1st International Symposium on Supply Chain 4.0

Trends, Challenges and Opportunities from the 4th Industrial Revolution

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of the

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Trends, Challenges and Opportunities from the 4th Industrial Revolution

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Welcome message

It is a great pleasure and honor for us to welcome you all to the ISSC4-2017 – 1st International Symposium on Supply Chain 4.0: Trends, Challenges and Opportunities from the 4th Industrial Revolution.

The ISSC4-2017 is the first initiative of the SC4 (Collaborative Research Network on Supply Chain4.0 - www.supplychain4.org), a collaborative initiative among more than twenty researchers from five different countries created to promote one thing: collaboration in research. This simple thing is recognized by all researchers as essential, but it is usually hard to put in practice.

However, in the context of the 4th Industrial Revolution, researchers have no choice but to collaborate, since problems in this field are particularly multidisciplinary in nature, requiring the involvement of researchers from diverse disciplines, working with different and complementary research methods. The challenge is huge! Some researchers believe that first-order implications will cause transformations everywhere: from products and services, to production, distribution and consumption. We will have to profoundly rethink the way we manage operations and supply chains. So, let’s work together!

In this context, the ISSC4-2017 is intended to provide an international forum that brings together the SC4 members and other invited researchers and practitioners to report on up-to-date, ongoing research and state-of-the-art research, and to exchange ideas and advances in all aspects of the Fourth Industrial Revolution. We hope this forum will create conditions for new research collaborations between SC4 members and other researchers and practitioners.

Organizing a scientific symposium, specially its first edition, it is not an easy task and cannot be brought together without the dedicated efforts of several people. I would like to take this opportunity to thank everybody involved in many committees (Organizing, Scientific and Best Paper Award). The undergraduate and graduate students of our laboratories deserve a special thank, since without them we would not have been able to face this challenge.

Finally, I would like to wish you all a very pleasant stay in Brazil at Unicamp. I hope that we will have a successful meeting with fruitful discussions, inspiring new friendships among researchers, engineers, managers and students from all around the world.

Prof. Luis Antonio de Santa-Eulalia, Ph.D.
President of the Scientific Committee

Prof. Paulo Sérgio de Arruda Ignácio, Ph.D.
President of the Organizing Committee

Organizing Committee

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Prof. Rui Tadashi Yoshino, Ph.D
Universidade Tecnológica Federal do Paraná - Departamento de Engenharia de Produção – Ponta Grossa, Brazil

Short Program

DAY ONE – August 28th

Open to registered attendants

Time	August 28, 2017		
13:00 – 13:30	**REGISTRATION (at the meeting hall)**		
13:30 – 13:45	Room UL12 Welcome – Opening Session FCA Director, Organization Committee		
13:45 – 14:30	**Global trends in Industry 4.0 – Sidnei M. da Silva (BOSCH)**		
14:45 – 15:45	Room UL12 Thematic session 1 (4 papers, 15 minutes each)	Room UL80 Thematic session 2 (4 papers, 15 minutes each)	**WORKSHOP** Multi-Agent Modeling Introducing ANYLOGI
15:45 – 16:15	**COFFEE BREAK**		**COFFEE BREAK**
16:15 – 17:15	Room UL12 Thematic session 3 (4 papers, 15 minutes each)	Room UL80 Thematic session 4 (4 papers, 15 minutes each)	**WORKSHOP** Multi-Agent Modeling Introducing ANYLOGI
17:15 – 18:00	**How Industry 4.0 can impact on internal supply chains and leverage competitive edge – Marco A. Baptista (SIEMENS)**		
18:00 – 19:00	**COCKTAIL**		
19:00 – 19:45	**Present challenges for future factory – Paulo G. M. da Rocha (ROCKWELL)**		
20:00 – 21:00	Room UL12 Thematic session 5 (4 papers, 15 minutes each)	Room UL80 Thematic session 6 (4 papers, 15 minutes each)	
21:00 – 21:30	**Roundtable**		
21:30 – 21:45	**WRAP UP AND CLOSING SESSION (Organizing committee)**		

DAY TWO – August 29th

Open to members of the SC4 Network and invited researchers

Dedicated to foster collaboration among actual and prospect members to SC4 – **Room UL12**		
Time	**August 29, 2017**	
9:00 – 9:30	Opening Session: Presentation of Collaborative Network on Supply Chain 4.0	
9:30 – 10:30	Research Groups Presentations: Competences and ongoing projects	
10:30 – 10:45	**Break**	
10:45 – 11:30	Working Group 1 – Thematic Discussion	Working Group 2 – Thematic Discussion
11:30 – 12:00	Final presentation	
12:00 – 12:30	Closing Session	

Dedicated to book collaboration – under invitation (only) – **Room UL12**	
Time	**August 29, 2017**
14:00 – 16:00	Discussion about Book chapters and organization as well as the publication process

Detailed Program

Detailed Program - ISSC4 - 2017

First International Symposium on Supply Chain 4.0: Trends, Challenges and Opportunities from the 4th Industrial Revolution

August 28-29th, 2017, University of Campinas (UNICAMP), Limeira, Brazil - Organized by the SC4 (Collaborative Research Network on Supply Chain 4.0)

TIME	AUGUST 28th - 2017			
13:00 - 13:30	REGISTRATION - Hall			
13:30 - 13:45	WELCOME SESSION - Room UL12			
13:45 - 14:30	KEYNOTE SPEAKER - Room UL12	Global trends in Industry 4.0	Sidnei M. da Silva (BOSCH)	
	Thematic Session 1: Strategy (Chair: Prof. Paulo Ignacio) - Room UL12		**Thematic Session 2: 3D Printing (Prof. Ieda Makiya) - Room UL80**	
14:45 - 15:45	A digital maturity scorecard for measuring Industry 4.0 readiness level of organizations (*)	Awasthi A, Bhullar K Rupinder	Understanding 3D printers-oriented supply chains using agent-based modelling: the case of 3D Hubs	Lima R, Santa-Eulalia LA, Yoshino R, Audy JF, Mosconi E
	Why the 4th Industrial Revolution will disrupt pre-existing economic and social structures (*)	Beliveau M, Santa Eulalia LA, Mosconi E	Additive Manufacturing in the jewelry industry: An analysis of the technologies and the Brazilian environment	Faria L, Yoshino R
	The View of Integration between Industry 4.0 Concepts and Supply Chain Management	Cordeiro GA, Ferro R, Cooper RE, Anholon R	Additive Manufacturing: definitions, applications and consequences in operations	Franco D, Santa-Eulalia LA de, Ganga GMD
	The impacts of Industry 4.0 on decision making in a supply chain (*)	Beliveau M, Santa Eulalia LA, Mosconi E	Distributed manufacturing of spare parts: challenges, enabling technologies and processes	Durao LFCS, Zancul E, Schützer K, Simon AT
15:45 - 16:15	COFFEE BREAK - Hall			
	Thematic Session 3: Applications (Chair: Prof. Anibal Azevedo) - Room UL12		**Thematic Session 2: Background (Prof. Giocondo César) - Room UL80**	
16:15 - 17:15	Challenges and Opportunities of Industry 4.0 in a High-Technology Sector: The Case of the Brazilian Aeronautics Industry	Ferreira MJB	Theoretical proposition of a model for RFID systems deployment for industry	Rampasso IS, Anholon, R, Cooper, RE, Santa-Eulalia LA, Ignácio, PSA
	Forestry in an Industry 4.0 perspective (*)	Bittencourt E, de Santa-Eulalia LA	Supply Chain 4.0 opportunities and challenges: a systematic review	Simon AT, Martins FC
	Industry 4.0: Development and application in the logistics area	Garcia IB, Nagura GI, Cubarenco NR, Yoshino RT	Quality 4.0: Bibliographic research proposal for the quality area within industry 4.0 context.	Basseto A, Machado I, Delgado L, Pontes J
	Disrupt or be Disrupted: Rethinking Auto Industry Supply Chain in a Big Data World (*)	Siegler J, Hughes S	Interoperable Smart Supply Chain: explorations towards industry 4.0 requirements	Gomes P, Bordini GA, Loures ER, Portela EA
17:15 - 18:00	KEYNOTE SPEAKER - Room UL12	stry 4.0 can impact on internal supply chains and leverage compe	Marco A. Baptista (SIEMENS)	
18:00 - 19:00	COCKTAIL & POSTER SESSION - Hall			
19:00 - 19:45	KEYNOTE SPEAKER - Room UL12	Present challenges for future factory	Paulo G. M. da Rocha (ROCKWELL)	
	Thematic Session 5: Components (Chair: Prof. Rui Yoshino) - Room UL12		**Thematic Session 2: Implementation (Prof. Alessandro Silva) - Room UL80**	
20:00 - 21:00	Industry 4.0: An analysis of existing conceptual frameworks (*)	Pereira P, Santa-Eulalia LA, Mosconi E	How to implement a Supply Chain 4.0?	Simoes R
	Supply Chain 4.0: The influence of Cyber-Physical Systems on the reduction of wastes	Nagura GI, Garcia IB, Cubarenco NR, Yoshino RT	Determining the Container Position in Container Ships and Port Yard Using Industry 4.0 Concepts	Azevedo AT, Junqueira C, Ohishi T
	Internet of things: Applications in Supply Chain Management	Mendes JV, Santa-Eulalia LA, Rocha KE, Moris VAS	SWOT Analysis of Industry 4.0 Context in Brazil	Nicolela P B, Cordeiro GA, Cooper RE, Ferro R, Anholon R
	iCyPhy - Industrial Cyber Physical Systems	Santos, MMD, Yoshino, RT	The Layout Problem under Time Varying Demand and its Relations with Industry 4.0	Azevedo AT, Dias EX, Scarpel RA
21:00 - 21:30	ROUNDTABLE - Room UL12			
21:30 - 22:00	WRAP UP AND CLOSING SESSION - Room UL12			

(*) these presentations will be done through Skype.

Additional activity: DAY 1 (28th) 14:45 - 15:45	WORKSHOP - Room UL57 **Multi-Agent Modeling: Introducing ANYLOGIC** Registration required at the hall - limited quantities

Web site: supplychain4.org/issc4-2017/

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website: http://supplychain4.org/issc4-2017/

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STRATEGY

First International Symposium on Supply Chain 4.0: Trends, Challenges and Opportunities
from the 4th Industrial Revolution, August 28-29, 2017, Limeira, Brazil.

A digital maturity scorecard for measuring Industry 4.0 readiness level of organizations

Awasthi A[1], Bhullar K Rupinder[2]

Abstract: The objective of the paper is to propose a digital maturity scorecard for measuring Industry 4.0 readiness level of organizations. The scorecard is based on various dimensions such as strategy, customer experience, technology and data, operational processes, people and culture. TOPSIS methodology is used to generate scorecard ratings. A numerical application is provided.

Keywords: digital maturity scorecard; TOPSIS, sustainability, Industry 4.0

1 Introduction

More and more organizations are demonstrating interest in moving towards implementation of Industry 4.0 technologies to achieve operational efficiency, business gains and maintain competitive edge (Lu, 2017). However, the main challenge faced by them is determination of right processes or business areas and technologies for implementation. The first step in this regard lies in assessing the digital maturity level of business organizations. In literature, few studies have been reported in this regard. Schumacher, Erol and Sihn (2016) propose a multicriteria model for assessing Industry 4.0 readiness and maturity of manufacturing enterprises. Nine dimensions are considered namely products, customers, operations, technology, strategy, leadership, governance, culture and people. Gill and VanBoskirk (2016) measure digital maturity based on culture, technology, organization, and insights. Stratford Corporation (2015) proposed a digital maturity assessment scorecard based on digital strategy, customer experience, technology and data, operational processes and people, and culture. In this paper, literature review and discussion with academic and industrial experts will be used to identify the dimensions and indicators for constructing the digital maturity assessment scorecard.

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CIISE, Concordia University, Montreal, Canada.

2 Objectives

The objective is to design and develop a digital maturity scorecard for measuring Industry 4.0 readiness level of organizations.

3 Methods

The proposed solution approach comprises of three steps.

1. Identification of indicators for constructing the digital maturity scorecard using literature review and discussion with experts from academia and industry.
2. Execution of the digital maturity scorecard using the identified indicators and multicriteria decision making method called TOPSIS.
3. Conducting sensitivity analysis to determine the stability of model results to variation in input parameters.

4 Results

A numerical application is provided to demonstrate the proposed digital maturity assessment scorecard for manufacturing sector.

5 Conclusion

The proposed digital maturity assessment scorecard has strong practical applicability in determining the readiness of business organizations in implementing Industry 4.0 technologies. The current work is dedicated to design and development of the scorecard and its execution is demonstrated through a numerical application. The future work will involve execution of the proposed scorecard using real data from business organizations in Canada and elsewhere.

References

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Schumacher, A., Erol, S. and Sihn, W., 2016. A Maturity Model for Assessing Industry 4.0 Readiness and Maturity of Manufacturing Enterprises. Procedia CIRP, (52), pp.161-166.

Martin Gill and Shar VanBoskirk, 2016, The Digital Maturity Model 4.0, Benchmarks: Digital Business Transformation Playbook, https://forrester.nitro-digital.com/pdf/Forrester-s%20Digital%20Maturity%20Model%204.0.pdf

Stratford Managers Corporation (2015), Digital maturity assessment scorecard, http://www.stratfordmanagers.com/wp-content/uploads/2015/10/DigitalMaturityScorecard_Example.pdf

Why the 4th Industrial Revolution will disrupt pre-existing economic and social structures.

Beliveau M[1,2], Santa-Eulalia LA [1,3], Mosconi E [1,4]

Extended Abstract: Since the time when the concept of the Fourth Industrial Revolution, or I4.0, was first presented at the Hannover Fair in Germany in 2011, discussion, research and business opportunity have exploded. Having some technologies aggregate into one concept was seen as the start of an industrial revolution. But for some, the buzz around the I4.0 revolution seems more a trend or even a simple continuum of what things were. The question if I4.0 is an evolution or a real revolution has not been clearly defining in the scientific community. Economists have studied certain technologies and innovations in history that cause a major shift in the economy and in social structure. Well-known technologies and innovations like the smelting of ore, steam engines, factory system, electricity and more recently the internet and biotechnology had a profound impact. Following certain criteria these *General Purpose Technologies* (GPT) were identified for their influence. This research considers the definition of I4.0 and analyses it through the historic economic perspective of GPT. Using also principle of *Neo-Shumpeterian* that state innovation should be the central goal of economics growth, the contribution of this research is to spark discussion on how important I4.0 will be in our society.

Keywords: Fourth industrial revolution; Economic; General Purpose Technology; Innovation, Neo-Shumpeterian.

1 Introduction

There is still no consensus on what Industry 4.0 (I4.0) is, but the proposal of Hermann, Pentek, and Otto (2016) is a good basis from which to define it. The consensus is related to promise of a faster time to market for new products and services, a real personalised mass-production offer, better efficiency of resource utilisation, more flexible and decentralised production (Lasi, Fettke, Kemper, Feld, & Hoffmann, 2014). However, beyond these promises this research will demonstrate that I4.0 can be more. Two major concepts need to be explained: 1) what I4.0 is,

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considering the definition from Hermann et al. (2016), and 2) what GPT and its criteria are, presented by Bresnahan and Trajtenberg (1995) and redefined by Bekar, Carlaw, and Lipsey (2016). We will use the six criteria as assumptions to define if I4.0 is a GPT and thus a have the potential of being a revolution. The assumptions are:

A1) Is I4.0 creating new opportunities rather than offering a complete, final solution (Bresnahan & Trajtenberg, 1995)?
A2) Is I4.0 involved in 'innovational complementarities', that is, will the effects of I4.0 grow with other innovation development and vice-versa. (Bresnahan & Trajtenberg, 1995)?
A3) Does I4.0 evolve and advance as it spreads throughout the economy, bringing about and fostering generalised productivity gains (Bresnahan & Trajtenberg, 1995). (Bresnahan & Trajtenberg, 1995)?
A4) Does I4.0 enable many new downstream inventions and innovations that were technically impossible without I4.0 technology.(Bekar et al., 2016)?
A5) Is I4.0 pervasive, meaning it spreads across multiple uses, not just the industrial sector. (Bekar et al., 2016)?
A6) Does I4.0 have no close substitutes (Bekar et al., 2016)?

2 Objectives

Is Industry 4.0 a real revolution according to the criteria used by economists to define a General Purpose Technology?

3 Methods

This research is exploratory as it will be the first time GPT criteria will be used to help define I4.0. To help illustrate the importance of I4.0 for our society, we will use the innovation economics principles of *Neo-Shumpeterian* proposed by Hanusch and Pyka (2006)

4 Results

The discussion will mainly be focused on the fact that it is an aggregate of technologies that creates the disruption of the pre-existing economic and social structure and thus I4.0 should be studied as a whole and not just one technology.

5 Discussion and Conclusion

The importance of I4.0 has been a revolution and what it implies.

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First International Symposium on Supply Chain 4.0: Trends, Challenges and Opportunities from the 4th Industrial Revolution, August 28-29, 2017, Limeira, Brazil.

The View of Integration between Industry 4.0 Concepts and Supply Chain Management

Cordeiro GA[1], Ferro R[2], Cooper R E[3], Anholon R[4]

Abstract: The goal of this research is present an overview about integration of some Industry 4.0 concepts and technology with supply chain structure. The result shows theoretical view that make relation between group of technology concepts, group of basic concepts and an integrated supply chain model identifying possible applications of the new technological trends and its impacts.

Keywords: Supply Chain Management; Industry 4.0; Technology Concepts.

1 Introduction

The integrated supply chain is characterized through collaboration between enterprises (supplier network - manufacturer - distributor network) within structure of flows and constraints of essential resources, where the value chain process should be alignment and manage from procurement of raw materials to distribution to costumer (Bowersox *et a*l., 2014). The Information Technology (IT) is one of the main aspects that more facilitate this activities due utilization of systems which provides strategic data to drive replenishment and production decisions. In this scenario are observed possible contributions of Industry 4.0 by autonomous activities.

2 Objectives

This paper aims to present a theoretical overview about integration of some industry 4.0 concepts and technology with integrated supply chain model.

3 Methods

This study is based on a literature review of the Industry 4.0 concepts/technologies and it also used a theoretical model of supply chain management.

4 Results

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A model of integrated supply chain supported in the Industry 4.0 context is shown in the follow Figure 1.

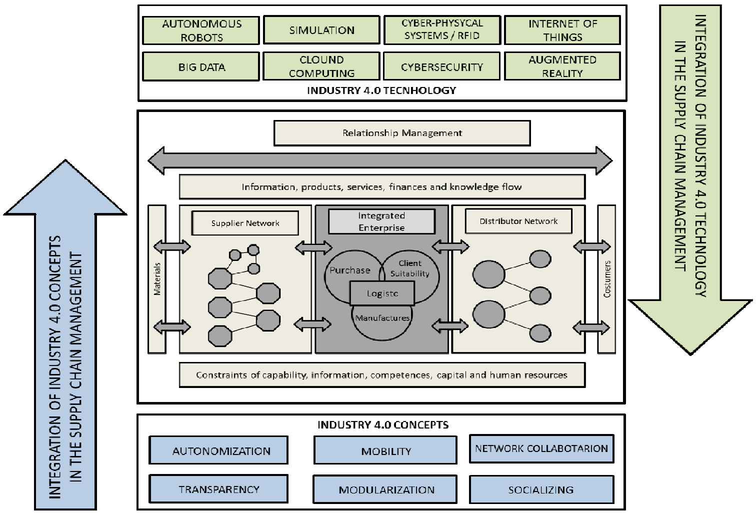

Figure 1: A model of integrated supply chain supported in the Industry 4.0

In this proposal, the information exchange in real time facilitates the coordination of production inputs, production process, storage, purchase orders, and delivery to costumers. This scenario is improved because there is vertical integration, for example with the use of RFID for effectively track and manage materials. Another improvement is the horizontal integration obtained by the efficient communication between all enterprises of value chain, in this case the cloud computing and Internet of Things allow access to a set of standardized data that avoids lack of information into supply chain.

5 Conclusion

The main contribution of this proposal is clarify how new technologies allow greater vertical and horizontal integration of the supply network. Thus, the supply chain management models are more integrated and flexible considering services customization, more data processing capacity and autonomous decision make.

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First International Symposium on Supply Chain 4.0: Trends, Challenges and Opportunities from the 4th Industrial Revolution, August 28-29, 2017, Limeira, Brazil.

The impacts of Industry 4.0 on decision making in a supply chain

Beliveau M[1,2], Santa-Eulalia LA [1,3], Mosconi E [1,4]

Extended Abstract: In the 21rst century, firms face increasing challenges in their decision making in markets that are in continual flux and products with shorter life cycles. It is a known fact that the quality of information for the manager and the business owner is pivotal in making decisions. But the barrage of data coming from so many sources can be overwhelming, and in the end, be ignored, thus losing opportunities for growth and competitive distinguishment. The quality of the information is essential, and with the right capacity to analyse can open up new possibilities. This shift of paradigm is mainly cause by new technologies and the speed how the information travel, is been updated regularly and created by new sources. To help explain the complexity of decision making and what it implies, research has used theories to study decision making such as: the transaction cost of using the market for supply, the cost of internal resources, the agency theory and game theory to name a few. Each time a decision maker must balance the pros and the cons for specific settings. Since the time these theories were proposed, technology has grown greatly and that affects the way decisions are made. The fourth Industrial Revolution or I4.0 is an aggregate of technology that will redefine how management and decision making are done in organisations. To help illustrate this, a case study of how decisions are made around a Volkswagen smart factory and its supply chain that builds custom-made cars in a mass production setting. Using the four theories previously stated, this chapter will show the benefits of using I4.0 technology in managing a supply chain.

Keywords: Supply chain 4.0; Transaction costs theory; Resource-based view theory; Agency theory; Game theory.

1 Introduction

The concept of I4.0 forwarded by Hermann, Pentek, and Otto (2016) present I4.0 design principles as: 1) Interconnection of machines, devices, sensors, and people 2) Information transparency between the physical world and virtual world, 3) Decentralized decisions are based on the interconnection of objects and people as well

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as transparency on information from inside and outside of the firm, 4) Technical assistance on physical work and decision making. This will be the base to present potential gain in decision making. A presentation of the four decision-making theories will be explained and the different approach of each to help define the challenge and complexity of the supply chain manager. Finally, a description of a smart factory in the I4.0 context will be given, in particular of what Volkswagen Germany is working on. These concept and notions will help answer the fallowing assumption:

A1) I4.0 will help reduce transaction costs for the firm
A2) I4.0 will help distinguish the firm from its competition
A3) I4.0 can reduce risk of asymmetric information between the firm and its supply chain
A4) Based on game theory, I4.0 technological possibilities will grow because of the edge it will give to firms and its supply chain.

2 Objectives

Understand how theoretical approaches of decision-making problems can support supply chain management with I4.0 technologies.

3 Methods

A case study of a Volkswagen smart factory with data collected by secondary sources of information.

4 Discussion

The discussion will focus on how the different technology and concept of I4.0 will help supply chain managers and it firms, in decision making in the future.

5 Conclusion

The limits of this paper as I4.0 technology and concept are still been developed around the world.

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3D PRINTING

Understanding 3D printers-oriented supply chains using agent-based modelling: the case of 3D Hubs

Lima R[1], Santa-Eulalia LA, Yoshino R, Audy JF, Mosconi E

Abstract: 3D printers (or additive manufacturing) are supposed to bring many innovations to the industrial world. This technology promises to change the way we do business and collaborate with supply chain partners, since the mass production process will have to change to a widely distributed, highly flexible, small-scale manufacturing. Some researchers believe that first-order implications will cause businesses all along the supply, manufacturing, and retailing chains to rethink all their strategies and the way operations are managed. However, the literature in this area is in its infancy and the phenomenon is yet to be understood. The main goal of this project is to propose a multi-agent platform allowing for understanding of social manufacturing behaviour of a highly-distributed 3D printing network. This platform is then applied in a known case in the area, the 3DHubs.

Keywords: 3D printers; Supply Chain Management; Social Manufacturing; Agent-Based Modeling; 3D Hubs; AnyLogic

Extended Abstract

Recent advances in additive manufacturing, also known as 3D printing, have the potential of revolutionising industrial production in many aspects (Wirth and Thiesse, 2014). It will cause business all along the supply chain because it uses readily available supplies from multiple vendors (Berman, 2012). This technology makes the concept of social manufacturing (Jiang et al., 2016) possible. In social manufacturing, the consumer becomes a prosumer (producer + consumer) and it enables information sharing on online platforms for contribution throughout the manufacturing process (Ras, 2016). Prosumers infiltrate in the product lifecycle activities and collaborate to improve the development, production and usage of products (Jiang et al., 2015). In this area, some highly distributed networks exist, such as 3DHubs, Shapeways, Thingiverse and so forth. The literature in this area is in its infancy and scholars still do not have enough knowledge about how these complex networks behaves. Consequently, we still do not know if the traditional Supply Chain Management approaches need to be adapted to this new context.

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In order to contribute reducing this research gap, the goal of this paper is to propose a simulation model in the social manufacturing context that can analyse the behaviour of a highly-distributed 3D printing network. We employed agent-based modelling and simulation (ABMS), since it is suitable to deal with complex systems composed of several interacting 'agents' (Borshchev, 2013). In ABMS patterns, structures and behaviours can be observed and it is also a proper usage for the study of supply chain (Macal and North, 2009).

A well-known case in the area is first choose for the generation of a proof-of-concept: the 3D Hubs. The company was founded in 2013 with the goal of sharing industry knowledge, capital and manufacturing expertise (3D Hubs, 2017). This specific network was selected because it is a successful business case in the area. The first step was to understand how 3D Hubs works and to create a BPMN (Business Process Model and Notation) model that represents the business process flow. Basically, the customer uploads a 3D digital file, chooses the most suitable material for his needs, chooses a 3D printing service after having received information on each one of them, makes payment and receives the final product in the stipulated time. The problem of selecting the best partners in the network using different criteria is also modelled.

The project is now in the agent-based simulation models phase with the use of AnyLogic, a multimethod simulation modelling tool. The simulation model is composed of thousands of nodes (3D Hubs, 3D printing services and customers) connected by complex relationships that are modelled as agent-based protocols. In this model, parameters such as nodes structure, localization and capacities are varied to analyse multiples scenarios to make conclusions for the real-world supply chain situations. The simulator is modeled bottom up by identifying the agents and then defining their interacting protocols and finally behaviours emerges from the whole system during simulation.

The impacts of these scenarios include profit, product quantity, lead time reduction, node distribution and effects on the network size and topology. The future results are expected to be scenarios considering financial and marketing aspects to demonstrate the potential of this platform and evaluate new supply chain structures in the 3D printing context that can later be used for future researches.

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Additive manufacturing in the jewelry industry: adding value on Brazilian market's technologies available.

Faria L[1], Yoshino R[2]

Abstract: The topic of additive manufacturing (AM) technologies is vastly discussed. The objective of this paper is to present the AM technologies applied to the jewelry manufacturing market and fit them into the Brazilian reality. It is an exploratory study based on the literature. The literature is not abundant, as this sector is growing, the literature guides to the best option of investment.

Keywords: jewelry prototyping; additive manufacturing; Brazil.

1 Introduction

The means of manufacturing have become more accessible to the population on account of the grown of the availability of equipment once before only available to large companies as CNC machines, laser cutters, 3D printers. This is happening because of the expiration of patents and the spread of the technology through the world(HATCH, 2013).

The additive manufacturing (AM), colloquially known as 3D printing, is the process to manufacture objects through layers. The usability of the AM is growing year by year, the facility to deal with this technology is also growing. Diverse types of industry have been beneficiating with AM technologies such as airspace, automobile and jewelry (RAYNA; STRIUKOVA, 2016).

The jewelry sector still in the Bronze Age (3500-3000BC) according to Zito (2017) as the result of its leading procedure being the lost-wax. This reality is changing with the introduction of SLM (Sintering Laser Melting) technology also cited by Cooper (2016) as the phenomenon of the geometric design freedom.

2 Objectives

Present the AM technologies used in the jewelry sector such as SLA, DLP, SLM/SLS and DOD comparing and fitting them to the reality of Brazil.

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3 Methods

This research is exploratory, based on the bibliographic review of the literature. It has a qualitative approach and the method used is the inductive.

4 Results

Based on the size of the company or in the target public, a type of technology is presented as more appropriate. It’s compared equipment's speed, layer thickness, price of castable resin.

The SLA printer has shown a better adequacy to small business, it offers the lowest price of equipment and resin with an average layer thickness but the slowest speed. Small business which searches for a good quality of printing and don’t have a large demand, should analyze this investment.

The DLP equipment is for small business with higher demand or the production of small batches. It has a great quality of the previous technology and is faster but the price is almost three times the SLA.

The SLM technology still being tested but it is the big promise of the new revolution to the jewelry market. It is for specific consumers that value design but the company has to be big, the investment for this equipment is high.

The DOD equipment is very precise, it is for companies that search for definition, it demands a high investment for de equipment and 2 different types of resin.

5 Conclusion

The most used technologies in Brazil is the SLA and DLP. Worldwide, the promise for future's market is the SLM technology. This technology has the advantage to print directly in the metal with designs that couldn’t be used before and it is able to produce hollow pieces which saves money.

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Additive Manufacturing: definitions, applications and consequences in operations

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Abstract: This is a chapter proposal for the book project about Industry 4.0. It will approach additive manufacturing (AM), which is one of the important technologies utilized in the Fourth Industrial Revolution. The topics presented will involve the relation between Industry 4.0 and AM; AM definitions, technologies and materials; AM business models and supply chain changes; and some cases of enterprises that are using AM.

Keywords: 3D printing; business model; supply chain; Industry 4.0; Fourth Industrial Revolution.

Industry 4.0 is an emerging concept that involves many technologies, one of which is additive manufacturing (AM) or known popularly as 3D printing. In this context, one cannot then disregard this important technology that is revolutionizing the way things are produced, according to Ben Lazarus (2016), Vice President Business Transformation and PMI of Stratasys, one of the main printer manufacturers currently. However, the literature lacks didactical material connecting technological aspects of AM to operations and supply chain management issues. Thus, this chapter aims to contribute to reducing this gap.

After reading this chapter the reader should be able to:

- Understand AM concept and its relationship with Industry 4.0;
- Learn the AM main stages;
- Master the technologies and materials used;
- Know the main changes and impacts of AM in operations (business models and supply chains);
- Find practical examples to illustrate the transformations caused by AM.

The book chapter will consist of the following subchapters with their learning objectives:

1 Introduction

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This subchapter discusses the relationship between Industry 4.0 and AM. It explains that AM is just one of the technologies that encompasses this new industry concept, but its potential to promote disruptive innovation is quite important.

2 Additive manufacturing

We will explore basic definitions, main technologies, manufacturing steps and materials. For example, for the main steps, we will employ the approach of Gibson, Rosen W. and Stucker (2010). We will include the following approaches, among others: Photopolymerization, Powder Bed Fusion (PBF), Extrusion-Based Systems, Printing processes, Sheet Lamination Processes and Beam Deposition Processes (BD). As for the materials, we will explore liquid polymer or photopolymer, powder or discrete particle, molten or fused and solid sheet, which can be employed with Polymers, Metals, Ceramics and Foods.

3 Additive manufacturing in operations

This subchapter will show the impacts that AM can have on business models and on supply chains (inbound, production and outbound logistics). In terms of business models, this section will approach the leagile and consumer-centric business model, in which customization and personalizing are the focus. As for Supply Chain Management, this section will exhibit the concepts of AM centralized and distributed supply chain in the consequences for enterprise performance.

4 Cases

This subchapter will cover examples of practical cases from companies that are using AM in their manufacturing process, including in different industry sectors, such as aerospace and automobile, and with different business models, such as 3DHubs, Thingverse, Shapeways and so forth. The reader will have real examples of the application of AM technology.

5 Exercises

Finally, exercises will be proposed for the reader to reflect on the transformation already occurring and possible changes that AM can cause to our everyday life and in business.
The book chapter will contain illustrations and frames that make the book more didactic. References will vary and they will be as up-to-date as possible. For subchapters “Introduction”, “Additive manufacturing in operations” and “Cases”, references from scientific and gray literature will be used. For subchapter “Additive Manufacturing”, references from books and International Organization for Standardization/American Society for Testing and Materials (ISO/ASTM) will basically be used.

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Distributed manufacturing of spare parts: challenges, enabling technologies and processes

Durao LFCS[1], Zancul E[2], Schützer K[3], Simon AT[4]

Abstract: In time provision and geographic location of customers are main issues in the production of spare parts. This paper describes the technologies and processes for the implementation of distributed manufacturing using Additive Manufacturing (AM) in the context of *Industrie 4.0,* varying the level of integration between sites. The scenarios provide effective strategies for mitigating distributed manufacturing challenges and providing a more responsiveness supply chain.

Keywords: Distributed Manufacturing; *Industrie 4.0;* Additive Manufacturing.

1 Introduction

The demand unpredictability in conjunction with the distributed location of clients are the main issues dealing with spare parts. Distributed manufacturing provides greater responsiveness to deal with a variety of products (Khajavi, Partanen and Holmström, 2014), whilst an efficient spare parts management is one of the key areas of SC 4.0 (Schrauf and Berttram, 2016).

The connectivity of *Industrie 4.0* and the flexibility of AM products (Khajavi, Partanen and Holmström, 2014) can provide the basis for implementing a distributed manufacturing (Schlund, Marrenbach and Baue, 2014). However, understanding which are the enabling technologies for responsiveness distributed manufacturing remains an open topic in the literature.

2 Objectives

The objective of this paper is to describe technologies and process for responsiveness SC through distributed manufacturing scenarios.

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3 Methods

The results presented are based on the simulation of four different scenarios. The scenarios involve the design, implementation, and testing of distributed manufacturing of spare parts. They represent various levels of integration, evolving from a non-connected to a fully connected environment (Durão *et al.*, 2016).

4 Results

Four different levels of distributed manufacturing integration were simulated: a regular production; a remote analysis of the production; a remote control of the production; and a remote control of the production and quality control, providing a full connected environment. The scenario simulation indicated that increasing adoption of distributed manufacturing may be enabled by key existing technologies, as proposed by *Industrie 4.0*. Existing high-end tools were combined to low cost available technologies to support scenario implementation and application. Among these technologies, a product lifecycle management (PLM) system was used to control information flows. For an automated quality control process, a software was designed using OpenCV library for image recognition, increasing the control levels of the central factory over the distributed sites. Then it was possible to understand enabling technologies to create an environment closer to the final customer and with improved supply chain management through *Industrie 4.0*.

5 Conclusion

This paper proposes an approach to deal with spare parts manufacturing by implementing distributed manufacturing based on *Industrie 4.0* technologies. The difficulties with this approach are mitigated by the use of communication technologies - brought by *Industrie 4.0* - integrating the whole system and providing a distributed system close to the customer and more reliable.

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APPLICATIONS

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Challenges and Opportunities of Industry 4.0 in a High-Technology Sector: The Case of the Brazilian Aeronautics Industry

Ferreira, MJB[1]

Abstract: The aeronautics industry has a prominent role in the Brazilian economy, being the only high-technology sector that presents outstanding competence on the global market. In this context, it is important to analyze the impact of the technological innovations brought by Industry 4.0 to the competitiveness of this industry, particularly for the Brazilian case. It is observed that there is a differential in the rate of incorporation of these new technologies, concentrating initially more on the productive processes than on the products (aircraft). However, both will have to be accompanied by the Brazilian aeronautical industry, at the risk of losing its position among global leaders.

Keywords: Aeronautical Industry; Embraer; Innovations; Competitiveness; Brazil.

1 Introduction

The aeronautics industry is one of the most advanced in the world and its products — airplanes and helicopters — are very close to the technological frontier. Aircraft are products of high complexity that seek to incorporate and integrate a wide range of innovations originating in other industrial sectors, resulting not only in the improvement of the aircraft, but also of the technologies incorporated therein (Mowery, 2006).

In this context of high technological dynamism, the Brazilian aeronautical industry stands out as one of the most advanced in the world. Its leading company, Embraer, is the world's third-largest manufacturer of commercial aircraft, and also displays outstanding performance in the executive and military aircraft segments. This success on the international market is reflected in the outstanding importance that the aeronautical industry has in the Brazilian economy, particularly with regard to exports and highly qualified jobs (Ferreira, 2016).

2 Objectives

The present study seeks to understand the main trends and technological breakthroughs brought about by Industry 4.0 for the aeronautical sector (McKinsey, 2016), with emphasis on the following technologies: a) Internet of Things (IoT); b)

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Communication network technologies; c) Big data and Artificial intelligence (AI), d) Intelligent and connected production. From this, to analyze what the main challenges and opportunities for the Brazilian aeronautical industry are.

3 Methods

The methodology used in this work presents a predominantly qualitative approach. First, the collection of data that can be divided into: (i) secondary sources that include a broad bibliographic review; (ii) workshops with experts from each of the four outstanding technologies; (iii) semi-structured interviews with managers of selected companies of the Brazilian aeronautical industry. In the second stage, the systematization and analysis of these data. Finally, obtaining the conclusions.

4 Results

The final report, in its first part, should present a brief description of the current market structure and the technological stage of the Brazilian aeronautical industry. Following this, the paper will discuss the main expectations of the aeronautics industry to incorporate, integrate and develop the technological innovations brought about by Industry 4.0 within approximately ten years. In the third part, it will analyze the expected impacts of these new technologies on competition, market structure and corporate governance of the aeronautical industry, particularly Brazilian, highlighting the main challenges faced by Embraer and the potential of new firms.

5 Conclusion

It is observed that there is a great differential in the rate of introduction and incorporation of the new technologies between product and process. The new commercial aircraft models just released by major manufacturers are just versions that incorporate incremental innovations. Nevertheless, a great advancement in process technologies is observed. In this context, in order to preserve its competitiveness, the Brazilian aeronautical industry should increasingly incorporate the new technologies — mainly processes — brought by Industry 4.0.

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Forestry in an Industry 4.0 perspective

Bittencourt E[1], de Santa-Eulalia LA[2]

Abstract: The migration to the Industry 4.0 dynamic in the forestry sector may be closer than many would imagine. The latest technology advancements, such as location detection technologies, big data and analytics to name a few, will bring gains in different parts of the forest products value chain. This paper highlights how the sector is transforming digital industrial technology into benefits, as well as the main challenges that lay ahead for this resource-intensive industry.

Keywords: Forestry 4.0; Precision Forestry; Business Intelligence.

1 Introduction

The end-to-end digitization of all physical assets and integration into digital ecosystems with value chain partners (Pricewaterhouse Cooper 2016a), also known as Industry 4.0, is an ongoing major transformation that is changing industrial processes. In forestry, this shift has been fueled mainly by the recent availability of the following technology advancements: mobile devices, location detection technologies, big data and analytics, simulation, horizontal and vertical system integration, internet of things platforms, cloud computing and augmented reality. Each of these advancements brings an extensive range of potential applications in the activities performed by the forest sector, ultimately translating into gains. The latest advancements and some implications of this new forestry however have not yet being understood by many.

2 Objectives

The objective of this paper is to overview how forestry is migrating to a digitally interconnected reality as well as the challenges that lay ahead for its full implementation.

3 Methods

The information described in this paper is a product of practical experience from the authors summed with in literature information on Forestry 4.0.

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4 Results

Information as a centre point: Data lies at the heart of the fourth industrial revolution, but the massively growing information flow brings little value without the right analytics techniques (Pricewaterhouse Cooper 2016b). More than just having data accessible, Forestry 4.0 will be characterized by the real-time availability of ready-to-use information. This is where data collection, big data analytics, simulations and information sharing will meet. In forest inventory, for instance, 100% of the target forest will be inventoried with the use point-cloud technologies - instead of the traditional sampling practice. This will result in a more detailed portrait of the forest to better track forest growth and better tailor forest management interventions.

From harvesting to other supply chain activities: Harvesting practices will also undergo transformations. As an example, technologically advanced harvesting systems will become available, where onboard computers will display which trees to harvest and which ones should be left standing to compose the next cohort. Sensors will get georeferenced information in real time, tracking for each working condition the machine productivity, fuel consumption and roundwood quantity by diameter class. Based on this information, optimized transport management can send the exact amount of log hauling trucks to the harvesting site at the right time.

5 Conclusion

Despite the technological advancements under way, the key challenges to implement Forestry 4.0 industry-wide are skills and change in culture (Pricewaterhouse Cooper 2016b). The lack of data analytics skills in the workforce is the major challenge to transform data into ready-to-use information. It is suggested that increasing in-house data analytics technology and skill levels could be the biggest improvement route to overcome this limitation (Pricewaterhouse Cooper 2016b). On the complementary side, transforming the culture inside a company equally poses its challenges (Pricewaterhouse Cooper 2016b). Companies should not wait for the perfect technology, as this is an evolving process. They should invest in the transformation of their people and culture to promote the long-term change that this type of movement requires.

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Industry 4.0: Development and application in the logistics area

Garcia IB, Nagura GI, Cubarenco NR, Yoshino RT

Abstract: With the evolution of factories and production processes there is a constant emergence of new technologies and methods within the entire industrial chain. One of the most important parts, and still little explored, is the logistics area that comprises both internal displacements of raw materials, semi-finished products and finished products, both the external displacements that would be from the supplier to the manufacturing unit and from it to the consumer (intermediary and final). Aiming at the relevance of this type of study, the present work address the issue logistics 4.0 and its current and future market impact.

Keywords: Industry 4.0; Logistic 4.0.

1 Introduction

In the current context, it can be seen that a new industrial concept has been introduced recently, which is called Industry 4.0. It encompasses a vision of cyber-physical, which connect machines and information regarding the entire value chain throughout the product cycle. That is, the main focus of the fourth revolution is complete automation for greater efficiency, autonomy and customization.

Within Industry 4.0. it is possible to study all the parts belonging to a chain, and in the case the one chosen was the logistics. Logistic 4.0. can be defined as the search for greater responsiveness, reducing costs and increasing quality through automation.

2 Objectives

The purpose of the study is to know Logistic 4.0 and its advantages better, researches in the literature on concepts of the fourth revolution, supply chain and logistics. Seeking the applicability in the current and future horizon, with the purpose of finding means of always attending the client, meeting their expectations and, if possible, transcending them.

3 Methods

In order to reach the goals, a bibliographic review research on the theme was carried out in there periodicals databases. However, as the subject is still very recent and incorporated only now in the 21st century, the materials found on the subject are scarce and with little information in completely innovative character.

4 Conclusion

Finally, it is concluded that because it is a new field it is still very little explored and therefore it has an enormous research potential. Yet there are already actions in this area, such as trackers in trucks (GPS and radio frequency) that provide real-time vehicle location, further on being able to follow the routes to see if there are any problems such as traffic jams. However current technology and automation can take us much further, the perspective is that most logistical systems will soon have enough technological intelligence to make more viable routes in an autonomous way, predicting already existent weather or that may arise in the middle of the way. That is, much more than the example just presented, Logistic 4.0 will provide reduction of asset loss (through knowledge of problems in time to be solved) and economy (with route optimization in an autonomous and efficient way).

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Disrupt or be Disrupted: Rethinking Auto Industry Supply Chain in a Big Data World

Siegler J[1], Hughes S[2]

Abstract: Examples and cases from the auto industry worldwide, such as Ford's production line, Toyota's production system, and lean manufacturing have been widely used to build models and theories in Operations and Supply Chain Management since the early beginning of the field. OM&SCM have long benefitted from learning from practice. In this chapter, however, we argue that it is time for the giant auto industry to learn from the practice of other industries and benefit from research and theories developed from them or we may, unfortunately, witness the fall of several giant auto manufacturers in the next decades. Extensive data is collected about automotive patent filers, startups, and mergers and acquisitions activities between 2006 and 2017. The automotive market is analyzed as a whole under the perspective of how big data, Internet of Things (IoT), Artificial Intelligence (AI), machine learning and remote intelligence can impact auto industry supply chain once and for all. One auto manufacturer case is studied in further details. Challenges and possible solutions are discussed.

Keywords: Auto Industry; Disruptions; Supply Chain 4.0; 3D Printing

1 Introduction

The world has changed at a pace that has become faster and faster. Over the last decade, we had witnessed giant secular corporations simply disappear in bankruptcy process that could never be imagined few years before it happened. Examples of this sad hall of shame include Kodak and Nokia. Even though these companies were innovative by nature, they failed spectacularly. Kodak indeed invented the first digital camera (Scott, 2016) and Nokia developed the first smartphones. What then happened to them? They missed the obvious and immense "gorilla in the room." They missed the timing and when they finally noticed – assuming they did – it was too late. The auto industry is one of the most researched and most efficient industries in all business settings, but especially in operations and supply chain management. Its manufacturing processes have developed so much over the last decades that it is almost safe to say that is the closest to perfection we have ever experienced in history. However, in a 4.0 industry wave, product and process

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quality or even perfection, neither guarantee market share nor company survival anymore.

2 Objectives

Analyze automotive industry, especially U.S. market, from the perspective of how big data, Internet of Things (IoT), Artificial Intelligence (AI), machine learning and remote intelligence can impact its end-to-end supply chain.

3 Methods

We use a multi-method approach, combining quantitative and qualitative data. Extensive data is collected about automotive patent filers, startups, and mergers and acquisitions activities between 2006 and 2017. We look at global vehicle sales from 2006 to 2016 in leading markets and emerging markets. We also take a closer look in one U.S. auto manufacturer through a combination of case study approach and participant observation (Flynn et al. 1990).

4 Results

Results indicate that revenue mix for the automotive industry is shifting. Traditional sources of revenue and profits, such as vehicle sales, aftermarket, financing, insurance, and supplier of conventional components and hardware tend to keep decreasing substantially. On the other hand, new sources of revenue and profits emerge and grow exponentially. Examples include suppliers of new technologies/software, digital services, and shared mobility. New non-traditional players as those related to communications and connectivity start to play core roles in the automotive supply chains. While one of the largest auto manufacturers in the world still negotiate with its supplier base contracts that obligate them to keep parts for aftermarket cars for at least 15 years, we found data for 700+ automotive startup just between 2014 and May 2017.

5 Conclusion

Large automotive manufacturers appear to not fully consider the strength of the Industry 4.0 on their supply chain. We discuss the autonomous driving impact, 3D and 4D printing on companies current and future strategy. We also propose that the definition of "supplier" must expand as well as their portfolios. Finally, we argue that to stay one step ahead, automotive industry players need to disrupt themselves before they are disrupted. To do this, the business model should shift from just manufacturing and be selling cars to becoming a Digital Service Provider, Data Collectors, Digital Enablers, and Digital Augmented Product Providers.

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BACKGROUND

First International Symposium on Supply Chain 4.0: Trends, Challenges and Opportunities from the 4th Industrial Revolution, August 28-29, 2017, Limeira, Brazil.

Theoretical proposition of a model for RFID systems deployment in industry

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Abstract: Bearing in mind the importance of RFID systems, the main objective of this extended abstract is to develop a theoretical proposition of a model for RFID systems deployment for industry. This model was developed based on a systematic literature review and the model obtained is composed of eight steps.

Keywords: Theoretical model; RFID systems; RFID deployment.

1 Introduction

In the context of industry 4.0, Radio Frequency Identification (RFID) stands out (Hofmann and Rüsch, 2017). RFID is a technology which, through radio waves, allows the automated identification of objects (Zhang and Liu, 2017). The visibility provided by this technology generates several benefits for companies (Cui et al., 2017). Although the advantages of its use, the deployment of this technology also faces many difficulties (Wei et al., 2015). In his study, Moretti (2017) found in the literature 18 difficulties associated to RFID deployments. The difficulties of the implementation phase must be considered as important elements for the success of the system. In addition, they require a deployment model for RFID, which is scarce in literature, as it will be shown below. Besides, the RFID implementation models from the literature did not have a clear definition of the steps to be followed by companies of any sector to successful implement RFID systems. However, they have ideas that can be used as insights to build a more complete model.

2 Objectives

In this context, the main objective of this paper is to develop a theoretical proposition of a model for RFID systems deployment for industry.

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3 Methods

The methodology used to achieve this objective was a systematic literature review, using different combinations with the words “RFID”, “model”, “implementation”, “deployment”, and “adoption”. The main limitation of this research is the lack of a practical application of the proposed model. However, because it is an exploratory study, regarding a subject little discussed in the literature, its contribution is important, since it provides a model for RFID systems implantation.

4 Results

In a literature survey, it was found eight articles with propositions of RFID implementation models. However, none of these articles presented a model with the steps needed as it is presented here. The theoretical model proposed is based on the difficulties found by Moretti (2017) and ideas from the studies mentioned above, such as the pilot unit for the implementation. The model proposed is presented below.

Step 1	Critical analysis of company's technology level
Step 2	Exact definition of the requirements for RFID deployment
Step 3	Exact definition of the implementation costs
Step 4	Cost-benefit analysis of deployment
Step 5	Structuring the deployment plan for the pilot unit
Step 6	Training and presentation of what is expected for workers
Step 7	Analysis of performance and lessons learned
Step 8	Expansion to other areas of the company

5 Conclusion

The model proposed aims to benefit both researchers and practitioners. Practitioners can employ it as a guide for RFID deployment and researchers can use this model as a base for future researches. For future researches, it is recommended the practical application of model proposed for validation purposes.

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Supply Chain 4.0 opportunities and challenges: a systematic review

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Abstract: The fourth industrial revolution, known as Industry 4.0, has brought technological advances in all industrial fields, including the Supply Chain, which is increasingly receiving attention from the industry and academia since its processes, when optimized, generate benefits for all the chain. This article aims to present Supply Chain 4.0 opportunities and challenges. Articles were identified, analyzed and interpreted to synthesize the current knowledge of Supply Chain 4.0. Results show Supply Chain 4.0 as an interconnected network that better meet customer needs.

Keywords: Supply Chain, Supply Chain 4.0; Industry 4.0.

1 Introduction

Managing all operations in a supply chain is complex and inexact once observed innumerous mismatch problems, such as delivery delays, stockout and overstocking (WONG *et al.*, 2012).

To eliminate such mismatch and increase production efficiency, the fourth industrial revolution – Industry 4.0 – is transforming the industry by connecting the digital and physical worlds, integrating individualized systems to exchange information between themselves to become resilient and responsive (REDDY, SINGH and HARIHARAN, 2016).

By doing so, Supply Chain 4.0 extends from isolated, local and single-company applications to wide systematic and interconnected supply chain, enabling companies to gain competitive advantage and to better meet customer needs (WU *et al.*, 2016; SCHRAUF and BERTTRAM, 2016).

Supply Chain 4.0 is a new area with few studies and still lacks research development to build a solid and robust theory.

2 Objectives

This paper aims to present Supply Chain 4.0 opportunities and challenges, exploring its current status, benefits and risks involving its implementation.

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3 Methods

Articles about Supply Chain 4.0 were identified, analyzed and interpreted using a systematic literature review pre-established criteria, such as search strings, selection and qualification, as example, in order to summarize the current knowledge.

4 Results

Results show the benefits of integrating Supply Chain digitally, once it is considered the core of all business. Eight core elements of Supply Chain 4.0 are identified (integrated planning and execution, logistics visibility, procurement 4.0, smart warehousing, efficient spare parts management, autonomous and B2C logistics, prescriptive supply chain analytics and smart supply chain enablers) that, when integrated, allow supply chain to become more competitive (SCHRAUF and BERTTRAM, 2016; KAGERMANN, WAHLSTER and HELBIG, 2013).
However, companies still need to deal with the compatibility of all connected devices, as well the complexity to secure and maintain data privacy on the network (BHARGAVA, RANCHAL and OTHMANE, 2012).

5 Conclusion

Presented as a fast, flexible, accurate, transparent and interconnected network, Supply Chain 4.0 allows companies to focus their efforts on core competencies, increase productivity and better meet customer needs. Future researches are needed in order to further develop this concept and improve benefits of its application.

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Quality 4.0: Bibliographic research proposal for the quality area within industry 4.0 context.

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Abstract: The present proposal is intended to base bibliographically the quality area in the industry 4.0 context. To reach the expected results, it's intended to use methodologies to form the systematized review, integrating the industry 4.0 concepts in the quality area.

Keywords: quality, industry 4.0, fourth industrial revolution

1 Introduction

The fourth industrial revolution has, among several characteristics, the informatization in the manufacturing area as one of those, needing a new organizational model with a systemic view and a new execution of the productive process in order to facilitate the all industry's area integration. Since the advent of the Total Quality Management – TQM the quality area has been following a wide and multidisciplinary way, but now, even though, it's finding adaptation due to work modes and technologies that are applied in the Industry 4.0.

These technologies will possibly cause great integrations in existing value chains, providing data transfer in real time that will influence the speed and quality of information analyses and decisions making to all industry areas, including the quality one. According to Krubasik et al. (2017), the quality 4.0 will be present in a system that will analyze in real time the whole process, monitoring through Sensors, Big Data and Internet of Things technology. With the implantation of industry 4.0, will

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maximize quality, beyond productive gains, it's also intended to reach cost reduction, mainly in products manufacturing (ASAKURA, 2016).

2 Objectives

The study objective is to search bibliographic research to the quality area within the industry 4.0 through specific methodologies of bibliometric analysis.

3 Methods

The proposal for a bibliographic research will be realized through bibliographic portfolio collection and systematized review. A reference manager, Mendeley, will be used through the Methodi Ordinatio (Pagani et al. 2015) to articles search in the databases that will be selected for this study.

4 Results

As principal expected results to this research, it intends to verify: Cultural changes in companies to reach quality 4.0; Technologies inserted in the quality 4.0 area; Quality 4.0 implementation and migration difficulties.

5 Conclusion

It is intended to conclude through this study that the industry 4.0 sustaining technologies will cause impact on the quality area.
From the expected results to this research, it's intended to create a portfolio that can be basis to others studies and, with it, give a foundation to quality 4.0. Such a basis will do great contribution to distinguish the new quality 4.0 age from the others one, through the process, technologies, services and products from industry 4.0.

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Interoperable Smart Supply Chain: explorations towards industry 4.0 requirements

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Abstract: This research aims to investigate the Industry 4.0 domain attributes considering its influence on an automotive supply chain. It focuses on analyzing how Industry 4.0 domain can interact with the dimensions of Interoperability to enable the evaluation of barriers associated with the Smart Supply Chain (SSC) performance. A Systematic Literature Review supported with Multicriteria Decision Analysis (MCDA) is proposed in order to analyze the criteria in such complex scenarios. The preliminary results obtained demonstrate the lack of formalization in SSC and interoperability relationship in the automotive domain.

Keywords: smart supply chain; industry 4.0; interoperability; multicriteria decision analysis.

1 Introduction

Almada-Lobo (2015) says the end of self-centralized industry emerged Industry 4.0 which, for Stock and Seliger (2016), consists of horizontal integration in the entire value chain, engineering throughout product life cycle, vertical integration and systems connection. For Shrouf et al (2014), some of the smart features are mass customization, flexibility and connected supply chain. One of SSC's requirements are being networked, which fosters collaboration and integration among the chain's partners. These elements are considered as interoperability barriers in the automotive industry between automakers and suppliers.

2 Objectives

The paper purpose is to highlight the structural and conceptual points of Industry 4.0 relating them with automotive supply chain (ASC) and interoperability attributes. The theoretical contributions take place on Industry 4.0, Automotive Smart Supply Chain and Interoperability domains. The motivations for this research are

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"How do the automotive supply chain attributes, categorized from the perspective of interoperability, are influenced by Industry 4.0?" and "How do these attributes are interrelated with the key points of Industry 4.0?"

3 Methods

This research focus on Industry 4.0 domain influence on ASC. With a similar to Bordini *et al* (2014) methodological approach, a systematic literature review is conducted to identify Industry 4.0 attributes. Then, the obtained knowledge from the attributes identification step is organized by MCDA methods structures. Towards comprehending how Industry 4.0 influences and is related to ASC, Dematel (Decision Making Trial and Evaluation Laboratory) and Promethee (Preference Ranking Organization METHod for Enrichment of Evaluations) are considered.

4 Results

The first research stage is a systematic literature review towards Industry 4.0 domain attributes. Its expected results are the attributes identification and categorization to promote the domain understanding. Then, the focus is on inferring the domain attributes interactions with ASC. The expected result is the comprehension about interactions and a broad view about the forth revolution influences on the productive chain.

5 Conclusion

This research stage focuses on Industry 4.0 domain exploration and its influence in the ASC. The identified concepts are important to highlight barriers in the automotive context that hinder Industry 4.0 in the smart supply chain perspective and the evaluation of interoperability relationship.

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COMPONENTS

Industry 4.0: An analysis of existing conceptual frameworks

Pereira P[1,2], Santa-Eulalia LA[1], Mosconi E[1]

Abstract: The existing frameworks of industry 4.0 are more focused on the technological and process fields. This article investigated the classification of the frameworks by subject, and discovered opportunities for new frameworks developments in terms of methodology, business model and human factors.

Keywords: Industry 4.0, Industrial Internet of Things (IIoT), Conceptual Frameworks

Extended Abstract

The term Industry 4.0 was created at Hannover, in Germany, in 2011, to identify the so-called 4th wave of industrial revolution, based on the connectivity of physical objects (sensors, machines, buildings, and other items) to the internet, and its connectivity among them (Schuh et al., 2017). Since then, several conceptual frameworks were created to explain this complex subject A framework is "a collection of modelling principles, methods, or tools relevant for a given domain of application" (Vernadat, 2002); however, there is a lack in the literature about frameworks classification and comparison, as well as discussion about their related research gaps.

Thus, the objective of this article is to classify the existing frameworks of Industry 4.0). Special attention will be given to the following aspects: business model, implementation methodology, supply chain, people, processes, technology of the Industry 4.0, since the literature usually neglects them to the detriment of technical aspects. These aspects were adopted because People, Process and Technology (PPT) have been broadly accepted as the three elements which are crucial for business performance (Prodan, Prodan, & Purcarea, 2015)

A systematic literature review was made using the largest database on technology, with the following keywords: (("Industr* 4.0" OR "Smart Manufacturing" OR "Industrial Internet of Things") AND ("Framework" OR "Architecture"), with the period from 2011 to 2017). In total, 23 articles were evaluated.

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Frameworks were classified according to the following criteria: 1) grey or scientific literature, 2) managerial aspects discussed: business model, implementation methodology, supply chain, people, processes, technology. The Framework relation with the subjects followed the criteria: **Medium/Strong** (detailed explanation about the subject, with some examples and/or research results); **Weak/medium** (superficial mention of the subject, with no examples or research results). The main results are summarised in Table 1.

		Framework Subjects occurence					
Literature Type	Framework relation with the subjects	Business Model	Implementation Methodology	Supply chain	People	Process	Technology
Grey	Medium/Strong	0	0	0	0	1	1
	Weak/Medium	2	1	2	2	4	5
	Non-existent	6	7	4	4	3	2
Scientific	Medium/Strong	1	0	0	1	0	3
	Weak/Medium	0	0	5	2	7	9
	Non-existent	14	0	10	12	8	3
Total Frames	Medium/Strong	1	0	0	1	1	4
	Weak/Medium	2	1	7	4	11	14
	Non-existent	20	22	18	18	11	5

Table 1- Industry 4.0 Frameworks classification

Table 1 shows some future works opportunities, like the low number of existing methodology frameworks (1), and business model (3, total frames, sum of medium/strong, weak/medium). People subject had a total of 5. Technology was the most common framework (18), followed by Process (12), which supports the hypothesis that the current literature emphasises the technical aspects. During the symposium, all the frameworks will be presented and discussed in more detail.

The main findings suggest that more efforts are needed to take into account managerial aspects, so that it can help decision makers to adopt the best approach to create value for their business.

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Supply Chain 4.0: The influence of Cyber-Physical Systems on the reduction of wastes

Nagura GI[1], Garcia IB[2], Cubarenco NR[3], Yoshino RT[4]

Abstract: Coordination among agents involved in a supply chain is a major challenge. One of the great difficulties is the exchange of information between the members of the chain. To this end, with the advancement of Industry 4.0, new technologies are being developed, one example is the Cyber-Physical Systems (CPS). The aim of this paper is to analyze, through a literature review, benefits gained from the use of CPS for a supply chain, which can achieve: (1) Real time and convenient data between the members of the chain, (2) Joint decision and simultaneous optimization of production scheduling, transportation scheduling, and storage space planning, (3) Decrease the bullwhip effect, (4) Reduce the intermediate stock, (5) Reduce the overproduction.

Keywords: Industry 4.0; Supply Chain; Cyber-Physical Systems; Information Sharing, New Technologies

1 Introduction

Industry 4.0 is the present and future of industry and even of people's lifestyles. Data and information are generated and exchanged all the time. In the Industry, new information affects the supply chain as a whole. However, coordination among the agents involved in a supply chain is a great challenge, the exchange of information between members of the chain is not always done in a symmetrical way. To this end, new forms of technologies must be used. Cyber-Physical System (CPS) is a system that can deals with physical technologies, as well as information technolo-

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gies. These systems were developed to allow the capture, processing and exchange of aspects of processes.

For that, the use of CPS, considered the next evolution for the design of production and transport processes in supply chains, to exchange information among members of the supply chain is fundamental to a rapid and systematic response for disturbances. The CPS aims to enhance the overall performance of distributed and autonomous processes that collaborate in networks.

Through the bibliographic review, it was possible to verify that the use of these new technologies can improve the performance of the supply chains. In fact, supply chain synchronization with the support of CPS incorporates a relevant opportunity to improve performance in terms of service level and flexibility. This flexibility can be achieved due to the real-time control. And the information sharing between the components of the chain will be done in a much more symmetric way. Whence, it will be possible to match the quantity of production and the demand, reducing wastes like the overproduction and reducing the costs of stock.

2 Conclusion

In addition to productivity gains, gains through savings and reductions must be analyzed. Since, through Cyber-Physical Systems, communication and information exchange between the companies that make up the supply chain can be done in real time, the production between the members is much more aligned, which reduces the overproduction of products and stocks, because companies can produce the necessary quantity in the time required. With this, companies can use the spaces that were used as stock for other purposes and the cost of inventory will decrease as well. And the energy and costs spent with the overproduction will be saved.

Finally, we should point out that this study merely presents an overview of our general concept from a research project. The detailed description and quantification of the generated savings values will be subject to related and future research.

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Internet of things: Applications in Supply Chain Management

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Abstract: The IoT is promoting the connection between all elements of supply chains, leading to important impacts on operations management and creating new business models. In this chapter, we explain the basic concepts of IoT in supply chain management and we present examples of applications to support the traditional supply chain operations management, such as logistic, fleet and stock operations and new business models' possibilities.

Keywords: IoT; IoT applications; Supply Chain Management; Industry 4.0; Fourth Industrial Revolution

1 Introduction and Context

The Fourth Industrial Revolution is "fundamentally changing the way we live, work, and relate to one another" (SCHWAB, p. 1, 2016). The Industry 4.0 concerns the development and the connection of emerging technologies in multiple areas in a way to promote disruptions in businesses. Among these technologies, the Internet of Things (IoT) is reaching substantial attention (CHUNG; KIM, 2016). According to Weinberger, Bilgeri & Fleisch (p. 700, 2016), the term IoT "was initially coined at the Auto-ID labs at the Massachusetts Institute of Technology (MIT) and describes the vision that virtually all objects become smart and connected". IoT is already a reality in many companies, and the purpose of this chapter is to present some of its applications that support typical supply chain operations management, and also discuss cases of companies that are changing their business model in this context. All examples mentioned are cases extracted from business literature. The goal of this description is to show the applications and results obtained,

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thus encouraging companies to consider solutions utilizing IoT in the management of their operations.

2 IoT and Supply Chain Management: Structure of the Chapter

The following sub-chapters are proposed:
A) Introduction and General Concepts: in this section, after presenting some historical perspectives, we introduce the IoT concepts to support the traditional supply chain operations.
B) Industry applications: two different types of applications will be explored: B1) Specific applications: in this sub-section, we explain that IoT resources support several activities in logistics and supply chain. For example, the monitoring of trucks with a system that integrates sensors, planning systems, high-precision GPS, telemetry, automatic triggers of information and shipments, sending instructions to drivers through applications, WhatsApp, texts or e-mail can change service levels in supply chains. For stocks, several technologies employ telemetry tools, that are basically the measuring and transmission of data to a monitoring and processing center. Therefore, the stock of many clients is managed with information sent every second to the logistics center. The data received are utilized to support the delivery time and the shipping plans.
- General applications changing supply chain structure or business models: more important implications in supply chains are explored here. For example, the use of sensors in the aeronautics industry has allowed companies, like Rolls-Royce, to come up with a plan to address the changing market with a more compelling set of services. Other cases, like Cummins Power Generation will be explained.
C) Future of IoT: some trends will be explored, in a way to stimulate creativity of managers and scholars.
At the end of the book chapter, some leaning activities will be proposed, such as questions and quizzes.

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iCyPhy - Industrial Cyber Physical Systems

Santos, MMD[1], Yoshino, RT [2]

Abstract: The complexity of the modern production systems will be much higher and will require sophisticated marketplace offerings incorporating high-tech technologies with features of Learning Machine, IoT, BigData, Deep Learning and others leading to the intelligent and autonomous systems. The production workflow since shall attend requirements for input, processing and output with flexibility to attend the best performance and quality of products in order to attend the final users requirements. Then, networked systems are emerging that use sensors to in the physical world, interpret these data and make them available to network-based services, whilst also using actuators to directly affect processes in the physical world and control the behavior of devices, objects and services. These systems are known as Cyber-Physical Systems (CPS). The proposal this chapter is provides an overview of key fundamentals for CPS. The scope includes cyber security, feedback systems, embedded systems, key area applications and case: automotive industry.

Keywords: Cyber Physical System; Cyber security; Embedded Systems, case

1 Introduction

Cyber-physical system (CPS) is a system controlled or monitored by computer-based on control algorithms that communicate between then under information exchange. The physical and software components are deeply intertwined, each operating on different spatial and temporal scales, exhibiting multiple and distinct behavioral modalities, and interacting with each other in a myriad of ways that change with context.

Industry Cyber-Physical Systems is an industry networked of autonomous entities merging the physical and digital worlds that enables and able to interact with their environment in a dynamic way. The main goal of the iCyPhy is to lead on the architecture and design, modeling, analysis techniques for cyber-physical systems, with emphasis on industrial applications which can integrate computing, networking and physical components. The main applications for the iChyPhy are not limited to transportation system, automation, security, smart buildings, smart cities, agriculture, military, process control, water treatment, energy generation and distribution, robotics, healthcare systems and others.

2 Objectives

Industry Cyber-physical Systems (iCyPhy) consist in the integration of physical systems, including sensors and actuators with digital ones, typically computer-based systems which are composed of intelligent cyber-physical entities that can cooperate, self-organize, act on their environment and make autonomous decisions in industry. Since they can be seen as a clear breakthrough in industrial organization, their integration into the next generation of industrial systems and their interaction with relevant information systems must be carefully addressed. They are expected to significantly improve industrial performances expressed in terms of agility, efficiency and reconfigurability. CPS constitutes a megatrend in international research roadmaps that requires a lot of research efforts in the next few years in many domains that constitute the background of the topic: computer science, mechatronics, automation, human factors to name a few....

3 Conclusions

The proposal this chapter is provides an overview of key fundamentals for CPS. The scope includes cyber security, feedback systems, embedded systems, key area applications and case: automotive industry.

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IMPLEMENTATION

First International Symposium on Supply Chain 4.0: Trends, Challenges and Opportunities from the 4th Industrial Revolution, August 28-29, 2017, Limeira, Brazil.

How to implement a Supply Chain 4.0?

Simões R[1]

Abstract: Albeit the subject Supply Chain 4.0 is currently a top priority for many companies, universities and research centers, a widely-recognized implementation approach, blueprint or model do not exist. Consequently, discussing the topic on an academic field is arduous, and so is implementing SC4 initiatives. This paper analyzes and argues the current main approaches to implement a SC4. The approaches focus primarily on how to switch over from the old model to a digital supply chain model in very effective way.

Keywords: Supply Chain 4.0; implementation; approach; Digital Supply Chain,

1 Introduction

We are in the beginning of a new era in global trade: the era of the Digitized Supply Chain (Handfield, 2015) or Supply Chain 4.0 (SC4). Organizations worldwide are re-thinking and transforming their supply chains while they observe emerging technologies and new management practices arising from the frontline of business (Ovans,2015). Simultaneously, there is scarce information available about how to actionably implement SC4 initiatives. Given it is relatively new concept, the scant contributions from academics and specialists have made the approaches to implement SC4 more fuzzy than solid (Bauernhansl et al., 2014).

2 Objectives

The objective of the study is to present a comparative assessment of some main SC4 implementation approaches, as a conceptual system, developed by academics and major players of technology and consulting market, in order to understand their main characteristics, differences and feasibility. Considering these distinction, academics may be enabled to further investigations, while specialists may find solid support in implementing suitable and feasible models.

3 Methods

Grounded on exhaustive literature review, the paper identifies four main approaches to implement a SC4 initiative. Subsequently, a comparative analysis (Pattom,1990) has been developed on the following features: adherence for strategic objectives,

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structural consistency among internal elements, scope of areas of interest, and feasibility for different sizes of companies.

4 Results

The results of this study indicate that organizations that adopt a SC4 implementation can minimize and control inherent business risks at the preliminary stage by selecting the suitable approach that determines how the SC4 initiative should be deployed and how feasible is to the company profile. A panoramic view of the approaches and their main characteristics have been put forth.

5 Conclusion

The evidence from this study suggests that SC4 implementation is a long and comprehensive effort. Because of that, an SC4 implementation approach must be criteriously selected, considering the organization technology maturity level and the needs of its specific market and supply chain ecosystem, in order to maximize the (ROI) Return on Investment, minimize business impacts and increase competitiveness in every point of the value chain (Kasarda, 2017).

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Determining the container position in container ships and port yard using Industry 4.0 concepts

Azevedo AT[1], Junqueira C[2], Ohishi T[2]

Abstract: Maritime transport is the most important mode of transport for international trade, and its continuous growth represents greater pressure on port terminals. To maintain competitiveness and productivity, as the organization of the container terminals significantly affects the entire supply chain, it is crucial for ports to adapt to the growing complexities issues that comes from the continues up-sizing of container ships.

In this context, the optimization of container terminals operations problems should be performed in an integrated way, so that better integration into global trade can be achieved. This paper cares about the integration of two container terminal operations problems related with cargo positioning which are:

• Stowage planning: this problem consists of determining how to organize the containers in a ship in order to minimize the number of movements necessary to unload and load the container ship.

• Block Relocation Problem (BRP): This problem deals with a given set of homogeneous containers (blocks) stored in a set of two-dimensional last-in-first-out (LIFO) stacks, which relocations are necessary to retrieve the containers from the stacks in a pre-defined order while minimizing the number of those relocations ([1]).

The Stowage planning has its complexity related with the cellular structure of a container ship which leads the organization of cargo in stacks as shown in Figure 1.

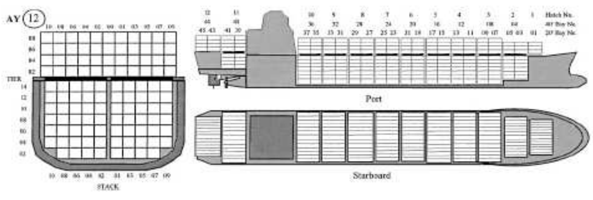

Figure 1: The cellular structure of container ship (source: [5]).

The BRP resembles with the Stowage Planning since it also organizes cargo in stacks as shown in Figure 2.

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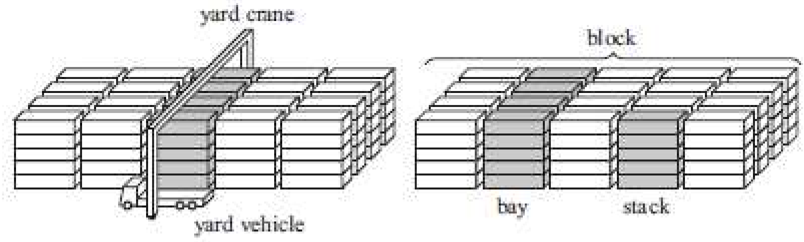

Figure 2: Organization of cargo in a port yard (Source: [3])

This article proposes an integrated mathematical model that could reduce the container ship stay time in port that could result in avoiding demurrage costs. Each container unloaded/loaded after the time estimated by the model is multiplied by US$ 110.00. This value is a mean since the cost varies according to container type and how long the container stays in port. More details are available at [4].

Although, the application of this integrated mathematical model depends on the task to obtain inputs for this problem, more specifically the container position. This could be a cumbersome task, since it is difficult to track where each container on ship or in port yard is. An alternative is to employ a series of technologies to track a cargo available with the advent of Industry 4.0. One option, for example, it is to employ a tracking system based on RFID for each cargo and its corresponding time spent in each stage or area in ship or port yard [2]. This proposal is a case of application of the industry 4.0 since it changes the form of iteration between the terminal ports and the shipping companies by bringing connectivity, intelligence, and more security throughout the processes studied here.

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SWOT Analysis of Industry 4.0 Context in Brazil

Nicolela PB[1], Cordeiro GA[2], Cooper RE[3], Ferro R[4], Anholon R[5]

Abstract: The purpose of this study is present the strategic perspective of the Industry 4.0 in Brazil by conducting SWOT analysis to help understand the projection of fourth industrial revolution. The results presented 11 aspects of internal and external conditions that Brazil can find during its development.

Keywords: SWOT, Industry 4.0, Strategic Perspective in Brazil.

1 Introduction

Industry 4.0 is a phase of the digitization of the manufacturing through application of technology of communication, intelligence and self-controlled systems (Anderl, 2014). Thus is necessary understand the strategic position of Brazil in these trends.

2 Objectives

This study aims to present the strategic perspective of the Industry 4.0 in Brazil.

3 Methods

The research method adopted SWOT (Strength, Weakness, Opportunity, Threat) analysis to present results, because it is a better tool for investigation of strategic.

4 Results

The table below summarizes the results from SWOT Analysis.

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	Strengths	Weaknesses
Opportunities	- Agrobusiness, oil and gas, and aeronautics industries stand out in the national scenario. So, first apply the concepts of 4.0 in these industries and then spreads to other segments. (CNI, 2016). - According to Aneel (2017), there is a forecast that the capacity of eletric energy grow up 16% in the next years, In addition, CNI (2016) predicts a decrease of energy consumption between 10% - 40% with the introduction of Industry 4.0. - UE – Brazil partnership can be help the development brazilians enterprises. (BNDES, 2017). - Import taxes of TI equipaments was reduce to 2%. Forecast of a 25% decline in the price of Internet of Things (IoT) chips in the period from 2015 to 2025 (Burniske, 2015). These aspects can promote the adoption of the 4.0 technology.	- Academic education nacional focuses in the especific knowledge. In the actual context, is necessary a general knowledge (CNI, 2016). - There are few examples of industries that apply Industry 4.0 in Brazil (CNI, 2016). - Although Brazil is not a reference in the IT segment. There is a prospect of growth in this área (ABES, 2017).
Threats	- Brazil already has a National IoT Plannig, however it has delays. According to CNI (2016), the development must be agile to strategic align Brazil with its competitors.	- Infrastructure problems can be delays Brazil (CNI, 2016). - The connection speed corresponds the percentage of 28% below average (Exame, 2015). - The brazilian transportation logistic is ineficiente. Thus, the country loses time and competitiveness,it damages the advances in the value chain (Globo Rural, 2017).

5 Conclusion

This study shows that there are still few strategic actions for the development of industry 4.0 in Brazil, such as the national plan for IoT development. However, from strengths, weakness, opportunities and threats mapped, strategic actions should be proposed aligned with this information.

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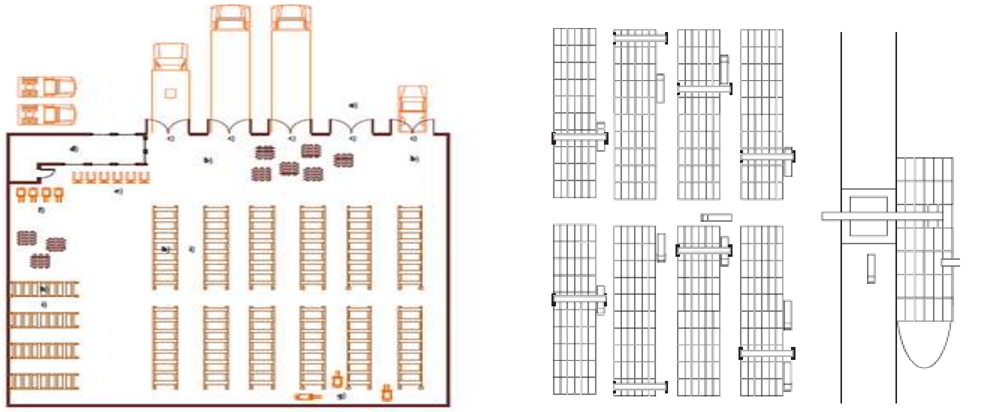
The Layout Problem under Time Varying Demand and its Relations with Industry 4.0

Azevedo AT[1], Dias EX[2], Scarpel RA[3]

Abstract: The layout problem is to determine how some elements will be positioned and organized to store, produce, or transport some goods. The Figure 1 shows applications of this concept to different contexts like warehouse and ports.



(A) Layout for a warehouse (Source: [5]) (B) Asian storage yard layout for a port (Source: [1])

Figure 1: Application of layout problem in different spaces: warehouse and port.

Mathematically the problem could be expressed like that: consider n departments and n specific areas. The department allocation and the corresponding workload are represented by letters i and j, respectively. Two different areas are represented by letters k and h, respectively. In this manner, the allocation of the department i to perform a workload j between areas k and h it will have a cost dikjh. In this manner, the layout costs depend on distance, but also the interaction between two areas [6].

The Layout problem could be formulated as an integer programming problem and such objective function and constraints could be described as (adapted from [3]):

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$$\text{Minimize } z = \sum_{i=1}^{n} \sum_{k=1}^{n} \sum_{j=1}^{n} \sum_{h=1}^{n} d_{ikjh} x_{ik} x_{jh} \quad (1)$$

Subject to:

$$\sum_{i=1}^{n} x_{ik} = 1, k = 1, \dots, n \quad (2)$$

$$\sum_{k=1}^{n} x_{ik} = 1, i = 1, \dots, n \quad (3)$$

$$x_{ik} = 0 \text{ or } 1, \text{for all } i, k \quad (4)$$

The equation (1) is the objective function to minimize the summation of d_{ikjh}. The equation (2) enforces that one department should be in one area and the equation (3) enforces that one area should have only one department. Equation (4) describes that x_{ik} should be a binary variable. This problem is known in literature as the quadratic assignment problem (QAP). The QAP is a non-linear problem and it is not possible to employ linear programming methods to solve it [6]. Finally, the parameter d_{ikjh} could through in time and different optimal layouts could be obtained.

The application of this mathematical model depends on obtaining inputs for this problem, and it could be a cumbersome task, since it is difficult to track where each cargo on warehouse or in port is.With the emergence of Industry 4.0, term referring to the fourth industrial revolution, the entire sphere of production will undergo a complete modification. In this way, there is the fusion of digital technology and the internet with the conventional industry [2]. It will happen, with the use of sensor technology, interconnectivity and data analysis. One option for determination the best layout, for example, it is to employ a tracking system based on RFID for each cargo and its corresponding time spent in each stage or area in warehouse or port [4].

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Innovation and its challenge emerging from the fourth industrial revolution

Beliveau M[1,2], Santa-Eulalia LA [1,3], Mosconi E [1,4]

Extended Abstract: Like the three other Industrial Revolutions, the Fourth, known as Industry 4.0 (I4.0) started in the secondary sector of the economy with the concept of smart manufacturing. Technologies used in I4.0 then spread out into all parts of the economy, leading to new kinds of businesses. Already, technologies that are part of the I4.0 revolution show promises outside the manufacturing sector with concepts like Retail 4.0, smart products, Logistics 4.0, Supply chain 4.0, enterprise 2.0 and so on. These innovations are only the beginning of what promises to be a paradigm shift in the way business and society will work. Innovation is the introduction of something new and it can involve an idea, a method or a device that becomes a product/service. It can also be a new process and new ways to produce something as well as a new managerial approach. Innovation is how value is added I4.0 is based on technology, but because it can be considered a general-purpose technology, it has a great impact on other types of innovation. For an organisation, innovation is a means to distinguish itself as long as the market or society is ready for the new or improved concept. The present research is to do a literature review on I4.0 and a quantitative and qualitative analysis to identify the type of innovation researchers are doing on empirical projects. The presentation of the result will give a portrait on what researchers are doing and where the focus is, from an innovation point of view. From these result, we will also present how I4.0 will impact all the paradigm change of innovation in firms by presenting the concept of of *I4.0 innovation value toward competitiveness* that combines the notions of value itself together with value creation, delivery and management. Finally, a discussion will mainly focus on how industry 4.0 brings many disciplines together and how management research needs to move forward on this subject.

Keywords: Fourth industrial revolution; Product and service innovation; Process innovation; organisational Innovation; value.

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1 Introduction

Innovation is a way to distinguish itself as long as the market or society is ready for the new or improved concept (Maranville, 1992). As I4.0 technologies promise to give an important edge to firms that successfully use them, it is important to know what impact they have on innovation. A brief review of all the technologies associated with I4.0 is presented, based on the work of Kersten, Blecker, and Ri (2015). For instance, cyber-physical system, the Internet of things, additive manufacturing, bid data, cloud computing, deep learning (Artificial intelligence) and virtual reality. We consider the three main categories of innovation: of products and services innovation, process innovation and management innovation. The hypothesis is that:
H1) I4.0 is a catalyser for different types of innovation that consist of new ways to introduce new products and services, new ways of doing things (process) and new business models (organisation).

2 Objectives

Propose a categorisation of I4.0 effects on innovation by each type and review the empirical research that has been done so far.

3 Methods

The systematic literature review is based on Conforto, Amaral, and SILVA (2011) and Roch and Mosconi (2016) as work guideline. 225 English articles from journals and conferences that were peer reviewed have been identified from five databases. Two from the engineering and science fields (Scorpus and Elsevier) and three from management fields (ABI/Inform, Business Source Complete and Emerald). Only if the article that are fully available were considered. The papers were then classified by three types: empirical research, reviews and conceptual papers. The articles were in turn separated into three groups depending on the subjects: a product or service innovation, a process innovation or an organisational innovation. The research domain of each article was identified as: computer science, economics, education, engineering, healthcare, management, operational research or psychology.

4 Results

Fewer than 6% of the scientific articles identified could not be categorised as innovation mainly because they were literature review or a state of things. Preliminary result shows that 34% of the articles are products and services innovation, 46% are process innovation and 20% are organisational innovation. Most innovation of products comes from the computer science community, while new services were mainly the focus for education and training. New ways of doing were what engineers focused on. Finally, management is the main contributor for new innovative organisation, but there are interesting findings from the psychological, engineering and computer science points of view. These results contribute that I4.0 contribute to all three type of innovations and these technologies will contribute in a broader spectrum on how firm will be able to compete. These will validate the *I4.0 innovation pillar of competitiveness* design presented.

5 Discussion

Innovation is an important part of generating value in today's firms. Traditionally, Innovation where made by one of the pillar presented in the result section. I4.0 can bring innovation across all of them. As shown earlier, I4.0 technologies already contribute to these in making new and innovative products, processes and organisations. Moreover, industry 4.0 is not only an aggregate of technologies, but also a focal point for many research domains and thus is becoming a multi-disciplinary subject and also will help firms to be more competitive in a complex and challenge market.

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Smart Collaborations on Research, Development and Innovation Projects

Amorim JA[1], Agostinho OL[2], Azevedo AT[3]

Abstract: Collaborations on research, development and innovation projects demand a method that may guide the organizational design. The method may favour the increase of the maturity of the strategic management of collaborative projects.

Keywords: Business Process Management; Improvement; Maturity; Method.

1 Introduction

Different technological trends are reshaping the industrial production. The building blocks of Industry 4.0 are said to be nine (Gilchrist, 2016): (1) big data and analytics; (2) autonomous robots; (3) simulation; (4) horizontal and vertical system integration; (5) the industrial internet of things; (6) cyber-security; (7) cloud services; (8) additive manufacturing; and (9) augmented reality. This leads to the automation of processes and it demands a workforce with "multi-disciplined generalists with computer, mechanical, and process engineering skills"; at the same time, the workforce should be capable to deal with "exceptions and anomalies that require expert analysis" (Gilchrist, 2016). In other words, new multidisciplinary problems will be challenging engineers. According to Sodhi & Tang (2017), emerging technologies may allow manufacturers to offer customized products with "unprecedented speed" to online customers; in this scenario, the supply chain should be "lean for cost efficiency or agile for time efficiency" while new challenges suggest a "need to strategically integrate" new models into manufacturing operations. Part of the new challenges will be addressed by collaborations on research, development and innovation (RDI) where projects may involve manufacturers, universities, research centres, government agencies, and so on (Pires et al., 2012). The collaborative projects may benefit from part of these emerging technologies while connecting teams through the intense use of virtual environments where appropriate processes, tools and techniques for RDI should be used.

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2 Objectives

The main objective of this investigation is to build a collection of processes and a method that may guide the organizational design, thus favouring the increase of the maturity of the strategic management of collaborative RDI projects.

3 Methods

The research method selected for this investigation on RDI projects is presented by Ahlemann et al. (2013). The authors present a four-step research procedure that was designed to serve as a guideline for theoretically grounded prescriptive project management research: (1) problem analysis; (2) solution design; (3) solution evaluation; and (4) documentation followed by communication.

4 Results

The result of this investigation is a framework focused on collaborative RDI projects, with four parts: (i) a set of processes for the management of RDI projects; (ii) a method that uses the set of processes; (iii) a practical guide for practitioners of project management; and (iv) a virtual environment for collaboration. An example of process is "Cost Estimation", where different tools and techniques like parametric estimating approaches (ISPA, 2008) may be of use.

5 Conclusion

The result of this investigation may benefit organizations in different ways. Future work will include further validation of the method while considering not only big data and analytics, but also simulation and mathematical models (Williams, 2003).

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Customer-Supplier Relations in the Industry 4.0: a case about automotive industry

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Abstract: The theme covered is the customer-supplier relations in the industry 4.0 focused on the automotive industry. The importance of this study is to identify the possible changes in the customer-supplier relations, in view of the new economic scenario established by the Fourth Industrial Revolution. The main results is the connectivity among the companies are each day more intense. Therefore, not only production line, systems, devices will be connected, but it will be crucial for buyer and supplier be connected. It will be a long-term relationship, companies will develop technologies together, flexibility and cooperation will be essential.

Keywords: Industry 4.0; Customer-Supplier Relations; Automotive industry.

1 Introduction

Nowadays, customer-supplier relations are mainly between the carmakers and the suppliers of the first level, followed by their manufacturers considering that the Original Equipment Manufacturer (OEM) spend between 70 and 80% buying parts, components or materials received from supplier as survey made by Henke (2015). The automotive segment is essential to the economic growth of the large majority countries. According to Vanalle and Salles (2011), quality and delivery are the minimum requirements for this segment, therefore the product development has been shared with the supplier and it can choose which technology will be used in the contracted price. In line with Faller and Feldmüller (2015), the opportunities identified with the Industry 4.0 relates to shop floor integration and the management team, bringing a more transparency in the process. Innovations will request some changes, and the companies have to be prepared for the new revolution that is already happening.

2 Objectives

The primary goal of the study is to evaluate how Industry 4.0 will influence directly or indirectly the commercial relations requirements that the carmaker has defined to use with the suppliers. The purpose is to analyze the good opportunities on the

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commercial relations based on this new concept for the automotive segment. The secondary objective is to identify industrial evolution phases, its characteristics and point the difference between the advanced manufacturing technology and the Industry 4.0 in the automotive market that historically has been responsible for many innovations.

3 Methods

The method employed is the systematic review of literature because it is a good approach to support the goals achievement that were proposed. Based on Ntabe et al. (2015), the table below was filled in for the evaluation.

Category	Criteria	Description
Published period	Searching by key words between 2006 to 2017.	ProQuest, Springer e Elsevier
Automotive	Spared parts industry	Aftermarket supplier
Industry 4.0	fourth industrial revolution, internet of things	supplier relationship, customer relationship

4 Results

The primary goal of the study concludes based on an analysis how the industry 4.0 will affect the relation between supplier and buyer, because a new dynamic will start and there will be different demands, mainly because of the mass customization. Moreover, the secondary objective establishes the concept difference between advanced manufacturing technology and the Industry 4.0 preceded by a chronological study of the three industrial revolutions.

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IoT oriented to predictive maintenance in an automotive industry

Cordeiro GO[1], Cestari JMAP[2], Deschamps F[3], Lima EP[4]

Abstract: Industry has gone through evolutions and technological paradigm breaks. At the beginning of the 20th Century, mass production led by Ford Corporation became a baseline for almost every other industry. Subsequently, the Toyota Production System rose, attending to higher customer requirements for better quality products, produced faster and delivered in shorter time. Nowadays it is possible to observe the rise of Industry 4.0 and its many applications in several areas of manufacturing companies. This extended paper presents an applications case of IoT technologies oriented to predictive maintenance in an automotive industry.

Keywords: predictive maintenance; automotive industry; internet of things

1 Introduction

Industry has gone through evolutions and technological paradigm breaks. Ford Corporation and its mass production system at the beginning of the 20th Century, followed by Toyota Production System had a great impact at that time.

Led by German industries, it is possible to detect the rise of a new technological movement, which will revolutionize manufacturing, and the way factories are designed. The Industry 4.0 (Liao et al., 2017) may become a new paradigm and production way and it is based on connectivity, supply chain integration, cyber-physical systems, capable of integrate the shop floor (robots, products, and logistics) and the application of new technologies.

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2 Objectives

To investigate the ways the auto industry is working with technologies related to IoT and Industry 4.0, from a predictive maintenance point of view, in an automotive industry.

3 Methods

The experiment and case study (Yin, 2014) last for six months (from its conception to the final solution implementation) and was divided in five phases: (i) understanding the business needs, (ii) assemble the team, (iii) data gathering from IoT devices, (iv) data analysis and (v) solution efficiency measurement.

4 Results

Three IoT vibration sensors were installed on the main engine of a machine located in the factory. The vibration data feeds a platform that visually shows the analysis online, adopting concepts of Data Analytics and presenting the behaviors of the measures. The generated alerts (deviations) contain the identification of the specific failure mode (e.g., engine misalignment, lack of lubrication) together with the action plan to mitigate the possible fault. Identifying the failure mode is possible because the tool analyzes the vibration wave frequency, predicting where the fault may occur.

The sensors were recently installed and there are no trend curves and prediction information yet, but the data are being collected and the expectation is that within three months it will be possible to contribute with predictive analysis, helping the maintenance team to act in a predictive way.

The large-scale application of these technologies will leverage gains and provide cost reduction to preventive and corrective maintenance. An integration between the Big Data platform with internal systems is a next step, enabling automatic scheduling for preventive actions based on the alerts from IoT devices.

5 Conclusion

As Industry 4.0 is a trend, companies are trying to achieve higher levels of technology implementation. New solutions are available to enhance customer experience and increase productivity and this work develops a case study aiming to propose a framework for IoT projects for predictive maintenance, generating cost reduction.

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Additive manufacturing: potential changes in operations

Franco D[1], Santa-Eulalia LA[2], Ganga GMD[3]

Abstract: Industry 4.0 involves many emerging technologies that when combined create conditions to innovate significantly in operations and supply chain management. Additive manufacturing (or 3D printing) is one of these promising technologies. This paper explores the potential changes provided by additive manufacturing in operations and supply chains.

Keywords: 3d printing; business model; supply chain; Industry 4.0; impacts.

Extended Abstract

Additive manufacturing (AM) is one of the technologies utilized in the Industry 4.0 (Lasi et al. 2014). The ability to produce customized products on a small scale is among the needs of consumers that can be met through Industry 4.0 (Chung & Kim 2016) and carried out by AM. For Bhattacharjya et al. (2014), Lasi et al. (2014) and Lau and Leung (2015), in innovative technological industrial contexts, AM has not been widely studied.

Thus, there is a need for research which specifically addresses the impacts of AM on supply chains and its management. In this context, this paper aims to explore the potential changes caused by AM in operations, with a supply chain and business models perspective. To do so, a literature review was performed.

This literature review was an initial research with an intention to better understand the potential changes that AM can cause in operations. So, it isn't a systematic review yet, only an exploratory research to obtain the main points approached by the authors.

Some papers were analyzed in relation to what the authors discuss about the consequences that AM can cause in the operations of a company. From this a table was drawn up with the main changes and the authors that quoted them. In this introductory research, it was noticed that few of the considered articles present empirical data about the impacts of AM on the operations. Thus, the changes discussed are consequences that, according to the authors, may potentially occur (Bhattacharjya et al. 2014; Ford 2014; Cozmei & Caloian 2012).

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Some results indicate that AM is transforming the way some companies produce and deliver products and services. Companies are beginning to employ AM to achieve objectives, such as increasing supply chain efficiency, reduction of time to market, transformation of mass production to mass customization and improving environmental sustainability (Ford 2014).

Others suggest that this technology can change every aspect of the business strategy - product design and development, manufacturing, assembly and supply, delivery, logistics and after-sales service. It can thus allow new products and associated services to be launched on the market faster with a low cost and with less risk (Cozmei & Caloian 2012).

In a future scenario, it is believed that the enterprise will consume printed products by order, using consumer design data practices in a globally distributed supply chain or with consumers owning in-house 3D printers at an affordable cost. Therefore, the companies must plan the AM implementation and compare their advantages from the analysis of comparison with conventional technologies, checking if it is worth doing or buying and reformulating the configuration of their supply chains, both downstream and upstream (Cozmei & Caloian 2012) and remodeling their business model.

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Fourth Industrial Revolution: Key perspectives and opportunities for skills and abilities development

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Abstract: This work seeks to present the principles of Industry 4.0 and the results being obtained by a research and development group in the area of this new industry, in relation to the contribution in the acquisition of skills by the people.

Keywords: Industry 4.0; Principles of the Fourth Industrial Revolution; Creation of competences.

1 Introduction

The new model of industry 4.0 appears with a context of disruption, innovation and high potential in response to industrial demands, in addition to bringing the concepts of high capacity in environmental preservation, a high level of integration among productive processes, modularization of activities among many others. One of the issues that should receive special attention in industry 4.0 is the human factor and what their respective occupations in this sector will be. According to Berger (2014), passive machines and robots have replaced the workforce, which means now that they are controlled by a human being without consciousness. Already in 2012, the number of industrial robots was about 273 per 1000 workers in Germany.

2 Objectives

This paper seeks to describe the principles of industry 4.0 and briefly present the results already achieved by a group of R&D in the area of the imminent industry regarding the cooperation in the acquisition of competences and abilities by the people.

3 Methods

The methodological approach adopted to this work consists of the systematic bibliographical review process, carried out by the research group in which the authors

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are also part, regarding scientific papers already published, related to the industry 4.0, its concepts and principles. The works considered are published in the year 2012 until the present moment. Priority levels from 1 to 5 were assigned to these works. In this manuscript, the works of higher levels were considered.

4 Results

The presentation of the principles of industry 4.0 starts with the interoperability that, according to Qin et al. (2016), it gives rise to multiple networks in a reliable environment, for the equipment to communicate, allowing awareness for the development of intelligent functions. Decentralization involves making the system's own decision as needed. For Hompel and Otto (2014), embedded computers allow the Cyber-Physical Systems (CPS) to make the necessary decisions by themselves. Only in cases of failure tasks are delegated at a higher level. Virtualization means that through the use of communication and machine-to-machine monitoring, a virtual twin can be abstracted. The sensor data are linked to virtual plant models and simulation models (Gorecky et al., 2014). For Schlick et al. (2014), modularity involves modular systems that can flexibly adapt to changing requirements, replacing or expanding individual modules, of production. The real-time capability includes plants that can react to the failure of one machine and forward products to another machine. As for service orientation, business, human and CPS services are made available through the internet for services and can be used by other participants, facilitating the creation of effective product service systems. Regarding the R&D project on industry 4.0, which the authors are part of, the results obtained so far are very satisfactory. The group has a special concern in the area of research in contributing to publications aimed at disseminating knowledge about the subject, and in the area of development, special attention is being given to educational game with the objective of contributing to the creation of competences regarding the industry 4.0. The group realizes that it is necessary to try to insert the concepts of the new industry in the process of formation the professionals, especially in the engineering, project focus area.

5 Conclusion

It is hoped that the work will contribute to a sound understanding of the industry 4.0. It is wanted by the authors the opportunity to present greater detailed results.

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Logistics Optimization in the Context of Industry 4.0

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Abstract: Logistics is one of the sectors that has the greatest potential for benefiting from Industry 4.0 technologies. In this work, we propose a chapter to describe how logistics planning can be addressed jointly with these new technologies. The chapter is planned to have a literature review of Industry 4.0 on logistics, a detailed description of dynamic logistics problems and solution methods for them (i.e., real-time optimization), with a focus on the dynamic vehicle routing problem (dVRP), and a final section connecting both fields and evaluating the potential impact of applying Industry 4.0 technologies on logistics. Ultimately, this work may benefit different areas including emergency and courier services, ecommerce, retail and general transportation companies.

Keywords: Logistics Planning; Industry 4.0; Dynamic Vehicle Routing Problem;

1 Introduction

Industry 4.0 is usually referred to as a digital transformation of traditional value chain processes (Geissbauer et al, 2016). This transformation of traditional manufacturing, logistics and services has a significant economic potential and is attracting significant attention and investments (Geissbauer et al, 2016). Nevertheless, there is a lack of works in the scientific literature that try to quantitatively evaluate the potential benefits of Industry 4.0 on logistics. In the proposed chapter, we expect to discuss and evaluate the potential benefits of Industry 4.0 and optimization on logistics planning. Next, we plan to propose dy namic solution methods that can be used in the Industry 4.0 context. Finally, we aim to discuss how both Industry 4.0 and optimization fields can be applied together to improve logistics planning. The methodology applied in the first two sections will follow a similar process model for content analysis as the one described in Seuring et al (2005). Below, we describe how dVRPs can be used to evaluate the potential advantages of Industry 4.0 on logistics, which is one of the main objectives of the chapter.

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2 Objectives

The VRP consists in selecting a set of routes for a fleet of vehicles to serve a set of customers, in which the objective is to minimize the total distance travelled. Traditional VRPs assume that all parameters are known and routing decisions are not readjusted. These assumptions may produce poor solutions in cases where information is uncertain or dynamic. In dVRPs, not only quality and evolution of information are considered, but also the possibility of readjusting the routes in an online fashion (Pillac et al, 2013). These aspects can be used to represent decisions supported by Industry 4.0 technologies such as real-time data and optimization, location detection technologies and decision support systems, whose potential benefits are the improvement of flexibility and service level, cost reduction and fast reaction to unforeseen events. Given the difference of both deterministic and dynamic formulations, it is possible to compare the different solutions in order to quantitatively evaluate the potential benefits aforementioned of Industry 4.0 technologies. Therefore, one of the goals of the chapter is to perform a computational experiment to compare both solutions in different circumstances and assess these benefits.

3 Conclusion

Although there are recent researches on logistics optimization problems and Industry 4.0, there is a lack of works that connect these two fields. This chapter aims to address this gap by bringing together Industry 4.0 concepts and optimization methods. The practical benefits of this study are the quantitatively evaluation of Industry 4.0 potential advantages on logistics planning and the proposal of an optimization approach adapted to the Industry 4.0 reality.

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Industry 4.0 in the Logistics Area: a Review Study

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Abstract: This work aims to develop a study of Industry 4.0, to assist companies that work in the logistics area. Considering the scarcity information about Industry 4.0 for the logistics area, It was sought to give a better understanding of how the solutions of this new concept can be used and also how they can add value to companies. This work used the bibliometric revision methodology, also the exploratory research, and was able to obtain references and useful information to form a more comprehensive analysis about this subject, allowing the application of the Industry 4.0 in the logistics area. **Keywords:** Methodology; Logistics; Industry 4.0.

1 Introduction

According to the Industry 4.0 paradigm., "We will have to deal with the require for a faster product development, flexible production and a complex environments "(Vyatkin et al., 2007, p.54) using Cyber-Physical-Systems (CPS) technologies, Internet of Things (IoT), Big Data, Cloud and others. Logistics 4.0, is a term used to relate logistics with Industry 4.0, which can help the professionals who work in this area to reduce asset loss, saving fuel, ensure temperature stability, inventory and also have a better efficiency in diferent area.

2 Methods

It was used only one database as a limitation - Scopus. As a second restriction it was establish by the work's publication period (5 years). Another delimitation was the search for words contained in the article title, abstract and keywords. Logistics AND Industry 4.0 Logistics AND "Technology Innovation" also Logistics AND

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Competitiveness. The variables are (RFID), Big Data, CPS, IoS, cloud, automation, 3D printing, IoT, vertical network change, horizontal network change and strategic path. The process used to create this article was a bibliographic portfolio and biometric analysis, That had a total of 62 bibliographical articals about the proposal for the implementation of Industry 4.0 in the logistics area.

5 Conclusion

From the Systematic Review of Literature and the bibliometric research, it was possible to identify how is growing the interest on the researches related to Industry 4.0.

For the logistics area with the Industry 4.0, it was able to analyze the value that these technologys will have. The term "Logistics 4.0" will be present in the coming years, which can be summarized as logistics and supply chain processes, supported by intelligent sensors, embedded software and the Big Data, which is also importante to say that a lot of information about the product will be share via (IoT). A large part from automation can be achieved and logistics can be seen as a network where all machinery can communicate between themselves and with humans via CPS and IoT.

So, considering that the supply chain is the base of logistics, by using Internet of things and considering all the digital transformation that will generated by this new technologie, we can say that the result can be a fully efficient chain. In addition, whereas there is a constant demand about competitive advantages, we believe that this revolution will considerably increase the search in this area.

For the continuity of this work, a broader scope is under development in three bases: Scopus, web of Science and Science Direct.

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Innovation and New Business Models on Industry 4.0 Approach

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Abstract: Nowadays we are experiencing the fourth industrial revolution setting, originally well-known in Hannover, Germany, in 2012 as Industry 4.0 (I. 4.0), expressing not only a technological challenge to the industry, but also it will have a strong organizational involvement, offering an opportunity to develop new business and corporate models as well as providing a greater employee engagement ACHATEC (2013).

Keywords: Industry 4.0; Business Models; Design Model;

1 Introduction

The increasing digitization and interconnection of products, value chains and business models characterize the Fourth Industrial Revolution, making the Industrial Internet of Things (IoT) get more attention in practice and research over the last years. Thus, in the future, businesses will establish global networks incorporating machinery, warehousing systems and production facilities in CyberPhysical Systems (CPS).The application of cyber-physical systems provides intelligence and communication to artificial systems known as “Smart Systems”. According to Anderl (2014), smart systems can be understood as a consequence of the successor technologies of mechatronic systems. The main feature is the integration of cyber-physical systems in order to enable communication between systems and the self-control operating systems.

2 Objectives

The paper aims to study new opportunities of business models and through its techniques and tools, enhancing innovation to the industry due to these new technologies.

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3 Methods

The starting point is an exploratory research in order to better understanding this approach and reveal existing opportunities in these new scenarios, by combination of tools generated by the I. 4.0, which will provide new business models, increasingly complex and changing environment.

4 Results

According to Osterwalder (2013), business model describes how a company creates, delivers and assimilates value and defines how business must be conducted, for example in terms of strategy, customer relationships, market segments and creative value mechanisms. Gerlitz (2016) states that it is necessary to change the focus based on customer experience and value capture. Indeed, there is a growing concern that Porter's classical strategy model constructed through differentiation, cost leadership, and focus are not sufficient, only strengthening value creation and capture. However, the combination of both is essential - valued products and their differentiation, supply chain, human resources, brands, just as related services. As a result, value creation and capture must be examined from the manufacturer and from the customer / consumer perspective.

5 Conclusion

This new scenario complexity signals an irreversible tendency in the creation and capture of value, defining new business models. From this perspective, this article will present international strategies related to I.4.0, which will define new requirements and performance standards in terms of strategy, customer relations, market segments and values.

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Technical and personal skills for Industry 4.0: a comparison between academic education and industry demand

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1 Introduction

The demands that industry 4.0 is creating, advancing in the organizations daily basis, put some pressure in the professionals to update their technical and behaviour knowledge so that they can face these new challenges in order to remain competitive.

Focusing on meeting this new demand, Hecklau et al (2016) propose a more integral approach to the professional and point out a set of competences, including technical, methodological, social and personal skills to deal with the increased level of automation, the level of complexity and interdependence of the sectors, processes and people in organizations.

For Hermann et al. (2016), industry 4.0 has as main principles the interconnection that link machines, devices, sensors and people composing collaborative interactions between people with people, people with machines and machines with machines; Transparency of information is enhanced by the interconnection between objects, machines and professionals in order to carry out their tasks on the basis of information which should be available to all professionals; Decentralized decisions are made possible by the interconnection between professionals and the objects and machines that contribute to access local and global information at the same time, improving decision making.

Still for Hermann et al (2016), the issue of technical assistance in this new context requires a professional who has the ability to make more strategic decisions and flexibility in problem solving in an agile way, which is guaranteed by the interconnectivity associated with the use of smartphones and tablets and, the substitution

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by robots for the most repetitive and insecure tasks, but with the interaction between the professional and these resources.

2 Objectives

This article target to identify the practices adopted by the academy regarding the education and students educating to work in the labor market and identify the skills that this new reality of industry 4.0 imposes on the professionals in the technical skills and behavour.

3 Methods

One of the issues to be solved between Industry 4.0 and the professionals who will work in this new context is the educating process so they can understand, follow and control automated processes, and among the main challenges are Industry 4.0 objectives such as integration and network control; The standard integration of components; The extraction of knowledge within systems; Control architectures that reduce complexity and increase system stability; Security at all levels; The complexity of the interaction; In the user interface question, the challenges lead to deal with large amounts of data in different levels of abstraction; Automatic decision systems; Introduction of advanced interface technologies; Introduction of collaborative systems; Working conditions and; Training, education, qualification (Pfeiffer et al., 2016).

On the other end of the process are the universities and their development programs and technical training of the students, who will be prepared for this new job market.

In this sense, a research was carried out in the scientific literature with the objective of identifying these needs and also a survey of the disciplines recommended by the Ministry of Education (MEC), by the Regional Council of Engineering and Agronomy (CREA); By the Brazilian Association of Production Engineering (ABEPRO) and the disciplines offered by the University of São Paulo (USP) regarding the production engineering course.

4 Results

As main results we present a comparative matrix between the industry 4.0 demand, versus the University offer referring to the course of industrial engineering and the recommendation of the Council and the Engineering Associations in Brazil. Among the disciplines offered by the University are general electricity, automation and control, modelling and simulation of production systems, factory design, quality management of products and processes.

In the scientific literature are skills and competences such as research, communication and language skills, conflicts resolution, decision making, flexibility, leadership, a person motivated to educate, including the ability to use technology in the workplace, etc.

5 Conclusion

We realize that connected to technical knowledge are the subjects offered by the University, it is important to consider in this academic context, social and personal skills that will contribute to a more integral education in the student so that the professional can realize how to work in this new Market.

As new demands of industry 4.0 must rise up, new research must be carried out to identify and adapt the needs in order to improve the skills needed to educate a professional better able to work in the area of industrial engineering.

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Emerging technologies and their impact in reverse logistics

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Abstract: In the context of the industry 4.0, this paper aims to propose a conceptual model to analyse the technology's impact the reverse logistics.The study considers the operational and strategic implications. It is an exploratory study and comprises the theoretical developments. It is divided into three main stages; first, a literature review to construct the conceptual model, which will is presented herein. Next, this model is then pre-tested through multiple case studies. In the near future, in a pre-confirmatory stage, we will employ a QCA (Qualitative comparative analysis) approach.
Keywords: Reverse logistics; Technologies; Industry 4.0, Impacts, Performance

Extended Abstract

The environmental issues have increased awareness of the importance of reverse logistics (RL) (Sangwan, 2017), which is being recognized as an approach to promote competitive advantage (Stock & Mulki 2009) and improve lifecycle management (Rogers & Lembke, 2013). This recognition has increased the investment in resources to support the RL operations (Meade et al. 2007) such as investments in technologies. With Industry 4.0 (I4.0), some emerging technologies have the potential to promote disruptive innovations (Schwab, 2016) including lifecycle management (Plattform Industrie 4.0, 2016). Studies about technology and organizational impact are not rare in the scientific literature (Yoon,2011; Fink et al, 2017). However, we have not found any specific study connecting RL systems and I4.0. Therefore, this paper aims to contribute to reduce this research by proposing a conceptual model to explore the relationship between technological resources adopted to support RL and their operational and strategic impacts. As an exploratory study comprising the theoretical developments, it is divided into three main stages; first, a literature review to construct the conceptual model. Next, this model is pre-tested through multiple case studies. Soon, we will employ a QCA (Qualitative Comparative Analysis) approach. The relationships among the constructs are being analysed from the perspectives of Resource-Based View and Contingency Theory (Cao et al. 2011). The relationship between the technological resources (systems infrastructure,

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human resources and processes) is responsible for the company's IT competence (Yoon, 2011). There will be an analysis of the traditional technological resources that are already utilized to support RL activities, that are complex and specific (Jayaraman et al. 2008), and make intensive use of information (Chouinard et al, 2003). In the context of I4.0 many of these resources are already in use but the integration between machines, components, products and systems connected along the value chain (BCG, 2015) enable improvements and innovations in all processes related to the product life cycle. This could lead to a new paradigm for the industrial segment (Lasi & Kemper, 2014), and needs to be investigated. The organizational impacts will be evaluated in terms of operational and strategic impacts (Fink et al, 2017) and are based on the SSCM framework (Carter & Rogers, 2008), the SCOR Model and the Business Model Canvas. The contribution will allow researchers perform connections between the technologies and their impacts on RL, considering innovations emerging from I4.0.

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Quality 4.0: the new Age of Quality

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Abstract: Technological changes are incorporated into the daily life of organizations, changing the way that the industry relates to its subsystems or areas. Different ways of conceptualizing Quality on the side of costumers, due advanced technologies and information systems, make the industry remodel to meet these requirements. In this way, a new Industrial Revolution supports such changes as well as the emerging changes that are visible in each of the areas of industry, including Quality. In this context, it is important to investigate, through a bibliographical research, the direction of the Quality area in the context of Industry 4.0, as well as the new related technologies and the main changes and difficulties between the previous Ages of Quality and the new Age of Quality, called Quality 4.0

Keywords: quality, industry 4.0, Age Quality 4.0

1 Introduction

The fourth industrial revolution has, among several characteristics, the informatization in the manufacturingarea as one of those, needing a new organizational model with a systemic view and a new execution of the productive process in order to facilitate the all industry's area integration. Since the advent of the Total Quality Management – TQM the quality area has been following a wide and multidisciplinary way, but now, even though, it's finding adaptation due to work modes and technologies that are applied in the Industry 4.0

2 Objectives

The objective is to search bibliographic research to the quality area within the industry 4.0.

3 Methods

After the data collection, systematically, all the information from all the above sources, based on the same set of keywords, it has proceeded to the first screening

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of the relevant work for the ongoing study. This selection was performed using the following steps and rejection criteria in the following order:
1. Sorting items alphabetically by author, to facilitate the removal of duplicates;
2. Removal of articles prior to 2004 (over 10 years). Any relevant articles with over 10 years are obtained from the reference lists of articles found in the first selection. This step allows remove a significant number of minor publications, thus reducing the search time;
3. Removal of items that do not provide the complete basic information (author, title, year of publication or source revised);
4. Removal of duplicate articles;
5. Removal of articles whose title does not show a relationship with the subject.
6. Removal of articles whose stated goals in the summary do not match the objectives of this study;
7. Removal of articles whose methodology are inadequate or does not fit with the present study;
8. Removal of articles without full text available.

4 Results

- Changes in companies to reach quality 4.0;
- Technologies inserted in the quality 4.0 area;
- Quality 4.0 implementation and migration difficulties;

5 Conclusion

It is intended to conclude through this study that the industry 4.0 sustaining technologies will cause impact on the quality area.
From the expected results to this research, it's intended to create a portfolio that an be basis to others studies and, with it, give a foundation to quality 4.0 trough an extensive review with a comparison and analysis about the migration from Quality to Quality 4.0.
Such a basis will do great contribution to distinguish the new quality 4.0 age from the others one, through the process, technologies, services and products from industry 4.0.

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Operations Management and Industry 4.0: The Impact of Cyber-Physical Systems on ERP and MES applications

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Abstract: In front of the 4th Industrial Revolution which has the capability of change the manufacturing landscape, to become far more efficient, flexible and smart. The Industry 4.0 combined impact of new disruptive technologies and digitization of manufacturing plants and supply chains have been examined by technology enablers such as 3D printing, Internet of Things (IoT), Cloud computing, Cyber-Physical Systems (CPS). In other words, sensors and controls systems allow the machines to keep connected in all the processes and production resources. The machinery, apart from processing the products, it will communicate with the system and prosecute exactly what is demanded. The shop-floor will become a marketplace of capacity (supply) represented by the CPPS and production needs (demand) represented by the CPS. As a consequence, the manufacturing environment will need to adapt the ERP and MES applications to be capable of support amounts of data which will be generated.

Keywords: Industry 4.0; Cyber-Physical Systems; ERP; MES.

1 Introduction

The 4th Industrial Revolution, the Industry 4.0 is based on a concept of industrial automation, with the connection by Internet between all the company, by Cyber-Physical Systems (CPS) that is a fusion of the physical and the virtual worlds, the Internet of Things, Cloud computing.
Cyber-physical Systems (CPS) are simply physical objects with embedded software and computing power, strictly speaking, based on connectivity and computing power, the main idea behind smart products is that they will incorporate self-management capabilities, which in the scenario 4.0 provide to the final products smart products characteristics. The mass production gives way to mass customiza-

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tion, each product, at the end of the supply chain, has unique characteristics defined by the end customer.

The main purpose of Enterprise Resource Planning (ERP) systems and Manufacturing Execution System (MES) is to improve the synchronisation between shop floor data and business information, in view of the ERP knows "why", since then it supports strategic decisions, while the MES knows "how to", seeing that it supports the operational ones.

Created by Industry 4.0 the news challenges of MES is following the four main pillars these systems shall consider: the decentralization of computing power does not need to be physical, but rather logical; vertically and horizontally integrated for aligning with manufacturing business processes and the overall supply chain; cloud computing; and connectivity. This way, it's validated in this study the adaption of the ERP and MES systems in a 4.0 environment.

2 Conclusion

The creation of the new business models from the fourth industry revolution will demand the adaptability of all the in the supply chain processes. In the decentralization vision of manufacturing operations on Industry 4.0, in other words, in this new and modern productive processes, the communication occurs step by step, identifying and demanding exactly what is needed for the assembling of the product, which helps in the production flexibility attending the big demand of mass production.

Therefore, a lot of information will be generated during the production, and a big amount of data will need to be stored. Because of that, the implementation of the cyber-physical systems is necessary for integrating the dynamics of the physical processes with those of the software and networking, providing abstractions and modeling, design, and analysis techniques for the integrated whole. As well as ERP and MES applications will need to adapt and become capable of making sense of the massive amounts of data which would be generated.

For a future study, it is proposed the implementation of the ERP and MES systems in a smart factory, with the use of the cyber physical systems. And related the gains of this study for the industrial environment. It may also cover the area of study for the Legacy Systems, that it is included ERP, MES, APS (Advanced Planning and Scheduling), WMS (Warehouse Management System), and others.

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The key role of data strategy in Supply Chain 4.0

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Abstract: The myriad of emerging technologies, data sources, business processes and systems have positioned data structure at the core of effective [SC4] Supply Chain 4.0 initiatives. SC4 is a data-centric concept that strongly demands from companies promptly actions to take control of data growth and complexity. That includes focusing, simplifying and standardizing data analysis through an enterprise data management strategy.

Keywords: Supply Chain 4.0; data; structure; model; emerging technologies

1 Introduction

In digital supply chains, the volume of data generated is exponentially growing at record rates. This unprecedented tsunami of data is generated and fueled by multiple emerging technologies. These include cloud, big data, [IoT] Internet of Things, [CPS] Cyber Physical Systems & Fog computing (Lee,2015), analytics, connected devices and social media. Consequently, it is not surprising that solely manufacturing stores more data than any other sector (Baily and Manyika, 2013).

However, at same time data grows phenomenally, the clear majority of world's corporate data is unstructured and not organized in a predefined way (Bhageshpur, 2016), on average 70%-80% of all data in organizations (Chakraborty, 2016). Unmanaged, that complexity occurs because organizations are trying to extract and store every kind of data, without first determining the data's business relevance and quality (Rozados and Tjahjono, 2014). Above all, persisting to disregard the need for a corporate data strategy and information management method, especially for SC4 implementations, will not only decrease the chain visibility and new insights, but it may certainly drive to faulty analyses.

2 Objectives

The purpose of the study is to present and analyze the predominant data strategies and models that can stablish a pivotal and solid foundation to effectively support a

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SC4 implementation. Most of the approaches were designed by technology solution providers, major consulting companies and academics.

3 Methods

Aiming to identify the prevalent data models and strategies applied to SC4 initiatives we proceeded an exhaustive literature review. Thereafter, we analyzed the four main models and outlined their unique characteristics. We summarized the common features and challenges. Then we focused on two selected dominant models and strategies and discussed the applications and connected challenges. Lastly, we also analyzed feasible further steps and opportunities.

4 Results

The results show that data is the foundation of a successful SC4 implementation. Enterprise data strategy is a prerequisite, since considerably essential business insights remain unused and eclipsed in an ocean of complex data. The adoption of specific data model must consider the corporate strategy, technological maturity and business process efficiency. The absence of that result in false insights and correlations without causal connections, that lead companies to erroneous tracks.

5 Conclusion

SC4 is not only about technology but primarily data. Data is now ubiquitous and highly valuable, standing as the basis to develop new business models and accelerate the decision making. As the supply chains are becoming more digitized and connected with parcels of strategic assets and core capabilities externally sourced and synchronized, the need for a data strategy and model is crucial.

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Logistical Services Digitalization in Small and Medium-Sized Enterprises

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Abstract: This paper aims to evaluate current stage of logistics services digitalization in semi-jewels' small and medium-sized enterprises (SMEs) located at Limeira region, in Brazil. Other objectives are mapping difficulties and analyzing the gaps to reach new challenges reality of logistic and supply chain 4.0. The results obtained allow to support other researches about logistic and supply chain 4.0, which is a concept still in implementation phase in Brazil, and to understand the digitalization level of semi- jewels' SMEs in Limeira region, as well.

Keywords: SMEs, Limeira, logistic, supply chain, digitalization.

1 Introduction

According to Council Of Supply Chain Management Professionals (CSCMP) (Cscmp.org, 2017), logistics is the supply chain's part which plans, implements, and controls the progressives and regressives flows and warehousing of goods, services, and information from the origin point to the consumption point for pursuant to customer's requirements.

Different approaches are used to plan the supply chain. One of these is Lean Thinking, in specific. It is mainly configured at the stage of the production process, where is used to correct the production bottlenecks. According to Womack and Jones (1998), Lean Thinking provides a way of specifying value, aligning value-creating actions in the best sequence, conducting such activities without interruption and executing them effectively.

Currently, along with Lean Thinking concept, a new industry idea has been implemented gradually. This new model, known as industry 4.0 or intelligent industry, is characterized by the union between automation and cybernetic system, allowing a fast and dynamic connection among humans, products and machines throughout an entire production chain (Prause and Weigand, 2016).

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Currently, 60% of all national production in jewellery segment is concentrated in Limeira, whose goods are exported to countries in Latin America, North America, Africa and Europe. According to the Commercial and Industrial Association of Limeira (CIAL) (CIAL, 2015), this chain employs about one third of the economically active population of Limeira.

Though the digitalization brings many economic advantages, the main internal and external barriers of its implementation are, respectively: the implementation cost and the lack of qualified workforce at the market (NCI, 2016). These points represents some difficulties in the implementation of industry 4.0, because of the high investments in technology, what is essential to create a digital network which connects machines, products and people in an efficient way. In addition, with the development of information technology, it is necessary employees qualified, who are familiar with technologies and data analysis.

Perhaps investment planning in large companies may be better done than in SMEs, because of their improvement capacity to manage cash flow. SMEs usually don't have own capital to invest on technology improvement due their low capacity for provide autonomy resources. This unbalanced relationship to provide resources should maintain a dependency position that postpone SMEs growth.

The question which remains to know is whether companies in semi-jewels segment of Limeira region will be able to adapt to the new reality 4.0 and, if they are already joining this industry perspective, how much they lack to achieve the logistical services digitalization.

2 Objectives

This paper aims to evaluate current stage of logistics services digitalization in SMEs located at Limeira region, in Brazil. Other objectives are mapping difficulties and analyzing the gaps to reach new challenges reality of logistic and supply chain 4.0.

3 Methods

This paper is about a scientific research not concluded yet, wherein is being used an exploratory method carried out through the methodology of multiple cases study. This method was chosen, because it’s used to investigate a phenomenon, usually contemporary, where the bounds between the phenomenon studied and its context are not clearly defined (Gil, 1996). In addition, it seeks to clarify a set of decisions, the reasons why they were taken, how they were implemented and what the results were obtained (Yin, 2001).

The first step consists of defining and planning the research, in which is did the bibliographic review, the selection of the cases that will be studied and the data collection. Then, in the second stage, the cases analysis are carried out and the information obtained are documented in a report. In the last step, it's done a cross data report and the conclusions about the results.

The performance and metrics attributes of SCOR (Supply Chain Operations Reference) model are being used as reference to create the interview script model, as well as the protocol for multiple case study research (Ignácio, 2010). In the SCOR model, there are five dimensions of analysis, which are: flexibility, reliability, responsiveness, asset management and costs.

4 Results

The results have gotten refer to the data analysis of a unique company. According to the information collected, the process of logistical services digitalization in the analyzed company is backward, comparing to the expected perspective for a current SME.

It was observed that the technologies' participation in logistical services of the company is low. It has been found that there is no digital tracking system for supplier merchandise (for example, RFID - Radio-Frequency IDentification) and production tracking. There is only one digital system in customer service, because the company prioritizes the satisfaction of the final consumer. Despite this company has many customers, some foreigners, the initial point of the chain (the suppliers) is still a limited network of contacts.

In addition, the production manager and the other employees are not used to handling digital tool to work. The manager don't know well the advantages that an integrated digital network can offer, which contributes to the stagnation of this technological development process. However, after the interview, the manager recognized that is needed to develop your supply chain in order to improve its processes.

5 Conclusion

Although the research is still in progress, it is possible to assume, from the data obtained, that there are still SMEs which are far from the reality of the industry 4.0. Some difficulties identified, during the study, illustrate the remaining challenges of traditional logistics, related to the qualification of employees and the large capital required for the technologies implementation.

Therefore, in order to the companies in this segment to be able to adapt to the new digital perspective, their managers need to recognize the importance of logistical services digitalization as a way to improve supply chain processes and increase competitiveness. Thus, strategies and action plans are elaborated with the objective of correcting remaining gaps and developing the digitalization of the current services up to the concept 4.0.

Currently, some large companies in Limeira region are already joining the reality 4.0. Romi industry, located in this region, has already created more technological machines, ensuring precision, safety and productivity; and has already connected machines and production line, through a virtual network (Romi, 2016). Learning and applying these practices would make the SME, mentioned in this paper, a reference in good lessons for other SMEs from other segments. Therefore, Romi is an interesting company for this SME get solutions 4.0 and implement it. The other SMEs in the region will certainly be influenced by the evolution of the industry analyzed in this report.

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Energy management: New Solutions from the 4th Industrial Revolution

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Abstract: The electric energy generation is a growing challenge and its consumption increases exponentially. To supply the demand of industries and residences, the main consumers of energy, it is necessary to invest not only in new energy sources, but also in ways of managing it better. With the ascension of Industry 4.0, new forms of energy management have become more accessible and more popular. This work is the development of a residential energy management product by means of internet of things, according to the methodology Lean Startup. A data collection was done to verify interests for the residential users, using the cost as a fix value. A sample with 104 users was evaluated by logistic regression and the results shown that the type of energy measurement, consumption monitoring and remote activation are the most important characteristic for the product.

Keywords: energy management; industry 4.0; big data, multivariate data analysis.

1 Introduction

Energy management systems have been improved with the internet of things. Companies use renewable energy and strategies based on the consumption of electrical devices to turn off equipments through sensors and actuators and ensure consumption reduction (Bornschlegl et al., 2013; Deloitte, 2015). Industry 4.0 is moving rapidly, with infrastructure adaptation and public acceptance (Batista et al., 2017). An alternative for saving energy is developing a product with some useful specifications. However, the features set that better attend the costumer's expectations are still not defined.

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2 Objectives

Develop a Minimum Viable Product (MVP) of a device for energy management using internet of things, verifying which attributes have greater weight in the costumers purchase decision.

3 Methods

A preliminary research in products available in the market identified four features with two levels: (i) type of energy measurement (general/ by energy point), (ii) data reception (smartphone/ specific device), (iii) consumption monitoring (on smartphone/ external device) and (iv) remote activation (worldwide/ local).

In order to evaluate which of these features would add more value to the residential customer, a conjoint analysis based on choice was made, with a full factorial experiment 2^4. The data collection was done using the survey methodology, performing the data analysis by logistic regression in IBM SPSS® v.23.

4 Results

It was verified that only the energy measurement and consumption monitoring attributes obtained significant results (p-value <0.05). From the attributes considered significant for the consumer choice decision function, it is possible to observe a greater influence of the consumption monitoring attribute. In addition, consumption monitoring presented results towards the optimization of the choice function by means of its positive level (Exp (B)> 1), while the attribute energy measurement adds to the optimization from its negative level (Exp (B) < (1).

5 Conclusion

The Lean Startup methodology is a good way to elaborate the MVP in a shortest possible time and at a lower cost. It is composed by general energy measurement (negative level) and consumption monitoring on smartphone (positive level). This solution can be used in the industries as a way to reduce production costs.

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Value creation in Industry 4.0: Data, a precious asset for manufacturing companies

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Abstract: Manufacturing companies are facing the Fourth Industrial Revolution: after automatizing production, the smart factories are now moving towards autonomous production lines and the entire factory generates lots of data. This represents an opportunity if it is properly analysed and used in decision-making to generate value for the companies. This paper presents a chapter proposition in an Industry 4.0 book covering a business intelligence value creation model. It will cover data collection, analysis and usage for better decision-making in smart factories context.

Keywords: Value creation; Business intelligence; Smart factory; Data analysis

1 Introduction

The smart factory of Industry 4.0 is characterized by the implementation of sensors and control systems, which generates large volume of industrial data at a great speed (Bagheri, Yang, Kao, & Lee, 2015). However, value creation coming from the usage of data has often been neglected by practitioners and scholars, yet there is much more potential for value creation when production data is explored accordingly, whether operational benefits such as cost reductions, or strategic benefits such as competitive advantage.

To guide investment strategies in manufacturing SMEs, there is a need to evaluate the factors contributing to value creation through data valorization. In this context, the proposed chapter will first present various Industry 4.0 data management approaches and applications for smart factories, with a focus on SMEs. In the following sections, we define and discuss how business intelligence (BI) can contribute to making factories smarter and finally we explore some ways in which BI leads to value creation.

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2 Smart Factory and Business Intelligence

Smart factory is an Industry 4.0 key feature (Hermann, Pentek, & Otto, 2016). They allow for better control of manufacturing processes like monitoring of remaining useful life and better product quality (Bagheri et al., 2015). The entire factory is constantly exchanging data, thus we need to understand this data to lead a smart factory to success.

Business intelligence (BI) is a broad concept including the collection, integration, analysis and visualization of organizational data to support and improve the decision-making process (Fink, Yogev, & Even, 2017). Without BI, data sits unused in databases. Even an autonomous factory must be guided by strategic objectives. Better decisions are related to value creation on operational and strategic levels. BI makes sure the factory is moving towards these objectives: it marks the difference between a high-tech factory and a smart factory.

4 A Value Creation Model: Methodology

Several value creation model or success measurement models already exists in BI literature (Fink et al., 2017), but few consider the limitations of SMEs. A multiple case study was made in four manufacturing SMEs to build on the existing theoretical models. A model adapted for Industry 4.0 and SMEs is suggested and will be detailed in a follow up article.

The full chapter will cover basic concepts and practical examples of value creation through usage of data. We will characterize value creation: direct and indirect benefits, operational and strategic value and basis of value measurement. We will then study different smart factory scenarios starting from simple performance indicators monitoring to predictive maintenance and autonomous production scheduling. In every scenario, we will demonstrate the ubiquity of BI and the essential role of data in the pursuit of Industry 4.0 principles.

Business intelligence offer an integrated approach to help companies exploit their smart factory data. This data presents an immense value potential that companies should learn to use for operational and strategic decisions.

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Implementing Industry 4.0 on Brazilian Highways to improve Emergency Response

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Abstract: The implementation of industry 4.0 in the service and health sector specifically on Brazilian highways aims at integrating accidents, distress, care and transport to a hospital. Industry 4.0 is one of the ways to try to reduce deaths caused by slow response time or by lack of information about victims at the time of care. This article introduces simple ideas and some ways of minimizing fatalities from highway accidents by reducing the emergency response time.

Keywords: Highway; Ambulance; Industry 4.0; Emergency Response;

1 Introduction

The 4.0 industry became a very significant concept recently. Technology is present everywhere, and this brings new features and advances, not only industrial related, but in other fields as well. This paper introduces a new conception, for the 4.0 industry. It is the link among the philosophy of the Big Data with Internet of Things and Internet of Services.

In this article, ideas will be introduced of how industry 4.0 can be used in the emergency response along highways to improve response time and efficiency of ambulances. Brazilian highways belong to the county, state or the federal government. The biggest highway system belongs to São Paulo state, spanning around 34000 km in length.

Brazil is ranked fourth in the list of countries with most highways accidents, according to the World Health Organization (2016). Analyzing about this problem, solutions could be suggested. Such changes concern emergency response companies with the technologies they already own and how to improve it.

The focus of this article is on the private companies which are represented mostly by the state. The research, reviews methods these companies use and how they work when an accident happens, with a step-by-step until the arrival of an ambulance and transport to the closest hospital. There is indication that

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industry 4.0's features could make this process more effective by analyzing all the environment and context of the present situation of the Brazilians highways.

A survey with 25 questions were made approaching accidents, time of arrival of the ambulance, camera monitoring along the highways and the fleet company had in possession. This survey was sent to fourteen companies but none replied the questions asked. With the data we could get on companies' websites we could make some decisions and planning of how we could use industry 4.0 for the benefit of the area.

2 Objectives

The main objective is to contextualize how industry 4.0 can be implemented to increase safety and improve how emergency personnel responds to emergencies on Brazilian highways. This is done in a number of ways.

- Determine the application of industry 4.0 can improve emergency care.
- Consider which tools optimize emergency response.
- Examine how to increase road safety.

3 Methods

Preliminary research was conducted online in order to establish a foundation of understanding, but nothing viable was discovered. From there, a survey was created with twenty-five questions and delivered to highway maintenance companies in São Paulo and Paraná state in Brazil. Responses to these surveys are expected soon.

4 Implementation ideas

The idea is to achieve a faster response time from emergency personnel. With the implementation of industry 4.0, response time would be faster, an incorporation of technological devices and software would be necessary for this to occur. In order to make the process more efficient for emergency responders as well as hospitals, a few things would be necessary:

- National Biometric Health Registry (CBNS): Through the help of a database with all patients, information would be created and this database would be made available for consultation by the medical sector of the emergency response concessionaires and the hospitals to which these patients would be taken. This information would be updated by the hospitals themselves and the data found in this database would include facts such as name, age, blood type, allergies, health problems, responsible persons and their respective numbers for the notification about an accident, among other information that may be relevant at the time of an accident.

The idea is to create a database where it's possible to download all necessary patient information using a victim's CBNS ID through a smartphone so it is possible to properly determine which actions should or should not be made on site and immediately be aware of procedures upon arrival to the hospital.

• Smart Cameras: Smart cameras and sensors to cover the entire perimeter of the highways, these smart cameras can detect through the image if any anomaly is occurring, and then send an alarm if necessary.

This action could result in sending an ambulance to an accident area, where there is little perceived movement of vehicles. This would result in faster emergency service than waiting for someone who was passing the event to call and report the accident. This faster action time would result in the possibility of a larger number of lives saved.

• Panic Button: A mobile application would be developed in partnership with the emergency response company. Drivers involved in any kind of high-risk situations like accidents or/and assaults, would have a quick access via their phone to a "button" that, when pressed, the GPS would give the location of the person, in case the emergency response does not provide cameras at the scene to check what is happening.

After confirming the activation of the panic button by the mobile device, the responsible company would issue a wellness check by calling the device. Personnel would then check with cameras or send emergency response personnel to the location if the need arises. Through these resources, the medical services of the emergency response would be faster than the conventional resources. The medical treatment of the patients would be more effective, since both the emergency companies and the hospitals would already have in their hands all the patient's medical history.

5 Conclusion

With the improvements that industry 4.0 can offer to the health and services sector, companies that are willing to implement these ideas could become a resource in the area and inspiration to other companies that deal with emergency situations.

The ideas and devices developed in this article would allow a faster arrival of the emergency response personnel to accident sites. Accidents can be physically seen by smart cameras and alarms signaled by the panic button. Knowing all the medical history of the victims would allow the first aid to be more effective. This could also help on accidents with unconscious or distraught victims because they could be in shock and forget an information, which could mislead to a fatal mistake. It also saves time if the affected persons need urgent medical because the medical records would pass to the hospital where the victim would be taken and everything necessary would be anticipated and prepared to save the victim's life.

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