore. * Competitive resources such as quality make consumers loyal to the brand. 	Vivek et al. (2007), Ng et al. (2014), Stevenson and Busby (2015), Zailani et al. (2015), Fratocchi et al. (2016)
TCT	<ul style="list-style-type: none"> * Reviewing transactional costs, internalizing processes and actions to protect copyrights and trademarks, can improve corporate performance and reduce risks in external operations, including product counterfeiting * More reliable transactions that can be guaranteed through new technologies help reduce costs and enable investment in risk management. 	Vivek et al. (2007), Lee and Lee (2010), Shu and Barton (2012), Fratocchi et al. (2016), Hartman et al. (2017), Skowronski and Benton Jr (2017), Stranieri et al. (2017)
SCRM	<ul style="list-style-type: none"> * Mapping the risks that involve the supply chain and that can also bring about a rupture, allows companies to understand where the risks are, manage them and fight them. * Develop capabilities that can reduce or mitigate counterfeit actions, and have resilience to fit the overall supply chain. * Internalization of processes as a way to guarantee security and reduce risks in external operations * Learning how the market operates and what trading possibilities can prevent illegal products from being marketed in gray markets as if they were original products. 	Manuj and Mentzer (2008), Tang and Tomlin (2008), Pettit et al. (2010, 2013), Gray et al. (2011), Vilko and Hallikas (2012), Ahmadi et al. (2015), Zailani et al. (2015), Huq et al. (2016), Durach et al. (2017), Hartman et al. (2017), Tukamuhabwa et al. (2017), Bak (2018), Machado et al. (2018)

Table 2 – Integrated view of theoretical discuss

TCT and RBV are generally the preferred approaches adopted in literature reviews and the theoretical frameworks used in the articles we analyzed (Table 2). Risk Management is also a central issue when it comes to discussing operational strategies, resilience and risk mitigation in companies.

Practices, technologies and benefits

The use of technological tools, process automation, OM practices and risk management strategies have helped mitigate risks in companies (Mehrejerdi, 2013). Technologies such as RFID tags, tracking sensors, and information sharing are among the ways that could be adopted for improving security in operations along the supply chain.

Papert *et al.* (2016) stressed the feasibility of using technological tools for strategic management in the pharmaceutical industry and its complex supply chain, thus diminishing the possible risks of counterfeiting.

Throughout the 2000s and up until the mid-2010s RFID technology was at the heart of these studies. Technological tools, such as RFID and EDI, are also used in management, in the control and tracking of products and to mitigate counterfeiting.

These issues are still on the agenda, especially with the advent of 3D printing, which opens up a new discussion about copyright, the counterfeiting of parts and piracy. Dwivedi *et al.* (2017) discuss the potential applications of additive manufacturing (AM) in achieving tools and customized products, thus seeking benefits in terms of lead time and operating costs. They claim that the discussion about copyright, however, should aim to avoid illicit copies being made or business opportunities arising in gray markets. A new view of managers and the possibility of developing mitigation capabilities should be recognized as an important way for combatting counterfeiting, as Machado *et al.* (2018) suggest.

Cultural differences, especially between western and eastern countries, are also seen by Durach *et al.* (2017) as possible causes of disruption in the supply chain, such as delays in deliveries, quality problems and understanding the laws; greater attention is needed in supply chain risk management. In order to mitigate counterfeiting and increase control over production, Fracocchi *et al.* (2016) reveal that outsourcing issues are being discussed that involve reviewing a policy for relocating manufacturing back to the country of origin, which would also meet a demand from consumers for greater reliability which comes from knowing the origin of the product they are acquiring and being sure about it. Therefore, it is understood that the effect of the place of origin can have an influence on strategic business decisions as to how production, brand building and product quality will be managed.

Ng *et al.* (2014) argue that the management of TQM processes can influence the construction of the brand and support market demands in relation to quality and the quantity available. We can say, therefore, that TQM process management can also help protect products against counterfeiting. Recent studies suggest, however, that the use of TQM is more suitable in stable environments where there is accurate information and few external interruptions. Improving the argument that TQM should be developed in more stable environments, Cho *et al.* (2015) explain that changes in the product quality function take time and often cannot be easily changed, since counterfeiting actions require rapid and assertive responses, so management should consider a change in the price function as one quick action in anti-counterfeiting. Huq *et al.* (2016) argue that the stricter quality standards of consumers and regulators in some countries imply that some companies need to develop this competence.

Management practices have sought the benefits resulting from strengthening confidence in the brand and improving the reliability of the product on offer, by controlling the operations carried out by companies, reducing delivery time and offering products with the quality standard demanded by customers. Counterfeiters, on the other hand, do not usually work with the same quality or requirements as regards customer satisfaction.

Future Research Directions

From the information obtained in the previous sections, it is possible to identify the characteristics of the studies and the elements discussed in the papers. It also provides additional analysis of the latest research.

There is a growing trend in research into counterfeiting, as indicated in this study. Between 2000 and 2009 four papers a year on average were published, while after 2010 that average increased to seven a year, their main methodologies being survey, modeling and case studies. Based on the economic sectors investigated by the papers that comprise this review, the retail sector is the most explored with 12 papers, 13 percent of the studies carried out, the pharmaceutical sector then follows with 7 papers (8%), and the logistics sector with 6 papers (7%). Other sectors were less explored. This raises questions such as:

- Which methodologies, such as the experiments, scenario analysis and or even multiple methods, can help expand our understanding of the counterfeiting phenomenon in companies?
- Specific industries in the supply chain, like retailers and pharmacists, are especially susceptible to counterfeiting. Should they be explored more closely, since they deal directly with the end consumer and people's health?
- Counterfeiting is present in transactional relationships, so might Business-to-business (B2B) transactions be affected to the extent that Business-to-Consumer (B2C) relationships are?

Taylor (2005) discusses the sensitivity of the software industry in promoting the development of trust and strategic alliances among the companies involved, since the industry is subject to piracy and counterfeiting.

IT systems and automation have created opportunities for managers to better control processes and product quality. Previous papers explored the use of technology for controlling and managing counterfeit products. We can cite RFID, EDI and product tracking systems as examples that gave positive results. Nevertheless, other technologies that are already available in the market can provide new opportunities for future studies:

- Will Industry 4.0 and 3D printing technologies reduce the volume of counterfeit products in supply chains, or not?
- Can blockchain technologies increase the mitigation of counterfeiting and resilience to it? How can this be explored in future studies?
- How can procurement managers develop mitigation capabilities in order to reduce counterfeiting?

With regard to the theoretical discussions reported in the papers we analyzed, there is a strong appeal in theories that are usual in OM/SCM. Discussions about strategic resources and how they are being applied against counterfeiting make RBV one of the most widely-used theories in past studies on this topic. Studies focus on the transactions between buyer and suppliers in an attempt to understand the costs involved in the relationship and how to protect brands, products and copyrights. In this case, TCT was the theoretical approach used in the analysis.

Stakeholder Theory (ST) also is a valid theoretical approach to the discussion of counterfeiting. ST may expand the analysis, bringing the focus to the role of Government, society and actors in issues like taxes, product control and registration, and sector regulation. Additionally, the perspective of Behavioral Operations arises with a relevant appeal in the analysis of the managers' decisions in the purchasing process. So we can list the following questions:

- How sectoral regulations imposed by the Government to register products with high risk of counterfeiting can contribute to the mitigation of counterfeiting?
- Is the purchase intention affected when the buyer understands that there is a risk of counterfeiting in the product purchased?

Finally, other questions emerge when we focus on B2B and counterfeiting:

- Is conscious or unconscious purchase also present in the case of the end consumer?
- How can the impacts of the extent and type of risk found in the supply chain be understood when there is counterfeiting?

Ahmadi *et al.* (2015) argue that companies are concerned about the markets in which their products are sold, so pricing policies can be triggered with the intention of controlling these activities. Buyers who base their actions on acquisition price identify parallel or gray markets as an alternative to the authorized channel, which leads to the opportunity to introduce counterfeit products. Therefore, it is understood that the buyer's behavior also becomes the target of analysis in understanding and studying the risk of counterfeiting in the supply chain.

From the issues presented in this section, it is possible to obtain new research relevant to the topic of counterfeiting in the area of operations management.

Conclusion

Counterfeiting is of increasing concern for companies and their supply chains. Therefore, this topic deserves more studies in several areas related to OM and SCM. Scholars from different regions are developing studies on counterfeiting, which make it a subject of growing interest (Anand and Gray, 2017). The main contribution of this study is to present an initial mapping and to bring new insights and questions to the OM and SCM area. The results confirmed the increasing interest there is in the topic. At the same time, there is a need to develop new studies to advance both theory and practice.

Based on 81 articles on counterfeiting published in academic journals from the ABS List, we analyzed the evolution of the discussion by way of a structured review of the literature. We were able to identify growth in the number of studies on counterfeiting over the last decade, with a strong increase in the last five years. Studies are still largely exploratory and case studies and surveys were the main methods used in the articles we analyzed.

The Transaction Cost Theory (TCT) and Resource-based View (RBV) were the most common theories used with regard to the subject of counterfeiting. Relations between buyer and supplier have been approached from the perspective of TCT, with the aim of improving the relationship within the dyad through anti-counterfeiting projects and copyright protection. Strategic resources are also a current approach. Since counterfeiters can jeopardize the market for companies, the latter need to understand their valuable resources and strategic capabilities in order to develop processes that increase security in their supply chains. SCRM focuses on discussions about supply chain resilience and vulnerability in the face of critical events and the possibility of disruption.

Discussion of counterfeiting in SCM, however, has several other potential theoretical paths that can be followed, suggesting that other theoretical approaches are needed to expand our understanding of the phenomenon. Even though many studies are based on TCT, RBV and SCRM, other theories can help expand our understanding of the phenomenon using an SCM approach.

Although the studies analyzed reported threats, such as the risk of counterfeiting and interruptions in the supply chain, Pettit *et al.* (2013) identified companies working to combat and mitigate these effects. Machado *et al.* (2018) present cases of companies with different levels of resilience for combating counterfeiting. SCRM, traceability and technologies like RFID have helped with the process of risk mitigation in counterfeiting.

Countries like the USA, the United Kingdom, China and Germany are leaders in SCM research into counterfeiting. This is explained by the fact that some manufacturing companies have their headquarters in these countries, and this is a major concern among these companies. At the same time, this creates research opportunities for SCM scholars. Countries like Australia, Brazil, Canada, Italy and Mexico are already beginning to develop studies on this topic.

Gaps Identified

Some future directions are indicated by this study. The results highlighted the risk of counterfeiting in companies and their supply chains and how it is being addressed by SCM researchers. Research in this vein should, therefore, improve understanding of this subject. Another aspect related to counterfeiting is the focus on the customer (or purchaser in a B2B relationship) for counterfeit products and their potential motivations.

Finally, other theoretical approaches may expand the understanding of the phenomenon of counterfeiting. Stakeholder theory can support studies in this sense, since the actions of internal and external actors can affect the strategic decisions of the firm. Finally, other methods can be used for exploring the behavioral aspects involved in counterfeiting, such as experiments and focus groups.

Limitations

As with any literature review, even though this paper adopts a structured methodology for looking for and selecting the articles that were discussed, it has its limitations because the results might be different if the research strands are changed. Therefore, it is possible that some studies have not been identified in this process. The scope of this review, however, allows readers to seek additional reading based on this study and to develop underlying studies.

References

- Ahmadi, R., Iravani, F. and Mamani, H. (2015). "Coping with Gray Markets: The Impact of Market Conditions and Product Characteristics." *Production and Operations Management Society*, Vol.24 No. 5, pp. 762-777.
- Ames, J. and Souza, D.Z. (2012). "Falsificação de medicamentos no Brasil", *Revista de Saúde Pública*, Vol. 46 No. 1, pp. 1-6.
- Anand, G. and Gray, J.V. (2017). "Strategy and organization research in operations management", *Journal of Operations Management*, Vol. 53 No.1, pp. 1-8.
- Associação da Indústria Farmacêutica de Pesquisa (INTERFARMA). (2017). "Guia 2017", available at: <https://www.interfarma.org.br/guia/guia-2017/apresentacao/>
- Baize, D. (1999). "De la contrefaçon à l'imitation", *Revue Française de Gestion*, Vol. 124 No. 1, pp. 76-81.

- Bak, O. (2018) "Supply chain risk management research agenda – from a literature review to a call for future research directions", *Business Process Management Journal*, Vol. 24 No. 2, pp.567-588.
- Bamossy, G. and Scamon, D.L. (1985). "Product counterfeiting: consumers and manufacturers beware", *Advances in Consumer Research*, Vol. 12 No. 1, pp. 334-339.
- Barney, J., Wright, M. and Ketchen, D.J. Jr (2001), "The resource-based view of the firm: ten years after 1991", *Journal of Management*, Vol. 27 No. 6, pp. 625-641.
- Bavar, A., Tahmasebifard, H. and Kheiry, B. (2017). "Studying the Factors Affecting Consumers Complicity with Counterfeit Products", *Business Management and Strategy*, Vol. 8 No. 1, pp. 39-57.
- Berman, B. (2008). "Strategies to detect and reduce counterfeiting activity", *Business Horizons*, Vol 51 No. 1, pp. 191-199.
- Bian, X. and Moutinho, L. (2011). "Counterfeits and branded products: effects of counterfeit ownership", *Journal of Product and Brand Management*, Vol. 20 No. 5, pp. 379-393.
- Chakraborty, G., Alfred, A.T., Sukhdial, A.S. and Bristol T. (1997). "Use of negative cues to reduce demand for counterfeit products", *Advances in Consumer Research*, Vol. 24 No. 1, pp. 345-349.
- Cho, S.H., Fang, S. and Tayur, S. (2015). "Combating strategic counterfeiters in licit and illicit supply chains", *Manufacturing & Service Operations Management*, Vol. 17 No. 3, pp. 273-289.
- Chopra, S. and Sodhi, M.S. (2004). "Managing risk to avoid supply chain breakdown", *MIT Sloan Management Review*, Vol. 46 No. 1, pp. 53-61.
- Christopher, M. and Lee, H.L. (2004). "Mitigating supply chain risk through improved confidence", *International Journal of Physical Distribution and Logistics Management*, Vol 34 No. 5, pp. 388- 396.
- Christopher, M. and Peck, H. (2004). "Building the resilient supply chain", *The International Journal of Logistics Management*, Vol. 15 No. 2, pp. 1-14.
- Dasu, S., Ahmadi, R. and Carr, S. M. (2012). "Gray markets, a product of demand uncertainty and excess inventory", *Production and Operations Management Society*, Vol. 21 No. 6, pp. 1102-1113.
- Drug Enforcement Administration (DEA) (2016). *DEA Report: counterfeit pills fueling U.S. fentanyl and opioid crisis*. DEA Strategic Intelligence 2016. available at: <https://www.dea.gov/press-releases/2016/07/22/dea-report-counterfeit-pills-fueling-us-fentanyl-and-opioid-crisis>.
- Dubois, B. and Duquesne, P. (1993). "The market for luxury goods: income versus culture", *Europe Journal of Marketing*, Vol. 27 No. 1, pp. 35-44.
- Durach, C.F., Glasen, P.C. and Straube, F. (2017) "Disruption causes and disruption management in supply chains with Chinese suppliers: Managing cultural differences", *International Journal of Physical Distribution & Logistics Management*, Vol. 47 No. 9, pp.843-863.
- Dwivedi, G., Srivastava, S.K. and Srivastava, R.K. (2017) "Analysis of barriers to implement additive manufacturing technology in the Indian automotive sector", *International Journal of Physical Distribution & Logistics Management*, Vol. 47 No. 10, pp.972-991.
- Engebø, A., Lohne, J., Rønn. P.E. and Lædre, O. (2016). "Counterfeit materials in the Norwegian AEC-Industry", in *Proc. 24th Ann. Conf. of the Int'l. Group for Lean Construction 2016*, Boston, 2016, sept.11, USA, pp. 13–22.
- Eisend, M. and Schuchert-Güler, P. (2006). "Explaining counterfeit purchase: a review and preview", *Academy of Marketing Science Review*, Vol. 12 No. 1, pp. 1-26.
- European Union Intellectual Property Office [EUIPO]. (2017). "Situation report on counterfeiting and piracy in the European Union". available at:

https://euipo.europa.eu/tunnelweb/secure/webdav/guest/document_library/observatory/documents/reports/Situation%20Report%20EUIPO-Europol_en.pdf.

Fratochi, L., Ancarani, A., Barbieri, P., Di Mauro, C., Nassimbeni, G., Sartor, M., Vignoli, M., Zanoni, A. (2016). “Motivations of manufacturing reshoring: an interpretative framework”, *International Journal of Physical Distribution & Logistics*, Vol. 46 No. 2, pp. 98-127.

Gray, J.V., Roth, A.V. and Leiblein, M.J. (2011). “Quality risk in offshore manufacturing: Evidence from the pharmaceutical industry”, *Journal of Operations Management*, Vol. 29, pp. 737-752.

Grenoble, W.L., Ruamsook, K., Bechtel, L., Craighead, C. and Wilkerson, T. (2014). “Counterfeiting: an omnipresent, critical and yet elusive supply chain issue”, *Supply Chain Management Review*, Vol. 7, No. 1, pp. 40-46.

Grossman, G. and Shapiro, C. (1988). “Counterfeit-product trade”, *The American Economic Review*, Vol. 78 No. 1, pp. 59-75.

Hartman, P. L., Ogden, J. A. and Hazen, B. T. (2017). “Bring it back? An examination of the insourcing decision”, *International Journal of Physical Distribution & Logistics Management*, Vol. 47, pp.198-221

Harvey, M.G. (1997). “Industrial product counterfeiting: problems and proposed solutions”, *Journal of Business and Industrial Marketing*, Vol. 2 No. 4, pp. 5-13.

Helfat, C.E. and Peteraf, M. (2003), “The dynamic resource-based view: capability lifecycles”, *Strategic Management Journal*, Vol. 24 No. 10, pp. 997-1010.

Huq, F., Pawar, K. S. and Rogers, H. (2016). “Supply Chain Configuration Conundrum: How does the Pharmaceutical Industry Mitigate Disturbance Factors?”, *Production Planning & Control*, Vol. 27, No. 14, pp. 1206-1220.

Hurtado, R.H. and Lasmar, M.C. (2014). “Medicamentos falsificados e contrabandeados no Brasil”, *Caderno de Saúde Pública*, Vol. 30 No. 4, pp. 891-895.

Hussain, S (2010). “Accounting journals and the ABS quality ratings”, *The British Accounting Review*, Vol. 42, pp. 1–16.

Instituto de Desenvolvimento Econômico e Social de Fronteiras (IDESF). (2015). “Custo do Contrabando”, available at: <http://www.idesf.org.br/exibir-post/o-custo-do-contrabando>

Jüttner, U. and Maklan, S. (2011). “Supply chain resilience in the global financial crisis: an empirical study”, *Supply Chain Management: An International Journal*, Vol. 16 No. 4, pp. 246-259.

Jüttner, U., Peck, H. and Christopher, M. (2003). “Supply chain risk management: outlining an agenda for future research”, *International Journal of Logistics: Research and Applications*, Vol. 6 No. 4, pp. 197-210.

Kitchenham, B. (2004). “Procedures for undertaking systematic reviews.” *Technical Report TR/SE-0401*, Keele University and NICTA.

Knemeyer, A. M, Zinn, W. and Eroglu, C. (2009). “Proactive planning for catastrophic events in supply chains”. *Journal of Operations Management*, Vol. 27, pp. 141–153.

Lee, H.L. (2004). “The triple-A supply chain.” *Harvard Business Review*, Available at: <https://hbr.org/2004/10/the-triple-a-supply-chain>.

Lee, I, and Lee, B. C. (2010). “An investment evaluation of supply chain RFID technologies: A normative modeling approach”, *International Journal of Production Economics*, Vol. 125, pp. 313–323.

Machado, S.M. and Bandeira-de-Mello, R. (2013). “A gestão estratégica e a ilegalidade: um estudo de caso do combate à pirataria no Brasil”, *Revista Brasileira de Gestão de Negócios*, Vol. 15 No. 47, pp. 186-203.

- Machado, S.M., Paiva, L.E. and Silva, E.M. (2018). "Counterfeiting: addressing mitigation and resilience in supply chains", *International Journal of Physical Distribution & Logistics Management*, Vol. 37 No. 5, pp. 557-576.
- Manuj, J. and Mentzer, J. T. (2008). "Global supply chain risk management", *Journal of Business Logistics*, Vol. 29 No. 1, pp. 133-155.
- Maruchek, A., Greis, N., Mena, C. and Cai, L. (2011). "Product safety and security in the global supply chain: Issues, challenges and research opportunities", *Journal of Operations Management*, Vol. 29, pp. 707-720.
- Mingers, J. and Liying, Y. (2017). "Evaluating journal quality: A review of journal citation indicators and ranking in business and management", *European Journal of Operational Research*, Vol. 257 No. 1, pp. 323-337.
- Morris, H., Harvey, C. and Kelly, A. (2009). "Journal rankings and the ABS Journal Quality Guide". *Journal of Management Decision*, Vol. 47 No. 9, pp. 1441-1451.
- Mehrjerdi, Y.Z. (2013). "A framework for Six-Sigma driven RFID-enabled supply chain systems", *International Journal of Quality & Reliability Management*, Vol. 30 No. 2, pp. 142-160.
- Mintzberg, H. (1983). "*Designing effective organizations*", 2 ed. Prentice-Hall, New Jersey, NY.
- Ng, S.C.H., Zhao, X, Fan, X. and Rungtusanatham, J.M. (2014). "TQM and brand-building by Chinese original brand manufacturers: impact on business performance", *International Journal of Production Research*, Vol. 52 No. 3, pp. 825-846.
- Organization for Economic Co-Operation and Development (OECD). (2016). "*Trade in Counterfeit and Pirated Goods: Mapping the Economic Impact*", OECD Publishing, Paris.
- Papert M., Rimpler, P. and Pflaum, A. (2016). "Enhancing supply chain visibility in a pharmaceutical supply chain: Solutions based on automatic identification technology", *International Journal of Physical Distribution & Logistics Management*, Vol. 46 No. 9, pp. 859-884.
- Pettit, T.J., Fiksel, J and Croxton, K.L. (2010). "Ensuring supply chain resilience: development of a conceptual framework", *Journal of Business Logistics*, Vol. 31 No. 1, pp. 1-21.
- Pettit, T.J., Croxton, K.L. and Fiksel, J. (2013). "Ensuring supply chain resilience: development and implementation of an assessment tool", *Journal of Business Logistics*, Vol. 34 No.1, pp. 46-76.
- Ridley, D. (2008). "*The literature review: a step-by-step guide for students*", Sage, London.
- Sanders, N.R., and Wagner, S.M. (2011). "Multidisciplinary and multimethod research for addressing contemporary supply chain challenges", *Journal of Business Logistics*, Vol. 32 No. 4, pp. 317-23.
- Schroeder, R.G., Anderson, J.C. and Cleveland, G. (1986). "The content of manufacturing strategy: An empirical study", *Journal of Operations Management*, Vol. 6 No. 3, pp. 405-415.
- Shu, J. and Barton, R. (2012). "Managing supply chain execution: monitoring timeliness and correctness via individualized trace data", *Production and Operations Management Society*, Vol. 21 No. 4, pp. 715-729.
- Skinner, W. (1969). "Manufacturing – the missing link in corporate strategy", *Harvard Business Review*, Vol. 47 No. 3, pp. 5-14.
- Skowronski, K. and Benton Jr., W.C. (2018). "The influence of intellectual property rights on poaching in manufacturing outsourcing", *Production and Operations Management*, Vol. 27 No. 3, pp. 531-552.
- Stevenson, M. and Busby, J. (2015). "An exploratory analysis of counterfeiting strategies: towards counterfeit-resilient supply chain", *International Journal of Operations and Production Management*, Vol. 35 No. 1, pp. 110-144.

- Stranieri, S., Orsi, L. and Banterle, A. (2017). "Traceability and risks: an extended transaction cost perspective", *Supply Chain Management: An International Journal*, Vol. 22 No. 2, pp.145-159.
- Svensson, G.A. (2002). "Conceptual framework of vulnerability in firms' inbound and outbound logistics flows", *International Journal of Physical Distribution and Logistics Management*, Vol. 32 No. 2, pp. 110-134.
- Tang, C.S. (2006). "Perspectives in supply chain risk management", *International Journal of Production Economics*, Vol. 103, pp. 451–488.
- Tang, C. and Tomlin, B. (2008). "The power of flexibility for mitigating supply chain risks". *International Journal of Production Economics*, Vol. 116, pp. 12–27.
- Taylor, A. (2005) "An operations perspective on strategic alliance success factors: An exploratory study of alliance managers in the software industry", *International Journal of Operations & Production Management*, Vol. 25 No. 5, pp.469-490.
- Vilko, J.P.P. and Hallikas, J.M. (2012). "Risk assessment in multimodal supply chains", *International Journal of Production Economics*, Vol. 140, pp. 586-595.
- Vivek, S. D., Banwet, D. K. and Shankar R. (2007). "Analysis of interactions among core, transaction and relationship-specific investments: The case of offshoring", *Journal of Operations Management*, Vol. 26, pp. 180–197.
- Vosgerau, D.S.R. and Romanowski, J.P. (2014). "Estudo de revisão: implicações conceituais e metodológicas", *Revista Diálogo e Educação*, Vol. 14 No. 41, pp. 165-189.
- Wagner, S.M. and Bode, C. (2008). "An empirical examination of supply chain performance along several dimensions of risk", *Journal of Business Logistics*, Vol. 29 No.1, pp. 307-25.
- Webster, J. and Watson, R.T. (2002). "Analyzing the past to prepare for the future: writing a literature review", *MIS Quarterly*, Vol. 26 No. 2, pp.13-23.
- Wilcock, A.E. and Boys, K.A. (2014). "Reduce product counterfeiting: an integrated approach", *Business Horizons*, Vol. 57, pp. 279-288.
- World Health Organization (WHO). (1999). "*Counterfeit drugs: guidelines for the development of measures to combat counterfeit drugs*", Available at: http://whqlibdoc.who.int/hq/1999/WHO_EDM_QSM_99.1.pdf .
- Wowak, K.D, Craighead, C.W. and Ketchen Jr.,D.J. (2016). "Tracing bad products in supply chains: the roles of temporality, supply chain permeation, and product information ambiguity", *Journal of Business Logistics*, Vol. 37 No. 2, pp. 132-151.
- Yang, C.C. and Wei, H.H. (2013). "The effect of supply chain security management on security performance in container shipping operations", *Supply Chain Management: An International Journal*, Vol. 18 No. 1, pp.74-85
- Zailani, S.H., Subaramaniam, K.S., Iranmanesh, M., and Shaharudin, M.R. (2015). "The impact of supply chain security practices on security operational performance among logistics service providers in an emerging economy: Security culture as moderator", *International Journal of Physical Distribution & Logistics Management*, V. 45 No.7, pp.652-673.
- Zsidisin, G.A. (2003). "Managerial perceptions of supply risk", *Journal of Supply Chain Management*, Vol. 39 No. 4, pp. 14-26.