

CHALLENGES OF BUSINESS MANAGEMENT FOR THE DIGITAL ECONOMY IN THE COUNTRIES OF THE ANDEAN COMMUNITY OF NATIONS

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Abstract

The fourth industrial revolution brings new technologies that have significantly impacted the way of working and production of all organizations worldwide which have adopted these changes. Thanks to this, significant advances have been achieved in optimizing their processes, which allows for better economic profitability and an essential impact on their value chain. In this work, we propose to develop a business management strategy that responds to the challenges of industry 4.0 in the digital economy in the countries of the Andean Community of Nations (CAN), to diagnose the current status of several companies in the manufacturing sector of the CAN countries regarding the use of the technologies implicit in industry 4.0, and thus, to generate strategies that highlight the importance of adopting the use of these in the development of their processes, ending with the management for digital commerce. The methodology applied is mixed: documentary and field. The companies surveyed have innovated and implemented technologies inherent to Industry 4.0 and consider the positive investment benefit. In addition, it was evidenced that most of them are aware of the barriers, limitations, and challenges when entering Industry 4.0 and the digital economy and the consequences of not doing so. This work shows the experiences of a group of manufacturing companies in the CAN countries regarding implementing Industry 4.0. Finally, the variables to be considered for the future challenges of manufacturing companies in automated processes and the digital economy are proposed.

Keywords: Industry 4.0, digital economy, innovation, manufacturing company.

RETOS DE LA GESTIÓN EMPRESARIAL PARA LA ECONOMÍA DIGITAL EN LOS PAÍSES DE LA COMUNIDAD ANDINA DE NACIONES

Resumen: La entrada de la cuarta revolución industrial trae consigo nuevas tecnologías que han generado grandes impactos en la forma de trabajo y producción de todas las organizaciones a nivel mundial, que han adoptado dichos cambios. Gracias a ello, se han logrado avances significativos en la optimización de sus procesos lo cual permite mejor rentabilidad económica y un impacto



importante en su cadena de valor. En este trabajo se plantea desarrollar una estrategia de gestión de empresarial, que responda a los retos de la industria 4.0 en la economía digital en los países de la Comunidad Andina de Naciones (CAN). Se diagnostica el estado actual de varias empresas del sector manufacturero de los países de la CAN frente al uso de las tecnologías implícitas en la industria 4.0, y así, generar estrategias que resalten la importancia que tiene adoptar el uso de estas en el desarrollo de sus procesos, finalizando con la gestión para el comercio digital. La metodología aplicada es mixta: documental y de campo. Las empresas encuestadas, han innovado e implementado tecnologías inherentes a la industria 4.0 y consideran la inversión-beneficio ha sido positivo. Además, se evidenció que la mayoría conoce las barreras, limitaciones y retos al incursionar en la industria 4.0 y la economía digital y cuáles serán las consecuencias de no hacerlo. Este trabajo permite mostrar experiencias de un grupo de empresas manufactureras de los países de la CAN con relación a la implementación de la industria 4.0. Finalmente, se proponen las variables a considerar para los retos futuros de la empresa manufacturera en cuanto a los procesos automatizados y la economía digital.

Palabras clave: Industria 4.0, economía digital, innovación, empresa manufacturera.

I. INTRODUCTION

In the coming years, the fourth industrial revolution is expected to generate outstanding benefits in different sectors of the manufacturing and service industries. The implementation of new technologies has had an impact on the optimization of industrial processes, generating more outstanding production and profitability. On the other hand, the manufacturing sector has always participated in a country's total gross domestic product (GDP) as an indicator of its greater or lesser degree of development [1].

Currently, in the context of globalization, the increasing participation of the manufacturing sector in a country's economic activity shows a higher level of economic development [2]. Therefore, the higher the level of progress of a country's industry, the higher the level of economic development.

The profound digital transformation, as a result of globalization, is impacting primarily on the business economy, thus evidencing the urgent need for a review of the competencies of managers, executives, and workers, who will guide the new business models in the transition of digital economies [3][4].

Historically, economic development is based on the dynamics between the factors of production, the emergence and implementation of new technologies, and the automation of production processes. The technological impact that is developing the digital economy is the new capabilities of the Internet infrastructure and the potentialities of emerging technologies: Cloud, Big Data, Internet of Everything (IoE), and Industry 4.0 [5][6].

The emerging technologies mentioned above can carry out the cross-cutting digital transformation of traditional industrial and service sectors, leading to the emergence of new digital services and product marketing strategies. Industry 4.0 and the digital economy are associated with a stage of economic development that will cross-cutting impact the production models of all sectors and countries.

Industry 4.0 is the digital transformation of the industry's processes through innovation, technological advances, and automated management so that companies become more efficient and optimize their activities through automation. Process automation in the era of Industry 4.0 implies new ways of working, new professions, and changes in habits and customs that impact productivity, innovation, quality, and efficiency of processes [8][9].

On the other hand, manufacturing companies in the CAN countries are investing resources to incorporate automated machinery and equipment, as well as different systems for planning and managing customer relations, as a way of approaching the digital transformation required by Industry 4.0 and the digital economy. However, managers, directors, and workers are not fully prepared for this change. Therefore, incorporating technology without having the right personnel can lead to economic losses [10].



The objective of this research is focused on analyzing how advanced the CAN countries are in the implementation of Industry 4.0 and the management of the digital economy of manufacturing companies. The aim is to identify the equipment and automated machinery used in the digital transformation towards Industry 4.0. In addition, to determine the factors involved in the process for companies in the CAN countries to advance in the digital economy and identify the risks of not implementing the digital transformation.

This work is distributed as follows: Section II shows concepts and fundamental aspects of the development and methodological aspects of the work. Section III shows the results, and section IV discusses them. Finally, the conclusions and primary references are shown.

II. DEVELOPMENT

From the 1990s to the present, the rise of new technologies has motivated companies to make changes and initiatives to adapt to digital trends. With digitization, technology began to impact all aspects of the company: processes, organization, business, corporate culture, services, products, and customer experiences [11].

Digital transformation goes beyond technology and is focused on the strategic transformation of the business, which requires not only technology but also a transversal organizational change in all areas of the company. The objective of digital transformation is to innovate, improve the customer experience, generate value, integrate systems, and change the way of working from infrastructure to administrative and sales processes [12][13][14].

DIGITAL TRANSFORMATION

Today's digital transformation changes all scenarios in the business and commercial environment. In this sense, it is necessary to develop adequate competencies for the new jobs required in an era dominated by the automation of machinery and equipment. It is necessary for companies to assume the competencies required to integrate into the digital change [13].

INFORMATION AND COMMUNICATION TECHNOLOGIES (ICT)

They interact with information: software, applications, hardware and devices, web services, and social networks. The business world has changed the market and business by incorporating these technologies. The advantages of automated processes and the Internet in companies are highlighted in productivity, communication, promotion, cost reduction, and marketing of products through digital commerce.

INTERNET

In the business sphere, it diversifies the promotion of products and services, speeds up marketing, increases customer power, and disrupts the market structure, influencing business decisions and all work areas.

INFORMATION AND ECONOMY

The changes that the Internet has brought about in the global economy have given way to the knowledge society, information society, or information economy. In the early 1990s, the information and knowledge economy concept began to be associated with an economic sphere immersed in globalization. The digital revolution, the liberalization, and the interaction of markets, information, and knowledge, are used as commodities.

EMERGING TECHNOLOGY

Emerging technologies are scientific or technological innovations that have the potential to transform an industry or create a new one significantly. They are divided into two groups.

1. Instrumental Technologies:



- **Mobility** (involves three factors):

- High sales of mobile devices,
- Broad connectivity across networks.
- Storage and availability of data in the cloud. In this way, mobility brings technology to everyday life and is fundamental to any digital transformation project.

- **CLOUD COMPUTING:**

- IT services that make it possible, among other things, to store and access information from anywhere if there is access to the Internet.
- This technology reduces costs and allows companies to use the most up-to-date applications to process data and information.

- **BIG DATA**

- Information is generated daily in telemetry systems, and the same name is used to refer to the analysis of this data.
- It helps improve efficiency, productivity, and business decision-making.

2. Transformative technologies:

- **IOE (INTERNET OF EVERYTHING)**

The Internet can connect people, things, processes, data, and practically everything with sensors and within a system that allows the management of the data and processes involved).

- Technology with high business prospects.
- Impacts on energy, transportation, smart cities, security, direct commerce to the public, and industries in general.

- **INDUSTRY 4.0**

Innovation can be developed with a customer-centric approach, starting from their needs to propose solutions for the design of a new product or service. They can be developed based on open innovation based on collaboration between customers, social networks, universities, suppliers, and the companies themselves, all functioning as a digital ecosystem that allows the generation of important innovations. Digital transformation happens when a company changes its products or services through the intelligent connection between them and people or the mix of physical products and virtual services. Digital transformation and innovation go hand in hand, leading to new business models framed in digital commerce.

THE DIGITAL ECONOMY

The digital economy includes all activities based on digital technologies or transformed towards them, which is why it has a cross-cutting nature in all productive sectors. Its main characteristics are the generation of new jobs, digitization of all industries, the digital connection between people and objects, the hybridization of physical products and virtual services, innovation, new production models, and digital business ecosystems.

ENTERPRISE AND THE DIGITAL ERA

Executives and managers aim to adjust the organization according to the company, to improve productivity, competitiveness, and innovation. It is an example of the new organizational design options enabled by the digital era, for example, flexible and global, horizontal and flat, knowledge-based organizations, others with greater employee autonomy, virtual, business ecosystems, and internal, stable, or dynamic network organizations.

WORK IN THE DIGITAL ERA

Work patterns and ways of working have changed in recent years. Working from home and virtual work teams are now prominent, perhaps driven by the COVID-19 pandemic. Hiring is also changing, focusing on the professional development of the worker. Finally, work itself is changing, as workers are no longer full-time and can bill different employers, becoming commoditized collaborators.



Core competencies for the digital era

Based on their characteristics and application, they are grouped into four sets:

Global digital enterprise management

It involves globally understanding the digital economy, connecting people and things through emerging technologies in mobility environments, managing physical-virtual value chains and global logistics, designing new digital business models, and managing the financing of digital enterprises.

Technology and digital innovation

It includes designing the technological architecture of the cloud business, developing the digital transformation of traditional enterprises and open innovation ecosystems, managing digital projects, and managing digital risk and business continuity.

Digital markets and customers

Involves targeting products and services to global markets and customers, managing e-commerce and distribution logistics, leveraging customer experience, driving digital marketing, and developing Big Data to support relevant decision making.

Work management of the future in digital ecosystems

Integrating the technologies mentioned above allows data to be analyzed to integrate work and technology effectively. In addition, it increases productivity and reduces inventories and internal logistics costs. The fourth industrial revolution requires the manufacturing sector and companies in the CAN countries to adopt new business models to meet current and future challenges. They must change how they develop, design, distribute and market their products.

Industry 4.0 and the digital economy allow measuring the potential of the manufacturing sector of the CAN to carry out a fourth industrial revolution that will allow intelligent factories. It is the opportunity for the necessary transformation of the production model of the CAN countries. A new organization and location of production close to demand and consumption are necessary, taking into account the elements implied by digital commerce in the industry 4.0 environment:

- Understanding the digital economy in an environment dominated by Industry 4.0.
- Connecting the company with its environment through Information and Communication Technologies (ICT).
- Manage information as a digital economic resource and manage technological innovation to improve business strategies and achieve productivity and profitability.
- Develop new business strategies.
- Develop higher frequency products, sales strategies, and customer services.
- Manage virtual business ecosystems-clusters for productivity and innovation.
- Managing automated teams and digital talent.

Decisions based on the implementation of Industry 4.0 and digital commerce could increase revenues for the manufacturing sector in the CAN countries. In addition, the set of technologies involved could help companies generate value and competitive advantage, that is, to have relative profitability superior to rivals in the sector and sustainable over time [15].

Methodology

The management situation of the companies selected for the study was evaluated, regarding the implementation of Industry 4.0 and digital commerce, to propose a series of variables and management improvement strategies for digital commerce. Therefore, the research is of a mixed type. It was oriented toward a field and documentary design because, in the development of this research, apart from direct observation, data were collected directly from where the facts occur through subjects surveyed in their daily environment and then analyzed and interpreted the results

of these activities. The documentary review was taken from books, records of company documents, theses, and scientific publications and, in this way, established the theoretical-practical foundations that served as a frame of reference and support for this research work.

The object of study constitutes a finite population, very small because most manufacturing companies have not implemented Industry 4.0 or the digital economy. Therefore, for the characteristics of this study, an integrated group was delimited according to the following criteria and in line with the strategy proposed in the research:

1. Core personnel involved in maintenance: supervisors and executors of automated activities.
2. Executive management personnel, middle management, and coordinators of logistical support and resource areas.

The application of the survey made it possible to determine information and data that contributed to evaluating the current context of the companies of the CAN countries selected for the study. Interviews were conducted with coordinators, supervisors, executors of maintenance activities, logistical support, resources, and management personnel, focusing on their views of the current maintenance management, delving into strengths and weaknesses, and including external factors that affect the digital economy and that are beyond the direct control of supervisors.

Procedure

A diagnosis was made of the situation regarding the potential of manufacturing companies in the CAN countries to adapt and implement management strategies for digital trade:

- Review documentation related to the operation of automated equipment and computer systems.
- Visualization of the programs and automated activities that are currently being executed.
- Conducting staff interviews.

A model is proposed taking into account the following aspects:

- All companies at the managerial and operational level are linked in knowledge and moving towards industry 4.0 and digital commerce.
- The working managers are aware of the aspects related to Industry 4.0.
- The company's infrastructure is adequate to cope with Industry 4.0 and digital commerce.
- The company has automated equipment and machinery, management, use of software, process automation, and computerized human resources.
- Promotion and marketing of its products through a website, email, or other digital media.

Surveys, interviews, and, in some cases, visits were made to the companies surveyed in the CAN countries. The companies were selected considering that they were on the way to implementing Industry 4.0.

III. RESULTS

Suppose digital manufacturing companies are to be developed in the CAN. In this case, it is necessary to plan the interrelation of their innovation systems and for managers to identify with the digital economy. It will lead to fantastic opportunities for professionals with scientific-technical-operational specialization, infrastructure, productivity, and personnel specialized in industry 4.0 and the digital economy.

Below, Table 1 shows the management strategies for digital commerce, which are raised in this work in the framework of industry 4.0 (adapted from [18]):

Table 1. Strategies for digital economy management.

Strategies			
Change and adaptation to automated processes and digital commerce.	Digitalization, automation, machinery and equipment and administrative processes.	To establish the management model for digital commerce, considering the aspects inherent to the activity.	Take into account all the spaces and activities of the company.

Strategies for transforming a company towards the digital economy are a continuous process, conditioned by a business framework dominated by the emerging change required by new technologies. The use of digital technologies enables the company to identify new ways to create strategies, in line with the idea that digital transformation is a process of continuous change.

When entering the digital world, once the company's vision in this new context has been defined, the next step is to put it into practice. First, it is necessary to define the path to follow to change the business model. Table 2 shows a possible roadmap that can serve as a basis for defining the management model for the digital economy (adapted from [18]).

Table2. Parameters for developing the vision of the management model in the digital economy in CAN countries.

Management planning	Targets, market
Market selection and potential customers	Local, national and international customers and how to engage and interact with each of them
Business model	Establish new business models adapted to the digital economy
Machinery, equipment, software	Updating of machinery, equipment, and software. Estimated time to update equipment and software

The following are the results of the surveys-interviews and, in some cases, the surveyed company was visited in the CAN countries. The companies were selected taking into account that they were on track and present significant progress in the implementation of Industry 4.0, considering aspects such as:

- Clear objectives and goals regarding ICT equipment, automated machinery, and software.
- Guarantee the availability of equipment or systems.
- Establish an order of priorities for the execution of actions.
- Systematized and digitalized inventories.
- Promotion and marketing of products.
- Training of human talent.

The results of the surveys and interviews conducted with manufacturing companies in the CAN countries are shown below. Table 3 shows the number of companies per country selected for the study and the number of workers per company. The research did not differentiate between small, medium, and extensive industries.

Table 3. The number of workers per manufacturing company in the CAN countries selected for the study.

CAN countries	Quantity of companies	Employees per company
Colombia	6	E1 =23, E2 =71, E3 =42 E4 =28, E5=32, E6=27
Peru	4	E1 =18, E2 = 31, E3 = 21, E4=31
Bolivia	2	E1 = 14, E2 = 23
Ecuador	5	E1 =41, E2= 42, E3= 31 E4



		=22, E5=27
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Ei: Employees per company for the study in each country of the Andean Community.

Table 4. The average based on the manufacturing companies of each CAN country selected for the study. Percentage with the implementation of Industry 4.0 and digital commerce is shown.

CAN Countries	Average percentage % (of companies in each CAN country).
Colombia	74
Peru	62
Bolivia	49
Ecuador	69

Table 5. The average percentage of manufacturing companies in the CAN countries with adequate infrastructure for using ICTs.

CAN Countries	Average percentage % (of companies in each CAN country).
Colombia	71
Peru	56
Bolivia	51
Ecuador	67

Table 6. The average percentage based on companies in each CAN country with automated equipment and processes, including human resources activities, management, use of software, and inventory control through software.

CAN Countries	Total % (of companies per country).
Colombia	71
Peru	64
Bolivia	54
Ecuador	69

Table 7. The average percentage of companies in each CAN country promoting their products through web pages, e-mail, and social networks.

CAN Countries	Average percentage % (of companies in each CAN country).
Colombia	84
Perú	71
Bolivia	63
Ecuador	79

Table 8. The average based on the companies of each CAN country. It shows the percentage of activities of acquisition of machinery, equipment, and software through online management. Also, it promotes the sale and marketing of its products, payment methods, account information, and catalogs through online management.

CAN Countries	Total % (of companies per country).
Colombia	87
Peru	70
Bolivia	61
Ecuador	81

These activities made it possible to put into practice the model with the variables to be considered for the management of digital trade to measure the management of the digital economy of manufacturing companies in the era of Industry 4.0. It also made it possible to detect weaknesses and strengths in these aspects in the CAN countries. Also, they included the corresponding improvements to raise the percentages of adaptation and adequacy in management and industry 4.0. It was also possible to detect weaknesses at the managerial and operational levels to address the management of companies for digital trade.

Integrating systems, machinery, and digital processes are one of the biggest challenges for the manufacturing sector of CAN countries to achieve innovation in the digital economy. Many companies are tied to IT systems that are the backbone of organizations responsible for supply chain management, human resources/payroll, and customer experience.

Figure 1 describes the variables and processes to consider for managing the digital economy in an environment dominated by Industry 4.0. It is fundamental to the division: automation of machinery and equipment, internal management, automation of critical activities, and management of digital commerce. The proposal, which includes the challenges of managing the digital economy in the era of industry 4.0, is established for the countries that make up the CAN but can be extended to other countries [20].

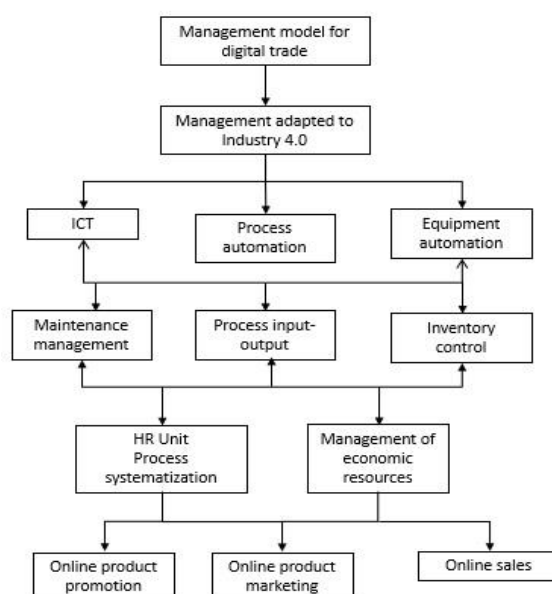


Figure 1. Variables to consider for managing digital commerce in an environment dominated by Industry 4.0: automation of machinery and equipment, internal management, automation of critical activities, and management for digital commerce.

Figure 1 describes the variables to be considered for managing digital commerce in an environment dominated by Industry 4.0, differentiating four areas:

- Automation of machinery and equipment: use of ICT, automation of machinery and equipment, data collection.

- Internal management: Systematization and automation of maintenance activities, automated input-output control, and inventory control.
- Automation of critical activities: Systematization of all human resources activities, administration, payments, and systematized income.
- Management for digital commerce: Online product promotion (web, social networks), online purchases, and sales.

Managers and executives of companies wishing to implement the technological changes required for Industry 4.0 and the digital economy must be aware of the advantages (and possible disadvantages) involved in the digital business world. The factors influencing the shift to the digital economy are primarily technologies related to the value chain upstream of marketing, production, logistics, business models, and the organization of companies and the way they work [16][17].

IV. DISCUSSION

In recent years, the manufacturing company has had to perfect and optimize its capacity to adapt to change, decision-making, business models, and leadership to ensure its survival and profitability. In addition, the company must solve a series of challenges to maintain and improve its competitiveness in the different markets: digital transformation, internationalization, information and communication technologies, social responsibility, and development objectives.

From an optimal level of 100%, tables 4 to 8 show the average percentage percentages by country of activities adapted to Industry 4.0 and digital commerce.

Table 4 shows the average percentage based on the companies in each CAN country with infrastructure, implementation, and knowledge of Industry 4.0 and digital commerce. Again, it can be seen that Colombia and Ecuador have the highest percentages [19].

Table 5 shows the percentage of adequate infrastructure for ICT use.

Table 6 shows the percentage of automated equipment and processes, including human resources activities, management, use of software, and inventory control through software.

Table 7 shows the promotion percentage of their products through websites, email, and social networks.

Table 8 shows the average percentage of machinery, equipment, and software acquisition and promotes the sale and marketing of their products, payment methods, account information, and catalogs through online management.

The digital economy is a globalization issue that is of great importance today, for different productive sectors, in different areas of the companies. This work marks a roadmap, considering the exposed variables, to mark the guideline of what should be the challenges of manufacturing companies in terms of digital commerce. On the other hand, the CAN countries are in a nascent phase of adopting Industry 4.0 and digital trade, with significant progress in Colombia, Ecuador, Bolivia, and Peru.

Digital commerce and Industry 4.0 in the CAN countries are just beginning. We could speak rigorously of its development when the changes impact the production models of all sectors of these countries and affect most companies. When the aggregate variables significantly change the composition of GDP, the level of employment, the international economy, or the country's standard of living, it can be said that the industrial market of these countries has already entered Industry 4.0.

One of the challenges for the manufacturing industry in the CAN countries to become more competitive is digital innovation. It adds value to companies' processes, products, and services, allowing them to be within reach of global consumer trends. Therefore, the investment must continue to be made in Industry 4.0 and management strategies for digital commerce, which



together is a digital transformation that makes it possible to evolve and introduce intelligent and efficient operating models.

Entrepreneurs in the CAN countries' manufacturing sector should focus on obtaining resources to invest in innovation to achieve digitalization equally. Thus, companies must renew their business models to adapt to new market needs and consumer expectations. In addition, manufacturing companies must maintain their stability and focus on gaining efficiency strategically [21][23].

Companies that have embarked on the path of digital transformation have also seen improvements in their productivity; work activities have been optimized to engage employees in activities that generate new revenues. Moreover, the transformation of the digital economy has created new business opportunities, expanding the boundaries of the sector and diversifying activities and revenues [22][24].

Conclusions

A study was conducted on Industry 4.0 and digital commerce in manufacturing companies in the CAN member countries. The companies selected for the study are contextualized and oriented on the concept of Industry 4.0. Most have even implemented digital transformation technologies for their infrastructure, procedures, and digital commerce. Additionally, they are willing to invest in knowledge through training for existing staff to ensure effectiveness in implementing the digital environment.

Colombia and Ecuador show significant progress compared to Peru and Bolivia. However, some indicators allow us to glimpse that they will march with common objectives and interests to advance towards implementing Industry 4.0 and the digital economy. It would be interesting to study the impact this could have on the manufacturing sector's contribution to each CAN country's GDP.

This work is a preamble to research that should be expanded due to the continuous changes to which the digital economy is subject in the industry 4.0 environment, and the trend is that more and more companies are joining these new paradigms.

Most companies recognize the importance of implementing the digital environment. However, the barriers to implementation (in companies that have not entered the digital world) and to progress (in companies that are in the digital world) in terms of Industry 4.0 and digital commerce in the CAN countries are economical, organizational, and coordination between the innovation systems of the countries that make up the CAN.

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