Productivity Induced By The Information System Technologies, Case Of Industry 4.0

Mohammed Ghouat, Abdellah Haddout, Mariam Benhadou

Abstract*: *Faced with the increasingly growing of specific customer needs, the global industry is dealing with a large and diverse number of information systems, this situation create challenges upon the information management and real time data analytics. The analysis of the different industrial revolutions since the 18th century has highlighted the main motivations for these mutations, which each time affect the interactions of the organizations with their interested parties. Understanding the motivations of each industrial revolution allows us to understand the main motivations of the Industry 4.0 concept and to understand how this concept impacts how organizations interact with their stakeholders. The Industry 4.0 concept is taking shape to specifically meet the needs of analysis and instant decision-making for better responsiveness with good quality control and increased productivity at lower cost. As a result, the Industry 4.0 concept imposes a new way of organizing and interacting with companies and their stakeholders. Indeed, it has been shown to have a direct impact on the key factors of the supply chain. In this work we seek to highlight the impact of the industry 4.0 concept on the entire production system environment and subsequently directly affect the level of performance of the company in terms of quality, cost of production and with improved productivity.

Index Terms*: *Industry 4.0, Production system, Productivity

I. INTRODUCTION

The fourth industrial revolution commonly known as Industry 4.0 is the result of a continuous evolution of the industry context and the changing needs of its stakeholders supported by an evolution of information technologies [1]. The continuous increase in production volumes and the continuous search for better productivity have been the main motivations of the various industrial revolutions.

The first industrial revolution known at the end of the 18th century was characterized by the replacement of the animal by water as a source of energy which gave rise to the steam engine used in several industrial applications to increase the volumes of production [10], [11], [2].

The second industrial revolution was appeared at the end of the 19th century and at the beginning of the 20th century it is marked by the discovery and the development of the electrical energy and by the subdivision of the work and the introduction of the chain work, the needs at that time was the simplification of repetitive tasks, relying mainly on a low-skilled workforce and control of the production costs. [2]

Industry 4.0 was appeared in a context in which the requirements of the industry stakeholders have evolved significantly in terms of responsiveness and reliability of the information exchanged, these requirements are particularly identified in the practices of the supply chain which involved customers, suppliers, storage, transport and manufacturing [3].

The Industry 4.0 concept was adopted for the first time in Germany in 2011, followed by the United States with the name "Smart Manufacturing" in continuation Japan and Korea adopt the same concept. Several countries then joined the concept under several names, such as:

- "Industrial Internet" concept, "intelligent manufacturing", "advanced manufacturing", "Integrated Industry", "Smart Industry" and "Smart Factory" [5].

The figure 1 indicates in the traditional pattern, the interaction between the different stakeholders with the organization supported by the ERP.

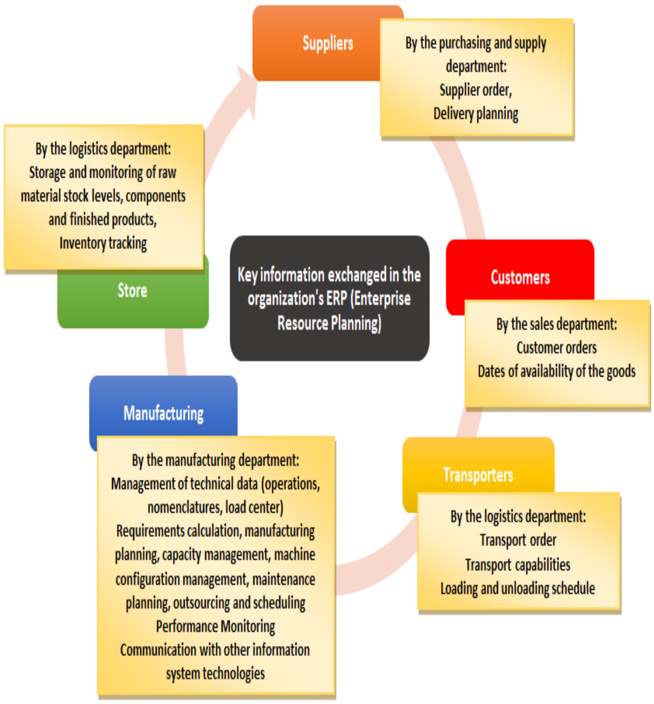

Fig.1 Interaction between the different stakeholders with the organization's ERP

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II. INTERACTION BETWEEN THE DIFFERENT INTERESTED PARTIES THROUGH THE ERP OF THE ORGANIZATION

To assimilate the contribution of the Industry 4.0 concept, we will describe the interactions of these stakeholders with the organization's ERP in a traditional pattern of operating. In this case, the management of these interactions is centralized into the organization and relies on an ERP or on independent applications for the management of the different processes.

A. Sales order management

For order management, the flow of data is generally incoming, the organization receives orders from customers and they prepare them and perform a delivery scheduling.

The evolution of customer needs are analyzed regularly by BAs (by exploiting the data collected from the ERP, the adjustment of the stocks is done later which causes a time lag between the instantaneous needs of the customers and this readjustment due the periodicity of the analyzes and the time of adjustment of the stocks which also includes the delay suppliers) [9].

B. Supplier order management

For the management of supplier orders, the flow of information is generally outgoing, according to the levels of stocks and the particular needs of the customers, the organization orders these orders and ensures a regular follow-up of the arrivals. In this scheme, a time lag between the detection of real needs and the orders placed with suppliers is mainly due to the processing time of the stock data managed by the ERP.

C. Stock management

With regard to the stock management, management is generally limited to tracking product inventory levels without worrying about the optimization of allocated space or the actual level of inventory coverage, the latter parameter is closely related to changing customer needs.

D. Manufacturing management

The role of manufacturing in this case is to make available to the organization the goods requested within the prescribed time, this relationship is usually managed through an ERP integrating the management of the manufacturing, the ERP process obeys to the management rules previously studied and implemented in the information system, these parameters are generally static, their updating is done during revisions of sales forecasts. Generally manufacturing does not interact directly with the customers; the needs of the latter are integrated into the ERP through a commercial department.

E. Transport management

Finally for the transport, the organization chooses its mode according to the quantities, the volumes, the weight, the origin and the destination of the goods, this is valid at the time of the collection as at the delivery.

III. INDUSTRY 4.0 CONCEPT

By reading the interactions between the interested parties with the organization we deduce that there is a mass of information managed by the ERP or by independent applications of customer relationship management, purchasing management, inventory management, transport management or manufacturing management. This information being independent of each other and static for certain management parameters, leads to increasing pressure on managers to perform reliable and real-time analyzes, with the aim of making rapid strategic decisions. This is the reason why several data analysis applications (Business Analytics: BA) have emerged and are generally integrated with ERP for decision support through an analysis of the data contained in the ERP database or in the database of specific applications [9].

However, these BAs do not typically analyze the data in real time, but rely on archived data for some time.
The Industry 4.0 concept goes beyond static analysis to real-time data analysis using new information and communication technologies (ICTs) [4]. The goal is to reduce the retention time of the relevant data before it is used in analyzes by BA applications.

Figure 2 represents the mode of interaction between the interested parties and the organization in the Industry 4.0 concept.

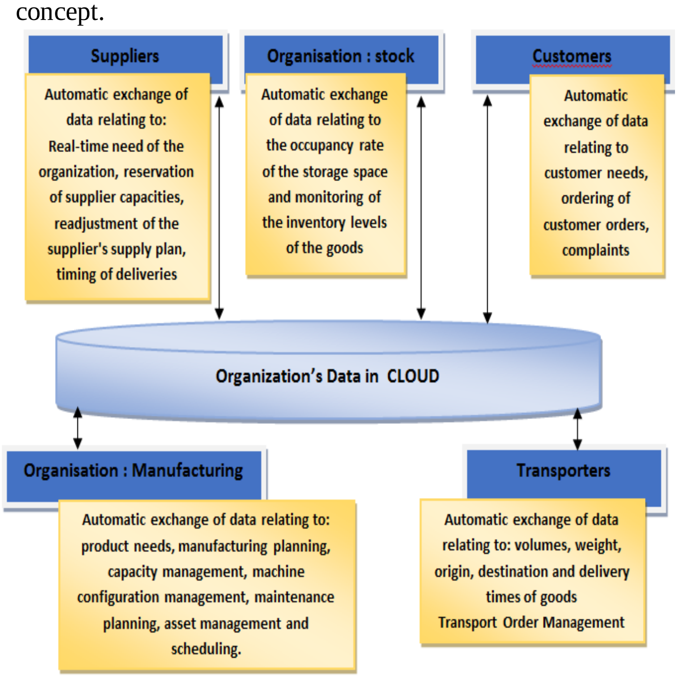

Fig.2 Interaction mode between the interested parties and the organization in the industry 4.0 concept

IV. INTERACTION BETWEEN INTERESTED PARTIES AND THE ORGANIZATION IN THE INDUSTRY 4.0 CONCEPT

A. Interactions of clients with the organization

Automatic real-time data exchange with customers improves the business model of the organization, products and services, and the relationship with customers [5], [8], providing near-immediate answers to the customers and with a data analysis, to be able to foresee the future needs of the customers.

The data that can be exchanged are, for example, stock levels, product data sheets, complaints, the immediate and future needs of customers and product customization needs, which leads organizations today to perform digital transformations in their relationship with customers [5]. This digital transformation must meet the requirements of interoperability, virtualization, decision-making decentralization, real-time analysis capability, service orientation and modularity [7, 5].

B. Interaction of suppliers and transporters with the organization

The Industry 4.0 concept in supplier relationships requires more transparency and autonomy in data exchange, collaboration between suppliers, organization and customers is crucial to increase transparency at all stages of the chain value, from the order to the end of the product's life.

In this context, the links between the supply chain and the Industry 4.0 concept have been highlighted. In this research, it has been shown that the technologies related to the Industry 4.0 concept below have an impact on the key performance indicators (KPI) of the supply chain, in this research limited to purchase, transport, storage and sale [3].

Technologies evaluated:
1. Virtual and augmented reality,
2. Additive manufacturing and 3D printing,
3. Simulation
4. Big data analytics
5. Cloud technology,
6. Cybersecurity,
7. The internet of things
8. The miniaturization of electronics
9. Automatic identification and data collection (AIDC),
10. Radio Frequency Identification (RFID)
11. Robotics, drone and nanotechnologies
12. Machine-to-machine communication (M2M)
13. Business intelligence (BI)

This analysis concluded that these technologies impact positively the KPI:
- 53.84% positive impact versus negative impact of the fulfillment of sales orders;

61.54% positive impact versus negative impact of logistics transport;
- 66.6% positive impact versus negative impact of storage;
- 71.43% positive impact versus negative impact of the purchase function.

The study clearly shows that the adoption of the Industry 4.0 concept is beneficial to the organizations, the most relevant benefits is the increase of the flexibility, the improvement of the quality standards, the improvement of the efficiency and the increase of the productivity [3].

V. MANUFACTURING IN THE INDUSTRY 4.0 CONCEPT

The Industry 4.0 concept is relatively new to manufacturing management because it relies on a complex, dynamic and real-time connection between objects, people and information systems, giving rise to new risks, these risks must be managed before any implementation of the Industry 4.0 concept and which can be based on the ISO 31000 risk analysis approach [12].

The risk analysis must be based on a clear vision on the objectives of this industrial transformation, for the establishment of these objectives, the ISO 9001 version 2015 standard gives the guidelines to conduct a context analysis according to the PESTEL approach (the political, economic, social, technological, environmental and legal) of the organization and to establish the key success factors (KSF) in line with the Industry 4.0 concept while conducting the current analysis of the maturity of the concept, this latest research measures the level of maturity of the Industry 4.0 concept according to 6 dimensions: Strategy and organization, smart factory, intelligent operations, intelligent products, data-driven services and employees [13].

A future maturity goal may be based on a target architecture design approach that can provide raw data acquisition and communications services, data readiness, data analysis, and data real-time visualization of relevant data for decision-making [14].

The Impact on manufacturing KPI measure can be based on the approach used to evaluate the impact of the Industry 4.0 concept on key performance indicators of the supply chain [3].

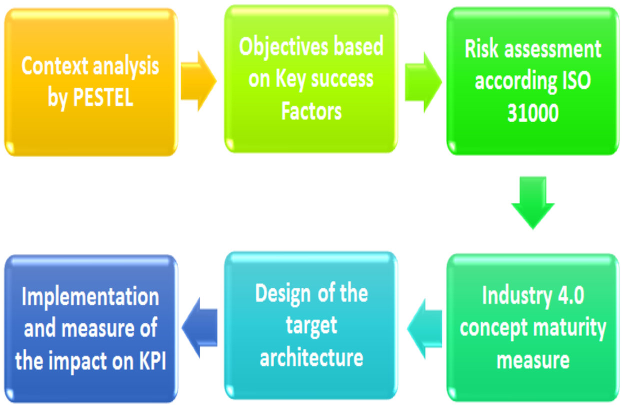

Fig.3 Phases of implementation of the Industry 4.0 concept in production

VI. CONCLUSION

We conducted a global analysis of the interactions between organizations and their stakeholders according to the Industry 4.0 concept. This implies a new mode of industrial management. Through this study, we have shown the direct positive impact of this concept on the key factors of the supply chain. We have developed a global diagram of the interactions between different production systems according to the Industry 4.0 concept.

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This new mode will allow a complex but dynamic connection in real time between the different components of the production system, the people and the information systems. This leads to better responsiveness in decision making, control of the production system with a high level of quality and improved productivity.

So far, several papers have addressed Industry 4.0 risk assessment models, concept maturity models in organizations, and Industry 4.0 architecture design models. . A detailed analysis of the impact results on key factors of production performance will be presented in our next article.

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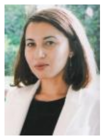

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