

Industry 4.0 Labor and Social Security

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INDUSTRY 4.0
LABOR AND SOCIAL SECURITY

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PRESENTATION

With permission of the reader, I will allow myself a literary licence. If an Uberland existed in the 21st Century, it would be surely similar to that city imagined by Charles Dickens in *Hard Times for These Times*: Coketown. A city which had been ruined so often; it was amazing how it had borne so many shocks. Surely, there was never porcelain as fragile as that of which the millers of Coketown were made out of. Handle them never so lightly, and they fall to pieces with such ease that you might suspect them of having been flawed before; and one even had to wonder if it had already been cracked. They were ruined, when they were required to send laboring children to school; they were ruined when inspectors were appointed; they were ruined, when such inspectors considered doubtful whether their right to chop people up with their machinery was justified; they were utterly undone, when it was hinted that perhaps they need not always to produce quite so much smoke”.

As in Uberland, whenever a Coketowner felt he was ill-used—that is to say, whenever he was not left entirely alone, and it was proposed to hold him accountable for the consequences of any of his acts—he was sure to come out with the awful menace, that he would “sooner pitch all his property into the Atlantic”.

In the 21st Century, it seems that companies are as fragile as Coketown’s factories. In the Uberland of fragile companies, for them to function properly, so that they are not ruined and that the so-called “sharing economy” receives a boost, they no longer need workers, but “partners”, “collaborators” or “independent entrepreneurs”. They require that workers labor a number of hours, which are not only variable but also indeterminate. It is required that Saturdays and Sundays are not considered as special workdays because, otherwise, companies are ruined. It is also required that night labor does not have a special schedule or a special salary, otherwise they are ruined; moreover, they point out that their “collaborators” voluntarily decide to work on Sundays, at nights, and that they do not mind having a differentiated wage.

Uberland companies are offended if it is suggested that their collaborators, after years of working, would also have to be entitled to vacations, or to survival income, that is, to a pension.

In short, they get offended when their employees are called workers and they are more aggravated when they are told that their “employees” need healthy working conditions. In 19th Century Coketown and in 21st Century Uberland, job insecurity is similar. In both cities the worker has to propose a substitute in case of illness or he has to simply stop working without receiving any pay for the days he didn’t work; also having to cover the medical expenses incurred on his own, and knowing that being dismissed is a real possibility due to the absence from work. Of course, in Uberland, “collaborators” are not fired because they are not workers, say businessmen, to reassure anyone who happens to worry.

The same as in Coketown, in Uberland, entrepreneurs feel aggravated when they are told they should not allow labor to slice –now physical or psychologically– their “collaborators” and they become even more disconcerted when, as in Coketown, someone speaks about the right of workers to have a union at their service.

So far the literary dispensation. The truth is that, in the middle of the Industrial Revolution, labor relations were regulated by civil law, commercial law, or what was once called industrial law. In times of the full Fourth Industrial Revolution or Industry 4.0, we observe a movement where contracts are excluded from labor law, or, where appropriate, “new contractual relations” escape labor law and cannot be regulated by it.

There is no doubt that the situation of Industry 4.0 workers and labor rights fit perfectly in *Hard Times for These Times*. However, it would be wrong to think about the disappearance of labor, though perhaps we may have to think about a transformation of the way we have known and regulated labor up to this point, but this does not mean an opportunity to have a new legal framework that regulates the new circumstances in which labor presents itself.

In this regard, regulation is necessary, but one with the same goals as the one born in the late 19th Century: to avoid exploitation at work and to respect everyone’s rights, regardless of their labor relationship’s nature. Without a doubt, the book *Industry 4.0, Labor and Social Security* will allow us to reflect on the situation of workers who are not properly framed in an employment contract or an employment relationship, but require a certain type of protection. As we point out in the part that we were appointed to write, the apparent difficulties faced by labor law are not insurmountable;

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they open the possibility to the development of labor law in a broad sense, which guarantees fundamental values, such as dignity and decency in work and of work.

Alfredo SÁNCHEZ-CASTAÑEDA
Ciudad Universitaria, Mexico City, November 2019

INTRODUCTION

Throughout history, technological advances have had their part in the process of human evolution. Areas like education, economics, health, research and work are closely linked to these technological changes, that have both positive and negative effects on people's lives.

These waves of technology have presented themselves in four major industrial revolutions that have shattered economic, social, cultural and labor paradigms in every country in the world.

The first one appeared in the 18th Century (1760–1840) with the invention of the steam engine and the construction of the railroad. The Second Industrial Revolution came in the late 19th and early 20th Centuries, defined by chain or mass production. The Third Industrial Revolution started in the 1960s; its importance lies in the invention of the computer and the Internet.

Today, we find ourselves before a fourth industrial revolution dubbed Industry 4.0, which is characterized by the complete automation of industrial production systems through augmented reality, process' digitalization, robotic technologies, and the Internet of Things –autonomous communication among devices through a network.

It is extremely complex to define Industry 4.0 since there are currently more than 300 definitions trying to explain the meaning of this phenomenon. Despite this, these concepts share certain elements that allow us to have a general idea of its meaning without seeking to establish a particular viewpoint. However, to have a minimal notion of its scope, Industry 4.0 refers to a new model of organization in production chains where the interaction among actors (suppliers and customers) directly influences the production processes using Information and Communication Technologies (ICT).

The Industry 4.0 phenomenon is coupled with the implementation of new information technologies that will have both positive and negative repercussions in all areas involving people. Therefore, the use of new ICT brings new factual situations that the law must regulate, specifically regarding the protection of labor rights. Industry 4.0 undertakes a digital transfor-

mation that involves mainly employers –companies– and necessarily workers. Consequently, this evolution in labor relationships that involves the use of new information technologies must be regulated by law from the perspective of labor and social security.

This Fourth Industrial Revolution has established two positions regarding the effects that may arise in the world of work and social security. The first position states that the use of completely automated processes with intelligent machines will lead to the displacement of the workforce by robots in industries, resulting in a massive loss of employment and precarious lives for workers and their dependants. Meanwhile, the second position holds that job posts that can be easily automated will indeed disappear in this digital age, but new sources of employment will be created at the same time, since they will be needed to develop and implement new technologies for production processes; emphasizing the fact that people’s re-education will be the key to obtaining these new jobs.

Regardless of any of these positions, it is true that the possible future reality of work will be reflected in the loss of jobs and sources of employment that, at the same time, will result in a decrease in social insurance coverage for people affected by the companies’ implementation of these technologies.

The standpoints for Industry 4.0 in each country are different not only because they have different economies and populations, but because of the lack of knowledge on how to deal with this global phenomenon.

For instance, in Romania there are important development opportunities within the context of Industry 4.0. To appreciate the true potential of Industry 4.0, Romania needs to plan its digital transformation. One of the most important things is, admittedly, the creation of an appropriate legal framework, such as the adoption of the Digital Single Market telework strategy and the promotion of artificial intelligence.

Meanwhile, companies in Spain are lagging behind the global industry in terms of digitalization. This country shows a lack of digital culture and adequate training; and also current Spanish labor and social security regulations do not have the necessary regulatory framework to accommodate the new forms of work and the emergence of artificial intelligence within Industry 4.0.

In Chile, the labor market is quite precarious. In fact, it has even been pointed out that it is a country with a flexi-precariousness model. While there are several economic areas where these new forms of work have appeared in Chile, the most conspicuous one is undoubtedly passenger transportation through applications like Uber and Cabify, as well as the legal loopholes generated by their use or by a lack of legislation on the matter.

In Brazil, the scope of the General Social Welfare System is a positive factor in the face of labor changes stemming from new technologies, since it includes all workers, whether urban or rural, in a labor relationship or self-employed. Therefore, changing the way work is performed will not be a factor for the absence of social protection, especially if legislation adopts measures to ensure that the worker is registered in the “new” job.

In France, although the term Industry 4.0 is not used, there is a growing concern to pursue the necessary labor reforms to ensure the pairing between technological transformations and digital workers’ social protection in the new era. So, the digital revolution is not considered as a threat posed by the loss of jobs or the obsolescence of labor institutions, but as a challenge and an opportunity to generate new, more creative jobs. To this effect, in recent years France has introduced reforms that allow digital platform workers to benefit from social coverage and certain fundamental rights. Not all digitized posts are covered by France’s new legal measures because some go beyond the national legal framework (micro-tasks on behalf of companies that are not established in French territory).

Italy is a country with a long-standing industrial tradition and its manufacturing companies have been the driving force behind the country’s growth and development, thus becoming one of the pillars of economic growth. However, Industry 4.0 has brought back the need to formulate new industrial policy plans that allow the country to successfully deal with challenges arising in this sphere. Thus, on September 21st, 2016, the Italian government presented the “*Piano Nazionale Industria 4.0*” which outlines various plans of action to address this phenomenon.

Mexico still lacks innovative public policies in terms of Industry 4.0 and an adequate legal framework to responsibly, pertinently and effectively address the disruption of artificial intelligent robotics that will inevitably affect decent employment by changing the basis of traditional labor relations, thus eliminating hundreds of thousands of jobs that will be taken over by robots. This compels the search for new collective forms of protection and strategies to answer the specialized public service of social security, which is essentially a human and social right to be demanded from the State so that the Mexican population can attain a dignified standard of living, with human beings always at the centre of the debate, above all technological tools.

In view of the above, the general objective of this endeavor is to examine the challenges workers and society in general face with the incorporation of Industry 4.0 in Mexico and the world from a multidisciplinary, labor and social security perspective. This will be done through a study of Com-

parative Law with the intention of formulating legal proposals that allow labor and social security protection for workers.

In this context, and due to the great importance of the topic, the “Multidisciplinary Social Security and Social Development” academic body, affiliated to the School of Law and Social Sciences of the Universidad Autónoma del Estado de Morelos (UAEM, Mexico), in collaboration with the Institute for Legal Research from the Universidad Nacional Autónoma de México (UNAM), took on the task of convening renowned researchers from various countries to join an international work team and participate in a collective production centered on Industry 4.0, labor and social security.

Each of the participants prepared a chapter for the book, using comparative law methodology, addressing case studies of the countries involved in the research project, based on the following categories of analysis:

- The reference framework for the implementation of Industry 4.0 in his or her country;
- National problems towards a 4.0 society;
- Legal labor and social security provisions that enable the protection of workers against Industry 4.0; and
- Proposals for legal reforms that provide a possible solution to national problems.

It should be noted that each chapter includes a proposal regarding the implementation of Industry 4.0 in the analysed country.

In order to discuss the preliminary documents that later evolved into the chapters that appear in this publication, a workshop for co-authors to present the topics contained in this work was held on September 12th and 13th, 2018, at the facilities of the *Universidad Autónoma del Estado de Morelos*, in Mexico.

This exercise consisted in making joint observations on papers written, in order to transform them from independent chapters of a collective work into a joint research project.

The selection and review of the final papers was carried out through blind peer reviews by UNAM’s Institute for Legal Research, with the valuable support of Alfredo Sánchez Castañeda Ph.D who directed the corresponding reviews.

In view of the above and following an in-depth adaptation process of the submitted papers, this collective work consists of eleven chapters of ex-

cellent quality written by national and international specialists, divided into three parts:

I. General Section

II. International case studies

III. Mexico and its problems regarding Industry 4.0

The “General section” consists of two chapters and focuses on providing a broad context for defining Industry 4.0, its effects on labor law and the consequences that will affect people’s lives, as well as the skills required for future jobs.

In the first chapter, “Social security and industry 4.0”, I had the opportunity to collaborate by discussing the advantages and disadvantages of Industry 4.0 in the world of work and social security. In it, I analyse the problems that might exist in social security systems and the need to establish a new form of insurance to counter the effects of the Fourth Industrial Revolution.

The second chapter, written by Dr Alfredo Sánchez-Castañeda, is titled “The Fourth Industrial Revolution (Industry 4.0), the less work there is, the newer the posts and a cyclic necessity: the protection of wage-earning and non-wage-earning workers”. It analyses the possible creation and/or disappearance of jobs because of new technologies and robotics, focusing on new non-standardized forms of employment, as well as the need for restructuring labor law and the role the State will assume in light of these new transformations caused by technological advances in the sphere of labor.

The second part of the book, “International case studies”, aims to conduct a comparative law study among different countries in the current context of the Fourth Industrial Revolution’s technological developments and their impact on the world of work and social security. This allows us to contrast similarities and differences in such legal systems in question, in order to improve the Mexican system. To this end, five countries are analysed, each with its own chapter: Brazil, Chile, France, Mexico and Romania.

The first chapter of this second part belongs to Drs Ángel Guillermo Ruiz Moreno, Ángel Edoardo Ruiz Buenrostro and Stephanie Calvillo Barragán from the meritorious *Universidad de Guadalajara* with their paper, titled “Mexico and Industry 4.0”. It analyses the problems in Mexico in regard to the Fourth Industrial Revolution. The authors discuss the consequences that hyper-technology will have on national public policies since a shift is foreseen in educational, cultural, social and economic spheres. Among other things, this shift will transform the production of goods and services and, therefore, the current social security system.

The chapter titled “Romania and Industry 4.0”, presented by Dr Dan Top of Valahia University of Targoviste (UVT, Romania), addresses the opportunities and challenges Romania faces in this new technological era, highlighting the importance of the positive effects of digitalization on workers, both at work and in their everyday lives. The author states that Romania needs to plan its digital transformation, but for this to happen, it is necessary to adapt its regulatory framework, naming as an example, that it did not adopt a law on telework, because it was not passed by the Romanian parliament.

The third chapter, “Chile and Industry 4.0”, was prepared by Dr Pablo Andrés Arellano Ortiz of the *Pontificia Universidad Católica de Valparaíso* (PUCV, Chile). In it, he critically analyses the regulatory challenges that the Chilean State faces with the new labor market within the Fourth Industrial Revolution, especially in the areas of labor and social security. The author points out that Chile is a country that is not exempt from these new atypical forms of work, which means that adapting the regulations that protect workers’ rights is essential to balance the positive and negative effects of Industry 4.0.

Dr Zélia Luiza Pierdoná from the *Universidade Presbiteriana Mackenzie* (UPM, Brazil), through her chapter titled “Brazil and industry 4.0: impacts on public pensions”, analyses the Brazilian social protection system in view of the challenges posed by the arrival of Industry 4.0. At the same time, the implementation of the Fourth Industrial Revolution in Brazil is relatively slow when compared to other countries with similar characteristics. Even then, challenges can already be seen in the labor market and consequently in the social protection of workers who can be replaced by new technologies, as well as in the reduction of social benefits for the same reasons.

To conclude the second part of this collective book, in “France and the 4.0 industrial revolution”, Dr Bárbara Palli of the *Université de Lorraine* (UL, France) develops a reference framework for the implementation of Industry 4.0 in the country and the problems created by this technological transition, not only in France, but also throughout Europe. As well, she analyses the current legal provisions regarding the protection of workers’ rights in the light of digitalization. The author concludes with possible reform proposals concerning the new forms of work in this digital era and her subsequent reasoning.

The third part of this collective work is called “Mexico and the problems related to Industry 4.0” and it consists of four chapters in which the central subjects are the current and future problems that the Mexican government, companies and workers will face in the areas of education, labor

and trade unions with the incorporation of new technologies from the previously mentioned Fourth Industrial Revolution.

In this context, the first chapter is titled “Industry 4.0 and trade unions”, written by Dr Carlos Reynoso Castillo from the Universidad Autónoma Metropolitana (UAM, Mexico). Here, he elaborates a detailed analysis on the consequences of the new organization of labor, which stems from Industry 4.0’s technological advances and in turn has direct repercussions on the trade unions that represent workers’ rights in Mexico.

Dr María Ascensión Morales Ramírez from the *Universidad Nacional Autónoma de México* (UNAM) wrote the second chapter, named “Young people and their integration into Industry 4.0”. This chapter deals with general aspects the Mexican State needs to prioritize in terms of the connection between school and work, so that young people are not left out of the labor market as a result of new job mutations in Industry 4.0.

Dr Julio Ismael Camacho Solís of the *Universidad Autónoma de Chiapas* (UNACH, Mexico) contributes with the third chapter of this section, called “Social inclusion in digital work”. He states the problems entailed in the implementation of new technologies in the world of work and the consequences that this might have on workers’ rights if there is no harmonization between labor and social security legislation in light of the Fourth Industrial Revolution and the effects emanating from it.

To conclude this section and the work itself, Dr Ana Esther Escalante Ferrer of the UAEM participates with her paper, entitled “The challenge of higher education in the light of Industry 4.0”. In it, she provides an accurate analysis of the changes public higher education faces with the emergence of technological advances of Industry 4.0 and the need to reconsider a shift in education for Mexico, in order to re-train human capital, making it possible for them to perform new and future tasks.

On a personal note and on behalf of my colleagues, I would like to thank all the authors of this collective work since its publication would not have been possible without the effort, dedication and professionalism of each one of them.

Last, but not least, I would like to thank the UNAM’s Institute for Legal Research for opening its doors to us and being the publishing house that gave life to this collective work.

GABRIELA MENDIZÁBAL BERMÚDEZ
General Coordinator
Cuernavaca, Morelos, September 2019

FIRST PART

GENERAL SECTION

SOCIAL SECURITY AND INDUSTRY 4.0

Gabriela MENDIZÁBAL BERMÚDEZ

SUMMARY: I. *Introduction*. II. *Conceptual Framework*. III. *Advantages and disadvantages of Industry 4.0 in social security*. IV. *Analysis of Industry 4.0 in social security systems*. V. *Is social insurance possible in light of Industry 4.0?* VI. *Conclusions and proposals*. VII. *Research sources*.

I. INTRODUCTION

Throughout history, different forms of production of goods and services have marked economic development, a large proportion of the relations between people, and relations between employers and workers. With the emergence of social insurance as the main work-related social security mechanism, it is possible to say that social security has also been influenced by production and economic processes.

It is therefore appropriate to analyse social security in the light of a new worldwide form of production: Industry 4.0. In other words, this new model of organization features the indispensable use of information technologies (digitalization), the control of the value chain during the product's whole life cycle, and the substitution of manpower in the process, to a large extent.

This chapter addresses several aspects of the analysis of social security in light of Industry 4.0. Afterwards, a second section follows, with a deductive research method and presents a conceptual framework that helps understand how the traditional figures of insurance, labor, worker, and so on, require different profiles when linked to Industry 4.0's needs. Only then can we speak of a 4.0 worker, 4.0 work and, naturally, 4.0 social security.

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A third section analyses the advantages and disadvantages that Industry 4.0 can convey to workers, employers and social security institutes. Section IV is devoted to the specific analysis of Industry 4.0 in social security systems from the perspective of the main social insurance systems in the Western world: the pay-as-you-go system and the individual capitalization system. An analysis on the changes and needs in each of the branches of social security is included before going on to the final topic: the theoretical discussion on whether social insurance is possible in Industry 4.0 and if so, what aspects it should include.

Lastly, the chapter closes with a few brief reflections reaching for a conclusion and the relative research sources.

II. CONCEPTUAL FRAMEWORK

To speak of Industry 4.0 –also known as the Fourth Industrial Revolution– means to immerse oneself in a phenomenon of a global nature, which affects many areas of life; and of course social security is not an exception. In this order of ideas, this conceptual framework will make it possible to define the main concepts which will serve as a guide for the analysis of this chapter's main topic. These terms include Industry 4.0, social security, 4.0 employment, 4.0 worker, among others, to stimulate the debate about the current development of these concepts and to establish a position in the course of this work.

1. *Industry 4.0*

From primitive to modern man, forms of work have mutated because of the technological advances that have taken place at given times in history. These major changes, also known today as Industrial Revolutions, tend to translate into abrupt and radical changes that have an impact on movements in a country's economic systems and social structures.¹

Throughout history, different authors coincide (Arnoldo Martínez Ramírez, Klaus Schwab and Giovanni Stumpo, among others) that four industrial revolutions can be identified because they have broken paradigms

¹ Cfr. Schwab, Klaus, *The Fourth Industrial Revolution*, Debate, 2017, p. 1.

within different aspects of people's lives around the world; also, undoubtedly, in the field of labor and social security.

- The First Industrial Revolution emerged in the 18th Century (1760–1840) with the invention of the steam engine and the construction of the railroad;
- The Second Industrial Revolution appeared in the late 19th and early 20th Centuries and was marked by chain or mass production;
- The Third Industrial Revolution began in the 1960s with the invention of the computer and the Internet;²
- Today we are facing the Fourth Industrial Revolution, also known as Industry 4.0, marked by the digitalization of the industrial world through manufacturing processes and the interconnection of the Internet of Things.³

The term Industry 4.0 appeared in 2011, officially established by the German government to refer to *a new model of organization and control of the value chain through the life cycle of a product and throughout manufacturing systems, supported and made possible by information technologies*.⁴

Simply put, digital technologies enable the interaction of physical elements (raw materials, machinery) with the digital world for a more effective and efficient production.⁵

Digital technologies are typically the famous *clouds* (data cloud), Big Data, cyber-physical systems, sensory and robotic technologies, additive or layered manufacturing 3D printers, robots, telework, remote payments, collaboration on shared documents, mobile communication, augmented reality, geolocation, apps⁶ and many more being developed day by day.

² Cfr. Departamento de Geografía e Historia, *Las revoluciones industriales*, Spain, <http://perseo.sabuco.com/historia/revolucionesindustriales.pdf>.

³ Fernández, Miguel Ángel, Pajares Roberto, *La digitalización del mundo industrial*, Spain, p. 41.

⁴ Conferencia de Directores y Decanos de Ingeniería Informática, *Industria 4.0: la transformación digital de la industria*, Spain, p. 3, <http://coddii.org/wpcontent/uploads/2016/10/Informe-CODDII-Industria-4.0.pdf>.

⁵ Blanco, Raúl, *et. al.*, *La industria 4.0: El estado de la cuestión*, Spain, p. 151.

⁶ Kahale Carrillo, D.T., *La formación (española e italiana) en la Industria 4.0*, Universidad a Distancia de Madrid, Spain, 2016, p. 45.

The Fourth Industrial Revolution consists, therefore, in the application of new technologies in production processes in such a way that their operation is automated, intelligent and efficient.

In this context, Industry 4.0 can be construed as man–machine interaction in a different way, stemming from the fact that communication goes from being solely between humans to being established between humans and machines or –more characteristically for this revolution– only between machines, without the intervention of the human hand.⁷

It should be noted that it is extremely complicated to have only one specific definition that applies to Industry 4.0. It is sufficient to say that in 2015, Carolina Castresna pointed out that there were more than 134 definitions to explain this global phenomenon.⁸

What is clear is that each of these concepts have certain similar components, worth analysing:

A. *New organization model*

This is a new model that breaks traditional work patterns between people or man–machine interaction. Now, this pattern stands out mostly because of its machine–machine relationship.

B. *Automated Systems*

To have an automated system, two very important aspects are involved: digitalization and the Internet of Things.

a) Digitalization is a process that began with the transformation of analogue information to digital information, which has many advantages. For instance, files are more compact and can be detected and measured by sensors, including, say, sound recordings, video recordings, documents, images, environmental data such as temperatures and wind speeds or magnetic fields, and so on. Therefore, information can be used, processed, reproduced, stored and distributed through data processing systems for a long

⁷ Mendizábal Bermúdez, Gabriela, *et. al.*, “¿Nuevo modelo de seguridad social en el contexto de la industria 4.0?” *Revista Internacional y Comparada de Relaciones Laborales y Derecho del Empleo*, Italy, Vol. 6, Year 2018, No. 1, January–March 2018, pp. 298-327.

⁸ Castresna Saenz, Carolina, *et. al.*, *Industria 4.0*, Universidad de la Rioja, Spain, 2016, p. 12, https://biblioteca.unirioja.es/tfe_e/TFE002004.pdf.

time and without any loss of quality. Nowadays, digitalization also generates *the process by which a message is converted into a series of electrical impulses responding to combined digits*⁹ in order to transmit a specific instruction and/or action to a receiver (a robot, machine, computer);

b) The Internet of Things, also known as connected smart devices, consists of *the integration of sensors and devices in everyday objects that are connected to the Internet through fixed and wireless networks*,¹⁰ producing autonomous communication (without the intervention of man) among said objects to achieve a specific objective. This means that the interaction is based on machines (objects) and almost completely eliminates human intervention. In this way, an autonomous system is created in production chains. Therefore, digitalization through intelligent production processes with Internet interconnection between objects can increase productivity and efficiency.

C. *Information and Communication Technologies (ICTs)*

ICTs are an essential part of the development of automatic systems in the Fourth Industrial Revolution. These are understood as *the technologies*¹¹ *needed to manage and transform information*;¹² that is to say, the medium through which a given action is intended to be carried out, notably computers, programs, and so on, that allows information to be created, modified and stored.¹³

D. *Efficient production*

The main objective of this industrial revolution is the production of goods or services in a shorter time and at a lower cost, but with higher quality, thus benefiting both companies and customers in such a way that

⁹ Multimedia, *Digitalización*: <http://www2.udel.cl/~lsalazarv/digitalizacion.html>.

¹⁰ Fundación de la innovación Bankinter, *El internet de las cosas en un mundo conectado de objetos inteligentes*, Accenture, 2011, p. 6.

¹¹ According to the RAE [Royal Spanish Academy], technology is the set of industrial instruments and processes of a given sector or product. <http://dle.rae.es/?id=Zj2KRZZ>.

¹² Sánchez Duarte, Esmeralda, “Las tecnologías de información y comunicación (TIC) desde una perspectiva social” *Revista Electrónica Educare*, Costa Rica, vol. XII, 2008, Special Issue, pp. 155-162.

¹³ *Cfr. Idem.*

efficient production is paramount in Industry 4.0. Unfortunately, with this efficient production, the worker can be a part of the losers in the process.

E. *Direct customer interaction*

One feature of this revolution is the client's direct intervention in the production process of the good and/or service (on-demand economy). From the comfort of their home and using information technologies, users can order a product, characteristics and features they want with a single click. This makes it possible not only to consider individual customers' wishes, but also to develop completely new industrial products and business models.

In this sense, we can say that Industry 4.0 is a new organizational model that relies on automated systems – made possible by information and communication technologies – to allow the efficient production of goods and/or services, including the customer's direct interaction amidst what is produced and what is done to produce it.

2. *Social Security*

Tomandl states that social security is every area of law that deals with covering the risks of illness, maternity, unemployment, age, disability, occupational accidents, family burden and death of the family's provider, within the framework of insurance, prevision or prevention, as well as the various processes that are instituted by the State or at least supported and controlled by said State.¹⁴

There is an endless number of definitions because there is no definition that adapts to the needs and the development this figure has in each country. It is a dynamic concept that is transformed by economic crises, social changes, the new needs of the population to be met and the tools developed to do so.

Notwithstanding the above, we can point out that social security today is a human right embodied in the benefits that the State must guarantee, in an orderly fashion, to all individuals in society with the aim of protecting them from social risks and meeting their basic needs.

¹⁴ Author's translation of: Tomandl, Theodor, *Grundriss des österreichischen Sozialrechts*, Austriaverlag, Wien, Austria, 1992, p. 4.

In other words, along with the social dimension of social security – which is enshrined in the protection of a society’s economically weak class – we can find the protectionist principle of solidarity to assist all the individuals in every population, in the event of any social risk. Therefore, in Mexico the main instrument to achieve this are social insurances, although the scope of some complementary measures that provide social assistance and public or private charity should not be undermined.

A. *Social Insurance*

In Mexico, social insurance is the instrument through which workers and the State combine their efforts to protect the rights of the working class against the rights of the employers and entrepreneurs, with the goal of enabling a better quality of life.

Social insurance is an instrument of social security; it is the organized and systematized knowledge of this legal field that allows it to define its precise application.¹⁵

For Gustavo Arce, social security is:

the instrument of workers’ rights, by which a public institution is obliged, through quotas or premiums paid by employers, workers and the State; or by only one of them, to provide the policyholder or his beneficiaries, who must be economically weak members, with a pension or subsidy when any professional risk or social accident occurs.¹⁶

B. *Social Assistance*

Mexican context requires that we understand social assistance as an important social security tool, since 60 per cent of the economically ac-

¹⁵ It is imperative that social insurance be seen as an instrument of social security and not erroneously confused with the IMSS (Mexican Social Security Institute). The results of surveys conducted in 1994 for the undergraduate thesis “Internationalization of Mexican Social Security” yielded surprising data: 60 percent of the people surveyed associate the concept of social security with social insurance and therefore with the Mexican Social Security Institute. *Cf.*: MENDIZÁBAL BERMÚDEZ, Gabriela, *Internacionalización de la Seguridad Social Mexicana*, Undergraduate thesis, School of Law, UNAM, 1994, p. 167

¹⁶ Arce Cano, Gustavo, *De los Seguros Sociales a la Seguridad Social*, Ed. Porrúa, Mexico, 1972, p. 15.

tive population works in the informal sector¹⁷ and therefore does not enjoy the benefits of social insurance. For them, social assistance programs established term to term by federal and state governments are important, and in many cases are only a mitigating factor to problems originated from the lack of insurance. Examples of this are *Seguro Popular de Salud* (People's healthcare insurance) and *Pensión para adultos mayores* (Pension program for the elderly), which are poor substitutes for health and old-age insurance. Even then, they should not be downplayed because *Seguro Popular de Salud* is the only form of healthcare available to many Mexicans and, for other Mexicans the pension program is the only economic income available in their old age. According to the Mexican Legal Encyclopaedia, social assistance consists:

of the instruments at the State's disposal to remedy or protect those who suffer from a certain degree of social precariousness or who are economically weak because they do not have any type of social protection or who receive insufficient benefits to meet their needs.¹⁸

In other words, social assistance is the legally organized aid provided by the State for the economically weaker classes or vulnerable sectors within a society.¹⁹

3. 4.0 Social Security

We contribute to the discussion on this last topic, social security 4.0, an initial – albeit still incomplete – reflection: 4.0 Social Security is the set of social programs (PPS), social insurances (labor law benefits) and mandatory public and private services, integrated in a network along with various mechanisms of legal enforceability, that positivizes and materializes the human right to social security in a society ruled by Industry 4.0.

This concept's construction responds to the objective of attaining social security in the face of Industry 4.0, more than to what it is today. To reach this concept, it is necessary to consider other factors that change in the pro-

¹⁷ Murayama Rendón, Ciro and Gómez Tovar, Rosa, *El mercado de trabajo en México. La opinión social sobre la precariedad laboral, encuesta nacional de economía y empleo*, UNAM, Mexico, 2015, p. 132

¹⁸ Cited by Mendizábal Bermúdez, Gabriela, *La seguridad social en México*, 3^a. Ed. Porrúa, Mexico, 2018, p. 95.

¹⁹ *Idem*.

cess of Industry 4.0, such as workers, labor, and so on; factors that are analysed within the following lines.

A. 4.0 *Work*

The Fourth Industrial Revolution and the important technological developments that have a direct impact on the world of work caused a transformation in the ways of working and normal work patterns are no longer being followed. As a result, the traditional concept of work is mutating to adapt to the current facts and realities seen in today's work environments.

In two books published by the Ministry of Labor and Social Affairs: the Green Paper (2015) and the White Paper (2017) on "4.0 work", the German government states that the term should be understood as:

changes taking place in the whole of the working world and their implications for society. 4.0 Work does not describe today's normality, but future perspectives, scenarios and opportunities to shape labor in a way which benefits people and advances our economy.²⁰

In view of the above, "4.0 Work" aims to break with the traditional patterns in the world of work by promoting labor led and accompanied by the use of new technologies, providing opportunities for flexible work through the use of digital networks and the cooperation between people and machines, which not only transforms the way goods are produced, but, in turn, creates new products and services to benefit people.²¹

Certainly, the term "4.0 Work" is closely related to the current Fourth Industrial Revolution, where the forms of work and employment are at the centre of everything, not only in the industrial sector, but in all aspects of the world of work.²²

²⁰ Mendizábal Bermúdez, Gabriela, *et. al.*, *op cit.* p. 305.

²¹ *Cfr.* Bundesministerium für Arbeit und soziales, Weiss buch Arbeiten 4.0, Bundesministerium für Arbeit und Soziales Abteilung Grundsatzfragen des Sozialstaats, der Arbeitswelt und der sozialen Marktwirtschaft, Berlin, 2017, p. 3

²² Author's translation of Bundesministerium für Arbeit und soziales, Weiss buch Arbeiten 4.0, Berlin, 2107, p. 198.

B. 4.0 Worker

The technological advances of Industry 4.0 undoubtedly have a direct impact on the fundamental subjects of the world of work, i.e., workers.

As stated above, these technological revolutions not only modify production processes, but they also include all the actors in the workplace.

In this context, the evolution of a worker into a 4.0 worker responds to the new needs of the world of work as a result of the technological wave it entails. The truth is that the evolution of labor has always been affected by the invention of new technologies, which has led workers to adapt to the changes brought by these developments.

The great paradigm that has shaken the Fourth Industrial Revolution has been the short transition time between this revolution and the previous one, as well as the digital technologies that are being implemented every day. These technologies cannot be compared to the ones from past industrial revolutions, where, although man was most certainly substituted in carrying out certain work activities, the human hand was indispensable to perform work, unlike what is seen today.

Thus, the 4.0 worker, the worker of the future, will most absolutely be one who has the skills needed to perform the new jobs or transformations that arise from Industry 4.0.

The 4.0 Worker will be versatile and capable of having a variety of skills, not just in a specific field, but he or she will be able to master and adapt to the needs the world of work calls for, or else the worker will become obsolete because of this century's technological developments.

The fact is that 4.0 Worker must have digital literacy²³ that allows him or her to be competent, flexible and indispensable to the work challenges he or she might face in this technological revolution.

To think otherwise or to refuse to do so would mean that traditional workers would be left out of the labor market, preventing them from acquiring the necessary means that would allow them to enjoy a dignified quality of life and, naturally, preventing their access to social security.

²³ Digital literacy is the knowledge and skills to deal with new technical devices and hence formed the necessary information and communication networks, https://www.bmas.de/SharedDocs/Downloads/DE/PDF-Publikationen/a883-weissbuch.pdf?__blob=publicationFile, p. 199.

III. ADVANTAGES AND DISADVANTAGES OF INDUSTRY 4.0 IN SOCIAL SECURITY

Any process of change brings advantages and disadvantages, as well as challenges to face. Labor and social security aspects of the process of Industry 4.0's change have the following benefits and shortcomings:

- The advantages of Industry 4.0 for social security include the following:
- A reduction of occupational risks: the use of intelligent safety models integrated into machines (automobiles, robots, etc.) reduces the risk of human error so that accident prevention is greater.
- Flexibilization of work: the use of technologies can assist the easing of work by reducing the time spent on performing an activity, and thus being able to allocate the remaining time to leisure, professional or personal training activities, which directly benefit workers' physical and mental health, as well as encouraging a balance of work, social and family life.
- Higher productivity gains: the use of technologies can lead to an unlimited number of economic possibilities.²⁴

At the same time, the disadvantages of Industry 4.0 are present in the following aspects:

- Rising unemployment: in producing a given good or providing a given service, new technologies like robots, sensors or computers will be used, running the risk of eliminating some or several jobs performed by human beings; therefore its direct impact on social security would be through the use of unemployment insurance.
- Wage reduction: reducing working hours will also reduce workers' wages and thus affect social security contributions, reducing pension amounts in turn.
- Transition from labor contracts to professional services contracts: going from labor contracts for an indefinite period to project contracts means that possibilities to access an old-age pension are lost under the current regulations as they imply shorter contribution times.

²⁴ Packaging, *Ventajas de la Industria 4.0*, 2017, <http://www.packaging.enfasis.com/notas/77824-lasventajas-la-industria-40-el-sector-alimentos-y-bebidas>.

- Greater burden on social assistance or aid: with a high unemployment rate, people will lose their main source of income and therefore will not be able to cover their basic needs, thus obliging the State to intervene through social assistance programs and not by strengthening social insurance.
- Increased psycho-social risks: Considering increased levels of work-related stress, the advancement and development of new technologies play an important role, since the pressure exerted by the environment to be up-to-date and master new technologies sets a rhythm and tension that may be difficult to overcome by oneself.²⁵
- New diseases: these are related to the direct collaboration of people with machines or robots, facilitating a person's isolation and restricting the person to act as a simple operator.

However, the main challenges are linked to the fact that *the future of work will be made up of jobs that still do not yet exist in industries that use new technologies*.²⁶ Therefore, provisions need to be made for training and capacity building for new jobs, as well as for new occupational risks or illnesses arising from said positions, which will need to be addressed. In addition, the challenge lies in finding a balance between technological development and the respect for workers' rights, as well as implementing the protection needed for work in the digital era.

The freedom and flexibility that workers gain with 4.0 Work should not be countered by the constant need of training or by the increased workload related to the loss of personnel or the displacement of human work by robots.

IV. ANALYSIS OF INDUSTRY 4.0 IN SOCIAL SECURITY SYSTEMS

1. *Pay-as-you-go system vs. individual capitalization system*

Given the technological advances in the world of work and the consequences of people being replaced by machines in production chains, the following questions should be considered: How will the right to social security

²⁵ Prado Sagera, A., *Nuevas tecnologías y nuevos riesgos laborales: estrés y tecnoestrés*, <http://rabida.uhu.es/dspace/bitstream/handle/10272/3414/b15756531.pdf?sequence=1>.

²⁶ Díaz, Viviana., *Revolución Industrial 4.0, inflexión para la fuerza laboral*, 2017, <http://www.prensariotila.com/19524-Revolucion-Industrial-40-inflexion-para-la-fuerzalaboral.note.aspx>.

be guaranteed to those who are displaced from their jobs by machines? How will protection be granted in the event of a work-related risk for 4.0 Workers? Or better yet, which insurance system will guarantee the benefit of a pension in old age?

At this point, concerns arise when it comes to determine how social security financing systems can be adapted to the demands and needs that Industry 4.0 implies for workers through the new transformations of labor.

Therefore, it is necessary to analyse the two main and polarized financing systems: pay-as-you-go and individual capitalization:

a) The “pay-as-you-go” system: Also known as the public system, is financed on a tripartite basis (worker, employer, State) and is marked by the established benefits at the time of earning the right to a pension. In other words, the amount of the pension *is not necessarily related to what was contributed during active life, but to a different designation that can be calculated in a number of different ways.*²⁷ In the case of a pay-as-you-go scheme, the contributions made by active workers will be used, for instance, to pay the pensions of older adults, while these active workers’ pensions will be financed by future generations, giving rise to the so-called intergenerational solidarity.²⁸

Considering the fact that one of the consequences of people being displaced by machines is the disappearance of jobs, then there will be no active workers to take up the intergenerational chain, which is in turn preventing the implementation of this type of pay-as-you-go system in the context of Industry 4.0.

Even then, the general tendency of the public pension system revolves around the Universal Basic Income²⁹ as *the right of each citizen to regularly receive an amount to cover their material needs, without any limitations.*³⁰ In other words, for the mere fact of existing, the State must provide the necessary (economic) means to guarantee the social welfare of the people.

This trend is somewhat utopian, especially for developing countries like most of those in Latin America. Social security systems in these countries

²⁷ Solange Berstein J., *Sistemas de capitalización individual (AFP) y de reparto (antiguo)*, Chile, 2013, https://www.spensiones.cl/portal/institucional/594/articulos-10300_recurso_1.pdf.

²⁸ Cfr. Hernández Cervantes, Aleida, *La seguridad social en crisis*, Porrúa, Mexico, 2008, p. 73.

²⁹ The distinction must be made between Universal Basic Income and Vital Minimum. The first consists of granting an amount of money to everyone, all people for simply being born in a certain country. Meanwhile, the vital minimum is the last rung of social protection to protect only the neediest.

³⁰ Iglesias Fernández, José, *La renta básica contra la renta básica*, Spain, p. 2.

are not fully consolidated and this does not allow them to bear the financial burden of complying with this proposal, since the economic systems of these States are not designed to provide unconditional economic benefits to their entire populations.

b) Individual capitalization system: This system is basically the *accumulation of workers' contributions in individual accounts*.³¹ This system means that:

Each affiliate contributes a fixed percentage of his or her income, to form a capital, which when invested in the account, combined with the financial returns generated, determines the value of the individual pension at the moment of retirement.³²

At first glance, this one seems to be the most *ad hoc* pension system that meets the requirements of the Fourth Industrial Revolution. But in order to do so, workers must adapt to the new forms of employment in this digital age.

Continuous training to acquire new skills and abilities will be essential for people who do not want to become obsolete in the new world of work; otherwise, workers would be left on standby and no longer desirable for employers because of the lack of qualifications to work with the new technologies applied to improve the production processes.

This individual capitalization system *places the individual and his or her decisions at the heart of the solution to the problem on how to finance retirement income*³³ and prepare for the future in old age.

2. *Analysis of the effects on insurance branches*

This section presents some of the effects that Industry 4.0 will have on each of the insurance branches that traditionally constitute social insurance and have been the cornerstones of social security since its creation in 1883.

³¹ Mendizábal Bermúdez, Gabriela (coord.), *El trabajo y las pensiones de los académicos en las universidades en el siglo XXI*, Fontamara, Mexico, 2012, p. 21.

³² *Idem*.

³³ Cox, Alejandro, *Las tendencias del mercado laboral y su interdependencia con los Sistemas de Pensiones de Capitalización Individual*, Federación Internacional de Administradoras de Fondos de Pensiones, 2012, Chile, p. 33.

A. Occupational risks

Technological changes in the world of work undoubtedly have an impact on occupational risks that can occur as a result of doing a work-related activity.

It is worth mentioning that the eventualities covered by this branch of insurance are divided into two types: occupational accidents and occupational diseases.

1. Occupational accidents. Although it is true that one of the advantages of Industry 4.0 is a reduction in occupational accidents in the workplace because the interaction between collaborative machines and humans is safer than those interactions among people only. This is due to the fact that the sensory programming from robots should be able to detect collisions that could cause an accident and put the worker at risk, as well as to control their speed, power and range of motion on their own.³⁴

At the same time, it should be noted that, despite the great technological progress a machine might have, there is always the possibility of a flaw in the machine's programming or perhaps a computer attack on interconnected robots' systems,³⁵ endangering the physical safety of the workers who are in the same area.

Therefore, industries' computer security systems must be on guard to avoid work-related accidents caused by new intelligent machines.

2. Occupational diseases. Unlike occupational accidents, work-related diseases in Industry 4.0 can have a significant impact on worker's lives.

From a psychosocial point of view, the uncertainty of the future job scenario can directly affect workers, causing psychosocial risks derived from work's social context.

Specific risk factors include:

- a) The lack of human interaction: interaction among people will be limited since co-workers will be robots and workdays will be shared

³⁴ Cf. Full Audit, *Prevención 4.0 ¿Cuáles serán los riesgos laborales de la cuarta revolución industrial?*, Spain, 2017, <http://www.fullaudit.es/prevencion-4-0-cuales-seran-los-riesgos-laborales-de-la-cuarta-revolucion-industrial/>.

³⁵ Cf. European Parliament, *Draft report with recommendations to the Commission on Civil Law Rules on Robotics*, European Union, 2016, p. 4.

with machines instead of people, an impending change in this Industry 4.0.³⁶

- b) Job instability: there is a doubt on whether at some point a worker's job will be filled by a robot that would be more profitable for the industry.
- c) Stress: this might happen when the work demands are greater than the workers' capacity, hindering his or her performance at work,³⁷ in view of this new industrial revolution that requires very specialized skills to hold such jobs.

Shorter workdays: since automated processes require fewer people to perform tasks, shorter work days will be forthcoming in certain jobs in which people can be easily replaced by machines.

The combination of these factors is reflected in the rise in psychosocial risks in this Industry 4.0, which leads to a greater increase in occupational diseases; these risks generate dangerous working conditions, which can result in work-related accidents.

The need to regulate psychosocial risks in labor and social security law is necessary to address future problems in the lives of workers by anticipating that the development of technologies can be detrimental to people's health in the workplace.

B. *Diseases and maternity*

The evolution of technology brings health challenges. Aspects such as food and its new forms of processing, environmental pollution, new lifestyles, more sedentary habits and stress are factors that influence the emergence of new diseases and an increase of existing ones, such as:

- a) Cardiovascular diseases. These are the set of heart and blood vessel disorders. They are classified into hypertension (high blood pressure), coronary heart disease (myocardial infarction), cerebrovascular disease (stroke), peripheral vascular disease, heart failure, rheumatic heart disease, congenital heart disease and cardiomyopathies.³⁸

³⁶ *Cf. Idem.*

³⁷ *Cf. European Agency for Safety & Health at Work.*

³⁸ World Health Organization, *Enfermedades cardiovasculares*, <http://www.who.int/mediacentre/factsheets/fs317/es/>.

- b) Cancer. It can occur anywhere in the body. *Normally, human cells grow and divide to form new cells as the body requires them. When normal cells age or become damaged, they die and are replaced by new cells.*³⁹ It should be noted that cancer is the second leading cause of death in Latin America.⁴⁰
- c) Eating disorders. These can range from an obsession with healthy eating, not eating or eating only specific foods. The most common disorders are: bigorexia, anorexia, polydipsia, pica (an irresistible desire to eat or lick unusual or non-nutritive substances like soil, chalk, etc.), bulimia and obesity. They have reached epidemic dimensions worldwide. Although it was previously considered a problem confined to high-income countries, obesity is now prevalent in low- and medium-income countries as well. According to data provided by UNICEF, Mexico ranks first in the world in childhood obesity and second in obese adults just behind the United States.⁴¹
- d) Pollution diseases. The most common are respiratory diseases (pneumonia, bronchitis, etc.) and viral diseases (dengue, hepatitis), which tend to increase because of the effects that new production processes in industries might produce.
- e) Mental disorders. These are the ones reflected in mental health: disorders that affect mood, thinking and behaviour. Examples of mental disorders are depression, anxiety disorders, schizophrenia, eating disorders and addictive behaviours.⁴²

Updating social insurance catalogues of diseases and ailments is essential to provide coverage to those who may require the necessary care to treat these possible diseases at any given time, with the understanding that curbing technological evolution is impossible. Even so, we can be prepared to deal with the implications of this transformation.

As for maternity, this fourth technological revolution's technologies could play a positive role in this branch of insurance since said technologies

³⁹ Instituto Nacional del Cáncer, ¿Qué es el cáncer?, NIH, Spain, <https://www.cancer.gov/espanol/cancer/naturaleza/que-es>, Date of consultation: July 24th, 2018.

⁴⁰ Pan American Health Organization, Programa de cáncer, United States of America, 2016, https://www.paho.org/hq/index.php?option=com_content&view=article&id=292%3Acancer-programa&catid=1872%3Acancer&Itemid=3904&lang=es, Date of consultation: July 24th, 2018.

⁴¹ UNICEF, *Salud y nutrición*, Mexico, <https://www.unicef.org/mexico/spanish/17047.html> Date of consultation: July 24th, 2018.

⁴² Salud es, *Trastornos Mentales*, Spain, <http://www.salud.es/trastornosmentales>, Date of consultation: July 25th, 2018.

would be applied in surgical procedures, pre- and post-natal care during the entire period of maternity, thus reducing the risks that may arise during this stage of a woman's life, as well as a better recovery and quality of life for the mother and the newborn.

The issue of job stability is still on the table in view of the fact that Industry 4.0 shows a tendency for replacing men with machines. If this tendency continues, it will result in the lack of the necessary social security contributions and, consequently, the right to receive not only the prerogatives of the maternity branch, but also all those provided by social insurance will cease to exist.

C. *Disability and life*

Some of the positive effects of Industry 4.0 in this branch of insurance are the developments and innovations in health, which have allowed workers with a disease or non-occupational accident to receive a quick recovery and rehabilitation from diseases and ailments suffered. As a result, workers can return to their positions sooner and with a lower chance of suffering from the consequences of the illness or accident.

Some advances are:

- Telesurgery; which are surgical procedures performed remotely by a surgeon who is kilometres away from the patient,⁴³ providing timely attention in emergencies, performed by specialists who are not physically available when their services are required.
- Telemedicine; with the use of communication technologies, medical assistance can be provided at a distance without having to go to a specific place,⁴⁴ saving the patient from the physical and psychological strain associated with going to doctors' offices and thus averting further suffering.
- Digital medical files; storing patients' medical files through Big Data and clouds is a reality. This information can now be shared with other health care specialists to obtain a more accurate diagnosis and establish the corresponding treatment that benefits the patient.

⁴³ Telemedicina, *Telecirugía*, Colombia, 2014, <https://telemedicina3.webnode.com.co/telecirugia/>.

⁴⁴ TopManagement, *Industria 4.0 en el sector salud*, Mexico, 2018, <http://topmanagement.com.mx/industria-4-0-sector-salud/>.

Meanwhile, with the pharmaceutical development that this Fourth Industrial Revolution may bring, a person's life expectancy might be considerably prolonged. Furthermore, the quality of life he or she will enjoy will probably be even greater than today, by preventing an early death.

D. *Old-age severance, old age and retirement*

One central issue that has engulfed in this Fourth Industrial Revolution is old-age insurance and retirement of people who finish their productive stage of life, in terms of what will happen to workers' pensions with the changes brought by Industry 4.0.

The invention and implementation of new technologies in the world of work are observed in the automation of production processes in industry that involve the substitution of human labor by robots.⁴⁵

Both the proliferation of machines and an aging population mean that social security systems⁴⁶ tend to be unsustainable for any State, thus directly affecting unemployment, old-age and retirement insurance.

Regardless of the type of pension system a person may have (individual or pay-as-you-go), displacing people from their jobs will have repercussions directly on old-age severance, and on old age and retirement insurance.

Without a source of employment, it is assumed that people will no longer contribute to the social security system. Therefore, they will no longer be entitled to receive the benefits that stem from said branch of insurance, the most important being economic income in the form of a pension.

In order to deal with this issue, several proposals have been put forward, including the following:

- a) Employers should make social security contributions for the workers who were replaced by a machine. In other words, the machine will be subject to contribute on behalf of the worker, allowing the worker to have access to the benefits derived from social security and hence the branch of old-age severance, old-age and retirement.

⁴⁵ El economista, *La máquina sustituirá al hombre: los empleos mas amenazados en España por la automatización*, Spain, 2018, <http://www.economista.es/economia/noticias/8128422/02/17/Donde-la-maquina-sustituira-al-hombre-los-empleos-mas-amenazados-en-Espana-por-la-automatizacion.html>.

⁴⁶ El independiente, *Pensiones sin futuro en la era de los robots*, Spain, 2018, <https://www.elindependiente.com/economia/2018/01/20/pensiones-sin-futuro-en-la-era-de-los-robots/>.

- b) Another proposal that has been voiced is that of granting a minimum subsistence income; that is, to give the necessary economic resources to people who do not have the means needed to satisfy their basic needs like health, education, housing, income, recreation and so on. This would allow them to fully develop and enjoy a dignified quality of life.

The pioneers of these proposals come from Europe, through the European Parliament's Legal Affairs Committee, in a draft report with recommendations to the Commission on Civil Law Rules on Robotics, which suggests that:

consideration should be given to the possible need to introduce corporate reporting requirements on the extent and proportion of the contribution of robotics and AI to the economic results of a company for the purpose of taxation and social security contributions;⁴⁷

It has also been shown that, as a result of the effects that robotics can have in the displacement of people in the workplace, Member States should consider the adoption of a general basic income⁴⁸ to avoid leaving thousands of workers in helplessness because of this Fourth Industrial Revolution.

Both proposals are too complex to implement in the real world, especially in countries in the American continent where social security systems are not usually a State priority and when combined with other factors like informal employment, they affect a smaller insured population compared to those in the European regions.

The truth is that the creation of a *specific legal statute for robots, so that at least those that are autonomous and more sophisticated acquire the status of electronic persons with rights and obligations*⁴⁹ is necessary in order for them to be subject to social security contributions.

⁴⁷ European Parliament, *op. cit.*, p. 10.

⁴⁸ *Idem.*

⁴⁹ Saiz, Sergio, ¿Deben cotizar los robots como si fueran trabajadores?, Spain, 2016, <http://www.expansion.com/juridico/actualidad-tendencias/2016/12/26/585d681aca4741ec378b45e4.html>.

V. IS SOCIAL INSURANCE POSSIBLE IN LIGHT OF INDUSTRY 4.0?

In the generation of workers retiring now and that of their parents, it was possible for workers to remain employed throughout their working lives in only one or very few workplaces, be they private companies or public establishments. This offered job stability and made it possible to generate rights to obtain social security benefits while working and later receive such benefits in old age, for workers and their families.

When the term “flexicurity” was coined in the last decade of the 20th Century and with the increase in life expectancy, the aforementioned situation became a rare exception. People’s professional lives have changed and are marked by frequent interruptions or changes in work with very little job stability and, even worse, with the increasing preference of using private contracts over labor contracting.

In this sense, and because there is yet again an asymmetry on this issue in countries like Germany, Sweden, Italy and so on, developing countries should anticipate the plurality of lifestyles and the new reality of work through legal reforms and changes in public policies, using innovative ideas to increase social security coverage in the face of the imminent changes brought by Industry 4.0.

Hence, we find that the main challenges for social security in Industry 4.0 are:

- Increasing coverage without making it exclusively a feature of formal employment;
- Extending protection against new health and safety risks at the workplace and health care;
- Developing new mechanisms to grant unemployment subsidies, job training subsidies and old-age pensions;
- Expanding regulations to provide mandatory coverage based on the carried out activity and not only through what is established in labor law.
- Ensuring the protection of workers’ data;
- Extending international social security law conventions, as migration is a growing factor in Industry 4.0;
- Rethinking national and international standards from the perspective of glocalization and not only globalization.
- Reforming private law legislation if new forms of On-Demand

Economy are governed by private law, so that these provisions also include protection guarantees, if necessary, through private pension, life and health insurances. If there is a law that governs insurance regardless of whether it is public or private, we would face new forms of social insurance through privatization.

- Establishing the required infrastructure for citizens to have access to the Internet and the networks that are indispensable in a digitized society. Social media on the Internet, comparison and evaluation portals, search engines to find data and information, sharing platforms for services and products, app stores, online marketplaces and media platforms increasingly impact our daily digital lives, as well as our work lives.
- Providing training and capacity-building to all members of society so that they can become 4.0 Workers, 4.0 Consumers and, in general, 4.0 Citizens.

There are not many proposals on how to contribute to the insurance of workers and their families facing Industry 4.0. The truth is that, regardless of whether the worker is a wage-earner, subordinate, independent; or an entrepreneur of a micro, small, medium or large enterprise, the world is changing for everyone. One consistent feature of such change is that, as the access to employer benefits decreases, more workers will need new ways of accessing benefits traditionally provided by employers and/or the State. We will start seeing that, as more workers find that work (or available work) is not enough to sustain a stable standard of living, the social security network must address these workers' needs.

Some of the proposals analysed by governments like Germany or drawn up by academics are the following:

- The simplest one that has been under discussion for over a decade is that of the “delaborization” of social security, separating social security protection from formal labor activities to simply recognize it as a human right and financing it through general taxes. It is easily said, yet so complicated that not a single country has managed to make the transition from an individual capitalization system to a delaborized social security.
- Other researchers offer future solutions like taxing the displacement of workers by robots, a universal public ownership of the shares of

new companies that produce goods by means of automated work.⁵⁰

- One proposal currently under discussion is that of the vital minimum or minimum income. It consists of guaranteeing each member of society a basic income, also known as a minimum income that allows them to live above the poverty line or within the welfare line (depending on the country being analysed). This would make it possible to reduce inequality and poverty, in addition to dismantling conditional economic transfers established through assistance programs that alleviate poverty and have certain negative effects like clientelism or political manipulation.

These proposals contain a neoliberal side that goes even further, suggesting – from a budgetary point of view – a low-level safety net at the expense of completely eliminating the existing social security systems, including the suspension of employer contributions that sometimes also reduces other social expenses. In other words, this proposal seeks to replace public pensions and other social insurances, as well as other public programs, with a UBI [Universal Basic Income] model, coupled with private insurance.⁵¹

VI. CONCLUSIONS AND PROPOSAL

To conclude, it can be stated that the direction Latin American governments need to take in their public policies should aim to:

- Achieve social insurance by transforming social security. To do so, it is necessary to uphold its basic principles in the new forms of insurance: solidarity, universality, the integration of benefits, mandatory nature, legal enforceability and internationalization.
- Legally coordinate the protection of each person in society by expanding the possible means for doing so, establishing a network made up of social programs (SOCPRO) social security (labor law benefits) and compulsory private services, a network where each

⁵⁰ Valenzuela, José Luis, *Cuarta revolución industrial: Llega el futuro*, Filosofía Política, 2016, p. 5, <https://arielenlinea.files.wordpress.com/2016/11/cuarta-revolucion3b3n-industrial.pdf>.

⁵¹ Cfr. Author's translation of Ortiz, Isabel, et. al., *Universal Basic Income proposals in light of ILO standards: Key issues and global costing*, Social Protection Department International Labour OFFICE, GENEVA, 2018, pp.26-29, <http://www.social-protection.org/gimi/gess/RessourcePDF?action?ressource.ressourceId=55171>.

person, whether privately or publicly, has insurance coverage for health and maternity, occupational (and non-occupational) risks, old-age and dependency, and a minimum income.

- Coordinate the digitalization process in public or private companies, as well as public services at State level, so that both workers and employers can profit from these changes for the benefit of the community without it being yet another factor of job insecurity.

Regarding Mexico, one possible proposal to address the negative consequences of Industry 4.0 in terms of social security would be the creation of a new social security system that would allow all people to be protected through social insurance. While it is true that describing a new social security model would be too extensive to include in this work, it is possible to mention its primary characteristics as follows:

- a) Delaborization of social security. The first important element of this new system would be the separation of social security from labor. In speaking of delaborization, we mean that the indispensable requirement of having formal employment in order to have access to social security should not exist, but that social security should be considered a human right and not a right derived from work, thus allowing all people to have access to social security.
- b) Obligation. Another feature that needs to be stated is the obligation of being insured by law and that this obligation must be shared. First, all people should be insured with at least a basic coverage that protects health, maternity, work-related (or occupational) risks, old age and dependency. Meanwhile, the State's obligation is to ensure that the people have the minimum insurance established by law, and if they do not, to insure them automatically through public insurance, by financing it from taxes or other mechanisms.
- c) Public and private insurances. Insurances may be public or private, thus giving the person the possibility of choosing themselves an insurance, based on their possibilities and needs. It is important to stress that both insurances, regardless of their nature (public or private) will have the obligation to offer at least the basic coverage required by law, that is, the mandatory insurances mentioned above.
- d) Social assistance. As the social security system's last safety net, this assistance shall be exclusively for those who do not have the resources needed to access social security benefits by themselves. This assis-

tance would aim to provide them with the necessary tools to access them.

By fulfilling these conditions, it is possible to head towards Social Security 4.0, made up of a set of social programs (SOCPRO), social insurance (labor law benefits) and mandatory private services that, incorporated into a network and diverse legal enforceability mechanisms, positivize and materialize the human right to social security in a society governed by Industry 4.0.

Therefore, the general conclusion is that the structure of labor changes, therefore the social security model must also change.

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THE FOURTH INDUSTRIAL REVOLUTION (INDUSTRY 4.0) THE LESS THE WORK, THE NEWER THE POSTS AND A CYCLIC NECESSITY: THE PROTECTION OF WAGE- EARNING AND NON-WAGE-EARNING WORKERS

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SUMMARY: I. *Introduction.* II. *Industry 4.0's transcendence.* III. *The disappearance, diminution or transformation of employment?* IV. *New forms or types of non-standard work.* V. *Subordination, independent labor and semi-independent labor: the courts' role.* VI. *Towards a labor status for wage-earning and non-wage-earning workers.* VII. *The State's active role.* VIII. *Research sources.*

I. INTRODUCTION

There are four great vectors that have started to influence the future of labor: 1) demographic vectors; 2) climate change; 3) globalization; and 4) technological advances. Each one of them is intimately related to the other. Regarding technological advances, the development of Industry 4.0 represents many challenges for different sectors within the world of work, and a necessary update of workers' skills;¹ among others. Some of these challenges are professional formation, the organization of work; the limits between employment and self-employment² labor inspection; a new corporate organization; the role of small and medium enterprises; automation and digitalization; the

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¹ OIT, *El diálogo social y el futuro del trabajo. Informe de la Conferencia OIT-AICESIS*, Athens, Greece, 23–24 November 2017, pp. 3-4.

² IT, *La iniciativa del centenario relativa al futuro del trabajo, Memoria del Director General, International Labour Conference*, 104th Meeting, Geneva, 2015.

creation, destruction and transformation of work, the weakening of the labor relations; legal clarity in collaborative economy or platform economy.

We can observe many aspects to be studied in Industry 4.0, because of this, through the present study, within the scope of the Fourth Industrial Revolution (II) we intend to show some aspects relative to the possible creation, or disappearance of work caused by the use of technologies and robotics (III), to point out the new forms of non-standard work (IV), commenting on doubts generated in courts (V), exposing the need to reconfigure labor law, so that it does not start from a univocal vision of the labor contract, making it necessary to reflect on the rights of wage earners and non-wage-earning workers (VI) and the role the State has to play in the matter (VII).

II. INDUSTRY 4.0'S TRANSCENDENCE

The weight of technology can be understood in two senses. In one sense, it extinguishes or blurs the labor relation, mainly in collaborative platforms, leaving the application of labor law in the background. On the other side, the use of technology and robotics has the diminution of labor as its consequence, which happens because of the substitution of workers with machines. In such a way, we face a society with less subordinate employment and less employment of labor.

Labor law, in contrast with other legal disciplines, suffers, in the strict sense of the word, from permanent transformations that have generated a constant identity crisis, especially in the last decades. In labor matters, the stages of prohibition, tolerance, regulation, flexibility and flexicurity³ have not been but the manifestation of labor law's adaptations made as a response to the great transformations known as the "four industrial revolutions".

The Industrial Revolution, in the middle of the 18th Century, is known by the key role the steam machine played in production, which allowed the birth of employers and a mass of workers who did not have any special norms to regulate their contractual relations at their service. The employers intended to keep or use the existing legal frame; and the workers started

³ Sánchez-Castañeda, Alfredo, "La nueva legislación laboral mexicana: ¿Flexibilidad del legislador y seguridad del juzgador?" en SEGOB, *Reforma laboral, derecho del trabajo y justicia social en México*, SEGOB, 2013, pp. 61-84.

a battle through a series of factual institutions, such as the union and the strike, that with time's passing would become law institutions.

Afterwards, a second Industrial Revolution would arrive, boosted by the use of electricity, chain and mass production. Workshops, occupations and handcrafted labor, would be seen as a precedent of the methods of pre-capitalist production.⁴ The advances made in technological matters on information would allow access to a third Industrial Revolution, also called the Scientific-Technological Revolution or the Intelligence Revolution. This implies the fusion of technologies of communication, the use of the Internet and renewable technologies.⁵

Currently, national economies are accessing the Fourth Industrial Revolution or Industry 4.0. In this setting, new technologies, 3D printers, Internet of Things (IoT), cloud services, Big Data, artificial intelligence, and social media change the way work is performed. This will have the creation of new employment positions or the disappearance of the existing ones as a consequence.

IoT allows products of daily use at home or at the workplace to become intelligent, a situation which, because of not requiring the control of human intelligence for its functioning, consequently causes the possibility of foregoing the human being and, through this, generating consequences at the employment levels. For example, *Siri* is a phone application that works as a personal assistant.⁶ We can also mention *Net Labs*, a multi-services enterprise which produces security systems enabled with Wi-Fi, which are self-learning and programmable for homes or buildings.⁷

As for Big Data, it implies analysing large amounts of data to anticipate mistakes, behaviours, time and cost reduction, and timely covering of demands – paradoxically produced from the anticipation of behaviours or a predisposition of the human being to a determined product and stemming from the analysis of personal and/or collective information. On the same line, on the cloud, we can digitally store a great amount of information that can be processed through Big Data analysis.

Before, computers gave answers (not necessarily smart answers), and they executed detailed and repetitive instructions; but they did not have

⁴ Marx, Karl y Hobsbawm, Eric J., *Formaciones económicas precapitalistas*, Mexico, Siglo XXI, 2004, p. 119.

⁵ Fifkin, Jeremy, *La tercera revolución industrial*, España, Barcelona, Paidós, 2011.

⁶ Apple, “Siri hace más cosas que nunca. Incluso antes de que se lo pidas”, <https://www.apple.com/mx/ios/siri/>.

⁷ Nest Official Site, Create a Connected House, <https://nest.com/es/>.

the capacity to comprehend concepts. Now, we have reached a moment in which computers generate artificial intelligence.

Artificial Intelligence (AI) will change the world of work (transportation, health, science, finances and the army). After a survey made to scientists, they considered that AI will surpass humans in many activities in the following years, such as: translation (in 2024), junior high essays (2026), writing a sales book (2049) and working as a medical surgeon (2053). The aforementioned survey points out that there are 50 per cent chances of AI exceeding humans in every activity in 45 years, and to automate every human job in 120 years. Less time, according to Asian researchers.⁸

On the part of social media, it represents a new way, not only of communication and information, but they are spaces which allow the sale and purchase of merchandises, and also the emergence of new activities and employment, i.e., youtubers or influencers.

The Fourth Industrial Revolution, through start-ups in collaborative economy or on-demand economy, allows the existence of new forms of transportation services (Uber, Cabify) or accommodation (AirBnB). The use of social media facilitates selling merchandise or services (Facebook). Technology has also allowed to displace direct sales in an establishment by online sales (Amazon).

There are new forms of employment that use new technologies, avoiding any type of social or legal responsibilities, through the lack of existence of a labor contract, social benefits (health insurance, work illnesses, retirement plans), and even without, apparently, an employer. Uber is one of the major transportation companies, without owning any vehicles. The same can be said about Airbnb, one of the biggest accommodation companies without owning a single real property. They also question the State's regulation and tax power by blurring country borders.⁹

Without a doubt, the Fourth Industrial Revolution has affected the costs of production, production times (24/7) and the way production is undertaking:

Through the Internet of Things, production is made more efficient. IoT allows connection and conversation through a network (the Internet) of diverse physical devices that execute tasks that were previously performed by human

⁸ Grace, Katja, *et al.*, "When will AI exceed human performance? Evidence from AI experts", *arXiv.org > cs > arXiv:1705.08807*, 3 May 2018, <https://arxiv.org/pdf/1705.08807.pdf>

⁹ Degryse, Christophe, *Impacts sociaux de la digitalisation de l'économie*, Working paper 2016.02, Institut syndical européen, Bruxelles, 2016, p. 36.

beings, and in that sense, aid them and allow optimizing times. There are many demonstrations of IoT: houses, buildings or even smart cities. It can be applied in the industry, commerce or in health.¹⁰

With 3D printers, it is possible to produce, with one only instrument, a product that used to require the use of many machines and human participation. Similarly, 3D printers have allowed us to transit from mass production to mass personalization. That way, for example, the new Adidas factory in Germany, has a 3D printer that quickly produces soles of shoes that can adapt to a determined person's feet.¹¹

Robotics, in the same way, increasingly allows us to substitute or displace human beings from the factory. In the present, there are factories that practically do not require the presence of labor, be it in the food industry¹² or the one of smartphone components, which has allowed production to triple.¹³

In fact, the robotization of production has generated a new relocation of production. If some decades ago, factories left industrialized countries because of the high cost of the work force and transferred to countries with cheaper costs; now they are returning to industrialized countries, because they no longer require using labor. That is the case of the Adidas factory in Germany, which left Asian countries to produce in Germany again, but without any human beings, only with robots.¹⁴

¹⁰ Ashton, Kevin. "That 'Internet of Things' Thing", *RFID Journal*, June 2nd, 2009, <http://www.rfidjournal.com/articles/view?4986>

¹¹ Palco23, "Adidas pone en marcha su fábrica de robots en Alemania", *Palco23*, May 24th, 2016, <https://www.palco23.com/equipamiento/adidas-pone-en-marcha-su-fabrica-de-robots-en-alemania.html>.

¹² Avicultura, "Una fábrica que pienso que funciona sin personal", *Avicultura*, January 11th, 2013, <http://www.avicultura.com/2013/01/11/una-fabrica-de-pienso-que-funciona-sin-personal/>.

¹³ Zahumenszky, Carlos, "Una fábrica cambia 90% del personal por robots y triplica la producción", *Gizmodo. Univision*, July 31st, 2015, <https://es.gizmodo.com/una-fabrica-cambia-90-del-personal-por-robots-y-triplica-1721368748>.

¹⁴ Chu, Kathy y Emmerentze Jervel, Ellen, "Adidas construirá en Alemania su fábrica más robotizada", *Expansión*, June 13th 2016. <http://www.expansion.com/empresas/distribucion/2016/06/13/575f0047e2704ec8788b4597.html>

III. THE DISAPPEARANCE, DIMINUTION OR TRANSFORMATION OF EMPLOYMENT?

Will repetitive physical jobs disappear by being performed by robots and therefore originate unemployment? Will unskilled people be substituted by robots? Must we get used to a robotized world with human supervision tasks? Will the new forms of production generate new employment positions out of new needs? These are some of the questions that do not have a clear answer. About them, we can point out some repercussions of technology on employment:¹⁵

- 1) The loss of employment: Replacement of workers by robots.
- 2) The generation of new jobs.
- 3) A permanent change in employment.
- 4) A constant change in the worker's labor status, from independent to subordinate and vice versa.
- 5) New labor illnesses.
- 6) The need for permanent professional training.
- 7) Changing working conditions because of automation.
- 8) A questioning of subordinate labor as the classical model of labor relations.
- 9) Jobs that imply human-robot interaction.
- 10) The increase of workers' productivity, thanks to their qualifications for new technologies.
- 11) Less employment opportunities for people without any professional training or digital skills.
- 12) Social conflict: The reduction of human jobs can imply unemployment.
- 13) The relocalization of companies by reducing the workforce needed to produce a good.
- 14) The reduction of labor force cost to zero, because of the automation of production.
- 15) Personalized production, i.e., transiting from mass production to mass personalization.

In labor matters, unemployment and employment in precarious conditions are concerning. The replacement of a worker with a robot improves

¹⁵ Avent, Ryan, *La riqueza de los humanos. El trabajo en el siglo XXI*, S, Ariel, 2018, p. 384.

a company's productivity. The robot, in fact, can have the capacity to not only boost the production of a company in terms of quality and quantity, but also the capacity to substitute more than one worker. The role that robots can perform in a company can make very few workers to exist; or it can disappear all manual labor that used to require an operator.

A panorama like the one pointed out will cause unemployment, without any certainty on what scale it will. Even though, without a doubt, another factor that will be produced is the creation of new jobs, linked to the use of technologies or based on them.

In case of the loss of jobs, there are many studies on the subject, or predictions to be more accurate, because it is hard to know what is going to happen accurately. Even though the attraction to technology in younger generations is a proven fact, the it's access has a limitation, which is an economic one, not only the wish or desire to have technology.

Some studies have considered that, for example, in the USA, 47 per cent of employment is compromised. For the European Union, it is calculated that between 45 and 60 percent of jobs are in risk of disappearing.¹⁶ In the first stage, most workers in transportation, logistics, office work, administrative support workers and labor in production occupations are likely to be computerized.¹⁷

The use of robotics will also imply, by 2020, the loss of 5.1 million jobs in the 15 most developed nations in the world, according to the World Economic Forum's report.¹⁸ Particularly in the USA, there have been professions pointed out that could suffer the effects of technology;¹⁹ most of them are labor activities performed all over the world, and because of that, the effects of technology on labor can be on a global scale.

- 1) Truck drivers. Today, there are 3.5 million truck drivers. If, in the next year, we experience the increase of autonomous cars and trucks,

¹⁶ Bowles, Jeremy, "The computerisation of European jobs", Bruegel, July 24th, 2014, <http://bruegel.org/2014/07/the-computerisation-of-european-jobs/>.

¹⁷ Frey, Carl Benedikt y Osborne, Michel A., "The Future of Employment: How susceptible are jobs to computerisation?" Oxford Martin School News, University of Oxford, September 17th, 2013, <https://www.oxfordmartin.ox.ac.uk/news/14-09-13-Jobs>.

¹⁸ World Economic Forum, *The Future of Jobs: Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution*, Switzerland, 2016, pp. 13 ff.

¹⁹ Rhpaenews, "7 profesiones que están destinadas a desaparecer", *Rhpaenews*, August 23rd, 2017, <https://www.rhpaenews.com/7-profesiones-estan-destinadas-a-desaparecer/>.

an important number of drivers is going to need to find another professional activity.

- 2) In the construction industry there are robots that allow the diminution of professional risks and that are more productive than humans, having consequently a possible reduction in the employment of masons/builders. This way, for example, SAM100 (Semi-Automated Mason), is a robot that undertakes repetitive and extenuating tasks, like bricklaying. In fact, for many years, machines have been the fundamental support for the increase of productivity in the construction industry, be it with cranes, staplers, painting robots, *etc.*
- 3) Legal support personnel: According to Deloitte, in the USA, 39 percent of employment in the legal sector will be automated by 2020. From simple information searches, we will transit to the use of artificial intelligence for the search of legal information or even the resolution of cases.
- 4) Doctors and medical personnel. Medical appointments, and patients' assistance and care are two activities where automation will be present. Possibly, for example, the exoskeletons will make the presence of a nurse unnecessary. The use of artificial intelligence and technologies is gradually becoming a common instrument for the patient's clinical analysis.
- 5) Accountants, the task of calculating income and outcome, payments and charges to make, or even tax declarations are activities performed all over the world through the use of technology. The increase in robotic accounting has been constant in the past years. In Mexico, for example, tax declarations of tax payments can be made through an IT system provided by the tax office, which could lead to forego accountants.
- 6) Report writers. It is known how, in China, there is a news agency that uses a robot for the drafting of news notes.²⁰ Recently, the use of a robot to paint a painting has been highlighted. It is one of the first "works of art" made by a robot.²¹

²⁰ El Universal, "En China 'contratan' a robot para dar noticias", *El Universal*, Mexico, 31 May 2018, <http://www.eluniversal.com.mx/ciencia-y-salud/ciencia/en-china-contratan-robot-para-dar-las-noticias>.

²¹ Fanjul, Sergio C., "¿Puede una máquina pintar como Picasso?, La inteligencia artificial ha logrado realizar poemas, pinturas o composiciones musicales, pero ¿en qué lugar queda la creatividad, la originalidad artística y las emociones? La inteligencia artificial ha logrado realizar poemas, pinturas o composiciones musicales, pero ¿en qué lugar queda

- 7) Salespersons. Electronic commerce, as a new modality for the sale of products and services, has without a doubt, affected the physical salesperson; this work also becomes disposable.
- 8) The diminution of the manufacturing industry. Through time, the use of machines, and now robots, has made the use of labor force to reduce in the manufacturing industry.

In 1995, General Motors employed almost 600 thousand people. Nowadays, in a much bigger economy, Google barely employs 50 thousand, Ebay employs 20 thousand and Facebook only 6 thousand. Apple, Microsoft and Amazon, together barely reach 100 thousand employees globally, nothing to do with Ford's and General Electric's glorious years.²²

We are directed towards a diminution of unqualified and repetitive work, and to an increase in employment and wages of labor that requires higher skills.²³ The type of labor susceptible to robotization or automation is all of it, to a certain extent, from services to production. The more exposed services are: transportation, sales, administrative work, *etc.* (see table 1 and 2)

TABLE 1
PROFESSIONS AND RISKS OF AUTOMATION

<i>Profession</i>	<i>Level of risk</i>	<i>Possibility (%)</i>
Social workers	Low	0,0031
Occupational therapists	Low	0,0035
Dentists	Low	0,0044
Information systems analysts	Low	0,0065
Medical services directors	Low	0,0073

la creatividad, la originalidad artística y las emociones?", *El País*, Spain, April 19th 2017. https://elpais.com/elpais/2017/03/27/talento_digital/1490615561_931227.html.

²² Rhpaenews, "Desciende la mano de obra humana en la industria manufacturera", *Rhpaenews*, March 2nd, 2017, <https://www.rhpaenews.com/desciende-la-mano-de-obra-humana-en-la-industria-manufacturera/>.

²³ CCOO Industria, *La digitalización y la Industria 4.0. Impacto industrial y laboral*, Secretaría de Estrategias Industriales. CCOO Industria, Madrid, September 2017, p. 50, <http://www.industria.ccoo.es/4290fc51a3697f785ba14fce86528e10000060.pdf>.

<i>Profession</i>	<i>Level of risk</i>	<i>Possibility (%)</i>
Junior high school / Secondary level teachers	Low	0,0078
Mechanical Engineers	Low	0,011
Chemical Engineers	Low	0,017
Fashion Designers	Low	0,021
Interior Designers	Low	0,022
Economists	Medium	0,43
Historians	Medium	0,44
Medical devices technicians	Medium	0,45
IT programmers	Medium	0,48
Agronomic engineers	Medium	0,49
Lift operators	Medium	0.50
Mining machines operators	Medium	0.54
Massage therapists	Medium	0,54
Commercial pilots	Medium	0,55
Audio and video technicians	Medium	0,55
Accountants and auditors	High	0.94
Waiters	High	0,94
Office workers	High	0.96
Dental lab technicians	High	0.97
Credit analysts	High	0.98
Cashiers	High	0.98
Librarians	High	0.99
Photographers	High	0.99
Watchmakers	High	0.99
Phone salespeople	High	0.99

Source: Elaboration from Djamil Tony, Kahale Carrillo, from Frey, C. y Osborne, M., *The Future of Employment: How susceptible are Jobs to computerization?* University of Oxford, 2013.

TABLE 2.
 JOBS IN THE DIGITAL ECONOMY

<i>Jobs with a higher risk of automation/digitalization</i>	<i>Jobs with a lower risk of automation/digitalization</i>	<i>New employment</i>
Office work and administrative tasks	Education, arts and mass media	Data analysts, data miners and data architects
Sales and commerce	Legal services	App and software developers
Transportation and logistics	Human resources management	Specialists in networks and artificial intelligence
Manufacturing and industries	Some aspects of financial services	Designers and products from new smart machines, robots and 3D printers
Construction	Information workers, engineers and scientists	Specialists in digital marketing and electronic commerce
Some aspects of financial services		Slaves to galleys or digital galleys (workers entering data or filters) and other “mechanical Turks” that work in digital platforms. Drivers in Uber, casual or “rare” employment (repairs, home improvement, animal care, domestic services, etc.) in a collaborative economy.
Some types of services (translation, tax consulting, etc.)	Some types of services (social workers, hairdressers, beauty and care, etc.)	

Source: Christophe Degryse (ETUI 2016), sur la base de Frey & Osborne, Ford, Valsamis, Irani, Head, Babinet. *Cf.* CCOO Industria, *La digitalización y la Industria 4.0. Impacto industrial y laboral*, Secretaría de Estrategias Industriales. CCOO Industria, Madrid, September, 2017, p. 50.

Among some of the new occupations, we can find:²⁴

- a) Robotics technicians
- b) Mechatronic technicians, superior 3D animation technicians
- c) IoT platform programmers
- d) IT technicians
- e) Cybersecurity experts
- f) Nanotechnology

In Latin America, it is estimated that 50 per cent of the employment that exists today will be occupied by machines. Labor in the region should be highly qualified and less mundane, so it is required to encourage cognitive and non-cognitive skills. However, in the region, amongst young people who are 15 years old, more than 60 per cent of them do not reach minimum standards in mathematics, meanwhile OCDE average is 23 percent. Regarding psycho-emotional aspects, young people in the region have problems related to perseverance, concentration and attention (PISA Report, 2015).²⁵

Insisting, since the loss of employment all over the world because of digitalization has been pointed out, it has also been affirmed that employment is also to be created. We do not have to necessarily think of a catastrophic scenario; even if it is true that robots will change the future of work, this does not necessarily imply that jobs will disappear *en masse*. Some tasks will be completely automated in practical terms, but such automation will allow workers to focus on new activities. In some countries, like Germany, as many jobs will be created as those that will disappear, although it is true that the German case cannot be extrapolated to the rest of the world.²⁶

A group of emerging labor activities will gain a significant importance in the next years, while another group of work profiles will become more redundant each time. According to the World Economic Forum a study of 15 million workers total forecasts a diminution of 0.98 million jobs and an increase of 1.74 million jobs. Extrapolating these trends to the global work-

²⁴ Djamil, Tony, Carrillo, Kahale, “La formación (Spanish and Italian) en la Industria 4.0”, labor Law Issues, Vol. 2, No. 2, 2016, p. 51, <https://laborlaw.unibo.it/article/view-File/6495/6282>

²⁵ Rhpaenews, “Los trabajos del futuro en América Latina”, *Rhpa News*, June 8th, 2017. <https://www.rhpaenews.com/los-trabajos-del-en-america-latina/>.

²⁶ Degryse, Christophe, Impacts sociaux de la digitalisation de l'économie, op. cit., nota 11, p. 26.

force (non-rural) employed by major companies, a loss of employment is estimated until 2022. An estimated 75 million jobs can be displaced by the trends mentioned before, while 133 million new additional posts can arise at the same time.²⁷

Considering the sample of 15 million workers, its reduction of 0,98 million jobs and the creation of 1,74 million jobs, when we extrapolate these tendencies for the global (non-rural) labor force, employed by large companies we can estimate the loss of employment until 2022. A possible estimation indicates that 75 million jobs can be displaced following the mentioned tendencies, meanwhile 133 million additional jobs can arise at the same time; although such perspective is centred on major transnational corporations and not on small and medium enterprises. This positive perspective on employment requires changes in the labor force and almost half of the people in the survey hope to have modified its geographical base of operations. Also, 50 percent of companies hope that automation leads to a certain reduction of its full-time work force, in function of their current employees' work profiles.²⁸

Also, for 2022, 38 percent of surveyed businesses hope to extend their workforce to new roles, improving productivity and more than a quarter of them hope that automation leads to the creation of new positions in their company. Also, companies are willing to widen the use of external contractors that perform specialized work in tasks, and many of the surveyed highlighted their intention to involve workers in a more flexible way, using remote personnel further than physical offices, and the decentralization of operations. Surveyed companies hope for a greater creation of jobs in roles that are based on projects, independent and temporary jobs, that points out structural transformations of the labor market in terms of contractual agreements, labor relations and occupational profiles. In summary, even though job losses in general are predicted, they will be compensated with the increase in employment; there will be a significant change in quality, location, format and permanence in new roles.²⁹

In the spectrum of roles that are expected to experience an increasing demand until 2022, we can find data analysts, scientists, software and app developers, e-commerce and social media specialists; the technology on which they are based on is drastically improving. The prevalence is also

²⁷ World Economic Forum, *The Future of Jobs Report 2018*, Switzerland, 2018, p. 9.

²⁸ *Idem.*

²⁹ *Idem.*

expected for roles that take advantage of distinctive “human” capacities, such as Service Workers, Sales and Marketing Professionals, Training and Development, People and Culture and Specialist in Organizational Development, as well as Innovation Managers. It will be the same for completely new specialists, related to the comprehension and exploitation of the last emerging technologies: AI and auto-learning specialists, *Big Data* specialists, experts on process automation, information security analysts, user experience designers, human-machine interface builders, robotics engineers and *blockchain* specialists.³⁰

³⁰ *Idem.*

TABLE 3. EXAMPLES OF STABLE ACTIVITIES, NEW AND REDUNDANT IN ALL THE INDUSTRIES

<i>Stable Activities</i>	<i>New Activities</i>	<i>Redundant Activities</i>
Director managers and executive directors General and operational managers * Software and app developers and analysts* Data analysts and scientists* Sales and marketing professionals* Sales, wholesale, manufacturing and technical/scientific product representatives Human Resources Financial and investment advisors Database and web professionals Supply chain and logistics specialists Risk management specialists Information security analysts* Organization and Management analysts Electric-technology analysts Organizational development specialists * Chemical processing plant operators High school and university teachers Compliance officials Energy and oil engineers Robotics specialists and engineers Oil and natural gas refinement plant operators	Data analysts and scientists * AI and auto-learning specialists General and operational managers* Big Data specialists Digital transformation specialists Sales and marketing professionals * New technologies specialists Organizational development specialists * Software and app developers and analysts * IT services Automation process specialists Innovation professionals Information security analysts* E-commerce and social media specialists User experience and Human-Machine interaction designers Training and development specialists Robotics specialists and engineers Culture and people specialists Information and service to the public employees * Service and solution designers Strategy and global market specialists	Data entry employees Accountability, bookkeeping Executive and administrative secretaries Assembly and factory workers Information and service to the public employees * Administration and commercial services managers Accountants and auditors Material imprinting and inventory General and operational managers * Postal Service workers Financial analysts Entrance tickets cashiers and salesmen Machinery mechanics and repairmen Telemarketers Electronic and telecommunications installers and repairmen Bank cashiers and related workers Cars, bans and motorcycle drivers Sales and purchases agents, and brokers <i>Telemarketers</i> Door-to-door salesmen, street vendors, news vendors and related workers Statistics, finance and insurance workers Lawyers

Source: *Future of Jobs Survey 2018*, World Economic Forum.

Note: The activities marked with an *, appear in more than one column. This reflects the fact that these could have a stable or decreasing demand in an industry but could be demanded in another.

In Mexico's case, the following emerging activities have been detected: General and executive directors, software and app developers and analysts, sales and marketing professionals; general and operational managers, sales, wholesale and manufacturing representatives; technical and scientific products, human resources specialists, financial and investment advisors. Also, there appears to be a series of emerging skills: analytical thinking and innovation; creativity, originality and initiative; active learning and learning strategies; technology design and programming; reasoning, problem resolution and creating ideas; complex problems resolution; leadership and social influencing; critical thinking and analysis; resilience, stress tolerance and flexibility; and emotional intelligence.³¹

IV. NEW FORMS OR TYPES OF NON-STANDARD WORK

The European Foundation for the Improvement of Living and Working Conditions has analysed the “new forms or work”, which are being developed in Europe and radically transform traditional relations between the employer and the worker. The Foundation has pointed out nine forms of work that have implications on working conditions and the labor market.³²

- 1) Shared time jobs. One worker is bound, along with a group of employers, to satisfy the needs of many companies in the field of human resources, which translates into permanent employment for the worker.
- 2) Job sharing: An employer hires two or more workers to share tasks, linked to one specific work position; this way combining two or more part time jobs into one full time job.
- 3) Interim management or supervision. Highly qualified experts are hired for a specific project or solving a concrete problem, this way incorporating external managing qualifications into the work organization.
- 4) Occasional jobs. An employer is not obligated to provide regular work to an employee, so he has a margin of flexibility that allows him to make the employee work according to his needs.

³¹ *Ibid.* pp. 88-89.

³² Eurofound, *New forms of employment, Luxembourg*, Publications Office of the European Union. *Cfr.* Degryse, Christophe, Impacts sociaux de la digitalisation de l'économie, *op. cit.*, note 11, 26 p.

- 5) Mobile labor based on information and communication technologies, workers can work anywhere and at any time, with the aid of modern technologies.
- 6) Work based on vouchers, where the labor relation is based on the payment of services through vouchers bought to an accredited organism, that covers salary and social security;
- 7) Work distributed in various activities. An independent worker works for a great number of clients, performing specific tasks for each one of them:
- 8) Cooperative work. An online platform connects workers and employers, often in very important tasks which are divided and assigned among various workers organized in a virtual cloud;
- 9) Collaborative work. Independent workers and microenterprises cooperate in a certain way to overcome limitations in professional size and isolation.

The ILO, for its part, leaving aside precarious labor and informality, has also detected the presence of non-standard forms of employment.³³

- 1) Temporary employment. Work and contracts for a determined time, including task-based projects, seasonal work and “casual” work.
- 2) Partial time. Tasks with a working schedule that do not complete one working day in a natural day (partial-time work, on-call work).
- 3) Agency work. Outsourced labor through an agency or employee institution, different from the company or place where the worker carries out her/his job.
- 4) Dependent auto-employment. Hidden, fraudulent, or undercover labor relations.

The Fourth Industrial Revolution, as it has been pointed out, is not going to end with employment, but it is true that it is redefining it; consequently there are three matters we need to pay important attention to:³⁴

³³ ILO, Non-standard employment around the world: Understanding challenges, shaping prospects, International Labour Office, Geneva, ILO, 2016.

³⁴ OIT, “Los cambios tecnológicos y el trabajo en el futuro: Cómo lograr que la tecnología beneficie a todos”, La iniciativa del centenario relativa al futuro del trabajo. Informative Note, OIT, 2016 (This note is based on Irmgard Nübler ‘s contributions). https://www.ilo.org/global/topics/future-of-work/WCMS_543154/lang-es/index.htm .

- 1) First, technological change will transform nature and the quality of existent and future labor positions. The suppression of good jobs and creation of bad ones is worrisome, even if this means increasing the quantity.
- 2) Second, job suppression and creation implies that workers and companies, as communities, will have to go through generally difficult and expensive changes and adjustments.
- 3) Third, technological changes will generate major incomes in productivity, where, again, the impact in the work environment in each country and around the world, will depend on the way such income is distributed among economies and social groups.

As we can observe, it is not the disappearance of jobs that must concern us, but the creation of bad quality and lowly paid jobs, bad adjustments made by national economies negatively affecting people who have a job, as well as the possible increase in inequality despite an increase in productivity.

V. SUBORDINATION, INDEPENDENT LABOR AND SEMI-INDEPENDENT LABOR: THE COURTS' ROLE

Collaborative economy has generated a debate, in labor matters, about the legal nature of the contractual relationship between a collaborative platform and people who use it as an instrument for work. It is deep-rooted as a classical worker-employer subordination relationship.³⁵ Most platforms involved consider their workers as independent workers. In fact, practically every digital platform in the collaborative economy responsibilities consider all of their workers as independent workers. This way, there are no labor responsibilities nor social security.

The courts' reaction has been tipsy and contradictory. There are resolutions in England, USA and France that can illustrate the courts' decisions that have had contradictory answers, even in the same country:

- 1) In the UK, in James Farrar's and Yassen Aslam's case against Uber, the company was sanctioned to pay for their salary and vacations, according to what was ordered by the Employment Appeal Court.

³⁵ Vega Ruiz, María Luz, "El futuro del derecho del trabajo: ¿Revolución industrial y tecnología o crisis del Estado Social", *IUSLabor*, 1/2017.

VI. TOWARDS A LABOR STATUS FOR WAGE-EARNING AND NON-WAGE-EARNING WORKERS

Changes in work are not going to happen in the future; we are experiencing them daily in different dimensions and proportions. Questions are: Which is the answer that labor law must offer, if labor law will continue to be the adequate instrument to regulate new labor relations? Or is it going to be able to regulate a segment, not of new labor relations, but of old and residual ones? Those two questions can be answered in three ways. One is considering the history of labor law, a second one parts from premeditated delaborization from labor law, and a third one has to do with redesigning labor regulations.

In the first place, we must not ignore that labor law appeared as a factual figure before becoming law. It was the old commercial and civil law which regulated relations between workers and employers. labor law, we can say, always appears as a factual figure, that law, sometimes unwillingly, has had to recognize.

In second place, we are not discussing the difficulty of analysing new labor relationships, because of the adversity of clearly distinguishing the existing work subordination link. Even so, it is also a fact that in some occasions that the disappearance of subordination is pointed out radically in the new ways of carrying out jobs; without closing the possibility that maybe it is not that way. It looks as if pointing out the inexistence of labor relations has as a purpose to exclude labor law definitely, without leaving open the possibility of an existence, at least partial or tenuous, of labor subordination

In third place, without disregarding the new ways in which employment is carried out and the new types of work, it would be a mistake to think that labor law will be completely displaced. However, we can no longer think about it in the transparent way it appeared originally, from labor subordination. The former implies parting from new paradigms and remembering the origins of labor institutions that, as we have commented, appeared in a first moment as factual institutions and then as law institutions.

At some time it was thought that chain labor and exploitation of workers had moulded labor law definitely. It has also been believed that the replacement of industrial labor, which involves a heavy use of work force, with labor made by a robot, along with the shift of capital-labor relation, in that dynamic, could only mean the disappearance of subordination and labor law with its protective function. This false idea has been deeply disseminated. In reality, labor transformations have been confused with legal

transformations. Man delivers each time less labor force, but the exchange of an activity for a continuous remuneration persists, and that is a legal act that requires clarity in the contracting parties' obligations and rights.³⁷

We insist: it is true that labor flexibility has translated to labor ultra-flexibility, characterized by non-contractual forms of employment; or in other words, working without a labor contract, salary norms, labor duration regulation, workplace determination, the right to professional training, collective contracting nor the right to form unions.³⁸ The State's absence in this phenomena is such that the establishment of rules is not even considered private law's perspective, in great measure because the State's legal regulations have been overwhelmed or surprised by the new forms of employment.

Unions from many parts of the world have presented their concerns stemming from the "platform economy". For instance, in *Frankfurt am Main*, Germany, the first *International workshop for union strategies in the platform economy* was celebrated on 13 and 14 April 2016, establishing as key points:³⁹

- 1) Online labor platforms online comply with applicable laws, including labor situation analysis.
- 2) Platform operators must work in both local and national level, alongside workers, researchers, clients, union organizations and politicians, to assure that platform work complies with regulations, including labor legislation; this is done with the purpose of analysing that those laws better those offered by the company and to assure transparency in the platform labor world.
- 3) Many online labor platform administrators deny being employers and demand workers to be considered as "independent contractors" or "auto-employees", instead of regular employees. Workers in platforms that are currently contemplated as contractors must take into ac-

³⁷ Lyon-Caen, Gérard, *Le droit du travail. Une technique réversible*, Francia, Paris, Dalloz, 1995, p. 2.

³⁸ Degryse, Christophe, *Impacts sociaux de la digitalisation de l'économie*, *op. cit.*, note 11, p. 26.

³⁹ With the presence of international organizations : the Austrian labor Camera, the Austrian Federation of Unions (OGB), the Danish Commercial and Official Workers' Union (HK) IG Metall from Germany, Teamsters Local 117 International Fraternity, the International Employee Union, alongside legal and technical experts from Asia, Europe and North America. Information contained in : CCOO Industria, *La digitalización y la Industria 4.0. Impacto industrial y laboral*, *op. cit.*, note 25.

count that the transition to the status of worker could imply a loss of liberty, especially the liberty to choose tasks and work times.

- 4) Through technology, some platforms will execute more control than many traditional companies with traditional workers, even with indirect control. The more control a platform establishes over workers, the more likely it is to be legally considered as an employer and because of that, being responsible for paying associated costs.
- 5) It is important to reaffirm the central importance of workers' rights to organize, contained in the main international, universal, fundamental Human Rights declarations, in general terms and specifically in terms of labor.
- 6) All work that is carried out in online work platforms should be paid, at least, with the minimum wage (after expenses, before taxes), of the legal scope, independently of the workers' legal situation or access to other work opportunities
- 7) Platform workers must have access to social security protection —be it public or private, in each country— including unemployment protection, handicap, health and sickness insurance, pensions, maternity protection and compensation in case of occupational sickness or work accidents.
- 8) Platform operators must work with clients, researchers, workers' organizations, workers and other actors, to develop clear and responsible methods when solving disputes between clients and workers; and between workers, when needed.

Without a doubt, there must be a series of rights and obligations to safeguard human dignity. Legal rules that implicate a violation of people's health or decent existences cannot be created. Work in the future and conditions in which they are to be performed, cannot ignore the previous two elements: the right to health that every person that carries out a paid activity has; and the right to a decent existence that results from performing work. In that sense, the State's obligation consists, in reality, to carry out a fundamental rights policy, offering everyone a possibility of exercising their rights.

A modern labor law must stay away from the typecasting of labor relations in a single scheme. Maybe the fact that labor doctrine has wanted to observe labor relations only when there is a link of subordination paradoxically caused that each time more legal relations, between a natural person providing a service and another one receiving that service, escape labor law little by little or disguise themselves as external to labor law.

The 21st Century's labor law does not have to be limited to one only scheme of contractual relations. It must be recognized that a univocal vision centred in subordination,⁴⁰ obstructs any possibility of defining the labor contract.⁴¹ Labor law must allow us to stem from a plurality of contracts that determine, depending each case, a set of special regulations according to labor law characteristics or to whatever activity it concerns. We must not think that labor law is looking to disappear through establishing a plurality of subjective rights depending on each contract, but to reinforce itself with a regulation that does not necessarily have to be unique; by looking for its homogeneity, it ends up excluding workers. This is exactly one of the mistakes we make by trying to conceptualize labor law as something uniform, when what we find since the end of the 20th Century is the heterogeneity of contractual relations between a natural person and another natural or juridical person.

Diversity does not destroy nor diminish labor law; on the contrary, it ends up rebuilding it and increasing its field of action. When there is a classic labor subordination, labor law has its field of action, of course, when we find ourselves in a relation of labor dependence. When there is a labor relation with grades of autonomy and subordination, it must be pointed out clearly in which cases it is relevant to talk about a *tertium genus*⁴² and in

⁴⁰ Supiot, Alain, "Les nouveaux visages de la subordination", *Droit Social*, N.2, February 1st, 2000, France, Paris, p.139.

⁴¹ Emmanuelle, Barbara, *Proposition pour une nouvelle définition du contrat de travail*, Semaine Sociale Lamy, no. 1767, April 2017.

⁴² On the matter, it is key to point out Thomas Pasquier's comments and sources from his article « Sens et limites de la qualification de contrat de travail », *Revue de Droit du Travail*, 2017 : « La question préalable qui pouvait se poser était celle de l'opportunité de la création d'un troisième genre entre subordination et indépendance. À cette question, l'on répondra assez nettement par la négative. À cela, deux raisons majeures. Au-delà de l'argument d'insécurité juridique tiré de la démultiplication des catégories juridiques soulevé par l'IGAS, c'est sur le plan de la politique juridique que la création d'une nouvelle catégorie doit être contestée: créer une catégorie intermédiaire entre subordination et indépendance aura pour effet de créer un appel d'air vers la nouvelle catégorie et de participer de l'externalisation juridique de nombreux salariés. À l'heure où le salariat et le droit du travail traversent une zone de turbulences sévères, il n'est sans doute pas opportun de charger encore plus certainement la barque sur laquelle ils naviguent. À cet argument d'inopportunité, il faut ajouter celui de l'inutilité. Pour le comprendre, il convient de rappeler, à grands traits, la teneur des expériences étrangères. Le caractère principal des catégories envisagées, telles que la parasubordinazione italienne ou le TRADE espagnol, est le lien d'exclusivité entre le travailleur et son cocontractant et le caractère personnel de la prestation de travail. L'idée est donc d'offrir à des prestataires qui sont juridiquement indépendants, mais dans une situation de dépendance économique à l'égard de leur prestataire du fait, notamment, du lien d'exclusivité qui

which cases we find ourselves with disguised outsourcing; thus recovering the notion of economic subordination, cultured by doctrine for years.⁴³ In the clarification of the labor relation, to know if workers are independent or subordinate in the collaborative economy, ILO's Recommendation 198 about the extension of the employment relationship is key in this subject.⁴⁴

When flatly the contractual relation is developed in an apparent independence of autonomy, labor law must think about a non-wage earning

les unit à leur fournisseur et du caractère personnel de la prestation, une forme de protection. Mais est-ce bien utile dans le système français ? Comme on l'a vu précédemment, la notion de service organisé – ou encore l'interprétation faite par la 2^e chambre civile dans l'arrêt Formacod de l'absence d'indépendance véritable – a précisément permis d'intégrer dans le champ du droit du travail les travailleurs en situation de « dépendance existentielle ». Dès lors, si l'ambition d'une nouvelle catégorie se réduit à faire autrement, voire plus mal, ce que la jurisprudence fait déjà par le biais de la qualification de contrat de travail, autant ne rien faire. Cela d'autant plus que, comme le remarque justement un auteur, la question n'est pas vraiment celle d'une alternative entre des travailleurs salariés, des travailleurs autonomes et des travailleurs indépendants, mais celle d'« une dynamique intrinsèque à l'auto-emploi qui le fait muter soit en direction d'une organisation partenariale ou entrepreneuriale, soit en travail intégré à une telle organisation ». En somme, l'alternative, tant sur le plan juridique qu'organisationnel, n'est pas celle d'un triptyque mais celle d'un diptyque entre le salariat intégré dans l'entreprise d'autrui et l'indépendance maîtresse de l'organisation de travail. Est-ce à dire qu'aucune protection n'est nécessaire ? Sans doute pas si l'on envisage que, de plus en plus, les organisations – même indépendantes juridiquement – sont directement intégrées ou coordonnées par une autre organisation – souvent de dimension internationale. » Sur le troisième genre, v. A. Perulli, Travail économiquement dépendant/parasubordination. Les aspects juridiques, sociaux et économiques, Rapport pour la Commission européenne, 2003; v. égal. T. Pasquier, L'économie du contrat de travail, préc., p. 295 s.; J. Barthélémy, "Essai sur la parasubordination", Sem. soc. Lamy 2003, n o 1134, p. 6; du même auteur, "Le professionnel libéral et les 35 heures", Dr. soc. 2000, p. 485; "Le professionnel parasubordonné", JCP E 1996, I. 606; A. Supiot, "Les nouveaux visages de la subordination", Dr. soc. 2000, p. 139; E. Peskine, "Entre subordination et indépendance : en quête d'une troisième voie", RDT 2008, p. 371; Rapport sur Le travail économiquement dépendant de P.-H. Antonmattéi et J.-C. Sciberras, 2008; Travailleurs Indépendants Économiquement Dépendants, Mesures statistiques, enjeux et opportunités, Projet mis en place dans le cadre du programme Relations industrielles et dialogue social de la Direction générale emploi, affaires sociales et inclusion de la Commission européenne, 2014; Rapport de l'IGAS, Les plateformes collaboratives, l'emploi et la protection sociale, November 2016.

⁴³ Francesco Ferrari and Mario de la Cueva have for many years already made reference to economic subordination: Ferrari, Francisco de, *Derecho del Trabajo*, Argentina, Buenos Aires, Ediciones Depalma, 2o Ed. 1969, p. 104 y De la Cueva, Mario, *Derecho Mexicano del Trabajo*, T. I, México, Porrúa, 1967.

⁴⁴ Recommendation on the Labor Relationship, 2006 (number 198). http://www.ilo.org/dyn/normlex/es/f?p=NORMLEXPUB:12100:0::NO::P12100_ILO_CODE:R198.

labor law, because independent workers, as *entrepreneurs*, live off their work.⁴⁵ Even when legal and economic independence is clear, the parts' obligations and rights must be safeguarded, with the limits that private law contains, where civil and political rights (freedom of assembly, expression, non-discrimination, *etc.*) and those of social and economic nature, particularly the right to health, decent existence and survival, coexist in decent conditions.⁴⁶

Redefining fundamental rights of all people who perform a job, without regarding the existence or not of labor subordination,⁴⁷ implies necessarily re-thinking the classical notion of labor law, to give place, among other rights to:

- 1) The right to a minimum wage
- 2) The right to social protection, fundamentally in case of work accidents or occupational illnesses. Also, unemployment handicap, health and illness protection, pensions and maternity protection.
- 3) The right of assembly
- 4) The right to collective bargaining
- 5) The right to a permanent training

Independently of finding ourselves in front of subordinate, semi-subordinate or independent labor, every person has the right to training that allows him or her to access a job, to be informed on existing jobs and professional training during the job; and in case of losing it, to obtain means of subsistence from society (social help or an unemployment insurance) and also support needed for creating employment and/or a company, through what is known as the right to a professional activity,⁴⁸ always in co-respon-

⁴⁵ Lyon-Caen, Gérard, *Le droit du travail non salarié*, Paris, 2000, 208p. In his book, Lyon-Caen points out that non-wage-earning work is characterized, at the same time, by the property of the instruments of work and by charging working risks to the economic activity. There are also many grades in which the non-wage-earning worker is close to the wage-earning worker, there are even cases in which they touch.

⁴⁶ Supiot, Alain, "Vers un nouveau statut social attaché à la personne du travailleur ?", *Droit Ouvrier*, no. 897, 2015, p. 559.

⁴⁷ ILO, *Informe de la Reunión de expertos sobre las formas atípicas de empleo*, Geneva, 16–19 February 2015. Protección de los trabajadores en un mundo del trabajo en transformación 78 ILC.104/VI.

⁴⁸ For example, in France, the Law of August 8th, 2016 introduces the notion of «activity of personal account» which allows workers to accumulate rights to assure their smooth transition from one labor regime to another.

sibility schemes, because in a context like Mexico's, political cronyism has pushed the government towards social handout and assistance policies.

VII. THE STATE'S ACTIVE ROLE

Before a situation of possible modern exploitation, maybe undercover or disguised by new Industry 4.0 technologies, the State, as it did in the 19th Century, must avoid this exploitation through a regulation that allows the respect of every person's rights, without regard to the nature of his or her labor relation. Such regulation must originate under the new features of the labor relation and under the new contractual modalities that arise; a regulation that can well be protected by civil, political, economic or social fundamental rights.

The State faces an engagement to articulate public policies in terms of Industry 4.0; it necessarily requires to know the situation of its labor market (in Mexico's case, high informality rate, professional training problems, juvenile unemployment, the lack of school-company interaction, among others) to regulate and coordinate technological, digital and productive change. This is to be done encouraging quality employment; new employment niches, fair distribution and expansion of labor; balanced participation and distribution of earnings; necessary labor security and health in Industry 4.0; the treatment of workers' personal data, among others.

Similarly, facing the lack of labor contract adaptations and the subordination of new modalities of employment, the State must reflect on them and re-think the situation of workers than cannot be framed in a labor contract or in a labor relation, but still their situation requires a certain type of protection,⁴⁹ through a right to a professional activity or a labor law for non-wage earners. For some authors, the difficulties that labor law faces are not possible to overcome; in fact, they face it against the possibility of pinpointing an old dream: the creation of a labor law in a wider sense that guarantees fundamental values, such as dignity and decency in work.⁵⁰

⁴⁹ Pasquier, Thomas, "Sens et limites de la qualification de contrat de travail", *Revue de Droit du Travail*, 2017, pp.102 ff.

⁵⁰ *Ibid.* p. 109.

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SECOND PART

INTERNATIONAL CASE STUDIES

MEXICO AND INDUSTRY 4.0

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SUMMARY: I. *Introduction.* II. *The emergence of the Industry 4.0 phenomenon in Mexico.* III. *The rise of Industry 4.0 and its rapid evolution.* IV. *Impact of Industry 4.0 in Mexico on matters of labor and social security.* V. *Conclusions.* VI. *Research sources.*

I. INTRODUCTION

Work rescues us by giving life a real meaning; that is why decent employment and the social security system that come with it are inevitably bound to keep the pace up on social and economic changes in the world of work, both employment and labor; specially when everything is being transformed by the so-called *Industry 4.0*; a new disruptive economic and production model with an uncontrollable exponential growth that produces transcendent changes.

Industry 4.0, or the Fourth Industrial Revolution, represents a radical change of legal paradigm in the existence of the 21st Century's Social Law, because its repercussions put the conception of work as we, labor lawyers, once conceived it, at risk. That risk persists in the social security's protective active system, originated from the unusual phenomenon of *intelligent automation* in the production of goods and services, which will predictably end up

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destroying hundreds of thousands of jobs and occupations in our country, during the following decade and those to come.

It is urgent to implement a restructure of the national labor legal system and public policies in accordance with the current reality in Mexico, foreseeing the changes involved in this unprecedented global industrial revolution, defending the *working class* and trying to achieve sustainable social welfare in Mexico.

II. THE EMERGENCE OF THE INDUSTRY 4.0 PHENOMENON IN MEXICO

We start from the following premises: human work gives a sense of belonging and relevance in life. Social law historically and legally emerged from the First Industrial Revolution as a right of social classes. This kind of revolutions in production of goods and/or services, emerging and expanding, have generated notable advances in the most diverse areas of our current societies thanks to innovation and favourable impact in terms of progress and collective human development. We will verify why the right to work and employment, as well as the right to access social security, are considered irrevocable and inalienable human rights in articles 23 and 24, and also 22 and 25, respectively, of the United Nations” «Universal Declaration of Human Rights».¹

Indeed, when the Industrial Revolutions have happened, everything has changed, even though they initially provoke uncertainty; without exception, all of them have ended up being beneficial for the societies in which they are produced and where they are replicated, as long as the human being is considered as the focus of the ends of improvement, since economy and society itself were transformed due to the positive implications caused by the new production system.

For instance, labor law arose from the First Industrial Revolution as a demand for the State to protect the operator against the *mechanization of factory system*; this legal discipline was called by some industrial law because its content tried to regulate the industry sector – and the French jurist George Scelle named it a *social class legislation* – It served as a starting point for the legal regulation of normal employment and originated the so-called social right.²

¹ Cfr. Asamblea General de la Naciones Unidas, “Declaración Universal de los Derechos Humanos”, 217 (III) A, proclaimed in Paris, 10 december 1948, <http://www.un.org/es/universal-declaration-human-rights/>, This document is, in fact, the source of all of the existing International Treaties, Agreements and Covenants on Human Rights on the planet.

² García Oviedo, Carlos. *Tratado Elemental de Derecho Social*. Librería General de Victoriano Suárez, Madrid, 1934, pp. 3 a 5.

Afterwards, during the Second Industrial Revolution, towards the mid-20th Century, the labor phenomenon of the workers' *unionization* gained strength, they joined forces to attain better benefits and greater social protection through collective bargaining.³ The Third Industrial Revolution started in 1971 with the *microprocessor* and ended around the middle of the first decade of this century. During this stage, in less than half a century there was a profound technological transformation, both in the productive and social areas, thanks to the *technological evolution and innovation* that globalized the economy – although with a notorious capitalist approach of the neoliberal system. Thus arises the Internet, the technological “network of networks”, towards the penultimate decade of the last century, radically changing human communication when popularized.

Yes, being interconnected through the Internet impacted social habits and customs. Since today the Internet is within reach of more than four billion users on the planet – we are talking about more than half the world's population – and this number of users increases exponentially in Mexico because, according to confirmed data from 2018, it is used by more than 79.1 million Mexicans in our country,⁴ that is, two thirds of the population.

Likewise, *most employment sources have become highly technified* and their main feature is having greater labor flexibility due to several phenomena that impact on employment through a series of legal or illegal tricks, which generate job instability and low wages, including *tercerización laboral* (outsourcing), *trabajo de muchedumbre* (crowdsourcing),⁵ *mecenazgo colectivo* (crowdfunding),⁶ corporate relocation,⁷ and flexicurity.⁸

³ Obtained data from Méndez Gutiérrez del Valle, Ricardo, *Las revoluciones industriales*, Instituto Geográfico Nacional, Ministerio de Fomento de España, https://www.ign.es/espmapi/figuras_industria_bach/pdf/Industria_Fig_01_texto.pdf.

⁴ Cfr. Martínez, León A., “7 gráficos sobre los usuarios de Internet en México en 2018”, *El Economista*, 17 May 2018, <https://www.eleconomista.com.mx/tecnologia/7-graficos-sobre-los-usuarios-de-internet-en-Mexico-en-2018-20180517-0077.html>.

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⁶ See data about crowdfunding —which encourages capital investment and entrepreneurship in Mexico— in the Crowdfunding México web link, <http://www.crowdfundingmexico.mx/>

⁷ The corporate relocation phenomenon is studied more in-depth in Pérez Ventura, Juan, “¿Qué es y cómo funciona la deslocalización de empresas?”, *United Explanations*, May 31st, 2013, <http://www.unitedexplanations.org/2013/05/31/la-deslocalizacion-o-como-abaratar-costes-en-un-mundo-global/>.

⁸ Cfr. Diego, Julián de, “La flexiseguridad como motor de la reforma laboral europea”,

All of these trends, in both labor occupations and business, have been impacting labor and employment relationships all around the globe; current inertia points out that the phenomenal impact will continue until reaching an extraordinary alteration of formal labor relations, which is a harsh scenario where specialized autonomous occupations, through remote work platforms, will eventually be the main income source for Mexican workers and many within the world's population; a worrying issue for which social security systems must prepare.

III. THE RISE OF INDUSTRY 4.0 AND ITS RAPID EVOLUTION

Known now as Industry 4.0, the *Fourth Industrial Revolution* is a concept coined by German teachers Henning Kaggermann, Wolf-Dieter Lukas and *Wolfgang Wahlster*, at the *Hannover Fair for Digital Technology*, in 2011,⁹ a polyvalent conceptual term that reveals the huge technological and industrial progress that evolved and revolutionized the organization of *global value chains* in Germany and all of Europe, as well as in other continents. This is the result of the convergence of innovative and disruptive developments realised in recent years.

It is true that technology can be very useful for us, however, the problem with its use is that there is no way of telling what kind of decisions we will make while operating it; obviously, morality and ethics have an important role in the deep change of productive schemes in our contemporary societies.

Industry 4.0, in few words, is an amalgamation of digital, physical and biological technologies, coupled with the use of genetic engineering, nano- and neurotechnologies, which are capable of creating, through the combination with artificial intelligence, fully autonomous mechanized factories; therefore, this will necessarily impact the labor market in a profound and radical way, using the process of *intelligent robotization of the goods and services industry*.

All of this is described in the introduction of the book *The Fourth Industrial Revolution*, Klaus Schwab, creator and executive director of the World Economic Forum, *WEF*, a prestigious global forum dedicated in 2016 to the subject of “Mastering the Fourth Industrial Revolution”:

El Cronista, 22 August 2017, <https://www.cronista.com/columnistas/La-flexiseguridad-como-motor-de-la-reforma-laboral-europea-20170822-0004.html>.

⁹ More information about this Fair on the website <http://www.hannovermesse.de/home>

Out of the multitude of diverse and fascinating challenges of today, the most intense and important thing is how to understand and shape the new technological revolution, which is nothing else but a transformation of humanity. We are at the beginning of a revolution that is changing the fundamentals of the way we live, work and relate. In its scale, range and complexity, what I consider to be the Fourth Industrial Revolution is nothing like anything mankind has experienced before.¹⁰

Immediately after, the German, Schwab – without any doubt the most visible authority of the complex Industry 4.0 subject – adds the following insights:

The Fourth Industrial Revolution is not defined by a set of emerging technologies itself, but by its transition to new systems built above the infrastructure of the (former) digital revolution. The *Fourth Industrial Revolution*, not only consists of intelligent and paired machines and systems, its range is wider, at the same time there are waves of advances in fields extending from genetic sequencing to nanotechnology, and from renewable energies to quantum computing. *It is the fusion of these technologies and their interaction through physical, digital and biological domains that makes the Fourth Industrial Revolution fundamentally different from the previous ones.*¹¹

Indeed, according to the promotional advertisement from the German world-wide channel *Deutsche Welle's website*, published on March 1st, 2018, a couple of documentaries about Industry 4.0 are shown, for the viewer to watch through the Internet in *DW Documental*, entitled: *Robots take charge* (parts 1 and 2), which allude what is to come in the next years:

Society is facing a radical change. And this has a name: Industry 4.0 is nothing less than a revolution in today's labor society. Artificial intelligence is gaining ground... *Soon there will be more intelligent machines and robots in the world than human beings. It is something that goes far beyond automotive production. The robots make surgical interventions and reproduce works of art.* Industry 4.0 may be the biggest challenge for the world, says Klaus Schwab, founder of the World Economic Forum in Davos, and warns of a top-down revolution that will turn millions of people into losers that no one will need anymore.¹²

¹⁰ Schwab, Klaus, *La cuarta revolución industrial*, trad. Portafolio México, Penguin Random House, Grupo Editorial México, 2017, p. 13.

¹¹ Schwab, Klaus, *op. cit.*, pp. 13 y 20.

¹² Martens, Klaus, *Relevo de Turno. Los Robots se hacen cargo (2/2)*, DW Documental, YouTube, 1 March 2018, https://www.youtube.com/watch?v=GOAiR8Z9w_c.

We think that in Mexico we should not ignore this powerful message, for we have been able to confirm that the phenomenon is developing at a global scale and full speed on three continents: Europe, Asia and America; so the bias towards the intelligent automation of manufacturing will inevitably lead to the *replacement* of human labor, a matter that, in Japan, has been called for five years as “The revolution of robots”, with the purpose – among other things and with a human approach on technology – of ending with *karoshi*,¹³ the sudden death caused by the overwork of the Japanese, a concept that is part of their peculiar culture and work idiosyncrasy.

This will be like that because the mechatronic systems (that is: systems that combine physical and tangible machinery with data and digital processes) have been capable of making better decisions and also have no problem in cooperating with each other and interacting with human beings, this will transform them, once all of the goods and services processes are automated, into a true factory – *intelligent, autonomous and robotized* – that will end up displacing human labor from millions of current jobs; shall this project advance at the same rate it does; towards the middle of this 21st Century some calculations estimate that only a third of the total world population will have a job and will be able to survive relying on the income obtained from their paid work.

Also, Klaus Schwab himself illustrates that in the *WEF* in Davos, held in January 2016, there was already a glimpse of what the most enthusiastic participants have in mind when they discuss Industry 4.0, which is the sum of the *interaction* of Artificial Intelligence, quantum computing, nanotechnology, neurotechnology, robotics, biotechnology, energy storage systems, drones and 3D printers, and the Internet of Things (IoT), which are its main agents – yet not the only ones.

Out of such technologies, let us take 3D printing as an illustrative example, in order to measure the magnitude, depth, speed and results offered, allowing Schwab himself to explain:

Also called *additive manufacturing*, 3D printing consists of creating a physical object by printing layer by layer of a 3D model or digital drawing; this is the opposite of subtractive fabrication, which is the way things have been done so far, subtracting layers from a piece of material until the desired shape is obtained. On the contrary, *3D printing starts with loose material and then builds an*

¹³ Cfr. Gorvett, Zaria, ‘Qué es el ‘karoshi’, la muerte por exceso de trabajo que en Japón es un problema de salud pública’, *BBC.NEWS*, October 9th, 2016, <http://www.bbc.com/mundo/vert-cap-37391172>.

object in three-dimensional mesh using a digital template. Unlike serial manufactured goods, 3D printed products can be easily customized.¹⁴

The future, then, has come and is here to stay. Because the basic principle of Industry 4.0 for companies is to have the capacity to create intelligent networks that will be able to control themselves throughout the whole “value chain”. To put it in a simple way we will explain it figuratively, exemplifying with an orchestra: the company will be able to operate without having a human person as director of the figurative orchestra (the intelligent automated company), since it will be able to play alone without needing an individual to direct or monitor it, tell it what or how to do it better, tell it to turn on, suspend or turn off, it will do things as planned and with additional advantages: it will be able to work continuously, it will not get tired or get pregnant, nor will demand vacations, payment of overtime, compensation and not to mention all kinds of pensions.

Due to this enormous technological disruption, the drastic change will imply that political, economic and social models should accompany this new and unprecedented productive reality, since it is necessary to understand what is happening to adopt more collaborative forms of interaction between governments and societies. Thus, Industry 4.0 is closely linked to an advanced production phenomenon that will play a transcendental role in the coming years, as a result of the research and innovation of new disruptive technologies,¹⁵ it is capable of creating *new markets and also totally new products*, instead of improving those whose obsolescence is predicted.

What does Industry 4.0 represent to future companies? For a better context on this answer, in 2017, the Massachusetts Institute of Technology (MIT) established a very illustrative list of the 10 most disruptive technologies, which may be an example:

- 1) The end of body paralysis, using electrodes connecting the brain and the affected part;
- 2) Fast and smart charging of electric vehicles, so they can move around 24 hours a day without using any other fuel.;

¹⁴ Schwab, Klaus. *op. cit.*, p. 31.

¹⁵ Cfr. Castillo, Mario, “Tecnologías disruptivas en la era digital. Las tendencias mundiales y el futuro de América Latina”, *ILPES y CEPAL*, Santiago, 12 December 2016, https://www.cepal.org/sites/default/files/events/files/01_mario_castillo_-_tecnologias_disruptivas_en_la_era_digital.pdf.

- 3) Facial recognition and body tracking, used in China for various purposes;
- 4) A new era of smart photography, capable of taking 360-degree photos;
- 5) Photovoltaic energy cells, to harvest sunlight at 100 percent efficiency.
- 6) Gene therapy 2.0, curing the patient's illness by changing damaged genes.
- 7) The *genetic Wiki*, which will create a cellular and genetic atlas of the human body with the purpose of more accurate diagnostic
- 8) Firewalls and systems created to avoid the latent risk of cyber-attacks and prevent hacking in networks;
- 9) *Machine learning*, that allows the faster understanding and solution of a problem; and,
- 10) New era computing: the functional quantum computers are applied in the field of Artificial Intelligence and big data, as well as the operation and creation of artificial neural networks.¹⁶

The speed of changes is such, that the MIT said that by 2018 there will be an advance in other sectors in surprising ways in 10 topics:

- 1) Metal 3D printing, for all kinds of spare parts;
- 2) Intellectual genes based on genetic risk score for drug creation;
- 3) Carbon dioxide-free (no-CO₂) natural gas, a less polluting energy in the planet;
- 4) Accurate and instantaneous translators in smartphones (Google Translate) or through Pixel Buds headphones that translate another language in real time;
- 5) Ultra-tech or smart cities, designed for latest technologies;
- 6) Artificial intelligence raised to "the cloud" for a wider and unrestricted market, not only for the exclusive use of technological giants;
- 7) Artificial embryos created from human stem cells, a topic with multiple ethical considerations;
- 8) Cryptographic financial privacy through the use of cryptocurrencies;
- 9) Robots with creative imagination, independent of humans; and,

¹⁶ Remírez, Diego, "Las 10 tecnologías más disruptivas de 2017 según el MIT", FORBES México, August 29th, 2017, <https://www.forbes.com.mx/10-tecnologias-mit/>.

- 10) Jump to quantum computing, for the creation of: molecules, proteins, electrolytes, solar cells, conversion of light into liquid fuel, also revolutionizing binary common computers.¹⁷

If we had to reduce what Industry 4.0 implies to a word, we believe that this word would be *disruption*, that is, *the abrupt rupture of what already exists*. To a point where it is not enough to be *innovative*, you have to be *disruptive*.

Nonetheless, disruptive technology evolves much faster than the rate at which its products can adapt to the current market; However, its constant increase mitigates the risk new inventions imply because a *new market will be generated thanks to the evolution of the product itself*, the replacement of which is assured and its eventual placement in a fixed segment or “market niche”. The simplest and clearest of examples are smart cell phones or smartphones, whose versions evolve year after year leaving behind the previous model – already technologically overpowered – and a satisfied consumer will become a captive customer: he will buy the newest, more useful and sophisticated model, leaving the previous one obsolete due to its apparent obsolescence.

That is why the Industry 4.0 phenomenon will inevitably impact individual, family and obviously social behaviours globally, and Mexico cannot be the exception; however, it will affect formal employment and will impact notably on the future of human labor and its social protection mechanisms – both in social welfare and social security – generating even larger social gaps in income inequality; this will influence national and regional geopolitical security, as it also will in the current existing moral and ethical frameworks, since not only will *what* and *how* things should be done in the social sphere change, but also perhaps the most transcendental: *who we are* in the current social context.

This technological revolution has positive implications for *the creation of value, business models, auxiliary services and work organization*. However, in order to benefit from all this, companies must follow a series of steps grouped into five strategic areas as main statements in the value chain: 1) data generation and input; 2) data analysis; 3) human-machine interaction; 4) flexible production; and 5) intellectual property. Professor Marc Sachon – academic director of the International Center for Logistics Research and the IESE

¹⁷ “Las 10 tecnologías más disruptivas que marcarán el año, según el MIT”. El Mercurio, Uruguay, March 2018, <https://www.elpais.com.uy/el-empresario/tecnologias-disruptivas-marcaran-ano-mit.html>.

Program – also reminds us, following the 1988 prophesy that, Harvard professor Shoshana Zuboff stated in terms of technology, about the value chains of technological advance:

All of the processes that can be automated will be automated; everything involved in the manufacture of products that can be computerized, will be computerized; and, all sensors, digital apps and devices that can be used for surveillance, control and distributed decision making will be used exactly for that purpose.¹⁸

It is obvious that the most advanced countries will make technological changes more quickly, and while it is initially possible that countries with emerging economies can benefit from some of the inventions, in the end they will have to adopt the new technologies... although they will have to pay the cost for its use because it will be the intellectual property of others. That is precisely why we should invest in research, in Mexico, right now.

About the disruptive innovation developed and to be developed, the World Intellectual Property Organization (WIPO) announces its World Innovation Index 2017, in which it states categorically that: Switzerland, Sweden, the Netherlands, the United States of America and United Kingdom, lead the annual ranking;¹⁹ And in this list, at the Latin American regional level, are located: Chile in 46th place, Costa Rica in 53rd, and Mexico occupies 58th place, WIPO affirms: no Latin American country presents better results in innovation, regarding their levels of development.²⁰

In a few words: in Mexico we are still stagnating and producing goods and services with systems from the late 20th Century.

On the other hand, considering several scoring factors, according to the classification made by the specialized magazine in business and finance FORBES Mexico, the most advanced countries in projects and achievements in Industry 4.0 are the United States (in America), Japan (in Asia) and Germany (in Europe).²¹

¹⁸ Sachon, Marc. “Los cinco puntales de la cadena de valor en la industria 4.0”, *IESE Business Insight. Business Knowledge*, Madrid, <http://www.ieseinsight.com/doc.aspx?id=1941&ar=5&idioma=1>.

¹⁹ Organización Mundial de la Propiedad Intelectual (OMPI), Índice Mundial de Innovación 2017: Suiza, Suecia, los Países Bajos, los EE.UU. y el Reino Unido encabezan el ranking anual, Geneva, June 15th, 2017, http://www.wipo.int/pressroom/es/articles/2017/article_0006.html.

²⁰ *Idem*.

²¹ Forbes Staff, “¿En qué consiste la cuarta revolución industrial?”, *FORBES México*,

These three countries, along with others who have joined the project of artificial intelligence in their respective continents, with the fixed purpose of achieving *intelligent industrial robotization*, will also be the managers of one of the most controversial premises of change; because although it is true that Industry 4.0 has the potential to raise global income levels and improve the quality of life of entire populations, it is also true that the *achieved transformation* will only benefit those who are able to innovate and adapt to it.

We should add that many countries' populations have benefited from the arrival of the *digital world* thanks to the possibility of making payments, listening to music or requesting a taxi from a ubiquitous and cheap cell phone; however, these benefits have not displaced traditional methods and, on top of that, organized crime has also wreaked havoc on users who trusted too much or knew little about the enormous potential of these transformations.

There is, above this last point, a proper cultural and educational matter we must never lose sight of, especially when not everyone sees the future with optimism: the polls for academic opinion reflect the concerns of employers and workers' unions about the so-called technological Darwinism, a scenario where those who do not adapt to change quickly will not survive. And if the change happens at full speed, the effect can be more devastating, than the one generated by the previous Industrial Revolution.

In this regard, Elizabeth Garbee, researcher at the *School for the Future of Innovation in Society*, in the Arizona State University, warns:

In the game of technological development, there are always losers. And one of the forms of inequity that worries me the most are values. There is a real risk that the technocratic elite will see all the changes that come as a justification of their values... This type of ideology severely limits the perspectives put in the table for decision making (policies), which in turn exacerbates inequity. The enthusiasm is not unjustified, because these technologies represent amazing advances. But enthusiasm is no excuse for ingenuity and history is full of examples of how technology overrides the social, ethical and political frameworks we need to make a good use of it.²²

February 26th, 2016, <https://www.forbes.com.mx/7-de-cada-10-empresarios-ve-positiva-la-cuarta-revolucion-industrial/>.

²² Quoted by Perasso, Valeria, "Qué es la cuarta revolución industrial (y por qué debería preocuparnos)", *BBC Mundo*, 12 October 2016, <http://www.bbc.com/mundo/noticias-37631834>, Date of consultation: July 5th, 2018.

We agree with the opinion of Elizabeth Garbee. Therefore, about having adequate ethical and political frameworks, we propose that a *political option* for Mexico is to carry out *an open, technical and democratic national debate, regarding the objectives of this new economy*, to assume and define responsibilities after analysing the pros and cons. And with respect to the complex *ethical issue* of the consequences of such a radical change, it should be properly pointed that, with that change, business productivity will be increased by decreasing its operating expenses and the companies' profit will be greater; However, inequality in the distribution of income will also bring all kinds of problems (unemployment, labor conflicts and social protection losses, among many other issues to be solved), which will generate ethical business dilemmas, geopolitical insecurity, and legal insecurity in the protection of personal data and intellectual property, among a multiplicity of ethical issues of social significance.

Perhaps for that reason, in the 2016 edition of the WEF of Davos, the theme of “dominating” (sic) this unpublished Industrial Revolution 4.0 was addressed,²³ because surely the price to pay for the benefit obtained was already in mind, apart from the purely social impact; this is demonstrated by the interventions of the experts in the WEF, since the economic benefits of moving forward are at risk due to the multiple existing national and international protectionist measures – particularly by non-tariff barriers, and the typical regulations of world trade that have been exacerbated since the financial crisis of 2007. This complex issue is a huge challenge that Industry 4.0 itself must also *master* if it really seeks to consolidate and legitimize itself socially, otherwise it will not advance as its authors predict.²⁴

It is obvious that with the use of Information and Communication Technologies (ICTs), *formal employment is being seriously threatened* by a peculiar phenomenon that is not only political, economic, social, cultural, legal and even ethical, but also it is a matter of enormous individual and collective human involvement. This phenomenon of production of goods – and above all, of services – known as “intelligent automation” or “total robotization of industries” has already displaced hundreds of thousands of human beings from their usual activity in factories and other work environments,

²³ Cfr. “La cuarta Revolución Industrial, el tema en Davos 2016”, El Financiero Bloomberg, Youtube, January 21st, 2016, https://www.youtube.com/watch?v=HtwPkg_3dAY. Watch the appearance of Joe Biden, former vicepresident of the United States, in Davos' World Forum in 2016, a forum that discussed as a main theme the Industry 4.0.

²⁴ Cfr. CEAL, *Algunas Conclusiones Foro Económico Mundial Davos, Colombia, 28 January 2016*, <http://ceal.co/algunas-conclusiones-foro-economico-mundial-davos-2016/>.

but this phenomenon is to grow exponentially and millions of people will soon be affected.

This *workforce displacement* is an unprecedented phenomenon for humanity, undoubtedly the product of human creativity and research through the use of artificial intelligence, advanced computation designs and the development of innovative and disruptive software designed for the total automation of industrial processes in repetitive tasks. The paradox of this issue is that all this happens when, in most of the world, the fundamental human rights of every individual to work and have access to social security are recognized at a constitutional and legal level.

This phenomenon has affected not only the peculiar way of *doing*, but also of *understanding* to better regulate the subordinate employment of the 21st Century. The implementation of the use of high technology of the most diverse nature in so many environments confirms what Martin Ford says: *robots and these technologies are a real threat of a future without employment.*²⁵

Of course, the main German promoters of the Fourth Industrial Revolution, Henning Kaggermann, president of the German Academy of Science and Engineering; Wolf-Dieter Lukas, of the Federal Ministry of Education and Research in Germany; and Wolfgang Wahlster, director of the German Research Center for Artificial Intelligence, know that Industry 4.0 will only work globally if alternatives are sought to help countries with emerging economies.²⁶ Because at the end of the day, we all know that the market needs buyers, but the unemployed will not be that.

That is why Industry 4.0 as a concept is not only a revolution of the industry, but also is a paradigm shift in the labor market and global trade, which entails a series of enormous social consequences and implications that need to be objectively analysed from all possible angles: political, economic, social, cultural, anthropological, sociological, psychological, medical, financial, actuarial, etc., and also without ignoring their necessary philosophical, philological, historical, legal and ethical analysis, topics specific to social sciences and humanities.

²⁵ Ford, Martin, *El ascenso de los robots. La amenaza de un futuro sin empleo*, trad. de Andrea Gálvez de Aguinaga y Víctor Manuel Cuchi Espada, Mexico, Ediciones Culturales Paidós, 2016.

²⁶ Martens, Klaus, *Relevo de Turno. Los Robots se hacen cargo (1/2)*, DW Documental, YouTube, March 1st, 2018, <https://www.youtube.com/watch?v=8w8Ra18Yiaw>.

IV. IMPACT OF INDUSTRY 4.0 IN MEXICO ON MATTERS OF LABOR AND SOCIAL SECURITY

One of the biggest challenges presented in Mexico by Industry 4.0, is that in this interconnected world we prioritize the urgent over the important. A clear example of this is that we do not recognize the most important social problems as a country and that, when we finally recognize them, we opt for easy ways out, however inadequate for our peculiar national idiosyncrasy.

A couple of examples will help us understand the issues raised:

- *In labor law matters*, two different sample statements: the first one is that in 2017 a constitutional reform was made to shift labor justice administration to the Judicial Power, disappearing *de jure* – although not *de facto* – both federal and local Conciliation and Arbitration Boards, that are tripartite bodies dependent on the Executive Power, this without considering neither time nor costs of such unusual change for which the country was not prepared.²⁷ The second matter is that Mexico was the last country in Latin America and the Caribbean to ratify Convention 98 of the International Labour Organization (ILO) on the application of the principles of the right to unionise, and to collective bargaining, on 20 September 2018,²⁸ This is despite the fact that our country was a world pioneer in recognizing Social Rights in our Constitution.
- *In terms of social security*, the individual pension capital model, accepted on July 1st, 1997 for employment, without an adequate constitutional framework, in the vast majority of cases will cover puny pensions of between once and thrice the minimum wage to the insured, which will impact not only in the life quality of the pensioner and his family, but also in our national economy.²⁹

These examples illustrate for themselves that Mexican Social Law for political reasons, is often late and wrong when trying to regulate the reality

²⁷ Decreto de reforma y adición a los artículos 107 y 123 de la Constitución Política de los Estados Unidos Mexicanos, published in Diario Oficial de la Federación, 24 February 2017, http://dof.gob.mx/nota_detalle.php?codigo=5472965&fecha=24/02/2017.

²⁸ Visit the website: <https://aristeguinoticias.com/2109/mexico/mexico-ultimo-pais-en-al-en-ratificar-convenio-98-oit-modelo-de-corporativismo-ya-no-es-sostenible-alcalde/>

²⁹ Cfr. Ruiz Moreno, Ángel Guillermo, *Las Afore, el sistema de ahorro y pensiones mexicano*, 7ª edición, Mexico, Porrúa, 2017.

of the country. If we adequately analyse the phenomenon of Industry 4.0 and its possible consequences, everything shows the likely threat of a future without employment, even though we have been aware of these changes for at least a decade.

In this context, it is to assume that Mexico has already understood several things: 1) the country is not prepared to adapt the enormous challenge that the aforementioned technological advance imposes on us, because the market is already transforming, with or without legal regulation by the State;³⁰ 2) *the manufacturing sector is the country's driving force*, in which there has been a strong and constant foreign investment, and it is precisely this sector the one prioritizing this Fourth Industrial Revolution;³¹ 3) in Mexico, *manufacturing represents 32 per cent of the Gross Domestic Product, and also represents 35 per cent of the total volume of exports*;³² and, 4) that Industry 4.0, apart from allowing the employer to save up to 30 per cent of the total costs, will completely change the business, since intelligent manufacturing will shortly be the new model of production and commerce, that is, *the new way of doing business*.³³

In that order of ideas, Martin Ford, in his book *The Rise of Robots*, makes a disturbing account of the effects of increasing automation in the economy and the way to earn a living in the near future:

In recent years the selection and hiring of personnel is being threatened; the salaries of recently graduated students have been decreasing at the same time to the point that more than half of them are forced to perform jobs for which a degree is not needed. In fact, as I will demonstrate in this book, many of the jobs for trained professionals – including lawyers, journalists, scientists, and pharmacists – have been significantly affected due to the advancement of information technology; and they are not the only ones. This indicates that

³⁰ Robotics forums, conventions and massive events, at a national and international level, have taken place in the country for more than five years. One example to prove that is a gathering of young people from more than a hundred countries, the so-called *FIRST Global Challenge-2018*, in Mexico City, <http://www.aztecauno.com/mundialderobotica>

³¹ Cfr. Secretaría de Economía, *De enero a diciembre de 2017 México registró 29,695.0 millones de dólares de Inversión Extranjera Directa*, Gobierno Federal de México, February 21st, 2018, <https://www.gob.mx/se/prensa/de-enero-a-diciembre-de-2017-mexico-registro-29-695-0-millones-de-dolares-de-inversion-extranjera-directa?idiom=es>.

³² Celis, Fernanda, “La Industria 4.0 cambiará por completo a los negocios”, *FORBES México*, October 13th, 2016, <https://www.forbes.com.mx/la-industria-4-0-cambiara-por-completo-a-los-negocios/>

³³ Cfr. Martínez, Guillermo, “Manufactura 4.0: un nuevo modelo de negocio”, *Énfasis Logística México*, November 7th, 2016, <http://www.logisticamx.enfasis.com/articulos/76434-manufactura-40-un-nuevo-modelo-negocio>.

we are heading for a transition that will subject society and the economy to a great tension.³⁴

Following these ideas and applying them to Mexico, the potentially devastating impact is a scenario of unemployment or underemployment that will affect society, whose economy will pay at a very high price. *The market requires buyers* and, without a fixed income, the virtuous circle between productivity, wage increases and increases in consumer expenses could collapse the national economy, so the market would have to be restructured in time for better sustainability. In this regard, Martin Ford points out: “*In Silicon Valley, the expression disruptive technology is used indiscriminately, because there is no doubt that technology has the ability to eliminate entire industries and alter specific sectors of the economy and the labor market.*”³⁵

So, the correct question to ask in such a disturbing scenario is not whether Industry 4.0 has already arrived in Mexico, because that is obvious considering our inevitable geographical proximity to the United States; the correct question – and the one that we Mexicans should answer – is be: how will Industry 4.0 affect Mexico in terms of employment and social security?

Since the beginning of the 21st Century, Mexico has undoubtedly followed the theme of Industry 4.0 from the most diverse sectors, among them:

- The *governmental sector*, the Presidency of the Republic³⁶ and the Federal Secretary of Economy³⁷ are pending, alongwith the other national public agencies;
- The *employer sector*, it is a priority to follow up the issue of industrial technology, global trade and business innovation, supporting economically – along with public dependencies – innovative disciplinary and transdisciplinary research as well as business entrepreneurship;

³⁴ Ford, Martin. *op. cit.*, pp. 19-20.

³⁵ *Ibid.* p. 21.

³⁶ Mexico was guest of honor in the Hannover Industrial Fair (Germany), in its 2018 edition, the first country in Latin America and the first Spanish speaking country that received such honor. *Cfr.* PROMÉXICO, “¿Qué tienen en común México, la Cuarta Revolución Industrial y el Foro Económico Mundial en Davos? Que el mundo está hablando de las tres”, *Gobierno Federal de México*, January 24th, 2018, <https://www.gob.mx/promexico/articulos/mexico-dando-forma-a-la-cuarta-revolucion-industrial?idiom=es>.

³⁷ NOTIMEX, *Cuarta Revolución Industrial será una realidad en México: Siemens*, 20 minutos. February 18th, 2018 <https://www.20minutos.com.mx/noticia/334018/0/cuarta-revolucion-industrial-sera-una-realidad-en-mexico-siemens/>. Mexico’s Federal Secretary of Economy and the industrial enterprise Siemens are working jointly in the *Alianza México 4.0* initiative.

- The *trade union sector*, national workers' organizations have barely begun to understand the enormous fragility of their situation in the face of future unemployment, underemployment and the precariousness of work caused by the possible reduction of employment posts, which will make unionising not only difficult, but also collective bargaining, without losing sight of the evident fragmentation that the union sector will suffer medium and long terms; and,
- The *national education sector*, there has been a decision to create committees of experts focused on the theme of Industry 4.0, holding congresses, courses and forums with the participation of specialists who analyse this complex topic; universities and technological institutes for five years have undertaken the task to make adjustments for the creation of new careers that educate young people for the hyper-technological future that awaits us, as well as to renew curricula and the content of subjects that address the topics of this Fourth Industrial Revolution.

As we can see, the inevitable job change in employment is already occurring in Mexico, it is beginning to change towards new forms of work that are not regulated by the Federal Labor Law, and it is oriented towards autonomous and distance work through computers connected to the Internet.

This new work modality will turn most of those who, with a computer, tablet or cell phone used as a digital communication tool wherever they are located and connected to the Internet, into digital nomads, who will do very specific tasks to obtain, in exchange for their intellectual effort, sufficient income to live; provided, of course, they have a digital expertise focused on a specific topic that exploits some specific skill or ability from the individual and qualified occupation market, and as long as that service is required by a third party with needs to receive specialized collaborations and the contractor has enough money to pay for the intellectual support received.

Thus, the *workplace* as we know it would cease to exist, because instead of an office, workers will work from home, a park, a cafeteria or in the car itself, at any time and place as long as there is an Internet connection, and they will be able to do so even through their cell phone. Currently, millions of people work like this.

Legally analysing this unstoppable phenomenon, the human right to work will subsist, although current Labor Law will require reforming the virtual reality complex, because we know that legal science is chasing reality to try and regulate it the best way possible, so it must evolve at the same

pace, in order to avoid leaving the current legal framework and the working class's tuition behind.

We must point out that *human work will not disappear*, because it is inherent and consubstantial to the nature of individuals and is socially useful. *Work* is established as a fundamental right of every individual according to the first paragraph of article 5 of our Mexican Federal Constitution; However, *work subordinated to an employer in exchange for a salary* – that is: formal or decent employment – will undergo an inevitable transformation due to the intrusion of the phenomenon of intelligent robotization, an inevitable consequence of the aforementioned disruptive technological transformation, being an unprecedented event in the history of mankind.

It is possible to forecast that, as the hyper-technological change of Industry 4.0 advances, there will no longer be written contracts, but electronic ones; except for a few exceptions, such contracts will not be for formal employment, but for personal services not subordinated to an employer; their validity will be limited to a specific task or work for a preset time, with the specific characteristics of an independent work, we cannot omit that *this will cause stability in employment to no longer exist* and, consequently, that contractual negotiation between employers and unions will be very limited.

In such scenarios, the old formula of legally regulated employment will not apply, in such subordination and *salary remuneration* were sufficient to guarantee the *jure instatum* legal presumption of the existence of an employment contract subordinated to an employer. The signatory parties of the contract of professional services for a fee will become a *client* and a *service provider*, respectively, instead of employer and operator. Thus, the current formula of the legal presumption about the existence of an ordinary labor relationship, established in Articles 20, 21 and 33 of the *Ley Federal del Trabajo* – regulatory of Section A of Article 123 of the Mexican Political Constitution – will be obsolete. and inapplicable because of the nature of the work substantially changing due to the unavoidable impact of Industry 4.0.

On the other hand, about the pernicious effects on employment, we add that ICT are used both in ordinary subordinate work, as well as in the daily work of public servants; therefore, *the impact of this phenomenon on the national bureaucratic law that regulates it at its three levels: federal, local and municipal will be inevitable*. Currently, we note a non-minor statistical fact: the country's public employees jointly add up to, in round numbers, over five million.³⁸

³⁸ Cfr., Martínez Muñoz, Aleida, “¿Sabes cuántos servidores públicos hay en México?”, IEXE Escuela de Políticas Públicas, Mexico, <http://www.iexe.edu.mx/blog/sabes-cuantos->

Because of this, Industry 4.0 also represents a huge challenge for the Mexican State itself, as it is the largest employer in the country, especially when the routine administrative tasks are the trades or jobs that will be more susceptible to be automated. In this thread of ideas, the government sector should invest in intelligent technology for its daily operation and, consequently, liquidate hundreds of thousands of public servants, who will suffer these profound changes over the years. This requires the design of *public policies in line with the new labor reality and social security*.³⁹

Thus, the unstoppable implementation of Industry 4.0 will affect both the current labor relations, and collective bargaining between employers and their workers' unions in terms of social security; there is to add that with equal strength *it will affect the current Mexican social security systems*, so there will be a need to rethink modifying this social protective system. And if formal employment decreases, then it becomes necessary to look for alternative sources of financing for this indispensable specialized public service that has brought a lot of welfare to Mexican society during its three quarters of a century of fruitful existence.

The big question to all this is: how will they protect all those unfortunate ones who are to be unemployed and replaced because of automation and their respective families, by extension? And this question is pertinent since in Mexico, historically and legally, a very peculiar phenomenon has been happening: since January 19th, 1943 – the date on which the original *Ley del Seguro Social* was published⁴⁰ – *there is definitely not a way of understanding employment without linking it to social security*.

An irrefutable proof that *social welfare* should be the protective system linked to employment and not social security, is in the name of our Constitution's Title Six: "Labor and Social Welfare", a Title that is reduced to a single precept: the already mythical constitutional Article 123. Without entering into conceptual problems or delimitations on the field of legal regulation of each social protective system, in our written work we have always maintained – and many work and social security experts agree on this – that the concepts of work and employment are not synonymous; because at least

servidores-publicos-trabajan-en-mexico.html Date of consultation: 5 July 2018. In this document, IEXE informs that, with the exception of medics, nurses, pólíce officers and teachers, around 4'925,493 Federal, State and Local public servers work in Mexico as of today.

³⁹ INEGI, *Estadísticas a propósito del Día de la Administración Pública (23 de junio)*, INEGI, Aguascalientes, June 21st, 2017, http://www.inegi.org.mx/saladeprensa/aproposito/2017/publica2017_Nal.pdf.

⁴⁰ Ley del Seguro Social, January 19th, 1943.

in Mexico, work is contemplated in Article 5, while employment is regulated by Article 123, both precepts of our Mexican Political Constitution. Therefore, it is logical that each of the articles and systems should have their own legal regulation.⁴¹

In this regard and as a proposal to meditate, the aforementioned constitutional precepts should be adequately regulated so each one counts with a specific social protection system:

- a) *Work* of all sorts, including independent work or self-employment, and informal work, this would be protected by the *classic social assistance* and have a proper *social protection floor*;⁴² this does not impede in any way the *free access to the national social security system, because it is a human right of all and for all individuals*, being also a public service whose only responsible guarantor is the Mexican State. and,
- b) *Subordinate or formal employment* must be protected through social welfare as its own system of labor protection, according to its own legal nature; and in addition, it should have a specialized public *social security* service that covers employers, the operator and its immediate family, coverage based on the theory of social risk in the *Ley del Seguro Social por México*, and extendible to the rest of Social Security.⁴³

Standing before a complicated reality of mass unemployment caused by Industry 4.0, it is a good idea to *legally separate, once and for all, formal employment from social security*, since by *removing the link between social security and work* and adopting new rules of access to insured social groups, rational benefits, and looking for a renewed way of financing; it is feasible to maintain this right, that the current generations could not live without.

V. CONCLUSIONS

We are at a crucial moment for the future of the country, because by properly combining protective systems it would be feasible to achieve a genuine *uni-*

⁴¹ Ruiz Buenrostro, Ángel Edoardo, *Bases mínimas para una seguridad social universal. La unificación de los seguros sociales en México*, Mexico, Porrúa, 2017, pp. 41-44.

⁴² Cfr. Schwarzer, Helmut et al.(coords.) *La Estrategia de Desarrollo de los Sistemas de la Seguridad Social de la OIT. El papel de los Pisos de Protección Social en América Latina y el Caribe*. OIT, Lima, 2014, http://www.ilo.org/wcmsp5/groups/public/---americas/---ro-lima/documents/publication/wcms_317898.pdf.

⁴³ Ruiz Moreno, Ángel Guillermo. *Nuevo Derecho de la Seguridad Social*, op. cit., pp. 482 ff.

versal social security, even implementing a *social protection floor* which Mexico has already recognized, but still does not dare to implement.⁴⁴

With the adoption of a reform to the Mexican social security's legal framework, adequate coverage could be given to the self-employed sector—Most of them, people who work behind a computer through the Internet—and in the same way, the income would be extended to anyone who wants to and has the possibility of voluntarily joining this specialized national system, because in reality *it has never been free*.

Whereas, with the adoption of an *innovative social protection floor*, the rest of the population would have the option of a *generic social protection*, integrated by different specific protective systems, namely:

- a) The *national system of social protection in universal health*;
- b) Social assistance paid by the State treasury, managed by the State;
- c) *Social labor welfare* for subordinate employees, a system created through collective bargaining; and,
- d) *Complementary social protection systems*, such as private life, disability, major medical expenses and unemployment insurances, etc.

Whatever we Mexicans decide to do in this regard, we must act as soon as possible; legislating and complementing operational public policies at a national level, because the Mexican State must react quickly to this contingency. While making these decisions, it should not be overlooked that the eventual replacement of individuals by intelligent machines and robots has moved people from the technological industry to look for ideas to sustain social protection. An example of this, is American billionaire, Bill Gates, owner and founder of Microsoft, the world's largest personal computer and software company, who surprised everyone when, on February 17th, 2017, in an interview for Web magazine Quartz Media, suggested that *robots that do work pay taxes*.⁴⁵

Of course, an intelligent robot is not a person and therefore cannot be taxed as such; however, the owners of these machines are human beings and obtain considerable savings by replacing people with robots and automated

⁴⁴ Cfr. OIT, *México y OIT firman convenio de protección social*, Noticias ONU, Geneva, 18 June 2013, <https://news.un.org/es/story/2013/06/1274761>.

⁴⁵ El Mundo, *Bill Gates opina que los robots deben pagar impuestos*, El Mundo, Madrid, Spain, February 2017, <http://www.elmundo.es/tecnologia/2017/02/20/58aab904ca4741657a8b45dd.html>.

machines, in the production processes of their companies. Therefore, they must pay higher taxes to contribute to public spending.

Bill Gates, as a pioneer and now a guru of information technology, argues with great reason that there may be a great inconvenience to consider in the future: *the eventual slowdown of the Industry 4.0 phenomenon*, that is, the fact that there will be fewer companies investing in automation, if they have to pay other taxes for using robots. However, he also believes that in the medium and long term, it would become the most manageable situation to alleviate the unemployment that the huge displacement of people will create; because those affected can be redirected to other sensitive activities that are complicated to automate, focused on social services, and improving the quality of social life, such as dedicating oneself to the care of children, the elderly, the disabled or the sick.⁴⁶

Of course there may be other options to finance our social security, among them: creating new taxes, raising taxes, or opting for the so-called *universal basic income*,⁴⁷ an alternative model with the premise that the State can grant every person in the community a basic income. This last topic will not be further discussed because of its enormous complexity and space reasons.

In the legal field, due to the massive use of the Internet and computer media, computer *security is necessary*, giving citizens legal certainty regarding the protection of their personal data, in addition to supporting the enormous investment from third parties that is required to carry out the necessary technological research to materialize Industry 4.0 throughout the country.

It is therefore imperative to legislate on Digital Law, to better address and regulate the issues of the National Industry 4.0 in Mexico. Not only we should have a *substantive federal regulation* that allows the creation of legal doctrine in technologies – because it is true that the Third Industrial Revolution forced us to contemplate, out of legal science, issues such as the use of

⁴⁶ Cfr. Delaney, Kevin J, “The robot that takes your job should pay taxes, says Bill Gates”, Quartz, Quartz Media LLC, February 17th 2017, <https://qz.com/911968/bill-gates-the-robot-that-takes-your-job-should-pay-taxes/>. Ver vídeo de la entrevista a Bill Gates.

⁴⁷ We recommend to readers interested on knowing what *universal basic income* is, the document: Artero López, Jesús Manuel *et al.*, ¿Es viable financieramente una renta básica universal en Andalucía?, Departamento de Economía e Historia Económica, Universidad de Sevilla, España, 2016, <http://ustea.es/new/wp-content/uploads/2017/11/Es-viable-financieramente-una-Renta-B%C3%A1sica-Universal-en-Andaluc%C3%ADa.-JM-Artero-L%C3%B3pez-y-otr@s.-US.pdf>.

electronic money, electronic trade, electronic signature, and electronic payment and transfer systems. However, legislating, for example, on electronic crimes, the use of crypto currencies or the eventual dematerialization of credit titles is a priority.⁴⁸ Millennials should collaborate to their own future, because in Mexico there is talent to spare.

It would also be urgent to create, in parallel to the substantive aspect, a *procedural federal legislation in the area of Digital Law* that includes such aspects as: administrative and judicial electronic procedures; elements of evidence – both in the presenting and in its objection – and basic rules that must be observed by jurisdictional resolutions in this matter; all in all with the idea of granting legal security in the administration of justice and being able to systematize the criteria used by the federal courts that process means of challenge or litigation for the aforementioned Law.

Finally, when it comes to the transformations that have generated technological changes due to the industrial revolutions in the production of goods and the supply of services, not only will society resent its impact but also the country's authorities. For that reason, the *State* must intervene in order to regulate once and for all the empire that is proper to the market, creating a new legal framework according to the needs of the country, alleviating as far as possible the unfavourable effects for the national working class.

The changes forged by Industry 4.0 not only will affect those working in the productive sector; at the same time, they have already had a profound impact on every conceivable area of contemporary societies, although they had a different impact among developed countries and emerging ones.

Out of the disruptive transformations generated by the implementation of new technologies in virtually the entire planet, there is a great concern on how to *preserve a social welfare system* that does not slow down the progress of this new industry. At the same time, it should be of use to all Mexicans in the most diverse sectors; hence the urgent need to anticipate events to take advantage of this technological progress, from all areas: political, social, economic, cultural, academic and legal.

It will be necessary to *reach a consensus and achieve social legitimacy* when making adjustments, legal changes and public policies; which will be achieved by providing the population with accurate and timely information about Industry 4.0. Particularly, emphasis should be placed on education and seek to redistribute income and social security to the workforce that

⁴⁸ Durán Díaz, Óscar Jorge (coord.), *Derecho y Medios electrónicos. Temas selectos*, México, Porrúa, 2012.

will be replaced in their usual jobs by automated machinery equipped with artificial intelligence.

We must never forget that technology is just a tool for facilitating the existence of human beings, being a great myth that intelligent robots *think*. Intelligent robots are programmed exclusively to act according to the programs of their creators, who in the end are also human beings.

All in all, the economic destitution in which part of the Mexican population would fall into, is a problem worth preventing, rather than solving.

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ROMANIA AND INDUSTRY 4.0

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SUMMARY: I. *Introduction*. II. *Level of implementation of Industry 4.0*. III. *Digitalization of work*. IV. *Necessary reforms in the economic and legal field*. V. *Advantages and opportunities for Romania*. VI. *Conclusions*. VII. *Research sources*.

I. INTRODUCTION

At the end of the 18th Century, the First Industrial Revolution replaced manual labor with steam engines and railways, and a century later, the Second Industrial Revolution brought electrification and mass production. The Third Industrial Revolution brought computers (after 1970) and the Internet (after 1990), second-hand electronics, information technology and the first robots to automate certain industrial processes.¹

With the effects of the First Industrial Revolution there were benefits for England, which managed to maintain the world's first industrial power in the 1900s, the Second Industrial Revolution, distinguished by mass production and the development of industries such as the electric, chemical or automotive industry, in the foreground of Germany's industry, and digitalization is considered the Third Industrial Revolution.

Currently, we are witnessing an unprecedented change in production patterns, business, government and social organization, a widespread use of the Internet and the digital technology gap that fully justify the announcement of the Fourth Industrial Revolution.

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¹ Vaida Paula, *Despre Industria 4.0 și implementarea conceptelor pe care le promovează în cadrul industriei românești de turnătorie*, <https://ccicj.ro/.../despre-industria-4-0/pdf>.

The emergence of the 3D printer, capable of producing even food, proceeds to what experts call “The Fourth Industrial Revolution.”

While, in Europe, focus is on personalized production, the quality and production of the consumer market in Romania as a member state of the European Union are under an important transformation of industrial production through the fusion of digital technologies and the Internet with the conventional industry.

More and more industries are looking to replace² employees with robots,³ which can work continuously and whose work is not subject to taxes by the State.

The automotive and metallurgical industries are the largest markets for co-workers and collaborative robots, followed by the processing of electronic, plastic, food and pharmaceutical products.

These robots work together with workers and are flexible, easy to program, safe and inexpensive. Romania had in 2016, according to the International Robotics Federation,⁴ 11 robots per 10,000 industrial workers.

Whilst South Korea had 437 robots per 10,000 employees, Japan had 323 and Germany, 282.

A study carried out by the World Economic Forum, titled “Work in the future,”⁵ predicts that by 2020 more than 5 million jobs will be lost in all sectors and all geographical regions, such losses would be partially compensated, through the creation of new jobs in highly qualified fields.

The notion of work through important changes caused by the development of technology and the development of supposedly sophisticated machines mark the existence of artificial intelligence work. However, the fear of the reduction in employment due to industrial robots is unjustified, since only less than 10 percent of jobs can be completely automated,⁶ the rest will be occupied by more human workers.

² Georgescu Laura, *Inteligența artificială și impactul ei în societate, mai ales în ce privește locurile de muncă*, Revista română de dreptul muncii, nr.2 de 2018, p. 25.

³ Colgate E. James, Peshkin A. Michael, Wannasuphprasit Witaya, *Operators*, Proceedings of the International Mechanical Engineering Congress and Exhibition, Atlanta, GA, DSC-Vol. 58,

Nov. 17-22, 1996, pp. 433-439.

⁴ ----- Raport Mondial privind Robotica 2016, *Uniunea Europeană ocupă primul loc în cursa globală a automatizării* <https://www.ttonline.ro/pdf>, fecha de consulta: 19 June 2018

⁵ ----- *The Future of Jobs*, <http://reports.weforum.org/future-of-jobs-2016/pdf>.

⁶ Deacu Elena, *Coboșii viitorul muncii automatizate?* adevarul.ro > Economie > Afaceri, Date of consultation: 19 June 2018..

The Fourth Industrial Revolution, or Industry 4.0, which “erases the boundaries between physical, digital and biological areas”,⁷ based on the digital revolution, it is already present to advance the economy in new directions, advanced robotics, artificial intelligence, nanotechnology, biotechnology, the Internet and 3D printing of autonomous vehicles, so that industrial relations change as robotization progresses.⁸

The “Industry 4.0” concept, promoted for the first time by Germany’s Ministry of Research and the Ministry of Economic Affairs,⁹ soon became a synonymous for the industry’s future, by essentially referring to the factories that have digitized their technologies so that the facilities and the equipment can communicate with each other through the Internet, marked by a strong personalization of products under mass production and interconnectivity.¹⁰

Industry 4.0 focuses on the complete digitalization of all physical assets and processes, as well as on the integration of digital ecosystems with partners in the value chain. Data Management and Analysis (Data & Analytics) has a central capacity for Industry 4.0, since they are facilitated by specific technologies.¹¹

It is announced that the Industry 4.0 impact will appear in several areas, with important effects at a socioeconomic level.

From an economic point of view, Industry 4.0 is an opportunity to re-launch, re-technologize production and develop commercial models for services and products.

Because the political and social objectives of reindustrialising¹² Europe for sustainable development after two decades in which production has moved to Asia and only one in 10 companies at the EU level have converted it into manufacturing, The European Commission has developed a plan for

⁷ Schwab Klaus, *The Fourth Industrial Revolution*, Crown Business, New York, 2016.

⁸ Sebe Mihai, *O dezbatere necesară privind viitorul muncii. A Patra Revoluție Industrială - este posibilă o robo-apocalipsă a locurilor de muncă tradiționale?* <https://adevarul.ro/tech/stiinta/o-dezbatere-necesara-privind-viitorul.../index.htm>

⁹ ----- *Ce înseamnă Industry 4.0 pentru angajații și patronii din România – salarii mai mari și profituri crescute*, www.zf.ro/.../p-ce-inseamna-industry-4-0-pentru-angajatii-si-patronii...romania...si-pr/.

¹⁰ Luca Dan, *România și revoluția industrială 4.0*, www.zf.ro/opinii/opinie-dan-luca-romania-si-revolutia-industriala-4-0-13780009/poze/, Date of consultation: 20 June 2018.

¹¹ ----- *O nouă revoluție industrială! Ce este “Industry 4.0”*, https://www.dnews.ro/o-noua-revolutie-industriala-ce-este-industria-4-0_511383.html/.

¹² Nae Laurențiu, *Industry 4.0 în România* 26.10.2016, <https://www.ttonline.ro/revista/t-t-plus/industry-4-0-in-romania>.

“European industrial renaissance”.¹³ In 2014, the added value in production represented only 14.5 per cent at the EU level and the growth target was 20 per cent by 2020.

The Fourth Industrial Revolution has produced a turbulence in the processes of production and the technology for information processing, transmission and communication induced by the Internet. With new intelligent processing industries, smart and personalized products are offered to consumers.

Throughout a vast historical evolutionary space, a theory of industrialization has been imposed for the last two centuries, and after 1990 the term of deindustrialization has also emerged.¹⁴ The last industrial revolution, and especially the deindustrialization, is under the impact of new materials and technologies of information and communication.¹⁵

The industry is preparing for a new era called Industry 4.0 or the Industrial Internet of Things.¹⁶ It is a world in which processes are locally pre-designed in factories and will be interconnected globally.

II. LEVEL OF IMPLEMENTATION OF INDUSTRY 4.0

There are opinions according to which Romania still could not make the leap from Industry 2.0 to Industry 4.0, although the current economic situation contradicts this claim.

It is shown that the job market will change, but it is difficult to predict if there will be more or fewer jobs in general. The lack of personal digital competence cannot be invoked because there is a necessary legal framework on tax incentives for such employees, who are exempt from payroll tax for several years.

On the other hand, the speed of the Internet connection in Romania is one of the highest in Europe, and digitalization skills can also be found. There is a tradition of production and good technical universities.

¹³ ----- Industrial Renaissance, <https://www.ecepr.org/projects/industrial-renaissance/>.

¹⁴ Ciutacu Constantin, Chivu Luminița *Romania's deindustrialization, from the „Golden Age” to the „Iron Scrap Age”*, Elsevier Procedia Economics and Finance, Vol. 22, 2015, pp. 209-215.

¹⁵ Ciutacu Constantin, Chivu Luminița, Georgescu George, *Descompunerea și recompunerea structurilor industriale din România direcții de strategie*, Institutul național de cercetări economice „Costin C. Kirițescu” septembrie 2016, <https://www.pirom.ro/descompunerea-si-recompunerea-structurilor-industriale-din-ro...>

¹⁶ Hângănuț Radu, *Roboții sunt industria*, www.revistasinteza.ro/robotii-sunt-industria.

A study conducted by the Centre for European Economic Research (ZEW)¹⁷ argues that two issues such as reducing unemployment and increasing robots are closely linked by the fact that robots create jobs and do not keep employees out of work, as many people would think.

The previous study confirms the events in Eastern Europe and Romania, where robotics has helped reduce unemployment and wage growth. In this context, the number of robots installed for every 10,000 employees in Slovakia and Slovenia is more than 130 units larger compared to the global average of 74 robots per 10,000 employees. Czech Republic has a density of 100 to 10,000 robots of workers, while Hungary has 60 and Poland has 30 units out of 10,000 workers.

Romania still has a low density of 15 robots per 10,000 employees and needs more than 10,000 robots in the coming years in order to maintain competitiveness in the region.¹⁸

In Romania, there is a national interest on these issues, leading to the adoption in 2015 of the National Digital Strategy for Romania 2020,¹⁹ although it does not directly address the issue of robotics, modelling in the European Parliament has an important economic component in field of action 3 – e-commerce, research, development and innovation in ICT– it is estimated that for the implementation of measures in the field of action 3 will generate an estimated impact on the Romanian economy increase of approximately 3 percent to GDP and 2 per cent to jobs in 2020²⁰.

The importance of this Strategy is once again reinforced by the 2017–2020 Governance Program, which has a different component than the Communication and Digital Convergence Policies.

The considered objective is “fast and unlimited access to information tools and their facilities, communication and information technology, in order to take advantage of superior human energies, creatively shaping an equitable

¹⁷ Abrihan **Raluca**, *Roboții și piața muncii: Mai puține joburi sau șomaj mai mic? – studiu*, <https://economie.hotnews.ro/stiri-it-22415572-robotii-piata-muncii-mai-putine-joburi/>,

¹⁸ Deacu Elena, *Robotizarea creează noi locuri de muncă și susține creșterea salariilor*, <https://adevarul.ro/Economie/Bani>,

¹⁹ Government Decision no. 245 of April 7th, 2015, published in the Official Gazette of Romania no. 340 of May, 19th 2015.

²⁰ ----- *A Patra Revoluție Industrială - este posibilă o robo-apocalipsă a locurilor de munca tradiționale?*, <https://www.antena.ro/.../a-patra-revolutie-industrială-este-posibilă-o-robo-apocalipsă/>.

society and contributing to economic growth and the competitiveness of Romania.²¹

Logistics companies were among the first to use mobile devices as means to manage and monitor their processes.²² Manual devices used by collectors or transporters have provided the first benefits in the automation of logistics processes.

One of the world's leading providers of technology and services is Bosch Group, which has announced that it is planning substantial investments from 2016 in Romania, especially to further develop the capabilities of producing mobility solutions.²³

III. DIGITALIZATION OF THE WORK

Digitalization is one of the fundamental concerns of the European Union. The Digital Single Market is part of the Europe 2020 strategy that is based on principles and ideas, such as “digital inclusion”²⁴ (related to social inclusion), ideas designed precisely to allow all categories of people to take part in technological changes that digitalization brings.²⁵

In May 2015, the Commission presented the Digital Single Market Strategy²⁶ to address the challenges facing the digital economy.

In this strategy, the Commission is committed to adopting simpler and less burdensome rules for companies. This includes making digital solutions that they can use throughout their life cycle available, especially to record and archive their own documents and information.

²¹ Governance Program 2017-2020 www.cdep.ro/pdfs/gw201706/Program_de_Guvernare.pdf.

²² Biszok Bogdan, *Industria 4.0, o nouă revoluție digitală în transport și logistică*, www.capital.ro/industria-40-o-noua-revolutie-digitala-in-transport.html

²³ ----- Bosch implementează, în fabricile de la Cluj și Blaj, soluții ale „Industriei 4.0“, www.agir.ro/Univers_Ingineresc/pdf.

²⁴ European Commission, *Digital Inclusion for a better EU society*, <https://ec.europa.eu/digital-single-market/en/digital-inclusion>.

²⁵ Dimitriu Raluca, *Dreptul muncii. Anxietăți ale prezentului*, editura Rentrop & Straton, București, 2016, p. 446.

²⁶ Comisia Europeană, *Strategie privind piața unică digitală pentru Europa*, <https://eur-lex.europa.eu/legal-content/RO/TXT/>.

We are witnessing a revolution that is supposed to generate mutations as important as the industrial one: digital upheaval.²⁷ The digitalization of work tends to structurally modify organization from a legal point of view.

First of all, we must admit that digitalization has remarkable effects on productivity or performance; it allows a general reduction in costs and especially in those with logistics. Digitalization has important positive effects on the worker–employer relationship and the personal life of those who work. It leads to the possibility of harmonizing professional and family life; A worker who is no longer required to be at work at a certain time enjoys a temporary flexibility that allows him to carry out the duties of the family, raise children, care for elderly relatives or respect personal biorhythm in their activities.

On the other hand, digitalization allows maintaining work contracts, even in conditions of relocation of the unit.

In some cases, workers who would normally have been laid off could be kept in the company; they continue doing the same activity as before, but when the employer is based in the territory of another country.

Many new jobs have been created thanks to digitalization; the flexibility this program allows and teleworking has made it possible for people who otherwise would not have had this opportunity, to enter the labor market .

Digitalization has the merit of allowing the labor inclusion of people with disabilities, whose journey to work in another way would be difficult or impossible. And even for people who have difficulty walking, it constitutes a work day relief by eliminating time spent in traffic, travelling to work.²⁸

On the other hand, according to some estimates,²⁹ digitalization would make it possible to avoid large urban areas, the choice to live in rural areas, close to nature and therefore does not mean the termination of employment by the company.

Digitalization is professional training. Even if the idea of lifelong learning is not new, it has to be said that with the digital revolution it has become an indispensable requirement for continuous, automatic employment: software programs change, communication systems change, devices are always

²⁷ Dimitriu, Raluca *op. cit.*, p. 445.

²⁸ *Ibidem*, p. 446.

²⁹ Smith Damien, *Future of work. Effects of the digital revolution on employment and civil society* Conferinta Eurofound “The impact of digitalization on work” (may 2016), http://www.eurofound.europa.eu/sites/default/files/ef_even/field_ef_documents/smith_p.pdf.

different – so the worker is subject to a process (often self-imposed) of continuous professional development.

There was a new indicator of this type in the analysis of the labor market: the number of contracts in which the worker carries out a job at least once per week outside the workplace; teleworkers are no longer a separate category, but represent the rule in certain systems (notably in the Netherlands).³⁰

The reality of labor relations makes it harder to keep up with these enthusiastic estimates. In fact, it is not usually the worker who initiates these changes in the work schedule; it is not he who wants to work from home or be permanently connected to his employer's platform. But it is the employer himself who proposes or imposes such arrangements; and the savings they make are important.

Because, in fact, changes in terms of free time, privacy relations and collective work are – as we have previously had the opportunity to demonstrate – the most important ones.

As it expands in all spheres of professional life, digitalization can lead to an unexpected evolution of the relationship of subordination; the worker is in permanent contact with the employer, so he is practically under his permanent control.³¹

- 1) Subordinate over-autonomy
- 2) Subordination to exploitation

This has sometimes led to promoting the idea of the “right to cancel” that any employee aspires to be entitled, without fear of reprisal.

Of course, we cannot jump to the conclusion that digitalization automatically leads to exploitation, since workers on the computer would immediately have a harder life than the lives of workers on the construction site.

But one cannot ignore the fact that change in employment and the effects of this change imply something more unknown than we think. In fact, the effects of digitalization can be felt:

- In terms of collective labor relations, the reduction of the unionisation rate is often confronted with the fact that workers do not work

³⁰ European Commission, *Digital Single Market*, <https://ec.europa.eu/digital-single-market/en/digital-inclusion-better-eu-society>.

³¹ Dimitriu Raluca, *op. cit.*, p. 447

together in the company, so that each individual develops a personal relationship with the employer and is not mediated. Although we are still in the embryonic stage, the so-called online activism has appeared in response to these events: new forms of collective organization, forums and online communities, which tend to move collectivism in the plane of virtual reality.

- In the disciplinary and subordination report plan, through platforms, workers are directly connected to customers. The presence of the employer is almost unrecognizable: it is the clients who exercise control over the way they work; through the comments provided after having benefited from the service provided, they determine the immediate evaluation of professional performance. The Uber case is emblematic from this point of view.³²

They are apparently self-created workers (because the management control that characterized the employer's position in a typical subordination relationship is no longer exercised by the same means). But, in reality, subordination is extended in this way: both in intensity and duration;

- In terms of work time. Time is no longer clear, as is its correlation with the duration of rest time. The number of hours actually worked can be difficult to quantify, and free time is not only less, but also more unpredictable – in relation to how Fordist work is performed. On the other hand, due to the open possibilities of digitalization, there are numerous companies that no longer control employees for arrival and departure times, only pursuing their results. The shorter the time of work, the paradoxical effect of the invasion takes place, so the work on free time can be anywhere, and the one who works - in the plastic expression of Patrice Adam - is considered a “nomadic worker”.³³
- In terms of contractual arrangements. Digitalization favours the conclusion of typical and atypical contracts. It is obvious that many

³² Adam D., Bremermann M., J., Fonta-Narosa F., Kraemer B., Westphal H., Kunert A., Tonnes Lonnroos L., *Digitalization Duran and working life: lessons from the Uber cases around Europe*, <http://www.eurofound.europa.eu/observatories/eurwork/articles/working-conditions-lawand-regulation/digitalization-and-working-life-lessons-from-the-uber-cases-around-europe>

³³ Adam Patrice, *L'individualisation du droit de travail*, Librairie Générale de Droit et de Jurisprudence, Paris, 2005, p. 364.

of the contractual arrangements that have emerged since the 2000s are fundamentally linked to the digital revolution;

- In terms of performance evaluation. Traditionally, the evaluation of employee performance is carried out by the employer, according to the evaluation criteria, in our country, (Article 17 para (3) e) of the labor Code) provided by the labor contract. Through direct relationships with customers, digitalization directly favours performance ratings through qualification and the comments that are made at the end of the collaboration with the company. This change is not without consequences in terms of the very concept of professional correspondence;
- In terms of health and safety at work. If industrial accidents and occupational diseases have arisen during the industrial revolution, new types of accidents also appear during the digital revolution, which can hardly be considered as accidents by common parameters of width, for example, accidents caused by wear and tear – a type of nervous overload that results from the state of tension and intensity of the activity for a long time, but it does not always correspond with the definition of the work accident. Studies in the field of occupational health attest to a multiplication of cases of exhaustion, anxiety and depression among workers who are in permanent contact with the work environment;
- In the level of professional training. Digitalization, technology and the rapid ageing of the means of production make it necessary to adapt to an unprecedented workforce. Accelerated technological progress leads to a rapid permeation of knowledge already accumulated by employees; “Survival” in an environment of such intense competition, an absolutely continuous intellectual effort is required;
- From the point of view of the right to privacy. The separation of privacy from private life is no longer very clear, and permanent contact with the employer through online platforms diminishes the worker’s area of personal freedom. It is said that the latter is an almost continuous availability. Producing effects and the appearance of superior technological surveillance, means practically permanent surveillance over employees (video, GPS, etc.), both in the workplace and outside of it. This is what some authors call “modern slavery”;
- In the field of human resources management and work organization. Monitoring is permanent; the employer does not always do it,

but the client does it directly. In fact, all elements of work organization tend to change as a result of digitalization;

- From the profile of the worker's point of view of technological changes have had a significant impact on the generation that graduated in the year 2000 (young people called "millennials"), whose differences exist with previous generations,³⁴ by values, attitudes and forms of social interaction that transform the labor relations, innovating in who these educated young people are, they show respect to the authorities— often with attention deficit, ambitious, anxious and aware of their value – millennials are generally determined by the many events that took place during its formation, but especially digitalization.

Companies in Japan and Germany are implementing digitalization mainly to increase their efficiency and product quality.

In the USA, the tendency is to develop new business models using digital services and offers and provide these products and services digitally, as quickly as possible.

China's manufacturing companies focus on ways to satisfy international customers by reducing costs.³⁵

IV. REFORMS NECESSARY IN THE ECONOMIC AND LEGAL FIELD

The digitalization of work tends to structurally modify how this activity is legally organized. Digitalization produces remarkable effects in terms of productivity or performance; allows the reduction of general costs, especially those related to logistics.

Digitalization has important positive effects on the worker / employer relationship and the personal life of those who work. It leads to the possibility of harmonizing professional and family life; a worker who is no longer required to be at work a certain time enjoys a temporary flexibility that allows him to carry out family duties, raise children, care for elderly relatives or biorhythm; and develop their personal activities

³⁴ Dimitriu Raluca, *op. cit.*, p. 449.

³⁵ -----O nouă revoluție industrială! Ce este "Industria 4.0?", https://www.dcnnews.ro/o-noua-revolu-ie-industriala-ce-este-industria-4-0_511383.html, Date of consultation: 24 June 2018.

After a legislative proposal,³⁶ Chapter IX, “Work at Home” of the Labor Code was amended and completed by adding four new articles (articles 1071 to 1074) that have defined rights and obligations for telework and *tele-salariatului*; it was stated in Law no. 81/2018 on the regulation of teleworking activity.³⁷

Teleworking³⁸ is defined by article 2

as the organization of work by which the employees regularly and voluntarily perform their functions in the office, occupation or profession that has a place other than the work center, organized by the employer at least one day a month, using information and communication technology.

The application of the labor Law in aspects of teleworking, to verify whether its provisions respond to the interested employers and employees, interested in the flexible way of organizing work.

Its application, on the matter, seeks to establish in its provisions a more flexible way of working in the employees–employers relation.

According to the European Statistical Office (Eurostat), in Romania, only 0.3 per cent of the total number of employees, aged between 15 and 74 years, work from home.³⁹

Europe must take into account rights and responsibilities related to providing robots with artificial intelligence, so, in 2017 the European Parliament adopted a resolution⁴⁰ that provides special legal status for “electronic persons” applicable to autonomous robots. “We are in an era where human intelligence supports artificial intelligence,” argues the report.

A new category of legal issues that could give birth to rights and obligations would be added to the traditional legal entities that could be arise at a certain moment in the labor market.

Dobozi comments⁴¹ that Sofia a

³⁶ Bill no. 109 of 10 February 2014, which modifies and completes the Labor Code, published in the Official Gazette of Romania, Part I, no. 173 of March 11th, 2014

³⁷ Published in the Official Gazette of Romania, Part I, no. 296 of 2 April 2018.

³⁸ Țop Dan, *Regulatory of the teleworking activities in Romania*, *Revue Européenne du droit social* nr. 3 (40) 2018, pp. 26-33.

³⁹ Database - Eurostat, *Statistics by theme*, ec.europa.eu/eurostat/data/database.

⁴⁰ News European Parliament, *Robots: Legal Affairs Committee calls for EU-wide rules*, www.europarl.europa.eu/news/.../robots-legal-affairs-committee-calls-for-eu-wide-rules.

⁴¹ Partner Dobozi, Colțan Tudor, *Drepturi civile pentru roboții umanoizi?*, www.HotNews.ro

humanoid robot, is the first robot that acquired citizenship (Saudi Arabia has decided to do it in October 2017). It is considered a thing and not a person, and must be dismantled and taken luggage to be able to travel by plane, for example; granting civil rights to humanoid robots, although reduced at an early stage, would be a serious mistake from any legislator. It will only be a step towards the elimination of people...

Starting from the idea that a humanoid robot is something made by man, it is for it to be considered as a legal entity, even in a legal fiction, as it was done in 19th Century legal entities, which grouped physical persons and cannot exist independently of individuals.

Even if it could be supported, humanoid robots cannot function without the individual software they use, however, there is a concern that they will be able to update to the point where software is not needed and therefore generate the elimination of the mastery of human intelligence.

According to forecasts, professions that are believed to be disappearing include court officials and the tax office.⁴²

A register of autonomous intelligent robots, as proposed by the European Commission, would not solve the problem of the patrimonial responsibility of intelligent robots, which would obviously become proprietaries and excludes the possibility of constituting a document of recognition for an “electronic person” to be a different subject.

In order for the European Union to maintain its competitiveness as a solid industrial base and manage the transition to an industrial economy and smart services, the digital transformation of all sectors is needed. 75 percent of the digital economy’s added value comes from traditional industries, not from the IT & C market.

But the integration of digital technology done by these traditional companies is the weakest element.

Europe’s digital development strategy is based on four lines of action:⁴³

- Guaranteeing easy access to digital technologies for all industrial companies, especially SMEs. This action can also help complement national and regional digital innovation infrastructures;
- Guaranteeing the primacy of current European industrial platforms in the European digital industry, based on key areas of the

⁴² Florea Magda, *Robotii umanoizi sunt printre noi*, www.manager.ro.

⁴³ -----*Industry 4.0 motorul producției digitale*, <https://cloudmania2013.com/2017/08/09/industry-4-0-motorul-productiei-digitale/>

manufacturing and engineering industries such as the automotive industry, aeronautics and energy;

- Preparing the work that digital transformation should count with - promoting digital literacy in Europe and its regions at all levels and stages of education and training;
- Identifying smart regulatory solutions for the smart industry - the search for the most appropriate way of politically approaching difficult issues, such as responsibility and security, or the ownership of autonomous systems and the use of industrial data.

The Opinion of the European Economic and Social Committee on the effects of digitalization in the service sector and employment in the context of industrial change⁴⁴ also establishes that the new industry of the industrial cycle 4.0 and digitalization have an impact on society. A constructive dialogue between social partners, Member States and the EU is needed to discuss the consequences for the labor market and the possible adaptations and necessary social and labor rights.

Romania's inauguration of the Presidency of the EU's Council in the first half of 2019 should locate Romania with clear options and actions to progress from 2017 to 2018, fulfilling a double conditionality given by national and European interests. Until then, a digitalization strategy of Romania, with priorities for each ministry, with a local public administration linked to the imperative of computerization as a basis to increase the quality of services to citizens, Digital Romania would be useful.

Part of these strategies could be assumed as a priority for Romania under the chairmanship of the Council (provided that it is a vehicle for growth for all Member States), for example, developing a European Cloud for all situations in which companies or people need all kinds of documents, in two or more Member States; or creating a European health card in which Romanian data are interoperable with foreign health systems. It is desirable to develop unique nomenclatures at European level (registration of private companies, and so on).⁴⁵

⁴⁴ -----*Strategia Națională privind Agenda Digitală pentru România 2014 – 2020*, <https://www.juridice.ro/wp-content/uploads/2014/12/Strategia-Nationala-AD.pdf>.

⁴⁵ Gafta Viorel-Nicolae (coordonator) Ioniță Angela, Nițu Ionel, Popa Iulian-Florentin, *România și Piața Unică Digitală a Uniunii Europene. Oportunități și provocări*, Institutul European din România, București, 2018, p. 69.

V. ADVANTAGES AND OPPORTUNITIES FOR ROMANIA

Between 2016 and 2020, there have been numerous research and development programs in Romania, reimbursable in the 4.0 technology industry. They will support the development of Romanian companies and attract foreign investors.

Industry 4.0 announces important benefits that are worth considering at the beginning of the journey. The majority of the benefits are using IoT in manufacturing and optimizing its commercialization.

First, Industry 4.0 would increase productivity through optimization and automation; the main benefit when talking to a player in this market, when all that an entrepreneur wants is more from this sector, is to abandon the costs of downtime and the lack of constancy in the production process. Reducing costs, increasing profits, reducing waste, avoiding errors and delays, increasing production speed and the ability to intervene if necessary is easier.⁴⁶

In the 2014–2020 programming period, Romania benefits from European funds amounting to some 42 billion euros, of which over € 22 billion are allocated to cohesion policy.⁴⁷

Among these programs, we can mention the Regional Operational Program 2014–2020, which aims to increase economic competitiveness and improve the living conditions of local and regional communities. This objective will be achieved by supporting projects for the development of the business environment, the development of Romanian infrastructure and services;

The Competitiveness Operational Program (funded by the European Regional Development Fund)⁴⁸ supports smart growth, promoting the knowledge and innovation economy, investing in strengthening research, strategic development and innovation and improving the use, quality and access to information and communication technologies; The Operational Program for Human Capital aims to increase economic growth by investing in the promotion of employment and labor mobility, especially among young people and people outside the labor market; promoting social inclu-

⁴⁶ Hângănuț Radu, *Roboții sunt industria*, www.revistasinteza.ro/robotii-sunt-industria.

⁴⁷ Programe cu finanțare europeană nerambursabilă 2014-2020, https://www.librabank.ro/programe_finantare_europeana_nerambursabila_2014-2020.

⁴⁸ Fondul European de Dezvoltare Regională, fondurile-euro.ro/fedr/fedr.php.

sion and the fight against poverty, and supporting the education, the development of skills and encouraging lifelong learning, etc.

Even if 60 percent of jobs in Romania could be affected by the 4.0 digitalization of the economy, executives and leaders of government agencies rely on the Fourth Industrial Revolution.⁴⁹

IT companies will have a greater participation; Industry 4.0 will attract new cyber-physical systems (CPS) or services: IT security, Big Data analysis, M2M solutions and Artificial Intelligence.

It is estimated that the automotive industry is the one that uses most of the resources and makes the greatest amount of investments. Even if there are only two car manufacturers, Dacia and Ford, the supply chain is well developed; of the 20 global suppliers, 13 are present in Romania through production facilities

One of the benefits of Romania in terms of Industry 4.0 is that it can become one of the best destinations to invest in new production facilities. Germany is the main sponsor of the Industry 4.0 strategy and one of the largest investors in Romania. The automotive industry will be the one that captures the greatest amount of resources and makes the biggest investment.

The Digital Agenda has evolved and has become a digital single market.⁵⁰ Adopted on May 6th, 2015, the Digital Single Market strategy aims to provide better access to the benefits of digital technologies to all citizens and businesses throughout Europe.

This will eliminate the essential differences between classical and modern economies and will break down barriers to the development of cross-border online activities.

In this new vision, citizens, governments and business environments can have the same access to the benefits of the digital age, favouring the unification of the 28 member states's markets. This could contribute more than € 415 billion to the EU economy and create thousands of new jobs.⁵¹

A single digital market would mean fewer barriers and more opportunities, that is, more opportunities to sell, buy and innovate safely, legally, at a cost or at an advantageous price.

⁴⁹ -----60% din locurile de muncă din România ar putea fi afectate de digitalizarea economiei, <https://www.ziaruldevanca.ro/>.

⁵⁰ European Commission, Digital Single Market , <https://ec.europa.eu/digital-single-market/>.

⁵¹ -----Viitorul digital al Europei se bazează pe a 4-a revoluție industrială, <https://cloudmania2013.com/.../viitorul-digital-al-europei-se-bazeaza-pe-a-4-a-revolut...>

Industry 4.0 is unleashing a revolution in the supply chain. Manufacturers who want to keep up with the evolution of the global industry are beginning to think things beyond the traditional pattern.

Logistic collaboration is a typical circular economy model in which maximum levels of efficiency and sustainability can be achieved in the supply chain.

In Romania, large consumer goods companies have already revolutionized their mode of operation and are working with suppliers and distributors to reduce the distances from factory to transport, costs and pollutant emissions. These companies are ready to take full advantage of Industry 4.0, because they can move and grow in tandem with consumer demand.⁵²

The industrial revolution 4.0 opens a period of opportunity under the impact of new technologies.

It will stimulate the agility of the business, production and logistics chains through the convergence of new technologies.

Transportation, communications and logistics costs will decrease, which will represent a long-term gain in efficiency and productivity.

Increasing the speed of response to the dynamics of demand will increase the competitiveness of manufacturers and the global market. Romanians will spend more on personalized services than on manufactured products, a notable trend in annual growth of 3.7 per cent in March, 2018; compared to 1.4 per cent in the growth of the industry.⁵³

In the context of the Fourth Industrial Revolution, in addition to investing in advanced digital technologies, the transformation into a “digital company” requires a much deeper change.

Companies will have to find new business models, fundamentally rethink how companies work and measure business success, reconsider how they attract, develop and promote digital talents.

Companies that will successfully complete this transformation process will truly become digital businesses with basic physical products, complemented by digital interfaces and innovative data services.

They will communicate in real time with customers and suppliers in interconnected digital ecosystems capable of generating important economic changes in developed and emerging markets, in the latter case, digitalization is a factor to accelerate the emergence process.

⁵² Industria 4.0: cum putem urmări procesul logistic pe smartphone, *www.roatiment.ro*.

⁵³ Revoluția industrială 4.0 – oportunități, sub impactul noilor tehnologii, *https://modernbuyer.ro › Retail & FMCG › Stiri*.

Very often, barriers in the single physical market also affect the on-line market. For example, online services are rarely marketed outside of a country.

Only 7 per cent of small and medium-sized enterprises in the EU carry out cross-border sales.⁵⁴ You can change the situation bringing the benefits of the single market to the online environment.

It was said in this context that

Romania is not yet ready to join the 4.0 agenda of Europe 4.0 ... the delay in the rapid start of actions will lead to the elimination of Romania from the map of the European agenda in this field with long-term negative repercussions for Romanian companies: An active awareness and support campaign is needed to adapt them to European and global digitalization of manufacturing trends.⁵⁵

The role of social partners in Romania in the formulation of industrial policies has a long tradition, but also faces many challenges.

According to a recent study by Eurofound,

industrial policy initiatives are often taken unilaterally by the government, but other options can include social partners in different configurations, which include: bipartite initiatives (a common approach of social partners): tripartite initiatives together with public authorities), tripartite initiatives (the three factors involved in the combination sometimes with other civil society actors, such as NGOs, research centres or qualified public figures), initiatives such as public-private partnerships (a social partner and public authorities), and unilateral initiatives of a single social partner.⁵⁶

It should be mentioned that Romania is struggling to keep up with the demand for specialists and the effects of the emigration of professionals, as a strategy⁵⁷ in order to develop and centralize, in the long term could grow into a market more bidding for investors in technology.

⁵⁴ Priorități | Comisia Europeană - European Commission, https://ec.europa.eu/commission/priorities_ro.

⁵⁵ Banabic Dorel, *Industry 4.0 started. Is Romania ready for the challenges of this new revolution?*, in *Revista de politică științei și scientometrie*, vol. 5, no. 3/ 2016, p. 201

⁵⁶ Vassil Kirov, *Industria României: situația actuală*, www.effat.org/sites/default/files/events.

⁵⁷ Dorobanțu Bianca, *A patra revoluție industrială*, <https://www.forbes.ro/articles/patra-revoluție-industrială-100314>.

VI. CONCLUSIONS

Industrial Revolution 4.0 is a natural step in the evolution of humanity, a new challenge for civilization, which should not have reservations about the use of robots in the economic activity they cannot completely replace human intelligence, artificial intelligence can be even greater than human intelligence, but will always depend on the latter who will have the main role.

New technologies help companies become more productive and create better quality products in a safer work environment. In addition, it allows them to grow and be more competitive in the global market.

There are important development opportunities for Romania in the context of Industry 4.0. To fulfil the true potential of Industry 4.0, Romania needs to plan its digital transformation. One of the most important things is, of course, the creation of an adequate legal framework, such as the adoption of the digital single market telework strategy and the promotion of artificial intelligence. The future of industrial production is digital, and Romania cannot ignore it.

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CHILE AND INDUSTRY 4.0

Pablo Andrés ARELLANO ORTIZ*

SUMMARY: I. *Current situation: our working premise.* II. *Industry 4.0 in the Chilean legislation.* III. *Closing remarks.* IV. *Research sources.*

I. CURRENT SITUATION: OUR WORKING PREMISE

A major factor for the creation of labor law and social security as branches of law was the Industrial Revolution. It generated a complete transformation of production and fundamentally changed the relationship between employers and workers, creating the need for its regulation.

An important feature of this first industrial revolution was the impact of technology on the whole labor market through the steam engine, standing for progress and change at the same time. In the early 1900s, new technological inventions and the appearance of new ways of communication and transportation gave rise to what could be called a second industrial revolution. The development of computers and the Internet at the end of the 20th Century and their impact on the way we work and produce, initiated what we can call the Third Industrial Revolution.

The Fourth Industrial Revolution, or Industry 4.0 as we call it in this project, consists of a period marked by the changes in the labor market due to digitalization and the cooperative coordination of the most diverse areas of the economy.

This new revolution, as all the preceding ones at their time, has fundamentally questioned the validity of the concepts of regulating the phe-

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nomenon of labor.¹ In this case, we have to ask ourselves if the traditional scheme of rendering services still makes sense. Here, we refer to the notion of the full-time working schedule and the fact of rendering services during this established working schedule in the workplace under the employer's supervision. Today, when the employee's presence at the place of work is no longer necessary and working hours do not seem to exist, these concepts appear outdated.²

When thinking about collective bargaining, the new technologies emerging in the wake of digitalization make the simple fact of meeting in a room for a trade union assembly look archaic. Hence, the question is, has the collective principle been overruled by individualism? It seems to be true that the new technologies give rise to the assumption that the Industry 4.0 worker is rather an individualist. This constitutes a challenge for the trade union movement, which sees its membership rate falling continuously.³ Certain voices have uttered doubts whether the unions will be able to survive in this digital platform economy.⁴ Thus, we can define the position of collective labor law, with the idea of getting together with co-workers in a union meeting, as directly opposed to the individualism of smartphone apps. Seeing things like this turns out to be extremely simplified when analysing the challenges and achievements that unions face in our present digital days. If you look properly, you may observe that union worker platforms have had the same effects as traditional unions, and there are plenty of examples of using different apps for union purposes.⁵ So, the good news is that not all is lost.

¹ For example, see: Todolí-signes, Adrián "The End of the subordinate Worker? The On-Demand Economy, the Gig Economy, and the Need for Protection for Crowdworkers" in *International Journal of Comparative Labor and Industrial Relations*, Vol. 33, Issue 2, 2017, pp. 241-268.

² An example of this is the zero-hour contract in the United Kingdom, to know more about see: Adams, Abi; Freedland, Mark R. y Prassl, Jeremias, "The 'Zero-Hours Contract': Regulating Casual Work, or Legitimizing Precarity?" 1 February 2015. *Oxford Legal Studies Research Paper No. 11/2015*. Disponible en SSRN: <https://ssrn.com/abstract=2507693>

³ Consult for example what is indicated in ILO & OECD, *Building Trust in a Changing World of Work, The Global Deal for Decent Work and Inclusive Growth Flagship Report 2018*, 2018; ILO, *Inception Report for the Global Commission on the Future of Work* Geneva: International Labour Office – Geneva: ILO, 2017.

⁴ Cfr. Vandaele, Kurt, "Will trade unions survive in the platform economy? Emerging pattern of platform workers' collective voice and representation in Europe" Working paper 2018.05, European trade union institute, etui, 2018.

⁵ Cfr. Jonhston, Hannah y Land-kazlauskas, Chris, "Organizing On-Demand: Representation, voice and collective bargaining in the gig economy", *Condition of Work and Employment Series No. 94*, Inclusive labor Market, labor Relations and Working Conditions Branch, Interna-

In Chile, the situation does not differ much from the reality elsewhere in the world. The diverse new ways of producing have arrived here too and have affected the local labor market. Atypical forms of employment or other non-standard ways of employment⁶ have a strong⁷ presence on the Chilean labor market, rendering it even more precarious. More so, as it has been pointed out, the Chilean model is one of flexi-precariousness.⁸ Facing a new transformation process of the market structure turns out to be highly complex. Especially when issues related to labor law and labor rights have recently been reformed yet still unsolved.⁹

In general, in the regional context, Chile is considered a relevant player. Its economy and political system are considered stable. Moreover, as OECD¹⁰ member, Chile forms part of the group of the richer countries in the world. This status implies that Chile has a high degree of connection to the Internet, social networks are widely used, and so are different applications for offering or making use of different services or trading different products. However, these indicators of wealth are in conflict with the reality of a highly precarious labor market, in which the protection of non-traditional employment is practically non-existent, neither when it comes to labor law's regulations nor in the case of social security.

The so-called Industrial Revolution 4.0 implies a modification of typical employment, where the traditional feature of subordination in the labor relation no longer prevails, and where the employee's physical presence in the employer's establishment for supervision purposes is no longer considered essential. Working over IT platforms or digital applications can be con-

tional Labour Office, Geneva, 2018; Vandaele, Kurt, "Will trade unions survive in the platform economy? Emerging pattern of platform workers' collective voice and representation in Europe" Working paper 2018.05, European trade union institute, etui, 2018.

⁶ Cfr. ILO, Non-standard employment around the world: Understanding challenges, shaping prospects, International Labour Office – Geneva: ILO. 2016.

⁷ Cfr. Dirección del Trabajo, *Encla 2014, Informe de Resultado Octava Encuesta Laboral*, Departamento de Estudios de la Dirección del Trabajo, Santiago, Chile, December 2015.

⁸ About this see: Arellano Ortiz, Pablo y Gamonal Contreras, Sergio, "Flexibilidad y desigualdad en Chile: el Derecho Social en un contexto neoliberal", *Boletín Mexicano de Derecho Comparado*, Mexico, nueva serie, año XLX, núm. 149, May–August 2017, pp. 555-579.

⁹ For an explanation of Law No. 20.940 see: Arellano Ortiz, Pablo; Liendo Roa, Ricardo, y Walker Errazuriz, Francisco, *Reforma Laboral Ley N°20.940, Moderniza las relaciones laborales*, Librotecnia, Santiago, September 2016; and also: Arellano ortiz, pablo; Feres Nazarala, Maria Ester y Severin Concha, Juan Pablo (eds), *Reforma al Derecho Colectivo del Trabajo. Examen crítico de la ley núm. 20.940*, Thomson Reuters, Santiago de Chile 2016.

¹⁰ See <http://www.oecd.org>

sidered a challenge for employees' protection in a fragmented labor market as is Chile's case. Hence, is there any effective legislation in place to protect workers in this new labor market?

There are different areas of the economy in Chile, where these new ways of working have appeared strongly. Without any doubt the most prominent example is passenger transport via smartphone apps, such as Uber and Cabify. These applications have created a major impact, as they have generated a considerable number of jobs. But also due to the regulatory voids of their use and their impact on the established passenger transport services, such as taxis, which are obliged to hire insurances for their clients. In contrast, neither Uber nor Cabify drivers have to hire these insurances, openly infringing the rules regulating this type of activities.

Under the recent government of President Bachelet, efforts were made to find a regulatory solution for this new category of drivers working in passenger transport. However, these efforts were not successful. On the other hand, the new government still has not clearly indicated its commitment to finding regulatory solutions for drivers or other categories of workers affected by this issue.

The present paper will study the current status of worker protection under the new 4.0 labor market in Chile. It will critically analyse some relevant aspects of the existing regulatory framework and have a look at the challenge of protecting the working population in view of social security as well as in labor aspects.

II. INDUSTRY 4.0 IN THE CHILEAN LEGISLATION

The first paragraph of this section explains the context of what we call Industry 4.0, providing some numbers to illustrate Chile's position. After that, some pre-existing difficulties related to the implementation of the digital industry will be presented, focusing mainly on the fragmentation of the labor market. In the following, certain regulations, which we consider relevant in the context of Industry 4.0 and workers' protection will be explained, starting with regulations defining the labor relation, followed by aspects of telecommuting, the right to union membership and some administrative aspects of social security access. The last section before the conclusions will describe the main reforms, which are currently being discussed in Chile.

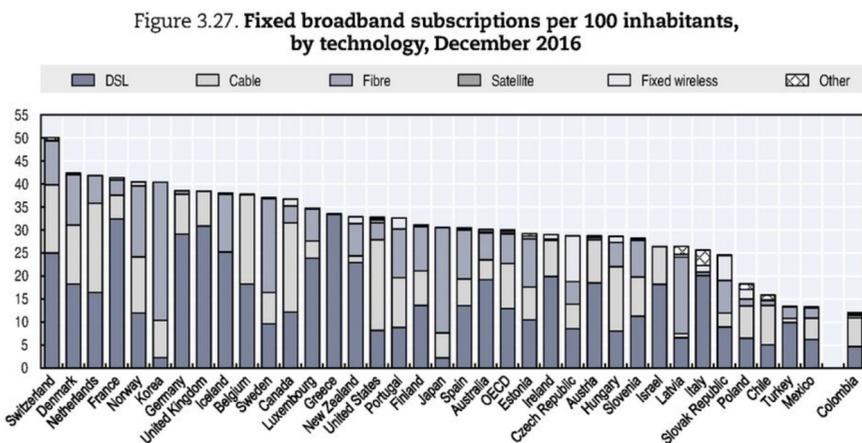
1. *Referential framework for the implementation of Industry 4.0 in the country*

According to OECD statistics, Chile’s IT and communications research and technology development expenses rank last.¹¹ This is an important indicator of the unbalanced development and political interest in this type of regulations.

The same OECD report shows that Chile’s position related to broadband Internet connectivity per 100 inhabitants, according to the speed of the connections, is rather poor compared to other OECD countries.

GRAPH 1.

FIXED BROADBAND SUBSCRIPTIONS PER 100 INHABITANTS, ACCORDING TO TECHNOLOGY, DECEMBER 2016

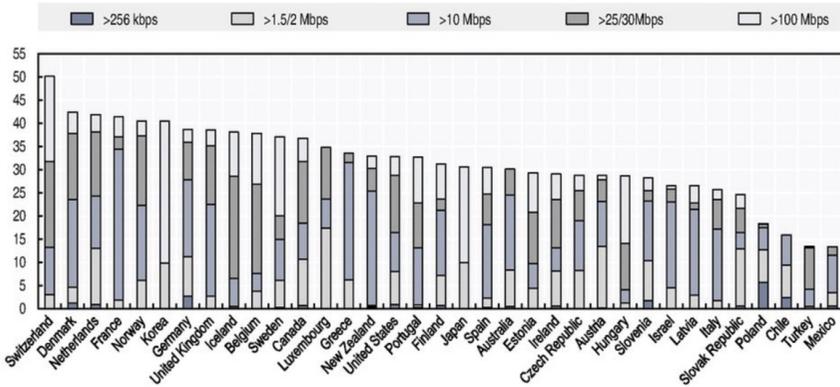


Source OECD 2017, p 134.

¹¹ OCDE, OECD Digital Economy Outlook 2017, OECD Publishing, 2017, Paris, France. p. 129.

GRAPH 2.
 FIXED BROADBAND SUBSCRIPTIONS PER 100 INHABITANTS, ACCORDING
 TO SPEED, DECEMBER 2016

Figure 3.30. Fixed broadband subscriptions per 100 inhabitants, per speed tiers, December 2016



Source OECD 2017, p 138

These numbers certainly have an impact on the implementation of Industry 4.0. Although the OECD report indicates that both connectivity and speed have generally increased within the group, Chile’s distance from the OECD average is considerable. This goes to show that the development of the digital economy in Chile is one step behind the major economic players.

2. National problems before the transition towards a 4.0 society

We have already stated in other occasions that one of the most characteristic features of the Chilean labor market is its fragmentation.¹² That makes it practically impossible for labor rights and social security to be effectively provided to the beneficiaries.

Hence, in our opinion the structure of the labor market is a factor of utmost importance in this transition towards a digital economy. Without a solid labor market, where workers are able to obtain a certain minimum lev-

¹² Cfr. Arellano Ortiz, Pablo, *Reto actual de las pensiones de vejez ¿Fin de las AFP? ¿Regreso a reparto?*, Librotecnia, Santiago, 2015.

el of protection, any change will produce negative effects. In this context it is important to remember that atypical employment forms have increased all over the world, affecting social rights everywhere.¹³ Also, when talking about this labor market fragmentation, it is important to not forget human rights aspects.¹⁴ Labor is always the same, no matter whether the person is employed full-time, works only part-time or forms part of the digital economy.

The fragile state of the Chilean labor market can be illustrated by having a look at the latest report of *Fundación Sol* upon labor quality. This report indicates that in the last 97 months, employment has increased, covering 1.456.787 persons, out of which 36 per cent are employed wage earners, 33 per cent to self-employed workers, and 27.5 per cent to external wage earners (subcontracted workers, temporary agency workers, and outsourced workers).¹⁵ This same study also shows that, between February and April 2019, 49.8 percent of the working population lacked solid employment, meaning a type of employment where one or more of the principles of the traditional labor relationship are becoming vulnerable. One of these cases would be the group of independent subordinate employees, whose labor contract condition is being violated by not recognizing their dependent state while maintaining subordination; 12.7 percent of the active population belongs to this category. Another relevant category is the group of independent non-professional workers, mainly subsistence jobs without any qualification, amounting to 14.3 percent of the working population.¹⁶

Periodically the Department of Studies of the Chilean Labor Office carries out a survey called *Encuesta Laboral* (ENCLA), where the Chilean labor market is analysed thoroughly, considering all different forms of labor contracts and working conditions, including statistics on union membership and collective bargaining. In the following we have selected some aspects

¹³ Cfr. ILO, *Non-standard employment around the world: Understanding challenges, shaping prospects*, International Labour Office – Geneva: ILO, 2016.

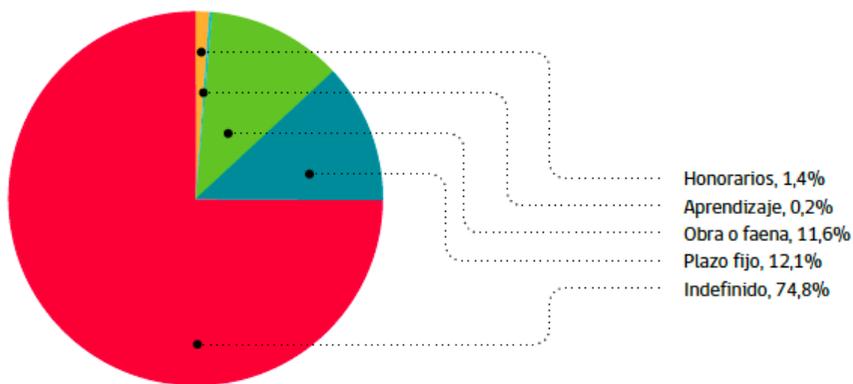
¹⁴ Cfr. De Stefano, Valerio, “Non-Standard Work and Limits on Freedom of Association: A Human Rights-Based Approach”, *Industrial Law Journal*, Vol. 46, No. 2, July 2017, pp. 185-207.

¹⁵ Fundación Sol, *Informe Mensual de Calidad del Empleo (IMCE) Análisis de los micro datos liberados el 31 de Mayo de 2018 correspondientes al trimestre móvil Febrero- Abril 2018 (FMA 2018)*, Unidad de Estadísticas del Trabajo (UET), Fundación Sol, Santiago, May 2018, p. 6.

¹⁶ Fundación Sol, *Informe Mensual de Calidad del Empleo (IMCE) Análisis de los micro datos liberados el 31 de Mayo de 2018 correspondientes al trimestre móvil Febrero-Abril 2018 (FMA 2018)*, Unidad de Estadísticas del Trabajo (UET), Fundación Sol, Santiago, May 2018, p. 7.

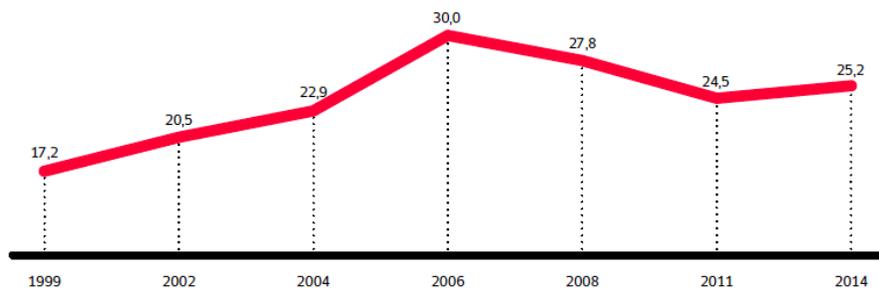
confirming this fragmentation from the ENCLA survey 2014,¹⁷ published in 2015, which is the most recent one.

GRAPH 3.
DISTRIBUTION OF WORKERS ACCORDING TO CONTRACT TYPE



Source ENCLA 2014, p. 50.

GRAPH 4.
EVOLUTION PERCENTAGE OF NOT INDEFINITE CONTRACTS. 1999, 2002, 2004, 2006, 2008, 2011 & 2014



Source ENCLA 2014, p. 51

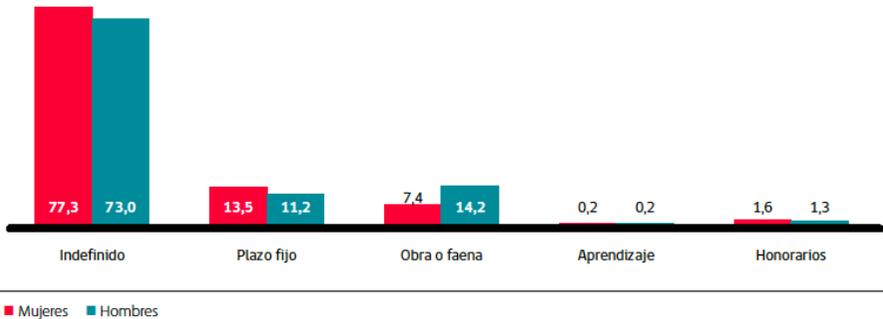
¹⁷ Dirección del Trabajo, Encla 2014, Informe de Resultado Octava Encuesta Laboral, Departamento de Estudios de la Dirección del Trabajo, Santiago, Chile, December 2015.

TABLE 1.
ABSOLUTE AND RELATIVE DISTRIBUTION OF WORKERS ACCORDING TO CONTRACT AND GENDER

Tipo de contrato	Hombres	Porcentaje	Mujeres	Porcentaje	Total	Porcentaje
Indefinido	1.861.783	73,0%	1.224.167	77,3%	3.085.950	74,7%
Plazo fijo	284.961	11,2%	213.092	13,5%	498.053	12,1%
Obra o faena	362.685	14,2%	116.369	7,4%	479.055	11,6%
Aprendizaje	3.895	0,2%	2.524	0,2%	6.419	0,2%
Honorarios	32.279	1,3%	25.242	1,6%	57.520	1,4%
Otros	1.236	0,0%	538	0,0%	1.775	0,0%
Total	2.549.372	100%	1.582.688	100%	4.132.060	100%

Source ENCLA 2014, p. 51.

GRAPH 5.
RELATIVE DISTRIBUTION OF WORKERS ACCORDING TO CONTRACT AND GENDER



Source ENCLA 2014, p. 52.

TABLE 2.
RELATIVE DISTRIBUTION OF WORKERS ACCORDING TO CONTRACT AND COMPANY SIZE

Tamaño de empresa	Indefinido	Plazo fijo	Obra o faena	Aprend.	Honorarios	Otros	Total
Microempresa	89,7%	6,1%	2,0%	0,0%	2,2%	0,0%	100%
Pequeña empresa	81,0%	11,0%	6,8%	0,0%	1,1%	0,1%	100%
Mediana empresa	73,2%	14,7%	11,3%	0,0%	0,7%	0,1%	100%
Gran empresa	71,4%	12,0%	14,4%	0,3%	1,7%	0,0%	100%
Total	74,7%	12,1%	11,6%	0,2%	1,4%	0,0%	100%

Source ENCLA 2014, p. 53.

TABLE 3.
 RELATIVE DISTRIBUTION OF WORKERS ACCORDING
 TO CONTRACT AND ECONOMIC ACTIVITY

Rama de actividad económica	Indefinido	Plazo fijo	Obra o faena	Aprendizaje	Honorarios	Otros	Total
Agricultura, ganadería, caza y silvicultura	56,3%	3,4%	40,0%	0,0%	0,2%	0,0%	100%
Pesca	75,1%	15,4%	9,4%	0,0%	0,2%	0,0%	100%
Explotación de minas y canteras	93,1%	4,4%	0,3%	2,0%	0,2%	0,0%	100%
Industria manufacturera	84,4%	10,3%	4,7%	0,0%	0,5%	0,0%	100%
Suministro de electricidad, gas y agua	93,2%	4,1%	2,0%	0,4%	0,2%	0,1%	100%
Construcción	39,7%	10,6%	49,5%	0,0%	0,2%	0,0%	100%
Comercio al por mayor y al por menor; Reparación de vehículos automotores, motocicletas, efectos personales y enseres domésticos	83,9%	10,5%	5,2%	0,0%	0,3%	0,0%	100%
Hoteles y restaurantes	83,3%	14,4%	1,1%	0,3%	0,8%	0,1%	100%
Transporte, almacenamiento y comunicaciones	88,3%	9,4%	1,7%	0,0%	0,4%	0,1%	100%
Intermediación financiera	93,8%	5,4%	0,1%	0,0%	0,8%	0,0%	100%
Actividades inmobiliarias, empresariales y de alquiler	75,2%	15,4%	7,3%	0,5%	1,2%	0,0%	100%
Enseñanza	70,2%	22,5%	0,0%	0,0%	7,2%	0,1%	100%
Servicios sociales y de salud	86,3%	10,6%	0,0%	0,0%	3,0%	0,0%	100%
Otras actividades de servicios comunitarios, sociales y personales	73,5%	15,2%	6,8%	0,0%	4,4%	0,0%	100%
Total	74,7%	12,1%	11,6%	0,2%	1,4%	0,0%	100%

Source ENCLA 2014, p. 54.

As already mentioned, the ENCLA 2014 survey, as well as preceding versions, shows the prevalence of indefinite contracts, although, at the same time, a certain shift towards limited-duration contracts can be observed. Even though this tendency seems to be slowing down, a considerable number of workers are subject to employment contracts of maximum 3 years. On the other hand, it becomes clear that indefinite contracts are being used more frequently by smaller companies.¹⁸

¹⁸ Walker Errazuriz, Francisco y Arellano Ortiz, Pablo, Derecho de las relaciones laborales, Tomo 1 Derecho Individual del Trabajo, Librotecnia, Santiago, 2014, p. 212.

In our understanding, the great challenge presented by the digital economy of Industry 4.0 in Chile, is being able to offer an alternative which provides better benefits and greater job stability in an excessively precarious and fragmented labor market. This is not an easy task, as Industry 4.0 is partly sustained by the current context of labor markets, adapting atypical employment situations to digitalization.

3. Existing legal regulations of labor legislation and social security for the protection of employees in view of Industry 4.0

The basic protective rule for workers in Industry 4.0, and in general, for all employees in Chile, are the rules and regulations related to the determination of the existence of a labor relationship. The first rule to be mentioned in this context is contained in Article 7 of the Labor Code and defines the employment contract. It says:

The individual employment contract is an agreement by which the employer and employee are mutually obliged, the latter to render personal services as a dependent and subordinate, and the former to pay a salary for such services.

A second regulation can be found in Article 8, stipulating that the rendering of services under subordination and dependency creates an employment contract, beyond the presence of a written agreement. Services provided by people performing professions or executing works directly to the public, or sporadically and discontinuously at home, do not originate an employment contract, neither do services provided by a student or graduate of an institution of higher education or technical-professional secondary education during a determined time in order to comply with the requirement of professional internship. Nevertheless, the company where such internship is performed shall provide transportation and meals or a previously and expressly convened compensation assignment of such benefits, which does not constitute the payment of a salary for any legal purpose. These standards of the Labor Code only apply to self-employed workers when expressly referred to as such.

A third regulation on this point is contained in Article 9 of the Labor Code, relating to the existence of an employment contract. For the Chilean legislation, the employment contract is a consensual agreement, which has

to exist in written form. In case there is no written contract, the assumption of its content is what the worker indicates.

The provisions contained in Article 9 indicate that the contract is consensual and must be laid down in written form within the indicated period in two copies, each signed by both parties of the contract. The employer must produce the written contract within a period of fifteen days after recruiting the employee, or within five days in the case of contracts regulating determined services for less than thirty days. Non-compliance on behalf of the employer will make him/her subject to a fine from the Labor Inspection Office.

In case the employee is unwilling to sign the written contract, the employer must send the contract to the pertinent Labor Inspection Office in order to request the employee's signature. If the employee insists on his/her unwillingness, he/she can be dismissed without any right to compensation, unless he/she can prove that he/she had been recruited under circumstances which differ from the ones established by the written document.

In case the employer does not make use of the rights inferred to him/her in the above paragraph, within the period of time indicated in the second paragraph, the absence of a written contract leads to the legal presumption of the provisions contained in the contract as declared by the employee.

These rules are of utmost importance as atypical employment situations are very common in Industry 4.0, and in the first place it would be important to determine if protection under the Labor Code applies. This protection system includes rules of individual rights, collective rights and social security obligations. So, basically there is not one single specific regulation for people working in Industry 4.0.

The possibility to apply the regulations related to the determination of a labor relationship to atypical contracts will depend on legal action before a Labor Court. For example, a person working with the Uber application will have to issue a declaratory action pressing for the recognition of the employment relationship between the person and the application. This court procedure thus will aim at proving the existence of the principle of subordination and dependence and the resulting labor contract obligations, such as complying with a work schedule and the periodical payment of a salary, but also the fulfilment of other obligations, such as those forming part of the disciplinary authority of the employer.

In the following we have selected three topics which are related to the implementation of regulations in connection with the digitalization of the

economy. Firstly, we will have a look at telecommuting, then at the challenges the unions are facing in this new setting, and thirdly, some aspects related to the access to social security.

A. Protection of Teleworking

Law N° 19.759 from 2001 adds a paragraph to Article 22 of the Labor Code, indirectly incorporating the concept of telecommuting by excluding the limitation of working hours to a certain type of employees. The current regulation on working hours is the following:

Article 22 defines that the duration of the ordinary work day must not exceed 45 hours per week. Excluded from this limitation of working hours are employees rendering services to different employers; the leading management, administrators, attorneys with administrative faculties and all those working without direct supervision; professionals hired under the present Code rendering services in their home or in a place freely chosen by them; commission and insurance agents, travelling salespeople, debt collectors and similar activities which do not take place in the establishment of the company.

Also excluded from the limitation of working hours are workers on board of fishing vessels. Likewise excluded are employees hired to render their services preferably outside the company establishments by using information technology or telecommunications.¹⁹

Sports professionals and workers' working hours, performing related activities are to be organized by the coaching staff and the corresponding professional sports entity, according to the nature of the sport and within the limits which are compatible with the athletes' health; paragraph 1 of this article is not applicable to these employees.

This is to say that, according to the incorporated text, with the existence of the relationship of subordination and dependence, all activities carried out beyond the physical site of the company using information technology or telecommunications media are considered individual employment contracts.

We have pointed out that,²⁰ as in the case of working at home, the administrative and judicial jurisprudence on this topic will have to define when

¹⁹ The underlining is ours.

²⁰ Walker Errazuriz, Francisco y Arellano Ortiz, Pablo, *Derecho de las relaciones laborales*, Tomo 1 *Derecho Individual del Trabajo*, Librotecnia, Santiago, 2014, p. 202.

these cases present the principle of subordination and dependence. Unfortunately, this type of situation has not been brought to court yet, so we were not able to find any jurisprudence thereon. This may be because the kind of workers we are talking about will consider going to court as lowly effective due to the precarious state of their employment, and it will appear easier to look for a new project to work on.

When trying to define the concept of telecommuting, the following elements should be present:²¹

- Work is conducted outside the company establishments;
- The use of new technologies, such as information technology in general, Internet or Intranet in particular, and all possible audio-visual media;

The actual impact of telecommuting on the Chilean market, however, has been rather limited. We have not been able to find recent studies on the topic. One document published²² by the Chilean Labor Office indicates that teleworking “is only slowly emerging as an employment option, and although its legislation and implementation as a work strategy have been discussed, its definition, limits and ways of putting it into practice are still unclear”.²³ It has also been concluded that, although it may have several favourable aspects, it also may be difficult to apply.²⁴ We agree to the statement that

in the case of teleworking, the faint borderline between considering it dependent employment for some cases and independent for other, easily relativizes the element which protect fundamental rights; such as health and safety at work, the differentiation between productive time and private time, and may turn it into another precarious form of employment rather than a real job opportunity.²⁵

²¹ *Idem.*

²² *Cfr.* Morales Varas, Gabriela y Romanik Foncea, Katy, Una mirada a la figura del teletrabajo, Informe de Actualidad Laboral N° 1, Dirección del Trabajo, Santiago, Chile, November 2011.

²³ *Ibidem*, p. 57.

²⁴ *Idem.*

²⁵ *Ibidem*, p. 58.

Teleworking as an employment option also “requires the socio-cultural adaptation within the collective conscience of our countries’ working population on what remote working actually means and which practical and legal implications it has”. This again requires time and an adequate legal framework regulating it”.²⁶ The development of Industry 4.0 holds this cultural challenge, on the part of the users of the platforms as well as on the part of the owners of these platforms, who at the same time are the employers in this new configuration of labor market.

As we have stated, Chile’s labor market is extremely precarious, and telecommuting has been slow to emerge due to the need of employers to be able to supervise the work carried out. Hence, just as in the case of telecommuting, a better development of Industry 4.0 will depend on cultural factors, allowing for its better implementation.

B. *Independent workers’ unions*

One question which has had a major impact elsewhere is the emerging union movement in the gig economy. Employees under this new market configuration can collectively stand for their needs. This turns out to be a priority for the survival of the global union movement.

So, one may ask whether the labor legislation includes some regulation which allows the workers to form a union. In this context Article 216 of the Chilean Labor Code gives an answer by listing the types of unions which can be formed:

Trade unions shall be constituted and named in consideration of the workers who are its members, as for example:

- a) Company union: members are employees of one company
- b) Inter-company union: members are employees of two or more different employers
- c) Union of independent workers: members do not depend on any employer
- d) Union of occasional or transitory workers: members carry out work under dependence and subordination periodically or intermittently.

Specific collective rights of workers under Industry 4.0 do not seem to exist. The different forms of unions contained in the Chilean frame-

²⁶ *Idem.*

work do not beforehand include the possibility that these workers form a union. This is due to the basic principle that in order to form a union it is necessary to be a dependent employee.

However, the regulation contained in Article 216 authorizes the creation of unions of independent workers or freelancers, which is the only channel for them to collectively claim their rights. Nevertheless, this solution is tricky in various aspects. For example, the fact of making use of this union format implies that all the employees recognize themselves as freelancers or independent workers, thus waiving the possibility to apply the Labor Code.

Also, the fact that independent workers may negotiate their remuneration might lead to an involvement of the authorities on free competition. This has occurred elsewhere; the cases of Ireland and Holland are known in this context. In these cases, the juridical argumentation of the authorities considered that negotiating remunerations in a group of independent workers is violating free competition by setting prices and distorting the market by forming a cartel.²⁷

In Chile, drivers working under the Uber application have had to face this dilemma. On one hand they want to be considered employees and eventually form a union of self-employed workers, on the other hand they want to be considered individual contractors. Until now, they have acted through a spokesperson which shows that for them also, the matter is delicate.

In other cases, digital workers have formed unions and succeeded in improving their working conditions. The best example, which is also comparable to the Uber case in Chile, would be the case of the New York Taxi Workers Alliance (NYTWA).²⁸ This association is registered as a non-profit organization, but at the same time it works on the principle of membership, and it is the first organization established to represent non-conventional

²⁷ Cfr. Jonhston, Hannah y Land-kazlauskas, Chris, “*Organizing On-Demand: Representation, voice and collective bargaining in the gig economy*”, Condition of Work and Employment Series No. 94, Inclusive Labor Market, Labor Relations and Working Conditions Branch, International Labour Office, Geneva, 2018; RUBIANO, CAMILO, “Los trabajadores precarios y el acceso a la negociación colectiva: ¿Existen obstáculos legales?”, en Boletín Internacional de Investigación Sindical, 2013, vol. 5, issue 1, pp. 151-170.

²⁸ About this case see: Jonhston, Hannah y Land-kazlauskas, Chris, “*Organizing On-Demand: Representation, voice and collective bargaining in the gig economy*”, Condition of Work and Employment Series No. 94, Inclusive labor Market, labor Relations and Working Conditions Branch, International Labour Office, Geneva, 2018; Vandaele, Kurt, “*Will trade unions survive in the platform economy? Emerging pattern of platform workers’ collective voice and representation in Europe*” Working paper 2018.05, European trade union institute, etui, 2018.

workers which is a member of AFL-CIO,²⁹ identifying strongly with the idea of being a union. Through lobbying with public authorities such as the New York Taxi and Limousine Commission TLC, they have obtained higher salaries, reduced rents and regulations which allow the drivers who rent their cars to press charges against the vehicles' owners in the case of abusive charges. Furthermore, they proposed other regulatory reforms reducing the risk associated with driving a taxi.

So, it becomes clear that the union movement may be very relevant when trying to improve working conditions, also in the Industry 4.0 reality. Until now, the union movement is still present and its survival into the future will depend on its adaptation to the new market.

C. Administrative facilities related to social security

One of the areas of social law where Industry 4.0 may sooner produce an impact is social security. This is due to the fact that reforms resulting from the incorporation of new technologies could have a short-term impact in the coverage of unprotected groups within the working population.

An example of this would be the implementation of a platform several years ago, where social security contributions can be paid. This is an integrated system where large, medium-size and individual employers can pay their employees' social security contributions. It also allows for the contribution payment of self-employed workers. Upon registering as a user, you can manage your payroll and receive a certificate of paid contributions. This platform is called PreviRed.³⁰

²⁹ See: <https://aflcio.org>

³⁰ See: <https://www.previred.com/web/previred/>

GRAPH 6. PREVIREO PLATFORM



PreviRed is used by practically all social security institutions in Chile, including the pension funds AFP, IPS (ex INP), health insurance schemes Fonasa and Isapres, mutualities, occupational safety insurance companies, unemployment funds (AFC) and the main companies operating the voluntary pension savings scheme (APV).

Still, this online payment platform constitutes only a very low level of progress in a time where technology offers significant advances. The first aspect which opens up for criticism is that this platform is private. It is owned and administered by a private institution. Even so, the payments made and the certificates issued are recognized as officially valid. In fact, these documents are regularly used before the Labor Court in order to prove that social security contributions have been duly paid. Despite all that, the Chilean State as such has not yet developed a similar mechanism.

Even though this kind of mechanism increases social security coverage due to the increase of payments, there are no mechanisms in place which make it possible to make use of modern technology to determine the bases of contributions of payments. Here we are referring to the possibility to use the platforms to calculate the payment basis for categories of workers who

are *de facto* excluded from the system, or to facilitate the payment by using the smartphone. One example for the use of technology would be to determine a calculation basis for taxi drivers, with which they would be able to pay social security contributions based on the kilometres they use their car for. This information is available in the vehicle they work with, so it would be enough to adapt a calculation scheme in order to obtain the contributions to be paid. Currently, taxi drivers either work on a dependent basis, with a labor contract with the owner of the car who pays the social security contributions, or—more commonly— they work free-lance and are themselves responsible for the payment of their social security contributions. Quite logically, the drivers often will choose to not pay contributions in order to increase their income. The use of technology for determining the use of the vehicle could improve this situation and will thus protect free-lance taxi drivers.

Using the smartphone also opens a wide variety of possible situations. The simplest example is paying social security contributions via the smartphone. For example, a text message (SMS) could simply discount the contribution payment from the existing credit (in the case of a prepaid phone) or add it to the monthly bill (in the case of a contract mobile phone). This mechanism would allow extending social security coverage onto *de facto* excluded groups of the working population.

Generally speaking, when it comes to the public sector, progress in terms of social security within Industry 4.0 has been pretty slow. If there are – timid – developments, they can be found in the private sector, primarily in the shape of the PREVIRED platform.

4. Proposals for legal reforms and current projects as measures to solve national problems

Different initiatives have tried to regulate the activities of certain areas within the digital economy. These initiatives started with the invasion of the Uber application into the Chilean labor market. But there also are other applications, such as AirBnB, which are difficult to supervise and are eventually methods of tax evasion. It has also been aspired to reform the regulation on remote work in order to better adapt to the current labor market.

Uber's regulation is rather complex. Originally, the idea of the application was to connect the service providers, the drivers, with their clients. But eventually the Uber requirements, the working hours and payment schemes make this agreement look very much like a labor relation.

Moreover, in Chile, public passenger transport needs specific insurance in the case of an accident. Uber drivers/independent businesses do not comply with this regulation, as the application defines itself as an agreement between individuals. In view of this fact, associations of shared taxis, which do comply with the transport regulation, have repeatedly and vehemently protested and demanded that Uber drivers also be subject to this regulation. In October 2016, during the government of President Bachelet, a draft act was issued with the aim of modernizing legislation on paid passenger transport. This draft bill considers the payment of an operations permit, demanding a professional driver's license, and vehicle quality control. Until the present day, no progress has been made in this context, so Uber in Chile still is an activity on the verge of legality. Uber drivers have even shown a tendency to try and avoid police controls, which has led to situations where police officers were forced to use their gun.³¹ Until this service is not properly regulated, complex incidents will continue to happen.

An interesting approach is the initiative to have certain platforms pay taxes for the services they offer. The principle of platforms is that all they do is establish contact between individuals. However, their activities are regulated and subject to tax payment due to the service they provide. An example of this situation is the accommodation service provided by the application AirBnB. Clearly, the individual renting the room does not declare this activity and hence does neither pay VAT nor income tax. This initiative has been discussed during the early stage of President Piñera's government, and operators have been open to the idea of paying taxes.³² It still remains to be seen, if they are willing to consider their operators as employees, protected by labor legislation.

Another reform repeatedly announced by President Piñera during his campaign and the first months of his government, and even explicitly mentioned in his first state-of-the-nation account, has been the reform on teleworking.³³ However, it is still unknown what this reform will look like. Apparently, the idea is to better reconcile work and family life, which seems perfectly important to us, but is in no way the only aspect to be considered when talking about remote working. Another reform project seems to be

³¹ See: <http://www.elmostrador.cl/noticias/multimedia/2018/06/13/carabenero-le-dispara-a-conductor-de-uber-en-el-aeropuerto-tras-confuso-procedimiento/>

³² See: <http://www.emol.com/noticias/Economia/2018/06/21/910703/Uber-y-anuncios-de-Hacienda-sobre-impuestos-Estamos-abiertos-a-contribuir.html>

³³ See: <https://prensa.presidencia.cl/discurso.aspx?id=75941>

the digitalization of the government platform *Chile Atiende*, in order to reduce the need for paperwork and bureaucracy. This measure will have a significant impact when providing social security benefits. For the time being, though, it is only an initiative in progress and it remains to be seen how it will be implemented.

Finally, we must highlight, however, that among all the different proposals which are currently being discussed, there is no initiative which helps workers in Industry 4.0 have access to better benefits through collective bargaining. In this context the currently active regulation is the 2016 reform of Law 20.940.³⁴

III. CLOSING REMARKS

First and foremost, it should be concluded that the actual impact on jobs under what is generally understood as Industry 4.0 is relatively low in Chile. The development of Industry 4.0 is only very hesitantly taking place, compared to the countries of the Northern hemisphere, where Internet connection is better and faster and culturally, teleworking is much more part of the reality.

To tell the truth, although this type of work does dogmatically constitute a challenge for social rights, its practical impact remains minor. This is even more so in a fragmented labor market, or fissured as some like to say,³⁵ as is the case in Chile, where the majority of jobs are generated in atypical categories of employment.

Interesting initiatives are currently being discussed, both in parliament and in public, but none of these has been able to really deal with the challenges presented by Industry 4.0. In this context we want to insist again that, if these measures do not take the characteristic features of the Chilean labor market into account, they might eventually rather increase the precariousness of the legal situation. In our opinion, one way to progress in the protection of these workers' social rights would be to develop new forms of unions, for which the promotion of union freedom seems essential.

³⁴ On this reform and its effects see: Arellano Ortiz, Pablo; Feres Nazarala, María Ester y Severin Concha, Juan Pablo (eds), *Reforma al Derecho Colectivo del Trabajo. Examen crítico de la ley núm. 20.940*, Thomson Reuters, Santiago de Chile 2016; Arellano Ortiz, Pablo; Liendo Roa, Ricardo, y Walker Errazuriz, Francisco, *Reforma Laboral Ley N°20.940, Moderniza las relaciones laborales*, Librotecnia, Santiago, September, 2016.

³⁵ Cf. Veil, David, *The Fissured Workplace: Why Work Became So Bad for So Many and What Can Be Done to Improve It*, Harvard University Press, 2014.

Let us face it, economic activity based on platforms is a reality which is sure to become more and more important in the years to come. For the time being, what is interesting is the way how social law pretends to protect this new category of workers. Hence, social rights continue to apply, and they are facing a major protective challenge.

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BRAZIL AND INDUSTRY 4.0: IMPACTS ON PUBLIC PENSIONS

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SUMMARY: I. *Introduction*. II. *Development*. III. *Conclusions*. IV. *Research Sources*.

I. INTRODUCTION

The Brazilian Constitution of 1988 established a system of social protection called “social security” (or “*seguridade social*” in Portuguese). This system is composed of three subsystems: public healthcare, public pensions, and social assistance.

Public healthcare was universalized under the aforementioned constitution. Thus, everyone has access to public healthcare, regardless of whether or not he or she is a worker. Social assistance (non-contributory protection) aims to protect citizens who are in social need and are not protected by public pensions or family assistance. Its goal is to ensure the minimum needs for dignified survival.

Public pensions is intended for workers and their dependents, and aims to maintain their standards of living by substituting work income. It is divided into mandatory protection and supplementary protection. Mandatory protection, in turn, is subdivided into the General Public Pensions Scheme and Special Scheme Pensions for Public Servants. The former protects all workers, except public servants, who are protected by the scheme instituted by each of the federative entities (i.e. the Federal Government, the States

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and Federal District, and the Municipalities), for the protection of their respective public servants.

Thus, Brazil's General Public Pensions Scheme protects all workers of the private initiative; those with an employment relationship or those who are self-employed (urban and rural).

The aim of this study is to analyse whether the current Brazilian social protection system, especially the public pensions subsystem, is appropriate to face the challenges arising from the implementation of industry 4.0.

This happens because, at the same time as the new technologies represent advances in several areas, in labor relations they have generated concerns; including the significant reduction of jobs, which brings direct reflections on public pensions, since many working-age people will not have access to a job and, therefore, will not have access to public pensions protection. Many workers will lose their jobs, which will require greater resources to ensure the payment of unemployment insurance. And others will still have work for short periods, which will not allow them to fulfil the minimum time for paying their contributions to obtain public pensions benefits, especially retirement benefits, thus not receiving social protection of public pensions and will therefore seek assistance protection.

Accordingly, this study assumes that the new technologies have repercussions on labor relations, especially reducing the number of jobs, particularly those with an employment relationship, which will have repercussions on public pensions protection and also on the financing thereof.

Therefore, this study will not address the repercussions that the new technologies bring to labor relations or the Labor Courts' jurisprudence on the use of the new technologies. Nor will it address recent legislative changes in labor rights. The study will address the impact of Industry 4.0 on public pensions, as well as whether the Brazilian legal system is appropriate to address these effects.

In order to do so, first, some data related to Brazil will be presented and, subsequently, the public pensions system will be contextualized in the Brazilian social security system, also presenting the sources of financing of the social protection system as a whole and, specifically, public pensions. Additionally, a brief demonstration of current expenditures and income from Brazilian social security will be made in order to analyse whether the Brazilian public pensions subsystem is the appropriate one to face the challenges arising from the implementation of industry 4.0 in Brazil, or whether changes are required.

II. DEVELOPMENT

1. *Data relating to Brazil*

Before addressing the topic *per se*, some data will be presented relating to Brazil, which will allow to better contextualize the social protection granted in the nation.

Brazil is a federation composed of the central entity (the Federal Government), 26 States, the Federal District, and 5,570 Municipalities. The Brazilian population in 2018, according to the Brazilian Institute of Geography and Statistics (IBGE) was 208.5 million inhabitants. In the three-month period from May to July 2018, the workforce (employed and unemployed people) – according to the results of the National Household Sample Survey (PNAD)¹ – was estimated at 104.5 million people, of which 91.7 million were employed and 12.9 million were unemployed.

In the aforementioned period, the survey showed that the number of employees in the private sector with a formal work contract was estimated at 33.0 million people, and the number of those without a formal contract was estimated at 11.1 million. Self-employed workers summed up 23.1 million people; employers added up to 4.4 million; and domestic servants numbered 6.3 million people. On the other hand, the number of employees in the public sector (including statutory public servants and military personnel) was estimated at 11.7 million people.

In July 2018, the number of benefits paid by the General Public Pensions Scheme was 30,067,095, not including unemployment insurance. The number of social assistance benefits (benefit in the amount of the federal monthly minimum wage payable to people over 65 years of age and people with disabilities), (also in July 2018) was 4,723,987.²

In 2016,³ the number of contributors (insured persons) of the General Public Pensions Scheme was 52,489,624, of which 40,020,878 were emplo-

¹ Brazilian Institute of Geography and Statistics - IBGE. <https://agenciadenoticias.ibge.gov.br/agencia-sala-de-imprensa/2013-agencia-de-noticias/releases/22389-pnad-continua-taxa-de-desocupacao-e-de-12-3-e-taxa-de-subutilizacao-e-de-24-5-no-trimestre-encerrado-em-julho>.

² Department Of Public Pensions Scheme, Ministry Of Finance, *Statistical Bulletin of Public Pensions Scheme*, Volume 23, p. 28. <http://sa.previdencia.gov.br/site/2018/09/beps18.07.pdf>.

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yed; 9,602,543 individual contributors (self-employed workers and employers); 1,540,453 domestic servants; 1,323,375 optional contributors; and 2,375 special insured persons, who pay on an optional basis to obtain benefits above the minimum wage. It is worth noting that, the number of employees includes public servants who are not protected by the Special Scheme Pensions for Public Servants.

The figures above demonstrate the importance of Brazilian social protection, especially the General Public Pensions Scheme, in the social and economic context. They also demonstrate the need for a responsible analysis that allows for the adoption of public policies that ensure sustainability, especially considering the effects of population ageing, as well as the challenges arising from the implementation of Industry 4.0.

In the next section, considerations will be put forth on the social security system, particularly the public pension's subsystem.

2. The Brazilian public pensions system as a subsystem comprising of social security

The Brazilian Constitution of 1988 established a system of social protection, called social security, which aims to protect everyone in situations of need. This system comprises a set of initiatives of Public Authorities and society, aimed at ensuring the rights related to healthcare, public pensions, and social assistance.

Thus, the Brazilian social security system must be seen as a system of social protection that is composed of three subsystems: healthcare, public pensions, and social assistance.

Regarding the healthcare subsystem, Brazil's Constitution established universal and equal access to public healthcare, and infra-constitutional legislation provided for free access to public health services, regardless of the economic situation of the user. Prior to 1988, healthcare was directed at workers and their dependents, but since then, there is no difference in access and care between a worker and a person who does not work.

As mentioned previously, Brazil adopted the federative form and, for this reason, the Constitution establishes both the attribution of each of the federative entities for the realization of the rights prescribed therein, as well

lic Pensions, Volume 23, p. 04. <http://sa.previdencia.gov.br/site/2018/09/beps18.07.pdf>. Date of consultation: 09/30/2018. It should also be noted that the data for 2016 is presented by the Department of Public Pensions in the Statistical Bulletin of July 2018.

as the competence to legislate on the matter, including to establish taxes, aimed at funding such rights.

In this regard, in relation to the responsibility for the realization of the right to healthcare, the Constitution stipulates that the administrative competence belongs to all entities of the federation, which executes it through Brazil's National Health System, known as "SUS" ("*Sistema Único de Saúde*" in Portuguese). Financing is guaranteed by the social contributions instituted by the Federal Government and by the revenue from the taxes of each of the federative entities.

Social assistance (non-contributory protection) aims to protect citizens in a situation of social need, who are not protected by public pensions or family assistance. Its objective is to ensure the minimum necessary for survival.

As in the case of healthcare, the federative entities are responsible for the implementation of social assistance policies, which are coordinated by the Unified Social Assistance System, although the two main pecuniary benefits are the responsibility of the Federal Government - family allowance ("*bolsa família*" in Portuguese) and the benefit of continuous receipt of minimum wage payable to seniors (aged 65 years or over) and people with disabilities. The funding of the foregoing benefits is through the social contributions established by the Federal Government.

Social security services, as a rule, are carried out by the States and Municipalities with funds from tax revenues of the federative entities and grants from the Union (which is entitled to institute social contributions earmarked for social protection and, therefore, for social assistance as well).

The public pensions system, in turn, is intended for workers and their dependents and aims to guarantee resources in situations where such resources cannot be obtained by the workers themselves. The aforementioned subsystem is aimed at maintaining the standard of living of those who live off the fruits of labor.

However, unlike the other two areas of social security, public pensions require the insured person to provide consideration so that they and/or their dependents will be entitled to public welfare benefits. The aforementioned consideration is provided through payment of public pensions contributions.

Thus, public pensions assumes the exercise of paid activity and direct consideration from the insured person, which attributes a professional-contributory nature thereto.

The public pensions system is divided into mandatory protection and supplementary protection. Mandatory public pensions is subdivided into General Public Pensions Scheme (protects all workers except public servants) and Special Scheme Pensions for Public Servants (directed only to public servants holding regular positions) and is aimed at protecting all workers, up to a certain limit.⁴

The Constitution also provides for supplementary pension, which aims to protect workers who receive remuneration above the public pensions ceiling. The aforementioned protection is optional.

The financial regime of both mandatory systems (General Public Pensions Scheme and Special Scheme Pensions for Public Servants) is known as a simple distribution system (i.e. “pay as you go”). Its benefits are defined by the Constitution and infra-constitutional legislation.

The General Public Pensions Scheme is the responsibility of the Federal Government, and the benefits are administered by the National Institute of Social Insurance (a federal authority). Social contributions are collected by the Brazilian Federal Revenue Service.

The Special Schemes Pensions for Public Servants were created by the respective federative entities to protect their public servants holding regular positions. Brazil is a federative republic, the federative entities are the Federal Government, the States (26), the Federal District (Brasília), and the Municipalities (currently 5,570).

The Federal Government, all of the States, the Federal District and approximately 40 per cent⁵ of the Municipalities have instituted Scheme Pensions for their respective public servants.

The servants of Municipalities that have not instituted their own scheme pensions are linked to the General Public Pensions Scheme, which protects all workers except the public servants who are linked to the Special Scheme Pensions for Public Servants of the federative entities that instituted such scheme.

For employees who joined public service up to the publication of Constitutional Amendment 41/2003, retirement based on the time of contribu-

⁴ The ceiling of protection of the General Public Pensions Scheme, for 2018, is R\$ 5,645.80.

⁵ Although only 40 per cent of the municipalities have instituted public pensions for their servants, these are the most populous Municipalities, accounting for 70 per cent of all municipal public servants. It is worth noting that in Brazil there is a municipality with more than 12 million inhabitants (Municipality of São Paulo) and there are municipalities with fewer than one thousand inhabitants, which justifies the foregoing percentages.

tion corresponds to the last remuneration, provided that the requirements established in the transition rules are fulfilled. For employees who joined public service after the aforementioned constitutional amendment, benefits are calculated based on the average remuneration.

In addition, constitutional amendments allowed the federative entities to adopt the same protection ceiling of the General Public Pensions Scheme (the ceiling for 2018 is R\$ 5,645.80),⁶ for the Special Scheme Pensions of their servants.

Article 201 of the Brazilian Constitution states the rules applicable to the General Public Pensions Scheme. The precepts directed to Special Scheme Pensions for Public Servants are set forth in Article 40 of the Constitution.

The precepts of the Special Scheme Pensions for Public Servants do not apply to military servants. The rules addressed to them are established only in infra-constitutional legislation.

Union military personnel do not contribute to their retirement, but only for pensions directed to their dependents. In some states, military personnel also contribute toward their retirement, as is the case in the State of São Paulo.

Therefore, all Brazilian workers are protected by the General Public Pensions Scheme, except for public servants (who hold regular positions), of the federative entities that have instituted Special Scheme Pensions for Public Servants, and military personnel.

Thus, the General Public Pensions Scheme encompasses all workers of the private sector, public servants who do not hold regular full-time positions (positions in commission, temporary agents, etc.) and servants who hold regular positions of the federative entities that have not established Special Pensions Scheme for them.

The General Public Pensions Scheme calls all workers “mandatory insured persons” and subdivides them into five groups: employees, domestic servants, temporary workers,⁷ individual contributors (self-employed workers and employers) and special insured persons (small farmers and artisanal

⁶ The federative entities may adopt the same protection ceiling of the General Public Pensions Scheme, provided that they institute supplementary pension plans for their employees. There are entities that have already adopted it, as is the case of the Federal Government (central entity) and several States, including São Paulo, Rio de Janeiro, and Rio Grande do Sul.

⁷ Workers – whether unionized or not – who provide services of an urban or rural nature to several companies, without an employment relationship, with the mandatory inter-

fishermen). All those who exercise paid activity and are not servants holding regular positions or military personnel shall be included in one of the types mentioned. Therefore, the Brazilian General Public Pensions Scheme included all types of paid work, whether through employment relationship or self-employment, both urban and rural workers.

Although all workers are included as mandatory insured persons under the General Public Pensions Scheme, the legislation sometimes states different obligations and benefits. For example, as a rule, the contribution of employees (with an employment relationship), domestic servants and temporary workers is 8, 9 or 11 percent of remuneration, while the contribution of individual contributors is 20 percent, which may be 5 or 11 per cent, cases in which they will not be entitled to retirement based on time of contribution and will receive benefits in the minimum amount (equal to the federal minimum wage). If a self-employed worker works for a company, without an employment relationship, he or she will pay the 11 per cent rate and have access to all the benefits.

The contribution of special insured persons (small farmers and artisanal fishermen) is different from the contribution of other mandatory insured persons, since it is not levied on the remuneration of the work, but rather on the proceeds from the marketing of their production. In this case, they will receive benefits equal to the amount of the minimum wage.

In addition to mandatory insured persons (workers), Brazilian legislation admits that those who do not exercise paid activity can be insured under the General Public Pensions Scheme, under the condition of “optional”.

The law does not require any prerequisite for someone who is not a worker, to enrol in system public pensions, as an optional insured person, unless they are over 16 years of age and pay the corresponding contributions to the General Public Pensions Scheme. Nor does it impose any restriction on access to benefits, because it grants the same benefits to optional insured persons as it grants to individual contributors.

In addition to mandatory protection, the Constitution provides for supplementary pension, which is optional and has the purpose of allowing the continuity of the same standard of living that the worker had when he or she worked,⁸ especially when his or her income exceeds the ceiling of

mediation of the labor manager or trade union of the category. For example, workers who perform wharfage activity.

⁸ According to the Beveridge Report, supplementary pension meets the real needs of workers. BEVERIDGE, William. *Seguro social y servicios afines: informe de Lord Beveridge*, Madrid,

mandatory protection. The aforementioned protection, which is private in nature, is organized independently in relation to mandatory protection. Its financial system is a capitalization system.

Supplementary pension is regulated by infra-constitutional legislation, and is operated by closed (non-profit) entities and open entities. It is regulated, supervised and overseen by the Federal Government.

Thus, it is verified that Brazilian social security is a system of social protection formed by the subsystems of healthcare, public pensions and social assistance. In order to ensure entitlement to the benefits of the aforementioned system, the Brazilian Constitution sets out the means of financing, to be borne by all of society, which will be the object of the next section.

3. *The financing of social security*

As previously mentioned, the Brazilian social protection system is financed by all of society, directly and indirectly, under the terms of Article 195⁹ of the Constitution. The indirect form is affected by the allocation of resources of the fiscal budget of each of the federative entities, especially from tax revenue. For example, there are the rules that require the Federal Government, the States, the Federal District and the Municipalities to allocate a percentage of the tax revenue to healthcare.

Centro de Publicaciones del Ministerio de Trabajo y Seguridad Social, 1989, p. 240.

⁹ Article 195 of the Brazilian Constitution: Social security shall be financed by all of society, either directly or indirectly, as provided by law, with funds coming from the budgets of the Federal Government, the States, the Federal District and the municipalities and from the following social contributions:

I – of employers, companies, and entities defined by law as being comparable to companies, assessed on:

a) the payroll and other labor earnings paid or credited, for any purpose, to individuals who render services thereto, even when there is no employment bond;

b) income or revenues;

c) profits;

II – of workers and other persons insured by public pensions, no contribution being assessed on retirement pensions and other pensions granted by the general public pensions scheme referred to in article 201;

III – on revenues from lotteries.

IV – of importers of goods or services from other countries, or of other parties defined by law as being comparable to such importers.

The direct form is carried out through the payment of social contributions, which are presumed in the Constitution and, according to the Federal Supreme Court, have a tax nature.

The Brazilian Constitution, by virtue of the adopted form of state (federalism), establishes rules that ensure funds to all federative entities, so that they can fulfil the duties attributed thereto. The aforementioned funds come primarily from their respective tax competencies, as well as transfers¹⁰ of tax resources.

In this regard, the Brazilian Constitution of 1988 establishes that all federative entities have the power to institute taxes, having distributed specific triggering events to each of the entities.

However, it attributed to the Federal Government only the competence to institute social contributions, among those which are destined to social protection (social security). The only exception for the institution of contribution by the States, Federal District and Municipalities is the social contribution of their respective public servants, which is directed to the respective Systems of protection.

Thus, the competence to institute social security contributions, as a general rule, is the responsibility of the Federal Government, since the States, the Federal District and the Municipalities only have the authority to institute a social contribution of their respective public servants.

The Constitution establishes the assumptions of seven contributions allocated to social security. Six are set forth in Article 195 of the Constitution (contribution of the company on payroll and other income paid to individuals, even if without an employment relationship; company contribution on revenue or billing; company contribution on earnings; workers' contribution; contribution on revenue from lotteries; and the contribution from importers of goods or services from abroad), and one is set forth in Article 239 (contribution to the Social Integration Program / Public Servant Savings Program - PIS/PASEP-, which, as a general rule, also affects companies' revenue).

The company's contributions on payroll and the workers' contribution are exclusively allocated to the payment of the General Public Pensions Scheme's benefits. As a result, the two contributions are called "public pensions contributions". Furthermore, the contribution to PIS/PASEP (also

¹⁰ Transfers of tax resources from one federative entity to another: from the Federal Government to the States and to the Municipalities, and from the States to the Municipalities.

paid by the companies), is earmarked for the payment of unemployment insurance, which is also a benefit of the public pension system.

Therefore, there are seven contributions destined to social security (social protection) and, although three of them are linked only to public pension, it is possible to call them “social security contributions”, since public pension is one of the subsystems of social security. The other contributions (the remaining four) can also be allocated to public pension, since they are intended for social security as a whole.

However, this does not mean that all of them must be attributed to public pension, since – in addition to public pension – healthcare and social assistance are also part of social security and require funds.

Thus, the other four contributions (from the company on revenue or billing, from the company on earnings, from lottery revenue, and from the importation of goods or services) should be allocated to the three social security subsystems and should meet the interests of the entire population and not only a part of it, as is the case of public pension recipients (only workers and their dependents).

It is worth mentioning, considering the subject matter of this study, that the Brazilian Constitution states, in Article 195, §9º, that the company’s social contributions “may have differentiated rates or assessment bases, according to the economic activity, the intensive use of workforce, the size of the company, or the structural situation of the labor market.”

Hence, one can see that the Brazilian Constitution authorizes lawmakers to establish differentiated rates and assessment bases for social protection contributions, among other things, by virtue of intensive use of labor.

Accordingly, if the use of new technologies reduces the use of labor, the company may – if the legislation so determines – contribute at higher rates or even calculated from different assessment bases.

Finally, it is worth noting that the contributions from public servants and contributions from the States and Federal District, on the remuneration of their public servants, are exclusively allocated to the payment of the benefits of the Special Scheme Pensions for Public Servants.

Given the social contributions destined to social security, the next section will address the main aspects of public pensions contributions.

A. *The contributions to public pensions system*

Public Pensions, as mentioned above, aims to protect workers and their dependents in situations of incapacity to work (real or presumed), substituting work income, for public pension's benefits. This gives it its "professional" characteristic. The other "contributory" characteristic derives from the need for direct contribution of the workers, not only those linked to the General Public Pensions Scheme, but also civil servants linked to the Scheme Pensions for Public Servants.

Thus, because public pensions have both professional and contributory characteristics, public pensions contributions must be assessed on the income earned through the performance of work activity. As a result, the calculation base thereof is income from work, assessed both for those who receive the remuneration (workers, including public servants) and those who benefit from their work and therefore pay the remuneration (employers and federative entities, the latter with regard to public servants).

In this sense, the Constitution establishes that earnings from work are considered for the purposes of contribution and repercussion on benefits. This means that workers pay contributions on their remuneration and the public pensions benefits they receive are related to their income. It is precisely for this reason that one can affirm that the aim of public pensions is to substitute income from work in order to maintain the worker's standard of living.

This is the basis of the contribution of the company on payroll as well as that of the worker, in addition to the contributions of the public servants and the federative entities that remunerate them.

Both contributions on work income (of the one who pays and the one who receives) form the basis for the financing of the social insurance model implemented by Bismarck in Germany in 1883. Such model was followed by the Eloy Chaves Act of 1923, considered the first Brazilian public pensions law, and by all subsequent public pensions laws that followed.

The Brazilian Constitution of 1988 maintained the aforementioned form of financing but, additionally, it established other bases for financing social protection, especially in view of the increase in protection, since it instituted non-contributory protection (social assistance) as a subjective right, and universal access to public healthcare, as previously mentioned in this study.

The only exception – that the public pensions contribution is assessed on work remuneration – is related to the contribution of special insured persons (small farmers and artisanal fishermen), who pay a public pensions contribution on the proceeds from the marketing of their production. This form of financing has existed since 1971, when public pensions protection was established for rural workers, having had a specific scheme of protection up to the 1988 Constitution.

The Brazilian Constitution of 1988, although maintaining this form of financing for one kind of rural worker (specially insured, small farmers and artisanal fishermen), included them in the General Public Pensions Scheme. It is worth noting that the other rural workers' pay contributions as urban workers do, i.e., on remuneration from work activity.

As previously mentioned, the Brazilian General Public Pensions Scheme includes all workers, except the public servants of federative entities that have instituted protection to their own servants. This happens because, if the federative entity has not created a Special Scheme Pensions for its public servants, the respective public servants are also linked to the General Public Pensions Scheme.

The revenue of both contributions (of the company on payroll and of the worker) is exclusively allocated to the payment of the benefits of the General Public Pensions Scheme. The contributions of public servants and federative entities are also earmarked to pay the benefits paid by the Special Scheme Pensions for Public Servants.

The Constitution, by establishing the “worker” as a participant in the funding of public pensions, included all forms of service provision. This is because, unlike the other two areas of social security, public pensions require a contribution from workers so that they and/or their dependents are entitled to public pensions benefits. Therefore, regardless of how the service is provided, workers must contribute to public pensions.

In this regard, Law 8212/1991 states that workers are considered mandatory insured persons for the purposes of public pensions and are classified into five¹¹ types: employee, domestic servant, temporary worker, special insured worker, and individual contributor (self-employed workers, including employers).

¹¹ It is worth noting that until the enactment of Law 9876/99, there were seven types of mandatory insured persons. The aforementioned law created the “individual contributor” type by uniting self-employed workers, workers considered as equivalent to self-employed workers, and business owners, since not only the benefits but also the contributions were the same for the three types of insured persons.

The calculation base of public pension's contributions, both of the company that remunerates workers and the workers themselves, is based on one's remuneration from work, except for the contribution of special insured persons, which is assessed on the proceeds from the marketing of their production, as mentioned above.

It is thus verified that the contributions exclusively for public pensions purposes are assessed on remuneration from work. Accordingly, if there is a significant reduction of jobs, especially those with an employment relationship, there will also be a reduction in the inflow of public pensions contributions. This will require the use of more resources from other contributions, which may jeopardize the sustainability of both public pensions and social security as a whole.

It was mentioned that the situation worsens when the number of jobs with an employment relationship decreases, because the company's contribution on remuneration from work represents, on average, to twice the percentage paid by the worker. This is because, while employees pay 8, 9 or 11 percent of their remuneration, limited to the protection ceiling, the company pays 20 per cent of the total remuneration, even if it exceeds that ceiling. In addition to the aforementioned percentage, the company pays another 1, 2 or 3 per cent for occupational accident insurance. These additional payments may be reduced by 50 per cent or increased by 100 per cent, depending on the company's performance, in relation to the measures taken to prevent work-related accidents.

Thus, although self-employed workers are included in the General Public Pensions Scheme and their benefits are the same as those of employees, the amount paid by them, as a rule, is 20 percent of the maximum, up to the ceiling paid by General Public Pensions Scheme. When they pay their contribution based on the minimum wage in order to receive benefits of the same amount, the rate can be 11 or 5 percent.

It should be noted that if the self-employed worker provides a service to a company, he or she pays 11 per cent, but the company, in this case, pays 20 percent of what it pays to the worker, without application of the maximum limit. It is also worth noting that, since 2003, Brazilian legislation requires the company to withhold the contribution of workers who provide services without an employment relationship and pay to public pensions, which had already been occurring with employees.

Such a measure was adopted in order to reduce the percentage of workers who are engaged in paid employment without an employment relationship, who do not pay public pensions contributions.

However, this only occurs when the worker provides services to a company. When he or she is self-employed and does not receive remuneration from a company, but rather from individuals, he or she must pay the corresponding contributions, which often does not occur.

Non-payment is even greater in cases where the self-employed worker is low-income, since Brazilian social assistance (non-contributory protection) grants a benefit equal to the amount of minimum wage to senior citizens (over 65 years of age) and persons with disabilities, who do not have financial conditions for their upkeep. The amount of said benefit, which is equal to the lowest benefit paid by public pensions, has discouraged the payment of public pensions contributions so as to obtain future public pensions protection.

Under Brazilian law, self-employed workers (even when working for a company with no employment relationship), as well as business owners who work at the company, are called individual contributors and, as already mentioned, are included in the protection granted by the General Public Pensions Scheme.

Therefore, even with the reduction of jobs with an employment relationship, Brazilian system of public pensions protects all workers, regardless of whether they are employed or self-employed.

The problem is whether self-employed workers pay or do not pay social contributions, because if they do not pay these contributions, they will not be protected. Moreover, when there is no employment relationship, the inflows are smaller, since there is no contribution from the company.

Thus, despite the fact that Brazilian system of public pensions includes all workers, the shift in labor relations – resulting from the use of new technologies – may jeopardize the sustainability of the public pensions system specifically, and of social security as a whole, which will be the object of analysis in the next section.

4. The impacts of industry 4.0 on Brazilian system public of pensions

As mentioned above, the system of public pensions protects workers, but, in order to do so, it requires them and those who use their services (if a legal entity) to pay social contributions, which are assessed on income from work.

These contributions represent the basis of financing of the public pension system. This is because the company's contributions on payroll and the

workers' contributions, as mentioned above, are exclusively allocated to pay the benefits of the General Public Pensions Scheme (administered by the National Institute of Social Insurance). The same happens with the contributions of public servants and contributions of the federative entities, which are assigned only for the payment of the benefits of the Special Scheme Pensions for Public Servants.

Therefore, the financing of Brazilian public pensions corresponds to the model of protection established by Bismarck (social insurance) in 1883, with some particular traits.

It is noteworthy that this model was maintained in the protection conceived by Beveridge, which – in addition to mandatory social insurance – provided for access to healthcare for all and social assistance for people who were not socially insured and who needed protection. It also established voluntary insurance, with the aim of providing protection beyond the protection limit established by mandatory insurance. Therefore, the Beveridge model is a mixed model, since it combines both contributory and non-contributory protection.

So, in addition to maintaining social insurance and making it mandatory for all workers, Beveridge considered it the main form of protection, since social assistance (non-contributory protection) would be subsidiary.

The Brazilian Constitution of 1988 adopted a model very similar to the one proposed by Beveridge, because in addition to maintaining Bismarck's model for public pensions, it guaranteed universal access to healthcare and social assistance to those in need, regardless of contribution.

Regarding workers' protection, contributory protection has been maintained, and social contributions, as a general rule, are assessed on remuneration from work (both for workers and for those who use their services, if they are legal entities). The benefits are calculated based on the average remuneration, except for specially insured persons (small farmers and artisanal fishermen) who, because they do not pay their contributions on work remuneration (the contribution is assessed based on the proceeds from the marketing of their production), their benefits always correspond to the amount of minimum wage.

One difference of Brazilian social protection, in relation to the Beveridge model, lies in the fact that the non-contributory benefit corresponds to the minimum limit of the contributory benefits, which, in a way, ends up discouraging the payment of contributions to public pension. As mentioned previously, this occurs when workers receive low income and the payment of contributions depends on the initiative of the workers themselves.

In the Brazilian model, contributions on remuneration from work represent the basis of financing of the public pensions system, as mentioned above. Thus, if there are losses of jobs, there will automatically be less revenue from these contributions, which will require more resources from other contributions to maintain the benefits already granted.

This is because both the General Public Pensions Scheme and the Public Servants' Scheme adopt a simple distribution system (i.e. "pay as you go"). Therefore, the contributions that are collected from active workers are used to pay the benefits to the current beneficiaries. This is the inter-generational pact, although currently – in the case of Brazil – it is not only the contributions of workers and companies on the remuneration from work that finance public pension, since funds from other social contributions mentioned above are increasingly being used.

Accordingly, in 2015, according to the Summary Report of the Federal Government Budgetary Execution,¹² the Federal Government spent 431 billion *reais* on the payment of General Public Pensions Benefits, and the income from the company's contributions on remuneration from work and the contribution of workers totalled 324 billion *reais*.

Thus, since the expenses on the General Public Pensions Scheme were 431 billion *reais* and the income from contributions, exclusively for the payment of the benefits of said system, were 324 billion *reais*, the difference of 107 billion *reais* was paid with the revenue from other social security contributions.

It is worth noting that the aforementioned amounts do not include the payment of unemployment insurance, which, also in 2015, exceeded the amount of 40 billion *reais*. Therefore, only with the workers' public pensions in general, excluding public servants,¹³ more than 470 billion *reais* were spent.

Also, in that year (2015), the total income from the seven social contributions was 670 billion *reais*, which – in addition to public pensions – were allocated to healthcare (102 billion *reais*) and social assistance (73 billion *reais*).

¹² Summary Report of the Federal Government Budgetary Execution Brasília, DF. National Treasury. 2015. <https://www.tesouro.fazenda.gov.br/documents/10180/352657/RRO-dez2015.pdf/a6524837-7907-4716-b607-062d8b081c61>

¹³ In 2015, the Federal Government spent the amount of 104.6 billion *reais* on the Special Scheme Pensions for Public Servants and on the payment of the reserve of its military personnel. This amount does not include the expenses of the States, the Federal District and the Municipalities on the public pensions of their respective public servants.

In 2016,¹⁴ the Federal Government's expenses on benefits from the General Public Pensions Scheme were 499 billion *reais*. This amount does not include expenditure on unemployment insurance. Income from contributions from companies assessed on remuneration from work plus workers' contributions totalled 360 billion *reais*, which means that 139 billion *reais*, allocated to the payment of the benefits of the General Public Pensions Scheme, refer to revenue from the other social security contributions.

In 2017,¹⁵ 549 billion *reais* were spent on the payment of the benefits of the General Public Pensions Scheme, and around 50 billion spent on unemployment insurance, which amounts to nearly 600 billion *reais* on public pensions, without including the amount allocated to the payment of public pensions benefits for civilian and military public servants.

In the analysis of the data above, especially those related to the Brazilian General Public Pensions Scheme and unemployment insurance, in the last three years, it was found that expenditure has increased at a greater proportion than the amount collected, and this alone would already be quite troubling.

However, there are two factors that will certainly aggravate the situation described above: longevity of the population, which is already demonstrating the challenges that must be faced in all areas of social security and, therefore, also in public pensions; and the effects of Industry 4.0, since estimates indicate that there will be fewer jobs, especially those with an employment bond.

Said decrease in jobs will lead, among other consequences, to the reduction of income from public pension's contributions, since, with fewer people working, there will be a reduction of remuneration from work (the basis of assessment of social contributions). Hence, there will be a need to increase revenues to finance social protection or to make adjustments to existing ones.

However, public pension's expenditures will not decrease, because the benefits that are currently being paid will be maintained, and for a longer period of time as a result of increased longevity. Therefore, there will be a decrease in specific revenue to public pensions, by at least maintaining expenses related to public pensions benefits.

¹⁴ Summary Report of the Federal Government Budgetary Execution Brasília, DF. National Treasury. 2015. <<http://www.tesouro.fazenda.gov.br/documents/10180/352657/RROdez2016.pdf/19a25934-21d9-4e40-9304-a488555c8dbf>>

¹⁵ National Treasury. *Summary Report on Federal Government Budgetary Execution – 2017*. <http://www.tesouro.fazenda.gov.br/documents/10180/352657/RREOdez2017.pdf>.

Furthermore, the reduction of jobs will increase claims for unemployment insurance, and, accordingly, there will be an increase in expenses, which will require resources from other contributions, in addition to those from the PIS/PASEP contributions. Unemployment insurance is a public pensions benefit, although in Brazil, it is not paid by the National Institute of Social Insurance.

It should also be emphasized that there will be a larger contingent of people who will seek non-contributory protection (social assistance), since many will not even perform work activities, and others, even if they do, will do so for brief periods of time, thereby not fulfilling the minimum time required for the granting of social protection. This is because, as a general rule, the legislation requires a minimum number of contributions for the benefits to be granted. Thus, only workers who pay contributions for the period established in the legislation (Federal Law 8213/1991) will have access to social protection.

It should be noted that the amplitude of the Brazilian General Public Pensions Scheme is a positive factor, given the changes in labor arising from new technologies, because it includes all workers except public servants, who are protected by Special Scheme Pensions allocated specifically to them.

Thus, the reduction in the number of jobs with an employment bond will not exclude the public pensions' protection of self-employed workers, which appears to be a trend with the advancement of new technologies.

For example, drivers who provide private urban passenger transportation services through apps or network communication platforms are mandatory insured persons under the General Public Pensions Scheme, with the status of individual contributor (self-employed worker) and must pay the corresponding contributions in order to obtain the benefits.

However, it has been found that many individual contributors do not pay the due contributions and therefore will not have access to the corresponding benefits.

In light of this, the law should be amended in such a way as to ensure the registration of self-employed workers in public pensions, as well as the regular payment of the corresponding contributions, which can be done by assigning to third parties (such as the platform administrators) the responsibility for withholding and paying the contributions.

In this regard, Federal Law 13.640 of March 26th, 2018 set out the new wording to Federal Law 12.587/2012 (act establishing the National Policy on Urban Mobility), determining the competence of Municipalities and the Federal District to regulate and oversee paid individual private passenger

transportation services, for individualized or shared trips, requested exclusively by users previously registered in apps or other network communication platforms.

In said regulation and oversight activities, the Municipalities and the Federal District must observe the following guidelines: effective collection of municipal taxes due for the provision of the service; requirement to purchase Personal Accident Insurance for Passengers and Compulsory Insurance for Personal Injury caused by Road Vehicles; and requirement for the driver to be registered as an individual contributor to the General Public Pensions Scheme.

Regarding the requirement to register as an individual contributor, the aforementioned legislative amendment is awaiting regulation, by means of a federal decree, since the Federal Government is responsible for the General Public Pensions Scheme, which it administers through the National Institute of Social Insurance.

It should be noted that the Funding Act can also be amended to make platform administrators responsible for the withholding and payment of contributions.

The foregoing regulation shows that the legal system can and should be changed, aimed at the effective registration and payment of contributions, with the corresponding future protection provided by public pensions.

Therefore, the modification of the way in which work will be performed – whether with or without an employment relationship – will not be a factor of absence of protection in Brazil, especially if legislative measures are adopted with respect to the responsibility for the withholding and payment of contributions on remuneration from “new” work.

What may occur is the even greater insufficiency of revenue from contributions, on remuneration from work, for the payment of the benefits of the General Public Pensions Scheme.

In this context it should be analysed whether the current rates, payable by workers and companies on work remuneration are sufficient to ensure financial and actuarial equilibrium, as referred to in the Brazilian Constitution, or whether they need to be adjusted. However, this can be subject to adjustments in infra-constitutional legislation.

And, as already seen, infra-constitutional lawmakers may increase rates or change the calculation basis of companies’ contributions in the event of a reduction in the use of workforce.

Finally, it should be analysed whether the Brazilian public pensions model, set forth in the 1988 Constitution, is suitable for the current context,

or whether a model with a financial capitalization system should be adopted, which complements a basic non-contributory income guaranteed to all. In this model, only contributions levied on remuneration from work would finance public pension's benefits.

However, in order to adopt such a model, there would be a transition cost, since current benefits should be guaranteed by means other than contributions on income from work. Therefore, any measure should be preceded by feasibility studies that also consider the aspects of social and fiscal justice.

III. CONCLUSIONS

In the course of this study, it was verified that Brazilian public pensions are just one part of a larger context of social protection, which the Brazilian Constitution of 1988 designates as "social security." This system, in addition to public pensions, consists of social assistance and public healthcare.

It was verified that there are seven social contributions allocated to the financing thereof, two of them being exclusively assigned for the payment of the benefits due by the General Public Pensions Scheme, which are insufficient, so part of the revenues from the other contributions are used, which are intended for the social security system as a whole, and not just for public pensions.

It was also found that expenditures on public pension benefits have increased, at higher percentages than the increase in revenue, which in mid-term may jeopardize the effectiveness of other social security rights (public healthcare and social assistance).

In light of the foregoing, Brazilian society, through its representatives, may decide that – even in the face of insufficient contributions on work remuneration, which even tends to increase with the advance of Industry 4.0 – the current model should be maintained, with or without adjustments, even to the detriment of other social security rights.

Or, on the contrary, it may decide that the Brazilian State should guarantee a basic income to all (non-contributory) and that public pensions' protection should be granted only in a financial model of capitalization. However, as seen previously, there is a transition cost, which may make it impossible to do so.

At any rate, the continuation of the current model, without any adjustment, or continuation thereof with the adoption of adjustments, or even a

change of model, should be preceded by clarification and transparency of data. This must be done in a responsible manner, in order not to jeopardize the rights of future generations or the effectiveness of other current rights, both within the social security system (including public healthcare and social assistance) and outside it, such as education, which is essential to address the new context created by Industry 4.0.

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FRANCE AND THE 4.0 INDUSTRIAL REVOLUTION

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SUMMARY: I. *Introduction*. II. *Industry 4.0 in France*. III. *The French legal framework facing the 4.0 Industrial Revolution*. IV. *Reform proposals and projects*. V. *Conclusions*. VI. *Investigation resources*.

I. INTRODUCTION

Expressions such as, “the Fourth Industrial Revolution” or “Industry 4.0”, are not commonly used neither by the media nor by the most authorised writers in the area of social law.

However, non-specialised magazines make use of expressions such as “digital revolution” or “artificial intelligence” with reference to the digitalization of the value chain aiming at the improvement of product quality and cost reduction.¹ These changes already affect both employment and working conditions and will affect them even more in the future, as well as required skills.

In this sense although the term “Industry 4.0” is not used in practice, France shows a major concern to introduce as much in advance as possible, such reforms that will secure labor and social protection for the digital workers of the new era. For this reason, the digital revolution is not seen as a threat in terms of employment losses or because of the obsolescence of work institutions but rather as a challenge and an opportunity to produce more creative jobs. With this goal in mind, France has recently introduced a law reform that offers platform workers labor and social security rights as well as some other fundamental social rights. Obviously, not all digitalized

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¹ La Tribune, n°6625, 14 September 2018.

work exercised within the French borders is covered by those legal remedies, because borders are not an obstacle to digital work. This is why part of the problem of work platforms is that they need to be regulated at a higher lever (other than national) such as that of the European Union or even better that of the International Labour Organization.

II. INDUSTRY 4.0 IN FRANCE

Before we examine the social security and employment law reforms with regard to digitalization of employment, we will first study the referential framework dominating the implementation of the Industry 4.0 in France (1) and then the French and European position towards transitioning to Industry 4.0 (2).

1. *The referential framework dominating the implementation of the Industry 4.0 in France*

France along with Germany are the most powerful economies of the European Union. However, in 2016 industrial products represented 10 percent of the GDP (while it represented 20.3 per cent in Germany) and 2.7 million of jobs in France.² Among the most developed industrial sectors we find, the car and plane, the metal, ammunition, and the food and chemical industry. However, contrary to Germany, France has lost a large amount of jobs in the past two decades due to a loss in competitiveness. In the year 2000 industrial products represented 14 percent of the GDP. In 2015 it represented only 10 per cent. Industrial employment has substantially decreased, from 5.1 million jobs in 1980 (26 per cent of global employment) to 3.1 million jobs (12.6 percent of global employment) in 2011.³ The most affected sectors were: ship building, textile and steel industry. In other words France has been exposed and is still confronted with a significant industrial contraction.

France has also been confronted with the relocation of its industrial production towards more competitive countries - including within the Eu-

² France has invested a lot on nuclear energy. Nevertheless, nuclear power covers only a third of the French needs. As a result, France is energetically dependent. In 2015, 44,4% of power needs have been covered through import. At the same time, only 15% of the consumed energy is renewable.

³ *Les échos*, February 7th, 2018.

ropean Union - practising longer working hours and lower salaries.⁴ For the same reasons (high social protection and energy costs), French industrial products are less competitive at the global level. This is why, one of the most important challenges for public policy is to encourage new products and therefore exports.⁵

The introduction of IT and the digitalisation of many tasks have affected not only industrial production but all sectors of the French economy, including retail and services. With the development of online sales of books, clothing, music and food neighbour shops close down. Another salient example is banking. Because of the digitalization of a large majority of tasks, 370.200 jobs have been lost in this sector since 2008.⁶

According to an OECD report on the transformation of the labor market because of technology and globalization, in the following 10 to 20 years, 9 percent of jobs will disappear in France due to the fact that robots will be able to execute more than 70 per cent of the relevant tasks. Another 30 percent of jobs will be significantly affected due to the fact that they will require new skills.⁷ For this reason, the previously mentioned report emphasises on the French case, on one hand that France needs to transform its economy towards innovation and on the other that it needs to enhance the relationship between business and vocational training.

For this reason, since 1983 France introduced tax benefits for those companies that choose to invest in technological innovation. In that sense the “tax credit for investigation” followed since 2013 from the “tax credit for innovation”⁸ encourage investment in new technologies and technological innovation (for instance for the purchase of three-dimensional printers, using robot directed production, or for having direct or indirect recourse to fundamental research) with the aim of promoting new products, improving quality and at the same time creating new jobs.⁹

⁴ BENCHOMOL G., *L'entreprise délocalisée*, Hermès, Paris, 1994, p.110 ; MOUHOUD EL M., *Mondialisation et délocalisation des entreprises*, 5ed. La Découverte, Paris, 2017, p. 127.

⁵ Report to the Prime Minister, Gallois Luis, *Pacte pour la compétitivité de l'industrie française*, 2012.

⁶ Le Monde, June 15th, 2015.

⁷ How technology and globalisation are transforming the labor market, OECD Employment Outlook, 2017.

⁸ LOI n°2017-1837, December 30th, 2017, Finance law for the year 2018.

⁹ The tax credit for innovation directed to small companies is capped to 80.000 €, while the tax credit for investigation directed to larger companies is capped to 100.000€.

Nevertheless, the creation of new digitalized jobs requires new skills. This is why the Statute n°2018-771, on September 5th, 2018, “on the freedom to choose one’s professional future”, develops apprenticeship, work-linked training and long-term vocational training, in order for the worker to obtain fresh qualifications.¹⁰

Taken that France is a European Union Member State, it would be impossible to imagine an exclusively national strategy in order to tackle digitalisation, since this is putting at stake the European Union’s global competitiveness.

At European level, the Commission has promoted three different strategies. All of them have an impact on the French situation. First of all, there is a common European strategy called “the European strategy for a unified digital market”, dating back to 2015. Then, in 2016, the European Commission has introduced “a European strategy for industrial digitalization¹¹” followed in 2017 by a “European data economy strategy”.¹²

According to Juncker (the former President of the European commission), “in order to secure the competitiveness of the European industry, Europe has to be at the forefront of the digital transformation. It has to promote its acceptance through the economy, aiming at the creation of new jobs linked to digitalization. If this is not the case, digitalization will be conceptualised by other countries and will only be consumed in Europe without getting out of it any benefit in terms of employment”.¹³

Within the European plan “called digital skills” one can find for instance, the project of digital opportunities tranship that offers recently graduated students the opportunity to acquire digital skills related to cyber-security, artificial intelligence, codification or digital marketing.

¹⁰ LOI n°2018-771, September 5th, 2018.

¹¹ Resolution of the European Parliament, June 1st, 2017, relative to the digitalization of the European industry (2016/2271 (INI) ; Communication of the European Commission under the title, « Digitalization of the European industry make the best of the united digital market » (COM(2016)0180).

¹² Communication of the European Commission, under the title « The construction of a European data economy » (COM(2017)9 final). Communication of the European Commission, April 25th, 2018 « Towards a common data space » COM (2018)232 final.

¹³ The translation is ours.

2. *French and European problematic before the 4.0 industrial transitions*

The introduction of IT and technological innovation in general affects all industrial sectors. The Post office, an originally public company has been transformed, in 2010, to a public unlimited company. Taken that traditional posting has lost an important part of its market though digitalization and e-mail, the “Post Office” has diversified its activities, introducing new ones such as banking, insurance, and telephone services. As a result, postal workers need to offer their services to elderly people such as bringing them a loaf of bread or making sure they are fine.¹⁴ The problem is that this diversification requires training new skills, and following the workers progress up. According to relevant trade unions, nine suicides and another five suicide attempts are related to the company’s transformations.¹⁵

The same tendency is found in companies such as “France Telecom¹⁶” or “Yellow pages¹⁷”, a private advertising agency, using paper advertisement. The transformation of its object, (from paper to digital) was accompanied with lay-offs, aggressive management, stress, bullying and suicides.

The French legal system tries to accompany these transformations as much as possible. To take an example, Article L1233-4 of the French legal Code¹⁸ puts on the employers a legal obligation to accompany employees in case their job position substantially changes. The new statute on lifelong training provides the worker with a right to require training in order to obtain a new (different) qualification. Moreover, the French legal system recognises that bullying can be collective in nature and result from aggressive management. As for suicides, they can be qualified as work accidents even if they do not occur at the place of work.¹⁹

With the use of computers and GPS, there is controversy about data and communication security; companies have a legitimate interest to monitor the employees’ conduct and to develop teleworking, while workers have a legitimate interest in safeguarding their right to privacy.

¹⁴ Le Figaro, May 22nd, 2017.

¹⁵ « A handful of suicides to the Post offices: a profound uneasiness”, Le Monde October 17th, 2016.

¹⁶ Thirty-five suicides in two years, from 2008 to 2009, Le Figaro, 7 July 2016.

¹⁷ One thousand workers were dismissed among 4500 from 2018 to 2019, Le Figaro, February 13th, 2018.

¹⁸ Statute n°2002-73, January 17th, 2002.

¹⁹ Supreme Court decision n°05-13-771, February 22nd, 2007.

Nevertheless, the most important challenge, not only for France, but for all European member States, deals with the development of platform work and its effects on employment and working conditions.²⁰ The so-called “collaborative economy” includes various activities among which some are not really “collaborative”. Under this term one can find platforms that have nothing or little to do with work such as flat hiring platforms like AirBnB or solidary transport like “Blablacar”.²¹ This report will not analyse this kind of platform as there is little, if any, link to work. The only platforms we will be interested in are work platforms such as Uber or Deliveroo.

Finally, it should be pointed out the European Commissioner for Economy and Digital society seems to be quite preoccupied by the fact that the vast majority of digital service providers (such as Google) are not Europeans. From this observation arises a suspicion that these services providers (twice) may deliberately refrain from promoting European products and services providers.

The European Commission wishes to solve this kind of problem at the European level by means of a Regulation bill.²²

III. THE FRENCH LEGAL FRAMEWORK FACED TO THE 4.0 INDUSTRIAL REVOLUTION

France, like Mexico, has a legal system based on statutory law. However, where statutory law is absent, case law may intervene in order to avoid vacuum. In those cases, statutory law intervenes promptly either in order to enshrine judicial solutions or on the contrary in order to counteract them.

²⁰ Platform work: Types and implications for work and employment, Eurofound, September 2018, <https://www.eurofound.europa.eu/publications/report/2018/employment-and-working-conditions-of-selected-types-of-platform-work>

²¹ Blablacar is a French private intermediation service. When for instance a car owner wishes to travel from Lille (north of France) to Marseilles (southern part of France), a distance of 1000 km that normally cost 165€ in gas and tolls, he can find, thanks to Blablacar’s services, other people who wish to travel the same route on the same date to share costs.

²² COM (2018)238 final proposal for a regulation on promoting fairness and transparency for business users of online intermediation services.

1. *IT and the protection of workers' rights according to the French and European case law*

The following developments deal first with the effects of the use of IT to the workers monitoring (A) and then with the definition of the applicable law to the relation between platform workers and platforms acting as intermediaries (B).

A. *IT and employee monitoring*

The use of IT makes it immensely easier to monitor the worker's conduct. However, case law seems to draw a fair balance between the company's legitimate interest and the workers right to privacy.

a. Employee geo-tracking

Geo-tracking necessarily intrudes workers' privacy. Nevertheless, according to the Supreme Court, social chamber,²³ geo-tracking is not illegal *per se*, as long as the employer has previously proceeded to the necessary declarations before the National IT Commission, called CNIL and has informed the relevant workers of geo-tracking. However, even under these conditions, geo-tracking remains licit if, and only if, the employer justifies a legitimate interest in using that intrusive means of locating workers.

According to a recent decision of the Supreme administrative Court,²⁴ the use of geo-tracking in order to monitor the workers' hours of work is no longer legal when it is possible to use less intrusive alternative means, although it might also be less efficient.²⁵

b. *The use of e-mail*

According to the Supreme Court, social Chamber, the employee has a right to intimacy and private life including during working time as well as at

²³ Supreme Court n°16-12.569, December 20th, 2017.

²⁴ Supreme admin. Court, n°403776, December 15th, 2017.

²⁵ Geo-tracking seems to be licit regarding truck drivers in order to monitor compliance with maximum working hours.

the place of work.²⁶ This protection derives from the fundamental right of the secret of correspondence. For this reason, the employer is deemed to violate the worker's fundamental freedoms, when he reads personal messages (correspondence) sent or received through to the computer provided to the worker for work purposes, even though the employer would have prohibited any non-professional use.

Nevertheless archives and folders created thanks to the computer provided to the worker for professional reasons are deemed to be professional in nature. As a result, the employer can open and read them even in the absence of the worker, unless the worker has identified them as personal folders.²⁷

A few years later the European Court of Human Rights decided that there is no excessive use of authority when an employer checks on workers in order to make sure they do their professional tasks during their working time.²⁸ However, in the same judgement, the plenary made clear that monitoring systems are not legal unless they comply with seven conditions: (i) previous complete information of the workers on the nature of the monitoring system (ii) legitimate framework of monitoring (iii) legitimate reasons to justify monitoring (iv) absence of less intrusive alternatives (v) consequences for the worker (vi) safeguards for the workers' rights to privacy (vii) access to a court or other judicial resource.²⁹

B. *The contract of platform workers*

According to their contractual provisions, in their vast majority, these workers are independent workers, while the platforms seem to act as an intermediary between the clients (consumers or users of a service) and the service providers (taxi drivers or food takers). As a result, in general, platform workers are not entitled to minimum salary, nor to maximum working time, or to any right on termination of the employment relations. They pay themselves social insurance, especially in case of accident or unemployment. However, some platform workers have brought claims before French

²⁶ Supreme Court n°99-2.942, October 2nd, 2001.

²⁷ Supreme Court, social chamber, n°11-12.502, July 4th, 2012.

²⁸ ECHR *Barbulescu v Romania*, n°61496/08, September 5th, 2017.

²⁹ *Ibid*;

courts in order to have access to a more favourable status, applicable to salaried work.

In one decision dating back to December 20th, 2017, the European Union Court of Justice (EUCJ) decided that Uber is not a simple intermediary but has to be considered as a service provider with respect to transport. In other words, the EUCJ might consider in the near future that platform workers are the platform's employees or at least it does not exclude this possibility.

At national level, the Supreme Court hasn't had yet the occasion to consider the nature of the contractual relation between Uber and the taxi drivers nor that between Deliveroo and the food takers. Nevertheless, French judges are not deemed to follow the contractual qualification expressly used by the contractual parties.³⁰ The employment contract is a concept of public order. For this reason, what the parties may have called an intermediation contract for the provision of services, the Judge is entitled to transform it into an employment contract, provided that the worker is legally subordinated to the platform. Legal subordination is defined as the employer's right to: give the worker orders as to the conditions of work (time-shifts, tasks and place of work); to provide him with the required production means; to control execution and to sanction the workers faults.³¹

In one of the few cases already known by the French courts, the Paris Employment Tribunal³² (*Conseil des Prud'hommes*) recognized that the relation between the platform LeCab and the taxi driver was an employment contract because of an exclusivity term. The fact that the driver was contractually obliged not to work for another platform/employer was considered to be sufficient evidence that he was not independent.

In another case, in front of the Employment Appeal Tribunal in Paris, the Court found there was no employment relation between the "Take eat easy" food takers and the relevant platform because the workers were free to organise their work according to their desires and fixed themselves their hours of work.

Thanks to judicial unrest, a case will be soon brought before the Supreme Court, social chamber.

³⁰ Supreme Court, Plenary, 4 March 1983, D. 1983, p. 381. «The existence of an employment contract does not depend neither on the expressed will of the parties nor on the terms used by the parties, but on the actual conditions the workers exercise their activity».

³¹ Supreme Court, social chamber, n°94-13.187, November 13th, 1996.

³² CPH, n°14/11-044, 20 December 2016.

2. *The legal protection of the workers confronted to the digitalization of their tasks*

Although the digital revolution has a significant impact on the French economy it has never been considered as a threat from a legal point of view. Since 2008, statutory law has intervened in various occasions, and with different aims and excuses, in order to adapt employment law and social security to the new forms of employment, related to the digital era.

In the first place, we will study employment law reforms facing digitalization of tasks (a) and then social security reforms regarding intermediary work platforms (b).

A. *Employment law reforms facing digitalization of tasks*

These reforms include, among others, the legal framework of telework (a); the right to “logout” (b); the legal protection whistleblowers (c) and the social responsibility of the work platforms (d).

a. *Telework*

The Statute n°2012-387 of March 22nd, 2012³³ incorporated a national generally applicable agreement on telework (dating back to July 19th, 2005³⁴) and a European framework agreement (of July 16th, 2002³⁵) on the same matter into the French Labor Code. The French statute on telework was ultimately revised on September 22nd, 2017.³⁶

According to the French legal framework, the employer is generally deemed to be responsible for all digital material. French legal scholars and practitioners are generally hostile to the “bring your own device” doctrine and practice, frequently used by Anglo-American legal cultures. As a result, generally speaking, from a legal point of view, the employer is the owner of the electronic/digital material, not only because he buys it but also because

³³ Statute law relative to the simplification of the law and the lightning of administrative procedures.

³⁴ National general agreement on telework, July 19th 2005

³⁵ Framework agreement on telework, July 16th, 2002.

³⁶ Statutory Decree n°2017-1387, September 22nd, 2017, relative to the predictability and security of the employment relation, JORF n°0223, September 23rd, 2017.

he is responsible for its installation and for the workers' training in order to be able to use it.

Since September 2017, the use of telework at company level supposes a framework collective agreement at company or plant level. When there is no such agreement, the framework for the use of telework is unilaterally decided by the employer under the condition he previously consults with the workers' representatives. As a result, since 2017 recourse to telework supposes a common, uniform and decentralised framework. For example, teleworkers have a legal right to a trial period, meaning that if they are not convinced by the conditions of employment under telework, they can go back to normal non telework conditions, provided they give notice according to a company agreement/plant collective agreement.

Moreover statutory law extends protection of the teleworkers private life. In effect, the previously mentioned collective agreement must determine among other things the time framework during which the employer can contact teleworkers. However, in order to make sure that the teleworker abides by his work schedule, the collective agreement may provide for a monitoring scheme. Monitoring has to be adequate and proportionate, the worker has to be informed in advance and the workers' representatives have to be consulted before the monitoring system is put in place.

Last but not least, statutory Decree n°2017-1387³⁷ provides for a legal presumption that when an accident occurs in the place determined by the employment contract as that of the execution of the telework, the accident is qualified as a work accident (article L 1222-9 of the French Employment Code).

b. The right to logout

The Statutory Decree n°2017-1385, from September 22nd, 2017 (Article 7) provides that companies with more than 50 employees have to negotiate with a trade union representative on the use of digital devices in order to make sure that employees effectively take advantage of their time off work (11 hours per day and 35 per week), holidays (5 weeks minimum), family and private life. If there is no such agreement, the employer is entrusted with training the workers to the reasonable use of digital devices (Article L 2242-17, 7 period, of the French employment Code).

³⁷ The statutory Decree n°2017-1387, 22 September 2017, has been ratified by Statute n°2018-217, 29 March 2018, JORF N°0076 March 31st, 2018.

c. The protection of whistleblowers

With the digitalization of data, it is much easier for an employee not only to notice but also to prove illicit acts taking place within the structure he works for such as an extensive tax evasion. Statute n°2016-1691, from December 9th, 2016³⁸ defines the whistle-blower and provides for the protection of anonymous denunciation under criminal sanctions (2 years of prison and a 30.000€ fine). The Employment Code also protects whistleblowers against discriminatory or vindictive termination of employment (Article L1132-3-3).

d. Social responsibility of work platforms

Statute n°2016-1088, from August 8th, 2016, introduced, within part VII of the Employment Code, title IV, under the title “platform workers” and a second chapter called “social responsibility of intermediary digital platforms”. According to Article L7341-1 of the French Employment Code, this chapter applies to “independent” workers, having recourse to the services of one or more intermediary platforms for the exercise of their professional activities under the condition that it is these platforms that determine the nature and particular conditions of the service, as well as its price.

The employed terminology is puzzling. On the one hand, when the platform unilaterally defines the conditions of service, especially its price, the existence of an employment contract is more than probable. However, the statute expressly defines its scope and limits it to independent workers. On the second hand, the use of the expression “social responsibility”, seems strange, as it implies a voluntary commitment more than a legal obligation. Even though the relevant Statute introduces mere incentives with regard to social protection against work accidents it also introduces actual legal obligations.

One thing should be made clear from the beginning, though. The relevant Statute does not seem to introduce a legal presumption that platform workers are not employees in the sense of the Employment Code. In a very neutral way, the law establishes its scope, restricting its application to independent platform workers. This however does not exclude the possibility that a platform worker might be an employee of the platform and can

³⁸ Statute n°2016-1691, December 9th, 2016, relative to transparency and fight against corruption and modernisation of the economic life, JORF n°0287, December 10th, 2016.

therefore rely on the application of the more favourable status provided by the Employment Code.

To start with, we will first examine the part of the law that is closer to what is generally called social responsibility. According to Article L7242-2 of the Employment Code, if the independent platform worker voluntarily subscribes to an insurance contract against work accidents, then the platform should pay him back the amount of the premium rates not exceeding a certain ceiling. However, statute law “encourages” platforms to voluntarily subscribe on behalf of their workers a work accident insurance.³⁹ Nonetheless, not all independent platform workers are covered by this law provision. According to Article D.7342-1 only platform workers that have earned at least 13 per cent of the social security ceiling, meaning at least 5.165,16€ in one year, can require the reimbursement of their premium rates.

From the previous results, the inductive and not obligatory nature of the law, regarding health and accident insurance for platform workers.

On the other hand, Statute n°2016-1088, August 8th, 2016, seems to guarantee platform workers with an authentic right to occupational training. In effect, according to article L7342-3 “it is the platform that takes in charge occupational training on behalf of platform workers”. In this sense, the platform “users” may validate their professional experience while the platform is required to accompany them and indemnify them.

Last but not least, independent platform workers can organise themselves in trade unions (Article L. 7342-6). This law provision was not necessary, given that the freedom to put in place and participate in trade unions is guaranteed by the French Constitution.⁴⁰ In relation to the previous, Article L.7342-5 provides that if the independent platform workers go on strike in order to further professional claims, this strike, unless abusive, does not engage their contractual liability, nor does it justify the termination of their contract to the platform or motivate any penalization of the worker whatsoever. It seems therefore that the 2016 statutory law guarantees independent platform workers the right to strike.

In contrast, the aforementioned Statute does not include a right to a decent salary, even though remuneration is one of the basic claims in case of strike. Neither provides remedies in case the platform ceases to exercise

³⁹ For instance Deliveroo has declared having subscribed to a global insurance for health care with AXA on behalf of 7.500 « platform users », La Tribune, September 7th, 2017.

⁴⁰ Article 6 of the Preamble of the French Constitution, October 27th, 1946.

its activities regarding justification in case of termination of the commercial relation between the independent worker and the platform.

In July 2018, in the framework of a statutory Bill known as “Freedom to choose one’s professional future”, an MP from the majority proposed an amendment in relation to platform workers. According to this proposal, that was finally rejected⁴¹, platforms were encouraged to introduce, unilaterally and *on a voluntary basis*, a private regulation applicable to digital workers including the absence of exclusivity terms; conditions permitting platform workers to receive a decent salary, training and social protection against work related risks; rights to information and representation in case their working conditions were changed and guaranties in case their working relation to the platform were terminated.

This amendment made it clear that in case a private regulation was introduced by a platform, it could not be used as a means to establish legal subordination of the platform workers to the platform. In other words the amendment, contrary to the 2016 Statute, seemed to exclude the existence of an employment relation between the platform and the worker. In order to avoid the adoption of the aforementioned amendment, the workers of UberEats, Deliveroo, Foodora, Glovo and Stuart went on strike during the last week of the world cup held in France.

B. *Platform workers and social security*

Platform workers are not necessarily undeclared. Generally speaking they are covered under the social regime of the micro or auto-enterprise.⁴² Additionally taken that for the past twenty years, social security reforms seek to unify the employee and independent worker regimes; recent reforms offer substantially comparable benefits both to employees and independent workers (a); better conditions in case of transitions from one regime to the other thanks to the portability of training and retirement rights (b) a voluntary social coverage against work related accidents and an obligatory coverage against unemployment, the financing of which is secured by taxes (c).

⁴¹ National Assembly, Amendments, Francia.

⁴² LHERNOULD J-P, Digital Age, Employment and working conditions of selected types of platform work, National context analysis France, Eurofound 2018.

a. The micro-enterprise: the favoured legal framework for platform workers

According to the French social security system all those residing within the French territory receive the same basic health care (medical treatment, medicine, hospitalization costs) even though they have no professional activity⁴³ whatsoever. In other words, even though they would be undeclared, platform workers would still be covered by the basic social security scheme.

However, in their vast majority, platform workers are registered as independent workers, and more specifically like micro-entrepreneurs. This regime was first introduced by Statute on August 4th, 2008.⁴⁴ Although revenues obtained out of services are capped to 33.200€ per year, this regime has certain advantages and is therefore attractive, especially to young people. These advantages include procedural simplicity; quarterly income declarations and tax payment through the Internet; social security contributions proportional to earnings; company and VAT exemptions.

As a result, the social security contributions of a micro-entrepreneur represent 22.7 percent of his income while for employees they represent 25 per cent, to which one should add employer contributions that ultimately reach 20 to 40 percent of the employee's gross salary.

In addition, in case of the worker's temporary incapacity (illness), the micro-entrepreneur has a right to a replacement income under two cumulative conditions: a minimal social security coverage period of at least one year at the date of the incapacity and at least 3.900€ declared income during the same period. This minimum coverage period (one year) might seem quite long at first glance taken that employees only need half (six months). However, the minimum income condition seems to counterbalance this inequity, taken that employees need to declare at least 10.028,20€ in only six months.

In contrast, the amount of the retirement pension may be very low considering that it results automatically from the declared income and the coverage period under this regime. However, in order to be able to declare four quarters (meaning one year of coverage) a micro-entrepreneur must at the same time declare at least 12.000€ income per year, which might seem low at the forefront but it is not for some platform workers.

⁴³ Statute n°2016-1827, December 23rd, 2016 on the financing of social security for the year 2017, JORF n°0299, December 24th, 2016.

⁴⁴ Statute n°2008-776, August 4th, 2008, on modernization of the Economy, LORF n°0181, August 5th, 2008, p. 12471.

President Macron has announced a reform of pensions for the year 2019. The idea is the unification of regimes in order to avoid that the change of sector or activity affects the amount of pension.

The Statute, relative to the financing of social security for 2018, has organised the absorption of the independent workers' regime from that of employees. This reform shows that there is a strong political will to unify not only management of the regimes but also benefits that separate them. Nevertheless this change will most certainly affect both contributions (that will increase) and benefits (that will be reduced as a consequence).

b. Personal activity account

Platform workers are in their vast majority either young people or they have a complementary activity as an employee or a public servant. As a result, they either seek to improve their professional perspectives or to increase their revenues. Moreover, their generation is conscious that, unlike previous generations, they might be frequently obliged to change activity. For these reasons, statutory law, from August 8th, 2016, has introduced a "personal activity account" in order to allow the accumulation of rights and therefore a comfortable transition from one regime to the other. This account unifies the previously existing, training, hardship at work and citizen commitment accounts.

Indeed, every worker, including employees, public servants and – from January 1st, 2018 onwards – independent workers, accumulate rights to occupational training (500€ per year). These rights increase every year until they reach a peak of 5.000€. They are attached to the worker and not to the employer. As a result, they follow the worker when he changes employer or regime (when for instance the platform worker crosses borders and becomes an employee, or the other way round).

In the same way, the consideration for hardship at work takes into account the work conditions in order to reduce the coverage period required in the case of requesting retirement, or in order to increase occupational training rights and therefore providing the worker with new qualifications in a less dangerous sector.

This last consideration contemplates citizen commitments such as membership to a political party or an association in order to increase occupational training rights or recognize acquired qualifications.

As a result, platform workers also have a personal activity account, in order to adapt to transitions.

c. The unemployment benefit reform for independent workers

Article 51 of the Statute n°2018-771, from September 5th, 2018, relative to the freedom to choose one's professional future, extends the unemployment benefit to independent workers as well as micro-entrepreneurs. As a result, theoretically, platform workers, registered as micro-entrepreneurs also have a right to receive the replacement benefit in case they cease their activity for the platform. In effect, the previously mentioned Statute provides for an unemployment replacement revenue for independent workers when they cease activity. This means that independent workers as well as micro-entrepreneurs will receive unemployment benefits in the future under conditions yet to be determined.

Although at the time of writing the content of the law Decree has not been made yet public, it seems that the Government intends to require: two years of previous continuous activity and at least a 10.000€ income per year. According to one author⁴⁵, these conditions are quite high, considering that 80 per cent of the micro-entrepreneurs have declared revenues of less than 10.000€ per year and 40 per cent among them have ceased their activity in less than two years.

In contrast to the unemployment benefit payable to employees, which amount and duration of payment depends on the duration of coverage and previous contributions, the replacement benefit for independent workers will consist in a flat rate (800€ per month) paid for a maximum period of six months. Moreover, the replacement benefit will be financed by the State budget and will be conditioned by the previous Court-ordered liquidation of the micro-enterprise. Finally, micro-entrepreneurs for whom this regime was acquired on behalf of a secondary activity, are excluded from the payment of a replacement benefit.

⁴⁵ Robert E., Which unemployment insurance for independent workers? Dr. Soc. July 2018, p. 614.

IV. REFORM PROPOSALS AND PROJECTS

The large majority of authors dealing with challenges related to the new forms of digitalized work, point out that part of the problem cannot be solved neither at national level nor at European level. In effect, when platforms are not legally established neither in France nor Europe it is difficult, if not impossible, to impose national legislation on them. This is why it seems to be of vital importance putting in place supranational measures either at European or, even better, at global level.

1. *The proposal of a European regulation for intermediation platforms: an essential requirement for transparency*

Among its other functions, the European Commission (EC) safeguards the implementation of the European competition law. In 2016 the EC initiated proceedings and fined Amazon in order to ensure the binding effect of terms included into the contracts concluded with certain (European) editors for the distribution of electronic books.⁴⁶ In June 2017, Google was fined for having abused its dominant position, offering its own price-comparison service an illicit advantage.⁴⁷

Faced to the competition from huge non European digital companies (such as Google, Amazon, Intel, Android) abusing their dominant position regarding European user companies, the EC proposed, in April 2018, a regulation aiming at the development of fairness and transparency for business users of online intermediation services in order to avoid the fragmentation of the united digital market.⁴⁸ According to the fundamental provisions of this proposal “Digital platforms and search engines are helpful to European businesses in order to reach consumers, as long as they do not make an abusive use of their power”.

The principal remedies proposed by the EC regulation, are the following: the digital platforms and search engines offering online intermediation

⁴⁶ On 11/06/2015, the European Commission initiated formal antitrust proceedings against Amazon http://ec.europa.eu/competition/antitrust/cases/dec_docs/40153/40153_1359_6.pdf

⁴⁷ On June 27th, 2017, the European Commission imposed on Google a fine of 2,42 billions.

⁴⁸ COM (2018)238 final, Proposal for a regulation promoting fairness and transparency for business users of online intermediation services.

services, should be obliged to guarantee accessibility of their services to all professional users (without unlawful discrimination); they should determine the reasons they might invoke to exclude or suspend access of a user company to their service; they should observe a reasonable notice in case they want to introduce a change to the terms and conditions of the online intermediation service provision. As a result, if an online provider of intermediation services revokes or suspends a business user's contract, it has to specify the reasons justifying this decision. Moreover, the online intermediation service providers should make their policy regarding their own products and services public in comparison to that of other professional users. Finally, the online intermediation service providers and search engines should determine and make public the criteria used in order to classify products and services among the results of a specific search.

These remedies are clearly of protectionist nature. However, they will have little effectiveness given that some European member States, like Ireland, have already denied the execution of Commission sentences and fines against Apple in order to preserve their relation to that firm.⁴⁹

Nonetheless, if the European level is not the most adequate one, because of its regional character, then it would be up to the United Nations or the ILO to convince the digital mastodons to undertake a commitment towards equitable conditions of work for global digital workers.

2. Current debates regarding the legal framework applying to new forms of work arising from the digitalization of the French and European economy

The digitalization of the economy challenges the perimeter of employment law and more precisely the concept of "employee" and as a result the scope of employment law in general. The current debate seeks to give a satisfactory reply to the following question: how can we protect platform workers if they are not employees in the sense of Employment law? To this question there are different answers that have been proposed in France.

⁴⁹ On October 4th, 2017, the EC introduced an action against Ireland for the non-execution of a sentence according to which the Commission was ordering the Irish government to recover 13 million dollars tax credit illegally granted to that company.

A. *The extension of the scope of Employment law*

Many authors propose the extension of the concept of “employee”.⁵⁰ This solution would suppose the abandonment or at least the adjustment of the legal subordination theory taken that the new forms of digital work suppose independency regarding work schedules, place of work and means of production. The majority of these authors propose the replacement of the legal subordination criterion by that of “economic dependency”. As a result, an employment relation would be established as soon as a worker would depend for his income from a unique or at least a major client. This proposal has already been enshrined in some decisions of the French Supreme Court.⁵¹

However this solution doesn't seem very appropriate in case of pluri-activity meaning in case the digital worker exercises more than one activities, such as an employment relation, or has a public service position, or in case he works simultaneously for more than one platform.

In this sense, although the criterion of legal subordination seems to become obsolete, the criterion of economical dependency also needs to be refined. For instance, it would be interesting to concentrate on the person of the employer instead of concentrating on that of the employee. The employment relation would therefore derive from the fact that the employer determines, more or less unilaterally, the conditions of work and especially the price for the service to be. As a result, it would be his dominant position within the employment relation that would impose liability and a number of legal duties towards the worker.

B. *The assimilation of platform workers to employees*

Another solution would be, without extending the concept of employee to platform workers, to assimilate platform workers to employees in order for the legal regime normally applicable to employees to apply to them, in part or as a whole. For instance the proposal of a European directive, offer-

⁵⁰ Barbara E., Proposal for a new definition of the contract of employment, Sem.soc. Lamy, 2017, n°1767 ; BOSSU B., Quel contrat de travail au XXI siècle, Dr. Soc. 2018, p 232 ; PASQUIER T., Sens et limites de la qualification de contrat de travail, RDT, 2017, p.95.

⁵¹ Supreme Court (social Chamber), n°98-40.572, Labbane v. Bastille Taxi and al., 19 December 2000 ; Supreme Court, n°08-40.981, June 3rd, 2009.

ing workers a clear, precise and transparent information as to their working conditions⁵², extending its scope to platform workers without expressly including them within the concept of employee.

As a result, the proposal of a directive imposes on the intermediation platform the legal obligation to inform the workers on: the duration and conditions of their trial period; their right to training; their work schedules and overtime payment or the social security system were receiving social security contributions.

In this sense the assimilation technique offers digital workers a fragmented protection that could evolve over time.

C. *The intermediary regime*

A third solution would consist of applying a specific regime like that applicable to para-subordination in Italy or Spain, to platform workers⁵³. Statute Law n°2016-1088, from August 8th, 2016, relative to the “social liability” of the work platforms has initiated this kind of intermediary regime. However the French legal framework is not that clear for the time being, as it seems to confuse legal obligations such as those regarding training and freedom of association and strike, and simple inducements to platforms in order to propose workers’ social protection against work related accidents. The rejection of an amendment seeking to enhance work platforms social liability shows that the French government is currently withdrawing from this solution: the creation of an intermediary legal regime.

D. *The creation of a unique regime applicable to all professional activities*

Under the influence or the seminal work of Professor A. Supiot, “Beyond employment”, (1999 revised in 2016), France has initiated the merger of two separate social protection regimes: that of independent workers and that of employed workers, in order to put in place a unique system, that of “professional activity”. This unique system applicable to all professional ac-

⁵² COM(2017)797 final on transparent and predictable working conditions in the European Union.

⁵³ PERULLI A., Le travail économiquement dépendant/ Parasubordination : les aspects juridiques sociaux et économiques, 2003, http://www.social-law.net/IMG/pdf/parasubordination_report_fr.pdf

tivities has the ambition to offer all workers, including platform workers, a complete and continuous social protection without disruptions and loss of rights when the worker changes activities or cumulates different activities and therefore regimes. Of course this ambitious project regarding social security unification has also certain disadvantages. For instance, the principle of universality affects the amount of benefits and requires funding through taxes. More substantially, unification is for the time being limited to social security, as employment law doesn't seem to follow the same trend: it still applies only to subordinate work.

V. CONCLUSIONS

In France, Industrial Revolution 4.0 is not considered as a disruption of the past but more as a challenge and an opportunity for the future. In the past twenty years France has introduced various measures in order to face digitalization of the economy. The efficiency of these measures is yet to be proven. However, it is important to emphasize that not only legislation (employment and social security law) but also case law seem to adapt themselves and to take up the digitalization challenge. Although social security and employment law reforms do not always serve the same purposes and therefore lack coherence, these developments show that in spite of the financial crisis, France still has a dynamic legal system.

A few ideas arise from the previous arguments, for taking up action in the near future. On one hand, at national level, it seems crucial to adapt the scope of employment law in order to extend it to employment relations with digital companies that determine alone, or almost, the price and conditions of performance. This measure would offer platform workers wider protection and would impede fraud from the application of employment law and social security.

On the other hand, it would be pragmatic to enhance the social responsibility of intermediary platforms using decent work as a guide.⁵⁴ In effect, given that companies of the digital era are not confined within frontiers and

⁵⁴ Decent work has become a universal criterion and has become part of the most important declarations of human rights, such as the Resolution of the United Nations and the final document of the principal conferences, including Article 23 of the Universal Declaration of Human Rights (1948); the World summit on social development (1995), the Document of the World Summit (2005). During the UN General Assembly in September 2015, decent work and the four pillars of the Decent Work Agenda – employment creation, social

that no national legislation seems to cover their global activities, the most pragmatic solution to ensure digital workers' protection (without taking into account their place of work), would be to encourage the voluntary submission of these companies to the decent work principles, with support from the ILO and the UN.

Certainly, we have to point out that problems related to worker vulnerability in the digitalization era are not solvable at a national or regional level but only at a global/world level. As a result, the national or regional measures we have presented can only be seen as opportunities to conceive adequate solutions at global level.

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THIRD PART
MEXICO AND ITS PROBLEMS IN
RELATION TO INDUSTRY 4.0

INDUSTRY 4.0 AND TRADE UNIONS

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SUMMARY: I. *Introduction*. II. *The effects in general*. III. *The effects on labor rights*. IV. *Conclusions* V. *Research sources*.

I. INTRODUCTION

The evolution of law has always been linked and sometimes determined by the evolution of societies and their economies; the need to have functional rules and norms, for a convenient coexistence in community would demand the existence of necessary agreements for its operation and progress. Although some legal schools claim the convenience of studying legal norms as part of a system where the law should only see itself, nowadays, being attentive to the context in which it is born and transformed is an essential need for any kind of approach to the legal; such as the doctrine, the sponsorship of interests, public policies, the forum, the judiciary, etc.

The history of Law reflects the integration of large legal families and their conformation into national legal systems that share regional and “family” traits, but in these times it also seems that important transformations are taking place where the traditional concepts that allowed to locate and characterize some particular legal systems are no longer functional for the few comparatists and the amateurs that study law beyond their countries. The change and the transformations seem to be the currency to be considered today when dealing with any institution or legal branch.

In fact, change is part of the Law. However, some branches seem to have a faster evolution than others for the simple reason that their object of

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study changes and is transformed in a dizzying way. This shows the regulatory framework as insufficient, exceeded or frankly obsolete, thus losing functionality or even its purpose of being. This seems to be the case of labor law, for which its main regulatory objective is labor as well as the actors involved in it. Both have been mutating very rapidly and in an accelerated manner in recent years leaving the labor legislation behind and in many cases inoperative and non-functional.

The “labor relationship” as a basic concept in the legal world of work has, as the classics have said, subjective elements which are the people involved: worker and boss or employer, and objective elements such as subordinate personal work, in addition to salary. This idea and initial concept, which legal evolution in the last hundred years, along with the doctrine, helped to define and refine basic concepts, needed to construct the autonomous normative and institutional building of labor law. However, in very few years that labor law went from emerging and consolidating itself as a basic structure in modern societies to the doubt of its relevance and even permanence. This is perhaps the crossroads where this novel branch of law is today, where traditional ideas and basic concepts help tell its story, but they no longer help to regulate and account for new forms of work and their organization.

The context in which Labor Law aims to be applied today has undergone very important changes. While one of the aspirations at the dawn of the 20th Century was that in this branch of law its fields of application were growing and expanding including increasingly in its bosom a larger number of people who were the object of protective benefits of labor regulations. Nowadays, this aspiration seems nostalgic when the tendency seems to go in the opposite direction.

We must remember that work in the industry would be one of the motivations so that labor standards would arise, and it would be in this “field” in which their development efforts would be focused on; but it would be precisely in this space where very important changes would take place in the forms of work and its organization. Seen from different disciplines such as sociology, business administration, anthropology, economics, among others, they have tried to tell the story of these changes in the industry and their evolution, while in legal matters the changes do not seem to have occurred with the same speed.

Today we are talking about Industry 4.0 as a way of characterizing a particular and different manner of organizing productive processes that impacts, not only the objective aspects but also the subjective ones of the

world of work, and to which Rifkin's omens about the end of work¹ seem to be fulfilled. In the background the confrontation between employment vs. technology seems to come forth once again, as it does in each industrial revolution and innovation in the productive process.² Now, there is the doubt that fuels the debate on whether we are facing a reissue of that discussion occurred in the preceding industrial revolutions, or if it is a stage with more catastrophic visions than the previous ones.

The truth is that, once again, in most countries the emergence of a new way of producing, like the one we are dealing with now, seems to show its limitations not only in the legal framework but also for unions, which are important actors in the labor relations models; this often makes these organizations to be seen as expendable and obsolete entities, an idea that since its conception has accompanied its detractors and opponents.³ We must say Mexico does not escape all this.

Trying to clearly dimension the different manifestations and effects that Industry 4.0 is having on labor relations and its actors is part of the aspects that are still discussed in the doctrine. Nevertheless, it is necessary to push ahead in the analysis on the legal implications that this type of phenomena is presenting to us.

And it is precisely in this issue, of which impacts have been widely explored,⁴ that this paper focuses on; trying, in an initial approach, to observe how these changes are impacting on the workers and specifically their trade union organizations, with special reference to the Mexican case of unions.

The way in which this work is intended to address the issue is to develop it in two parts: the first one, devoted to review the effects that are generally seen in labor law and particularly in terms of general principles of labor law and the so-called individual rights of workers; the second one is the study of impacts that Industry 4.0 would have on collective rights, specifically on

¹ Rifkin, J. *El fin del trabajo, Nuevas tecnologías contra puestos de trabajo: el nacimiento de una nueva era*, Paidós, Mexico, 1996.

² Cfr. Bergeron L., Furet F., Koselleck R. *La época de las revoluciones europeas 1780-1884*, Siglo XXI, Mexico 1976, p. 21.

³ Cfr. Trejo Delarbre R. "Sindicatos desprevenidos ante los cambios de la economía", in: *Sindicalismo y democracia*. International Meeting, Collection N, Vol. IV, SNTE, Mexico 1992, p. 153

⁴ Cfr. Global Challenge Insight Report, *The Future of Jobs, employment, skills and workforce strategy for the fourth industrial revolution*, www3.weforum.org/docs/WEF_Future-of-Jobs.pdf, date of consultation: 9 May 2018.

unionisation, collective bargaining and strikes. One of the objectives of this work is to offer an analytical proposal from which the different aspects and implications Industry 4.0 could have in the unions can be addressed. Finally, a series of conclusions are presented in which the various challenges the topic faces are mentioned.

Although Industry 4.0 is a current issue, there is little literature that addresses it from a strictly legal point of view, at least in Mexico. This is due, among other reasons, to the fact that the specialized doctrine is busy and devoted only in accounting for the ways in which the Mexican labor model and its labor law are changing in recent years, where both legal and constitutional reforms seem to envision an important change in the evolution of the Mexican labor model.

In fact, in recent years, important stages in the evolution of Mexican labor legislation seem to be happening. It must be remembered that the social constitutionalism initiated in 1917, allowed to have an important support and foundation to later develop a regulatory codification in 1931, a constitutional reference and precision for the bureaucracy in 1962 and later: in 1970, a new update on substantive aspects of the labor relation as well as a modification in 1980 of the adjective topics. There is no doubt recent changes to labor standards have another connotation, for example the modification to Article 1 constitutional by which human rights are placed as the axis articulator of the entire Mexican legal system since 2011, and that is spreading to all branches of law including labor law. Likewise, the reform of the Federal Labor Law of 2012, by virtue of which various “flexibilizing” modifications and additions were made to labor relations, as well as the constitutional reform of 2017 in matters of labor justice, show how the Mexican labor model is in full evolution. But beyond the legal historiography that can be exposed, it is convenient to note the reasons behind the important changes in each of these historical moments. In each of them there is a certain motivation derived from the changes the productive processes were experiencing. It cannot be measured to what extent these reasons determined the additions and modifications to labor legislation, but there is no doubt that somehow they caused said changes. This statement, which could be the subject of a separate specific investigation, allows us to consider changes in the objective elements of labor relations as having some influence on labor standards. This idea may be important if we consider that Industry 4.0 is influencing the outline that labor legislation is presenting in recent years in the sectors in which its presence is most tangible. Here by labor legislation

we will have to understand and include, not only the heteronomous norms but also the autonomous ones.

It is necessary to remember that a good part of the legal doctrine, at least in labor matters, has been built from the analysis and description of the changes and evolution that occur in its normative body and in its different formal sources. That is why the analysis focuses basically on the description of the scope and effects that the normative changes are having, but there are also studies on legal prospective and legal “futurism” to a lesser extent. So the doctrine is nourished above all by the objective evolution of the legal system and not by those changes that are not yet positivized and this is precisely the framework within which the impact of Industry 4.0 in the world must be studied. Particularly in Mexico, where labor law and the specialized doctrine generally go in search of “catching” and including in its field of application and study phenomena, new situations which are not yet regulated.

These are some of the reasons why many of the comments made in this work are highly speculative, since they are based on inferences and abstract assumptions, or they go to sources from other areas of research. Indeed, the very little theoretical development of the subject has been given more in studies of other areas of the social sciences such as sociology, anthropology, statistics and not precisely in the legal area. We are aware of the limitations that a jurist has when trying to venture into areas of empirical research. However, it will be necessary in this or another stage of the investigation to illustrate some of the affirmations and concepts of this work with some concrete cases, to appreciate how unions are seeing the impacts of Industry 4.0.⁵

A convenient point, as part of the premises to address the issue, is that Industry 4.0 may well be seen as a stage in the evolution of production pro-

⁵ On the occasion of the present investigation, we elaborated a survey that was conducted in a sample of several unions in Mexico, amongst which are Sindicato de Trabajadores de la UNAM, Sindicato de Telefonistas de la República Mexicana, Sindicato Único de Trabajadores de Nissan Mexicana, Sindicato de Trabajadores de la Industria Química, Petroquímica, Carboquímica y similares y conexos de la República Mexicana, among other thirty cases. The survey raised specific questions, which sought to know the position and strategies of the Mexican unions in relation to Industry 4.0. They were asked, among other things, their opinion on the 4.0 industry, their position on the processes of modernization in their company, the impacts on employment and the working conditions of those changes, what actions and strategies have been implemented, what position the unions should assume in front of these transformations, and so on.

Unfortunately, none of the unions to which the survey was sent responded; however, in the future it will be necessary to consider carrying out these field studies, in order to have more knowledge on the subject.

cesses, in terms of modernization and adaptation to the needs of markets in a country like Mexico. This stage that today appears as something novel and impactful in terms of the implications at different levels has a history of several years, and all its background has been studied profusely resulting in terms and expressions such as “restructuring” or “industrial restructuring”⁶ in Mexico. Likewise, these changes, both present and past, have not occurred in a homogeneous manner throughout the national economy or industry, but they are rather processes that have been present at different speeds.

There are economic sectors with a broad development and modernization, while others seem to be left behind. At least, it is important to keep in mind this diverse and heterogeneous situation, since it is not an element or factor taken into account when performing a labor legal analysis, just like the norm as universal and abstract does not take into account the diversity of actors and spaces of the economy where its application is considered. For the purpose of this study, it is important to consider and take into account that this diversity can help understand which has been the attitude and position of the unions in front of those modernization processes, depending on the type of trade unionism existing in these different sectors of the economy. According to some studies, there are exemplary industries in Mexico in the implementation of technological advances in specific areas such as the automotive industry, aeronautics and electrical-electronics⁷, or certain regions of the country where the state has already been actively working in the implementation of technological advances in coordination with local universities, this is the case of Nuevo León.⁸ In most of these examples, there is an important loss of jobs, but it varies according to the sectors of the economy and the regions.

Some opinions of the Mexican Government indicate that, to be able to insert the country in this industry, it is necessary to have services and ICTs infrastructure (information and communication technologies). Both companies and populations have access to the Internet. It can also be noticed

⁶ Cfr. De la Garza Toledo, E., “El Nuevo patrón de relaciones laborales en México”, in: Barbosa F., De la Garza E. (Coords), *Modernización y sindicatos*, UNAM-III, Mexico 1993, p. 12.

⁷ Cfr. Industrial Cluster: <https://clusterindustrial.com.mx/post/3498/mexico-referente-de-la-industria-4.0>. Date of consultation: 2 July 2018.

⁸ Cfr. Reportero Industrial, “Nuevo León camino hacia una Economía 4.0”, <http://www.reporteroindustrial.com/temas/Nuevo-Leon,-camino-hacia-una-Economia-40+123983>.

in a general way, that progress is being made towards the construction of a public strategy of the Federal Government in this matter.⁹

Regarding the access to the Internet, the coverage in Mexico has been exponential. For many people today, the world is divided between those who are connected to the network and those who are not, creating a duality that has various effects, some of them translated into inequity and injustice, which has already had an impact on the legal field, considering that access to the Internet is a right that must be cared, encouraged and recognized at the highest normative, even at constitutional levels. Thus, the construction of a “right to access” moves rapidly, not only because of its international recognition as a human right but also for its recognition in 2013 by the Mexican Constitution in Article 6 that says that the State will guarantee the right of access to information and communication technologies, as well as to broadcasting and telecommunications services, including broadband and internet.

In this way, in a world that is transformed in a vertiginous way, in its forms of producing and communicating, unions appear outdated and most of the time lack proposals for many workers that claim what they call their “new needs”, among which are precisely their “right to access”.¹⁰

We should notice the importance of the concept “Industry 4.0”. This idea of Industry 4.0 seems to have been a concept created in Germany to refer to a modern industry with a high degree of automation and intensive

⁹ For our country, the digitalization of industries is a very important step. An example is the map Ruta de Industria 4.0, promoted and promoted by the Ministry of Economy. This map analyzes the characteristics of the manufacturing sector in Mexico, strategies around the world, as well as the most important trends in this matter. On the other hand, it identifies the main actions that could be implemented, with emphasis on new technologies, education, digital economy, as well as strategic projects. “

“An exercise has been carried out to prioritize the technologies identified in said road map and public policies focused on technologies linked to digital platforms have been created; Big Data / data analysis and internet of things “

“For its part, the Ministry of Economy, through the Program for the Development of the Software Industry (PROSOFT) and innovation, promotes the adoption of technological tools considered in the 4.0 industry model, through the generation of innovation centers industrial (CII) in various entities in the country such as Aguascalientes, Baja California, Chihuahua, Mexico City, Colima, Jalisco, Nuevo Leon, Queretaro and Tamaulipas “. <https://www.gob.mx/se/articulos/se-lleva-a-cabo-el-evento-industria-4-0retos-para-mexico?idiom=es>. Date of consultation: July 2nd, 2018.

¹⁰ It should be noted that little by little this right appears as a vindication of the workers against their employers, giving rise to agreements with the workers concerned or their unions.

use of information technologies. Although there is a great diversity of definitions of the term, there is also some consensus in the sense that it is a concept aimed at emphasizing the genesis and development the industry has had throughout history, indicating that there has been at least three revolutions that have marked the organization of the productive processes in the industries.¹¹ The first was the industry that used steam to put machines in motion, the second one was the mass production of products, a third one in which electronics and technology would be the basis of its operation, while the fourth revolution is characterized by having an organization of productive processes fully computerized and an intensive and extensive use of the Internet, networks and systems, with a broad connection between systems, production processes and their components.

There are those who consider that an important and characteristic element of Industry 4.0 is the flexibility of the productive processes, as well as the individualization of these processes. Flexibility, because they are not rigid production processes, and its adaptation to new and varied needs would be normal; individualization related to flexibility in that the products would no longer be mass produced and may be subjected to very specific details and characteristics in their manufacture.¹²

On the other hand, in relation to the importance of Industry 4.0, the data seems to show an important growth of the IT industry, which is growing with a high impact on GDP.¹³ Also the extensive use of technology in

¹¹ Cf. Bergeron L., Furet F., Koselleck R. *La época de las revoluciones europeas 1780-1884*, Siglo XXI, Mexico 1976, pp. 8 ff.

¹² Some sites with business information point to a series of more concrete and specific characteristics of Industry 4.0, such as the following: “reconfigurability” as an adaptation to change, digitalization of processes, “smartization” as the learning of other experiences and response to unforeseen situations, cyber physical systems, big data, predictive analytics, “cloud computing” or offering of computer services with the use of the internet, collaborative robotics, augmented reality, artificial vision, additive manufacturing, amongst others; the concepts, terms and ideas, all of them are part of a reality in the new productive processes, against which the law usually seems absent. Cf. Huerta Rodríguez I. “Características y tecnologías de la Industria 4.0 4.0”, <http://www.nube.villanett.com/2016/12/01/caracteristicas-industria-4-0/>, Date of consultation: July 3rd, 2018

¹³ The use of information technologies in our country (Mexico) dates from the 1970s, however, several factors have created favorable conditions for the growth of the sector: the promotion of the formation of human capital oriented to information technologies: the adoption of small and medium enterprises of computer systems; the rapid growth of the use of electronic communications; and the geographic proximity with the main software consumer of the world (United States). These factors have allowed an accelerated growth of the information technology sector in Mexico. The annual growth average of information technology

production processes is relatively found in some sectors of the economy such as manufacturing and robotic automation processes.

According to information, new technologies implemented in productive processes in the Mexican industry goes up. As it can be read on the official website of the government, Mexico has become the third largest exporter of information technology and the second destination for investment in software; a large exporter of information technology services exceeded only by India and Philippines; in 2014, this industry contributed 4.1 percent of GDP.¹⁴

As it can be seen, the arrival of Industry 4.0 is a fact, although at different intensities in several countries and even at different speeds within the same country, all of this is having impacts at different levels such as economic, social, political, organizational, business management, etc. However, at this moment, it is interesting to focus on the effects it is having on labor matters.

II. THE EFFECTS IN GENERAL

A first approach to understand the impacts that Industry 4.0 is having, is to ask whether these changes have any implication in the general principles of labor law. The question is pertinent since it could be considered that it is not only a matter of affectations in some specific labor concepts or institutions, but it would be affecting important foundations of labor normative building.

It should be remembered that general principles are basic and fundamental guidelines and ideas on the basis of which a whole legal system or branch of law in particular is founded, constructed and integrated. Particularly, in the case of labor law, its general principles are rooted in its history; they are proof of their aspirations and to a large extent reflect the intention to build a whole normative edifice that embodies a project of social justice. In this sense, the evolution of the industry and with it the production relations intended to be regulated, have come to hinder the concretion of said general principles since the conditions and the context in which we try to apply the labor law have changed.

services was 6.5% of GDP between 2002 and 2006, while the total of the economy did so at 2.8% for the same period “Cfr. https://prosoft.economia.gob.mx/imagenesmaster/Estudios20prosoft/BREF_02.pdf Date of consultation: May 18th, 2018.

¹⁴ See: <https://www.gob.mx/se/articulos/conoce-mas-sobre-la-industria-de-las-tecnologias-de-la-informacion-y-la-comunicacion-tics-en-mexico>, Date of consultation: May 4th, 2018

Among these principles and traits historically explained, at the moment we only refer to two of them, one that we could be considered to have a static connotation of labor law referring to the idea that it should permeate everything. On the other hand, it has a dynamic characteristic since it refers to how this legal discipline has to evolve throughout the time. In the first case, there is the idea of considering that work is a right and also a social duty. This “formula” that emerged in the international concert of the middle of the last century means, among other things, that man, as part of a society has rights and obligations implying that he is required to carry out a useful and honest life, but can also claim against that society the security of an existence that respects human dignity. In addition, society must provide men with the opportunity to develop their skills” or, as it can be read in the Charter of the Organization of American States, “... that man has the right to achieve their material well-being and their spiritual development “. ¹⁵ In this way, in search for those ideals, work plays a determining role as a means to achieve them. If a society cannot provide sufficient work to achieve those ideals, or is each time less able to do so, this principle will fade away at least in the way it was conceived during the 20th Century. Industry 4.0, in this case, would seem to be a factor that would be distancing labor law from being able to achieve these aspirations, which were part of its initial foundations, not only because of the quantitative reduction of work, but also because of its qualitative modification. Currently, this idea is only outlined, but would require to carry out a rethinking and revision of the labor law from its foundations in this case, in the near future.

Secondly, we have another of the fundamental features attributed to labor law, namely, its “expansive force.” ¹⁶ Indeed, due to an aspirational vision of a large part of the great labor law specialists of the 20th Century, labor law was seen as an unfinished right, but one that contained the bases and institutions not only to revolutionize the system of sources of law recognized by private law until then, but to allow spreading and increasing the expansion of its recipients, as well as the quality and quantity of recognized rights. Not only were the rules for the interpretation and integration of Law as the principle that, in case of doubt, the most favourable norm should apply to the worker, but also institutions recognized in collective law such as collective bargaining by means of which the labor law showed its solidarity,

¹⁵ Cfr: De la Cueva M, *El nuevo derecho mexicano del trabajo*, Porrúa, 6th ed., Vol. I, Mexico 1980, p.107 ff.

¹⁶ Cfr: De la Cueva, *op. cit.* p. 92

classist and vindicating profile, being able through its workers organization to obtain more and better rights for workers from employers as time went by. Today, this nostalgic vision of the rules of work seems far distant. Furthermore, for Industry 4.0, it seems to be a space of frank denial because those rights and benefits that formed the compulsory core between worker and employer do not exist any more, or they are simply there in a different way. Therefore, talking about expansiveness in terms of rights and in terms of its field of application seems to be a contradiction.

The implications of Industry 4.0 go beyond questioning the foundational features and principles of labor law, since they transcend to question if they belong to their basic concepts. So we have that this industry has come to transform the different aspects that traditionally allow to identify, for example, a working relationship; in this case we have that the pattern appears today as a diffuse and plural concept, insofar as it is difficult to identify it even its location in time and space, elements that the substantive law, but above all the adjective law points as necessary conditions to move forward in claiming labor rights. In these situations and for many cases the worker has stopped being the person who was the object of benefits based on his presence and permanence in a work centre; In the same way, the link that traditionally tied an employer with a worker, such subordination in these types of industries assumes significantly different characteristics. Sometimes, the relationship between the parties is established and carried out through the use of information technologies, such as virtual spaces of convergence to give instructions, on the one hand, and receive results, on the other.

This virtual space of encounter escapes, for purposes of its conceptualization, from all the terms and abstractions that labor law historically would have used. However, one of the challenges to be faced in the years to come is try to build a legal category that allows us to recover the need to have an obligational link from labor law, as a premise for the application of the labor legal statute, regardless of all the other factors and objective elements that were necessary to verify its existence.

In this sense and daring to present here a first “sketch” of that necessary and urgent conceptual construction, we need to talk about the existence of a *cyberdination*,¹⁷ as a first line of abstract construction, in which not only

¹⁷ *Cyberdination*” is a compound word, derived on the one hand from “Cybernetic” in English, “cibernética” in Spanish, the latter term which, according to the Real Academia de la Lengua, indicates a relationship with computer networks and which, according to us, evokes the idea of virtual spaces where today they are way apart from communications in the world; and on the other hand the word “subordination”, with which historically, at least in

would try to emphasize the “virtual space” in which services are present today, but also to say that the objective elements of labor relation could be, in the best of cases, only indications or presumptions of the existence of a subordinate work, but where the application of labor standards, current or future, would depend more on the verification of the existence of the tangible effects of the relationship between the parties. On the other hand, these tangible effects would be the need that a party states its requirement, need or offer of services and the other part shows the attention and satisfaction of those needs. The satisfaction of these matching needs in a virtual space would allow us to try to build a legal framework that translates into rights and obligations the State would have to recognize and enforce.

This situation and complex conceptual landscape is particularly important for the exercise of workers’ collective rights, since the legal regime of the trade unions, from their formal birth, and their internal and external performance have been based on the demonstrable and tangible existence of workers, understood in their traditional meaning, and as they are recognized in the labor legislation. In such a way, when one or several of the elements of the worker concept are not present, the union lacks the basic and primary “cell” that gives reason to its legal existence. Industry 4.0 could be contributing to the unnecessary existence of the union as a defender and promoter of conditions and benefits for workers whose absence is greater.

Likewise, we must remember that in legal matters one of the obligations sources between individuals is the consent between them. In the concrete case of labor relations, the legal framework of “consent” has had an interesting evolution going from considering and recognizing that there is consent when it has been expressed in a determined legal act such as an employment contract; to recognize, in the last quarter of the last century, the existence of a tacit and implicit consent when there is evidence that the parties behave as if there was an employment contract. Today we could be in a third stage in the evolution of “consent” in labor matters, accepting that there may be other ways and means of expressing it, for example by electronic means.¹⁸This situation has a number of implications not only in

Mexico since 1970, the link that ties a worker to an employer with regard to work has been identified, and has served to give rights and obligations in labor matter.

¹⁸ Some authors rightly point out that among the many things that have changed with the irruption of ICT and the internet is the way in which consent can be presented between the parties in a legal act: “In our country, the formal legal recognition of this digital environment occurred from the moment in which the Código Civil para el Distrito Federal en Materia Común was reformed and for the whole republic in federal matters, the Código de

the case of creditors and debtors in labor matters, but also in the defence of workers' rights by a union, since a contingent of workers is being fed in an accelerated manner, people whose "formalization" as a creditor of rights, did not happen and was not given by the traditional mechanisms to express their consent and that of their counterpart. In this way, what we could call "virtual consent", as a source of obligations, seems today an exotic idea against which the legal world tries to frame and rescue for itself, while for trade unions, they find it non-existent or distant.

III. THE EFFECTS ON LABOR RIGHTS

The effects that industry 4.0 has been having in various fields can also be identified within the traditional fields in which labor law has been divided, regarding individual and collective matters.

1. *Effects on individual rights*

Most of the pieces for the construction of the basic concepts of "individual labor right" seem to be destined to change, allowing workers to enter or leave the job. Nowadays we are witnessing the growing emergence of labor relations with special characteristics that come to question the traditional characteristics on the basis of which labor law was built.¹⁹

For example, we have several impacts on access to employment since there have been important changes in the types of individual contracts. In fact, it must be remembered that at different times in the evolution of labor standards, access to employment was formalized through the signing of a work contract, in such a way that a contracting scheme was developed, giving rise to types of individual contracts. From their origins these new types of contracts got away from the basic rules of contracts in civil matters (au-

Comercio, the Código Federal de Procedimientos Civiles and even the Ley Federal de Protección al Consumidor of 29 May 2000. The principle introduced by this reform was that the consent can be expressed in the traditional way (verbal or written) and in a new form that is by electronic means⁴⁴. Cf. Rostro J.L. *El derecho del trabajo en la era de internet*, JP, SA, Mexico 2013, p. 24

¹⁹ Some of the characteristics of labor relations in this new context are that they are temporary, interoperable, there is ubiquity, cross-border, multidirectional, instantaneous, intangibility, electronic signatures are common, sometimes there is an electronic convergence, etc. Cfr. Rostro, J.L. Op. Cit. p. 34.

tonomy of the will of the parties for example), but there was a benefit allowing to have several contractual modalities that established as a priority the permanence of workers in their jobs. So in most Latin American countries, for example, the labor codes included several types of individual contracts, in which the main modality would be hiring for an indefinite period and only by exception some other modalities; but in all cases the guideline for the design of the contractual model was the time and duration of labor relations.

All this conception and regulation of the permanence of labor relations and the linking workers to companies allowed to develop such important theories in the specialized doctrine as stability in employment, which allowed the construction of an entire conceptual apparatus as well as legal institutions aimed at providing workers with rights and expectations of the continuity of the employment relationship and with it the permanence of the worker in a work centre, which were the foundations of the above mentioned rights. This situation is important for the trade union organization, since the unions built throughout the 20th Century, legal and political structures, contained precisely the ideal of a stable and permanent worker in work centres, while today Industry 4.0 shows how the hiring or dismissal of its workers is part of their “normality”, thus taking away from the union one of the factors that allowed its existence.

Today we have different opinions that point out that apparently we are evolving towards a new concept of stability in employment, since this is more linked to the so-called “employability” of workers; that is the permanence of a worker in his job is closer to a certain idea of its “relevance” in the productive processes, where flexibility, for example in terms of individual contracting, is not necessarily seen as something negative.²⁰ The design of the union model had employment stability as a key element in the recruitment of supporters, followers and affiliates, because the union workers struggle had its core and recipients precisely in the permanent workers.

Likewise, based on the analysis of the permanence and duration regulations of labor relations in various work sectors, it seems that progress is being made towards a new vision of stability in employment; perhaps, no longer located in a specific work centre, but in a stability centred in the development of the worker in a certain field of the industry and in the whole

²⁰ Cfr. Padulla Martín “¿Qué significa trabajo estable en el siglo XXI?”, <http://staffingamericatina.com/que-significa-trabajo-estable-en-el-siglo-xxi/>, Date of consultation: 10 April 2018.

economy. These guarantees and rights are no longer tied to a specific company.

It should be noticed that since the eighties of the last century, this model of individual hiring has been “flexibilized” to expand the catalogue of contractual modalities, giving rise to figures that are little by little going further away from the general rule of hiring for an indefinite term. This situation is important because, the starting point for this was, and it is still today, that individual recruitment was basically on the bases of undetermined period which would allow workers could, given their long stay in the workplace, establish strategies for action and defence at long term. In fact, recent developments in the legal models of individual hiring in several countries are beginning to show changes as the traditional modalities of individual hiring seem to be increasingly insufficient to meet the companies’ needs. Although at the time being there are no studies showing the extent to which the diversification in the individual contracting models has affected the unions, the truth is that the “attractiveness” for both parties, worker and union, decreases if it is a person with a fixed-term contract.

In Mexico, the 2012 reforms in terms of individual contracting can be seen as a sample of these changes. Indeed, it must be remembered that the old model that privileged hiring for an indefinite period with its limited exceptions of a definite term, gave rise to the expansion of the contractual catalogue, now allowing contracts to be subject to a trial period or an initial training period, apart from the possible contract for hours and seasonal hiring, also having recognized the figure of subcontracting or “outsourcing”, all of this putting behind the old principle of stability in employment.

It is also important to notice the changes in the object of individual contracts. As we already know, one of the central issues that must be clearly and accurately stated in an individual contract are the tasks the worker will perform; For instance, we must remember that in Mexico the current Article 20 states that among the data a work contract should contain, are the tasks to be performed described as accurately as possible, as the law says. Throughout the years there have been many controversies to know if what had been ordered by the employer was or not expressly indicated in the employment contract. It is also important to mention, regarding this point that in the 2012 reform to the Federal Labor Law a possible solution was incorporated to establish in the new Article 56-bis that workers may perform duties or tasks related or complementary to their main work. So a great part of trade unions’ performance focuses on defending that the tasks assigned to workers, either directly and explicitly in their individual contracts, or in-

directly in the tabulators, job catalogues, procedure manuals and any other document, cannot be modified or altered. It is so to the extent that labor legislation and jurisprudence have considered that a unilateral modification of the tasks agreed with a worker can be equal to an unjustified dismissal and the different consequences this entails. However, this historical way of approaching the definition of the tasks that a worker must carry out will change with Industry 4.0, it seems that workers whose tasks and functions are less rigid and who are more flexible are required, so that workers have a wider margin of adaptation to work processes.

On the other hand, related to workers fringe benefits, it must be remembered that a good part of them would be associated with an employment relationship, where the worker was the beneficiary. These benefits were designed from an employment relationship model in which the seniority and permanence of the employment relationship were important and protected not only by labor regulations, but by the same economic relationships; in this way some concepts associated with seniority made sense (such as premiums, bonuses, compensations, vacations, etc.). Likewise, the length of time of physical stay of workers in the workplace is still today an element that allows quantifying benefits for workers, that is the case of salary and overtime, for example. In Industry 4.0 things seem to move in another direction and with another logic where premises like these are destined to change. If indefinite permanence of workers as a basis of their labor relation or the continued presence in a determined place disappear or vary, the rights associated with this new relationship would also change, as shown by some case studies in some countries where issues such as training and specialization of workers take a particular and significant relevance, not only for companies, which seek a more skilled workforce, but for the workers themselves who can compete in better conditions in the new labor markets.²¹ In that sense, the union struggle to achieve certain fringe benefits would assume a different character in Industry 4.0 when changing said benefits and aspirations and also with the arrival of new ones.

In other topics such as the working day and the duration of work, Industry 4.0 has a new way of approaching them. In this aspect, the strategy of trade unions had been historically centred in the reduction of working

²¹ Cfr: Economía digital: su impacto sobre las condiciones de trabajo y empleo, <https://universoabierto.org/2018/02/08/economia-digital-su-impacto-sobre-las-condiciones-de-trabajo-y-empleo/>. This work is relevant to the extent that it is a multidisciplinary analysis resulting from a research carried out in European companies in the technology sector, particularly in Spain, and it seeks to identify the transformations experienced by employment and work conditions. Date of consultation: 11 April 2018.

hours. In fact, many collective contracts or even legislations which were able to diminish the maximum limits of working hours represented a union triumph. In this sense, the construction of a working day concept and the protections and rights associated with it, would be irrelevant in Industry 4.0, where these concepts would be blurring to be transformed into a new and diverse conception of working hours and work place.

Other issues related to the above mentioned which are part of wide-ranging debates in other latitudes, such as Spain and France, and hardly addressed in Latin America, are those related to the right to disconnection²² and the right to conciliation between family life and professional life.²³ In the case of Mexico, the inclusion of telework in the reform of the Federal Labor Law of 2012 within the chapter related to any kind of work done at worker's home, for example 'home office', (article 311) is presented as a first attempt to approach new ways of work at distance using new technologies which industry 4.0 takes advantage of. Once again, unions' participation is absent trying to understand and protect the new teleworkers through collective bargaining for example.

On the other hand, it is also interesting to notice the impacts taking place in the rules to finish the employment relationship. In fact, a good part of the studies on Industry 4.0 indicates that the extensive use of robots and computers will result in the elimination of jobs.²⁴

2. *Effects on collective rights*

The effects of Industry 4.0 have not only been given in trade union matters from the evolution of individual rights, but also in other manifes-

²² Based on the Law 2016-1088 of August 2016, in force in 2017 in France, the right of workers to "disconnect" from mobile devices in order to fully respect their rest time and vacations was recognized, under certain modalities.

²³ One of the countries in which the legislation has been advancing on this issue is Spain, where reforms of the last years (for example, Royal Decree Law 3/2012) have incorporated new rules, for example, regarding breastfeeding permission, reduction of working hours, holidays in case of maternity, etc.

²⁴ According to studies such as the one carried out by the World Economic Forum in early 2016 (Future of employment), it is estimated that between 2015 and 2020 automation and digitalization could lead to the loss of 7.1 million jobs, especially of administrative type, although it would also imply the creation of two million other jobs in areas such as computing, engineering and mathematics. Cfr. Manufacturing "El nuevo empleo de la revolución 4.0", <http://www.manufactura.mx/industria/2018/01/24/el-nuevo-empleo-de-la-revolucion-40>, Date of consultation: July 4th, 2018

tations of labor relations. As in other areas of labor law, the impacts that Industry 4.0 is having in terms of collective rights are undeniable. It must be remembered that the organization of workers and the construction of a legal framework that protects it, arose also having a model of production relations in which certain factors took place, such as the concentration of a large number of workers at a given time and place that allowed to “centralize” the defence of their interests. Union membership was designed from exclusivity in the union’s contractual commitments, in the procedures of entry into the company (for example: the so-called exclusion clauses via), union patrimony was basically and predominantly fed on members quotas as well as on the company’s contributions, based on the number of workers of the union. Likewise, the physical and geographical location of workers in a city, province or country determined a national legal framework appropriate to that condition.

Today, Industry 4.0 seems to go in the opposite direction to those premises from which the union concept was constructed. Today phenomena such as decentralization and delocalization have a superlative degree in this industry. In addition to the drastic reduction of the workforce, workers may be linked to a productive process but in different physical spaces, even remotely from each other, so the traditional tasks and role of the union get complicated. Now, in this interconnected world, in the so-called “new knowledge economy” there are characteristics such as the fact that “traditional workers” are displaced.

We must remember that the workers’ union organization emerged with the aim of dignifying and improving the living conditions and particularly in the work of the workers, and that aspiration continues in spite of the evolution of the industry. Therefore, the existence and *raison d’être* of unions remain valid. Any place where there are people who lend their efforts to others in exchange for an income that allows them to survive; in that place, their organization and defence, as well as the rules for them are necessary.

The union concentrates its strength largely from the premise that workers, human beings, are necessary for the development of productive processes, and this is why, from the beginning of processes where the human factor is part of, either partially or totally, the union seems to empty itself on the interests it sponsors.

Collective rights, unionisation, collective bargaining and strike were designed with the premise of the existence of certain types of employment relationships and certain types of actors and parties and we must say all of this is changing. Obviously if the premises of the scheme built for both

organization, action and defence of the workers change it will have effects, depending on its extent. Some examples identified in North American and European experiences show how these “new workers” are moving on, looking for new ways of organization and defence,²⁵ doing it creatively but still incipiently; or that they can even be identified coexisting in old and new forms of representation and collective organization of workers.²⁶ Likewise, some experts have said that these new workers “... do not have elements of reference that will help them to join others in order to organize and act in defence of their interests”, it means that they are people who suffer from a “lack of work identity”,²⁷ and so the typical tasks of organization and union actions are difficult.

In addition to the above considerations, for Mexican history of unionism it is worth adding one related to its birth and evolution. Something that has been said several times is that a union is mostly part of the inheritance of a gestated political model in the first decades of the last century; it is a union model in which normal and traditional concerns about the defence of its members are undoubtedly present, but its role in terms of its “political significance”²⁸ is also present, especially since the Mexican Revolution, at the beginning of the 20th Century where the representations of the workers would play a role not only professionally, but also politically in the construction of Mexico, in the last century.

²⁵ “If the concept of worker changes because of the change in the way of performing the productive performance typical of a time of digitalization, it seems clear that it is also necessary to reflect on the forms or tool of protection or self-defence of new workers, especially the development of the forms of organization of the same in the new digital platforms, the space and the new contents of the collective negotiation and the way to exercise the right to strike in the digital era. Movements such as Alt-Labor in the United States, Verdi’s German experience as a freelancers’ defence organization, or the creation of a website like Turkopticon for Amazon Mechanical Turk workers, can serve as an example of new forms of organization and defence of this new class of workers, although it is really complicated to do it for the individualism and the lack of a solid professional identity present in almost all of them “. See. Digital Economy, *op. cit.*

²⁶ *Cf.* Vandaele K. “Will trade unions survive in the platform economy? Emerging patterns of platform workers’ collective voice and representation in Europe, working paper 2018.05, European Trade Union Institute, ETUI, Brussels 2018, p. 18. *Cf.* Johnston H., Land-Kazlauskas C. “Organizing on-demand: representation, voice, and collective bargaining in the gig economy”, Conditions of work and employment series no. 94, ILO, Geneva 2018, p. 7.

²⁷ *Cf.* Rodríguez Luz, “Sindicalismo y revolución tecnológica”, https://www.infolibre.es/noticias/luces_rojass/2018/02/28/sindicalismo_revolucion_tecnologica_77634_112_1.html, Date of consultation: May 18th, 2018.”

²⁸ *Cf.* Trejo Delarbre R. *op. cit.* p. 155.

This political role in many occasions would be the most relevant and of utmost importance in its performance. Undoubtedly, this is an element that plays an important role in an integral analysis of Mexican unionism and in particular its position and attitude towards phenomena such as Industry 4.0, since many times their strategies were determined, or at least influenced by its relation with the political power in general and particularly by the government in turn, more than in its performance as defenders of its members.

Industry 4.0 could well be seen as a stage in the economic and productive development of a country, which has different manifestations and modalities which would be diverse not necessarily homogeneous in the country depending on the different sectors of the economy, their degree of implementation of the different types of industries in certain sectors and also the position of the unions, if they exist. For example, some authors point out that in the period of the so-called “stabilizing development” that allowed inflationary stability, sustained growth and control of economic variables at the beginning of the second half of the last century, among some of the characteristics of labor relations we could find the State guardianship of workers, their organizational control, limited protection of employment and salary, and little intervention by the unions in technological aspects and in the organization of work.²⁹ For example, in the 1980s in Mexico we experienced an important technological change concentrated in industries of the manufacturing sector, especially the larger companies, basically exporters. In this panorama, the “high-technology electronic sector”³⁰ stands out. It should be remembered that in those years the need for “update” in the labor legislation was at the centre of the debate, the business sector pointed out the need to modify the labor legislation as a condition to modernize the national economy.³¹ This sector had already claimed it several times before. So, since then, the changes that would have been proposed and adopted would be largely influenced by that model of labor relations prevailing in Mexico, so as a consequence, the position and attitude of the unions

²⁹ Cfr. De la Garza, *Reestructuración productiva y respuesta sindical en México*, UNAM.IIE, UNAM, Mexico, 1993, p. 74.

³⁰ Cfr. De la Garza, *op. cit.* p. 120.

³¹ From the recognition of ‘incompatibilities’ between the old model of labor relations inherited from the Revolution and the demands of economic modernization launched by the last two administrations (it refers to the eighties), the debate on that occasion was oriented to clarify those aspects of current legislation - and the practice that falls on it. That they should undergo modifications aimed at overcoming them. “Cfr. Bensusán G. and García C. (Coord.) *Modernidad y legislación laboral*; Mexico, Ebert Stiftung Foundation-UAM, 1989, p. 10.

towards Industry 4.0 is, to a large extent, determined or at least influenced by that model.

Regarding collective bargaining, the effects of Industry 4.0 should be identified, at least, from two points of view. On the one hand, the negotiation aspects of collective agreements, which are the process and mechanisms of collective bargaining; on the other hand, the impacts on the merits of the contracting, that is the contents and themes of collective bargaining itself.

With regard to the aspects of form, it should be remembered that in the Mexican labor legislation, as it happens in other countries, a specific regulation on the negotiation process of a collective contract so as how to negotiate, where to negotiate, what principles and rules to respect in the development of a negotiation is not included. These are questions that have no answer in the current legal framework. This situation could change in the future because Mexico has ratified Convention 98 of the International Labour Organization (ILO). However, it should be noted that administrative labor authorities, both at the federal level (Ministry of Labor and Social Welfare) and at the domestic one (labor secretaries in each State of the Republic), have generic competences to intervene in the development of collective negotiations. These competences have more to do with the role of facilitators that must be assumed by “conciliatory” officials in these public offices; Their intervention in these cases is not necessarily bonding nor mandatory for the parties of the negotiation because it is not provided with this character in the administrative legislation that regulates it.

However, in practice we can find a wide diversity on the form and modalities assumed by this government intervention, from a discreet participation where only the parties are commanded to carry out their collective negotiation process, until real interventions pressing the parties to reach an agreement. This scenario constantly leads to wrong interpretations and misunderstandings since there is no broad and clear regulation on the role to be played by the authorities in collective bargaining. The above mentioned could be eliminated by incorporating a minimum legal framework on the subject into the labor legislation. In that sense, Industry 4.0 does not seem to influence a change, at least for now, in real or formal collective bargaining procedures.

Regarding the issues involved in collective bargaining, the Federal Labor Law in Mexico states in its Article 391 that a collective agreement may contain several topics, such as its field and scope of application, working days, rest days, and vacations, as well as training and joint committees the parties wish to integrate, etc. This thematic list is enunciative and allows

the parties to add other topics if they agree. Based on this, some collective agreements, over the years, and in very specific sectors of economic activity have been enriching topics addressed by collective agreements and in many cases significantly expanding the rights that the labor legislation establishes for workers. However, it should be noted that most of the set of obligations contained in a collective contract is intended and benefits the worker who is part of a labor relationship or a work contract understood and identified in a traditional way. That is, with a working day, a place of ascription, etc., so that when it comes to people or workers who do not meet the “normal” characteristics of a worker, the collective contract openly shows its limitations, and such is the case of Industry 4.0, where the collective contract, as a bilateral legal act and recognized as a formal source of labor law, seems inoperative. This has not prevented unions from trying to incorporate rights for workers who escape the traditional way in which they work through collective bargaining in exceptional cases.³²

In the recent past and among other things, the flexibility of collective agreements has been determined by the strategy the union has assumed when it has faced these processes (reaching agreements or rejecting that possibility)³³; in this case, although there could be a generalized perception of acceptance of the productive processes adjustments, based on the majority corporate union tradition in the country, we would have to see the casuistry. For example, some studies show how in the 1980’s there was an important process of “flexibilization”, with different degrees of intensity of collective contracts in sectors such as the automotive industry and the maquila export. In these cases the unions accepted, sometimes without any participation, changes in the execution of the workers’ everyday labor relation (schedules, subcontracting, etc.). There were parastatal cases such as PEMEX and Aeromexico with limited or without any participation of the

³² Some experts point out, when referring to the Spanish case, that one of the topics that would be destined to be transformed is that related to labor training (capacity building and training in Mexico) as an obligation at the employer’s expense, and usually part of the subjects of the collective bargaining, as it is very likely that it will no longer be limited to providing technical knowledge and professional skills but would very likely expand to information and communication techniques. Cf. García Muñoz M, Salvador Pérez F. “El derecho a la formación laboral en nuevas tecnologías: una aproximación en el ordenamiento español”, *International and Comparative Review of Labor Relations and Employment Law*, vol.6, no.1, January–March 2018. At http://ejcls.adapt.it/index.php/rlde_adapt/issue/view/57: Date of consultation: July 5th, 2018.

³³ *Cfr.* De la Garza, *op. cit.* p.123

unions in the definition and possible agreement on the implementation of productive processes changes.³⁴

In any case, the themes and contents of collective agreements will have to be impacted by Industry 4.0 and possibly new issues such as workers' health due to the intensive use of new technologies will lead to new claims in the workplace, regardless of the impacts on social security. Throughout this process of change and conception of what a collective contract is and what it can or should contain, the participation of unions will be crucial and determinant, as the union becomes aware of its new role in production processes and the relationships stemming from them.³⁵

Finally, it should be noted that in terms of strike, it is in full evolution, in a stage of implementation of Industry 4.0, so its analysis may be ambivalent. On the one hand, the conception of this important human right, expression of the collective action seems to disappear when having difficulties to be carried out in a traditional context of work source, while on the other hand, the very essence of the strike, as a legalized act of defence by the workers translated into the interruption of work, could have another meaning and other ways of manifesting in a context of high technology.

IV. CONCLUSIONS

Unionism and unions have been facing a crisis for some time,³⁶ not only because of the significant decline in the number of workers within unions and for their lack of influence in determining the rights and benefits of workers, but also because they are far distant from the foundation they are supposed

³⁴ *Cfr.* De la Garza E. "El nuevo patrón de relaciones laborales...", *op. cit.* p.19.

³⁵ For some authors collective bargaining in the context of industry 4.0 could help to articulate mechanisms that allow the implementation of new production processes, trying to achieve the least impact on workers. *Cfr.* Moreno Díaz J.M. "La negociación colectiva como medio fundamental de reconocimiento y defensa de las nuevas realidades derivadas de la industria 4.0", *Revista Internacional y Comparada de Relaciones Laborales y Derecho del Empleo*, vol. 6, no.1, January–March 2018, *file: //C:/Users/Carlos%20Reynoso/Downloads/557-1159-1-PB.pdf*; Date of consultation: July 5th, 2018.

³⁶ Since 1989 one of the most outstanding Latin American workers such as Dr. Héctor Hugo Barbagelata spoke of technological change as one of the causes of the crisis of workers' organizations, which was translating into the inability of unions to "adjust to the new times and give new proposals for the solution of problems". Cf. X Congreso Iberoamericano de Derecho del trabajo y de la Seguridad Social (Anales), Panel: The Future of Labor Law, Montevideo 1989, p. 28. Cf. Dávalos J. (Coord.), *El derecho del trabajo ante el siglo*, Conferencias magistrales en homenaje al Mtro. Mozart Víctor Russomano, UNAM, Mexico 1989.

to be in. The arrival of technology and in particular Industry 4.0 has come to denature the unions, since Industry 4.0 places unions far away and distant from the context, premises and concepts from which its role was built during the 20th Century in production relations systems in the world. Some experts say this could explain to some extent its delayed reaction before the phenomenon of work transformation.³⁷ Some other experts who explain the situation of contemporary labor movements refer to their current weakness to the fact that the changes brought in many economies in recent years privilege individualism in the employment relationship which goes to the detriment of their own collective and even natural dimension at other times.³⁸

Faced with this situation, there are several challenges ahead. Now we note two of them. One is in the conceptual field, as it was already noted in this work, many of the basic concepts labor law was born with and consolidated during the 20th Century were among others the employer, work, subordination, work contract, collective bargaining agreement, internal labor regulations, strike. These were at the same time concepts and foundations on which the union of workers would build their development, and today in a context of radical changes, as is the case of Industry 4.0, these concepts will have to be revised, revisited and eventually modified or replaced by new ways of thinking about the organization and defence of workers. Indeed, the responses which unions have generally offered in this context show lack of new and creative conceptual proposals from which defence strategies could be articulated.

Another challenge has to do with the principles that justified and gave birth to the labor law itself, highlighting among them the protective principle. It should be remembered that in the 19th and early 20th Centuries labor legislation found one of its most important justifications for birth and consolidation, since its institutions and concepts appeared as an act of rebellion against the omnipresent private right in which human and social aspects were not part of its construction and interpretation. In this context, labor law was a way to incorporate inequities and inequalities into legal

³⁷ Cfr. Raso Delgue J. “ América Latina: el impacto de las tecnologías en el empleo y las reformas laborales”, *Revista Internacional y Comparada de Relaciones laborales y Derecho del Empleo*, Vol. 6, no. 1, January-March 2018, p. 13. http://ejcls.adapt.it/index.php/rlde_adapt/issue/view/57 Date of consultation: July 5th, 2018.

³⁸ Cfr. Albuquerque R. “El sindicalismo contemporáneo ante la globalización y la revolución tecnológica”; <https://rafaelalburquerque.com/2017/02/14/el-sindicalismo-contemporaneo-ante-la-globalizacion-y-la-revolucion-tecnologica/> and the technological revolution, Date of consultation: July 5th, 2018.

norms, as part of a political and even philosophical project that nowadays seems to be forgotten.

For some sectors, the eventual elimination of jobs that Industry 4.0 irremediably seems to bring goes hand in hand with the creation of new positions but with other characteristics and needs: technical, electronics, robotics, Internet, etc. Therefore, the role of the union would have to be revitalized and renewed having to meet the new needs and demands of a new generation of workers, in such a way that the actions of the trade unions do not disappear but will be transformed into new ways of defending their union members. It implies a deep reflection within syndicalism about its present and future role. This leads to the idea that unions in the new context of Industry 4.0 will have a renewed agenda, with issues linked for example to safety and hygiene at work, vocational training, working hours, salary, etc.

In the need to reinvent themselves, unions will have to look for new strategies to struggle. There are already those who talk about a “virtual trade unionism” to refer to strategies of organization and protest with the use of new information technologies.³⁹

But the emergence of new technologies and their impacts transcend the workplace and go beyond to areas such as education, this will lead to the need of designing public educational policies that address workers and professionals training for whom their participation in the productive processes would also be different and efficient.

More widely, among the proposals that could be made to various actors, it is an example that the Mexican State, starting with the Federal Government, in coordination with the Governments of the States of the Republic, should include iIndustry 4.0 in the design and implementation of a future labor policy as part of new things to come in the labor market and in the national industry in the short and medium term. In spite of efforts made in

³⁹ New ways of defending workers have been appearing in recent years, for example, “raiders for rights” in some European cities, where they are distributors of goods that have even begun to be organized in a virtual way with the use of platforms to claim more and better protections and rights.

On the other hand it should be noted that at international level there are already some demonstrations that show how some trade union organizations are analyzing and discussing their position in the face of the changes implied by Industry 4.0, a great part of them claiming the need for trade unions to be taken in account, at company level, at regional level, at public policies level, etc. by making decisions about the implementation of these changes in production processes. An example of this are the agreements and action strategy adopted at the World Conference of the Industrial Global Union on Industry 4.0. Recently, <http://www.industrial-union.org/es/la-industrial-establece-estrategias-para-industria-40>.

that sense, they do not seem to be enough due to the implications that this topic will probably have in the years to come. Likewise, it is urgent to take this issue as part of the reflections and challenges that trade unionism will have to face in the near future. It is also important that the academy goes deeper into the multidisciplinary studies that can shed light on the impact of Industry 4.0 in Mexico providing more comprehensive information on the subject, not only to expand their knowledge but also to offer elements to support public policies.

As it can be seen, the challenges posed by Industry 4.0 are great for the whole society, but in particular for actors of the world of work such as trade unions, who urgently need to move forward reflecting over strategies that allow them to understand and creatively face these challenges as their subsistence lies in this.

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YOUNG PEOPLE AND THEIR INTEGRATION INTO INDUSTRY 4.0

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SUMMARY: I. *Introduction*. II. *Industry 4.0 Education-Work*. III. *National Youth Context*. IV. *The Way Forward*. V. *Conclusions*. VI. *Research Sources*.

I. INTRODUCTION

The world is changing rapidly and is becoming increasingly more complex as a result of technological advances and convergence, which are having a multifaceted impact by changing production, consumption, transportation, the way of living and interacting in a digital, hyper-connected world. It is therefore transforming work, jobs, ways of doing work-related activities and the work environment. While these implications are already underway, they will escalate in the coming decades.

In addition to gaining importance, technological change, as well as one of its concepts, “Industry 4.0”, are posing challenges in all areas and, specifically, in the integration and participation of young people in today’s society.

The issue of education in relation to work provides a broad vision because both concepts cover a wide scope in terms of their objectives, rationale and dynamics. Throughout history, the relationship between these two fields has been complex and ever-changing because this link is conditioned by economic, political and social contexts. Indeed, demographic trends, changes in the world of work and economic crises have had unique and complex manifestations for the young population. Today, a high percentage

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of young Mexicans cannot enter the labor market, while the participation of others is usually marked by precariousness, instability and lack of protection.¹

Thus, in view of the changes that are coming and within a framework of discussion, it is important to identify the aspects on which Industry 4.0 will have an impact in this already difficult transition from school to work.

In light of this, this paper begins by giving an account of the trends on Industry 4.0, and goes on to describe the professions, skills and type of training that are profiled for this industry. It then examines the national youth context to see whether the education-work nexus will be able to take on the challenges of the new industrial era, what steps have been taken and what actions are needed to effectively face it and ensure the insertion of young people in the workforce in the best conditions.

II. INDUSTRY 4.0: TRANSITION FROM SCHOOL TO WORK

1. *Concept*

The idea of “Industry 4.0” and its strategy were presented at the Hannover Trade Fair in Germany in 2011, stemming from a project to be carried out by a working group, which submitted its recommendations to the government in 2012. The project focuses on the digital dimension of future industrial structures (smart factories that quickly and autonomously adapt to market needs in order to integrate customers and suppliers, as well as to produce small customized series in a short time).²

Other terms are also used to describe this technological change: *Industrial Internet* (United States of America), *Made in China 2025* (China), the Internet of Things (IoT),³ digital economy, the new era of industrial automation, digitalization, computerization, the Second Machine Age⁴ and the Fourth Industrial Revolution,⁵ among others.

¹ Saraví, Gonzalo, “Desigualdad en las experiencias y sentidos de la transición escuela-trabajo”, *Papeles de Población*, vol. 15, No. 59, 2009.

² Schroeder, Wolfgang, *La estrategia alemana 4.0: el capitalismo renano en la era de la digitalización*, Madrid, Friedrich-Ebert Stiftung, 2017, p. 17

³ Krull, Sebastián, *El cambio tecnológico y el nuevo contexto del empleo. Tendencias generales en América Latina*, CEPAL, 2016, p. 7.

⁴ This term was coined by Erik Brynjolfsson and Andrew McAfee in *The Second Machine Age. Work, Progress, and Prosperity in a Time of Brilliant Technologies*, W.W. Norton & Company, 2014.

⁵ The First Industrial Revolution of the eighteenth century came about with the intro-

Industry 4.0 is driven by technology and includes: *digital information*, process *automation*, smart connected products, value chain *connectivity* through information and communication technologies (ICT) and *digital access to the consumer*.⁶ This means there is flexibility in the production process tailored to each customer, greater speed reducing the time needed to place the product on the market and greater efficiency through data analysis that allow digitalization and the Internet of Things. Its scope is wider because of its interaction with physical, digital and biological technologies.⁷

The main elements of Industry 4.0 are individualization, decentralization and networking. The first refers to the optimization and customization of products on a massive scale to be produced through flexible processes and the inclusion of the members of the supply chain in the value chain. Decentralization is the form of productive organization in which certain operations of the production process are entrusted to third parties. This feature enables mass production of individualized products. Networking involves all the relationships between the factors that interact to create a 4.0 environment and includes universities, and technical and training institutions, because they prepare the new workforce and should liaise with companies through models like the Triple Helix Model, which will be discussed below.⁸

2. *Ideological Positions*

Literature on the subject states that Industry 4.0 will generate changes in all fields, with major consequences. In this regard, three ideological currents can be identified: technological determinism, perfect market and nuanced ideology.

duction of mechanical production equipment powered by water and steam energy. The Second Industrial Revolution began in the late nineteenth and early twentieth century and was characterized by mass production arising from the division of labor and the use of electricity. This period was greatly influenced by the ideas of Frederick W. Taylor in which production was increased by reducing workers' qualifications. The Third Revolution began in the 1960s and involved the use of electronics and information technologies to boost automated production. This period is also known as the Digital Revolution: computing, personal computing (1970-1980) and the Internet (1990).

⁶ Schroeder, *op. cit.*, pp. 3-4.

⁷ Schwab, Klaus, *La cuarta revolución industrial*, Mexico, Debate, 2017, p. 14.

⁸ Fernando Franco, David, *Utilización del Modelo de Triple Hélice para el desarrollo de nuevos sectores productivos en el contexto de la Industria 4.0*, Master Degree Dissertation, Facultad de Ciencias Económicas y Empresariales, Universidad del País Vasco, 2015, p. 5.

a) Technological determinism.⁹ According to this current, Industry 4.0 will imply: radical changes at great speed, scope and depth that occur simultaneously; diversification of the fields to which it is applied; reduction of production costs; the emergence of more highly skilled professions;¹⁰ occupations with a greater degree of complementarity with robotization and/or digitalization; and the progressive elimination of occupations requiring repetitive, low-skilled tasks easily susceptible to being automated or replaced by robots, mainly in the manufacturing and service industries.¹¹

b) Perfect market. This approach assumes that supply and demand will compensate for the creation and elimination of jobs. It notes that the debates on the adverse effects of Industry 4.0, and specifically on the world of labor, are very similar to those of the 19th and 20th Centuries, which means that such concerns are not new.¹² Previous industrial revolutions have historically shown that after the initial shocks, technological change leads to improvements in the quality of work and does not necessarily entail losses in the overall number of jobs. Thus, this current argues that technology destroys professions, but not the opportunity to work because jobs will continue to exist, although the skills needed to perform them will be different and, in some cases, will include a more or less in-depth knowledge of some of the new fields. This position also holds that some of the new professions will simply be specialized, updated or transformed from existing ones¹³, for example, data scientists emerge from mathematicians; multimedia engineers or UX experts from computer engineers; communication managers from public relations, and so on.

c) Nuanced ideology. This position assumes that despite the uncertain scenario, the consequences will depend on macroeconomic dynamics, political and institutional factors including State action; public institutions; the education system; forms of work organization; existing labor regulation;

⁹ Brynjolfsson, Erik, *op. cit.*

¹⁰ The number of jobs in the fields of research, development and support for new technologies will increase.

¹¹ These include transportation, sales, work in offices and administrative areas, among others.

¹² Krull, Sebastián, *op. cit.*, p. 10.

¹³ Morrón, A, Will the fourth industrial revolution come to Spain?, CaixaBank Monthly Report MR02, vol. 398, pp.36-37, cited by Pernías Peco, Pedro A., “Nuevos empleos, nuevas habilidades: estamos preparando el talento para la cuarta revolución industrial?,” *La economía Digital en España*, ICE, September-October 2017, No. 898, pp. 59.

union organization; and the capacity to create spaces for collective bargaining and social dialogue.¹⁴

3. *School-Work Nexus*

Regardless of the accepted position on Industry 4.0, the truth is that technological change will bring profound changes in education and in the world of work due to the accelerated transformations that it implies in all the areas of human life,¹⁵ in the generation, application and validity of knowledge¹⁶ and uncertainty as a daily occurrence.

Within this framework, Industry 4.0 requires a 4.0 education that trains the professionals of today and of tomorrow. Such education should have the following aspects: the creation of new professions; the enhancement of certain skills; a more technical profile stemming from dual vocational training or university education in collaboration with companies, mainly in innovation and development centres; and continuous learning.

A. *Industry 4.0 Professions*

New professions in Industry 4.0 will be linked to science, technology, engineering and mathematics (STEM) where more importance will be placed on cyber-physical systems (CPS: industrial objects connected by sensors and actuators),¹⁷ computer science, robotics, data management, and computer security, among others. Thus, the following professions can be given as examples:¹⁸

¹⁴ The ECLAC (*Linkages between the social and production spheres: Gaps, pillars and challenges*, Santiago, UN, 2017) and the ILO (*The Future of Work We Want: A Global Dialogue*, Geneva, 2017) focus on this position.

¹⁵ This means increased access to goods, services and information in real time via the internet or digital platforms.

¹⁶ Knowledge advances at an accelerated pace, is generated and transferred in different spaces: universities, research centers, companies and civil society organizations.

¹⁷ CPS can be applied in many sectors, such as manufacturing, energy, health, transportation, smart cities, and so on.

¹⁸ Schwab, Klaus, *La cuarta revolución industrial*, Mexico, Debate, 2017; CABARCOS, Rafael and PONZ, Carlos S., “Ganar mayor resiliencia: de la integración con la tecnología al cambio radical del modelo económico y social: retos de futuro para España en el albor de la 4ª Revolución Industrial”, Instituto Español de Estudios Estratégicos, August 2017, www.iiie.es

- Robotics technicians or engineers
- Mechatronics technicians or engineers
- Senior 3D animation technicians
- Internet of Things or cloud platform programmers
- Information technology technicians
- Digital content curators
- Cybersecurity experts
- Big data experts¹⁹
- Nanotechnology experts
- Statisticians
- Drone pilots
- Tele-surgeons
- Augmented reality architects

Likewise, education will have to strengthen the professions that will remain in place. These professions are those that involve human interaction and creativity: social workers, psychologists, therapists, physicians, nurses and all health professionals, as well as those that involve manual and non-routine tasks.²⁰

B. *Skills*

Industry 4.0 will require a burgeoning influx of highly skilled professionals who, in addition to the specific skills of the corresponding professional field, will need to acquire and develop multidimensional skills that enable future workers to maintain their relevance in the workforce; successfully navigate and adapt in a constantly evolving work environment; or undertake independent projects.²¹ These skills have different names,²² including the following:²³

revista-rio.org/index.php/revista-rio/article/wiew/215 ; KAHALE CARRILLO, Djamil Tony, “La formación (española e italiana) en la industria 4.0,” labor *Law Issues*, LLI, vol 2, No. 2, 2016; <https://www.forbes.com.mx/que-nueva-habilidades-requeriran-las-nuevas-profesiones/> date of consultation: August 9th, 2018.

¹⁹ These experts are able to collect, store and analyze large amounts of data to identify production inefficiencies and obstructions.

²⁰ Schwab, Klaus, *op. cit.*, p. 63.

²¹ These skills should be encouraged and acquired from the basic levels of education as core elements from which students can build upon to reap greater benefits in terms of future professional development.

²² The term “skills” is used in the areas of both education and labor. In the first, they are called competencies/skills of knowing, doing, being and coexisting while in the second, they are transferable and technical skills.

²³ Pernías Peco, Pedro A., “Nuevos empleos, nuevas habilidades: estamos preparando el talento para la cuarta revolución industrial?,” *La economía Digital en España*, ICE, September-October 2017, No. 898

a) Transversal Cognitive Skills. These are skills that are developed in all fields of knowledge. They consist of different types of skills, such as: digital skills (managing information and communication technologies), working with data and making decisions based on these data, solving complex problems (as a result of automation); procedural (communicating, listening to other people's ideas), critical thinking (questioning ideas by applying the scientific method, which includes the formulation of hypotheses and experimentation); computational thinking²⁴ (a form of reasoning that uses computer tools and methods to solve problems of any kind, reframing an apparently difficult problem into one that we know how to solve, possibly by reduction, integration, transformation or simulation), mathematical thinking, connected algorithmic-coding thinking, heuristic-approximation thinking/ imagination (related to problem-solving using scant information with scenarios that are not very clear), design-disruptive thinking/hacking, creative and innovative-prospective thinking and knowledge of foreign languages.

b) Soft Skills.²⁵ These consist of attitudes and skills for socializing, teamwork, leadership, passion for change, emotional intelligence,²⁶ teaching others, persuasion, self-learning, resilience (the ability to adapt to new circumstances and current challenges, especially in a changing environment), networking and assertive communication, creativity, entrepreneurship, management²⁷ and others. These types of skills are called soft skills²⁸ and are a key complement to the skills needed for the digitalization of work and Industry 4.0.

In short, Industry 4.0 requires skills to apply knowledge in new contexts, as well as skills that cannot be performed by robots.

²⁴ In 2006 Janet Wing developed the concept of computational thinking, *Cfr. "Computational Thinking", Communications of the Association for Computing Machinery (ACM)*, vol. 49, pp. 33–35, cited by Pernia, *op. cit.*, p. 66.

²⁵ ILO, *The Future of Work We Want: A Global Dialogue*, Geneva, 2017, p. 13. Pernías, *op. cit.*, p. 73.

²⁶ Emotional intelligence helps be more innovative; enables to be an agent of change; involves self-knowledge, self-regulation, motivation and empathy; as well as becoming more agile and flexible.

²⁷ These are skills that are difficult to automate and provide the flexibility to move from one job to another.

²⁸ Weller, Jürgen. "Youth Employment: Characteristics, tensions and challenges." *CEPAL Review*, 2007.

C. *Technical-Vocational Training/Dual Training*

Technical-vocational training or dual training will be key in Industry 4.0 because it will make it possible to acquire the skills to handle the new characteristics of jobs and new qualification needs associated with technological change processes, given the closeness to companies and their demands. Moreover, it is a system with more than 100 years of proven effectiveness in the employability of young people.²⁹

The dual model trains students in professions and trades through coordinated participation of the school, the company and the government. The student receives theoretical training at school and practical training in the workplace. The contents of the training are determined jointly by the government, institutions and representatives from business organizations. It implies double mentoring. The company trainer organizes learning and defines the objectives. Meanwhile, the school teacher is a counsellor and facilitator who guides the student and the company to preserve the connection between the trainee's professional experience and the training program. Funding for the system is shared between the government and the employers. Grades are assigned through written and practical examinations, which are developed and evaluated by external examiners. After obtaining their degree, students can apply for work with their employer or another company.³⁰

Theoretical and practical knowledge are indispensable to performance in the world of work because they allow young people to have their first

²⁹ The dual training system originated in the medieval craftsmen's guilds, which sprang up mainly in central Europe. The system was based on the idea of "learning by doing" under the supervision of a master and was adapted throughout the nineteenth and twentieth centuries to give way to the merging of the educational and productive areas. *Cf.* Adimad, *Formación profesional sistema dual. Análisis, reflexión y propuesta para un debate*, Madrid, 2012.

³⁰ *Cf.* International Labour Organization, *The youth employment crisis: A call for action*, Geneva, 2012; ILO, *Resolution concerning youth employment: Pathways for decent work for youth*, Geneva, 2005. ILO, *Global Employment Trends for Youth. A generation at risk*, Geneva, 2013, R. European Commission, "The dual training system: Integration of young people in the labor market", *News*, June 7th, 2013; Tiraboschi, Michel. "Young People and Employment in Italy: The (Difficult) Transition from Education and Training to the Labor Market", *The International Journal of Comparative Labor Law and Industrial Relations*, the Netherlands, vol. 22, No. I, 2006; (Coord.), *Youth Unemployment and Joblessness: Causes, Consequences, Responses*, Adapt Labor Studies Book-Series, UK, T.E., *Modelo de formación profesional dual*, Madrid, CC00 Enseñanza, No. 328, 2011; Morales Ramírez, María Ascensión, "¿Sistema de aprendizaje dual: una respuesta a la empleabilidad de los jóvenes?" *Revista Latinoamericana de Derecho Social*, Mexico, Instituto de Investigaciones Jurídicas, No. 19, July-December, 2014, pp. 87-110.

work experience and, thereby, to assume the responsibilities that professional life entails. In addition, this knowledge aims to raise the company's level of productivity and competitiveness. Thus, work experience through student training tied in with the labor market can enhance the employability of young people entering specific niches of Industry 4.0.³¹

D. Higher Education Institutions 4.0

Industry 4.0 requires universities and higher education institutions to partner with companies in order to design specialized training programs that respond to technological changes, new professions and skills, real projects and applications for a real world.³² To this end, they need:³³

- To increase the quality in internationally competitive undergraduate and postgraduate degrees in science, technology, engineering and mathematics.
- To align curriculum skills and standards with actual market conditions and digital transformation: curriculum design that is open, flexible, interdisciplinary, modular, innovative, interconnected and reconfigurable with international accreditation, which makes it possible to train highly qualified workers capable of overcoming technological challenges.
- To implement new models of active self-centred training with a focus on quality and permanent innovation (creativity and innovation) where learning takes place in various spaces: linked to productive units, social spaces and problem-solving in the environment, i.e. learning based on projects and with the experience of real undertakings.
- To introduce technology as an enabling and transformative tool for learning.
- To assume that the university professor's new role is that of mentor and educational *coach*.

³¹ ECLAC, *Linkages between the social and production spheres: Gaps, pillars and challenges*, Santiago, UN, 2017, pp.68-69,

³² Universities and research centers no longer have a monopoly on knowledge and innovation.

³³ Cf. Cataldi, Zulma, Dominighini, *Claudio*, "La generación millennial y la educación superior. Los retos de un nuevo paradigma", Buenos Aires, *Revista de Informática Educativa y Medios Audiovisuales*, vol. 12 (19), 2015, pp. 14-21.

- To combine online and face-to-face training.
- To promote research and innovation with public and private support, as a means for training with internationally competitive standards.
- To introduce and/or consolidate the Triple Helix Model³⁴ with strategic alliances between universities, governments and productive sectors,³⁵ and the culture of innovation in all areas of academic work that promote, *inter alia*, the development of digital platform ecosystems; technological entrepreneurship and the socio-productive sphere (the creation of employment and wealth).

E. *Lifelong Learning*

Technological changes, especially those coming from Industry 4.0 with a culture of constant innovation and reinvention, require and will require training processes that will accompany people throughout their active lives. Thus, continuous training will play an important role in responding to changing technological requirements while ensuring adaptability and increasing workers' employment opportunities at the same time.

Now that the minimum bases required by Industry 4.0 in the school-work nexus have been described, it is time to begin an analysis on the real scope of Mexico's case.

III. NATIONAL YOUTH CONTEXT

The country is in a somewhat discouraging position to face Industry 4.0. Generally speaking, this is due to conditions of poverty, inequality and social exclusion, particularly because of the youth's current situation within a context of low economic growth.

³⁴ Cfr. Etzkowitz, Henry, *The Triple Helix: University-Industry-Government: Implications for Policy and Evaluation*, Stockholm, Science Policy Institute, 2002.

³⁵ The model was proposed by Loet Leydesdorff and Henry Etzkowitz to stimulate innovation and therefore development through relations and interactions of the university with other producers of scientific knowledge (the first blade), with companies and industry (the second blade) and with the government or public administration (the third blade). The premise is that innovation does not emerge by itself. Therefore, the model enables the public planning of actions and decision-making in industry, education and research.

In the fourth quarter of 2017, the National Survey on Occupation and Employment reported that young people between 15-29 years of age numbered 31.03 million,³⁶ representing 25 per cent of the total population. Of this figure, 50.9 percent were women and 49.1 percent were men.³⁷ This social group faces serious problems in the transition from school to work.

1. *Education System*

The education system presents several problems, but three are especially important:

A. *Educational Deficit*

This phenomenon has been a problem throughout the country's history. The 2015 Intercensal Survey³⁸ indicated that 1.2 per cent of young people did not have any schooling and 1.6 per cent had three or fewer years of schooling, which translates into 2.8 percent of functional illiterates.³⁹ Educational deficit is greater in the poorest states,⁴⁰ a situation that prevents access to higher levels of education. In 2015, the average number of years of schooling for the population aged 15 or older was 9.2 years of basic education, despite the progress that has been made.

Coverage at the secondary and higher levels of education is still low. As to higher education, the country is 37.3 percent behind countries that have far exceeded the 50 per cent threshold. Moreover, this figure is below the average for Latin America, which in 2015 stood at 43 per cent.

³⁶ In Mexico, according to Article 2 of the Youth Law, the youth population comprises those between the ages of 12 and 29 (37.5 million people, or 31% of the total population). However, the Federal labor Law allows persons to work starting at the age of 15, which is why youth employment studies focus on the population between 15 and 29 years of age.

³⁷ INEGI, *Estadísticas a propósito del día internacional de la juventud*, Mexico, INEGI, 2017.

³⁸ INEGI, *Encuesta intercensal EIC 2015*. Database, Mexico, 2016.

³⁹ UNESCO defines functional illiteracy as a person's inability to use his or her ability to read, write and calculate efficiently in everyday life situations. In other words, although persons may know how to read and write simple phrases, they do not have the necessary skills to succeed both personally and professionally.

⁴⁰ These states are Chiapas, Veracruz, Michoacán, Oaxaca, Guerrero and Puebla.

B. *Quality of Education*

The situation of youth shows that there has been a lack of quality in the teaching-learning process because young people do not acquire the skills that enable them to enter the world of work more effectively, or to be prepared to engage in independent ventures and not out of necessity.

While the education system does have an evaluation and accreditation system, data focuses more on input and process indicators than on the results and impact of quality improvement. In terms of the evaluation and accreditation of higher education institutions, only 16 per cent (458) have credited at least one program by organizations recognized by the Council on Higher Education Accreditation; 43.1 percent (1,677,596) of the students are enrolled in quality programs and 17.3 per cent (4,593) programs have valid quality recognition. At postgraduate level, only 11.2 per cent (157) of the institutions have a quality program from the National Council of Science and Technology (Conacyt).⁴¹

C. *Financing*

Public investment (federal and state) in higher education is very low: 0.91 per cent of the Gross Domestic Product (GDP). Investment in science and technology stands at 0.54 percent of the GDP, far below the OECD country average (between 2.3 and 4.25 per cent), as well as in comparison with Brazil, Argentina and Costa Rica.⁴² Likewise, ties with the productive sector in research and innovation are minimal (one out of every four companies participates with an educational institution).

There is no existing legal framework for higher education and science and technology since the current one is fragmented, inaccurate and insufficient.⁴³ Similarly, the budget does not have a long-term projection. This allotment is uncertain because there is no guarantee that it will continue, and the amounts approved in the Federal Expenditure Budget every year

⁴¹ ANUIES, *Visión y acción 20130. Una propuesta de la ANUIES para la renovación de la educación superior en México. Diseño y concertación de políticas públicas para impulsar el cambio institucional*, Documento de Trabajo 1.0., Mexico, 2017, pp. 63-66

⁴² CONACYT, *Informe general del estado de la Ciencia, la Tecnología y la Innovación*, Mexico, 2011, pp. 27-28.

⁴³ ANUIES, *op. cit.*, p. 85.

do not correspond to the growth in enrolment nor do they reflect actual institutional operations, because this financing also covers staff salaries and operating expenses.⁴⁴

2. *Employment*

Addressing the educational deficit involves creating opportunities for decent employment. In this category, the number of young people in the economically active population in 2017 was 16.4 million and can be classified into three critical groups:

- a) Employed. 15.4 million young people were employed (9.7 million men and 5.67 million women). 60 percent of this group (9.2 million) had informal jobs, working in activities and companies associated with low-productivity sectors, with minimum wages (one and up to two minimum wages), a lack of social protection or stability. Young people with lower incomes and lower levels of schooling are usually found doing this kind of work⁴⁵ although in some cases this phenomenon also applies to young people with secondary and higher education (dependents and self-employed),⁴⁶ despite them having greater skills than those needed to perform the job.⁴⁷ This situation charts the life and work trajectory of young people.
- b) Unemployed: 970,000 young people are found in this situation.⁴⁸ This group includes young people with a professional level, technical studies, high school and middle school diplomas. Of these, 19.8 percent lack work experience, a requirement established by the productive sector, in addition to a series of skills that this social group does not have.

⁴⁴ *Ibidem*, p. 90.

⁴⁵ This inequality is exacerbated by socio-economic, gender, ethno-racial and territorial situations that are entrenched over the years.

⁴⁶ IMJUVE, *Panorama de la ocupación juvenil en México*, Gobierno de la República, Sedesol, Año 1, No. 4, October-December, 2017

⁴⁷ The higher the level of schooling, the less likely they are to find employment consistent with their vocational training.

⁴⁸ IMJUVE, *op. cit.*, p. 12.

- c) No schooling, no job. Nine per cent of men and 35 percent of women are in this situation.⁴⁹ This group usually includes young people who do household chores or care for others (mainly women).

The above situation regarding levels of education and the possibilities of youth employability shows the weakness of the school-work nexus. Those who manage to complete their basic education and enter a higher education institution face the challenge of remaining in school and successfully finishing their studies. However, having a diploma does not ensure successful incorporation into a workplace with labor and social security rights. They are threatened by unemployment because in many cases they lack the abilities or skills required by the productive sector. This affects the quality of employment, the income and job mobility. This situation reveals, on the one hand, that the university curriculum does not correspond to the needs arising from technological changes and, on the other hand, that the country's low economic growth does not generate employment opportunities for young people.

3. *Actions Undertaken*

Despite the regrettable scenario described above, various actions have been carried out over time, albeit with slow progress, so far. These actions include following:

A. *Dual Vocational Training*

In 2013, the Mexican Dual Training Model was implemented as a pilot program in technological and technical vocational high schools and this model was formalized in 2015.⁵⁰ To date, it is taught at 104 schools⁵¹ in 15 states with the participation of 400 companies from the Mexican Employ-

⁴⁹ In its study *Out of School and Out of Work: A Diagnostic Study of Ninis in Latin America*, the World Bank reports that there are 4.2 million young people in this situation in Mexico.

⁵⁰ On 11 June 2015, Secretarial Agreement No. 06/06/15 was published in the Federal Official Gazette, establishing dual training as an educational option for secondary level education. SEP, CONALEP, *Modelo Mexicano de Formación Dual*, Mexico, 2013. www.conalep.edu.mx/academia/Documents/mmfd/prsnctn_mmfd.pdf

⁵¹ At schools from the National College of Professional Technical Education (CONALEP), Centers of Scientific Technological Education (CECYTES), Industrial Technologies

ers' Association (Coparmex). The model currently operates for 13 industrial and service degrees.⁵²

<i>Industrial degrees</i>	<i>Service degrees</i>
1. Electromechanics	1. Tourist hospitality services or lodging services or hotel services
2. Tooling machines	2. Food and beverages or food and beverage preparation
3. Mechatronics	3. Accounting
4. Plastics processing	4. Telecommunications
5. Autotronics	5. Management or administrative management processes or sales or logistics or human resources administration
6. Industrial maintenance	6. Information technology or programming, or computer equipment support and maintenance
	7. Trucking services

In the implementation of the model, the following goals were set: to have 10,000 students by 2018, and to attain national coverage and greater participation of companies in all the country's productive sectors.

In November 2017, the subject “digitalization and Industry 4.0” was incorporated into the model programs, as well as a degree in “industrial engineering”, as part of an agreement between Mexico and Germany, with the backing of Siemens. A pilot program was also developed at the National College of Technical Professional Education schools to certify young people in digital skills, in order to identify which skills are more demanded by the productive sector and thus develop and implement specific programs to close the gap between supply and demand, and the impact on employability and competitiveness of young people.⁵³

and Services Studies Centers (CETIs), under the *General Office of Industrial Technology Education* (DGETI) and the *General Office of Agricultural Technology Education* (DGETA).

⁵² SEP, *Información de la Subsecretaría de Educación Media y Superior de la SEP*, http://www.sems.gob.mx/es_mx/sems/avances_ubicacion_mmfld

⁵³ The Digital Skills Certification Committee was formed with the participation of the Business Coordinating Council, BSA and CONOCER, representatives from the Undersecretary of Higher Secondary Education of the Ministry of Public Education, CONALEP, General Office of Work Training Centers (DGCFT), University of Valle de México (UVM),

However, this model faces stigmatization and has yet to show whether it responds to the needs of companies in strategic areas of the country. Moreover, one of the difficulties this model faces is the fact that in Mexico, 90 percent of the companies are small and medium enterprises. It is therefore necessary to evaluate the model so as to correct or reinforce the course to be followed in the school-work nexus and, where appropriate, to recognize and further its real dimension with all the necessary transversality.

B. *Higher Education*

This level of education underwent several changes covering aspects such as:⁵⁴

- Growth in enrolment: 4,430,249 students: 134,000 new places in schools a year
- Diversification processes of institutions: federal universities and institutions, state public universities; technological institutes coordinated by the National Technological Institute of Mexico; technological universities; polytechnic universities; intercultural universities; institutions for training basic education professionals; public research centres and other public institutions⁵⁵
- Deconcentration and decentralization of options to access the system: school-based, mixed, open and distance modalities in both undergraduate and postgraduate studies
- Evaluation of individual and institutional performance
- Evaluation approach and accreditation criteria⁵⁶
- Implementation of new governance and management systems and modalities
- Presence of private investment

CANIETI and AMITI, International Youth Foundation, Mexico Exponential, Autodesk, Adobe, Dell and Microsoft, and the United States Embassy.

⁵⁴ ANUIES, *op. cit.*, p. 34.

⁵⁵ Although there is no functional system that connects the different types of higher education institutions, it provides a clearly articulated and differentiated range; common rules, incentives and aids, and a long-term vision and program.

⁵⁶ This covers the evaluation of programs, academics, students, institutions and administrative processes.

- Development of alliances between universities, companies and government or citizen organizations
- Internationalization of the curriculum and student and professor mobility.
- Generalization of quality assurance platforms
- Flexibilization of university curriculum
- Design of learning-centred educational models geared towards acquiring professional skills

Likewise, many higher education institutions already offer degrees linked to Industry 4.0 (Science, Technology, Engineering and Mathematics), such as information systems, biomedical systems, nanotechnologies, technologies and biotechnology, as well as robotic, information, mechatronic, computer, and smart systems engineering, among others. However, the percentage of these professions and enrolment are still low, especially in terms of women's participation.

Hence, it is possible to observe new Industry 4.0-related degrees being offered at universities and technological institutions of higher education, as well as some traditional degrees focusing on activities in a setting of the Fourth Industrial Revolution: the National Autonomous University of Mexico offers degrees in Biomedical Engineering, Mechatronics, Nanotechnology and Information Technologies in Science; the Autonomous University of Zacatecas teaches Industrial Electronics Engineering centred on Robotics and Digital Systems⁵⁷ and Computer Technologies Engineering centred on the Internet of Things (IoT).⁵⁸

The Autonomous University of Aguascalientes describes the skills of an “engineer in smart technologies” will have mathematical and theoretical bases of computer science, artificial intelligence, and software industry through the design and creation of environments, facilities and innovative computer applications, base software and application development, the formulation of theories and practice of models of complex realities and undertakings to provide efficient computational solutions to real and complex problems, as well as to assimilate and adapt new technologies.”⁵⁹

⁵⁷ <http://campusjalpa.uaz.edu.mx/iei> date of consultation: April 27th, 2018.

⁵⁸ <http://campusjalpa.uaz.edu.mx/itc> date of consultation: April 27th, 2018.

⁵⁹ http://www.uaa.mx/direcciones/dgdp/catalogo/ciencias_basicas/ing_computacion_inteligente.pdf date of consultation: April 10th, 2018.

Universities have also signed agreements with various industrial chambers to train human resources specialized in cutting-edge technology although they are still few. Similarly, industrial chambers have some programs that apply to young people, such as the Network of Training and Innovation Centres of the Mexican Cement Chamber (CANACEM) in which the government, companies and higher education institutions participate in the training of professionals with up-to-date knowledge concurrently with the development of technological knowledge in the field.⁶⁰ The National Chamber of Textile Industry (CANAINTEX)⁶¹ gives courses along the same lines, such as “LECTRA Be Fashion/able: Integral Solution 4.0”.⁶¹ While these courses are not exclusively for young people, the programs are open to young people and active workers alike. The Mexican Chamber of the Publishing Industry (CANIEM) has a Professional Training Centre , unique in Latin America and offers training and refresher courses.⁶²

The National Chamber of the Electronics, Telecommunications and Information Technologies Industry (CANIETI) even has scholarships for Mexican students to prepare for postgraduate programs in areas related to the most innovative and cutting-edge technologies in the sector, such as: Internet of Things, Mobile Internet, Big Data analysis, Automation of Knowledge Work, Cloud Computing, Advanced Robotics, Autonomous Vehicles, 3-D Printing and so on.⁶³

⁶⁰ http://www.alianzafiudem.org/centros_formacion.html date of consultation: April 17th, 2018.

⁶¹ <http://www.canaintex.org.mx/curso/> date of consultation: April 18th, 2018.

⁶² <http://www.caniem.com/es/capacitacion> Date of consultation: June 10th, 2018.

⁶³ <http://www.canieti.org/servicios/ProgramaTexasCANIETI.aspx> Date of consultation: April 18th, 2018.

INDUSTRY 4.0 PROFESSIONS IN MEXICO

<i>University</i>	<i>Degree</i>	<i>Enrollment</i>
National Autonomous University of Mexico	Biomedical Systems Engineering	Not available
	Electrical and Electronics Engineering	1594 men and 177 women
	Mechatronics	21 men and 27 women
	Computer Science	670 men and 119 women
	Informatics	462 men and 171 women
	Nanotechnology	Indirect admission
	Technologies	Indirect admission
	Information Technologies in Science	8 men and 6 women (new admissions)
National Polytechnic Institute	Computer Engineering	4,533 men and 1,064 women
	Industrial Robotics Engineering	1228 men and 199 women
	Computer Engineering	1380 men and 373 women
	Computer Systems Engineering	2493 men and 411 women
	Biotechnology Engineering	303 men and 260 women
	Mechatronics	1201 men and 110 women
Metropolitan Autonomous University	Control and Automation Engineering	1901 men and 303 women
	Information Technologies and Systems	190 men and 52 women
	Electronics Engineering	1236 men and 64 women
	Computer and Telecommunications Engineering	No information available
	Biomedical Engineering	403 men and 262 women
	Computing	377 men and 306 women
	Computer Engineering	1059 men and 219 women
Computer Sciences	No enrollment information available	

<i>University</i>	<i>Degree</i>	<i>Enrollment</i>
Autonomous University of Mexico City	Software Engineering	581 men and 219 women
	Industrial Electronic Systems Engineering	592 men and 158 women
	Energy Systems Engineering	156 men and 80 women
Autonomous University of Aguascalientes	Intelligent Computer Engineering	159 men and 34 women
	Computer Systems Engineering	456 men and 111 women
	Informatics and Computational Technologies	No enrollment information available
	Industrial Statistics Engineering	112 men and 82 women
	Renewable Energy Engineering	76 men and 44 women
	Robotics Engineering	200 men and 39 women
Autonomous University of Baja California	Manufacturing and Automation Engineering	68 men and 19 women
	Computer Science	73 men and 15 women
	Computer Engineering	952 men and 191 women
	Mechatronics	930 men and 133 women
	Nanotechnology	33 men and 54 women
Autonomous University of Baja California Sur	Aerospace Engineering	No information available
	Information Technology Management	No information available
	Software Development Engineering	No information available
	Computational Technologies Engineering	232 men and 27 women
Benito Juárez University	Technical Innovation Engineering	No information available
	Computing	113 men and 33 women
Del Carmen University	Computer Engineering	29 men and 8 women
	Computer Systems Engineering	164 men and 51 women
	Mechatronics	177 men and 25 women

<i>University</i>	<i>Degree</i>	<i>Enrollment</i>
Autonomous University of Coahuila	Information and Communications Technologies Engineering	1737 men and 364 women
	Computer Systems Engineering	308 men and 168 women
Autonomous University of Colima	Mechatronics	212 men and 38 women
	Electronics Technologies Engineering	29 men and 6 women
	Electronic Systems and Telecommunications Engineering	57 men and 2 women
Juárez University of the State of Durango	Chemical Biotechnology	58 men and 83 women
	Computer and Administrative Systems Engineering	90 men and 31 women
University of Guadalajara	Computer Engineering	1606 men and 253 women
	Biomedical Engineering	88 men and 64 women
	Informatics	1010 men and 219 women
	Nanotechnology Engineering	330 men and 96 women
	Mechatronics	694 men and 59 women
	Electronics and Computer Engineering	408 men and 97 women
	Food Engineering and Biotechnology	154 men and 263 women
Universidad de Guanajuato	Computing	246 men and 65 women
Autonomous University of Guerrero	Computer Engineering	350 men and 144 women

<i>University</i>	<i>Degree</i>	<i>Enrollment</i>
Autonomous University of the State of Hidalgo	Computer Systems	121 men and 51 women
	Computer Engineering	127 men and 36 women
	Industrial Automation Engineering	75 men and 9 women
	Software Engineering	63 men and 26 women
	Information Technologies	No information available
	Nanotechnology Engineering	24 men and 8 women
Michoacán University of San Nicolás de Hidalgo	Electronics Engineering	234 men and 28 women
	Computer Engineering	262 men and 46 women
	Technical Innovation Engineering in Materials	No information available
Autonomous University of the State of Morelos	Robotics and Industrial Manufacturing Systems Engineering	No information available
	Technology for Applied Physics and Electronics	No information available
	Molecular Design and Nanochemistry	No information available
Autonomous University of Nuevo León	Aeronautical Engineering	1737 men and 364 women
	Electronics and Automation Engineering	963 men and 77 women
	Mechatronics	3,490 men and 380 women
	Software Technology Engineering	1,263 men and 225 women
	Information Technology Security	400 men and 101 women
	Genomics and Biotechnology	416 men and 458 women
Autonomous University of Querétaro	Software Engineering	312 men and 47 women
	Information Technology Management	23 men and 8 women
	Nanotechnology Engineering	127 men and 46 women
	Automation Engineering	297 men and 70 women

<i>University</i>	<i>Degree</i>	<i>Enrollment</i>
Autonomous University of San Luis Potosí	Computer Engineering	255 men and 53 women
	Computer Engineering	212 men and 65 women
	Intelligent Systems Engineering	30 men and 23 women
	Electrical and Automation Engineering	No information available
Universidad de Sonora	Electronic Technology Engineering	146 men and 12 women
	Computer Science	109 men and 13 women
	Information Systems Engineering	512 men and 62 women
	Mechatronics	1029 men and 293 women
Autonomous Juárez University of Tabasco	Computer Science	No information available
	Computer Systems Engineering	43 men and 14 women
	Administrative Informatics Engineering	178 men and 194 women
	Computer Systems	363 men and 127 women
	Information Technologies	19 men and 23 women
Autonomous University of Tamaulipas	Computer Systems Engineering	773 men and 219 women
	Production Systems Engineering	114 men and 73 women
Veracruzana University	Computational Technologies	145 men and 33 women
	Software Engineering	159 men and 23 women
	Electrical Engineering	944 men and 130 women.
	Electronics and Communications Engineering	199 men and 52 women
	Biotechnology Engineering	90 men and 193 women
	Computational Technologies Engineering	99 men and 33 women
	Computer Engineering	142 men and 30 women
	Mechatronics	262 men and 48 women
	Computer Networks and Services	102 men and 34 women

<i>University</i>	<i>Degree</i>	<i>Enrollment</i>
Autonomous University of Yucatán	Biotechnology Engineering	100 men and 76 women
	Mechatronics	256 men and 32 women
	Computer Engineering	134 men and 21 women
	Software Engineering	200 men and 30 women
Autonomous University of Zacatecas	Industrial Electronics Engineering Centered on Robotics and Digital Systems	No information available
	Computer Technologies Engineering Centered on the Internet of Things (IoT)	

Source: Developed by author from websites of Higher Education Institutions. Enrollment data obtained from the 2017 ANUIES Annual Report.

IV. THE WAY FORWARD

The scenario described in this paper on the transition from school to work forces us to consider appropriate measures, strategies and policies to avoid even more undesirable consequences for young people. Said measures must be seen from different angles, not only industrial and technological policies to meet the requirements of Industry 4.0, but also inclusiveness and integration; that is, educational and employment opportunities so that those born in impoverished households can better their economic situation and thus break with the vicious cycle that social origin decides a person’s destiny. Changes in the education system must go hand in hand with greater opportunities of decent employment, since there is little point in training young people if the labor market does not have the capacity to accommodate them (especially those in poverty, vulnerability or living in remote areas).

Actors at different levels and national and international agencies have spoken out on transforming the circumstances of young people through a comprehensive approach. This means that the problems to be solved and their possible solution have been identified.

The National Institute for Education Assessment (INEE) has identified the following important issues that require attention: the strengthening of teacher training colleges; the strengthening of schools, the assessment and revision of study plans, educational research, parent participation, equal

educational services (disadvantaged communities), education, productivity and work (providing skills for work and life), autonomy in education; material conditions, problems of governance in the education system, funding for education and the sole basis of official information.

The National Association of Universities and Institutions of Higher Education (ANUIES) has proposed five main lines of action to strengthen higher education:

- 1) Ensuring better governance for the development of the higher education system (regulatory framework and a national higher education system);
- 2) Expanding coverage with equality and quality; reduce drop-out rates and broaden the range of educational modalities, that is, to continuously improve the quality of higher education;
- 3) Creating a national evaluation and accreditation system at this level and stimulate its internationalization;
- 4) Fostering social responsibility: to strengthen the quality and relevance of their functions, extend their contribution to regional development and participate in a more prosperous, democratic and just society;
- 5) Acknowledging the strategic nature of higher education, science, technology and innovation through a State policy with a medium- and long-term vision.

The 2030 Agenda for Sustainable Development considers several goals related to education:

- Ensuring inclusive and equitable quality education and promote lifelong learning opportunities for all;
- Ensuring equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university;
- Eliminating gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations;
- Providing the necessary skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship;
- Substantially increasing the number of scholarships available at all levels of education, including vocational training and technical, sci-

- entific, engineering, information technologies and communications programs; substantially reducing the number of youth who are not employed nor receiving education or training; and having an evaluation and accreditation system that focuses on the learning process; that is, on the outcomes and impact to ensure quality education;
- Increasing scientific research and innovation through public and private funds.

As seen from the above proposals, the important items to be addressed are clearly identified: equal opportunities, the education deficit, the quality of education; allocating a larger budget and a long-term vision to finance higher education and increasing investment in science, technology and innovation in order to channel it to projects with greater growth potential. Furthermore, it is important to:

- Strengthen and consolidate dual training as an option to facilitate early and effective transitions to work, mainly for lower-income students. It is also important to increase ties with the productive sector, using labor market prospects to direct education supply towards the demand of this sector locally, regionally and nationally.
- Promote the participation of women in professions associated with science, engineering and mathematics to reduce the gender gap, empower the coming generation in these fields and avoid replicating traditional roles.
- Regulate the various ways of acquiring work experience before completing studies (internships, professional practices and dual training) from the educational and work spheres because there is a lack of comprehensive regulations that establish the minimum bases to protect students from the possible divergences or abuses of a covert job.
- Celebrate agreements among institutions, companies and trade unions to ensure that the skills acquired match those requested by the productive sector and, therefore, that quality employment is offered.

Lastly, whenever there are diagnoses and possible solutions, it is necessary to act on them; that is, to implement them with a view to making the school-work transition socially fair and respectful of fundamental rights, particularly labor and social security rights. In other words, the aim is to

seek the social dimension of technological change in order to influence its path. All the above must take place within a framework of sustained, inclusive and sustainable economic growth with full and productive employment, and decent work for all, as stated in Goal 8 of the 2030 Agenda for Sustainable Development.

V. CONCLUSIONS

Currently, the school-work relationship as a means for personal and social progress is being seriously questioned by the high percentage of young Mexicans who are unable to enter the workforce. This condition also exposes an institutional framework that is incapable of dealing with Industry 4.0.

It is the time to take the necessary steps, because if not, the consequences will be even greater. The insertion of young people into Industry 4.0 requires improving all levels of education to produce benefits of subsequent professional development, solving the problem of dropping out of school at an early age, bringing the added value to the workforce that Industry 4.0 is seeking. It is particularly important to inspire the next generation of women leaders in science and technology.

With the new industrial era and advanced, intelligent technologies, intelligent legal frameworks are also needed. As for the education sector, 1.5 percent of the GDP should be earmarked for education and 2.5 per cent for science, technology and innovation. In terms of employment, adequate legislation on mechanisms for acquiring work experience prior to graduation is needed: internships or professional practice contracts and dual training, under a system of alternating paid work activities in a company and training activities in the education system, as well as probationary and training contracts as provided for in labor law, so that they can effectively have an impact on decent work, productivity and, consequently, wages.

The industry is recognized as an important player in the economy: it is a cornerstone of research, innovation, productivity, job creation and exports. Therefore, a vision shared by the government, the business community, universities and research centres are needed at these times in order to build 4.0 industrial ecosystems centred on persons and 4.0 talent, and thus stimulating innovation.

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SOCIAL INCLUSION IN DIGITAL WORK

Julio Ismael CAMACHO SOLÍS

Summary: I. *Introduction*. II. *Innovative Work*. III. *Digital work*.
IV. *labor Inclusion vs. labor Exclusion*. V. *Industry 4.0 and Social Security*.
VI. *Emerging Social Rights*. VII. *Conclusions*. VIII. *Research sources*.

I. INTRODUCTION

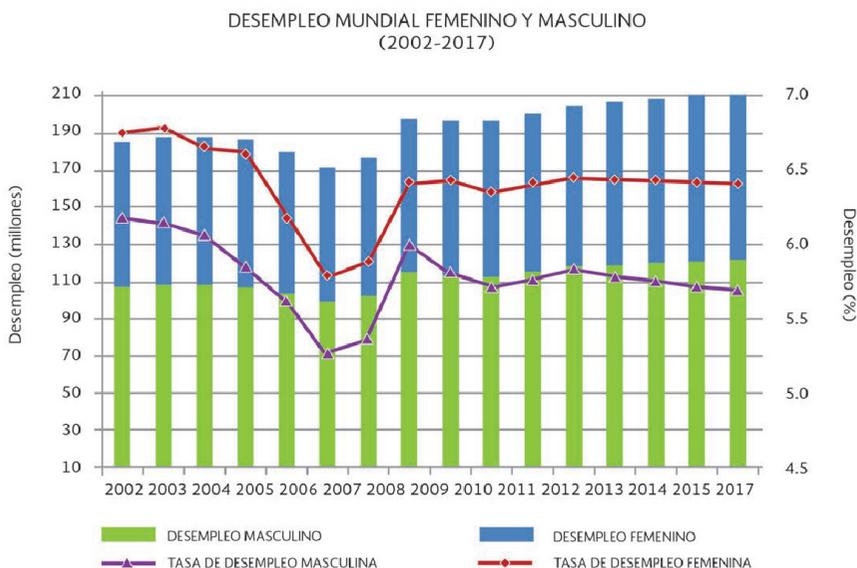
The advances in the systematization of daily life, as well as the instantaneous innovative communications interspersed with today's information systems determined by global technological development, mainly influence various areas of society in general, and particularly in labor relations, whether these are traditional, atypical, informal or formal. New forms of labor relations have been generated with a certain characteristic that has an impact on the organization and development of the work. Consequently, legal systems that protect the rights of workers, which give a legal definition to the labor relation, are outside the practical scope. This generates vulnerability considering the lack of legal protection of what is new or what is constantly evolving in a productive society. These innovations in digital robotization labor modify two dimensions of human existence in time and space.

II. INNOVATIVE WORK

Nowadays, there are several ways of providing subordinate work framed in the current labor legislation of our country. On the other hand, the other groups of workers, located outside the formal scope of labor law, are inserted in informality. This segment of employment consists of various labor relations and activities that have a common factor, being outside the protective labor and social security rules.

In the last ten years, the unemployment rate has increased 25 per cent world-wide, we live in a much richer society, but with poorer working conditions, where few jobs are being created to serve an expanding workforce, especially for those displaced by the structural changes of globalization: modernity, technology, innovation; elements that are determined by new work processes in a digitalized manner.

GRAPH 1 (SOURCE: OCDE, UNEMPLOYMENT TRENDS)



The development of labor relations has moved from the industrial era, where massive labor worked alongside machines to produce goods and services. We are in the age of access, where intelligent machines, in the form of computer software; robotics; nanotechnology; and biotechnology, progressively replace human labor in agriculture, industry and services.

The social reality of the world moves gradually, but firmly towards the use of digital platforms. In the digital age, work does not necessarily generate tangible parts or products; it also generates knowledge, making it much more difficult to measure productivity. Working conditions change, they move and their needs are adjusted. Competitiveness has become more voracious and looks for ways to channel the work mechanisms that allow it to

achieve its objectives; companies compress labor to keep their business up to date.

In the unconsciousness of the collective imaginary, technology is seen as something surprising and rarely considered as a factor of productivity; rather, it is placed on the road towards the digitalization of all productive activities, at least in the world of work, without neglecting the daily development of people in society; it is believed that certain technological advances represent a serious threat to current and future workers' development aspirations, because they will have to compete with new mechanical, systematized, digitized and artificial skills.

The reallocation of the workforce to the labor sectors with an increasing use of information technologies is gradual and sustained. It maintains uniformity and requires a great deal of highly trained workforce, which is not always or rarely properly paid. With the technological innovations of today, these differences will result in greater diversification and technological industries will try to increase the value variable of knowledge about the products and the consumer society, which implies that the company, employer or work centre will become an economic unit of modernity, technology, and development.

Nowadays, new technologies, at least in theory, systematically allow the organization and focus on time and space, which is required by the very restructuring of productive organizations; at least, the most remarkable necessity is trying to eliminate downtime within organizations, due to dysfunctions, and thus obtaining a much higher level of productivity.

New technologies have also led to the creation of new ways of working, through Internet platforms or on-demand work through mobile applications.

Digital technologies have become a powerful force for social and economic development, offering substantial benefits for both individuals and society. The average labor productivity of the member countries of the Organization for Economic Cooperation and Development (OECD) is 50 points; Mexico reaches 20 points.

One of the causes attributed to the low productivity is that the educational level of the Mexican workforce is very low in relation to the rest of the members of the OECD.

This causes low productivity in Mexico. It is also one of the causes of hiring decrease as well as low wages; thus achieving that the deregulation and flexibility of labor standards comply with the dominant and prevailing economic and social globalization, to which the State attributes itself while

replicating it ordinarily in the field of work. The State forgets, without a doubt, the primary objective of opportunities for decent or dignified work.

Labor organizations determined by technology are presumably related to the social environment through that same technology, but the problems inherent to decision making originate tendencies that can be unstable for the work determined by the technology; this entails the following determinations.

- 1) Organized labor involves two sets of physical and social coercion that are in basic opposition to each other.
- 2) No system of work can adapt to physical and social demands at the same time.

Conclusion: Well-organized innovative work can be institutionalized in four different ways: 1. Organizations determined by production, 2. Organizations determined by technology, 3. Organizations determined by society 4. Pluralist organizations. Each of these four characteristics provide the organization for work according to the context that reflects its own social existence.

III. DIGITAL WORK

Currently, workers offer their work in the market under serious conditions of disadvantage, exclusion, limitations, incompetence, ignorance, misinformation and uncertainty; employers do not find better affordable conditions for workers in the labor market when it comes to locating available workers for jobs that require certain digital skills.

A successful matching of individual capabilities with the requirements of new technologies or new skills is overlooked as a prerequisite for access to work, which should improve production efficiency and significantly increase national production, development and wealth, based on the existing workforce.

The scenario of globalization has been marked by a radical bet on the benefit of competitiveness, resulting everywhere in a hardening of wage labor conditions. The main consequences have taken the form of lower wages, longer working hours, declining social rights and widespread precariousness.

The work-related problems of a labor society are to some extent very mutating, as well as the inability to work and produce, unlike low wage levels, which are the main source of poverty in Mexico. What is important in the workforce is not its size itself, taking into account that our country has a population of more than one hundred million inhabitants, where 40 per cent of the population is part of the workforce.

Robotization, digitalization, uberization, gig economy and crowd-working are terms that in a very short time have been incorporated into our vocabulary to describe the rapid changes that are taking place in the world of work and in all economies, where the action of working will be effective and efficient, fast and inserted in the route of digital productivity from the most industrialized to the least developed ones.

Present and future workers are all those based on their multipurpose knowledge. They have maximum mobility to take it anywhere and put it at the service of any company, without fixed and inflexible strings, and without stable relations, in a nomadic or wandering way, so that 45 percent of the population by 2022 will be part of a nomadic knowledge society, making this professional profile the largest segment of the workforce.

Similarly, companies based on their organization for vertical work, will give guidelines for the existence of crowdsourcing, where there will be work shifts, similar to legal days, which will be developed on digital platforms through Internet connection. What is new now is the speed and impact of these changes due to the simultaneous effect of globalization and digitalization. In the same way, crowdfunding will be used by global companies as a corporate action, as well as by the global market through a multitude of workers who perform the function of obtaining income for virtual companies through the Internet. The market also works quite well when it comes to determining relative levels of wages for different plants, industries, trades, occupations, and regions, so ultimately the labor market is the only artifice we have to classify many millions of workers with diverse skills and interests among a multitude of different jobs in the market economy.

When we summarize our current knowledge about the effects of modernization, digital globalization manifests itself as the generally most constant means of accumulating learning, resulting in this trivial conclusion: Digital media as a link and their specific attributes can have a positive effect on learning under certain conditions and can be used as effective tools for instructional purposes.

The technologies that provide access from home, as in today's case, are the ones that give greater flexibility to the workers; those that are only ac-

cessible from workplaces are undoubtedly those with less flexibility, forcing workers to transit constantly.

The introduction of technologies in work processes can mean a change in the organizational structure of companies and workplaces, the inertia of an organization can be an insurmountable obstacle to the use of any technology as a tool for work.

Digital is a term associated with technology, although it was initially used to denote everything related to fingers, it began to be used when technological science made its presence in the different fields in which it is known. The important thing between the two definitions of digital that are known, it could be the interaction that the human being can have with the computers or any digital device that includes a capacity that is exploited with the fingers.

The only man educated for work is the one who has learned to learn, the man who has learned to adapt to change, who has come to realize that no knowledge is safe and understands that only the process of knowing how to seek this knowledge will give him security.

The above may determine that for paradigms of digital work as meaningful learning must be determined by the ability that is what allows certain things to be done, the motivation determines what is done and the attitude determines how well it is done.

Jobs of the present, as well as those of the near future, require technological training, at least young people will need a solid theoretical base, a good practical training and be in contact with the world of hardware and software. Manual and repetitive work will be the most likely to be replaced by machines, although it will be carried out through a constant process with certain uncertainties.

At the same time, new ways of providing work will modify existing business strategies for offshoring, as automated work incorporates cheaper and more efficient production in the country of origin.

According to the most recent study of Internet user habits in Mexico, in 2017, just over half of Internet users (52 per cent) remain connected 24 hours a day. On average, each Internet user is on the net eight hours, a minute and 47 seconds a day.

Six out of ten users, pay for a data plan and eight out of ten, connect from home. Sending and checking emails is the second most popular activity on the Internet, just below access to social media.

This news of developing the way to work via email, as an additional tool, to simplify activities, even outside the working day, is undoubtedly the

effectiveness of technological control, with unlimited forms giving way to a centralized and objective subordination, which leaves a perennial and cybernetic trace, even automatically.

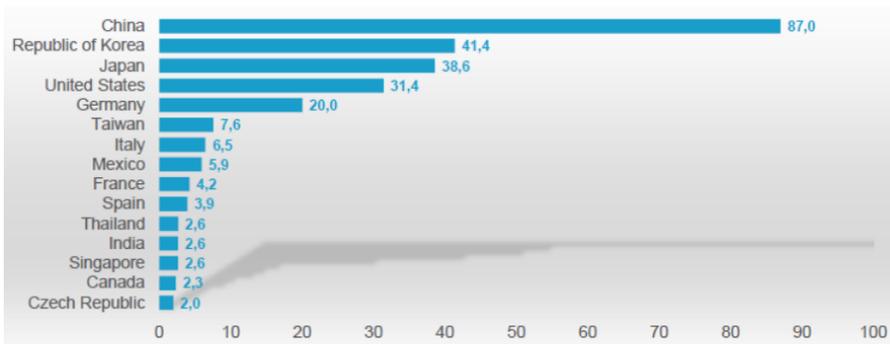
Out of the countries that make up the Organization for Economic Cooperation and Development (OECD), Mexico is the country with the most hours worked per year: 2,255. This club of developed nations' average is 1,763 hours.

The marriage between Big Data and robotization heralds a new economy and, therefore, a new world of work is all recognized by the benefits of this development, while highlighting its uncertainty about employment.

The Digital transformation is not only changing our economy, but also the nature of labor markets and the workforce. The fourth industrial revolution, the eruption of robots and artificial intelligence changed the labor market environment, which is relatively significant, as illustrated in the following graph:

GRAPH 2 (SOURCE: INTERNATIONAL FEDERATION OF ROBOTICS 2017).

Oferta anual de robots industriales por países en 2016 (en miles de unidades)



Fuente: International Federation of Robotics (2017)

In Latin America, the introduction of robotization is still limited. It is estimated that there are currently about 28,000 robots, concentrated mainly in Mexico and Brazil. However, considering the rapid evolution worldwide, it is important to ask how this process of technological change can impact the region; for this end, it is necessary to consider three main factors: the pro-

duction structure, the level of innovation and the situation of the labor market.

In Mexico, almost unanimously, the development in which this finds itself is considered as a dual economy, an economy with modern and other traditional sectors, it is an economy where 57 per cent of the population does not find employment in the formal sector, it is an economy where less than 20 per cent of the labor works in the manufacturing sector.

As the principles that regulated the new industrial revolution that we have been living since the end of the 20th Century and up to the present day are being consolidated, the typologies of the new ways of working that most companies will have in the future and the profile of the appropriate worker to cover these needs begin to be glimpsed.

However, the values of digitalization and change are not limited to the world of work. The processes of change are intertwined with all spheres of society such as social security systems, culture, education, citizen security, and infrastructure.

This reality incorporates a sensitive concern about how the competitiveness of markets may affect working conditions, employment levels and the distribution of income as labor income. These situations, as they consolidate, will have a significant effect on paid employment, work organization and the financing of social security systems, as well as on the role and tasks of workers' representatives.

Traditional employment systems face profound and far-reaching changes, although the direction, speed and scope of these achieve an unstoppable advance, which reflects a duality compared to the usual work that escapes having incorporated some technological requirement for their performance of the same activity.

Conclusion:

The format for the digital work of the new Industrial Revolution 4.0 will mean the end of the need to maintain the rules of social and labor protection. Less human work and the little that remains will be more autonomous, connected by computer applications via algorithms. The reality is more ambivalent and evidence as both digital work and analogue work, have similar social protection needs.

IV. LABOR INCLUSION VS LABOR EXCLUSION

We are far from understanding the fact that work is what made our species human. The species would extinguish much faster without work than without copulation. Work remains the primary activity on which the access to the satisfaction of basic needs for most of humanity depends.

The aspects that reflect the social scenario of Industry 4.0 and can be altered are: the rate of unemployment, low wages, high inequality and fear of the future, where the use of Information and Communication Technologies should be aligned with labor competencies in the short term should contain; analysis, design, development, implementation and evaluation.

Modern technology has led to the concentration of economic and political power and to the development of a society governed by totalitarian states that disguise and make democracies invisible, in a society made up of individuals who can fulfil themselves according to their potential and, above all, achieve a happy and fruitful life.

However, the new global production diminishes the importance of manual labor, which means that the world of work is becoming more abstract, more immaterial; now value is based on the ability to be accessed; today the essential is not to dominate a territory but to have access to a network with connectivity.

What follows is that there is a social exclusion of new social classes of a global nature to be mentioned

- 1) The upper-class, with all the means of knowledge and information and the capacity of manipulation.
- 2) The nomads of misery, millions of people in poverty, forced to fight to survive.
- 3) A gigantic middle class that will live in the hope of reaching the upper-class.

For this reason, the value of the work itself is secondary, its central importance is reduced, it is translated only as the generation of employment derived from economic growth, but it is even more basic to find ways to build true processes of digital globalization with equity, which should guarantee a broad respect for the basic minimum of worker protection rules.

Science can be defined as the reduction of multiplicity to unity; the last century's successive advances in technology have been accompanied

by matching advances in organization, so organization is indispensable because freedom exists and it has a meaning only of a self-regulated community of individuals who cooperate freely.

Individuals have had to individualize, the dehumanizing effects of surplus organization are reinforced as they develop the effects of excessive population on the labor market, substitution to subordinate themselves to all ends by means. An organization is not a conscious or living entity; its value is instrumental and derivative, it is not good in itself; it is good only insofar as it promotes the good of the individuals who are part of the collective whole.

As we gain more experience in an area, we gain more precise and detailed knowledge, but we also become less flexible in our way of thinking. De-individualization, by reducing self-awareness, also reduces accessibility to norms of behaviour. People believe that having the Internet is an illusion of being unique people and being able to manage the excess search for meaning in life.

The human beings of the 21st Century are from two worlds, the online world and the offline world that urges and encourages us to build our ways and means, using strategies, tools offered by information technology.

Most sociological research shows that the majority of users use the Internet, not so much because of the opportunity for access, but because of the exit, which is more attractive for building a shelter to reserve an exclusive comfort zone.

Instead of serving the cause of increasing the quantity and improving the quality of life of human integration, mutual understanding, cooperation, and solidarity, the network has facilitated practices of isolation, separation, exclusion, enmity, and conflict.

It is not possible to increase our security without reducing our freedom, nor to increase our freedom without renouncing a little our security; intelligence as that capacity of the human being to adapt to the environment, be it social or physical; the more adapted one is, the more intelligent one is for others.

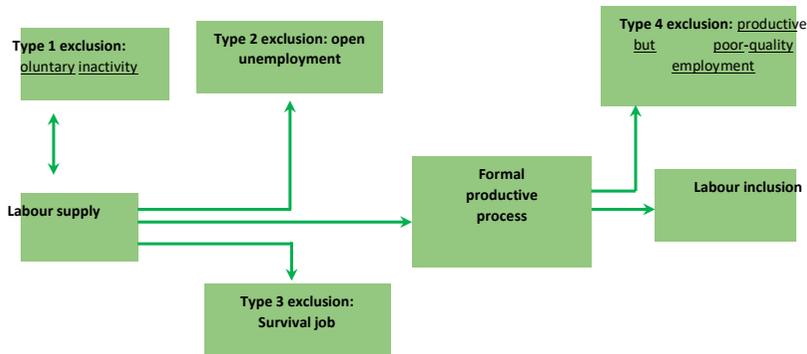
As a natural consequence, the education of the workforce in Mexico is a reflection of illiteracy: 33 percent of employed people have as maximum level the primary level almost half of them did not finish it, another third of the employed population has secondary education which, even today, no longer means the completion of compulsory education, which already considers the baccalaureate. Finally, 32.8 percent of the workers have a maximum level of middle and superior education studies.

In Mexico, there are more than 119 million registered people, among which 7.6 million (a total of 6.4 per cent) have disabilities that often prevent them from getting a job.

Similarly, it is considered that the lack of employment reflects social exclusion understood in the following way: a) Physical, mental or sensory disability, insofar as this favours their situation of social exclusion; b) School failure: young people at risk of social exclusion due to their school difficulties and who are enrolled in programs of social guarantee, initial professional qualification, curricular diversification, and any other educational offer that includes digital literacy.

GRAPH 3 (SOURCE: OWN ELABORATION BASED ON A STUDY ON LABOR INCLUSION, ADVANCES, AND CHALLENGES, STPS 2015.)

TYPES OF LABOUR EXCLUSION



The complex field of labor inclusion should be at least adjusted to the following aspects to mention:

- a) Professional competence: A set of knowledge and skills that enable professional activity to be carried out by the requirements of production and employment.
- b) Specific skills: Technical knowledge, attitudes, and skills demanded by the occupational exercise in the labor market.
- c) Capacities: The set of resources and aptitudes that an individual has for carrying out a certain task is called capacity; in this sense, this no-

tion is linked to education, the latter being a process of incorporation of new tools to develop in the world.

- d) Knowledge: It is a set of stored information, through experience or learning or through introspection. Taken by itself, it has a lower qualitative value.
- e) Attitudes: A positive or negative predisposition towards something or someone, is composed of three parts. The effective, cognitive and behavioural.

The ability of a person refers to his ability to contract obligations applied to labor law, and it becomes an obligation for the employer to ensure the maintenance of the ability of its employees to maintain a job.

In the media, but also among academics, the debate around digital platforms is focused on discerning whether service providers through them are workers, self-employed or independent.

For the International Labour Organization, the central dimensions of social exclusion are: economic, social and institutional; the latter implies non-participation in the labor market (inactivity), lack of access to employment (unemployment) and the impossibility of access to quality jobs, in addition to other dimensions such as the conditions that the global labor market and some of these are:

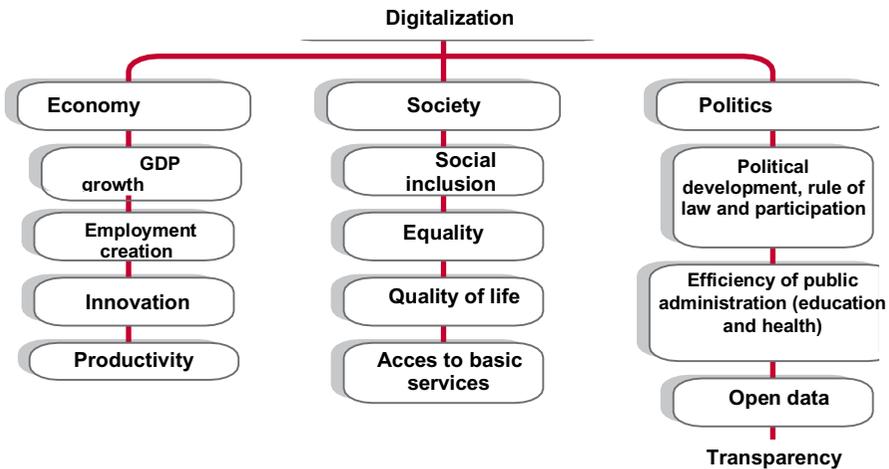
- 1) Only a part of the population enjoys the benefits of generating wealth and welfare, where employment is the guarantee of it.
- 2) The costs in terms of the potential for economic growth, due to the non-inclusion of important segments of the population in the productive processes, which gives social exclusion in relation to access to work.

On the other hand, the creation of jobs can be interpreted as a reflection of the demand for labor force on the part of companies arising from their investment or production plans and, at the macro level, as one of the products of economic growth that includes digital literacy understood as the set of training actions aimed at the development of technical, social and ethical skills related to the use of Information and Communication Technologies.

From the National Digital Strategy contemplated by the 2012-2018 sectoral development plans, the digitalization of various services is integrated as a fundamental premise, so that the population transits in that sense. Tak-

ing into account the people who have a job, this becomes a duality to work in the projection of six-year goals.

GRAPH 4 (MARCO ESTRUCTURAL DE LA ESTRATEGIA DIGITAL NACIONAL)



Thus digital inclusion, located as a fundamental element of the fields of social justice and human rights, must be fundamentally the ones that must foster new spaces for tolerance and integration, to counteract the attempts of individuals and groups that seek to impose values, customs or beliefs, paradigms in the digital world, ultimately also affect non-connected areas in which the following concepts are considered necessary to take into account because of the importance they represent:

- 1) Digital skills: skills and knowledge for personal development in any situation of the Information and Knowledge Society. It implies from the ability to use digital devices (computers, smartphones, among others) to make use of the Internet, in such a way that they can be used for all the activities of the people (social, relationship with the government or economic)
- 2) Digital Inclusion: it is the democratization of access to Information and Communication Technologies in such a way that the entire population can be successfully inserted into the Information and Knowledge Society.

- 3) Information and knowledge Society refers to the transformations of society that includes ethical, social, political, and economic, among others, because of the massive adoption of ICTs.⁶⁴

The validity of labor contracting, where vulnerability is located, where ignorance and ignorance are elements contrary to access to employment, which reaffirmed with the use of the digital signature, which consists of the use of an encryption method called asymmetric, key or public key. This method consists of establishing a pair of keys, one public, known or not by the subjects or the contracting parties, and the other private, known only by one party, which results in a disadvantage.⁶⁵

Digital labor contracts that represent virtual rights which are perfected with the will of the parties that give them the elements of existence. For example, in the civil-law tradition of formalizing agreements, such as one's consent and the object that are perfected with virtual formality, this finds its sustenance in cryptology.⁶⁶

Currently, three aspects of understanding the concept of digital inclusion can be identified: access, digital literacy and the appropriation of technologies. The first aspect is based on the distribution of goods and services that guarantee access to infrastructure and information and communication technologies.

The second aspect emphasizes basic skills in the same tools, which allow the individual to know how to use them and, in this case, the access to the physical means and the school literacy represent the necessary requirements to develop.⁶⁷

In addition to knowing how to use them, individuals must develop an understanding of the new means by which they can appropriate these resources in order to reinvent their uses and not become consumers.⁶⁸

⁶⁴ Brogna, Patricia, *adultez, trabajo y discapacidad*, editorial trillas, Mexico, 2014, p. 58.

⁶⁵ *Idem*.

⁶⁶ Cryptology is defined as the science that studies the concealment or encryption of information, as well as the design of systems that perform these functions, which include data, text, images, voice or sounds.

⁶⁷ Conectas, Programa de incentivo a la producción académica en derechos humanos, <http://www.conectas.org/revista-sur/conectas-e-fundacao-carlos-chagas-divulgam-selecionados-para-o-programa-de-incentivo-a-producao-academica-em-direitos-humanos?pg=2>, Date of consultation: June 3rd, 2018.

⁶⁸ *Idem*.

Conclusion: Inclusion from the labor perspective, in relation to Industry 4.0, is related with the scope and implications of the concepts of labor inclusion and exclusion, which are identified as twin concepts, insofar as they refer to processes that allow the access of a part of the population to productive jobs with favourable or adequate working conditions, while another part of the population does not have access to this type of employment, it is necessary to emphasize that the concept of labor inclusion is a fundamental component to achieve social inclusion, or in other words, it is a determining factor to combat social exclusion.

V. INDUSTRY 4.0 AND SOCIAL SECURITY

There is a widespread conviction that the labor revolution based on digital knowledge, added to robotization will not only change the economy but society as a whole, therefore, the dominant work will be a society called the labor society, which is not far from being the society of knowledge to work.

In the new society of digital knowledge, new forms of work are appearing that make the classical prototype of work with stability, convenience, adaptation, subsidies disappear, which would require not only changing labor laws, but also the very culture of social security and social security, where the future of work is mentioned indistinctly.⁶⁹

After the automation of industry in the 18th and 19th Centuries (Industry 1.0), the division of labor and chain production (scientific organization of work) of the 20th Century (Industry 2.0), and the technological revolution of the late 20th Century (Industry 3.0), we would now speak of the era of the digitalization of the economy. This would cause a real mutation in companies (business models), in work (modes of provision) and the economy (shared and non-competitive) (Industry 4.0).⁷⁰

Faced with the current displacement of the ends of social welfare, by the means of digitalization of the world as the maximum expression of cultural and technological innovation and, in parallel, faced with the replacement of the decision of citizen sovereignty by the power and knowledge, with

⁶⁹ Organización Internacional del Trabajo, *El futuro del trabajo que queremos, conferencia nacional tripartita*, http://www.ilo.org/wcmsp5/groups/public/-europe/rogeneva/ilo-madrid/documents/publication/wcms_615487.pdf Date of consultation: April 12th, 2018.

⁷⁰ Molina Navarrete, Cristóbal, *Derecho y trabajo en la era digital: revolución industrial 4.0 o economía sumergida 3.0*, http://www.ilo.org/wcmsp5/groups/public/europe/ro-geneva/ilo-madrid/documents/article/wcms_548619.pdf Date of consultation: April 15th, 2018.

the necessary expertise that in turn represents the voice of the dominant thought of the global, there is no effective alternative to the free market.⁷¹

It is up to social law to create, and in many cases maintain, the necessary balance between: Social protection, digital economy, labor inclusion, market distribution and policy development, supposedly only as an economic state of emergency but which the ungoverned digital economy threatens to turn the development of digital labor markets into a structural one.⁷²

What is happening today in our pension system is not something purely circumstantial driven by prevailing changes, but is the symptom that changes in the world of work are putting at risk a system that in its original conception was based on another employment model, because the discontinuity and fragmentation of employment affect the very coverage, expansion, coverage, and financing of Social Security, taking into account the most penetrating reduction in employment as a result of the advance of the technological and robotic revolution. That is to say, the more technology, the less protection for work, that can guarantee access to coverage against occupational risks, which is based on the scheme that service providers, through digital platforms, work in a discontinuous and fragmented way over time.

The main challenge is not technological, for employers, the State, and society, but management with institutional responsibility, since this process of technological, digital and productive change must prevail with social strength, without ignoring the fact that it deepens the precariousness of employment, access to social security, as well as equalizing or disappearing inequalities between workers and, above all, promoting social and territorial cohesion.⁷³

Because the problem is not the number of jobs lost through automation, but rather that enough jobs are produced to compensate for the loss of jobs caused by digitalization, this process requires sharing decisions, which entails a new business culture, granting greater power and influence in decision-making, in the organization of labor relations and the structure of labor activity.

⁷¹ *Idem.*

⁷² *Idem.*

⁷³ In 2016, 68.4 million people lacked access to social security. Because of this situation, federal and state governments have created non-contributory programs. However, the proliferation of dispersed and unconnected instruments does not solve the underlying problem. Having, therefore, a universal social protection system with more equal access among population groups may be a factor that reduces poverty, but particularly equal opportunities.

The so-called Fourth Industrial Revolution implies a radical change in the substance and form of development of enterprises, the education system, workers, governments, social security and society as a whole.

Given that Mexico is a country with a high economic inequality compared to others, with a Gini coefficient of 0.48 (World Bank 2018), we face the serious risk of low social mobility in the future as reflected in the graph 1.⁷⁴

In Mexico, the labor market is the main source of income and could therefore become an engine for increasing social mobility and decreasing inequality. Precisely, given that in Mexico the population obtains 74 per cent of its income from the labor market, it is crucial to analyse the ways in which people enter the labor force and how their income is distributed, reveals a severe stagnation or even a fall in labor income in the last 10 years (2007-2017), depending on the source.⁷⁵

The form of access to social protection and the protection of social security and other rights of workers on digital platforms and robotization as components of Industry 4.0 is part of the process of integrating the global economy, which draws a perspective of uncertainty for many people and communities in precarious situations, it can be effective and beneficial if we adopt a sufficiently broad approach to the conditions that govern our lives and our work.

VI. EMERGING SOCIAL RIGHTS

Alongside social rights, specific rights appear from the same intellectual structure, which no longer belong to everyone. They demand unequal treatment to achieve equality and equality with people who enjoy the fullness of human rights, as well as those imaginary collectives of society who find themselves in social life in inferior conditions.

For this reason, in the face of digital inequality, equalization will be the point of arrival to make possible an equal coexistence from comparable principles in the quality of life, in the means available to the social groups of workers in the area of protection that each one enjoys.

⁷⁴ Informe desigualdades en México 2018 / El Colegio de México, Mexico: Colegio de México, Red de Estudios sobre Desigualdades, 2018, p.48.

⁷⁵ *Idem.*

They are also emerging social rights that enrich the heritage of the original rights of the poor and workers, today generalized and converted into rights for all and have their origin in the idea of dignified equality. There is a difficulty in considering social rights as full rights because they are difficult to justify and also because they involve a substantial economic effort that clashes with the scarcity of welfare, which is a reality in which all societies find themselves in any case.

These difficulties do not dilute the radical mandate of the Constitution to remove obstacles and promote conditions so that freedom and equality can be real and effective for all, although they do oblige to distinguish between different social rights categories where the approach to the protection of individual freedoms in which information and communication technologies are the means to achieve balance or equity.⁷⁶

According to Article 19 of the Universal Declaration of Human Rights: Everyone has the right to freedom of opinion and expression; this right includes freedom without interference, to hold opinions and to seek, receive and impart information and ideas through any media and regardless of frontiers.⁷⁷

In addition, Article 13 of the American Convention on Human Rights (pact of San José, Costa Rica), in force since 1978, states that:

Everyone has the right to freedom of thought and expression. This right includes freedom to seek, receive and impart information and ideas of all kinds, regardless of frontiers, either orally or written, printed, in an art form, or through any other process of one's choice.⁷⁸

The main factors that generate situations of inequality and that can cause discrimination and exclusion at work for people in vulnerable situations.

- Belonging to lower levels in the social scale.
- Cultural differences to adapt to socio-labor patterns.
- High level of prejudices of society regarding the integration they can achieve.

⁷⁶ Alexy, Robert, *Derechos sociales y ponderación*, Editorial Fontamara, Madrid 2010, p. 52.

⁷⁷ Declaración Universal de los Derechos Humanos, <https://dudh.es/19/> Date of consultation: 15 February 2018.

⁷⁸ Organización de los Estados Americanos, *Artículo 13 convención americana sobre derechos humanos*, <http://www.oas.org/es/cidh/expresion/showarticle.asp?artID=25&IID=2> Date of consultation: February 16th, 2018.

- Prejudices about the lower labor productivity of some people in comparison with others.
- Less physical, mental or professional capacity of certain people.
- Greater risk of expulsion from the labor market due to potential or effective changes in the jobs and the contents of the jobs.

Digital inclusion initiatives, for example, must intrinsically involve the creation of creative and intelligent situations in isolated environments often characterized by rurality, orality, isolation, population aging, poverty, and social traditions.⁷⁹

The aforementioned problem of the digital divide, along with other barriers such as information poverty, censorship, the political use of technologies, disinformation, media manipulation and the destruction of public information especially in the contexts of social change, social justice, and global market fundamentalism.

Facing the emergence of new components that integrate telecommunications, computer equipment and digital programs, to access decent employment, however, the true pillars of information societies focused on human development with guaranteed social protection; where the societies of shared knowledge are education, ethics and participation must be articulated as an integral systemic process.⁸⁰

An approach to the society-technology-culture relationship which is more appropriate to the problem of digital inclusion must take as its assumption that technology, as well as language, influences the contexts in which it arises or is introduced, as well as having its meaning, its form in time and space by the way they are used in heterogeneous contexts of social rights that are transformed in an emergent way in the world of work.

IX. CONCLUSIONS

First: The competitive challenges of a globalized and technical world of work focus on the fact that workers have greater freedom to move and to adapt, where social inclusion for work ensures respect and protects human rights of

⁷⁹ Alexy, Roberto, *op. cit.*, p. 54

⁸⁰ López-López, Pedro, Samek, Toni, *Inclusión digital: Un nuevo derecho humano, Educación y biblioteca*, 2009, v. 21, n. 172, p. 114.

social justice without fear of being excluded from where the most competitive companies expand the labor market.

Second: Today, more than ever, companies require flexibility to answer to the challenges of globalization and technological advances. This flexibility extends to the ability to hire and fire workers, and to be able to adjust the scenario quickly and quickly is indispensable in the current global competitive context, where the current labor legislation must adapt to the context of the reality of the advance of the digital labor market.

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THE CHALLENGE FOR HIGHER EDUCATION IN THE LIGHT OF INDUSTRY 4.0

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SUMMARY: I. Introduction. II. Industry 4.0 in Public Higher Education Institutions. III. Collateral Damage of Industry 4.0. IV. The Case of a Public State University and its Challenge to Access Industry 4.0 //Industrial Engineering Program. V. Conclusions and Comments. VI. Research Sources.

I. INTRODUCTION

Within the framework of the so-called Industry 4.0, the challenge of higher education to deal with this trend is analysed. The general aspects of Industry 4.0 are discussed in a documented review of the response of public higher education to the upcoming Fourth Industrial Revolution. While not yet real, these aspects represent a risk that will mark changes that will not only affect the industry, but also entail social, economic and educational transformations in the years to come.

Some of these changes may be good for people, economic development and respect for the environment. However, there are also disadvantages associated with this industrial transformation. Literature recognizes the difficulty of organizations, including educational ones, to adapt to the new proposals. If this is worrying for the industry, it is even more serious for the training of professionals to fulfil the needs of the production process. This concern is partly because the technological changes on which Industry 4.0 is based are dynamic and because it calls into question the fact that what

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higher education offers is not only not in line with the needs of professionals but may also be seriously lagging behind.

Among other aspects, attention should be given to the balance of power, since innovation and access to resources in developed countries can lead less developed countries to excessive and even dangerous changes in employment conditions and in meeting workers' needs.

While the speed at which the industry advances can lead to greater inequalities and social fragmentation, it might not be such a concern for Mexico since, on one hand; Industry 4.0 has an enormous technological dependence given the fact that the machinery requires a high level of specialization. It is also possible that Mexico may not be able to obtain the capital to adapt to such machinery due to the economic cost involved and the need to consider the return on investment.

This trend calls for an intensive use of the Internet and cutting-edge technologies. It is mainly aimed at the development of industrial plants and more intelligent and environmentally friendly ways to generate energy. This is technically consistent with production chains that are much better connected to each other, to supply and demand, and to the need to promote sustainability.

The new processes require personnel with greater specialization, which is not always available; and if it is, these workers seek higher remuneration. It is precisely here where one of the niches of opportunity for higher education institutions can be found. Therefore, functions and characteristics are analysed, with emphasis on the social responsibility of the university that guides the training of professionals within the framework of Industry 4.0.

The case study included herein is set within an institution whose philosophy lies in humanism and the competency-based model. The conclusions are ambivalent, expectations are high, and conditions are ambiguous. Hence, Mexican public higher education will have to take giant steps in order not to fall further behind and take even bigger steps if it is to train the human capital that will be required in the coming years.

II. INDUSTRY 4.0 IN PUBLIC HIGHER EDUCATION INSTITUTIONS

In a review of the literature, we find an analysis on the impact of Industry 4.0 with notorious differences according to countries' economic devel-

opment. In this regard, Ricardo Swain Oropez¹ describes the evolution of industrial revolutions and their relationship with higher education, stressing that such advances have been of little use in Mexico. He presents a proposed curriculum for the field of engineering with a strong element of the student's comprehensive training. In addition, the university-business relationship is considered a fundamental aspect of his program. He builds his proposal on a challenge-based educational approach.

In his article, Jaime Humberto Carvajal Rojas² focuses on the need to:

...review the technologies embodied in the Fourth Industrial Revolution where automation, robotics, information technologies and telecommunication technologies stand out as a whole or as a multidisciplinary [sic] engineering unit to formulate or re-formulate new production instruments, new means of production, new production methods and new production systems, in the city and in the country, that will require new actors for their successful and efficient operation.

This means that the need to train new technicians, technologists and professionals in ways of doing research that will revolutionize higher education activities in the world, and especially in Latin America, is essential because of the technological dependence that has historically prevailed in countries that have made do with being assembly plants.

Quoted by Carvajal,³ Festo states that:

...ensuring the skills evolution of qualified personnel and junior employees for current and future changes in the workplace will require employees who are 4.0 specialists and possess interdisciplinary skills uniting classic mechatronics with sound IT knowledge and high levels of social competence to qualify for digital production.

¹ Swain Oropeza, Ricardo, "Modelo Educativo para la Industria 4.0", *Academia de Ingeniería México*, 2017, <https://es.slideshare.net/AcademiaDeIngenieriaMx/modelo-educativo-para-la-industria-40>

² Carvajal Rojas, Jaime Humberto, "La Cuarta Revolución Industrial o Industria 4.0 y su Impacto en la Educación Superior en Ingeniería en Latinoamérica y el Caribe", 15th LACCEI International Multi-Conference for Engineering, Education, and Technology: Global Partnerships for Development and Engineering Education, 19-21 July 2017, Boca Raton, FL, United States.

³ Carvajal Rojas, Jaime Humberto, *op. cit.*, p. 2.

What he presents is a proposed curriculum for engineering that responds to the expectations of Industry 4.0. This proposal will be appraised in a study program from a Mexican public state university since *industry and services must be able to influence university and vocational training curricula to identify training interests because of the impact of digitalization in all sectors and industries*.⁴

Another view of the effects of Industry 4.0 has to do with employment. In a state of knowledge of the issue analysing challenges pertaining to public policy and the impact Industry 4.0 has on labor and training, Raül Blanco, Jordi Fontrodona and Carmen Poveda⁵ found that *automation has a replacement effect: it eliminates job vacancies in certain sectors and occupations. But there is also a complementarity effect: there are jobs in which automation complements human work, thus increasing productivity and remuneration*. In addition to these two effects, *technological innovation widens the boundaries of production: with the same resources, more can be produced [... but] in order to deal with the consequences of industrial digitalization in the workplace, ongoing training will be essential for people* (p. 155). This continuous vocational training is an outlay more than an expense; it could even be considered an investment.

Higher education has the responsibility to provide continuing education. However, higher education institutions, especially public ones, are under pressure to respond to human capital formation in a way that meets *the changing needs of the global labor market without neglecting the learning needs and interests of local communities* from a more social and less economic perspective.⁶ According to Vargas, this perspective is part of a long deliberation process of the United Nations Educational, Scientific and Cultural Organization (UNESCO) which, since 1973, has strived for the comprehensive formation of individuals and has *set out to bridge the gap between education and employment and create flexible pathways between education, employment, leisure and retirement* (p. 2).

⁴ Secretaría de Estrategias Industriales, “La digitalización y la industria 4.0 Impacto industrial y laboral”, 2017, *CCOO Industria*: Spain.

⁵ Blanco, Raül, Fontrodona, Jordi and Poveda, Carmen. “La Industria 4.0: El Estado de la Cuestión”, *Revista Economía Industrial*, No. 406, pp. 151-164, 2017, <http://www.mine-tad.gob.es/Publicaciones/Publicacionesperiodicas/EconomiaIndustrial/RevistaEconomiaIndustrial/406/BLANCO,%20FONTRODONA%20I%20POVEDA.pdf>

⁶ Vargas, Carlos, “El aprendizaje a lo largo de toda la vida desde una perspectiva de justicia social”, *Objetivos de Desarrollo Sostenible*, Serie de documentos temáticos sobre Investigación y Prospectiva en Educación, No. 21, Paris, Organización de las Naciones Unidas para la Educación, la Ciencia y la Cultura, 2017, <http://unesdoc.unesco.org/images/0025/002500/250027s.pdf>, date of consultation: September 15th, 2018.

A review of the investment made in higher education to deal with the challenges of Industry 4.0 shows that in Germany,⁷ the country driving this Fourth Industrial Revolution, the quality of education is more important than its quantity. Therefore, it is necessary to reconsider the consequences of Mexico's education policies of which's main axis since the 1970s has focused on expanding coverage with "good intentions" so that the education provided is of quality.

In the case of Mexico, the National Association of Universities and Higher Education Institutions (ANUIES) is a plural organization that analyses higher education policies. The section on University Social Responsibility in *Agenda SEP – ANUIES for the development of higher education*⁸ was aimed "to consolidate a learning community." As analysed below, it poses the risk of a neoliberal approach while at the same time allowing institutions to be studied in order to make decisions regarding:

[...] the type of professionals, citizens and people it trains; the type of knowledge it produces, its social relevance and its recipients; the democratization of access to knowledge, particularly for disadvantaged groups; university community mechanisms for participation and liaison with social groups to work on projects with local or regional impact to ensure collective learning and progress in addressing important problems; the consequences and effects of their processes and performance.

This would have made it possible to readjust the training of professionals needed by the Fourth Industrial Revolution without losing sight of the social function of public universities. One of the expected results of Project 3.1 in the section on the Model of University Social Responsibility was to have a *National Liaison Program between Universities, Businesses and Social Innovation Management*. However, the time frame for this agenda has run out and the program was not designed.

In summary, Industry 4.0 will reveal the seriousness of technological dependence and will continue with or widen the gaps in personnel qualifica-

⁷ Secretaría de Estrategias Industriales, *op. cit.*

⁸ ANUIES, "Agenda SEP - ANUIES para el desarrollo de la educación superior", Mexico, 2015, http://www.anui.es.mx/media/docs/Agenda_SEP-ANUIES.pdf, date of consultation: 19 September 2018.

tions needed for digitalization, if higher education does not assume its role in training qualified and ethically responsible people.⁹

III. COLLATERAL DAMAGE OF INDUSTRY 4.0

1. *The Speed of Progress and its relation to social fragmentation*

The International Labour Organization (ILO) has two positions regarding the influence of technological progress: one it calls pessimistic, which endorses the idea that technology displaces manpower and therefore causes unemployment, and an optimistic one that holds that technology consolidates jobs. The optimistic position is based on the results of predictions that failed to materialize in the 1970s and on studies showing that production in the target country *benefits the localization process, helping national industries to recover all the processes in the value chain (botsourcing), propitiating, in turn, the creation of jobs in the country.*¹⁰

However, in both positions, this same organization recognizes that technological changes have social consequences. This is partly due to the fact that automation is closely associated with increased productivity and lower production costs, which leads companies¹¹ to seek new technologies to achieve this relationship. Therefore, without it being a linear equation, competitiveness eliminates more jobs than those created by digitalization.

The ILO issue note shows alarming data. Quoted by the ILO, Frey and Osborne:

[...] explored the potential automation of occupations, that is, the technical easiness or feasibility of computerizing occupations. They estimated that 47 per cent of total US employment is technically in a high risk category “over

⁹ As Humberto Bustince states (quoted by Secretaría de Estrategias Industriales, *Ibidem*, p. 43), “in fifteen years, the production chains of any company will change. In Germany, out of every hundred jobs, around eighty mechanics will be replaced by machines.” He goes on to affirm that “we are not socially prepared for the revolution that is coming.” Therefore, public universities will have to analyze and propose measures that conciliate the advent of digitalization and the short-term consequences that could result in social outbursts associated with unemployment and uncertainty on the one hand, and to prepare its students to deal with a hitherto unknown world of managing their economic income, on the other.

¹⁰ Secretaría de Estrategias Industriales, *op. cit.*, p. 2.

¹¹ Spanish experience suggests that within the framework of Industry 4.0, it is thought that the company sustaining society is a healthy combination of large companies and SMEs.

the next decade or two”. The comparable estimate for the UK is 35 per cent, and studies for Germany and France produced similar results. An ILO study has recently produced a much higher estimate for ASEAN countries: about three in five jobs face “a high risk of automation” (Chang and Hyunh, 2016), thus raising important questions about regional variations in job destruction.

And it is not only the elimination of jobs that is worrisome, but also the fact that most of the good jobs or those that social security calls decent employment may be lost.¹² According to *Secretaría de Estrategias Industriales*,¹³ *the role of the State is decisive for [...] concentrating economic and human resources, and coordinating actions with the same objective: for this process of technological, digital and productive change to become a reality and on the other hand, it will tend to prevent it from deepening the precariousness of employment, inequalities among workers and, above all, for it to contribute to social and territorial cohesion.*

Unfortunately, although the impact of technological innovation allows significant gains in productivity, the resulting profits are not distributed among the general population. These profits go to the owners who developed or patented said innovation, which leads to greater inequality¹⁴ and in the case of underdeveloped countries, the poor are more and more numerous and even poorer.

Employment income is polarized. On the one hand, some skilled workers receive high amounts for their work while others are unemployed, and on the other hand, unskilled workers barely earn enough to survive. Therefore, one concern of the emergence of the Fourth Industrial Revolution is the escalation of social inequality through sustained technological progress.¹⁵

¹² Lifelong learning under a *social justice approach would reconcile economic growth and social cohesion and maintain the latter [...] as the enhancement of everything collective, common and social, including a sense of community. For the State, this would imply a policy approach centered on addressing inequalities in and through education, and providing learning opportunities that, at the same time, encourage the development of skills and competencies for a decent work*, which is the social function of public education, and especially of public universities. Vargas, Carlos, “El aprendizaje a lo largo de toda la vida desde una perspectiva de justicia social”, *op. cit.*, p. 12.

¹³ Secretaría de Estrategias Industriales, *op. cit.*, p. 4.

¹⁴ International Labour Organization (ILO) The Future of Work Centenary Initiative, 2015, http://www.ilo.org/wcmsp5/groups/public/---ed_norm/---relconf/documents/meetingdocument/wcms_370408.pdf

¹⁵ International Labour Organization (ILO), “The Future of Work Centenary Initiative”, *op. cit.*

2. *Technological Dependence and the Demands on Countries with Limited Development*

It is a fact that technological progress leads to the outsourcing and fragmentation of production processes. This has a negative effect on jobs, even in developed countries because with new technologies to improve productivity in both logistics and communications, companies have specialized in specific tasks where routine work done by workers in low-skilled jobs that have not been automated yet is sent to underdeveloped countries in which workers there receive even lower wages than in developed countries. This, in turn, leads to the unemployment of unskilled workers in developed countries. "... developed economies have specialized in high-skilled tasks such as R&D, design, finance and after-sales services..."¹⁶

Other conditions in developed countries imply the advent of new jobs to cater to other activities, like entertainment, as working hours get shorter and there is more time for leisure.

On the other hand, emerging economies can capitalize on the positive effects of technology, which generate new jobs as a result of innovations in intelligent machines that require the appropriate infrastructure, as well as systems, transport and communication equipment, without necessarily opening up opportunities for qualified personnel.

Therefore, underdeveloped countries like Mexico have a two-fold challenge: to temporarily provide unqualified workers for routine jobs, which will tend to decrease or disappear with automation and, in the future, to have professional profiles that will take on the activities for operating within the framework of Industry 4.0 (globalization).

The production of knowledge to meet the challenges mentioned in the previous paragraph does not necessarily lead to an analysis of the "academizing" tendency of universities in terms of their focus on research. This has perverted researcher evaluation systems in higher education institutions, resulting in an overproduction of academic papers of which contribution to knowledge is debatable since they respond to the need of professor-researchers to be promoted or even to keep their jobs.¹⁷

¹⁶ International Labour Organization (ILO), Issue Note, *op. cit.*, p.5

¹⁷ Altbach, Philip G, and de Wit, Hans, "The problem is the publishing system, not the scholars", *University World News the global window on Higher Education*, September 18th, 2018, <http://www.universityworldnews.com/article.php?story=20180918080942756>, date of consultation: September 20th, 2018.

3. *Professionals for Industry 4.0*

The ILO recognizes that transformations in the world of work apply to productive chains, but also to institutions that train human capital and generate knowledge, including universities and other institutions, to thus develop new technologies to increase productivity and lower costs.

The truth is that the transformations stemming from technological advances imply modifying the training of the population in general. In addition, to process automation not only requires digital literacy,¹⁸ but also the ability to train people for new jobs and for the transformation of existing jobs.

This leads us to ask ourselves the types of workers that will be needed in the light of the transformations taking place. Since jobs will become more complex, *[c]ollaborative worker-machine interaction requires a higher level of autonomy of operators and designers, shifting focus from rule-following to value-finding*¹⁹ Hence, the training needs to go beyond the use of technology.

Managers who rely on intelligent machines to *support day-to-day management decisions and take over routine decisions require more soft skills acquired mainly through experience, such as good judgment, creativity and problem solving*²⁰ This entails new ways of manager training that responds to *exceptional circumstances highlighted by increasingly intelligent algorithms, and learning to cope with ambiguity*.²¹

The jobs of the future require young people to have a *solid theoretical foundation, good practical training and to be in contact with the world of hardware and software. Finding junior profiles with training in these two languages is becoming more and more difficult*.²²

Moreover:

¹⁸ By digital literacy, we mean “teaching and evaluating the basic concepts and skills of information technology so that people can use information technology in their daily lives and develop new social and economic opportunities for themselves, their families and their communities.” Blog Educativo que Promueve las Destrezas de Literacia Digital en Puerto Rico Alfabetización digital, 2018, <https://literaciapr.wordpress.com/2008/06/28/definicion-de-alfabetizacion-digital>

¹⁹ International Labour Organization (ILO). *The Future of Work Centenary Initiative*, *op. cit.*, p. 8.

²⁰ *Idem*.

²¹ *Idem*.

²² Secretaría de Estrategias Industriales, *op. cit.*, p.3.

New occupations will emerge, in particular at the intersection of professions, software and machines, such as big data architects and analysts, cloud service specialists, software developers and digital marketing professionals (Frey, 2016). Susskind and Susskind (2015) predict that a range of new legal roles will be created at the intersection of software and law, such as legal knowledge engineer, legal technologist, project manager, risk manager, and process analyst.²³

While this seems to support the optimistic position on the consolidation of new jobs, it is likely that the need for managers to have more skills for these new jobs, especially in terms of the above-mentioned soft skills that the ILO says can only be acquired through experience, will contribute to greater social inequality in developing countries.

The challenge [...] is not technological, but people management through social dialog and collective bargaining, with new rights and incorporating new digital skills; managing the change in work organization, occupational safety and health, skills; working hours and workplace and, ultimately, labor legislation.²⁴

4. *The Capacity of HEIs to Train Professionals for Industry 4.0*

As quoted by the ILO,²⁵ Nübler reports that in comparison with Germany, *the net job loss in manufacturing employment as a share of total employment was much lower when compared to the US* although the latter had a lower rate of robots. This makes it possible to infer that the conditions of each country are subject to their particular circumstances. So, academic and research infrastructure is an element that is available to train the professionals required by Industry 4.0.

The strategy Mexico could take advantage of to improve its conditions regarding the professionals that can close the gap of technological dependence²⁶ is training engineers in the necessary soft and digital skills and

²³ International Labour Organization (ILO). “*The Future of Work Centenary Initiative*,” *op. cit.*, p. 9.

²⁴ Secretaría de Estrategias Industriales, *op. cit.*, p.4.

²⁵ International Labour Organization (ILO). “*The Future of Work Centenary Initiative*”, *op. cit.*, p. 7.

²⁶ Technological dependence is measured “according to the sales of royalties and technical support regarding the payments made abroad for the acquisition of the same concepts.”

training researchers in other fields of knowledge, like law. This is in line with the objectives of Mexico's science, technology and innovation education policies, specifically for the purpose of *Contributing to the training and building of high-level human capital*²⁷ through postgraduate scholarships, postdoctoral scholarships and programs such as repatriation of researchers. This program aims to incorporate Mexican researchers residing abroad, higher education institutions or research centres to strengthen existing research groups and consolidate the training of researchers by connecting the scientific capacity of public, private and social sectors.

IV. THE CASE OF A PUBLIC STATE UNIVERSITY AND ITS CHALLENGE TO ACCESS INDUSTRY 4.0// INDUSTRIAL ENGINEERING PROGRAM

The diagnosis of the conditions of Science, Technology and Innovation (STI)²⁸ in terms of the institution under study reports that Morelos is a state that ranks 5th nationwide in aspects such as: 1. Academic and research infrastructure; 2. Human resources training; 3. Teaching and research staff; 4. Investment in STI; 5. Scientific and innovative productivity; 6. Business infrastructure; 7. Information and communication technologies; 8. Institutional component; 9. Gender in STI and 10. Economic and social environment. Its main strengths lie in numbers 3, 4 and 5.

Meanwhile, an important component that guides the study plan under review is its adherence to its institutional mission, which seeks to:

[...] comprehensively form citizens as well as free, critical and socially responsible professionals, capable of purposefully constructing their own life project; of contributing to building democracy and living in a world without frontiers [that are] uncertain and paradoxical, recognizing themselves as members of the human race and as part of nature; of acting ethically with communication and cooperation to contribute to solving the problems and satisfying the

Consejo Nacional de Ciencia y Tecnología, "Informe General del Estado de la Ciencia, la Tecnología y la Innovación", Mexico, Conacyt. 2014, p. 86.

²⁷ Secretaría de Energía, Secretaría de Educación Pública, Consejo Nacional de Ciencia y Tecnología, *Programa Estratégico de Formación de Recursos Humanos en Materia Energética*, Mexico, Sener-SEP-Conacyt, s/f.

²⁸ Consejo Nacional de Ciencia y Tecnología, "Informe General del Estado de la Ciencia, la Tecnología y la Innovación," Mexico, Conacyt, 2014.

needs of the different sectors and population groups of the State of Morelos and, in general, of the globalized society of which they are part.²⁹

The Industrial Engineering educational program is based on humanism, an approach that guides the University Model of the institution in question. Its study plan is from the School of Chemical and Industrial Sciences and was restructured in 2015. This reorganization recognizes the speed with which knowledge and technological change are generated, which can be consistent with training professionals under the competency model. It uses the 2013–2018 Sectorial Education Program (PSE) of the Ministry of Public Education, the 2013–2018 State Development Plan (PEDE) and the 2012–2018 Institutional Development Plan (PIDE) as references. The tendency towards a lifelong learning approach with neo-liberal nuances can be observed in these documents stemming from the 2012-2018 National Development Plan.³⁰

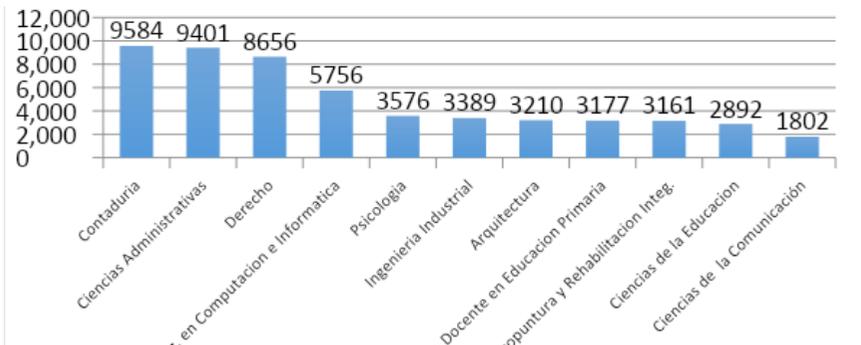
According to data from the National Employment Service, a position as an industrial engineer pays more than the national average (although the national average only comes to \$11,200 Mexican pesos a month).³¹ While it is not a very flattering picture, it shows its importance in the labor market, as it occupies the sixth place among the professions with the highest demand in terms of jobs. This makes it possible to assume that employment opportunities for engineering in the state are high in comparison to other professions (See Graph 1).

²⁹ FCAEI, “*Ingeniería Industrial, Plan de Estudios 2015*”, Mexico, UAEM, 2015, pp. 10-11.

³⁰ Vargas, Carlos, *El aprendizaje a lo largo de toda la vida desde una perspectiva de justicia social*, *op. cit.*

³¹ In real terms, the income received from practicing a profession is equivalent to the income received by unqualified personnel in developed countries.

GRAPH 1.
PROFESSIONS WITH THE HIGHEST DEMAND IN MORELOS (2010)



Source: FCAEI, Industrial Engineering, 2015 Study Plan. Mexico: UAEM. 2015

The proposed curriculum's *rationale* considers the growth needs of the state where it is located, as well as regional and national needs, in order to *train highly qualified engineering professionals capable of competing in a globalized world through the development of their professional skills*.³² In contrast, there is only one high-tech company of all the innovative companies in the state under study, revealing that it is, at best, an assembly line state where small and medium enterprises predominate.

The basic reason for restructuring the plan³³ was because:

The globalization of economies is marked by a fast, progressive, accelerated and uneven expansion of (virtual and real) cross-border flows and movements of goods, services, money, technology, ideas, information, cultures and population. This process makes use of technological resources, especially electronic information and communication resources, to increase productivity, creating information networks that make it possible to carry out more efficient actions.³⁴

This justification shows a willingness to meet the requirements of qualified personnel for Industry 4.0 with a study plan based on four main aspects:

³² FCAeI, *Ingeniería Industrial, Plan de Estudios, op. cit.*, p. 5.

³³ *Ibidem*, p. 8.

³⁴ Bold added by author.

- 1) a globalizing approach to emerging issues in the field
- 2) an innovative and interdisciplinary approach
- 3) a learner-centred approach based on professional competencies³⁵
- 4) stress on professional profile guidelines according to the demands of the social and productive sectors in the state and country.³⁶

However, the same document citing the results of the Consulting Scientific and Technological Forum A.C. (FCCyT) recognizes that even when they are in charge of training the scientific, technological and humanistic cadres in the country, public higher education institutions do not innovatively generate and apply knowledge or train researchers in a way that lowers technological dependence.³⁷ Nor is it possible to establish a liaison between schools and workplaces, a situation that can be traced back to a dual education model.³⁸

According to the National Agency of Quality Assessment and Accreditation of Spain (ANECA),³⁹ the structure of the curriculum should provide the foundations of the training at the beginning and the most technologically specialized courses at the end. With this approach, professionals can be provided with the necessary flexibility and adaptability for conditions in the near future.

In line with this, the study plan proposes to:

- [...] technological solution alternatives through planning, design, evaluation of production management systems and services using continuous improvement methodologies in organizations.

³⁵ Within the framework of the specific core disciplinary competencies for the *Tuning para América Latina* project report (Beneitone, et. al., 2007, quoted in FCAeI, *Ingeniería Industrial, Plan de Estudios*, op. cit.

³⁶ FCAeI, *Ingeniería Industrial, Plan de Estudios*, op. cit.

³⁷ FCCYT, *Diagnósticos en Ciencia, Tecnología e Innovación*, Morelos, 2012, <http://www.foro-consultivo.org.mx/home/>

³⁸ Dual vocational training systems “are being strengthened (EU and ILO) in order to counteract youth unemployment. Inspired by the German model, dual training refers to training in which apprentices, young people up to around 19 years of age, undergo structured, long-term training that combines periods in the classroom and in the company, leading to accreditation (diploma or certificate). The process is structured through a specific work-training contract and is often driven by labor unions and the business community.” Secretaría de Estrategias Industriales, op. cit., p.71.

³⁹ Agencia Nacional de Evaluación de la Calidad y Acreditación de España, *Informe sobre el estado de la Evaluación Externa de la Calidad en las Universidades Españolas 2016*, Spain, 2017, <http://www.aneca.es/Sala-de-prensa/Noticias/2017/Informe-sobre-la-evaluacion-de-la-calidad-en-las-universidades-espanolas-2016>

- Organize and manage interdisciplinary work teams that lead to the development of improvement projects that exceed customer's expectations and apply different manufacturing tools while taking into account cost-benefit parameters.
- Manage logistics and supply chain operations nationally and internationally through the use of ICT.
- Implement national and international standards in a productive setting and establish the commitment to the conservation of natural resources and sustainable development.
- Have the ability to adapt to different environments.⁴⁰

The professional competencies of the Specialized Cycle (see Table 1) of the educational program are those that would provide certain aspects of training including the development of competencies that allow making administrative decisions using soft skills, creativity and problem-solving skills that define an Industry 4.0 professional since such skills lead the trainee to:

- a) Manage projects in industrial plants and companies
- b) Plan, supervise and lead multidisciplinary teams
- c) Use industrial diagnostic techniques to measure a company's functional efficiency
- d) Select and adapt the technologies needed in production processes to increase production capacity
- e) Develop projects to promote a better quality of life in society, taking its technical, economic and sustainable feasibility analysis into account
- f) Manage logistics operations and supply chains nationally and internationally through the use of ICTs
- g) Implement national and international standards in a production setting and establish the commitment to the conservation of natural resources and sustainable development
- h) Formulate projects based on marketing, technical, administrative and financial aspects.⁴¹

⁴⁰ FCAeI, *op. cit.*, p. 39.

⁴¹ *Ibidem*, p. 46.

TABLE 1
 STUDY PROGRAM SPECIALIZED CYCLE SUBJECTS
 FOR INDUSTRIAL ENGINEERING

Code	Name	Type of Course	Type	Hours per Week	
				Theory	Practice
IIN17	Strategic Planning	Subject	Theoretical	4	
EAD05	Marketing	Subject	Theoretical	4	
IIN18	Project Engineering	Subject	Theoretical	4	
IIN19	Logistics	Subject	Theoretical	4	
IIN21	Lean Manufacturing	Subject	Theoretical	4	
IIN20	Green Engineering	Subject	Theoretical-Practical	2	2
	ELECTIVES				
PRO01	Product Design	Subject	Theoretical	4	
PRO02	Process Optimization	Subject	Theoretical	4	
PRO03	Ergonomics	Subject	Theoretical	4	
PRO04	Sustainable Processes	Subject	Theoretical	4	
LCS01	Purchasing	Subject	Theoretical	4	
LCS02	Supply Chains	Subject	Theoretical	4	
LCS03	Packaging Engineering	Subject	Theoretical	4	
LCS04	Reverse Logistics	Subject	Theoretical	4	
CAD01	Equipment Uncertainty and Calibration	Subject	Theoretical	4	
CAD02	Problem-Solving and Continuous Improvement	Subject	Theoretical	4	
CAD03	Six Sigma	Subject	Theoretical	4	
CAD04	Information Systems Engineering	Subject	Theoretical	4	

Source: FCAEI, Industrial Engineering, 2015 Study Plan. Mexico: UAEM. 2015

However, it is noticeable that, although some subjects regarding these aspects are mentioned, almost all of them are theoretical subjects that do not involve the student in decision-making. Moreover, there is no training for research, except in the case of developing industrial products, processes and methods since the recommended educational activities limit the possibility of carrying out research-development+innovation and attaining technological independence from developed countries.

Industry 4.0 is identified with the term the Internet of Things (IoT) and the Internet of Services. A study plan aimed at these elements should necessarily include:

Advanced analytical skills (Big Data), Advanced Simulation and Virtual Plant Modelling, Computer Engineering Skills, Man-Machine Interface Skills, Integrated Closed-Loop Quality, Process and Product Management, Logistics and Inventory Optimization, Physical and Virtual Computer Integrated Manufacturing Design⁴²

Teaching methodology should focus on innovation and the curriculum design should be flexible, “interdisciplinary, intelligent, modular and re-shapeable,”⁴³ constantly updated and achieving international accreditation.

The nine technologies for Industry 4.0, which in turn require specific skills and are deemed absent from the study plan in question, are:

- 1) *Big Data*: The ability to collect, store and analyze large amounts of data to identify inefficiencies and bottlenecks in production
- 2) *Autonomous Robots*: Skills for human-robot interaction at the workplace
- 3) *Simulation*: The ability to conceive, model, implement, operate and optimize products and processes in virtual settings
- 4) *Universal System Integration*: The ability to integrate all the production systems in the Digital Factory physically and virtually, and horizontally and vertically
- 5) *Industrial IoT*: The ability to have an industrial Internet connection in real time with devices, plants, offices and companies to share information
- 6) *Cybersecurity*: Skills in Information System (IS) and Telecommunication System security techniques

⁴² Carvajal Rojas, Jaime Humberto, *op. cit.*, p. 1.

⁴³ *Idem.*

- 7) *Cloud Computing*: IoT and Big Data cloud computing capability
- 8) *Additive Manufacturing*: 3D design and printing capability for small batches and quick design changes, reduced material stacking and low transportation costs
- 9) *Augmented Reality*: The ability to merge physical elements with virtual elements to create an augmented reality in real time in the Digital Factory⁴⁴

Furthermore, although one of the lines of action outlined in the Comprehensive Institutional Strengthening Program (PIFI) includes the *management of opening full-time positions that contribute to gradual improvement in activities like peer work, academic administration, school evaluation and group assistance and tutorials*⁴⁵, this contrasts with the Spanish experience that prefers professors with direct experience with companies.

This aspect of the composition of the academic personnel needs to be reviewed because in the proposed curriculum, experience is an unnecessary or little desired condition for most areas of knowledge and it is only required in the case of Applied Engineering (see Table 2).

⁴⁴ *Ibidem*, p. 2.

⁴⁵ FCAeI, *op. cit.*, p. 64.

TABLE 2.
 DESIRED PROFILE FOR ACADEMIC STAFF ACCORDING TO THE ACCREDITATION COMMITTEE FOR EXACT SCIENCES
 AND ENGINEERING (CACEI)

<i>Fields⁴⁶</i>	<i>Academic Background</i>		<i>Professional Experience</i>	<i>Work Schedule for the Program</i>	<i>With knowledge in:</i>		
	<i>Origin</i>	<i>Level</i>			<i>Applied Research</i>	<i>Tech. Dev.</i>	<i>Design & Project</i>
Basic Sciences and Mathematics	Bachelor in Engineering or in Specialty	Post-Graduate desirable	Not necessary	Full-time Part-time	Desirable in area or teaching research		
Engineering Sciences	Bachelor in Engineering	Post-Graduate	Desirable	Full-time	Necessary	Desirable	Necessary
Applied Engineering	Bachelor in Engineering	Updated	Vast	Part-time Full-time depending on specialty	Necessary	Desirable	Necessary
Social Sciences and Humanities	In the field	Bachelor	Desirable in field and/or academic area	Part-time			

Source: FCAEI, Industrial Engineering, 2015 Study Plan 2015. Mexico: UAEM. 2015

⁴⁶ In order to perform the general functions of their profession, undergraduate students in engineering need specific basic knowledge in the fields of Basic Sciences and Mathematics, Engineering Sciences, Applied Engineering and Social Sciences and Humanities.

The above situation is somewhat contradictory. On the one hand, it suggests that a professor who teaches subjects like basic sciences and mathematics may not necessarily have professional experience and can hold a position as a full-time or subject-based professor while applied research activities are simply desirable. In other words, the personnel who prepare learning experiences for training students are exempt from having to deal with the work experiences their students will face.

Concern in the curriculum design is more in line with the recommendations of study plan accreditation bodies than with the requirements emerging in the labor market.

The adjustments made to the 2015 plan as seen in the curriculum are dictated by the above-mentioned organizations and not in terms of their relevance to the labor market:

[...] the comparative analysis of the General Basic Stage of the 2002 Study Plan regarding the recommendations issued by the evaluating and accrediting bodies; particularly those indicated by the Inter-institutional Committees for the Evaluation of Higher Education (CIEES), as well as those of the Accreditation Committee in Engineering Education (CACEI) and the National Center of Evaluation (CENEVAL).⁴⁷

And not only that, but it also failed to gather information on the expectations of the employers of future graduates of the profession being analysed.

In light of this scenario, it is necessary to question the institution's social responsibility since it is a much-discussed position that includes the analysis of applicability in the training of higher education students. The UNESCO states that: "*Higher Education as a public good is the responsibility of all stakeholders, especially governments.*"⁴⁸ In this specific case, this public good is committed to seeking the good of society, since:

[...] university influences the training of young people and professionals, their scale of values, their way of interpreting the world and of behaving in it. It also influences professional ethics and – knowingly or not – guides the definition of professional ethics for each field and its social role. A responsible university asks itself about the type of professionals, citizens and people it

⁴⁷ *Ibidem*, p. 31.

⁴⁸ UNESCO, *World Conference on Higher Education*, 2009, Paris, p. 2.

educates, and about the proper teaching structure to guarantee a socially responsible education of its students.⁴⁹

In this vein, university social responsibility is tied in with the need for the training of professionals to respond to the social function of the profession; that is, to the social needs beyond the processes of coverage, permanence and quality that graduates must meet to achieve their objectives, among which should be to satisfy the demands of Industry 4.0.

In summary, the Industrial Engineering study plan is an academically consistent program with a differentiated academic load that is similar to that of other higher education institutions, but which's relevance can be seriously questioned if the school teaching the curriculum disregards the conditions that will emerge with the Fourth Industrial Revolution.

V. CONCLUSIONS AND COMMENTS

Industry 4.0 is a process that is underway and affects the countries implementing it, as well as those that are technologically dependent.

Studies in Latin America on the suitability of higher education systems to give emerging economies an opportunity to incorporate their qualified personnel to this production trend are limited.

Public higher education institutions in Mexico can commit to the education of the personnel required by Industry 4.0 with the advantage of not only addressing technological considerations, but also with ethical training and social responsibility that reduces the gaps of inequality.

The institution and educational program studied show that while there are intentions of providing an education consistent with current conditions and times, the possibilities are limited because they prioritize strictly academic recommendations and disregard the components that liaise with businesses, innovation and research development.

The study plan prepares students for a labor market that is limited to the implementation of technological development techniques and processes that come from other backgrounds, and does not encourage research and

⁴⁹ ZARATE RUEDA, Ruth and GARCIA RINCON, Sonia Cristina. *La cultura socialmente responsable de la UIS: una perspectiva desde el ámbito educativo y social*. Encuentros [online]. 2014, vol.12, n.2 [cited 2019-06-26], pp.105-120. P108. Available from: <http://www.scielo.org.co/scielo.php?script=sci_arttext&pid=S1692-58582014000200008&lng=en&nrm=iso>. ISSN 1692-5858.

development with innovation, which would set the tone for a better quality of life for the Mexican population.

Faced with the complexity of the issue, the possible strengths the public university wields, like that of having full-time staff, becomes a weakness since such exclusive involvement in university activities limits their participation in companies dealing with the challenges of professional training, which is a common situation if these companies want to be competitive.

Although the paid work to which industrial engineering professionals have access is considered “high”, compared to the earnings of other occupations in Mexico, their wages are considered similar to those of unskilled personnel in developed countries. Moreover, prevalent working conditions in Mexico marked by uncertainty and the lack of social security are disappointing for professionals who have graduated from public higher education.

The economic, social and political conditions that currently define the world of work in Mexico reveal a lack of social justice towards professionals. Situations of injustice are visible and can become a cause of social instability, especially because peace is threatened. The ILO aspires to ensure that *every working man and woman can claim freely and on the basis of equality of opportunity their fair share of the wealth which they have helped to generate*.⁵⁰ For almost 100 years, the ILO has not changed this principle, but nor has it been attained. Hence, in view of educational research on student learning, it is necessary to urge governments, employers and workers to act on this demand for social justice. And what better way to do so than through a critically constructive analysis that can shift curricular design to meet the future demands of the labor market, prioritizing equality over efficiency and giving education the status of a public good.

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