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The Application of Smart Supply Chain Technologies in The Moroccan Logistics

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Abstract

The new technology has recently experienced remarkable progress which enlarged its domain of application. In supply chain domain, this increase appeals to new models that can collect, analyze and control big data. Emerging technologies form the 4th industrial revolution which consider the smart supply chain as essential component of it. This composition articulates on many concepts such as Internet of Things and Blockchain. These smart concepts help supervising the supply chain by supervising its equipment. Internet of Things consists of creating an interconnected field of all the objects composing the logistic chain and makes them active and accessible in real time. While Blockchain stills a very trending and complex concept that can be exploited advantageously in the transmission and storage of data in a secure and decentralized manner. The purpose of this study is to present, initially, a global view of the Moroccan industry classification according to its Gross Domestic Product, then, studying the percentage of major contributions of the industrial branches. In addition to that, to design a survey about the application of smart supply chain technologies in the Moroccan industry.

Keywords: Smart supply chain; Supervision; Internet of Things; Blockchain; GDP; Moroccan industry;

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1. Introduction

The 4th industry revolution brought a new change on the automated industry which transformed it, radically, into an autonomous decision making one. Internet of Things, Big Data analytics, Blockchain, 3D printing, machine learning, artificial intelligence and more are considered as technological pillars of the industry 4.0 that intervene all along the supply chain equipment and processes. Their intervention makes the activity easy to access and control by making smart decision in real time using complex logistical models.

The concept of smart supply chain concretely performs the entire logistic chain from customer to customer, regardless of their location, by effectively controlling the flow of suppliers. This control concerns simultaneously the cost reduction and the quality exigence. To achieve this performance, smart supply chain exploits intelligent sensors and devices existing in all the chain equipment. However, data security against cybercrime and data reliability remains to be major issues in the integration of smart technologies into the supply chain. These problematics persist side by side with the infrastructure problems, complexity of procedures and policies, but also with cost instability. Therefore, it is strongly necessary to achieve a condition of transparency in all logistics flows in order to ensure a fast and secure transmission of information, products and money.

The Internet of Things and Blockchain present two emerging technologies that are starting to attract researchers in logistic domain. The first technology aims to create an interconnected system linking all equipment and devices through their smart sensors and cards using the Internet features. While the second technology aims to improve the previous operation done by IoT and to ensure it by providing secure and reliable data transmission. Blockchain was first created to manage Bitcoin as a digital currency [1]. This new concept is then transmitted to the supply chain by providing secure, reliable, traceable and authentic data between the supplier and the customer, whatever their location is.

The main objective of this article is to discuss the application of smart supply chain technologies in Moroccan industry. To do this, we have segmented our study into three sections. First, presenting a global view of the classification of Moroccan industry according to its Gross Domestic Product. Second, displaying the logistics percentage in each industry classification. Third, designing a survey on the application of smart supply chain technologies in Moroccan industry.

This paper is organized according to the following sections: Section 2 presents a literature review about the main concepts of smart supply chain. Section 3 treats material and methods used to analyze the application of smart logistic tools and technologies in the Moroccan context. Section 4 discusses the study results. And, section 5 is dedicated to the conclusion.

2. Literature review

2.1. Equipment supervision

Equipment supervision is the process of connecting devices and machines to a network, in order to create an interconnected system that generates, collects, analyzes and interprets data [2]. It demands a system visibility condition, which is necessary in all sectors based on the supply chain. This condition allows a real time monitoring of the process using trending technologies such as barcodes, Radio-Frequency Identification (RFID), Near Field Communication (NFC), Optical Character Recognition (OCR) and biometrics. These tools are characterized by automatic identification functionalities [3].

Equipment supervision technologies articulate on several principal functions: identification of physical objects function, locating and positioning, generating object status using sensors, communication and accessibility, data storage of equipment and logic function allowing critical events identification [4].

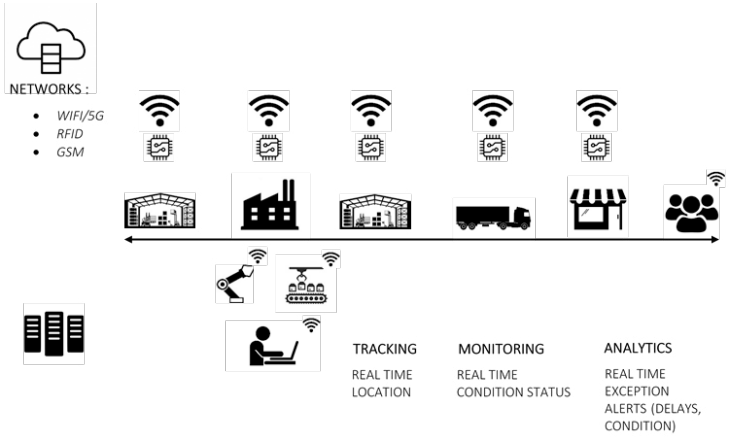

Figure 1. Architecture of equipment supervision system in smart supply chain

2.2. Smart supply chain

Supply Chain Management (SCM) is defined as a controlled grouping of all processes and equipment contributing in the creation of the added value according to the customer-to-customer concept [5].

SCM goes through many stages starting by customer and ending by customer. The main constraint of the whole chain is to make the right product at the right time and in the right place, respecting the right cost [6]. SCM manages to make this constraint disappears using precise monitoring system along the chain and through the three flows physical, information and financial. This system participates in the digital transformation of the supply chain from the provision of new solutions using advanced analyzes, to the optimization of SCM by artificial intelligence and IoT. These technologies are seen as the keys to smart logistics.

However, supply chain stills confronting many technical and organizational problems such as production and shipment delays, over storage or insufficient storage and raw materials shortage and disruption. Facing these logistical challenges, measures have been implemented by many developed countries to help distribute the gains from participation in global value chains to the rest of the economy. These strategies highlight national productive integration and proactive engagement and learning between governments, global businesses, local suppliers and the human resources. In particular, the adoption of new technologies by leading companies places new requirements on supply chain participants, as the competitive advantage counts today on skills, services and infrastructure [7].

2.3. Internet of Things

The concept of the Internet of Things (IoT) first appeared with Wireless Sensor Networks (WSN) in 1998 [8].

Due to technology progress, electronic devices have improved their requirements relatively to new industrial constraints. The Microcontroller Unit (MCU), digital radio transceivers and sensors are the main component of developed IoT equipment: MCUs are small in size and consume less power and are very inexpensive, digital radio transceivers are easy to set up and present energy efficient functionality and sensors are the identification tool of any physical properties. However, device memory remains a major constraint in the new generation of IoT devices [9].

Regarding the increase of technological constraints, the need of a new form of objects' connection becomes essential. As a result, many standardization organisms have begun to design protocols like IPv6 over IEEE 802.15.4 networks (6LoWPAN) [20,21]. Internet Protocol (IP) persists as a fine working network system protocol, enabling an end-to-end connectivity between interconnected devices through internet functionalities.

2.4. Blockchain

Blockchain is an emerging technology that has introduced a new concept of distributed database. It works by storing and transmitting data in a decentralized, transparent and secure manner. The blockchain allows users to share, publicly or privately, all digital events that have been executed and shared in the same chain [10].

Blockchain is composed of blocks that each block contains a distributed data shared or executed by users. These transactions are secured by complex algorithms that enable users to create and apply agreed rules enforcing data security. They make it unbreakable by all users including system administrators. Blockchain is a single platform system with multiple application areas [11].

To add a new operation in the blockchain, many transactions are involved with the chain nodes, as shown in figure 2. The new created block is characterized by decentralization and security. It goes through 5 stages:

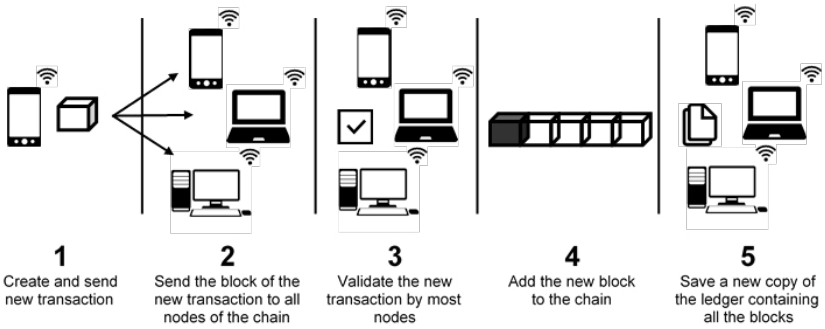

Figure 2. Steps to create a new block

3. Materials and methods

The main objective of this section is to present the methodology adopted in studying the application of smart technologies in the Moroccan logistics. First work aims to present a global view of the national industry contribution to the GDP. Next, studying the percentage of major contributions of the industrial branches. Then, designing a survey to extract their real applications of smart technologies in their supply chains.

3.1. Moroccan industry contribution to the gross domestic product (GDP)

This subsection presents a global view of the main industrial branches' contribution to real GDP growth in Morocco. The Moroccan industry, known as the secondary sector, is composed of 12 branches: Automotive; Aeronautical; Textile; Leather; Electronics; Electric; Chemistry & Para-chemistry; Pharmaceuticals; Building materials; Renewable energy; Mechanical & metallurgical; and Offshoring.

Each branch contributes in the GDP by creating wealth during a specific period. Figure 3 details the contribution part in the GDP of each branch during 10 years (2008 to 2018) [12].

Due to the COVID-19 pandemic, all sectors around the world have been adversely affected [13]. This study focused on a period before the crisis giving an approximate and significant vision of the national industry.

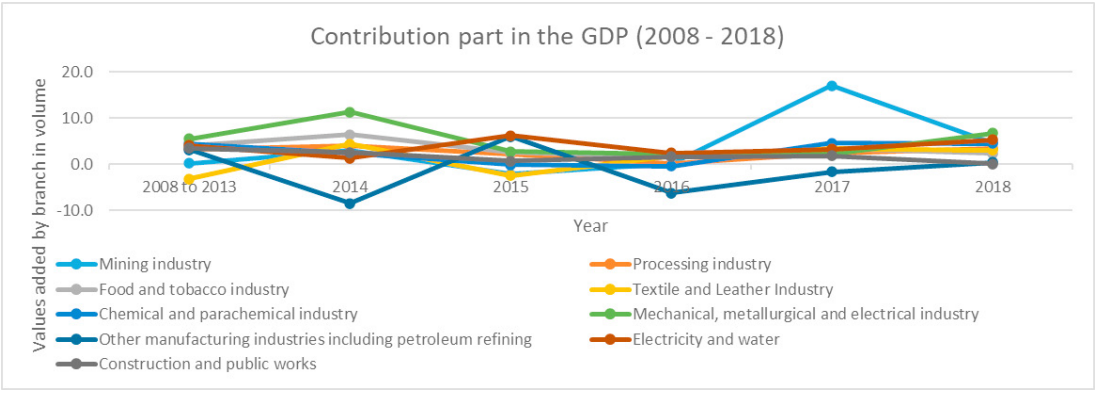

Figure 3. Contribution part in the GDP (2008 - 2018)

As shown in Figure 3, industrial branches have experienced an unstable development over the years, making GDP a variable input. During 2018, Mechanical, metallurgical and electrical industry presents a 6.7 point as the highest value added by branch in volume. Figure 4 presents the contribution part of each branch in the GDP during 2018.

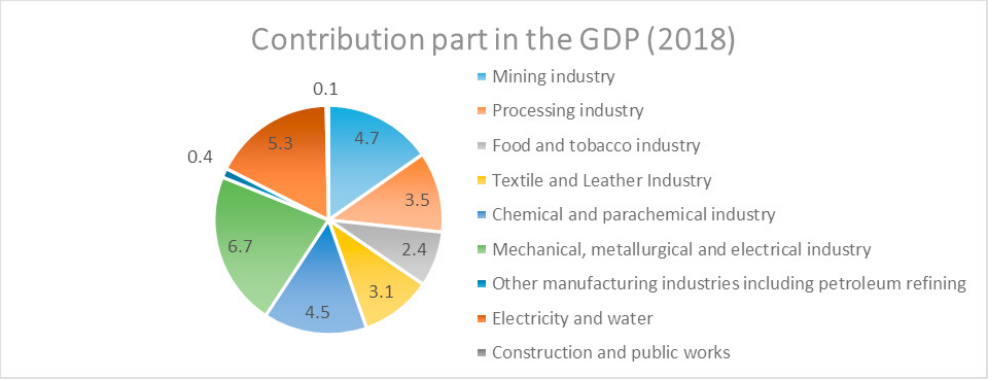

Figure 4. Contribution part in the GDP (2018)

By applying Pareto principle, 80% of the GDP contribution is distributed over the Mechanical, metallurgical and electrical industry, Electricity and water, Mining industry, Chemical and para-chemical industry and Processing industry.

These branches play a dual role from suppliers to subcontractors. This makes them essential links in the supply chain and important branches to be studied in this article. The study treats the application of smart technologies and tools on the logistic chain of these branches, using a questionnaire detailed on the following subsection.

3.2. Survey architecture about the application of smart supply chain technologies in Moroccan industry

In this part, the article presents the conception and design of a survey destined to Moroccan industries. It takes the form of an extracting questionnaire relating to the application of smart supply chain technologies in a specific industry. The survey contains the following axes:

- Company Name, its industrial branch and activity.
- Type of production flow (Pull flow, push flow, just flow) and its size of logistics equipment.
- Logistics chain monitoring mode (Automatic, autonomous or manual)
- Existence of smart technologies for logistics supervision, and a list of them
- Actual performance with the integration of smart technologies compared to performance without them

The questionnaire provides a clear image about the existence of smart technologies in the Moroccan manufacturing sector. This image includes a description of a company's business, technical sourcing, and a benchmark between current and past performance with and without the implementation of smart tools. In addition, this survey provides an adaptive version of Internet of Things and Blockchain applications on the domestic industry.

4. Discussion

This research conducted a survey aimed at the application of smart technologies in Moroccan industries contributing the most to GDP. The survey consisted of three categories of data. Each category plays a sourcing function of generating real parameters of logistics chains in Morocco.

The first category concerns the technical sheet of a manufacturer giving its identification, its industrial activity, the type of its production flow and the size of its logistics equipment. A well-organized structure must, effectively, control its entire supply chain including all of its internal and external processes, first, to improve them, then, to achieve good Overall Equipment Performance (OEE). Consequently, the supply chain management, according to the first category of the questionnaire, is a key parameter for the success of the company improvement.

The second category is considered the main objective of the survey. It shows how, technically, a company monitors its own supply chain in three ways: automatic, autonomous or manual. It also presents a detailed list of all the equipment, devices and technologies used in each logistics flow and how they manage to collect, analyze, store and transmit data. In addition, it gives technical actions vis-à-vis data security constraints. For this thing, IoT provides real-time supervision of all interconnected equipment in the chain, while the Blockchain guarantees the transmission of data in a decentralized and secure manner.

The third category summarizes the concrete benefits of integrating smart tools by comparing new performance with and without these smart technologies. A gap is calculated to carry out an economic study and to conclude on the gains concerning the technological investment.

5. Conclusion

Industrial companies are constantly faced with growing demand in a very competitive market. This constraint requires manufacturers to improve their activities and methods by exploiting new concepts and innovations [14].

The implementation of smart technologies at industrial manufacturers, such as Internet of Things and Blockchain tools, has shown a significant improvement in performance. However their investment cost, smart technologies lead to significant advantages in terms of productivity, performance and profit.

The diversity and improvement of innovative technologies make them easy to implement in all types of industrial sectors. Due to their functionalities and standards, models are now becoming more dynamic and adaptive to follow, autonomously, technological and machine evolutions. One of these new technologies is the accessibility of the 5G network which is becoming a faster highway in the digital world. It presents an opportunity to design new models under IoT concept, integrating 5G devices with the data security of the blockchain. These models allow a more developed supervision of the supply chain management, in particular on the Moroccan industry.

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References

[1] F Tian. 2017. "A Supply Chain Traceability System for Food Safety based on HACCP, Blockchain & Internet of Things*." International Conference on Service Systems and Service Management (ICSSSM).*

[2] Y.Guo, Y.Sun and K.Wu. 2020. Research and development of monitoring system and data monitoring system and data acquisition of CNC machine tool in intelligent manufacturing. *International Journal of Advanced Robotic Systems*: 1–12.

[3] Papert, M., Rimpler, P., Pflaum, A., 2016. Enhancing supply chain visibility in a pharmaceutical supply chain - solutions based on automatic identification technology. *International Journal of Physical Distribution & Logistics Management* 46.9, 859–884.

[4] Lempert, S., Pflaum, A., 2011. Development of an Integration and Application Platform for Diverse Identification and Positioning Technologies. *Microelectronic Systems – Circuits, Systems and Applications*, 207–217.

[5] Council of Supply Chain Management Professionals. 2005. Supply Chain Management/ Logistics Management Definitions.

[6] S Mallik. 2010. The Handbook of Technology Management: Supply Chain Management, *Marketing and Advertising, and Global Management (Hossein Bidgoil. ed.),* vol 2 (1 ed.). Hoboken, New Jersey: John Wiley & Sons, Inc.

[7] F Lehmann, C Cordon. 2020. Business supply chain strategies are evolving, can poor countries benefit? The Institute for Management Development (IMD) and Trade for Development News by EIF.

[8] J.M. Kahn, R.H. Katz, K.S. Pister, 1999. Next century challenges: mobile networking for Smart Dust, in: Proceedings of the 5th Annual ACM/IEEE *International Conference on Mobile Computing and Networking*, ACM Press, pp. 271–278.

[9] L. Mirani. 2014. Chip-makers are betting that Moore's law won't matter in the Internet of Things.

[10] M Crosby, P Pattanayak, S Verma, V Kalyanaraman. 2016. "Blockchain Technology: Beyond Bitcoin." *Applied Innovation* 2: 6–9.

[11] S Saberi, M Kouhizadeh, J Sarkis, L Shen. 2018. Blockchain technology and its relationships to sustainable supply chain management. *Taylor & Francis*

[12] Haut Commissariat au Plan Maroc. Comptes Nationaux, Valeurs ajoutées par branche en volume (Croissance aux prix)

[13] P Ozili and T Arun. 2020. Spillover of COVID-19: impact on the Global Economy. *SSRN Electronic Journal*.

[14] Y. Issaoui, A. Khiat, A. Bahnasse, H. Ouajji. 2019. Smart logistics: Study of the application of blockchain technology, *Procedia Computer Science*, Volume 160, Pages 266-271