Industry 4.0 and the emergence of new business models

Federico Walas Mateo, MSc. in Advanced Manufacturing Systems[1],
[1]Universidad Nacional Arturo Jauretche, UNAJ, Argentina, fedewalas@gmail.com,

***Abstract*– The Industry 4.0 Paradigm generates, among other impacts, the possibility to apply new business models in the Industrial Sector. From the emerging of the concept till present days it can be seen an important number of new business models as a result of the innovative adoption of digital technologies in industrial firms. As an example a paper of the Boston Consulting Group (2015), states that the model Industry 4.0 allows faster response to customers demands, increase flexibility allowing the adaptability to manufacturing processes, and provides a tremendous amount of tools for quality improvement in the processes, among other advantages. Some authors also refers in their works to the arising opportunities in the production systems due to the advance of digitalization, in particular those that impact in the integration and operation in the global value chains.**

***Regarding smart products Porter and Heppelman (2014) indicates they offer exponentially expanding opportunities for new functionality, far greater reliability, much higher product utilization, and capabilities that cut across and transcend traditional product boundaries. The changing nature of products is also disrupting value chains, forcing companies to rethink and retool nearly everything they do internally.**

***Besides, it can be considered what Borja (2020) says about blockchain, Virtual and Augmented reality, Artificial Intelligence and Robotics. He observes that these are disruptive technologies business models and the impact of technology in business changes the economic and social organization.**

***This work approaches one of the edges that shows the Industry 4.0 Paradigm, and aims to explore opportunities and challenges that arise from its adoption, transforming traditional value chains to facilitate the creation of value and reach new levels of competitiveness.**

Keywords—Smart Manufacturing, Industry 4.0, cyberphysical systems , Industry digitalization, collaborative economy.

I. INTRODUCTION

To begin the treatment of the subject that this work focus on, it should be referred an early article in which Porter and Millar (1985) anticipated what happens with the advance of digitization in the industrial field and competitiveness. They stablished that information technology affects competition in three ways:

1. It changes industry structure and, in so doing, alters the rules of competition.
2. It creates competitive advantage by giving companies new ways to outperform their rivals.
3. It spawns whole new businesses, often from within a company's existing operations.

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Following this article, Porter and Miller (1985) pointed that managers must first understand that information technology is more than just computers, and that information technology must be conceived of broadly to encompass the information that businesses create and use as well as a wide spectrum of increasingly convergent and linked technologies that process the information. In addition to computers, then, data recognition equipment, communications technologies, factory automation, and other hardware and services are involved. This affirmation made more than 30 years ago, and that has been amplified by a cumulus of devices and equipment is one of the pillars of Industry 4.0.

Later Porter and Heppelmann (2014, 2015), wrote two articles about how smart connected products change the nature of competition. In the first one, Porter & Heppelmann (2014) examined the implications external to the firm, looking in detail at how smart, connected products affect rivalry, industry structure, industry boundaries, and strategy. In this article it is affirmed that no manufacturer can survive the coming years without introducing intelligent and connected products into its catalogue.

Iansiti and Lakhani (2014) proposed three properties to understand why connected products are changing business models: (1) Unlike analog signals, digital ones can be transmitted perfectly, without error. (2) Moreover, digital signals can be replicated indefinitely without any degradation. (3) Once the investment in network infrastructure has been made, the page can be communicated to the incremental consumer at zero (or almost zero) marginal cost. And a digital task performed at zero marginal cost will immediately supersede any traditional analog task completed at significant marginal cost.

These properties (exact replication infinite times at zero marginal cost) improve the scalability of operations and make it easy to combine new and old business processes and connect industries and communities to generate novel opportunities.

According to the logic of the digital world, machines little by little will stop being products and become services. Instead of buying an engine, the customer is going to buy a service ventilation, generation or propulsion. And the manufacturer is going to have the real-time data of the thousands or millions of your creations spinning, generating energy or moving things around of the world. With this data, companies will not only be able to maintain machines without accidents and losses due to inactivity, but they could also use the data to design the next version of the machine with the benefit of knowing the whole story. Exactly how the previous version did.

II. BEYOND PRODUCTS AS A SERVICE

Porter and Heppelmann (2014) stated that connected products open up a spectrum of new business models for capturing value, from a version of the traditional ownership model where the customer benefits from the new service efficiencies to the product-as-a-service model in which the manufacturer retains ownership and takes full responsibility for the costs of product operation and service in return for an ongoing charge. Customers pay as they go, not up front. Here, the value of product performance improvements that reduce operating cost (such as better energy efficiency) and service efficiencies are captured by the manufacturer.

Iansiti and Lakhani (2014) establish in their work that adapting to ubiquitous digital connectivity is essential to competitiveness in most sectors of the economy. They reinforce the concept by saying that they have examined transformation across dozens of industries and companies—both traditional and born-digital, talked to hundreds of executives in an effort to understand how traditional modes of innovation and operational execution are changing. (Disclosure: they have consulted with or have interests in several of the companies mentioned in their article.) They have seen that digital transformation is no traditional disruption scenario: The paradigm is not displacement and replacement but connectivity and recombination.

The concept product as a service has broaden to anything-as-a-service (XaaS). Costa (2019) defines that this concept means that instead of offering a product as an investment or cost, it is offerd as a service paying for what it is used reducing the cost of ownership of the equipment or machine. I his article Costa (2019) put XaaS as the future of collaborative economy and gives examples beyond Uber or Airbnb, like Mobike or BMW in China.

An article from Deloitte, by Sharma et al (2019) suggest that the ever-changing technology landscape—currently shaped by technologies such as cloud computing, anything-as-a-service (XaaS), and the Internet of Things (including industrial IoT)—has solidified the need for businesses to adopt a customer-in mindset, shifting focus from selling a product to nourishing a customer relationship: understanding expectations and maximizing customer value from offerings.

Robotics is also advancing at an exponential rate. Today it is possible for UR industrial robots and other robots suppliers to implement as a service business models to facilitate any firm to afford having a robot. Beyond that UR introduced the concept of collaborative robot or cobot, making possible human and robots to work very close each other in the industrial environment.

III. PLATFORMS, COOPERATION, AND LEAN

The work of Borja (2020) points that there are three different kind of disruptive business models, some of them derivates from digital transformation, economy of platforms, descentralized models or superfluid economy. The new business models and the companies that represent them lean on a series of repeating premises: personalization, pay per use, collaborative model, agile and flexible organizational models, and the data.

The paper of the BCG (2015) approach the cooperation in Industry 4.0 where companies, departments, functions, and capabilities will become much more cohesive, as cross-company, universal data integration networks evolve and enable truly automated value chains. In this line, it is presented an example of how Dassault Systemes and BoostAeroSpace launched the platform AirDesign, for the European aerospace and defense industry as a common workspace for design and manufacturing collaboration. This platform is available as a service on a private cloud. In this way it can be managed the complex task of exchanging product and production data among multiple partners.

Andrei Vazhnov (2015), refers to computer platforms and their integration that allows an effect of ubiquity and extraordinary scope, allowing disruptive business and work models. The author especially mention the Uber and Airbnb cases. A platform is an environment where an application runs, and based on network connectivity, this definition has been extended to a space where different users can interact with each other or with physical objects. The latter gives rise to what it is known as Cyber-physical systems.

The integration and scope of the platforms is generated by being connected through APIs. An API, an acronym for Application Programming Interface, is the mechanism that allows devices and platforms to be integrated. It is something that facilitates, for example, that applications using georeferencing to access information from Google Maps.

This phenomenon of liquid world, as it is called by Vazhnov (2015) from the possibility that generates Internet and ubiquity, makes possible to reconfigure global value chains, and integrate different platforms to make easier operations management.

The European network of Kiala can count on 7,200 Points and 1,050 Click & Collect Points distributed in 5 European to offer a delivery service without a single drop-off or pick-up point in a building of its own. This is an example of a new level of liquid business that is becoming increasingly common.

Another element to consider when talking about new business model under Industry 4.0 paradigm is uncertainty. To cope with this fact, sensing and rapid response when planning a new strategy is critical. A tool that could help to develop and find a product and business model that really works is an Agile methodology called Lean Start Up. The real challenge is to develop and validate the value proposition, and look for a profitable business model that allows to consolidate sales and scale the volume of business.

The Lean Start Up methodology created by Eric Ries, collecting the adjective "lean" widely disseminated when describing production methods developed by Toyota and other Japanese manufacturers for dispense with everything that is left over, hinders and lengthens the Productive processes). The

fundamental objective of Lean Startup is shortening the product development cycle and employing agile development methods, with validation tests by the market, to match the processes to the acceptance of the clients, adjusting and pivoting -when needed-Indicators are used incremental to measure the result of the actions on the interested customers and sales and the model is analyzed and controlled appropriate growth based on acquisition costs, of customer retention and the value of customers throughout its life cycle. In sum, a set of techniques for match the product development processes with the customer discovery and development.

IV. Adoption of the new business Models and the organization

Adopting the new business models means changes in organization structures and roles. Porter and Miller (1985) stated that as more and more of their time and investment capital is absorbed in information technology and its effects, executives have a growing awareness that the technology can no longer be the exclusive territory of EDP or IS departments. As they see their rivals use information for competitive advantage, these executives recognize the need to become directly involved in the management of the new technology.

In a later work, Porter and Heppelmann (2015) the changes in organization is reinforced pointing that smart, connected products also alter interactions between functions, in ways that hold major implications for organizational structure. Intense, ongoing coordination becomes necessary across multiple functions, including design, operations, sales, service, and IT. Functional roles overlap and blur. Entirely new functions—unified data organizations, dev-ops, and customer success management—begin to emerge.

To address the changes of the organization, Cornella and Planellas (2020) use the analogy of the modern organization with a computer operating system. As computer is made of many interacting components, and the correct interlacing of these interactions is the role of the operating system. A computer does not work because it has 'parts', but because its functionalities are connected. They apply this metaphor to a modern organization considering the typical hierarchy tree of an organization, the 'parts' are departments, units, divisions. Following this analogy, the same way that the operating system of a computer can be updated (with more recent versions), it is possible to 'update' an organisation by modifying its operating system. But in the same way that drastic changes in an operating system force the purchase of new hardware (because the old hardware cannot 'run' the new operating system), so profound changes in the business environment (the market) require radically different organisations (that is, operating systems). The long-range digital transformation that we are experiencing is a clear example of this: many conventional (incumbent) companies have enormous difficulties competing with emerging companies (which are founded with a different operating system).

Customers will also be part of the company, especially those who prove to be the best 'sensors' for real demand. Suppliers will also become part of the corporate 'we', and value chains will be interwoven through information systems built on global standards (today's emerging platforms). Each new opportunity will require the participation of people and departments who are today isolated in their silos, and so creating multidisciplinary teams. Collaboration with other companies will be the norm once we understand that the world is too complex to be solved in isolation.

Another approach for successful adoption is given by Siemens (2019) in a paper where it is stated that it has been identified three key imperatives in successful digital transformations. These imperatives have shaped their Integrated Change Management methodology:

- Instituting an integrated approach across facts – i.e., tangible elements such as technology, processes and social interactions – i.e., intangible elements such as culture and teams throughout the transformation journey and across the entire company.
- Living agile by proactively updating change measures to meet both current needs and overall objectives effectively
- Adapting "classic" Change Management levers such as communication, leadership, team setup, training, etc. for digitalization needs

V. CONCLUSIONS

Different firms in a broad spectrum of sectors are shifting value from manufacturers and distributors to companies that operate end-to-end platforms and provide outcomes as-a-service. Many firms face growing threat of market obsolescence, and then constant change seems to be the golden rule.

A paragraph in the conclusion deserves the importance of Change management when adopting a new business model. Changing the business model means transforming the firm.

Cornella and Planellas (2020) conclude in their work that customers will also be part of the company, especially those who prove to be the best 'sensors' for real demand. Our suppliers will also become part of the corporate 'we', and our value chains will be interwoven through information systems built on global standards (today's emerging platforms). Each new opportunity will require the participation of people and departments who are today isolated in their silos, and so creating multidisciplinary teams. Collaboration with other companies will be the norm once we understand that the world is too complex to be solved in isolation.

Finally, the need for agility, where a Lean start up approach to test the new business model and go for a fast ROI seems a good option.

The next step in this line of research, is the data driven organization as IoT evolution from leading edge innovation mainstream technology and its business potential. Also very important is to watch the progress of Artificial Intelligence (AI) solutions for industry, such as those presented by new companies like LLamasoft, which provides AI for supply chain management (SCM), and Canvass Analytics, which provides an AI platform to optimize processes.

Finally, jointly to this subject is the emergence of technological start ups that solve market needs and generate value from business models based on disruptive technology.

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