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Distribution trends in Industry 4.0: Case Study of a major soft drink multinational enterprise in Latin America

Verteilungstendenzen in Industrie 4.0: Fallstudie eines multinationalen Großunternehmens für Erfrischungsgetränke in Lateinamerika

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This study comprises a literature review of logistics 4.0 and distribution techniques in smart cities. The results of the literature review are then used to offer innovative solutions for the distribution needs of a new sales channel of a major soft drink multinational enterprise in Ecuador, Latin America. The objectives of this study are achieved through the use of two methodologies: The Literature Review Methodology for Scientific and Information Management, through its structuring and systematization; and the Design for Six Sigma (DFSS) methodology, with the integration of marketing and market segmentation concepts for the determination of an existing local opportunity. The literature review shows that Information and Communication Technology (ICT) uses technologies such as the Internet of Things (IoT), cyber-physical systems (CPS), and Big Data to analyze, control and manage data that allows an efficient flow of information for decision-making purposes. ICT enables smart cities and smart factories to develop flexibility and quick adaptation to market changes, as well as to generate green logistic practices that comply with environmental regulations. Regarding the case study, the present study starts by analyzing the market needs for the implementation of the sales channel "At Work" for a multinational company dedicated to the production and distribution of soft drinks. Finally, the study presents innovative alternatives for distribution, focused on the results of the literature review, in order to optimize the delivery of soft drinks to the final customer of the "At Work" sales channel.

[Keywords: Logistics 4.0, distribution, smart cities, smart factories, market segmentation]

Die vorliegende Studie ist eine Literaturrecherche zu Logistik 4.0 und Vertriebstechniken in Smart Cities. Die Ergebnisse der Literaturrecherche werden dann verwendet, um innovative Lösungen für die Vertriebsanforderungen eines neuen Vertriebskanals eines multinationalen Großunternehmens für Erfrischungsgetränke in Lateinamerika anzubieten. Die Ziele der vorliegenden Studie werden durch die Verwendung von zwei Methoden erreicht: Die Literaturprüfungsmethodik für das Wissenschafts- und Informationsmanagement, durch ihre Strukturierung und Systematisierung; und die Design for Six Sigma (DFSS) -Methode mit der Integration von Marketing- und Marktsegmentierungskonzepten zur Ermittlung einer vorhandenen lokalen Chance. Die Literaturrecherche zeigt, dass die Informations- und Kommunikationstechnologie (IKT) Technologien wie das Internet der Dinge (IoT), Cyber-Physical Systems (CPS) und Big Data verwendet, um Daten zu analysieren, zu steuern und zu verwalten, die einen effizienten Informationsfluss ermöglichen Entscheidungen fällen. Mit IKT können Smart Cities und Smart Factories Flexibilität entwickeln, sich schnell an Marktveränderungen anpassen und umweltfreundliche Logistikpraktiken entwickeln, die den Umweltvorschriften entsprechen. In Bezug auf die Fallstudie beginnt die vorliegende Studie mit der Analyse des Marktbedarfs für die Implementierung des Vertriebskanals "At Work" für ein multinationales Unternehmen, das sich auf die Herstellung und den Vertrieb von Erfrischungsgetränken spezialisiert hat. Schließlich werden in der Studie innovative Distributionsalternativen vorgestellt, die sich auf die Ergebnisse der Literaturrecherche konzentrieren, um die Lieferung von Erfrischungsgetränken an den Endkunden des Vertriebskanals "At Work" zu optimieren.

[Schlüsselwörter: Logistik 4.0, Distribution, Smart Cities, Smarte Fabriken, Marktsegmentierung]

1 INTRODUCTION

Vanguard technology and services have caused an accelerated evolution in the world; for this reason, industries must adjust and make changes in their core strategies, including the addition of an environmental consciousness approach (Barreto, Amaral & Pereira, 2017). Progress in the development of knowledge and changes in the industry have been promoters of the transformation of society; this has been evident since approximately the second half of the 18th century, when the invention of the

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steam engine led the way to the first industrial revolution (Pereira & Romero, 2017). In chronological order, by the second half of the 19th century, the second industrial revolution started, and was characterized by mass production and the use of chemical and electrical energy for industrial processes (Pereira & Romero, 2017). One century later, third industrial revolution began, with the boom of computers and electronics, which enabled the automation of processes through the development of technologies and mechanisms (Pereira & Romero, 2017).

Nowadays we speak of a fourth industrial revolution, known as "Industry 4.0", which focuses on the digitalization of processes and services, and the creation of new business models (Zezulka, Marcon, Vesely, & Sajdl, 2016). Some of the new technologies that lead the path to this revolution are: cyber-physical systems (CPS), internet of things (IoT), internet of services (IOS), robotics, Big Data, cloud manufacturing, 3D printing and augmented reality (Pereira & Romero, 2017). These information and communication technologies enable industries to increase their efficiency and competitiveness' level (Barreto, Amaral & Pereira, 2017). Additionally, these technologies enable companies to connect directly with their customers, to whom they must provide services and/or products at the lowest cost (Kiba-Janiak, 2016). The use of such technologies allows real-time communication between the customer and the company.For instance, Information and Communication Technology (ICT) transforms industries by using wireless and 5G communication technologies, smart sensors, among others (Pereira, Barreto & Amaral, 2017; Quin, Lui & Grosvenor, 2016). Therefore, as the business model is transformed, the supplier - customer relationship is also transformed, allowing the customer to acquire prominence and driving company actions towards meeting customer needs (Gregor et al., 2017).

Given this transformation, the Ecuadorian headquarters of a multinational soft drinks enterprise aims to deepen into the fourth industrial revolution by researching new and better practices for the distribution of their product (Ahmed, 2017). In this line, the abovementioned company sees the segment formed by companies' employees as a new potential direct sales channel, which they called "*At Work*", whose needs can be satisfied with mechanisms that use new technologies and logistics 4.0 initiatives (Ahmed, 2017). The interest in the study of this new sales channel appears under the premise that Ecuadorian companies have few choices for their employees to hydrate during the work day, which can have the potential to affect the body's self-regulation causing acute and/or chronical diseases such as: urinary tract infection, bronchopulmonary disorders, constipation, among others. (Stanhewicz. & Kenney, 2015). Additionally, low hydration may impact a person's performance and productivity (Stanhewicz. & Kenney, 2015). The feasibility and supply chain strategies of this new sales channel is determined through the combination of marketing, logistics 4.0 and distribution techniques in smart cities. The main reason for this combination of techniques is based on the convergence of both branches regarding increasing customer satisfaction by developing effective commercial processes (Lynch & Whicker, 2008). Therefore, this research, aims to combine the results from different studies on industry 4.0, logistics management, and market research of the new sales channel, in order to provide with avant-garde choices in the distribution of this major multinational enterprise of soft drinks

Methodology

This research study is divided in two stages, the first stage comprises of a literature review, the second stage includes a market study and recommendations of 4.0 innovative alternatives for product distribution in the particular case study. The description of the methodology of each stage is the following:

The methodology proposed by Gómez-Luna, Navas, Aponte-Mayor and Betancourt-Buitrago (2014) in their publication *Literature Review Methodology for Scientific and Information Management, through its Structuring and Systematization* was followed in order to conduct the literature review of the present study. This methodology was selected since it develops an organized and methodic four-stage process: problem definition, search of information, organization of information, and analysis of information.

- Stage 1 – Problem Definition: at this stage, the main objectives of the literature review are determined, considering the historic context of the industry and its evolution in time. Additionally, the key terms related to this research topic are defined and established, these are: "Industry 4.0 AND logistics", "Logistics 4.0 AND distribution", and "Industry 4.0 AND logistics AND distribution".
- Stage 2 – Search of information: here, the search of information is performed using several digital data bases such as JSTOR, EBSCO, ScienceDirect-Elsevier, among others. The papers were selected based on titles, summaries, and key words.
- Stage 3 – Organization of information: the software *NVivo* is used to organize the information based on key words or nodes (technically denominated by the software) and their similarity analyzed throughout the documents' content. In this way, the most used words in the publications were obtained and grouped.
- Stage 4 – Analysis of information: the literature review results are reported and organized on the basis of concept sharing and software-defined groups, these can be observed in Chart 1, which shows the grouping of publications previously read and analyzed considering words' similarities. In this case, each color in Chart 1 belongs to a specific group of publications, within

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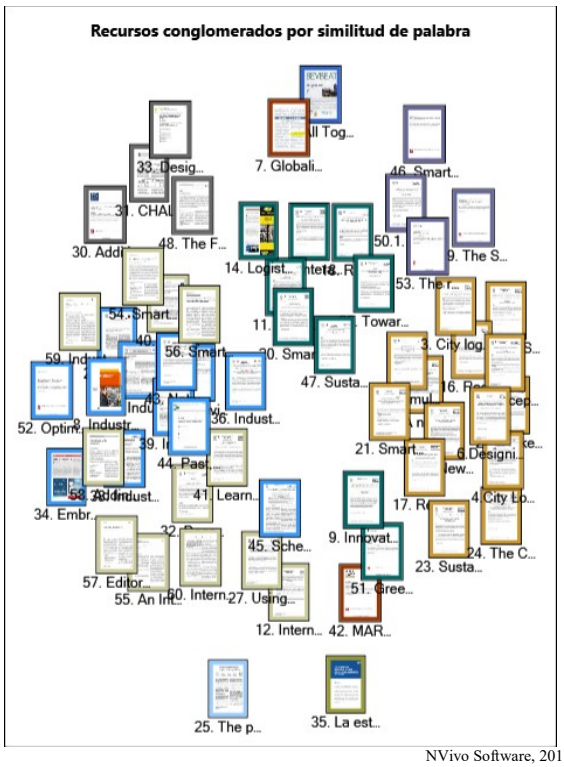
which they are associated according to the content of equivalent terms.



NVivo Software, 2018

Chart1. Resources grouped by word similarity, as a result of the Nvivo software.

In the case study, the methodology *Design for Six Sigma (DFSS)* is applied, which was originated in General Electric at the end of the 1990s (Werkema, C., 2012). According to Michael Winkler, this is a systematic process that guarantees that a product or service is operating within the ideal quality standards, it is also known as reliability design (2007). This methodology considers the customer's requirements as a starting point (Smith, 2016). To do so, it promotes following steps divided into the following phases: Define, Measure, Analyze, Optimize and Verify [DMAOV] (Rafique, 2013).

In the definition phase, the potential market demand is determined, which indicates the amount of products the customers will be willing to buy in a specific period of time (Fernández, 2009). In order to identify the potential market, the marketing tool *industrial market segmentation* is used, since it allows to divide the general population into groups that share at least one homogeneous characteristic (Fernández, 2009). Taking into account that the *"At Work"* beverage service will be offered to occupationally active people; demographic, operation, localization and relation variables are considered for the division and segmentation (Fernández, 2009). Additionally, a Pareto analysis is made to find *"a distribution of data frequencies of attributes ordered per category"* (Montgomery, 2013). This analysis reveals the principle of relation 80/20 known as "few vital, many trivial" (Sales, M., 2006). The purpose of this analysis is to know the amount of employees who work in 80% of the companies registered in the city of Quito, Ecuador, so the company can focus on them.

In the measuring phase, considering that the study identifies market opportunities, the potential demand for the new sales channel is determined by conducting a survey to the target population. The surveys were designed in such way that the respondent could give brief and clear answers. Equation 1 was applied to determine the survey sample size:

$$n = Z_{\alpha/2}^2 \frac{(p)(q)}{i^2} \qquad (1)$$

For analyzing the sample size, an infinite population is considered as it is more efficient economically and technically, given the fact that the target population exceeds 100,000 individuals (García, 2008). Subsequently, in order to make a more direct and less expensive process, convenience sampling is used. For this sampling procedure the percentages of presence of the companies in the surveys were validated according to their size in the records of the *Companies' Superintendence* (Baca Urbina, 2013).

In the analysis phase, the quantification of the survey results regarding potential customers for the new market segment is made. Furthermore, the sectors of greater demand, and preferences regarding types of containers and beverage sizes to be offered through the new sales channel are determined. After obtaining the market size, it is necessary to make an estimation of the total demand. With this purpose, equation 2 is applied (Fernández, 2009). This equation offers an approximate demand perspective when segmenting the market adequately, as it has an error margin proportional to the study's factors and variants (Fernández, 2009).

$$Q = nqp \qquad (2)$$

Where Q is the total market demand in monetary units [USD], n is the number of purchasers in the market, q is the quantity purchased by one buyer in a year [milliliters/year] and p is the price of the average unit [USD/milliliter] (Fernández, 2009).

Finally, the analysis phase, alternatives for product distribution are proposed, taking into account the results of the literature review focused on logistics 4.0 and contemplating new technologies. In addition, cases of application of the new trends in different parts of the world are compared in order to obtain possible implementation opportunities in the Ecuadorian market. It is important to note that the last two phases of the DFSS methodology (optimize and verify) were not developed because the time and cost involved in developing a pilot test exceeds the scope of the study.

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2 LITERATURE REVIEW

First of all, on the basis of compiled publications, it is found that 35% of the 60 documents reviewed (21 documents) were published in the year 2017. Also, 43.33% (26 documents) were articles and 43.33% were conference proceedings. Finally, 58 publications (96.67%) met more than 50% of the search criteria (based on key terms).

Secondly, the keywords established in a previous stage of the research enabled the execution of a qualitative analysis that provided a preliminary view of the different research approaches that have been studied in terms of industry 4.0, logistics and distribution. The approaches found are: industry 4.0 emergence and characteristics; combination of logistics with innovations and added technological applications, better known as logistics 4.0; and the benefits of future distribution systems (Barreto et al., 2017). The most relevant results of this analysis are shown below.

Emergence and Characteristics of Industry 4.0

According to the World Economic Forum, the Fourth Industrial Revolution refers to the continuity of the technological developments arising from the inclusion of digital, physical and biological systems; smart industry; internet of things and big data (2016). In addition, according to García Ferrari, in his article Design and the Fourth Industrial Revolution. Dangers and Opportunities for a Mutating Discipline, this revolution places Internet, 3D printers and genetic algorithms as the main technical achievements, and green energies as a source of energy (2017). In the same way, Schrand indicates that in the near future, it is likely that basic logistics could be routinely redirected to supply materials for the manufacture of pieces in the field, representing time and money savings (2016).

In the research studies reviewed, it is evident that the authors do not reach a consensus of the year in which this revolution began. However, there are certain sporadic events that have occurred since the year 2000 as flashes of the beginning of Industry 4.0. Thus, the discovery of new sources of energy, development of high technology and reconceptualization of transportation modes, gave way to the industrial revolution changes (Prisecaru, 2016).

Linked to the concept of the Fourth Industrial Revolution, the term "industry 4.0" appears in 2011, in an article published by the German government, as a result of a high-tech development strategy focused on year 2020 (Pereira & Romero, 2017). In this sense, Industry 4.0 addresses the development of manufacturing technologies to enable higher levels of interconnectivity, generating greater communication between machines and local data processing (Embracing Industry 4.0., 2015). Tae Kyung Sung calls this a "smart factory" (2017), which works autonomously thanks to the cyber physical system (Tjahjono, Esplugues, Ares & Peláez, 2017). For Wolfgang Schroeder, industry 4.0 grows hand in hand with the areas of life and the economy, since this development aims to establish technological standards to obtain market leadership (2015). To achieve this goal, it is vital to promote communication between people, machines and resources (Baena, Guarina, Mora, Sauza & Retat, 2017). This objective is attained through the use of technologies such as: The Internet of things (IoT), the Internet of services (IoS) and the Internet of people (IoP) (Zezulka, Marcon, Vesely & Sajdl, 2016). Consequently, industry 4.0 does not determine the end of the industrial job, but its transformation (Schroeder, 2015).

Since Industry 4.0 is the evolution of multiple factors, it promises to provide greater flexibility, massive personalization, greater speed, better quality and greater productivity in the manufacture and services products (Zhong, Xu, Klotz & Newman, 2017). As a result, companies can face various challenges, implementing completely new business models and solutions that integrate industry 4.0 with logistics 4.0 (Rosenbach & Köckler, 2017; Zheng, et al., 2018).

Logistics 4.0: Innovations and added technological applications

In the literature review process, it was found that logistics 4.0 is defined as an efficient and profitable approach that coordinates the plan, design, and control the supply chain processes (Jabeur, Al-Belushi, Mbarki & Gharrad, 2017), optimizing workflow and reducing delivery times (Kayikci, 2018). Taking into account the multidisciplinary and highly dynamic nature of logistics 4.0, digitalization enables industry to have product information available at the right time and place (Jabeur et al., 2017); and generates an impact on the economic, environmental, and social dimensions of sustainability (Kayikci, 2018).

Regarding the previous point, logistics within industry 4.0 requires planning that interconnects real data from the logistic resources control system with the monitoring system, that is, an interactive projection planning and process simulation (Furmann, Furmannová & Więcek; 2017). This smart logistics principle requires information technologies (IT), such as radio frequency identification (RFID) that allows controlling the condition of logistics objects, generating data sources for documentation, and allowing control in the supply chain (Kirch, Poenicke & Richter, 2017). Logistics solutions that use IT generate value to the customer, who is more and more demanding in terms of installment of delivery services, product availability, and reliability (Witkowski, 2016).

However, smart logistics is also linked to environmental problems, in fact Wu and Dunn show that environmental problems can affect numerous logistics decisions, including the acquisition of raw materials, and other decisions regarding logistics inputs and outputs throughout the value chain (1995, cited by Murphy & Poist,

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2000). The importance that companies are giving to the environmental objectives is generating benefits in the current economy. Such strategies that may reduce operating costs are considered, while promoting environmental value by reducing waste (Sxoinaraki & Panou, 2016). Responsible logistics programs should be based on regulations such as ISO 14000, which is an environmental standard developed by the International Organization for Standardization (ISO) (Murphy & Poist, 2000).

Under these parameters, Wolfgang Schroeder indicates that digitization leads to a more efficient flow of goods and information, reducing warehouse inventories and enabling efficient facilities (2015). Behind this alternative are the cyber physical systems (CPS), whose operations are the sum of physical and engineering systems that monitor, coordinate, control and integrate operations (Barreto et al., 2017). In coordination with this topic, Tae Kyung Sung points out that the Internet of Things (IoT) has a direct relationship with cyber-physical systems (CPS) that communicate and cooperate with each other through internet services (2017).

Thus, in the context of innovation, IoT is a concept that encompasses a variety of technologies and research areas that aim to extend the existing internet to real-world objects (Sánchez, Ranasinghe, Harrison & McFarlane, 2012). In order to achieve this goal, industries make use of interoperability, which is the capacity of a product or a system to operate with others (Qin, Liu & Grosvenor, 2016). The combination of IoT and cloud computing enables the optimal management of information, associated in real time with geo-positioning and product tracking (GPRS / GPS), radio frequency identification (RFID), sensor technologies, the logic of embedded objects and Internet-based information infrastructure (Gnimpieba, Nait-Sidi-Moh, Durand & Fortin, 2015, Sánchez et al., 2012, Xu & Li, 2014). This advanced technology paradigm generated a restored and improved logistics management of the global supply chain that allows a possible dramatic reduction of inefficiencies, costs, emissions and social impacts (Accorsi, Bortolini, Baruffaldi, Pilati & Ferrari, 2017).

Therefore, in complex industrial ecosystems or large companies, success depends on a complete transformation of the value chain (Poonpakdee, Koiwanit, & Yuangyai, 2017). In this way, the integration of advanced communication technologies leads to the expansion of IoT at the industrial scale, known as the industrial internet of things (IIoT) that can be used in various areas, such as: smart transportation systems, environmental monitoring, security surveillance, among others (Bai, 2017). IIoT works through a network connection, which needs an infrastructure that has a remote interconnection of industrial applications and users, through technologies, such as distributed computing, ubiquitous computing and the cloud (Lu & Cecil, 2016; Maglaras et al., 2017).

Hence, Ivanov, Sokolov and Ivanova, affirm that the alignment of business processes and information systems enable a new quality of support for decision making, and supply networks increase; which include: cloud computing, technologies, methods and tools that seek to achieve a higher level of operational and productive efficiency, as well as a higher level of automation (2016). The result of this transforming action, are benefits that range from labor costs savings, high use of storage space, better flow of materials, greater inventory control and lower incidence of loss or theft (Hausman, Schwarz & Graves, 1976).

Logistics 4.0 applied to cities

From the 8th International Conference on Environmental Systems, Networks and Technologies, a report was drawn up showing the problem of collaboration between logistics objects and a proposal to solve it, based on the knowledge of the characteristics and role of multi-agent systems for intelligent logistics or "Smart Logistics" (Jabeur et al., 2017). These facts reveal that solutions and approaches, where a large number of everyday items are being transformed into reactive logistics assets, are the product of the nascent progress of ubiquitous and mobile communication and computing technologies (Jabeur et al., 2017).

The search process shows that the most important logistics issues currently include infrastructure and space restrictions related to the time and place of deliveries, inefficient processes, loading / unloading of goods, the increase of energy costs and high CO2 emissions. For this reason, the main orientation of sustainable city logistics is the cooperation between suppliers, customers and public administration (Kaufa, 2016).

Something similar is shown by Nathanail, Adamosa and Gogasa in their publication A Novel Approach for Assessing Sustainable City Logistics, by making a framework for city logistics considering multi-criteria decisions of various stakeholders (2016). The contribution of these authors was the estimation of a "logistics sustainability index of demand" and "sustainability index of supply logistics" (Nathanail et al., 2016). Similarly, in 2012, this topic was presented under the premise of analyzing the urban modeling of goods from the stakeholders' perspective. Many researchers have concluded that the generation of urban freight traffic depended to a large extent, on the supply and demand activities of the trade and transportation markets (Anand, Quak, van Duin & Tavasszy, 2012).

Furthermore, Taniguchi mentions that city logistics may contribute to creating more efficient and ecological urban freight transportation systems, through the application of information and communication technologies (ICT) and smart transportation systems (2014). To achieve these objectives, the author used the cycle: Plan, Do, Verify and Act (Taniguchi, 2014). It is important to

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emphasize that, in order to consolidate the systems mentioned by the author, it is necessary to consider the characteristics of the area where they will be implemented, such as, commercial activity density, schedule-based vehicle access control, and the licenses that vehicles need to circulate and deliver in that area (Navarro, Roca-Riu, Furió & Estrada, 2016).

According to Kiba-Janiak, there are several projects on passenger and freight urban transportation that have been successfully implemented worldwide (2016). In the publication Key Success Factors for City Logistics from the Perspective of Various Groups of Stakeholders, this author indicates that city logistics' objectives are primarily sustainability, mobility and quality of life (Kiba-Janiak, 2016). Based on these points, companies must conduct a thorough analysis of the organization, in order to identify their strategic potential in the field of city logistics through the use of key success factors to carry out successful urban logistics projects (Kiba-Janiak, 2016).

To be more specific, Kiba-Janiak mentions that the list of success factors for urban logistics must be created specifically for each stakeholder, contemplating their expectations (2016). For this reason, she proposes using the Kauffman Firm Survey (KSF) methodology, as it is a support tool in the strategic analysis of local authorities, shippers, transportation companies or public transportation operators (Kiba-Janiak, 2016).

Logistics solutions of the future

Regarding solutions for different problems when implementing industry 4.0 initiatives, Karakikes and Nathanail in their publication Simulation Techniques for Evaluating Smart Logistics Solutions for Sustainable Urban Distribution, show that smart logistics solutions have been developed over time to alleviate the adverse effects of increased freight transportation in urban areas (2017). This information is based on the study of Tomáš Gregor et al., which refers to the logistics costs of companies, and suggests that systems without human operators provide direct savings of 80% to 90%, and a yield increase of 20% to 30%, together with a reduction of risk of failures due to negligence (2017).

It was found that as a 4.0 distribution and logistics initiative, a pilot test was carried out in Barcelona and Valencia, specifically in downtown of both cities, since they have access restrictions (Navarro et al., 2016). The proposed solutions combine shared urban micro-consolidation centers and electricity-assisted tricycles that have significant potential for the decarburization of urban transportation and climate change mitigation (Navarro et al., 2016).

The study conducted in France by Rizeta, Cruz & Vromant, evaluated the scope and impact of transferring urban diesel cargo to electric vehicles in order to find a way to reduce CO2 emissions (2016). For the analysis of the situation, the authors proposed two scenarios, the first presented an electric vehicle with a two-ton payload, while the second scenario showed a six-ton payload (Rizeta et al., 2016). In both cases, the reduction of CO2 was evident, but the traffic was higher with the vehicles used in the first scenario (Rizeta et al., 2016).

In relation to this information, the publication New Opportunities and Challenges for City Logistics, mentions that electronic commerce is generating increased home deliveries, which increases the social and environmental costs of consumer goods (Taniguchi, Thompson & Yamada, 2016). For this reason, the development of alternative fuel vehicles and advanced manufacturing systems has a good potential to reduce the impact of cargo in urban areas (Taniguchi et al., 2016).

It is important to take into account the traffic flow in transportation networks using procedures, such as traffic allocation within location modeling (Yamada, Russ, Castro and Taniguchi, 2009; Wang, 2011 cited by Taniguchi, Thompson & Yamada, 2014). Regarding urban logistics modeling, sensors play a significant role, because they allow to automatically collect a range of vehicle movement data and can therefore, help understand distribution systems and increase their efficiency (Taniguchi et al. al., 2016).

In Brazil, an exploratory study was carried out in which the use of loading and unloading systems together with a reservation system was successful due to a raised in product distribution trends (Fonseca de Oliveira & Kelli de Oliveira, 2016). The proposal was executed through the application of a smart transportation system with sensors (Fonseca de Oliveira & Kelli de Oliveira, 2016). Another option to optimize city logistics is shown in the paper by Taniguchi et al., which mentions the feasibility of creating joint delivery systems and establishing common dispatch zones (2014). This alternative raises the option of consolidating freight products transporters, even competitive ones, in a strategic place in the city, in order to reduce monetary and environmental impacts (Taniguchi et al., 2014).

When analyzing transportation systems, their assessment is expected to be based on their performance, considering factors such as efficiency and reliability (Nathanail et al., 2016). An example of this is the Straightsol project, where one of its key concepts indicates the viability of creating shared scenarios to reach 100% of truck cargo and reduce environmental impact (Nathanail et al., 2016). The aforementioned project has carried out various pilot tests in European countries, where the use of small vehicles for last-mile distributions and wagons that work as mobile distribution centers stand out (Straightsol, 2012). Images 1 and 2, taken from the official Straightsol project website, show the delivery means used by TNT Express and DHL.

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Straightsol, 2012

Image 1. TNT Express Tricycles in Brussels.

Straightsol, 2012

Image 2. DHL Tricycles in Llobregat

In the above-mentioned trends, the proposal of developing smart cities where infrastructure is accessible and representative of the digital era is observed (Pagam, 2018). In addition, a significant aspect of the smart city concept is the production of sophisticated data analyses (such as machine learning, deep learning, etc.) to understand, control, regulate and plan cities (Kitchin, 2014). Also, the implementation of technologies that allow managing and monitoring urban systems is promoted by large hardware and software companies that aim to guarantee a unique life and work experience (Roy, 2016). For example, a case study of Coca-Cola in the United States reveals that when faced with a product distribution problem for Wal-Mart stores, they had to take renewed distribution measures. These measures' focus was turned towards the customer, placing them as a priority, and implementing the delivery system direct to the point of sale or consumption (Kaplan, 2007).

Additionally, Recent Developments in Urban Logistics mentions that it is important to determine the relevance of urban logistic problems and identify their gaps (Behrends, 2016). These problems require indicators that will be used to evaluate the proposed solutions, which will facilitate decision making (Nathanail et al., 2016). The possible distribution solutions must be implemented consideringthe benefits they would bring to the stakeholders, such as operators, retailers, residents and administrators (Fonseca de Oliveira & Kelli de Oliveira, 2016), ensuring economic well-being, social cohesion, quality of life, sustainability and environmental justice (Holguín-Veras, Sánchez-Díaz & Browne, 2016, Roy, 2016, Tjahjono et al., 2017).

In order to have a robust design, the solutions must use key support technologies, such as: Internet of Things (IoT), Internet of Services (IoS), Internet of People (IoP) and Internet of content and knowledge (IoCK), Physical Cyber Systems (CPS), cloud computing, Big Data Analysis (BDA) and Information and Communication Technology (ICT) (Zhong et al., 2017; Yao et al, 2017). Many of these technologies combine to form others, such as Physical Cyber Production Systems (CPPS) that include end-to-end integration based on ICT, ranging from entry logistics, to production, marketing, departure and service logistics (Zheng et al., 2018). The future of the industry lies on innovation and sustainability, and this is where IoT enables the creation of customized products or services in new markets, to sustain economic growth, human activities and well-being (Yao et al., 2017). In addition, it brings benefits and opportunities, such as product and service digitization, increased production and efficient resource management (Geissbauer, Schrauf, Koch & Kuge, 2014; Liao, Deschamps, by Freitas Rocha Loures & Pierin Ramos, 2017).

Factors inherent to the logistics of the future

For the logistics solutions shown before, the customer plays a significant role in the changes made by the companies in their distribution processes. For this reason, quality decision making and increased supply networks are an integral process that combines commercial performance with information systems. In addition, it should be noted that in the last decade, marketing positioning is an important issue, particularly in some industries, such as print media, retail sales and wholesale, among others. (Ivanov, Sokolov & Ivanova, 2016; Tsai, Shyu, Ou, Hsu & Lee, 2015).

Considering the facts mentioned above, several current studies indicate that companies promote quantifying the impact of social networks participation and technology use in consumers' profitability (Tsai, Shyu, Ou, Hsu & Lee, 2015). In this way, in 2009, the article "Distribution Channels and Value for the Consumer" was presented at the Center for Management, Entrepreneurship and Investment Research of Argentina (Vásquez, 2009). This research analyzes the importance of creating distribution channels in order to satisfy segmentation and positioning, as marketing strategies to increase companies' profits (Vásquez, 2009).

Likewise, in 2008 Lynch, J. & Whicker, L. published the article "Do Logistics and Marketing Understand Each Other? An Empirical Investigation of the Interface Activities Between Logistics and Marketing". The article highlights the problems that exist specifically between the logistics and marketing areas, and also deals with supply chain problems in a research study conducted at a food company (Lynch & Whicker, 2008). The problems between these areas are basically due to functional barriers that must be broken. The research concludes that both marketing and logistics have a different vision, and by achieving a joint work, the development of effective business processes is attained (Lynch & Whicker, 2008).

In summary, the literature review process determined the importance of working jointly in the areas of market-

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ing and logistics, but above all, adding technological and environmental support, characteristics of industry 4.0, in order to make cutting-edge decisions that enable industries to obtain a competitive advantage.

3 CASE STUDY

3.1 PROBLEM DEFINITION

The Ecuadorian headquarters of a major multinational enterprise of soft drinks aims to be part of the beginning and development of industry 4.0 in Ecuador. In addition, it wants to generate a closer relationship with its final customers and satisfy their needs in an optimal way that considers the technological advances tested in several cities around the world (Ahmed, 2017). Under this premise, the company´s goal is to analyze the feasibility of establishing a new direct sales channel, for companies' workforces (Ahmed, 2017). This new channel would offer their whole product portfolio to the customers, which essentially includes soft drinks, milk, water, energizers, tea, beverages with high and low content of fruit juice, plant-based beverages (soy milk, milk almonds) and sport / isotonic drinks (Ahmed, 2017). In order to achieve these objectives, a market research was carried out to find out the potential demand, as well as the literature review described before will be used to show the distribution trends worldwide.

The focus on this sales channel is based on the fact that Ecuadorian companies have few options for the hydration of their employees during working hours, which can affect the performance and productivity of a person (Stanhewicz. & Kenney, 2015). Additionally, the plan outlined for this study points out the importance of not only determining the potential demand of the new market niche, but above all, of raising possible product distribution options, in order to reach the consumer efficiently and effectively using avant-garde means.

3.2 DESIGN FOR SIX SIGMA METHODOLOGY (DFSS)

3.2.1 DEFINING PHASE

Based on market segmentation, this study considers companies located in the urban sector of the Metropolitan District of Quito. The activity or turnaround of the company was indifferent for the objectives of this study (Ahmed, 2017). To mitigate risk variables found within the relationship variables, that is, those that refer to relationships between companies, only established companies were considered (Fernández, 2009). That is, only companies that currently have a record of the number of workers and annual sales income in the database of the Superintendency of Companies, Securities and Insurance of the Republic of Ecuador were included. This showed that in 2017 there were 37,2431 people employed in 4,346 companies (Superintendency of Companies, Securities and Insurance of the Republic of Ecuador, 2017). The Pareto analysis showed that approximately 80% of the workers are found in approximately 20% of the registered companies, which means that 290,227 people are employed in 1,778 companies.

3.2.2 MEASUREMENT PHASE

When applying Equation 1 to calculate the sample size of people that should be surveyed for the market research, it was determined that 273 persons should be included in this portion of the present study. This is due to the fact that according to the National Institute of Statistics and Census, 81.5% of the population consumes sugary drinks (2016), 79.1% consume safe water in the urban area (INEC, 2017) and 35.66% of the population of Quito has adequate and formal employment (INEC, 2016).

In the sampling planning, the percentages of employees' accumulation in small, medium and large enterprises was determined, giving as a result that 6.73% of employees are in small companies, 18.97% are in medium companies and 74.3% are in large companies. Therefore, the sample was made up with the relative percentage of each category (Baca Urbina, 2013), giving a number of 273 respondents. The results are shown in Table 1.

Table 1. Results of sample conformation.

Company size	Number of surveys to be applied
Small	18
Medium	52
Large	203

Buestán & Cañizares, 2018

3.2.3 ANALYSIS PHASE

The survey began with filter questions to ensure that the people surveyed were currently employed in the target companies. Then questions of general knowledge were presented, within which it stands out that 74.4% of the people surveyed work in big companies, 19% in medium companies and 6.6% in small companies. Additionally, 60.8% of the people surveyed have operational positions, 24.9% managerial positions and 14.3% have executive positions.

Among the results obtained, it is important to note that the market acceptance of having a vending machine or refrigerator in the workplace is 86.5% (Chart 2). This result considers the answers to question 14 of the survey, which asks whether or not people agree to have a vending machine or refrigerator in their work place. The choice of answers for this category were: completely agree (35.2%), agree (51.3%). Additionally, it was estimated that the target population consumed approximately 1.25 liters of soft drinks during the day.

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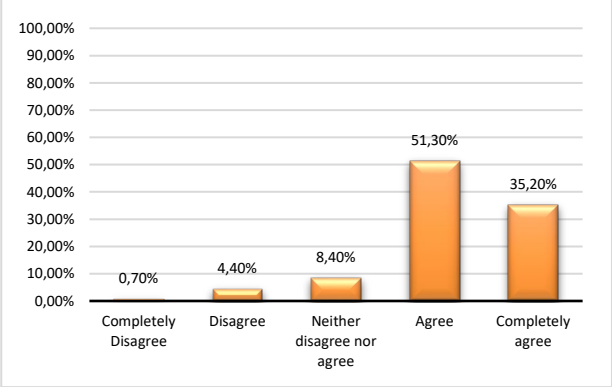
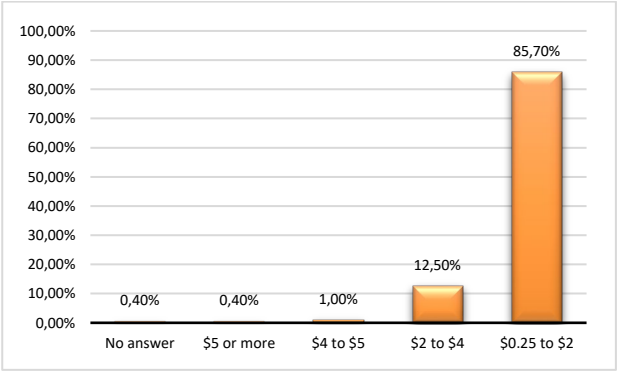
Another key point for the analysis was the result of question 18 of the survey, which asks how much a person is willing to spend daily in their work place if there was a vending machine. In this case the results indicate that 85.7% of the target population is willing to spend between $ 0.25 and $ 2.00 a day to buy soft drinks (Chart 3).



Buestán & Cañizares, 2018

Chart 2. Question 14. Would you like to have a vending machine or refrigerator in your workplace to buy soft drinks?



Buestán & Cañizares, 2018

Chart 3. Question 18. If there was a vending machine or refrigerator in your workplace, how much money would you be willing to spend?

Based on the above information, the total market demand was estimated considering three possible scenarios: First, where the customer was willing to pay the minimum value of the range established in question 18. Second, the scenario where the price is the average value of the range evaluated in question 18. Finally, the third scenario, where the price is the maximum value that a person is willing to spend in a working day. The results in US dollars for each scenario are shown in Table 2.

Table 2. Results of the total market demand in the north industrial area

Scenario	Value to be paid in one day	Q (total market demand)
1	$ 0.25	$4 billion
2	$ 0.88	$15 billion
3	$2.00	$35 billion

Buestán & Cañizares, 2018

3.2.3.1 RESULTS OF THE ANALYSIS PHASE

Taking into account the results of the measuring phase to objectively outline the possible product distribution choices of the major soft drink multinational enterprise, it is decided to start a pilot analysis in the geographical sector of greater response, called Iñaquito. In this sense, the location of the closest distribution center is determined, since this is a vital point in the logistics delivery sequence. It is found that the distribution center to be used is the one located in the sector of Calderón and that there are two possible routes to reach the established delivery site in the Iñaquito parish. With this information and considering Image 3, that shows available product delivery options based on the distribution site's density, it is concluded that Iñaquito is a parish with a high population density. Iñaquito has approximately 26.9 inhabitants per km2 (INEN, 2010), and an area of 1505.72 km2. This parish is located in the lower section of Image 3, that is, in urban areas with a density between fifty thousand and one million inhabitants. Consequently, and as the new sales channel is aimed at workers of active companies, the optimal way of doing business is B2C (Business To Consumer), this means that this "At Work" channel involves the retail sale of products and services to individual consumers (Laudon, 2016). For this reason, one of the possible choices to introduce avant-garde distribution in the company in study, is the implementation of autonomous vehicles with lockers. However, due to the traffic and location restrictions of the Iñaquito parish, the use of electric bicycles is proposed, which allow for quick transportation of the product for replacement through the busy streets of Quito.

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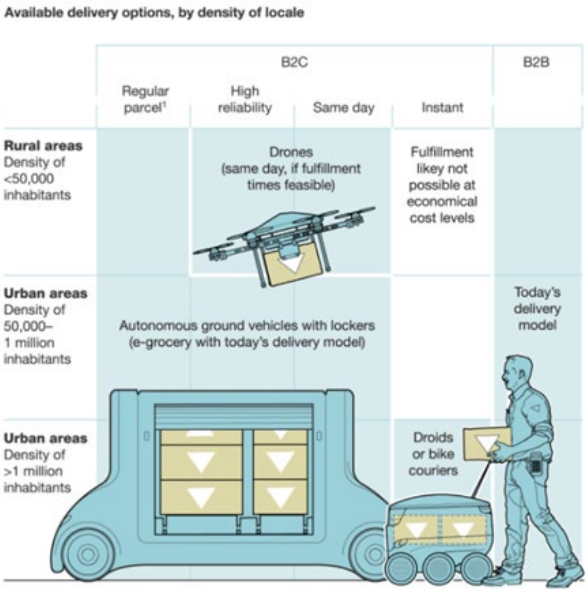
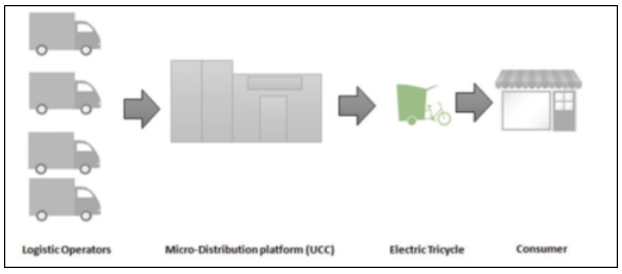


Joerss, Neuhaus & Schröder, 2016

Image 3. Available delivery options, according to population density

Furthermore, transshipment terminals should be established. In this particular case, it is proposed to pick up the product from a strategically located micro distribution centers. The first step is to establish possible alliances with medium-sized neighborhood stores that will work as small collection and distribution centers. This is proposed because according to Líderes Magazine, in 2016 there were around 16,195 neighborhood stores in Pichincha, and in Quito specifically, there were around 13,400 neighborhood stores (INEC, 2010 cited by Magazine Leaders, 2016). As observed, there is a high record of potential micro distribution centers, therein lies the importance of establishing relations between the major soft drink multinational enterprise and neighborhood stores. The proposed model would follow a similar route to that outlined by Navarro et al. in 2016, in the Spanish case mentioned in section 3 and shown in image 4.



Navarro, Roca-Riu, Furió, y Estrada, 2016

Image 4. Scheme of the last mile-distribution system used in the pilot test in Valencia - Spain

The pilot test proposal includes considerable benefits such as the possible reduction of vehicular and environmental traffic; in addition to having a large potential market by owning financial, banking and business centers within the sector. Aligned with this information, the boom in the creation of exclusive bicycle lanes in the metropolitan area of Quito is established as an opportunity in this proposal, as stipulated in article 204 of the Organic Law of Land Transportation and Traffic Safety (LOTTSV) that determines the rights of cyclers in all public roads (Metropolitan Ordinance 194, 2003) and the increased access to heavy traffic areas. Nevertheless, the weakness in the proposal is the decreased capacity of vehicles when using last-mile direct deliveries and the extra time needed to replace the cargo in vehicles. Finally, the threats of the country's economic regulations should be considered, as well as safety policies and cyclers' protection.

5 LIMITATIONS

Throughout this work several restrictions raised, mainly because the major soft drink multinational enterprise submitted limited detailed information on its sales channels operation and data on management of product distribution. Additionally, the research of the potential market of the "At Work" sales channel was made based on theory and field research. It is also important to mention that due to cost and scope, this study does not include a more detailed and deeper sampling of the target population.

The present work does not analyze all the actors involved in opening the new sales channel, so it is recommended that the company analyzed in the case study carries out a similar research clearly directed at the companies, to validate this market opportunity and combine both results. Additionally, it is recommended to analyze the costs associated with the implementation of new distribution systems and their acceptance in the local environment in a deeper and more detailed way, considering the determining factors mentioned in the results of the analysis phase.

6 CONCLUSIONS

Finally, and agreeing with authors Brutto (2010) and Rifkin (2015), the main conclusion of this study is that from the first industrial revolution up to revolution 4.0, there is a high impact in the world of logistics. In the last revolution, logistics 4.0 or logistics of the future was developed, which has grown stronger thanks to the joint use of the internet of things and Big Data. The analysis of both technologies has allowed the generation of algorithms to accelerate efficiency, increase productivity and reduce the marginal cost of producing and distributing goods and services.

Additionally, the literature review showed the rise of new technologies applied to industry, and presented different distribution trends oriented to urban logistics. In terms of logistics 4.0 trends or solutions similar points were found, among which the following stand out: crea-

tion of micro distribution centers for last mile logistics, use of electric vehicles for deliveries, use of smart transportation systems, among others. The creation of urban distribution centers is important, as makes it possible to considerably optimize a company's logistics operations, and contributes to the city by reducing traffic, which is an important environmental issue. In fact, in the literature review, it was found that the environmental impact is a determining factor, both for companies and customers; and in the process of optimizing management, various logistic solutions are proposed to minimize CO2 emissions. To illustrate this statement, the use of electric vehicles, both heavy and light, has been proposed in some countries.

As a result of the literature review, and seeking to satisfy the requirements of the major soft drink multinational enterprise, a detailed study was carried out to create a new sales channel, which would be supplied through new logistics strategies. In this way, considering that the market acceptance of the new sales channel "At Work" is 86%, possible choices of product distribution were generated. For this analysis, the following factors were taken into account: population density, traffic flow and feasible distribution techniques to be implemented in Ecuador. Due to the aforementioned, it is concluded that it is of the utmost importance to carry out a pilot test in the sector with highest business density, Iñaquito parish, under the guidelines of the case study. However, it is recommended to use a combination of micro distribution centers with electric bicycles, because the city of Quito in recent years has developed urban mobility initiatives by establishing exclusive lanes for certain vehicles. Additionally, the feasibility of creating strategic alliances with neighborhood stores should be analyzed in order to reduce the costs of implementing the pilot proposal. This study will allow the determination of the parameters needed to implement urban distribution centers, such as the time it takes to dispatch products, and the associated costs of their implementation at the macro level in the Metropolitan District of Quito.

REFERENCES

[1] Accorsi, R., Bortolini, M., Baruffaldi, G., Pilati, F. & Ferrari, E. (2017). Internet-of-Things paradigm in food supply chains control and management. Procedia Manufacturing, 11, 889-895. doi: 10.1016/j.promfg.2017.07.192

[2] Ahmed, S. (27 de Octubre de 2017). General meeting for exposition of the research. (G. Buestán & K. Cañizares, Interviewers)

[3] Anand, N., Quak, H., van Duin, R. & Tavasszy, L. (2012). City Logistics Modeling Efforts: Trends and Gaps - A Review. Procedia - Social and Behavioral Sciences, 39, 101-115. http://www.sciencedirect.com/science/article/pii/S1877042812005617

[4] Baca Urbina, G. (2013). Evaluación de Proyectos. Séptima Edición. McGraw-Hill

[5] Baena, F., Guarin, A,. Mora, J., Sauza, J. & Retat, S. (2017). Learning Factory : The Path to Industry 4 . 0. Procedia Manufacturing, 9, 73-80. http://dx.doi.org/10.1016/j.promfg.2017.04.022

[6] Bai, Y. (2017). Industrial Internet of things over tactile Internet in the context of intelligent manufacturing. Cluster Comput. DOI 10.1007/s10586-017-0925-1

[7] Barreto, L., Amaral, A., & Pereira, T. (2017). Industry 4.0 implications in logistics: an overview. Procedia Manufacturing, 13, 1245–1252. https://doi.org/10.1016/j.promfg.2017.09.045

[8] Behrends, S. (2016). Recent developments in urban logistics research – a review of the proceedings of the International Conference on City Logistics 2009 – 2013. Transportation Research Procedia, 12, 278-287. doi: 10.1016/j.trpro.2016.02.065

[9] Brutto, D. (2010). Globalization 4.0 and the New Logistics. Vital Speeches of the Day. McMurry Inc. vsotd.com

[10] Fonseca de Oliveira, G & Kelli de Oliveira, L. (2016). Stakeholder´s perceptions of city logistics: An exploratory study in Brazil. Transportation Research Procedia, 12, 339-347. doi: 10.1016/j.trpro.2016.02.070

[11] Furmann, R., Furmannová, B. & Więcek, D. (2017). Interactive design of reconfigurable logistics systems. Procedia Engineering 192 (2017) 207 – 212. doi: 10.1016/j.proeng.2017.06.036

[12] Elhedhli, S., & Goffin, J. (2005). Efficient Production-Distribution System Design. Management Science, 51(7), 1151-1164. Retrieved from http://www.jstor.org/stable/20110405

[13] Embracing Industry 4.0. (2015). Plant & Works Engineering, (399), 22.

[14] Esteban, I. G., & Fernández, E. A. (2017). Fundamentos y técnicas de investigación comercial. Esic Editorial.

[15] Fernández, P. (2001). Determinación del tamaño muestral. Unidad de Epidemiología Clínica y Bioestadística.

[16] García Ferrari, T. (2017). Design and the fourth industrial revolution. dangers and opportunities for a mutating discipline. The Design Journal, 20, 2625. doi:http://dx.doi.org.ezbiblio.usfq.edu.ec/10.1080/14606925.2017.1352774

[17] Geissbauer, R., Schrauf, S., Koch, V. & Kuge, S. 2014. Industry 4.0 - opportunities and challenges of the Industrial Internet. PricewaterhouseCoopers Aktiengesellschaft Wirtschaftsprüfungsgesellschaft. www.pwc.de/industry4.0

[18] Gnimpieba, D., Nait-Sidi-Moh, A., Durand, D & Fortin, J. (2015). Using Internet of Things technologies for a collaborative supply chain: Application to tracking of pallets and containers. Procedia Computer Science, 56, 550-557. doi: 10.1016/j.procs.2015.07.251

[19] Gómez-Luna, E., Fernando-Navas, D., Aponte-Mayor, G y Betancourt-Buitrago, L. (2014) Metodología para la revisión bibliográfica y la gestión de información de temas científicos, a través de su estructuración y sistematización. Dyna, vol. 81, núm. 184, abril, 2014, pp. 158-163. Universidad Nacional de Colombia. Medellín, Colombia

[20] Gregor, T., Krajčovič, M. & Więcek, D. (2017). Smart Connected Logistics. Procedia Engineering, 192, 265-270. http://www.sciencedirect.com/science/article/pii/S1877705817325924

[21] Hausman, W., Schwarz, L. & Graves, S. (1976). Optimal Storage Assignment in Automatic Warehousing Systems. Management Science, Vol. 22, No. 6 (Feb., 1976), pp. 629-638. http://www.jstor.org/stable/2629933

[22] Hillier, F & Lieberman, G. (2010). Introducción a la Investigación de Operaciones. Novena Edición. México: McGrawHill.

[23] Holguín-Veras, J., Sánchez-Díaz, I. & Browne, M. (2016). Sustainable urban freight systems and freight demand management. Transportation Research Procedia, 12, 40-52. doi: 10.1016/j.trpro.2016.02.024

[24] Ildelfonso, G. E & Fernández, E. A. (2017). Fundamentos y técnicas de investigación comercial. Esic Editorial.

[25] INEC. (2016). Encuesta Nacional de Salud y Nutrición. Ecuador.

[26] INEN. (2010). Censo poblacional a nivel parroquial. Extraído de http://www.ecuadorencifras.gob.ec/?s=POBLACI%C3%93N+POR+SEXO%2C+SEG%C3%9AN+PROVINCIA%2C+PARROQUIA+Y+CANT%C3%93N+DE+EMPADRONAMIENTO

[27] Ivanov, D., Sokolov, B. & Ivanova, M. (2016). Schedule coordination in cyber-physical supply networks industry 4.0. IFAC-PapersOnLine 49-12 (2016) 839–844. doi: 10.1016/j.ifacol.2016.07.879

[28] Jabeur, N., Al-Belushi, T., Mbarki, M. & Gharrad, H. (2017). Toward Leveraging Smart Logistics Collaboration with a Multi-Agent System Based Solution. Procedia Computer Science, 109, 672-679. http://www.sciencedirect.com/science/article/pii/S1877050917310438

[29] Joerss, M., Neuhaus, F. & Schröder, J. (2016). How customer demands are reshaping last-mile delivery. McKinsey&Company. Extraído de https://www.mckinsey.com/industries/travel-transport-and-logistics/our-insights/how-customer-demands-are-reshaping-last-mile-delivery

[30] Kaplan, A. (2007). All Together Now?. Beverage World, 126(3), 14-16.

[31] Karakikes, I. & Nathanail, E. (2017). Simulation Techniques for Evaluating Smart Logistics Solutions for Sustainable Urban Distribution. Procedia Engineering, 178, 569-578. http://www.sciencedirect.com/science/article/pii/S1877705817301108

[32] Kauf, S. (2016). City logistics – A Strategic Element of Sustainable Urban Development. Transportation Research Procedia, 16, 158-164. http://www.sciencedirect.com/science/article/pii/S2352146516306305

[33] Kayikci, Y. (2018). Sustainability impact of digitization in logistics. Procedia Manufacturing, 21, 782-789. http://www.sciencedirect.com/science/article/pii/S2351978918302245

[34] Kiba-Janiak, M. (2016). Key success factors for city logistics from the perspective of various groups of stakeholders. Transportation Research Procedia, 12, 557-569. doi: 10.1016/j.trpro.2016.02.011

[35] Kirch, M., Poenicke, o. & Richter, K. (2017). RFID in Logistics and Production– Applications, Research and Visions for Smart Logistics Zones. Procedia Engineering 178, 526–533. doi: 10.1016/j.proeng.2017.01.101

[36] Kitchin, R. (2014). The real-time city? Big data and smart urbanism. GeoJournal, 79, 1, 1-14. http://www.jstor.org/stable/24432611

[37] Laudon, K. y Laudon J. Sistemas de información gerencial. (2016) Pearson, 14ed. (DIGITAL eBOOK).

[38] Liao, Y., Deschamps, F., de Freitas Rocha Loures, E. & Pierin Ramos, L. (2017). Past, present and future of Industry 4.0 - a systematic literature review and research agenda proposal. International Journal of Production Research, 55:12, 3609-3629. DOI: 10.1080/00207543.2017.1308576

[39] Logistics 4.0 meets Industry 4.0. (2017). Plant & Works Engineering, (417), 39.

[40] Lu, Y. (2017). Industry 4.0: A survey on technologies, applications and open research issues. Journal of Industrial Information Integration 6, 1–10. http://dx.doi.org/10.1016/j.jii.2017.04.005

[41] Lu, y. & Cecil, J. (2016). An Internet of Things (IoT)-based collaborative framework for advanced manufacturing. Int J Adv Manuf Technol, 84, 1141–1152. DOI 10.1007/s00170-015-7772-0

[42] Lynch, J. & Whicker, L. (2008) Do logistics and marketing understand each other? An empirical

investigation of the interface activities between logistics and marketing, International Journal of Logistics Research and Applications, 11:3, 167-178, DOI: http://dx.doi.org/10.1080/13675560701602708

[43] Maglaras, L., Shu, L., Maglaras, A., Jiang, Jicke, H., Katsaros, D. & Cruz, T. (2017). Editorial: Industrial Internet of Things (I2oT). Mobile Netw Appl. DOI 10.1007/s11036-017-0937-3

[44] Montgomery, D. (2013). Control estadístico de calidad. Limusa Willey: México.

[45] Murphy, P. & Poist, R. (2000). Green Logistics Strategies: An Analysis of Usage Patterns. Transportation Journal, 40:2, 5-16. http://www.jstor.org/stable/20713450

[46] Nathanail, E., Gogas, M. & Adamos, G. (2016). Smart interconnections of interurban and urban freight transport towards achieving sustainable city logistics. Transportation Research Procedia, 14, 983-992. doi: 10.1016/j.trpro.2016.05.078

[47] Nathanail, E., Adamos, G. & Gogas, M. (2017). A novel approach for assessing sustainable city logistics. Transportation Research Procedia, 25, 1036-1045. http://www.sciencedirect.com/science/article/pii/S2352146517307846

[48] Navarro, C., Roca-Riu, M., Furió, S. & Estrada, M. (2016). Designing New Models for Energy Efficiency in Urban Freight Transport for Smart Cities and its Application to the Spanish Case. Transportation Research Procedia, 12, 314-324. http://www.sciencedirect.com/science/article/pii/S2352146516000697

[49] Pagam, J. (2018). Smart Cities The Next Frontier. US Black Engineer and Information Technology, 42:1, 78-80. http://www.jstor.org/stable/26305582

[50] Ordenanza Metropolitana 194. (2003). Artículo 204 de la LOTTTSV. Derechos de los ciclistas. Extraído de www7.quito.gob.ec/mdmq.../Ordenanza%20Metropolitana%20No.%20194.docx

[51] Park, S. (2017). The fourth industrial revolution and implications for innovative cluster policies. AI & Society, , 1-13. doi:http://dx.doi.org.ezbiblio.usfq.edu.ec/10.1007/s00146-017-0777-5

[52] Pereira, T., Barreto, L. & Amaral, A. (2017). Network and Information Security Challenges within Industry 4.0 paradigm. Procedia Manufacturing, 13, 1253-1260. doi: 10.1016/j.promfg.2017.09.047

[53] Pereira, A. C., & Romero, F. (2017). A review of the meanings and the implications of the Industry 4.0 concept. Procedia Manufacturing, 13, 1206–1214. https://doi.org/10.1016/j.promfg.2017.09.032

[54] Poonpakdee, P., Koiwanit, J. & Yuangyai, C. (2017). Decentralized Network Building Change in Large Manufacturing Companies towards Industry 4.0. Procedia Computer Science, 110, 46-53. doi: 10.1016/j.procs.2017.06.113

[55] Prisecaru, P. (2016). CHALLENGES OF THE FOURTH INDUSTRIAL REVOLUTION. Knowledge Horizons.Economics, 8(1), 57-62. Retrieved from https://search.proquest.com.ezbiblio.usfq.edu.ec/docview/1793552558?accountid=36555

[56] Qin, J., Liu, Y. & Grosvenor, R. (2016). A Categorical Framework of Manufacturing for Industry 4.0 and Beyond. Procedia CIRP, 52, 173-178. doi: 10.1016/j.procir.2016.08.005

[57] QRS International. (2017). NVivo Starter (Versión 11). [Software]. Obtenido de http://www.qsrinternational.com/nvivo-spanish

[58] Rafique, S. M. S. B. M. (2013). The use of design for six sigma (DFSS) methodology in product design. Lecture Notes in Engineering and Computer Science, 1 LNECS, 664–669. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-84887886038&partnerID=tZOtx3y1

[59] Rifkin, J. (2015). Market Share. RSA Journal, 161:5562, 32-35. http://www.jstor.org/stable/26204411

[60] Rizeta, C., Cruz, C. & Vromant, M. (2016). The Constraints of Vehicle Range and Congestion for the Use of Electric Vehicles for Urban Freight in France. Transportation Research Procedia, 12, 500-507. doi: 10.1016/j.trpro.2016.02.005

[61] Rosenbach, K & Köckler, J. (2017). Logistics 4.0 meets Industry 4.0. Plant & Works Engineering, 39, 417.

[62] Roy, S. (2016). The Smart City Paradigm in India: Issues and Challenges of Sustainability and Inclusiveness. Social Scientist, 44:5/6, 29-48. http://www.jstor.org/stable/24890283

[63] Salazar, B. (2016). Problemas de asignación. Ingeniería Industrial. Recuperado de https://www.ingenieriaindustrialonline.com/herramientas-para-el-ingeniero-industrial/investigaci%C3%B3n-de-operaciones/problemas-de-asignaci%C3%B3n/

[64] Sales, M. (2006). Diagrama de Pareto. EALDE Business School, 1--8

[65] Sánchez, T., Ranasinghe, D., Harrison, M. & McFarlane, D. (2012). Adding sense to the Internet of Things. Pers Ubiquit Comput 16:291–308. DOI 10.1007/s00779-011-0399-8

[66] Schroeder, W. (2015). La estrategia alemana Industria 4.0: el capitalismo renano en la era de la digitalización. 1-30.

[67] Smith, J. L. (2016). DFSS Integration. Quality Magazine, (March), 18.

[68] Stanhewicz, A. E. & Kenney, W. L. (2015). Determinants of water and sodium intake and output, Nutrition Reviews, Volume 73, Issue suppl_2, 1 September 2015, Pages 73–82, https://doi.org/10.1093/nutrit/nuv033

[69] Straightsol. (2012). Project demostrations: Demonstration B: TNT Express in Brussels - City Logistics Mobile Depot. Brussels. Recuperado de http://www.straightsol.eu/demonstration_B.htm

[70] Sung, T. (2017). Industry 4.0: A Korea perspective. Technological Forecasting and Social Change. http://www.sciencedirect.com/science/article/pii/S0040162517313720

[71] Sxoinaraki, E. & Panou, K. (2016). Innovative business models for exploiting green vehicle potential in urban logistics. Transportation Research Procedia 25, 954–964. doi: 10.1016/j.trpro.2017.05.470

[72] Taniguchi, E. (2014). Concepts of City Logistics for Sustainable and Liveable Cities. Procedia - Social and Behavioral Sciences, 151, 310-317. http://www.sciencedirect.com/science/article/pii/S1877042814054718

[73] Taniguchi, E., Thompson, R. & Yamada, T. (2014). Recent Trends and Innovations in Modelling City Logistics. Procedia Social and Behavioral Sciences, 125, 4-14. doi: 10.1016/j.sbspro.2014.01.1451

[74] Taniguchi, E., Thompson, R. & Yamada, T. (2016). New opportunities and challenges for city logistics. Transportation Research Procedia, 12, 5-13. doi: 10.1016/j.trpro.2016.02.004

[75] Tjahjono, B., Esplugues, C., Ares, E. & Pelaez, G. (2017). What does Industry 4.0 mean to Supply Chain?. Procedia Manufacturing, 13, 1175-1182. doi: 10.1016/j.promfg.2017.09.191

[76] Tsai, P., Shyu, Y., Ou, Y., Hsu, H. & Lee, P. (2015). The power of customer values with social communication in the marketing segmentation. 4th Annual International Conference on Enterprise Marketing And GLobalization. doi: 10.5176/2251-2098_EMG15.5

[77] Vásquez, G. (2009). Los canales de distribución y el valor para el consumidor. Temas de Management - Centro de Investigaciones En Management, Entrepreneurship E Inversión (CIMEeI)2, 2, 10–15.

[78] Werkema, C. (2012). DFLSS-Design for Lean Six Sigma - Ferramentas Básicas Usadas nas Etapas D e M do Dmadv. Elsevier Brazil

[79] Winkler, M. (2007) Design for Six Sigma. Professional Bulletin of United States ARMY Logistics.

[80] Witkowski, k. (2016). Internet of Things, Big Data, Industry 4.0–Innovative Solutions in Logistics and Supply Chains Management. Procedia Engineering 182, 763–769. doi: 10.1016/j.proeng.2017.03.197

[81] World Economic Forum. (2016, Abril 13). La Cuarta Revolucion Industrial | Versión completa. [Archivo de video]. Recuperado de https://www.youtube.com/watch?v=-OiaE6l8ysg&list=PL7m903CwFUgnP-IIuBRhBYGkN0ImPefAE&index=3

[82] Xu, L. & Li, S. (2014). Internet of Things in Industries: A Survey. IEEE TRANSACTIONS ON INDUSTRIAL INFORMATICS, 10:4. doi: 10.1109/TII.2014.2300753

[83] Yao, X., Zhou, J., Lin, Y., Li, Y., Yu, H. & Liu, Y. (2017). Smart manufacturing based on cyber-physical systems and beyond. Journal of Intelligent Manufacturing. https://doi.org/10.1007/s10845-017-1384-5

[84] Zheng, P., Wang, H., Sang, Z., Zhong, R., Liu, Y., Liu, C. & Mubarok, K. (2018). Smart manufacturing systems for Industry 4 . 0 : Conceptual framework , scenarios , and future perspectives. 13, 137-150. https://doi.org.ezbiblio.usfq.edu.ec/10.1007/s11465-018-0499-5

[85] Zhong, R., Xu, X., Klotz, E. &. Newman, S. (2017). Intelligent Manufacturing in the Context of Industry 4.0: A Review. Engineering, 3, 616–630. http://dx.doi.org/10.1016/J.ENG.2017.05.015

[86] Zezulka, F., Marcon, P., Vesely, I. & Sajdl, O. (2016). Industry 4.0 – An Introduction in the phenomenon. IFAC-PapersOnLine, 49, 8-12. https://doi.org/10.1016/j.ifacol.2016.12.002