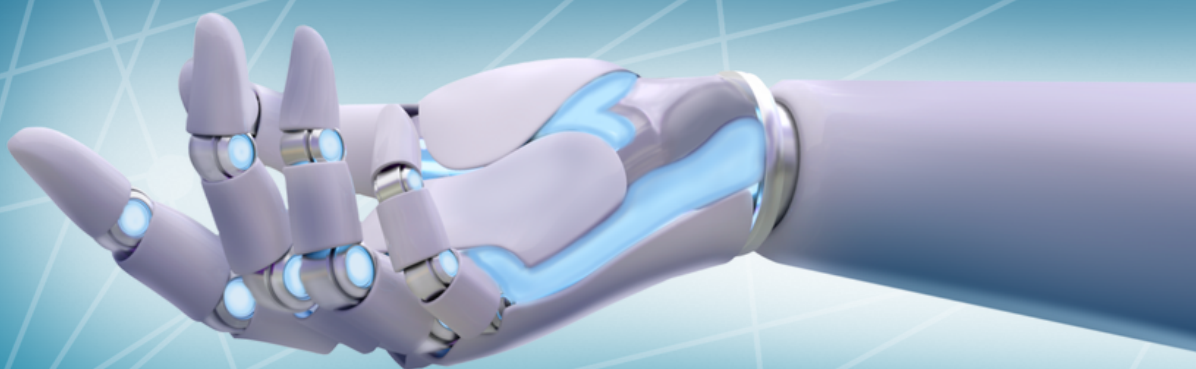




CAIINNO[®]
CENTRO DE ANÁLISIS PARA LA INVESTIGACIÓN EN INNOVACIÓN

PROBABILITY AND EFFECT OF COVID-19 ON THE JOB AUTOMATION IN THE MEXICAN CREATIVE ECONOMY



2023

AUTHORS

Esteban Santamaría Hernández.
Carlos Castro del Ángel.
Jessica Elidé Ávila González.
Antoine Esper Abud.

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Luz Leticia Rivadeneyra Rodríguez
Magda Lizbeth Morales Salas
Gabriela Esther Rodríguez Conde

Translation by:

Ari Monserrat Taboada Elvira
Diana Guadalupe Camacho María
Isabel Espinosa Osorio
Valeria García Rueda

Design by:

Brayan Silvestre Castillo

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Motivation.

This research aims to contribute to academic literature. But, also to serve as a tool to help decision-makers and public officials to identify challenges as well as opportunities that will allow Mexico to emerge from the crisis that the pandemic is causing. This research considers a period of time that allows us to look at what has happened in the last few years.

Scope and limitations.

This research does not seek to suggest that other sectors should be neglected to prioritize those related to the creative and cultural industries, but rather to show the reality based on the available evidence. So that governments can take the necessary action thus, that Mexico can have the growth and development it needs.

Political note.

CAIINNO's work, as well as that of this research and its researchers, is not related to any political party in Mexico or abroad. It was developed because it was of interest to the authors, as well as to help improve conditions in the country. While it is intended to be useful for decision-makers and public officials, many of whom are linked to political parties, this publication is not designed for attacks between political parties or candidates, and its use for such purposes is prohibited.

INTRODUCTION

According to Schumpeter, long before the industrial revolution, it was conceived that machines would displace human labor (History of economic analysis, 1954). Therefore, he considered that economic progress tends to be depersonalized and automated. Although this trend may be much talked about today, the reality is that it is not a new phenomenon.

COVID-19, according to Reynolds & Autor (2020), made the phenomenon of automation that was already being experienced more evident, although it could not be said that the pandemic forced the transition to automation. It is true that one of the most significant effects of COVID-19 has been on employment, but the risk that some jobs could be related to other factors such as teleworking. An example, according to Reynolds & Autor, is the reduction of security personnel since several companies transitioned to teleworking, making the use of offices less necessary, and therefore unnecessary to hire security to a certain extent.

About ten years ago Pastor Bustamante (2011) wrote an article, in a distinguished journal, where he referred to the 2008 economic crisis, reflecting that "while the global market contracted by 12% due to an overpowering drop in the demand, worldwide exportations of creative goods and services reached 594,000 million dollars, with annual growth of more than 14% from 2002 to 2008". The author was referring to the creative economy.

Several studies have proposed that automation could put millions of people out of work around the world in the next decade. Mexico is no exception. To identify that risk, the Bank of Mexico (2018) recently published a study containing the classification of the employed population in Mexico according to their probability of automation. The results showed that two thirds of the country's employed population work in occupations classified with a high probability of automation for the period from 2005 to 2017, which exemplifies the challenge facing the country.

First, the importance of the creative economy for Mexico is explained in general terms. Then, the generalities of the fourth industrial revolution are discussed, as well as its relationship with automation. Then some effects of COVID-19 on the creative economy and automation are shown. Next, the central issue, which is the probability of automation in the creative economy is addressed. Finally, a brief analysis is made on the General Law of Culture and Cultural Rights, as well as on the state legislations that contemplate in their texts the cultural and creative industries.

The main objective of this research was to identify for Mexico the probability of automation of the population employed in jobs related to the cultural and creative industries, as well as those not related to them. To reach this important finding and contribution, more than 4 million records were used, as well as big data analysis processes. Two periods were considered: i. Pre-pandemic, covering from the first quarter of 2017 to the fourth quarter of 2019, and; ii. Period considering the presence of the pandemic, covering from the first quarter of 2020 to the second quarter of 2022.

For the first period it was found that the national average probability of automation for jobs in the cultural and creative industries was 0.10%, while for the second period it was 0.20%. In the case of jobs in neither cultural nor creative industries, it was 63.47% in the first period, and 63.86% in the second period. This shows that jobs in the creative economy have a much lower probability of automation than the rest of the jobs

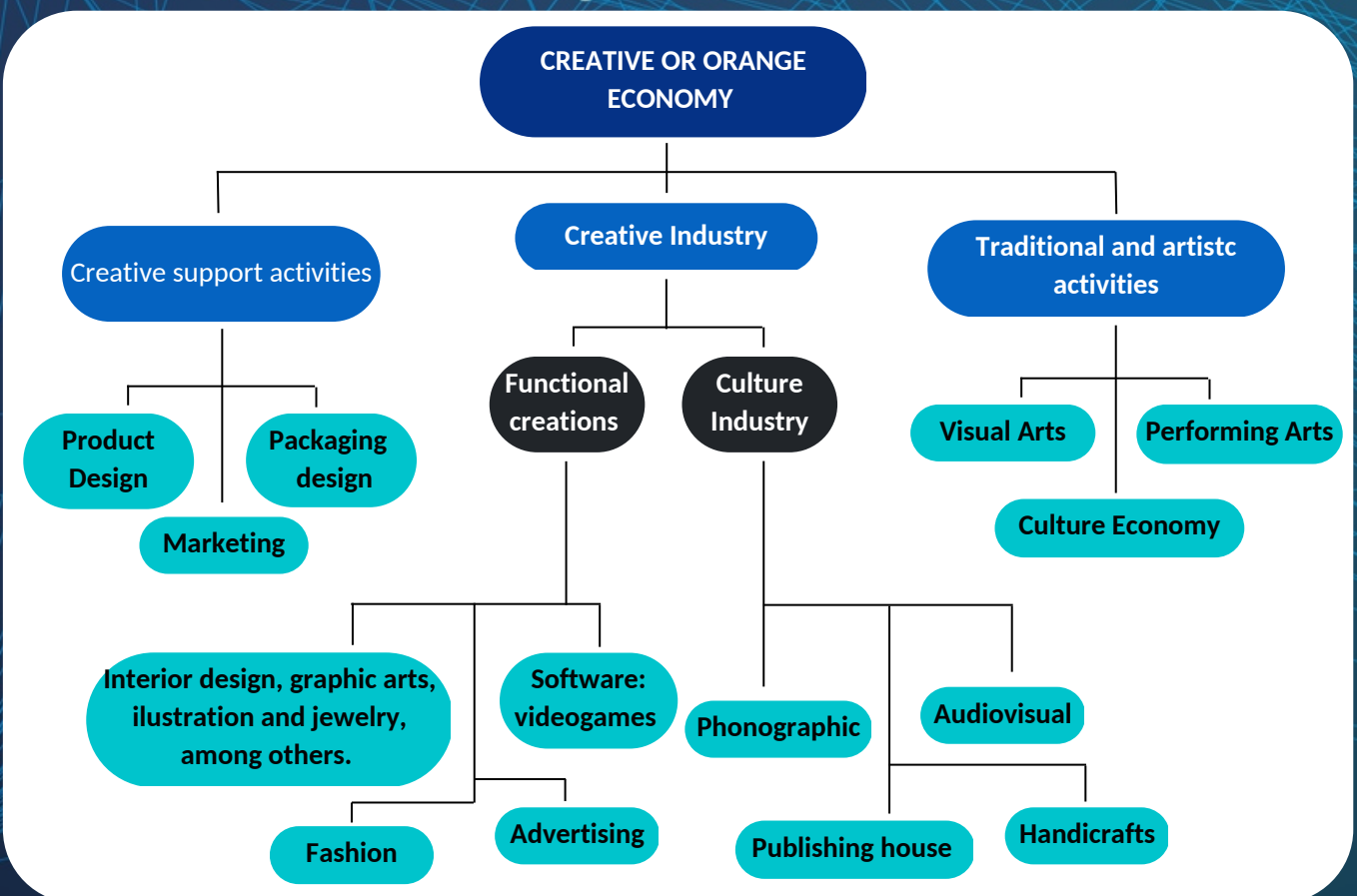
By the same token, legislation on culture, directly related to the creative economy, was reviewed in order to identify if the country has provided the legal tools to support it. The federal law does not contemplate cultural or creative industries. At the subnational level, only twenty-one states have laws on the subject, but seven states incorporate the creative and cultural industries into their legislation.

The contribution of this work is relevant since it is an unprecedented study in Mexico. Moreover, it takes on special importance due to the country's search for options and tools to overcome the negative effects that COVID-19 is generating. Thus, the results presented here help to justify the investment of the federal government and local governments in the creative economy, even in the copyright-based industries. Mexico is a country rich in culture and creativity, a resource worthy of further exploitation.

THE CREATIVE ECONOMY AS A DRIVING FORCE FOR THE WORLD AND MEXICO

According to Benavente & Grazzi (2017), the creative economy is the group of activities through which ideas are transformed into cultural and creative goods and services, whose value is or could be protected by Intellectual Property Rights (IPR). This economy is integrated by the cultural and creative industries such as film, theater, video games, cultural tourism, music, crafts, and others. The following chart explains the previous definition of the creative economy.

Figure 1. Creative economy



Source: Benavente & Grazzi, 2017, Public policies for creativity and innovation: Promoting the Orange Economy in Latin America and the Caribbean.

The importance that several countries have given to the creative economy is justified by its impact and benefits in various economic and social sectors, resulting in jobs, investments, exports, among other areas. In fact, in several countries, its contribution to the national Gross Domestic Product (GDP) is higher than other traditional sectors such as agriculture or manufacturing.

Arguably the most significant effort to calculate the impact of the creative economy on countries' GDP was undertaken several years ago by the World Intellectual Property Organization (WIPO). They published a research paper to measure the impact of IP (Intellectual Property)-based industries, most of which are linked to the creative economy, showing the following results for countries in Latin America and the Caribbean:

Table 1. Economic performance results of IP-based industries.

Country	Evaluation period (years)	Contribution to GDP (percentage)
Argentina	2003 - 2008	4.7 %
Colombia	2000 - 2005	3.3 %
Ecuador	2010 - 2014	4.47 %
Jamaica	2001 - 2005	4.8 %
México	1998 - 2003	4.77 %
Panamá	2002 - 2006	3.17 %
Perú	2002 - 2007	2.67%*
Trinidad y Tobago	2000 - 2011	5.5 %

Source: Own elaboration based on data from The economic performance of copyright-based industries, available at: <https://www.wipo.int/copyright/en/performance/index.html>

Note: some percentages cover an average of the evaluation period, and in other cases are taken as a reference, but the percentage that is published is from the last evaluation year.

*In Peru, national value-added was considered, not GDP.

Reports from Argentina (Massot, Prieto, & Weiry, 2013), Colombia (Castañeda Cordy, Cubillos López, Sarmiento López, & Vallecilla Gordillo, 2008), Ecuador (Cardoso, 2017), Jamaica (James, The Economic Contribution of Copyright-Based Industries in Jamaica, 2007), Mexico (Márquez-Mees, Ruiz Funes, & Yaber, 2006), Panama (Martínez, 2009), Peru (Morales Saravia, Távara, Solórzano, & Villanueva, 2009) as well as for Trinidad and Tobago (James, 2012), agreed that the lack of data and statistical information makes identifying the impact of copyright-based industries a challenge.

At times, the results seem only statistical in terms of a country's GDP, but they represent income for many people. For instance, the series "Narcos" owned by Netflix, employed 400 Colombians for seven months, used 28,500 hotel nights, involved the purchase of 4,420 international plane tickets to Colombia, and 9,197 domestic flight tickets (Proimágenes Colombia, 2015). Another example is the film "Los 33", for which 355 Colombians were hired and 6,300 hotel nights were booked (Proimágenes Colombia, 2015).

For Mexico's case, the National Institute of Statistics and Geography (INEGI) [by its initials in Spanish] published its Culture Satellite Account in 2017 (p. 1), revealing that the GDP of activities linked to the culture sector amounted about to 32 billion dollars, which represented 3.2% of the country's GDP. Likewise, activities related to the culture sector generated employment equivalent to 1 million 384 thousand 161 jobs, representing 3.2% of the country's total employment.

In the latest edition of INEGI's Culture Satellite Account (2019), activities linked to the culture sector once again accounted for 3.2% of the country's GDP in 2018, although this time it registered an economic growth reaching 34 billion dollars, approximately.

In the same report, the main consumption was the acquisition of audiovisual media, handicrafts, and the cultural production of households, representing 78.3% of total spending on culture.

However, in Mexico due to the COVID-19 pandemic, it is estimated that 1.4 million jobs generated by the cultural industries could be at risk of being lost if action is not taken promptly and with precision (Hernández, y otros, 2020). This situation is likely to cause Netflix to withdraw the US\$200 million investment announced in September last year for the country (Alegría, 2019).

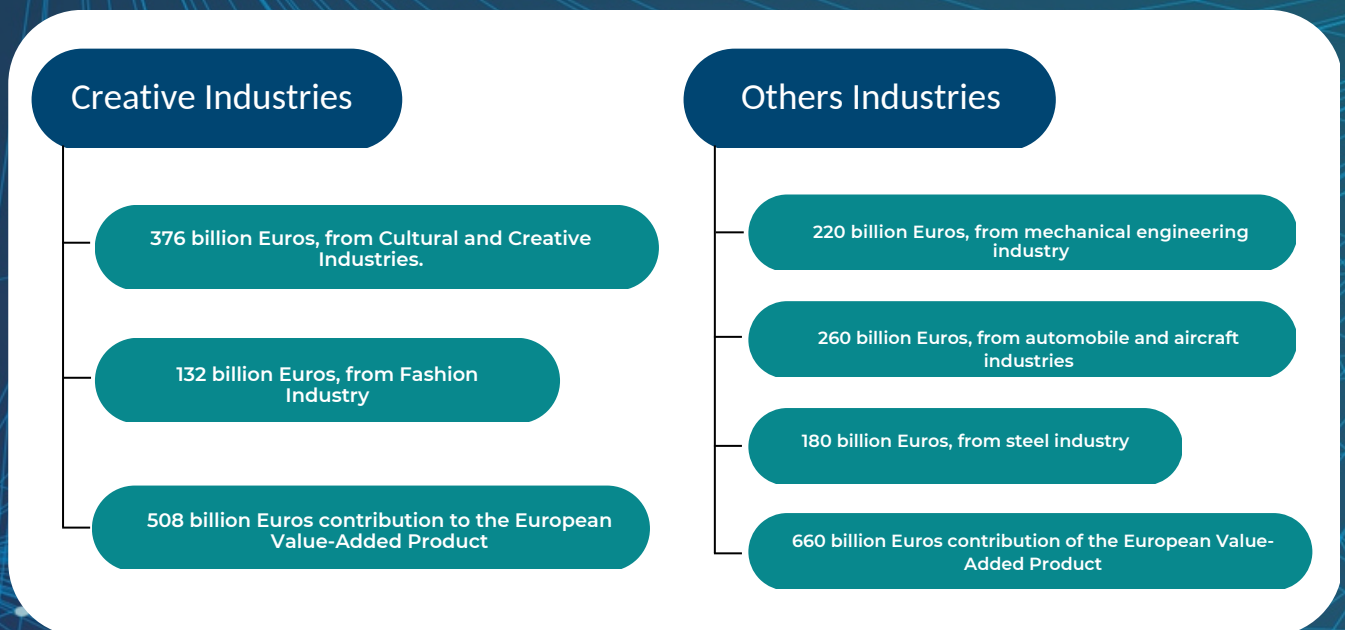
In the face of a crisis, decision-making based on the best available information is ideal. Hence, it may be useful to know what the performance of copyright-based industries was, both in GDP and in labor matters in Mexico for several years, as calculation recently published by CAIINNO (Santamaría Hernández, et al., 2022). Considering that these rights are the most related to the creative economy, this study considers valuable information for decision makers, especially for those who legislate or design policies on the subject.

WHY IS THE CREATIVE ECONOMY SO IMPORTANT IN DEVELOPED COUNTRIES?

In the United States, for example, it was identified that until 2014, IP (Intellectual Property) intensive generating industries, which are mostly part of this economy, were responsible for 27.9 million direct jobs, which represented an increase of 0.8 for 2010 in that country (USPTO, 2016). Those related to copyright, possibly the most linked to the creative economy, generated 5.6 million works. According to official data from that country, these industries represented 38 percent of its GDP (US Department of State).

For its part, the European Union (EU) has carried out various studies on the subject, a recent one shows that the importance of the creative sector in that region was reflected in its contribution to 6.8% of European GDP, which is approximately 860 billion Euros, as well as 6.5% of European employment, which is an estimated 14 million direct jobs (Benzoni, 2014). For its part, Snoendermann (2019, p. 6), to better exemplify the impact of this economy in the EU, compared the economic and product contribution to the Value-Added Product (VAP) of certain cultural and creative industries with traditional industries:

Figure 2. Comparison of economic contribution between creative industries and others.



Source: Own elaboration based on Michael Soendermann (2019, p. 6), available at: https://unctad.org/meetings/en/Contribution/cep2019-25-10-contribution_en_Germany.pdf

The previous graph shows the relevance of the economy in economic terms for several countries. But to leave it at that level is to limit its benefits. Stern & Seifert (2008) have exposed that this economy also generates important social benefits, from helping to solve urbanist problems in cities, to generate a more creative and educated society, which has an impact on democracy, citizen participation, and even the social fabric.

OVERVIEW OF THE FOURTH INDUSTRIAL REVOLUTION: ITS LINKS WITH AUTOMATION.

According to Palacios, for Landes an industrial revolution is the “complex of technological innovations that, by replacing human ability with machinery and human and animal strength with mechanical strategy, causes the transition from artisan to factory production, thus giving rise to the modern economy” (2004, p. 96).

These substitutability processes bring with them structural changes that have effects on the economy of any country. These changes can be seen from different perspectives, for example, for Schumpeter (1942, p. 82), situations such as the emergence and implementation of new methods of production or transportation, and even phenomena such as wars could generate them.

According to Zambon, Cecchini, Egidi, Saporito, and Colantoni (2019), the reference of these changes is observed in the history of industrial revolutions. They indicate that the first began in the middle of the 18th century in England with the mechanization of production through steam and water. In 1870 the second arises as a result of mass production thanks to the use of electrical energy. At the end of the 1960s, the third began according to Perasso (2016), derived from the creation of the first programmable logic controller, a computer that automates mechanical processes, bringing with it telecommunications, information technology, and electronics.

Since 2011, the world has been in what is known as the fourth industrial revolution or Industry 4.0 (Zambon, Cecchini, Egidi, Saporito, & Colantoni, 2019). This fourth revolution is based on cyber-physical systems that connect computing with physical systems (Chandy, 2010). Among its main objectives is the homogenization of physical and digital spaces, and the Internet of Things plays an elemental role in this process.

A fundamental part of this new revolution is the Internet of Things IoT for its acronym in English (Internet of Things), which is understood as a scenario where computational connectivity is extended to objects, allowing them to interact with each other, exchanging and consuming information with a minuscule human intervention (Rose, Eldridge, & Chapin, 2015). The effects of the IoT possibly touch almost all types of work in any sector, including jobs that are within the creative economy.

Among its main objectives is the homogenization of physical and digital spaces, and the Internet of Things plays a fundamental role in this process. However, sometimes the “facilitation” of human tasks leads to their replacement and there are few functions that are exempt from this possibility. Today we already know of machines capable of writing poems and novels, composing and interpreting music, designing houses, writing news and scientific papers (Nobre G. F., Artificially Intelligent Creative Economy (AICE): The Impact of Automation and Public Policies Designing, 2019). From this arises the importance of governments and individuals considering both the risks of their jobs being automated, in order to make decisions based on that information. Currently it is possible to identify studies showing the role of automation in the growth of a country's productivity (Mazacheck, 2020). According to Mayoral (2006), its impact on the economy is conditioned by the quality of the productive factors and their evolutionary adjustments.

Hence, when talking about the labor factor, workers are practically forced to be part of the changes. At this point, educational and training differences between countries are becoming increasingly important in the labor market.

So, when questioning the direction that education should take in order prepare future workers, Carvajal (2017) proposes three considerations to be considered to have or maintain work in the fourth industrial revolution: i. Programming as the new communication language engineer-engineer and engineer-machine; ii. Entrepreneurship with a focus on technological innovation; and iii. A new type of analytical learning that facilitates the understanding of digital signals. Applying the above to any career or program can be difficult, but it serves as reference. In this sense, it is possible to find that the transversality between different areas, for example, those of art being to collaborate with those of technology or engineering in the generation of new creations (Gever, 2012). In this way, both governments and creatives could find in the literature examples and ways in which to make this type of link between art and technologies such as the IoT, to be better prepared for the fourth industrial revolution.

OVERVIEW OF THE EFFECTS OF COVID-19 ON THE CREATIVE ECONOMY AND AUTOMATION.

COVID-19 and the pandemic influenced working conditions in the world, which has given way to the acceleration of automation and digitization processes (Giordania & Rullani, 2020). According to Petropoulous (2018) the above had an impact in different ways, such as: i. On the supply side, the automation processes caused some industries to establish efficient virtual interactions through digital platforms, and; ii. On the demand side, many buyers moved to the supply side digitally.

The pandemic crisis also affected the creative economy. Some industries suffered more than others, for example, hygiene measures especially hurt those industries that depend on physical presence and personal interaction (Naylor, Todd, Moretto, & Traverso, 2021). According to Nobre (2020), among the affected industries are tourism, entertainment, and culture, which have been forced to go through a dematerialization process. For example, he explains that although works such as books, magazines, and music began their dematerialization process years ago, the pandemic accelerated this change due to the urgency of distributing and allowing users to consume these products in digital formats and platforms.

In a joint effort carried out by various organizations such as the Inter-American Development Bank, the United Nations Educational, Scientific and Cultural Organization, among others (2021), it was identified that in Ibero-America, more than half of the cultural industries have registered up to 80% losses after the start of the pandemic.

This represents a loss of more than 2.6 million jobs in Ibero-American countries.

However, according to the same source and following the data provided by different information sources of the Ministries and Organizations of Culture, taking March 2020 as the base date, when the sanitary restriction measures began, Table 2 shows the minimum number of creative establishments closed in the first 6 months of the pandemic in Mexico:


Table 2. Minimum number of closed establishments of the Cultural and Creative Industries by activity in Mexico.

Cinema complexes	Theatres	Museum	Libraries	Publishing agents	Bookstores	Cultural centers	Exhibition halls/galleries
825	713	1395	7464	1269	1643	2095	933

Source: Own elaboration based on data obtained in Assessment of the impact of COVID-19 on cultural and creative industries, UNESCO, 2021, available at: <https://unesdoc.unesco.org/ark:/48223/pf0000382281>

As can be seen above, the pandemic caused more than 2000 cultural centers not to operate and more than 700 empty theaters. It must also highlight the almost 7500 libraries that together with more than 1500 bookstores remained closed. Sectors such as the performing arts had to close all their stages, concert halls and spaces for live music (Triguboff et al., p. 56).

In a survey carried out by the International Council of Museums (2020), where nearly 1600 responses from museums and museum professionals are analyzed, it was found that more than 90% of the museums in the world had to close their doors between April 7th and May 7th of 2020. The same source identified that also during the period from April 7th to May 7th of 2020, 6% of museum workers lost their jobs around the world.



But the pandemic represents a critical juncture that also becomes the opportunity to generate profound changes. Although before making them, it is worth starting with studies and diagnoses that provide key knowledge in decision-making. For this reason, CAIINNO (2022) prepared a publication for the Inter-American Development Bank with some proposals on how the creative economy can be used as a tool for Mexico to emerge from the crisis caused by COVID-19.

AUTOMATION PROBABILITY IN THE CREATIVE ECONOMY: RESULTS AND COMPARISON.

The idea of robots replacing humans has been around for many years. Books to movies have exposed that reality in the very distant future. However, already in academic studies, such as one produced in 2013, it has been identified that between 22% and 29% of jobs in the United States will disappear in a decade or two (Frey & Osborne, p. 5). It is about to be the first decade of this projection, has it been fulfilled? During the last American presidential campaign, candidate Donald Trump expressed and justified several times that one of the reasons why the construction of a wall on the border with Mexico was justified was that the Mexicans who crossed illegally occupied the jobs that corresponded to them, to the Americans. However, according to authors such as Horsey (2017), Trump's premise is false since it is the robots and not the immigrants who are taking the jobs.

The following table picks up part of an MIT Technology Review article, which shows some of the job projections lost to automation (Winick, 2018):

Table 3. Projections of jobs lost to automation.

When?	Where?	Destroyed jobs	Generated Jobs	Predictor
2020	Worldwide	1,800,000	2,300,000	Garnet
2030	Worldwide	400,000,000 - 800,000,000	555,000,000 - 890,000,000	Mckinsey
2025	Jobs in the United States	24,186,240	13,604,760	Forrester

Source: Own elaboration based on Erin Winick, Every study we could find on what automation will do to jobs in one chart, available at: <https://www.technologyreview.com/2018/01/25/146020/every-study-we-could-find-on-what-automation-will-do-to-jobs-in-one-chart/>

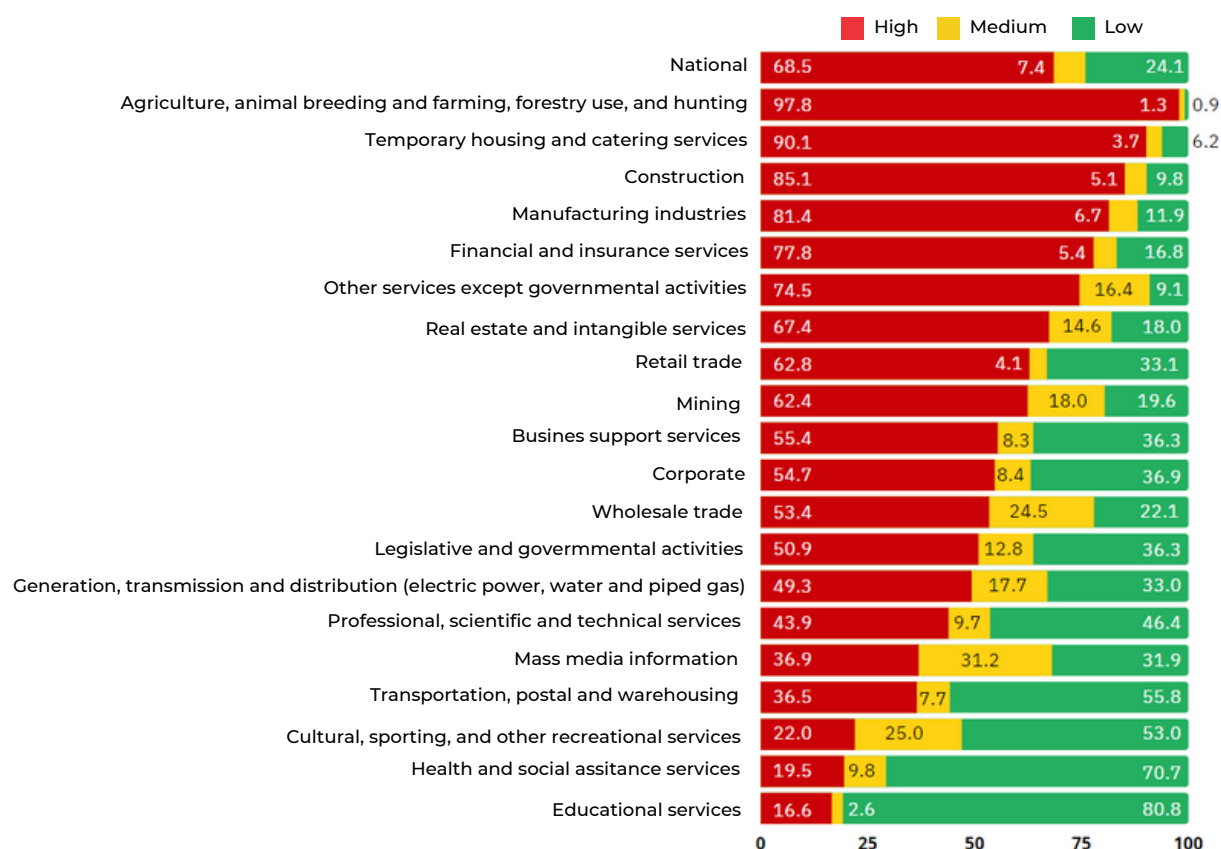
Considering automation should not be a minor issue for Mexico, according to the International Labor Organization (2018), 1.4 billion people in the world are in “jobs that are vulnerable,” meaning they are at high probability of disappearing for reasons such as automation. According to the same source, this global trend will continue to grow.

For some time, some of the most important international organizations in the world have expressed that automation will change the future of work, for which there are different positions, being more common than the positive one (Dobrusin, 2019). The negative is the loss of jobs, projected for a future came forward by COVID-19, as the coronavirus is forcing many companies to accelerate their automation process (Chandler, 2020). This is worldwide, so Mexico is not exempt from the impact in the short term.

JOB AUTOMATION IN MEXICO’S FUTURE.

A study by the Bank of Mexico(2018) was recently published containing the classification of the employed population in Mexico according to their probability of automation. The results were classified into three categories: i) high (greater than 66%); ii) medium (between 33% and 66%), and; iii) low (less than 33%). The results showed that two-thirds of the country’s employed population work in occupations classified with a high probability of automation for the period 2005 to 2017, exemplifying the challenge facing the country.

Figure 3. Employed population by the range of probability of automation and sector of activity.



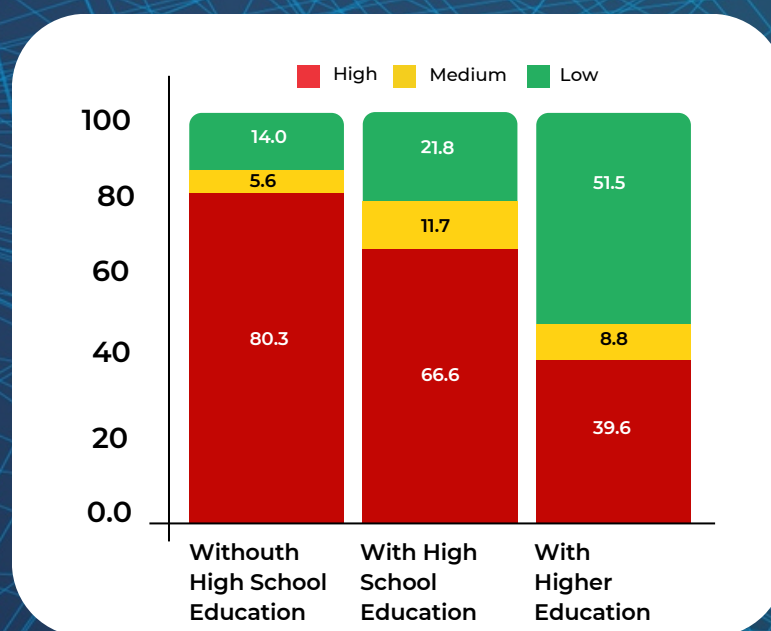
Source: Bank of Mexico, *La Automatización de México desde una Perspectiva Regional*, available at: <https://www.banxico.org.mx/publicaciones-y-prensa/reportes-sobre-las-economias-regionales/recuadros/%7BE3665296-DCDE-78FD-54CB-0420E1CD9A36%7D.pdf>

Note: The figures presented correspond to the average of all quarterly of the National Survey of Occupation and Employment, published between 2005 and 2017.

The problem is not a minor one, since a very high total percentage of the country's workers are in vulnerable employment situations. The challenge facing the country increases because a good part of the economic, development, and labor policies considered in the National Development Plan (Diario Oficial de la Federación, 2019), contemplate jobs with a probability of 50% or more. It is worth distinguishing that legislative and governmental activities have a 50.9% probability of automation.

The situation becomes more complex when it comes to locating those most at risk, regardless of their occupation. Bank of Mexico's findings show that the higher the education, the lower the probability of automation, and the lower the education, the higher the probability of automation. This means that 80.3% of workers without secondary education have a high probability of having their activity automated, as can be seen in the following graph:

Figure 4. Employed population by the range of probability of automation according to educational level.



Source: Bank of Mexico, La Automatización de México desde una Perspectiva Regional, available at: <https://www.banxico.org.mx/publicaciones-y-prensa/reportes-sobre-las-economias-regionales/recuadros/%7BE3665296-DCDE-78FD-54CB-0420E1CD9A36%7D.pdf>
Note: Figures presented correspond to the average of all quarterly of the National Survey of Occupation and Employment, published between 2005 and 2017.

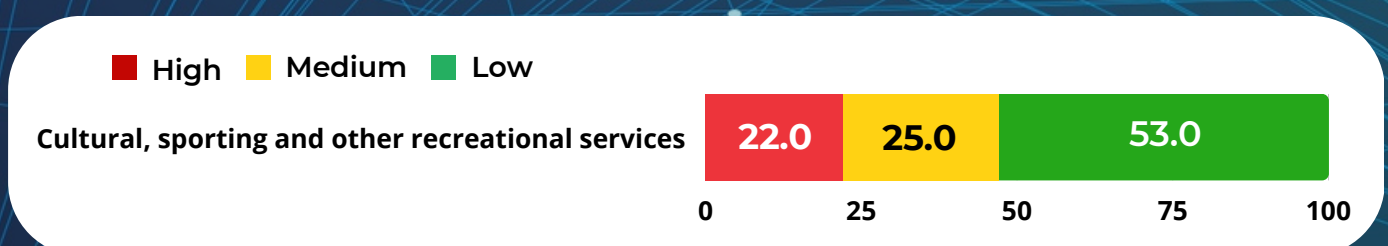
The previous graph shows a reality that the World Economic Forum (2016) had predicted for Mexico a few years ago, and which expressed the need to react urgently to this phenomenon. But the future is being brought forward but the pandemic. It is possible to find several articles in various Mexican media proposing companies accelerate their transition to automation, as the best alternative both to be more competitive and to accelerate the recovery of revenues lost due to COVID-19 (Forbes, 2020).

AUTOMATION AND MEXICO'S CREATIVE ECONOMY

Up to this point, two inferences can be made based on the cited bibliography: i) Automation is irreversible in Mexico, and; ii) It will accelerate because of COVID-19. So, what can be done about it? A viable option is to give greater attention to the cultural and creative industries, which are part of the creative economy, as well as to link this economy with the knowledge economy.

The first argument in favor of the above assertion is based on Figure 3 of the Bank of Mexico's research (2018, p. 3), which shows that "cultural, sporting and other recreational services" are the third least likely group of occupations to automate, with a 22 percent probability (see image 1). Although the study considers sports services, for this research it was possible to exclude them.

Image 1. Range of probability of automation of employed population.



Source: Bank of Mexico, La Automatización de México desde una Perspectiva Regional, available at: <https://www.banxico.org.mx/publicaciones-y-prensa/reportes-sobre-las-economias-regionales/recuadros/%7BE3665296-DCDE-78FD-54CB-0420E1CD9A36%7D.pdf>

To provide another argument and as the most important contribution of this research, the range of probability of automation of the employed population in jobs related to the cultural and creative industries at the subnational level was identified. This will allow the reader to confirm that supporting the creative economy is a viable decision in the face of the effects that COVID-19 will generate. It will also let the reader know how jobs in the creative economy have fared from 2017 to 2022.

METHODOLOGY

First, the study period was divided in two, as follows: I) the first one was integrated with data from the first quarter of 2017 to the fourth quarter of 2019, which is the last quarter without measures to close establishments by the government due to COVID-2019, and ii) The second one with data from the first quarter of 2020 to the second quarter of 2022, period in which mobility restrictions measures were implemented in Mexico.

The methodology used is explained below and the results are presented:

1. It started by identifying all the jobs contained in the National Survey of Occupation and Employment, also known as ENOE (by its acronym in Spanish), (INEGI, 2020) considering the two periods previously mentioned. From these jobs, a data concentrate of more than 4.4 million records was made, from which, through big data analysis processes, the database was reduced to more than 1.5 million records.

2. These employment records were related to the results of the Frey and Osborne's (2013) study methodology on the probability of automation of professions in the United States in the coming years (see Appendix 1), which was the study of reference for the previously mentioned report of the Bank of Mexico (2018). From these results, the percentages of automation of more than 900 jobs in the United States were used and 478 trades that were identified at the state level within the National Survey of Occupation and Employment questionnaires were standardized.

3. In the case of this research, thirty jobs directly related to the cultural and creative industries were identified (see Appendix 2), and it is from this list that the comparison of jobs in cultural and creative industries is made with those that are not. It is important to mention that the selection of jobs was made by the authors due to the lack of consensus or availability in the Mexican literature of a classification such as the one carried out here.

4. The information was concentrated to define 4 indicators relevant to the study:

- a. Percentage of state population engaged in employment within the cultural and creative industries (creative economy).
- b. Percentage of state's population engaged in employment in any industry other than cultural and creative industries.
- c. Percentage of state jobs with probability of automation of employed population within the cultural and creative industries (ratio of automation to existing creative jobs), and.

- d. Percentage of state jobs with probability of automation of employed population within any industry other than cultural and creative (ratio of automation to existing non-creative jobs).

The results of the indicators were used to calculate the following tables:

1. For the first two tables, the percentage of jobs with probability of automation of the population employed in the cultural and creative industries (creative economy) is presented, as well as that employed in other sectors, in order to determine the level of evolution by region of the:
 - a. Pre-pandemic period - First quarter of 2017 to last quarter of 2019 (table 4), and
 - b. Period considering the presence of the pandemic - First quarter of 2020 to second quarter of 2022 (table 5).
2. The third table shows the evolution of jobs within the creative and cultural industries from the first quarter of 2017 to the second quarter of 2022 (table 6).
3. Then, for table 7, the range of probability of automation of the population employed in any other industry other than cultural and creative industries by federal entity is calculated, comprising data from the first quarter of 2017 to the second quarter of 2022 (table 7).
4. In the last table, the range of probability of automation of the employed population in the cultural and creative industries by federal entity is determined, comprising data from the first quarter of 2017 to the second quarter of 2022, the period before the pandemic (table 8).

RESULTS AND COMPARISON

As a starting point, the following table can identify the percentage of jobs with probability of automation until before the pandemic, comparing those in the creative and cultural industries with respect to other industries, covering the first quarter of 2017 to the fourth quarter of 2019. To calculate the percentage, the average by region was obtained from the analysis of the degree of automation, considering the study period.

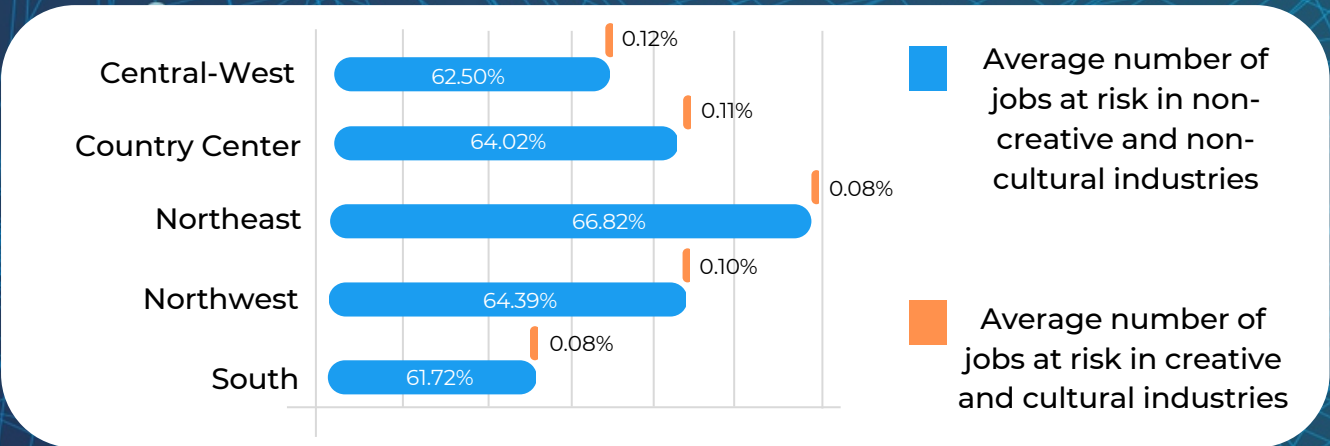
Table 4. Comparison of probability of automation of the employed population before COVID-19 (2017-2019).

Mesoregions	Average probability of automation for jobs in non-creative and non-cultural industries	Average probability of automation for jobs in creative and cultural industries
Central Westh (Aguascalientes, Colima Guanajuato, Jalisco, Michoacan, Nayarit, San Luis Potosi and Zacatecas)	62.50%	0.12%
Country Center (Mexico City, Hidalgo, State of Mexico, Morelos, Puebla, Querétaro and Tlaxcala)	64.02%	0.11%
Noretheast (Coahuila, Durango, Nuevo Leon and Tamaulipas)	66.82%	0.08%
Northwest (Baja California, Baja California Sur, Chihuahua, Sinaloa, and Sonora)	64.39%	0.10%
South (Campeche, Chiapas, Guerrero, Oaxaca, Quintana Roo, Tabasco, Veracruz and Yucatan)	61.72%	0.08%
Total	63.47%	0.10%

Source: Own elaboration based on microdata from the National Survey of Occupation and Employment (ENOE), population 15 years of age and older (first quarter of 2017 to the fourth quarter of 2019).

Using the same data as in Table 4, the following graph is made to show another way to represent the percentage of the probability of automation for jobs that were at risk of being automated prior to the pandemic, comparing creative economy jobs to other industries.

Figure 5. Probability of automation of the employed population before COVID (2017-2019).



Source: Own elaboration based on microdata from the National Survey of Occupation and Employment (ENOE), population 15 years of age and older (first quarter of 2017 to the fourth quarter of 2019).

Table 4 and graphic 5 are useful to identify the following: i) the probability of automation of the employed population in jobs in other non-creative and non-cultural industries is high. This shows that the probability of millions of people losing their jobs due to automation in Mexico is high. As will be seen later, although the magnitude varies from state to state, this situation is persistent throughout the country.

Now, in the following table can be identified the percentage of jobs that are at risk of being automated, comparing those in the creative and cultural industries with respect to non-creative and non-cultural industries during the presence of COVID-19, as it covers the first quarter of 2020 to the second quarter of 2022. To calculate the percentage, the average by region was obtained from the analysis of the degree of automation, considering the study period.

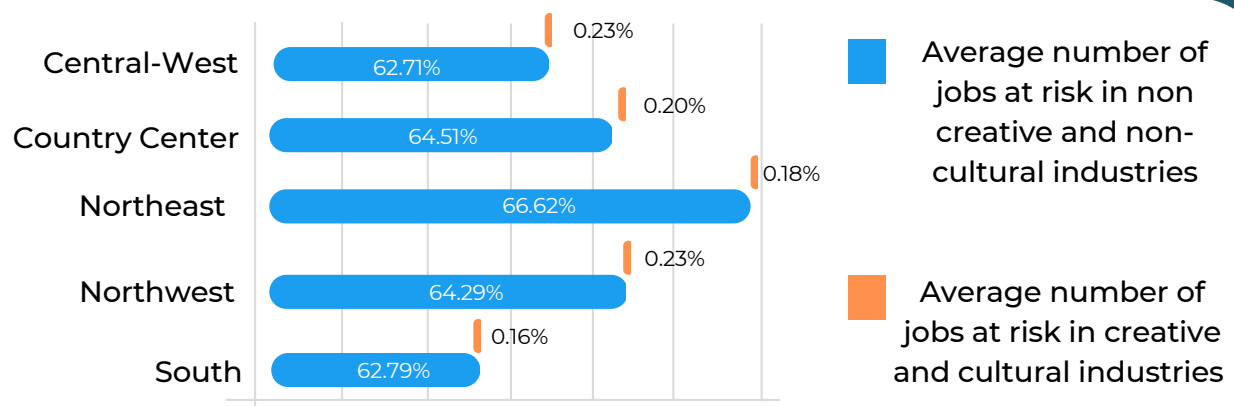
Table 5. Comparison of probability of automation of the employed population during COVID-19 (2020-2022).

Mesoregions	Average probability of automation for jobs in non-creative and non-cultural industries	Average probability of automation for jobs in creative and cultural industries
Central-West (Aguascalientes, Colima, Guanajuato, Jalisco, Michoacan, Nayarit, San Luis Potosi and Zacatecas)	62.71%	0.23%
Country Center (Mexico city, Hidalgo, Sate of Mexico, Morelos, Puebla, Querétaro and Tlaxcala)	64.51%	0.20%
Northeast (Coahuila, Durango, Nuevo Leon and Tamaulipas)	66.62%	0.18%
Northwest (Baja California, Baja California Sur, Chihuahua, Sinaloa and Sonora)	64.29%	0.23%
South (Campeche, Chiapas, Guerrero, Oaxaca, Quintana Roo, Tabasco, Veracruz and Yucatan)	62.79%	0.16%
Total	63.86%	0.20%

Source: Own elaboration based on microdata from the National Occupation and Employment Survey (ENOE), population 15 years of age and older (first quarter of 2020 to the second quarter of 2022).

Similary, the information in Table 5 is shown graphically in the following representation (Figure 6). Despite showing an increase of almost double in the percentage values of the probability of automation with respect to the first period (before pandemic), the probability of automation for jobs in the creative and cultural industries remained well below that of the rest of the industries.

Figure 6. Probability of automation of the employed population during COVID (2020-2022).



Source: Own elaboration based on microdata from the National Occupation and Employment Survey (ENOE), population 15 years of age and older (first quarter of 2020 to the second quarter of 2022).


Now, the following table shows the evolution of jobs within the creative and cultural industries covering the two study periods (2017 to 2022), where the first state is the one that shows the highest growth propensity. The case of Guanajuato is noteworthy as it has the highest percentages but the lowest average variation. It is also observed that, since 2017, only six states showed total decrease in the variation in creative jobs.

Similarly, by observing Table 6, it can be inferred that the country is divided into three groups with respect to the evolution of jobs in the creative and cultural industries: i) States in which jobs have increased, such as Mexico City; ii) States in which jobs have been maintained, such as Veracruz, and iii) States in which jobs in the sector have decreased, such as Puebla and Guanajuato.

Table 6. Evolution of jobs within the creative and cultural industries.

State	2017	2018	2019	2020	2021	2022	Variation 17-18	Variation 18-19	Variation 19-20	Variation 20-21	Variation 21-22	Average Variation
Mexico City	1.84%	1.81%	2.12%	2.19%	2.39%	2.44%	-0.03%	0.31%	0.07%	0.20%	0.05%	0.12%
Sinaloa	1.37%	1.32%	1.27%	1.38%	1.80%	1.97%	-0.05%	-0.06%	0.11%	0.42%	0.17%	0.12%
Coahuila	0.73%	0.79%	0.71%	0.72%	1.13%	1.27%	0.06%	-0.09%	0.01%	0.41%	0.14%	0.11%
Nayarit	1.31%	1.10%	1.19%	1.22%	1.56%	1.79%	-0.20%	0.08%	0.04%	0.34%	0.23%	0.10%
Tamaulipas	0.59%	0.83%	0.75%	0.72%	0.77%	1.06%	0.24%	-0.08%	-0.03%	0.05%	0.29%	0.09%
Campeche	0.60%	0.68%	0.69%	0.68%	1.03%	1.06%	0.08%	0.01%	-0.01%	0.34%	0.03%	0.09%
Baja California Sur	1.17%	1.29%	1.25%	1.11%	1.36%	1.62%	0.12%	0.01%	-0.13%	0.24%	0.27%	0.09%
Colima	1.04%	1.21%	1.10%	0.90%	1.30%	1.44%	0.17%	-0.04%	-0.21%	0.40%	0.14%	0.08%
Sonora	1.03%	0.93%	0.91%	1.09%	1.33%	1.42%	-0.11%	-0.10%	0.18%	0.24%	0.09%	0.08%
Durango	0.98%	0.91%	0.96%	0.87%	1.01%	1.36%	-0.07%	-0.01%	-0.09%	0.13%	0.35%	0.08%
State of Mexico	1.14%	1.10%	1.14%	1.16%	1.30%	1.52%	-0.04%	0.05%	0.02%	0.14%	0.23%	0.08%
Chihuahua	0.88%	0.96%	0.87%	0.81%	1.13%	1.25%	0.08%	0.04%	-0.05%	0.32%	0.12%	0.07%
Baja California	0.92%	0.93%	1.13%	1.15%	1.46%	1.26%	0.01%	0.21%	0.01%	0.31%	-0.20%	0.07%
Guerrero	0.81%	1.12%	1.13%	0.96%	1.39%	1.11%	0.31%	0.01%	-0.17%	0.43%	-0.28%	0.06%
Nuevo Leon	1.02%	0.94%	0.90%	0.78%	1.15%	1.32%	-0.08%	-0.04%	-0.12%	0.37%	0.18%	0.06%
Oaxaca	1.10%	1.23%	1.33%	1.45%	1.34%	1.40%	0.13%	0.09%	0.12%	-0.11%	0.06%	0.06%
Michoacan	1.61%	1.36%	1.45%	1.05%	1.17%	1.88%	-0.25%	0.09%	-0.40%	0.12%	0.71%	0.05%
San Luis Potosi	0.91%	1.01%	1.08%	1.09%	1.22%	1.15%	0.10%	0.07%	0.01%	0.14%	-0.07%	0.05%
Quintana Roo	1.70%	1.51%	1.57%	1.38%	1.79%	1.93%	-0.19%	0.06%	-0.19%	0.41%	0.14%	0.05%
Aguascalientes	1.03%	1.08%	0.96%	0.92%	1.13%	1.20%	0.05%	-0.11%	-0.04%	0.21%	0.08%	0.04%
Zacatecas	1.21%	1.20%	1.03%	0.97%	1.47%	1.38%	-0.01%	-0.17%	-0.06%	0.50%	-0.09%	0.03%
Queretaro	1.13%	1.20%	1.22%	1.36%	1.44%	1.23%	0.07%	0.02%	0.13%	0.08%	-0.21%	0.02%
Chiapas	0.94%	1.05%	0.96%	0.86%	1.14%	1.03%	0.11%	-0.09%	-0.10%	0.28%	-0.12%	0.02%
Hidalgo	1.41%	1.23%	1.26%	1.25%	1.34%	1.49%	-0.18%	0.03%	-0.01%	0.09%	0.14%	0.02%
Morelos	1.33%	1.26%	1.18%	1.28%	1.43%	1.40%	-0.07%	-0.08%	0.09%	0.16%	-0.03%	0.01%
Veracruz	1.16%	1.09%	0.92%	0.98%	1.04%	1.23%	-0.07%	-0.17%	0.05%	0.06%	0.19%	0.01%
Yucatan	1.31%	1.15%	1.29%	1.33%	1.25%	1.28%	-0.16%	0.13%	0.04%	-0.08%	0.04%	-0.01%
Tabasco	1.07%	0.84%	0.80%	0.92%	0.90%	1.03%	-0.23%	-0.04%	0.12%	-0.02%	0.13%	-0.01%
Tlaxcala	1.13%	1.09%	1.27%	1.19%	1.12%	1.04%	-0.04%	0.18%	-0.07%	-0.07%	-0.09%	-0.02%
Jalisco	2.09%	1.98%	1.90%	1.69%	1.74%	1.96%	-0.11%	-0.08%	-0.20%	0.04%	0.22%	-0.03%
Puebla	1.49%	1.29%	1.15%	1.00%	1.11%	1.30%	-0.19%	-0.14%	-0.15%	0.11%	0.19%	-0.04%
Guanajuato	4.53%	4.33%	4.11%	3.95%	3.74%	3.69%	-0.20%	-0.22%	-0.16%	-0.21%	-0.06%	-0.17%

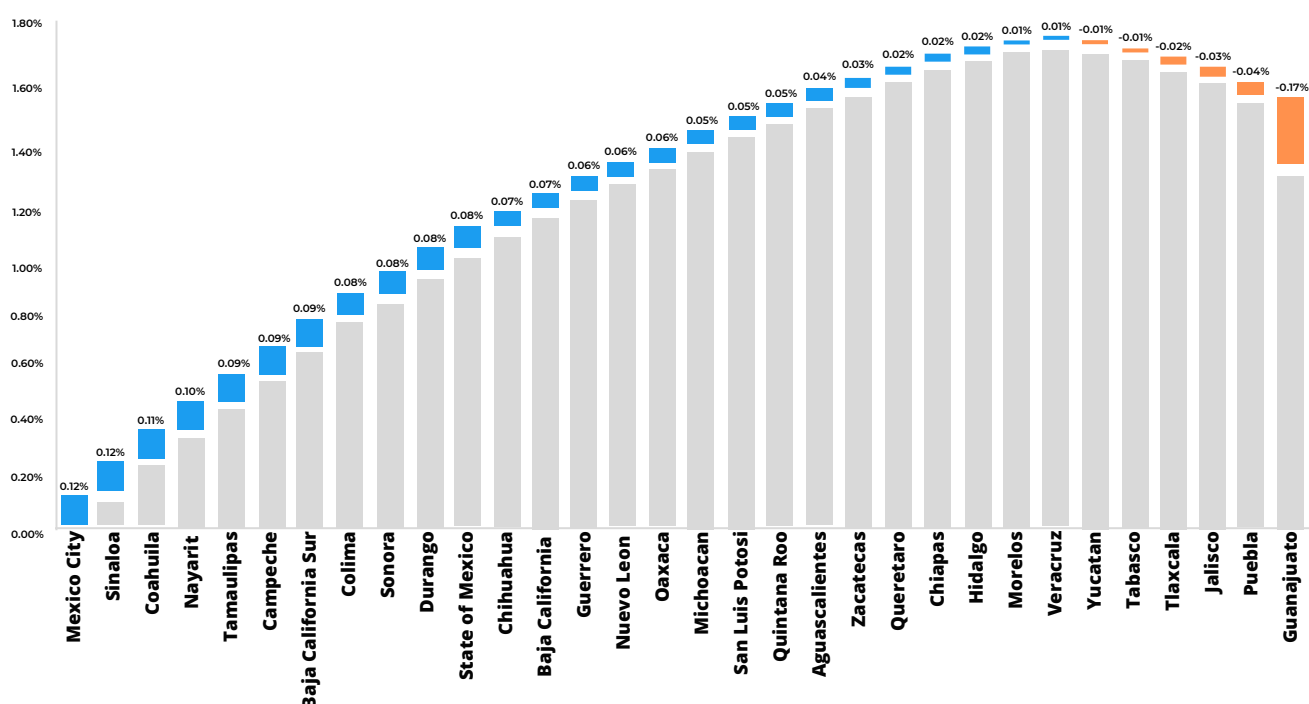
Source: Own elaboration based on microdata from the National Occupation and Employment Survey (ENOE), population 15 years of age and older (first quarter of 2017 to the second quarter of 2022).



Among the last category, there are states that, despite the reduction in the sector, have a high percentage of jobs in the creative economy, such as Guanajuato, Jalisco, Michoacan, Puebla, and Quintana Roo, even above some states that have maintained or increased their levels, such as Campeche or Tamaulipas. It is important to note that as of 2020 the effect of COVID-19 can be identified in several States, however, this does not reduce the significance of the contribution of the industries at issue.

Taking the information from Table 6, in figure 7 the data “average variation” (understood as the average of the variations of the years 2017, 2018, 2019, 2020 and 2021) was taken as the order parameter and the data is presented in a descending order. That is, the highest average variation was placed on the left side with gradual decreases going to the right. The only six states with negative average variations were Yucatan, Tabasco, Tlaxcala, Jalisco, Puebla and Guanajuato, that is, that jobs in cultural and creative industries decreased in the two study periods.

Figure 7. Average variation of the evolution of jobs within the creative and cultural industries from 2017 to the first quarter of 2022.



Source: Own elaboration based on microdata from the National Occupation and Employment Survey (ENOE), population 15 years of age and older (first quarter of 2017 to the second quarter of 2022).

EMPLOYED POPULATION IN NON-CREATIVE AND NON-CULTURAL INDUSTRIES' PROBABILITY OF AUTOMATION

The next table presents the results of the analysis of the probability of automation of the employed population in industries that are neither creative nor cultural, keeping in mind the existing job lost related to the federal entity. The percentages in the columns for the year 2017 to the second quarter of 2022 show the probability of automation. All results that are positive in "average variation" show that the trend is towards automation.

Observing Table 7, it can be inferred that the country is divided into three groups with respect to the probability of automation of the employed population within industries that are neither creative nor cultural: i) States where the probability of automation has increased, such as Guerrero or Veracruz; ii) States where the probability of automation has remained almost constant, such as Durango, and; iii) States where the probability of automation has decreased, such as Nuevo León.

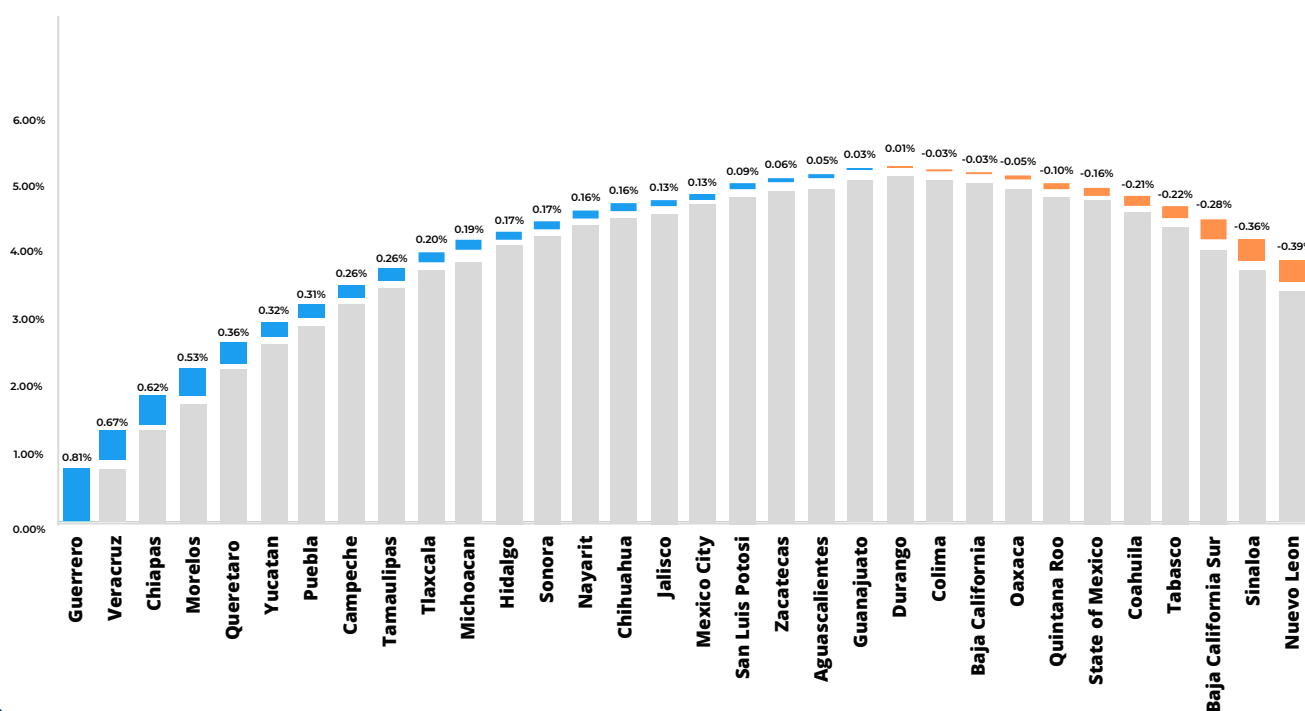
Table 7. Average probability of automation of the population employed in industries other than creative and cultural industries.

State	2017	2018	2019	2020	2021	2022	Variation 17-18	Variation 18-19	Variation 19-20	Variation 20-21	Variation 21-22	Average Variation
Guerrero	57.12%	58.97%	61.48%	62.81%	59.92%	61.17%	1.85%	2.52%	1.33%	-2.89%	1.25%	0.81%
Veracruz	59.71%	59.73%	62.64%	65.12%	63.75%	63.08%	0.02%	2.92%	2.47%	-1.37%	-0.67%	0.67%
Chiapas	56.94%	56.61%	57.02%	59.45%	59.06%	60.07%	-0.34%	0.42%	2.42%	-0.39%	1.00%	0.62%
Morelos	64.15%	64.02%	65.00%	64.57%	66.13%	66.77%	-0.13%	0.98%	-0.44%	1.56%	0.64%	0.53%
Queretaro	64.13%	63.71%	63.72%	64.36%	65.14%	65.92%	-0.42%	0.01%	0.64%	0.79%	0.78%	0.36%
Yucatan	64.57%	65.75%	64.82%	65.31%	64.90%	66.17%	1.18%	-0.94%	0.49%	-0.41%	1.27%	0.32%
Puebla	60.74%	61.65%	61.05%	61.26%	61.55%	62.28%	0.90%	-0.60%	0.21%	0.30%	0.73%	0.31%
Campeche	62.52%	61.80%	62.51%	64.57%	64.11%	63.83%	-0.72%	0.71%	2.06%	-0.46%	-0.28%	0.26%
Tamaulipas	66.67%	66.32%	68.04%	67.86%	68.05%	67.95%	-0.35%	1.72%	-0.17%	0.18%	-0.10%	0.26%
Tlaxcala	65.00%	65.67%	65.22%	65.47%	65.65%	65.99%	0.67%	-0.45%	0.24%	0.18%	0.34%	0.20%
Michoacan	59.95%	59.35%	61.03%	60.96%	59.46%	60.92%	-0.60%	1.68%	-0.07%	-1.50%	1.46%	0.19%
Hidalgo	61.51%	62.60%	62.76%	63.28%	62.42%	62.37%	1.09%	0.17%	0.52%	-0.86%	-0.04%	0.17%
Sonora	63.92%	63.72%	62.86%	63.23%	64.75%	64.75%	-0.20%	-0.86%	0.37%	1.52%	0.00%	0.17%
Nayarit	61.49%	61.22%	60.72%	59.96%	62.35%	62.28%	-0.27%	-0.51%	-0.75%	2.39%	-0.07%	0.16%
Chihuahua	64.38%	63.37%	65.84%	65.61%	64.93%	65.16%	-1.00%	2.47%	-0.24%	-0.67%	0.23%	0.16%
Jalisco	64.81%	64.73%	65.35%	65.45%	64.75%	65.47%	-0.07%	0.61%	0.10%	-0.69%	0.72%	0.13%
México City	64.08%	64.61%	64.82%	63.98%	64.34%	64.73%	0.54%	0.21%	-0.84%	0.36%	0.39%	0.13%
San Luis Potosi	62.30%	62.11%	63.71%	63.17%	61.89%	62.74%	-0.19%	1.59%	-0.54%	-1.27%	0.84%	0.09%
Zacatecas	59.30%	59.60%	59.63%	60.53%	59.08%	59.60%	0.30%	0.03%	0.90%	-1.45%	0.52%	0.06%
Aguascalientes	66.18%	66.60%	67.11%	66.83%	66.88%	66.44%	0.42%	0.51%	-0.28%	0.04%	-0.44%	0.05%
Guanajuato	63.43%	63.79%	63.82%	64.51%	64.32%	63.59%	0.36%	0.03%	0.69%	-0.19%	-0.73%	0.03%
Durango	65.12%	66.21%	66.41%	66.38%	65.30%	65.17%	1.08%	0.21%	-0.03%	-1.08%	-0.13%	0.01%
Colima	61.15%	61.36%	61.12%	62.12%	60.76%	61.02%	0.21%	-0.25%	1.00%	-1.36%	0.26%	-0.03%
Baja California	66.15%	66.27%	65.88%	65.58%	65.72%	65.99%	0.12%	-0.39%	-0.30%	0.15%	0.27%	-0.03%
Oaxaca	59.09%	59.23%	59.72%	60.43%	58.44%	58.83%	0.13%	0.49%	0.70%	-1.98%	0.39%	-0.05%
Quintana Roo	66.38%	66.42%	66.28%	65.43%	64.70%	65.90%	0.03%	-0.14%	-0.84%	-0.74%	1.20%	-0.10%
State of Mexico	66.73%	66.27%	67.06%	66.97%	65.68%	65.90%	-0.45%	0.79%	-0.10%	-1.28%	0.22%	-0.16%
Coahuila	67.51%	67.27%	66.46%	67.25%	66.72%	66.48%	-0.24%	-0.81%	0.79%	-0.53%	-0.24%	-0.21%
Tabasco	64.36%	64.10%	63.47%	62.95%	63.84%	63.25%	-0.26%	-0.62%	-0.52%	0.89%	-0.59%	-0.22%
Baja California Sur	64.74%	64.35%	64.65%	64.96%	63.67%	63.36%	-0.39%	0.31%	0.31%	-1.29%	-0.31%	-0.28%
Sinaloa	62.69%	63.30%	63.69%	63.57%	62.16%	60.90%	0.62%	0.39%	-0.12%	-1.41%	-1.26%	-0.36%
Nuevo Leon	67.18%	67.50%	67.17%	66.80%	66.33%	65.21%	0.32%	-0.33%	-0.38%	-0.47%	-1.12%	-0.39%

Source: Own elaboration based on microdata from the National Occupation and Employment Survey (ENOE), population 15 years of age and older (first quarter of 2017 to the second quarter of 2022)

The information in Table 7 is shown graphically below. It shows the probability of automation of the employed population in the states excluding the creative and cultural industries. What can be seen is that there are ten states with decreases in their average variation: Colima, Baja California, Oaxaca, Quintana Roo, State of Mexico, Coahuila, Tabasco, Baja California Sur, Sinaloa, and Nuevo Leon. This means that their tendency is the opposite of automating.

Figure 8. Average variation of the probability of automation of the population employed in industries other than creative and cultural industries.



Source: Own elaboration based on microdata from the National Occupation and Employment Survey (ENOE), population 15 years of age and older (first quarter of 2017 to the second quarter of 2022).

The results confirm that several people working in non-creative and non-cultural industries have a high probability of their jobs being automated. Almost all states have a slightly worrisome trend toward automation, which should alert local and federal governments to the urgency of doing something about it. As previously mentioned, this situation could accelerate as a result of COVID-19.

The next table shows the results of the probability of automation of the employed population in the creative and cultural industries considering the jobs lost related to the federative entity. The percentages in the columns for the year 2017 to the second quarter of 2022 show the degree of risk due to automation. All results that are positive in "average variation" show that the trend is towards automation.

It can be observed that in all states the probability of automation of the employed population in the creative and cultural industries has increased. However, looking at Table 8 and unlike Tables 6 and 7, it can be inferred that the country is now divided into two categories: i) States in which the probability of automation of the employed population has increased, such as Chihuahua and; ii) States in which the probability of automation of the employed population has remained practically constant, with extremely low increases, such as Campeche or Chiapas.

In the same way, the impact that COVID-19 had towards higher values of the automation probability of the employed population can be observed. It is inferred that the high values in the variation 20-21 are due to the impact that the pandemic had on the automation acceleration processes. In Sinaloa, the percentage variation of the probability of automation of the employed population for the industries of the sector had not exceeded 0.01%, until the variation in the years 20-21 took values of 0.32%.

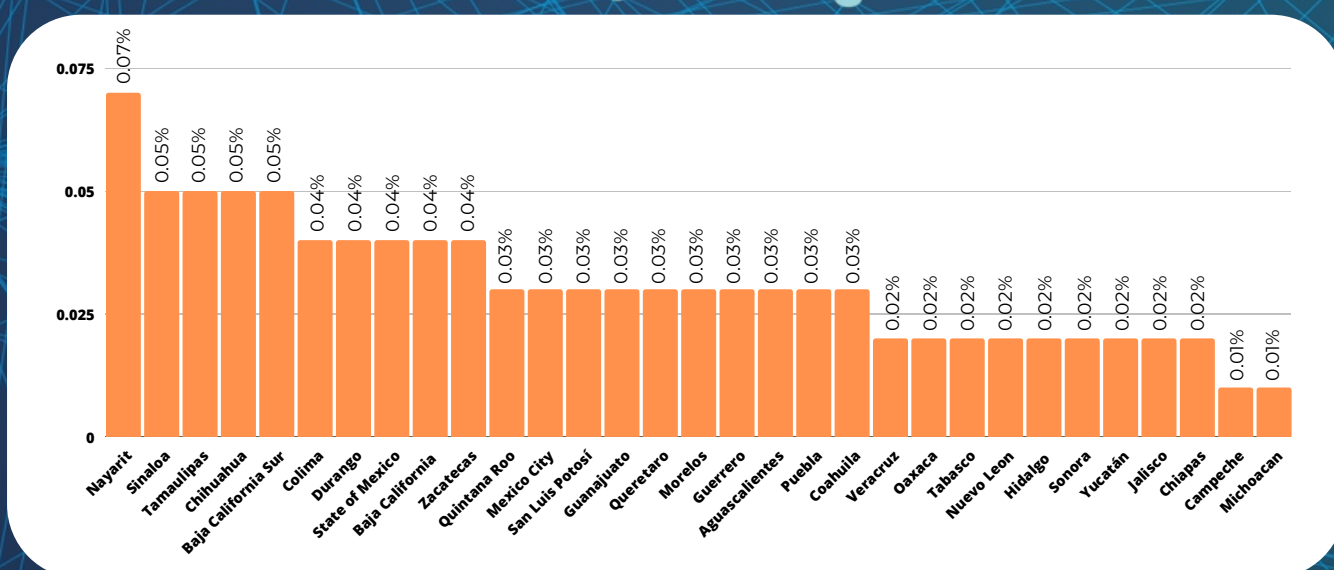
Table 8. Average probability of automation of the population employed in the creative and cultural industries.

State	2017	2018	2019	2020	2021	2022	Variation 17-18	Variation 18-19	Variation 19-20	Variation 20-21	Variation 21-22	Average Variation
Nayarit	0.10%	0.08%	0.11%	0.12%	0.45%	0.45%	-0.02%	0.03%	0.01%	0.33%	0.00%	0.07%
Sinaloa	0.12%	0.13%	0.08%	0.09%	0.40%	0.38%	0.01%	-0.04%	0.00%	0.32%	-0.02%	0.05%
Tamaulipas	0.04%	0.09%	0.09%	0.09%	0.23%	0.29%	0.05%	0.00%	0.00%	0.14%	0.06%	0.05%
Chihuahua	0.08%	0.12%	0.10%	0.12%	0.25%	0.32%	0.03%	-0.01%	0.01%	0.14%	0.06%	0.05%
Baja California Sur	0.10%	0.10%	0.11%	0.08%	0.25%	0.33%	0.00%	0.01%	-0.02%	0.17%	0.07%	0.05%
Colima	0.09%	0.08%	0.11%	0.10%	0.33%	0.31%	-0.01%	0.03%	-0.01%	0.23%	-0.02%	0.04%
Durango	0.08%	0.07%	0.07%	0.07%	0.25%	0.30%	-0.01%	0.00%	0.00%	0.18%	0.05%	0.04%
State of Mexico	0.09%	0.08%	0.12%	0.10%	0.29%	0.30%	-0.01%	0.04%	-0.01%	0.19%	0.01%	0.04%
Baja California	0.08%	0.10%	0.12%	0.12%	0.25%	0.29%	0.02%	0.02%	0.00%	0.14%	0.03%	0.04%
Zacatecas	0.09%	0.08%	0.07%	0.07%	0.24%	0.30%	-0.02%	-0.01%	0.00%	0.18%	0.06%	0.04%
Quintana Roo	0.12%	0.09%	0.12%	0.09%	0.24%	0.29%	-0.02%	0.03%	-0.02%	0.15%	0.05%	0.03%
Mexico City	0.13%	0.15%	0.19%	0.25%	0.34%	0.29%	0.02%	0.05%	0.05%	0.09%	-0.04%	0.03%
San Luis Potosi	0.06%	0.06%	0.08%	0.09%	0.20%	0.22%	0.00%	0.02%	0.01%	0.11%	0.02%	0.03%
Guanajuato	0.24%	0.22%	0.23%	0.23%	0.37%	0.39%	-0.02%	0.01%	0.00%	0.14%	0.02%	0.03%
Querétaro	0.08%	0.13%	0.12%	0.14%	0.26%	0.23%	0.04%	0.00%	0.02%	0.12%	-0.04%	0.03%
Morelos	0.11%	0.10%	0.07%	0.09%	0.21%	0.26%	-0.01%	-0.03%	0.02%	0.12%	0.05%	0.03%
Guerrero	0.05%	0.05%	0.07%	0.07%	0.23%	0.20%	0.00%	0.02%	0.00%	0.16%	-0.03%	0.03%
Aguascalientes	0.11%	0.08%	0.08%	0.10%	0.18%	0.24%	-0.02%	0.00%	0.02%	0.08%	0.06%	0.03%
Puebla	0.09%	0.10%	0.09%	0.06%	0.20%	0.23%	0.01%	-0.01%	-0.03%	0.13%	0.03%	0.03%
Coahuila	0.06%	0.08%	0.07%	0.06%	0.20%	0.19%	0.03%	-0.01%	-0.01%	0.14%	-0.01%	0.03%
Veracruz	0.08%	0.08%	0.12%	0.08%	0.20%	0.20%	0.00%	0.04%	-0.03%	0.12%	0.00%	0.02%
Oaxaca	0.08%	0.09%	0.07%	0.08%	0.26%	0.20%	0.01%	-0.02%	0.01%	0.18%	-0.06%	0.02%
Tabasco	0.07%	0.06%	0.07%	0.12%	0.16%	0.18%	0.00%	0.01%	0.02%	0.04%	0.02%	0.02%
Nuevo Leon	0.16%	0.09%	0.08%	0.07%	0.21%	0.26%	-0.07%	-0.01%	-0.01%	0.14%	0.06%	0.02%
Hidalgo	0.13%	0.12%	0.09%	0.12%	0.21%	0.23%	-0.01%	-0.02%	0.03%	0.08%	0.03%	0.02%
Sonora	0.10%	0.09%	0.08%	0.08%	0.25%	0.21%	-0.01%	-0.01%	0.00%	0.16%	-0.04%	0.02%
Yucatan	0.12%	0.11%	0.11%	0.18%	0.15%	0.22%	-0.01%	0.00%	0.07%	-0.03%	0.07%	0.02%
Tlaxcala	0.08%	0.07%	0.09%	0.11%	0.19%	0.16%	-0.01%	0.01%	0.02%	0.09%	-0.03%	0.02%
Jalisco	0.16%	0.14%	0.13%	0.14%	0.27%	0.24%	-0.03%	-0.01%	0.01%	0.13%	-0.02%	0.02%
Chiapas	0.07%	0.08%	0.09%	0.05%	0.19%	0.12%	0.01%	0.01%	-0.04%	0.14%	-0.07%	0.01%
Campeche	0.06%	0.06%	0.05%	0.03%	0.14%	0.11%	0.00%	-0.02%	-0.01%	0.11%	-0.03%	0.01%
Michoacan	0.20%	0.14%	0.15%	0.09%	0.23%	0.24%	-0.06%	0.02%	-0.07%	0.15%	0.01%	0.01%

Source: Own elaboration based on microdata from the National Survey of Occupation and Employment (ENOE), population 15 years of age and older (first quarter of 2017 through the second quarter of 2022)

Figure 9 shows the average variation indicating that the probability of automation of all jobs in the cultural and creative industries has a positive propensity, that is, if there is a certain degree of probability that jobs in the creative and cultural industries sector will be automated. However, even though all values are positive, it is observed that the propensity in general is very low, with 0.07% being the highest value for the state of Nayarit.

Figure 9. Average variation of the probability of automation of the population employed in the creative and cultural industries.



Source: Own elaboration based on microdata from the National Survey of Occupation and Employment (ENOE), population 15 years of age and older (first quarter of 2017 through the second quarter of 2022).

Figure 9 results show that, compared to non-creative and non-cultural industries, these industries have a much lower tendency to automate their employed population. While this situation has changed due to COVID-19, the evidence shows that this automation process has impacted the creative economy less than others.

In conclusion, automation is not a transitory phenomenon, as other historical processes to make productivity more efficient were not. The transition began years ago, especially with the increase in productive activities in which automation goes hand in hand with artificial intelligence. The previous data evidence highlights a phenomenon that requires urgent attention from all branches and levels of government in Mexico

ON MEXICO'S GENERAL LAW ON CULTURE ACT AND CULTURAL RIGHTS; LOCAL CULTURAL LEGISLATIONS AND THOSE THAT SUPPORT THE CULTURAL AND CREATIVE INDUSTRIES IN MEXICO.

This is the federal legislation of recent creation (2017), it does not contemplate in its text neither the creative industries nor the cultural industries. Although the norm contemplates the necessary elements to support culture in various ways, it leaves aside the industrial perspective on which so many Mexicans depend. An initiative was introduced in 2018 (Gaceta del Senado, 2018), however, it was rejected.

Other countries have already taken important steps to promote these industries. Colombia, for example, designed a specific law for the creative economy that saw the light of day the same year as the Mexican norm (Congreso de Colombia, 2017). This law, called Law to Promote the Creative Economy (Ley Naranja), is part of a state policy. It establishes guidelines for the legislation to serve as a tool for the country to continue benefiting from the benefits that the creative and cultural industries have brought it. Like any regulation, it is not perfect and there have been criticisms and mistakes that serve as a reference to avoid making them here.

The example of Colombian legislation is just one of several in Latin America supporting the creative economy, or specifically the cultural and creative industries. Other regions of the world also give a lot of importance to the issue, such as the European Union, China, the United Kingdom, even countries like Ireland recently launched a series of measures that go hand in hand with a legislative framework that includes several linked legislations (Government of Ireland, 2020).

However, support for the creative and cultural industries must also come from local legislation, which is why for this research a review was made of local and cultural legislations, as well as legislations aimed at supporting these industries in general or in particular, in order to identify in how many and which states these industries are supported. It was done as follows:

Methodology.

1. All State legislations that could be related to the creative and cultural industries were searched.
2. Of those found, it was identified which ones had “creative industries” and/or “cultural industries” in their text.

The following table contains the culture legislations identified at the State level. In the columns “cultural industries” and “creative industries” only two values were added: i) YES, when the term appears in the text, and ii) NO, when the term does not appear in the text. As a first finding, twenty-one States have cultural legislation, and only the State of Hidalgo considers in its text the creative and cultural industries and the creative economy.

Table 9. Cultural legislations identified at the state level.

State	Legislation	Creation Date	Cultural Industries	Creative Industries
Aguascalientes	CULTURE ACT OF THE STATE OF AGUASCALIENTES	25/10/2010	YES	NO
Campeche	LAW OF CULTURAL DEVELOPMENT OF THE STATE OF CAMPECHE	13/09/2013	YES	YES
Mexico City	LAW OF THE CULTURAL RIGHTS OF THE INHABITANTS AND VISITORS OF MEXICO CITY	22/02/2018	NO	YES
Coahuila	LAW OF CULTURAL DEVELOPMENT FOR THE STATE OF COAHUILA	29/04/2005	NO	NO
Guanajuato	LAW OF CULTURAL RIGHTS OF THE STATE OF GUANAJUATO	20/04/2018	YES	YES
Guerrero	LAW NUMBER 239 FOR THE PROMOTION AND DEVELOPMENT OF CULTURE AND THE ARTS OF THE STATE OF GUERRERO	08/11/2013	YES	YES
Hidalgo	CULTURE ACT OF THE STATE OF HIDALGO	31/06/2018	YES	YES
Jalisco	LAW FOR THE PROMOTION OF CULTURE OF THE STATE OF JALISCO	21/12/2000	YES	NO
Michoacan	LAW OF CULTURAL DEVELOPMENT FOR THE STATE OF MICHOACAN DE OCAMPO	26/09/2007	YES	YES
Nayarit	LAW OF THE CULTURAL DEVELOPMENT FOR THE STATE OF NAYARIT	27/06/2011	YES	NO
Oaxaca	LAW OF THE CULTURAL DEVELOPMENT FOR THE STATE OF OAXACA	03/04/2010	YES	YES
Puebla	CULTURE ACT OF THE STATE OF PUEBLA	12/01/2009	YES	NO
Queretaro	LAW FOR THE CULTURE AND THE ARTS OF THE STATE OF QUERETARO	30/12/2005	YES	NO
Quintana Roo	CULTURE AND ARTS LAW OF THE STATE OF QUINTANA ROO	17/12/2007	YES	NO
San Luis Potosi	CULTURE ACT FOR THE STATE AND MUNICIPALITIES OF SAN LUIS POTOSI	10/05/2008	YES	NO
Sinaloa	CULTURE ACT OF THE STATE OF SINALOA	13/08/2008	YES	NO
Sonora	LAW FOR THE PROMOTION OF CULTURE AND PROTECTION OF THE CULTURAL HERITAGE OF THE STATE OF SONORA	01/12/2011	NO	NO
Tamaulipas	LAW FOR THE PROMOTION OF CULTURE AND PROTECTION OF THE CULTURAL HERITAGE OF THE STATE OF SONORA	01/09/2011	NO	NO
Veracruz	LAW FOR THE CULTURAL DEVELOPMENT OF THE STATE OF VERACRUZ DE IGNACIO DE LA LLAVE	26/02/2010	YES	YES
Yucatan	LAW FOR THE PRESERVATION AND PROMOTION OF THE CULTURE OF YUCATAN	08/08/2005	YES	NO
Zacatecas	LAW OF CULTURAL DEVELOPMENT FOR THE STATE AND MUNICIPALITIES OF ZACATECAS	16/08/2003	YES	NO

Source: Own elaboration based on the legislations mentioned in the table. Access date: December 15, 2020.

The above table makes it possible to identify: i) Only seven States consider the creative and cultural industries in their legislation (Campeche, Guanajuato, Guerrero, Hidalgo, Michoacan, Oaxaca, and Veracruz); ii) Three States do not consider any of the two (Coahuila, Sonora, and Tamaulipas); iii) The rest of the States with a culture law consider some of the industries in question.

Of the State legislations that do include the terms cultural industries and/or creative industries, it was not possible to evaluate the degree of support they provide to these industries on this occasion. The objective was only to identify whether their legislation contemplates the terms since this is an important step to recognize their legal existence, and the effects that derive from it, such as the possibility of receiving a budget, the obligation of the State to generate support programs, and policies, among other things.

The legislative evidence of what has been presented so far allows to identify at least three ways to support the creative economy in Mexico:


1. Through the integration of a section focused on cultural and creative industries in culture legislation. As an example, the legislation of Guanajuato previously cited in its Article 21, section XVI.
2. Through the creation of an ad hoc law for the creative and cultural industries, which is different or complementary to cultural legislation. As an example, the legislation of Colombia was previously cited.

3. Through the creation of legislation linked to a culture law, which supports some of the creative and cultural particularity supports some. As an example, the Law for the promotion, encouragement, and development of the cinematographic and audiovisual industries of the State of Baja California.

The trend of laws supporting the creative economy is more towards creating an ad hoc standard independent of culture legislation. For reference, the United Nations Educational, Scientific and Technological Organization (UNCTAD) recently approved funding to support the development of Jamaica's Creative Economy Act (2020), in collaboration with the European Union.

It is not a minor issue the existence of a forecast in the law (either within a law or as an ad hoc law), already in various UNCTAD recommendations (2011). In order to promote the creative economy, a fundamental element is the existence of one or more laws that allow the State to increase its attention to the issue.

The above becomes even more important in Mexico, as there is a very important gap at the subnational level on the contribution that the creative and cultural industries have to the national GDP, as Mexico City concentrates a very high percentage of the national total, more than 75 percent as of 2014, leaving almost all the rest of the States with a tiny contribution (Santamaria & Tuiran, 2019, p. 3). This is worrying because the country's cultural wealth is not concentrated in that State alone. One tool to change that reality is the law.



However, not all industries can receive the same attention, as not all States possess the same strengths. Therefore, the ideal is always to start from a diagnosis that allows identifying which are the areas that could be promoted, and to evaluate if, at a legislative level it is worth an ad hoc law for a type of industry, or it is enough with a more general law that prioritizes certain industries in its text.

An obligatory reference is the European Union, which makes it clear that given the complexity of the creative economy for all that it covers, it was important to create a very broad regulatory framework that ranges from legislation to promote this economy in general to particular but also adding regulations on intellectual property, taxes, internet regulations, among others (European Commission, n.d.). This should also shed light on the Mexican Congresses.


THE FUTURE OF THE CREATIVE ECONOMY AND NEW TECHNOLOGIES: THE ROLE OF THE LAW.

The change in the creative economy derived from the use and application of ICTs in the creative and cultural industries began several years ago. In the last twenty years, new industries have emerged in the sector, such as video games and digital animation. Today almost a huge number of universities in the country offer higher education programs related to ICTs.

But the innovation comes hand in hand with new challenges, according to the World Economic Forum and McKinsey company (Cocorocchia, Dunn, Hall, & Takahashi, 2018), new technologies such as artificial intelligence and blockchain, have had effects on value chains, supply chains, as well as in the creation of new consumer experiences, giving life to a new niche and type of consumer.

The changes came with questions about the scope of national laws, especially intellectual property laws. Historically, at least since it allowed to believe that works were divine creations, and that only humans were creators and therefore authors. However according to Davies, Klinger, Mateos-Garcia, & Stathoulopoulos (2020, p. 5) artificial intelligence is already used in the UK for the creation in the creative industries to:

- ·Generate collaborations between academics and these industries, and:
- ·Operate industries of this type with the help of artificial intelligence.



According to Leonard (2019), the use of technologies such as artificial intelligence are on the rise, helping to solve tedious tasks that can be both administrative (e.g., collections, payments and accounting), to tasks in which intelligence does intervene in the creation (e.g., color selection and placement). When a new work arises from collaboration, as are tasks of the second type, then ownership should be shared, but this premise applies only to humans.

The situation becomes even more complicated when no artist is involved, and all the work is left in the hands of programmers and artificial intelligence. Such was the case of the “new Rembrandt” (ING, 2016), a project that consisted of answering the question: “If Rembrandt were alive what picture would he have painted?” The result was a new work that fulfilled everything necessary to obtain copyright protection, except for one detail, that it was not created by a human, a *sine qua non* requirement for access to protection (Guadamuz, 2017).

Therefore, any legislative work aimed at promoting the creative economy should consider the new phenomena faced by the creative and cultural industries. Several issues are already considered by the latest reform resulting from the new Treaty between Mexico, United States and Canada. However, there is still much work to be done.


CONCLUSION

Automation is a process that began several years ago, which various studies have shown is progressing steadily. Different projections have been made to calculate its impact worldwide, especially taking as a reference the loss of jobs that humans still do today. The future is bleak for millions, especially in countries that rely heavily on manufacturing as the main source of employment.

In the case of Mexico, the situation is no better than in other countries. The research identified the average probability of automation for domestic jobs in non-creative and non-cultural industries as 63.7% as of the second quarter of 2022. This coincides with the projection made by the Bank of Mexico.

On the other hand, the creative economy, represented by the cultural and creative industries, being within the employed population with less probability of automation, represents a viable option in which the government should perhaps provide more support to this sector. In this research, it was identified that the average probability of automation for domestic jobs in the creative and cultural industries is 0.15% as of the second quarter of 2022.

Despite the above, there is currently no federal legislation that specifically supports these industries. The General Law on Culture and Cultural Rights does not provide for them. At the subnational level, twenty-one States have cultural legislation, and only the State of Hidalgo considers creative and cultural industries and the creative economy in its text. The evidence presented here demonstrates that betting in the creative economy is not a shot in the dark, but a wise and viable position in the medium and long term.



It is not new that automation has relevant effects, sometimes negative, in the distributive consequences that Mexico and the world are experiencing today. The literature shows that although technological evolution has been key on the path to economic prosperity, historically it has also disadvantaged the less qualified. Projections on automation have changed in Mexico and the world due to the pandemic, so the transition to automation will accelerate significantly in certain sectors.

The government, at any level, must take into consideration the possible effects that economic globalization and automation may have on times of COVID-19 and post-pandemic. There is an opportunity to design and implement generalized measures that society makes its own, and that remain outside of becoming policies. Options in education and training or improvement of soft skills for all Mexican students is an example. With the correct design, something like this would not imply an intervention of the State in the market, it would also avoid a high fiscal redistribution, and would improve the possibilities of development in Mexico.

Given all the above, the creative economy can be used as a tool to help Mexico emerge from the pandemic. But this requires the creation and reform of laws, as well as the design of ad hoc public policies. This economy in combination with other projects, will be key to the future.

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APPENDIX 1. FREY & OSBORNE METHODOLOGY TO CALCULATE THE PROBABILITY OF JOB AUTOMATION.

For the realization of the present investigation, results from “The Future of Employment”, from authors Frey and Osborne (2013) were used. Not all the methodology to be described was replicated. These results are a data base that comprises each of the United States Government’s Labor Department’s Standard Occupational Classification jobs and their risk of automation. For this research, the list of occupations was taken and their counterparts for Mexico were sought.

The way in which Frey and Osborne arrived at their results was through generating a classification for automation risk occupations. Automation risk classifications represent the technical viability in which job trades can be informatized or automatized with technology available nowadays. To calculate automation risk, they evaluated the capacity of computers to realize underlying tasks associated with the given occupation, taking in account the next classifications:

- “High rank” occupations are the higher risk quartile, with at least an 85 per cent automation risk for a determined occupation.
- “Medium risk” occupations are those within the second risk quartile, between 50 and 85 per cent automation risk for a determined occupation.
- “Low risk” occupations are those in the bottom two quartiles, with less than 50 percent risk.



First, classifications aren't the probability of a job really being automated. The fact that a computer can technically realize a job, or a task doesn't mean that the computer is in fact doing it. A large range of legal, logistic, commercial, financial, political, and social factors could decrease the actual rate at which businesses and employers adopt technology and automate functions. In addition, technology predictions have a relatively high degree of uncertainty.

Second, jobs that have some tasks that can technically be automated will not necessarily be displaced. Instead, the nature of many jobs will change, in some cases dramatically, but it will not be eliminated (Consulting firm McKinsey estimates that only 5 percent of jobs will be eliminated entirely, but that half of work tasks could be automated.) The implication of this change is the need for workers in hazardous occupations to continually improve their skills to keep up with the changing requirements of their occupation.

Finally, while technology and automation will displace some jobs and change other, new jobs will be created and others will expand. Nevertheless, our analysis doesn't capture the impact of the projected job creation.

Following the above, the model used in the determination of automation tasks looks to have the faculty of not only predict workforce substitution of daily tasks, but to encompass every task that is not attached to any engineering bottleneck for digitalization.

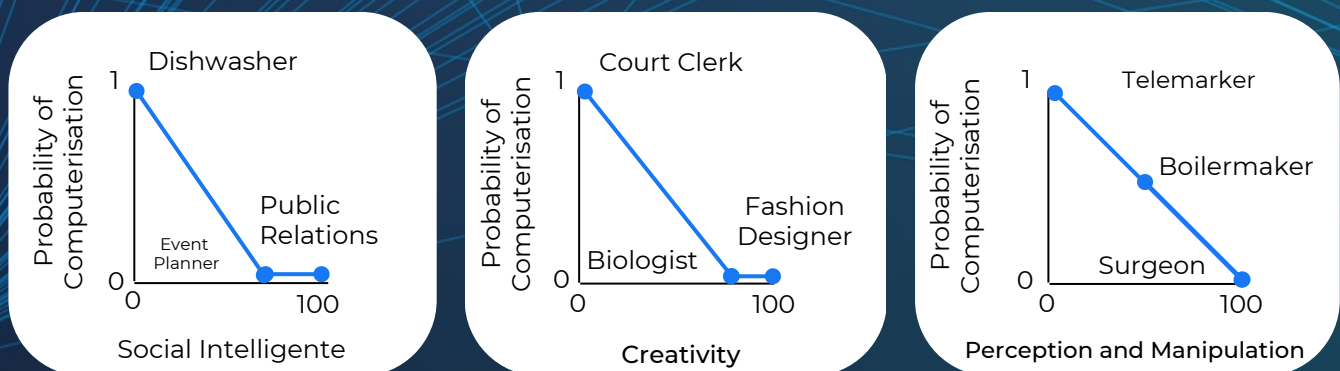
Based on the above considerations and on the existing Machine Learning (ML) and Machine Reasoning Engine (MRE) literature, several engineering and work activities with significant bottlenecks were determined at the University of Oxford. According to the findings, the determinants that define automation susceptibility can be represented by the following equation:

$$L_{NS} = \sum_{i=1}^n (L_{PM,i} + L_{C,i} + L_{SI,i})$$

Where LPM, LC and LSI represent perception and manipulation, creative intelligence, and social intelligence within the tasks.

The probability that a work activity will be automated can be described as a function of these task characteristics where, the low degree of social intelligence required by a dishwasher makes this occupation more susceptible to automation than a public relations specialist, for example, the authors present the following figure:

Figure 1. A sketch of how the probability of computerisation might vary as a function of bottleneck variable



To implement the previously described equation, authors made use of United States Government's Labor Department's Standard Occupational Classification, where information of 903 detailed occupations is collected, open descriptions of specific tasks were used for each occupation. This allowed them: (a) to objectively classify occupation according to the combination of knowledge, skills, and abilities they require; and (b) subjectively categorize based on the variety of tasks involved.

Table 1. O*NET variable that serve as indicators of bottlenecks to computerisation

Computerisation bottleneck	O*NET Variable	O*NET Description
Perception and Manipulation	Finger Dexterity	The ability to make precisely coordinated movements of the fingers of one or both hands to grasp, manipulate, or assemble very small objects.
	Manual Dexterity	The ability to quickly move your hand, your hand together with your arm, or your two hands to grasp, manipulate, or assemble objects.
	Cramped Work Space, Awkward Positions	How often does this job require working in cramped work spaces that requires getting into awkward positions?
Creative Intelligence	Originality	The ability to come up with unusual or clever ideas about a given topic or situation, or to develop creative ways to solve a problem.
	Fine Arts	Knowledge of theory and techniques required to compose, produce, and perform works of music, dance, visual arts, drama, and sculpture.
Social Intelligence	Social Perceptiveness	being aware of others' reactions and understanding why they react as they do.
	Negotiation	Bringing others together and trying to reconcile differences
	Persuasion	Persuading others to change their minds or behavior.
	Assisting and Caring for Others	Providing personal assistance, medical attention, emotional support, or other personal care to others such as, coworkers, customers, or patients.

Taking in account the variables of weight that worked as indicators to determine bottlenecks towards automation, in conjunction with the work of the ML team to, subjectively, hand assign the degree of automation for 70 occupations, where 1 is if they are automatable and 0 if not, the following algorithm was built, which is a gaussian process classifier to provide the probability label given the existing variables:

$$P(z_* = 1 \mid f_*) = \frac{1}{1 + \exp(-f_*)}.$$

The iteration for the validation of this algorithm against others proposed resulted in an area under the curve (AUC) punctuation of 0.9, which represents a precise classification, meaning the algorithm was able to successfully reproduce the subjective labels with the indicators to determine bottlenecks towards automation. Form this algorithm, a value between 0 and 1 that determines high, medium, and low risk according to their automation probability was obtained.

APPENDIX 2. MEXICAN JOBS CONSIDERED WITHIN THE CULTURAL AND CREATIVE INDUSTRIES, AND THEIR PERCENTAGE OF AUTOMATION.

As explained in Appendix 1, of more than 900 jobs in the United States that Frey & Osborne considered, 468 occupations that were identified at state level within the National Occupation and Employment Survey questionnaires were standardized. Then, the following thirty jobs were identified as those directly related to the cultural and creative industries. It is from these thirty jobs that the comparison in this study is made.

Key Code of the National Institute of Statistics and Geography	Description	Percentage of automation
1421	Film, Theater and related artistic activities Directors and Producers	2
1422	Directors and Managers of Museums, Cinemas and other Sports and Cultural Establishments	2
1721	Coordinators and Area Managers in artistic Film, Theater and related activities	25
1722	Coordinators and Area Managers in Museums, Cinemas, Sports and Cultural Services	25
2151	Writers and Literary Critics	4
2152	Reporters and Editors	11
2153	Interpreters and Translators	38
2161	Painters	4
2162	Drawers and Artistic Designers, Illustrators and Engravers	4
2163	Sculptors	4
2164	Set and Exhibit Designers	4
2171	Composers and Arrangers	1.5
2172	Musicians	7
2173	Singers	7
2174	Dancers and choreographers	13
2175	Actors	37
2542	Commercial and Industrial Designers	4
2543	Graphic Designers	8
2561	Athletes and Sports Competitors	28
2635	Precision and Musical Instrument Maintenance and Repair Technicians	91
2636	Precision and Musical Instruments Maintenance and Repair Mechanics	91
2655	Photographers	2
2712	Instructors in Artistic and Training Studies	1
3222	Tour Guides at Museums, Casinos, Parks, Movie Theaters and other recreational facilities.	6
7353	Artisan Shoemakers	4
7401	Supervisors of craftsmen and workers in the manufacture of oilcloth, India rubber, plastics and chemical products.	4
7411	Workers in the manufacture and repair of oilcloth, India rubber, plastic and tire vulcanization products.	83
7601	Supervisors of craftsmen and workers in the manufacture of ceramic, glass, tile and similar products.	4
7611	Potters and Ceramic Workers	4
7999	Other craft workers not classified above	4

Note: "Athletes and Sports Competitors" are considered because there is no specific classification for activities such as the circus.

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