



**PhD Thesis**

# **Artificial Intelligence, Competitiveness and Employment**

**Presented by**

**José Miguel Zaldo**

**Thesis Director**

**Carlos Gregorio Hernández Díaz-Ambrona**

**Department**

**Deusto Business School**

**PhD Program**

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“Much has been written about AI’s potential to reflect both the best and the worst of humanity. For example, we have seen AI providing conversation and comfort to the lonely; we have also seen AI engaging in racial discrimination. Yet the biggest harm that AI is likely to do to individuals in the short term is job displacement, as the amount of work we can automate with AI is vastly bigger than before. As leaders, it is incumbent on all of us to make sure we are building a world in which every individual has an opportunity to thrive.” -Andrew Ng, Co-founder and led of Google Brain.

"As more and more artificial intelligence is entering into the world, more and more emotional intelligence must enter into leadership." -Amit Ray, AI Scientist, Author of Compassionate Artificial Intelligence.

“If the government regulates against use of drones or stem cells or artificial intelligence, all that means is that the work and the research leave the borders of that country and go someplace else.” —Peter Diamandis, co founder and executive chairman of Singularity University.

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## List of acronyms

AI - Artificial Intelligence

AJ - Active jobs

AJDA - Active jobs displaced on application

AM - Additive manufacturing

AoAI - Application of AI

ASEAN - Association of Southeast Asian Nations

BCG - Boston Consulting Group

BIG - Basic Income Guarantee

C+I - Companies and Institutions

CAO - Chief Analytics Officer

CC - Current competitiveness

CDO - Chief Digital Officer

CG - Company growth

CLD - Causal Loop Diagram

CS - Computer Science

DL - Deep Learning

EBITDA - Earnings Before Interest Taxes Depreciation and Amortization

ECC - Enterprise cognitive computing

GANs - Generative Adversarial Networks

GES - Global economic situation

GNDJ - Growth on non-displaceable jobs

GTJ - Growth on traditional jobs

HBR - Harvard Business Review

HRD - Human Resource Development

ILB - Internal leisure business

ILO - International Labour Organization

INDJ - Initial non-displaceable jobs

IoT - Internet of Things

JLB - Jobs for leisure businesses

KPI - Key performance indicator

LB - Leisure businesses

MIT - Massachusetts Institute of Technology

MIT SMR - MIT Sloan Management Review

MOOCs - Massive Open Online Courses

MGI - McKinsey Global Institute

NBBAI - New businesses based on AI

NICM - Net improvement of competitiveness on the market

NJMIAI - New jobs to maintain and improve the application of AI

NJNBAI - New jobs for new businesses based on AI

PIAAC - Programme for the International Assessment of Adult Competencies

PiT - People in training

Rate C - Growth rate of annual increase of competitiveness because of AI application

RBTC - Routine-biased Technological Change

RL - Reinforcement learning

RRI - Responsible Research and Innovation

RRTC - Routine-replacing Technological Change

S - Salaries

SFD - Stock and Flow Diagram

SD - System Dynamics

STEM - Science, Technology, Engineering and Mathematics

STEAM - Science, Technology, Engineering, Arts and Mathematics

TBTC - Task-biased Technological Change

TJ - Traditional jobs

TL - Transfer learning

TNDJ - Total non-displaceable jobs

UBI - Universal Basic Income

UKCES - United Kingdom Commission for Employment and Skills

UNCTAD - United Nations Conference on Trade and Development

WEC - World Employment Confederation

WEF - World Economic Forum

WoL - Working online

WT - Working time

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## Summary

This Thesis titled “Artificial Intelligence, Competitiveness and Employment” was born because of our concern about future employment in Spain and in Europe and specifically our concern about the effects that the last new technologies will have on employment -in quantity and quality-. There are so many specialists -around 50%- which believe that this time it will be different than in the past and therefore we will not be able -at least in economically advanced societies as EE.UU and Europe- to create as many jobs as the ones displaced by the new technologies, that we decided to carry out this research in order to fully understand the phenomenon so as to contribute to give solutions to the potential unemployment problem that the application of new technologies could create. A few months after starting this research we decided to concentrate on AI - Artificial Intelligence- systems and the technologies around AI, as the most disrupted ones changing jobs and displacing tasks on

next ten or twenty years at least. Our next step was to understand the most pessimists positions about the displacement of jobs -the displaced are really tasks and therefore less jobs are needed for the same work- by AI applications, coming to the conclusion that the most pessimistic specialists are probably right about the quantity of tasks that will likely be displaced by AI systems and other technologies around it. It was also essential to study and understand the tasks less likely to be displaced by AI and we did it.

The next step of this research was about the possibilities of job's creation with AI applications, and finally we researched the solutions proposed in the Academy to solve the potential unemployment problem. From the literature review we got many ideas about jobs creation when new technologies are applied but not a systematic proposition to improve the employment -in quantity and quality- and to

avoid the time gap -affecting to employment and wages- between displacement and creation of jobs, accepting that AI applications will displace many tasks and therefore many jobs.

As the displacement is happening not depending on our will, because the AI application is globally unstoppable and whoever tries to stop it will become non competitive and will destroy more jobs than those destroyed by the displacement, we propose that the best solution is to apply AI systems as soon as possible doing whatever might be necessary to foster the jobs' creation to avoid unemployment and to do it very fast to avoid the time gap -affecting employment and wages- between displacement and creation of jobs. Using System Dynamics (SD) we build the Causal Loop Diagrams (CLDs) to understand the relation among all the variables that intervene on the phenomenon between AI applications and employment and we introduced the variable Competitiveness because we want to propose the creation of competitive new jobs which are the only ones that guarantee a sustainable future with enough and good employment.

We also use Stock and Flows Diagrams (SFDs) to quantify the relations among AI, Competitiveness and Employment.

And finally, we propose new models based on SFDs to help the decision makers -private and public- to get better employment on any reality where they apply AI systems, or any technology based on AI; also avoiding the wage and unemployment time gap. If we get better employment on any reality where we apply AI it is obvious that we will contribute to the improvement of global employment in our society.

The models are easy to adapt to any reality that the applier controls, as long as he accepts to create only competitive jobs. We hope that for any decision maker it is clear that to create non-competitive jobs is an easier solution for unemployment but it is not sustainable and sooner or later this will destroy jobs, weakening the society and affecting - as usual- to the most needy people.

## General introduction

The main author of this Thesis, the doctoral student, has been for most than forty years, businessman, president or high manager in different companies and institutions and have clearly noticed that employment, in quantity and quality, has been always affected by the technology changes, therefore he has chosen this theme in order to explore an methodology which contribute to anticipate the changes, specially the ones coming from AI systems as the most disrupted new technology of twenty first century.

This research has the next steps:

First step is to identify the problem -the gap in academic literature- that we want to contribute to solve.

Then making the correct questions to find answers in the academic literature.

To make the literature review.

To study, understand and classify the answers from the literature review.

To identify all the variables that intervene in the phenomenon between AI application and employment with competitiveness as very important intermediate variable to create only sustainable jobs.

To explain why to use System Dynamics (SD) as a very adequate methodology to analyse this complex problem.

With SD as method and Vensim as software we build the Causal Loop Diagrams (CLDs) to understand how each variable acts on the relations between AI and employment.

The research follows with Stock and Flow Diagrams (SFDs) to quantify the effects of each variable on any reality applying AI systems.

We propose new models based on SFD to apply AI on any reality improving employment in quantity and quality on each application -therefore the global employment will be improved-.

Finally, we validate the models with specialists on AI, competitiveness, employment and SD, with in-depth meetings with those people and with managers of technology companies; and also applying the models on different realities -sometimes the models have to be adapted to each

reality- as it will be shown in the examples of applications. We also explain and analyse the sensitivity of our results to the most important variables.

# Chapter 1. Research plan

## Introduction

The main thread of this chapter is based on the model used on the courses of Doctorate in DBS -Deusto Business School- as we following explain.

We start by the relevance of this research explaining the relevance of the three main concepts of this Thesis: AI, Competitiveness and Employment.

Then, as AI is not a new concept but it is, at this moment -in year 2020-, evolving so much, we have considered necessary to explain the current situation and the expected evolution, including the definition of AI that we are going to use in this research.

Following the model used in DBS we go to the Academic motivation, to Personal motivation, to Problem statement, Research questions, Main objectives, Conceptual framework, Focus and scope, Hypothesis/propositions and

we finish with the contributions in Conferences and publications by the author of this Thesis.

This is exactly the main thread that I learned in Deusto for the research plan, it is the model that followed this research plan approved in 2018 and of course we maintain it because, in essence, our objectives are the same as in 2017 and 2018 when we started this research.

### 1.1. Relevance of this research

In order to write about the relevance of this research we must prove the relevance of AI, Competitiveness and Employment, therefore we will analyse the relevance of each of the three concepts.

#### 1.1.1. Relevance of Artificial Intelligence

We fully agree with Dietzmann and Alt (2020) assessment that the impact of Artificial Intelligence (AI) is compared to the effects of the steam engine had onto the economy and society in the 17th century. It is accepted that AI and its applications profoundly impact organizations in various

ways: By implementing the technology into processes and tasks, AI is reshaping jobs, employment and working environments. To understand the significant effects of AI on organizations, the assumption is that it does not primarily aim to replace tasks or even jobs, but that it rather pursues a human-machine cooperation approach. Therefore AI is displacing tasks made currently by humans but the main effect is to increase competitiveness through human-machine cooperation.

We also agree with Westerheide (2019) who assessed that whoever controls the strongest artificial intelligence controls the world, because Artificial intelligence is the most important technology of the 21st century.

In 2018, the European Commission appointed 52 experts to a High-Level Expert Group on Artificial Intelligence, comprising representatives from academia, civil society, as well as industry. The general objective of the group is to support the implementation of the European initiative on AI. As the Vice-President for the Digital Single Market in the European Union, Ansip (2019) assessed that AI applications

will affect all sectors including healthcare to improve cancer diagnosis and treatment.

Like electricity in the past, AI is transforming the world. Its effect can be seen in homes, businesses and public spaces. In its embodied form of robots, it will soon be driving cars, stocking warehouses and caring for the young and elderly. (WEF – World Economic Forum, 2019).

Very few topics have captured the imagination of the public and promised to transform humanity more than artificial intelligence. (Report of United Nations Activities on Artificial Intelligence 2019)

**In summary, there is not any organization, country, decision maker or specialist who does not mention AI as the most relevant and disruptive technology on next 20 years at least.**

#### 1.1.2. Relevance of competitiveness

There are so many authors who, since many years ago, even centuries ago, have written about competitiveness and its relevance, that we do not think it necessary to insist on this point especially when it is not the main focus of this research

-the focus is on AI and employment- as this variable is only an intermediate variable between the two main ones, that we imposed ourselves on this research to avoid the easy but ineffective -and irresponsible- way of trying to solve the potential unemployment problem that could be caused with AI application, creating inefficient employment that only reduce the competitiveness and therefore the global employment and welfare.

We want only to highlight that competitiveness is the essential variable to growth and therefore to create employment on the market for any company or institution that have to compete in the open market. Unfortunately many people in Spain -and in some other countries- think that public service does not need to be competitive to grow, something that sooner than later must be corrected as public debt cannot grow forever and taxes must be as low as possible if we want a competitive economy that grows, pays taxes and creates many and good jobs; for those reasons competitiveness is an essential variable on this Thesis. (Zaldo; Maura; 2000)

### 1.1.3. Relevance of employment

People need to work, to develop professionally even if they do not have economic needs.

It is an economic waste, an injustice and a great social risk, that people who want and are able to work, cannot bring value and wealth, this is unfair and hurts all of our society.

It is a social and economic responsibility that people who want to work has a productive job as employees, as entrepreneurs or any other competitive job. Otherwise we will have social instability and many problems - economical, political and social-.

The ultimate end of society must be to achieve the happiness of all its members. We can understand that other things could be not so obvious to be guaranteed to all citizens, but the jobs, the possibility to use each capacity to contribute with wealth to themselves and to society, that is something that we must guaranty. Of course that there may be people who having opportunities do not take advantage of them, but that

is under their responsibility and not of the society. (Zaldo; Maura; 2000).

Creating more and better jobs is one of the main goals of the Europe 2020 strategy. (European Union 2019).

Also the article 23.1 of the Universal Declaration of Human Rights states -and we agree- that everyone has the right to work, to free choice of employment, to fair and favourable conditions of work and to protection against unemployment.

The International Covenant on Economic, Social and Cultural Rights states in Part III, Article 6: “The States Parties to the present Covenant recognize the right to work, which includes the right of everyone to the opportunity to earn their living by working where they freely chooses or accepts, and will take appropriate steps to safeguard this right”.

Similar statements are supported by many authors and most of the international organizations related with human rights as: The African Charter on Human and Peoples' Rights; (Hughes, 2014, p.1); (Glenn and Florescu, 2016, p.2).

Following history it is truth that more jobs were created than replaced during both the Industrial and Information revolutions. However, there are authors that argue that the speed, integration, and globalization of technological changes of the next years will be different and will cause massive structural unemployment. (Rejeski; Bezold, et al., 2015, p.6).

We must be able to get that richness created by AI are fairly shared avoiding unfair unemployment that in many countries (especially in Southern Europe or Northern Africa), is mainly affecting to young people. (Wisskirchen et al., 2017, p.37).

Our fear is that households situated at the bottom of the income distribution may be the least prepared to adjust to the new world of work, producing a vicious cycle of unemployment widening inequalities. (Balliester and Elsheikha, 2018, p.26).

**In summary, there is not any organization, country, decision maker or specialist who does not mention**

**employment -both in quantity and quality- as one of the most relevant objectives of any society.**

## 1.2. Understanding Artificial Intelligence and selecting a definition for this research

Let us start with the evolution of the term AI.

McCarthy (1956) first coined the term artificial intelligence when he invited a group of researchers from a variety of disciplines including language simulation, neuron nets, complexity theory and more to a summer workshop called the Dartmouth Summer Research Project on Artificial Intelligence to discuss what would ultimately become the field of AI. At that time, the researchers came together to clarify and develop the concepts around “thinking machines” which up to this point had been quite divergent.

Today, modern dictionary definitions focus on AI being a sub-field of computer science and how machines can imitate human intelligence (being human-like rather than becoming human). The English Oxford Living Dictionary gives this definition of artificial intelligence: “The theory and

development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages”.

Merriam-Webster defines artificial intelligence this way: “A branch of computer science dealing with the simulation of intelligent behaviour in computers. The capability of a machine to imitate intelligent human behaviour.” “The Encyclopaedia states, “artificial intelligence (AI), is the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. Intelligent beings are those that can adapt to changing circumstances”.

While some of the major tech companies haven’t published a dictionary-type definition for AI, we know the importance they give to AI by reviewing that their research areas always include AI as a priority.

It is logic that we have problems defining AI because we do not have a generally accepted definition of human intelligence. For example Psychologists generally do not

characterize human intelligence by just one trait but by the combination of many diverse abilities.

Research in AI has focused chiefly on the following components of intelligence: learning, reasoning, problem solving, perception, and using language.

The earliest substantial work in the field of artificial intelligence was done in the mid-20th century by the British logician and computer pioneer Turing, who in 1935 described an abstract computing machine consisting of a limitless memory and a scanner that moves back and forth through the memory, symbol by symbol, reading what it finds and writing further symbols. The actions of the scanner are dictated by a program of instructions that also is stored in the memory in the form of symbols. This is Turing's stored-program concept, and implicit in it is the possibility of the machine operating on, and so modifying or improving, its own program. Turing's conception is now known simply as the universal Turing machine. All modern computers are universal Turing machines.

In 1945 Turing predicted that computers would one day play very good chess, and just over 50 years later, in 1997, Deep Blue, a chess computer built by the International Business Machines Corporation (IBM), beat the reigning world champion, Garry Kasparov, in a six-game match. While Turing's prediction came true, his expectation that chess programming would contribute to the understanding of how human beings think did not. The huge improvement in computer chess since Turing's day is attributable to advances in computer engineering rather than advances in AI—Deep Blue's 256 parallel processors enabled it to examine 200 million possible moves per second and to look ahead as many as 14 turns of play.

In 1950 Turing sidestepped the traditional debate concerning the definition of intelligence, introducing a practical test for computer intelligence that is now known simply as the Turing test. The Turing test involves three participants: a computer, a human interrogator, and a human foil. The interrogator attempts to determine, by asking questions of the other two participants, which is the computer. All

communication is via keyboard and display screen. The interrogator may ask questions as penetrating and wide-ranging as he or she likes, and the computer is permitted to do everything possible to force a wrong identification. (For instance, the computer might answer, “No,” in response to, “Are you a computer?” and might follow a request to multiply one large number by another with a long pause and an incorrect answer.) The foil must help the interrogator to make a correct identification. A number of different people play the roles of interrogator and foil, and, if a sufficient proportion of the interrogators are unable to distinguish the computer from the human being, then (according to proponents of Turing’s test) the computer is considered an intelligent, thinking entity.

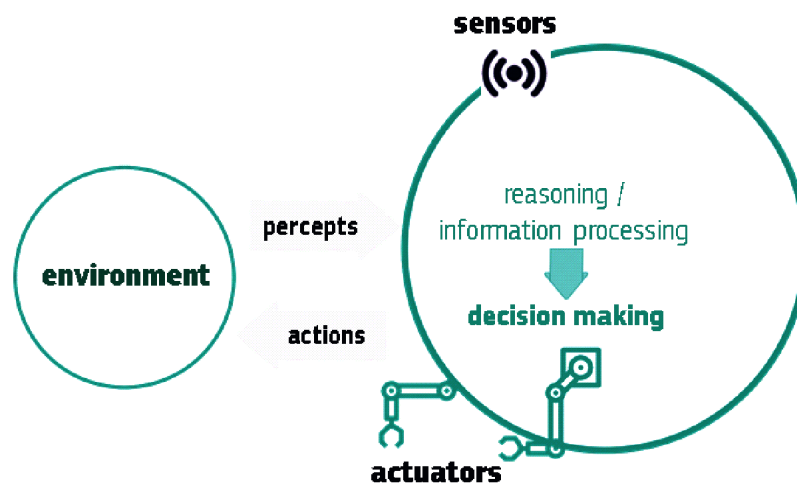
AI systems: The term AI contains an explicit reference to the notion of intelligence. However, since intelligence (both in machines and in humans) is a vague concept, although it has been studied at length by psychologists, biologists, and neuroscientists, AI researchers use mostly the notion of rationality. This refers to the ability to choose the best action

to take in order to achieve a certain goal, given certain criteria to be optimized and the available resources. Of course, rationality is not the only ingredient in the concept of intelligence, but it is a significant part of it.

In the following pages we will use the term AI system to mean any AI-based component, software and/or hardware. Indeed, usually AI systems are embedded as components of larger systems, rather than stand-alone systems.

An AI system is thus first and foremost rational, according to one of the most used textbooks of AI (Russell and Norvig, 2020). But how does an AI system achieve rationality? As pointed out in the first sentence of the above working definition of AI, it does so by perceiving the environment in which the system is immersed through some sensors, thus collecting and interpreting data, reasoning on what is perceived or processing the information derived from this data, deciding what the best action is, and then acting accordingly, through some actuators, thus possibly modifying the environment. AI systems can either use symbolic rules or learn a numeric model, and they can also

adapt their behaviour by analysing how the environment is affected by their previous actions. The illustration of an AI system in Figure 1 may help.



In summary, as we see in Figure 1, that an AI system receive information through sensors and make decision and actions following the instruction that we have given to the system. The advantage over humans is that the system can process much more information than humans, faster and without mistakes, always following the rules and objectives given by humans, which, of course, can be changed.

Figure 1. A schematic depiction of an Artificial Intelligence system. (Russell and Norvig, 2020)

Understanding how AI system work will be easy to understand that any task that we can structured can be displaced by machines with AI always that the machine is able to interpret properly all the information needed to make the task. Today -in 2020- AI is a scientific discipline that is advancing very rapidly not for displacing people as the main objective but especially to improve competitiveness with

new and better products and services -solutions to problems- in all sectors of activity.

The techniques to teach AI systems to interpret the informations needed to make the tasks are called learning techniques, being the most important, machine learning -supervised or not- reinforce learning and deep learning; all of them used to teach AI to interpret any information, speech, noises, vision, etc. In supervised machine learning, instead of giving behavioural rules to the system, we provide it with examples of input-output behaviour, hoping that it will be able to generalize from the examples (typically describing the past) and behave well also in situations not shown in the examples (that could be encountered in the future).

Another useful kind of machine learning approach is called reinforcement learning. In this approach, we let the AI system free to make its decisions, over time, and at each decision we provide it with a reward signal that tells it whether it was a good or a bad decision. The goal of the

system, over time, is to maximize the positive reward received. This approach is used, for example, in recommender system (such as the several online recommender systems that suggest users what they might like to buy), or also in marketing.

Machine learning approaches are useful not just in perception tasks, such as vision and text understanding, but in all those tasks that are hard to define and cannot be comprehensively described by symbolic behavioural rules.

Notice the distinction between machine learning approaches to learn a new task that cannot be described well in a symbolic way and learning rational agents that adapt their behaviour over time to better achieve the given goal. These two techniques may overlap or cooperate but are not necessarily the same.

Robotics can be defined as “AI in action in the physical world” (also called embodied AI). A robot is a physical machine that must cope with the dynamics, the uncertainties and the complexity of the physical world. Perception, reasoning, action, learning, as well as interaction capabilities with other systems are usually integrated in the control architecture of the robotic system. In addition to AI, other disciplines play a role in robot design and operation, such as mechanical engineering and control theory. Examples of robots include robotic manipulators, autonomous vehicles (e.g. cars, drones, flying taxis), humanoid robots, robotic vacuum cleaners, etc.

Other references: (AI Finland. 2019); (Aleryani, 2019); (Anderson, Janet 2018); (Andrew, Ng.2016); (Antonescu, 2018); (Autor et al. 2003); (Brown et al. 2019); (Brynjolfsson and McAfee 2014); (Czarniswka, 2020); (Fari, 2018); (Fekry, 2019); (Huet, 2019); (Krafft et al. 2019); (Russell et al. 2020); Now we can distinguish between

narrow (or weak) and general (or strong) AI. A general AI system is intended to be a system that can perform most activities that humans can do. Narrow AI systems are instead systems that can perform one or few specific tasks.

Narrow AI is now widely used -through algorithms and programs like Python and others- to substitute structured tasks by machines in many C+I -Companies and Institutions- increasing the productivity and accuracy of the set human-machine and therefore increasing the competitiveness of C+I.

We think that now we can understand the terms mostly used in AI systems and we can conclude this point with the definition of AI to be used in this Thesis.

For this Thesis we will use the following updated -in 2019- definition of Artificial Intelligence from the European Commission:

“Artificial intelligence (AI) systems are software (and possibly also hardware) systems designed by humans (humans design AI systems directly, but they may also use AI techniques to optimise their design) that, given a complex goal, act in the physical or digital dimension by perceiving their environment through data acquisition, interpreting the collected structured or unstructured data, reasoning on the knowledge, or processing the information, derived from this data and deciding the best action(s) to take to achieve the given goal. AI systems can either use symbolic rules or learn a numeric model, and they can also adapt their behaviour by analysing how the environment is affected by their previous actions.

As a scientific discipline, AI includes several approaches and techniques, such as machine learning (of which deep learning and reinforcement learning are specific examples), machine reasoning (which includes planning,

scheduling, knowledge representation and reasoning, search, and optimization), and robotics (which includes control, perception, sensors and actuators, as well as the integration of all other techniques into cyber-physical systems). And to refer to this document as a source of additional information to support this definition”.

### 1.3. Academic Motivation

In the academic world, there are strong academic discussions between techno-optimists and techno-pessimists about the global effect of the application of AI systems on Employment; currently each group represent around 50% of the specialists. The techno-optimists think that the AI will create more global jobs than the ones it displaces. Their arguments are based on feelings, and their feelings are based mostly on historical reasons like “technology has always created more employments that it destroys”. The techno-pessimists think the opposite -AI will destroy more global employments than it creates- focusing mostly on analytical reasons, about the many jobs that they expect that

the application of AI will displace, and the belief that, on this case, it will not be possible to create as many jobs as the ones displaced.

To better understand the phenomenon, we will analyse the historical effects of technology on employment.

We start with the paper (Autor; 2015).

There have been periodic warnings in the last two centuries that automation and new technology were going to wipe out large numbers of jobs. The best-known example is the Luddite movement of the early 19th century, in which a group of English textile artisans protested the automation of textile production by seeking to destroy some of the machines. A lesser known but more recent example is the concern over “The Automation Jobless,” as they were called in the title of a TIME magazine story of February 24, 1961 which claimed that the number of jobs lost to more efficient machines is only part of the problem. What worries really many job experts is that automation may prevent the economy from creating enough new jobs. Throughout industry, the trend has been to bigger production with a

smaller workforce. Many of the losses in factory jobs have been countered by an increase in the service industries or in office jobs. But automation is beginning to move in and eliminate office jobs too. In the past, new industries hired far more people than those they put out of business. But this is not true of many of today’s new industries. Today’s new industries have comparatively fewer jobs for the unskilled or semiskilled, just the class of workers whose jobs are being eliminated by automation. (Autor, 2015, p.3). The last paragraphs were written in 1961 and evidently they were not right.

Everybody accepts that the past two centuries of automation and technological progress have not made human labour obsolete: the employment-to-population ratio rose during the 20th century even as women moved from home to market; and although the unemployment rate fluctuates cyclically, there is no apparent long-run increase. But those concerned about automation and employment are quick to point out that past interactions between automation and employment cannot settle arguments about how these

elements might interact in the future: in particular, the emergence of greatly improved computing power, artificial intelligence, and robotics raises the possibility of replacing labour on a scale not previously observed. There is no fundamental economic law that guarantees every adult will be able to earn a living solely on the basis of sound mind and good character. Whatever the future holds, the present clearly offers a resurgence of automation anxiety.

In 1900, 41 percent of the US workforce was employed in agriculture; by 2000, that share had fallen to 2 percent, mostly due to a wide range of technologies including automated machinery.

The mass-produced automobile drastically reduced demand for many equestrian occupations, including blacksmiths and stable hands. Successive waves of earth-moving equipment and powered tools displaced manual labour from construction. In more recent years, when a computer processes a company's payroll, alphabetizes a list of names, or tabulates the age distribution of residents in each Census enumeration district, it is replacing a task that a human

would have done in a previous era. Broadly speaking, many workplace technologies are designed to save labour.

Given that these technologies demonstrably succeed in their labour-saving objective and, moreover, that we invent many more labour-saving technologies all the time, should we not be somewhat surprised that technological change hasn't already wiped out employment for the vast majority of workers? Why doesn't automation necessarily reduce aggregate employment, even as it demonstrably reduces labour requirements per unit of output produced? These questions underline an economic reality that is as fundamental as it is overlooked: tasks that cannot be substituted by automation are generally complemented by it. Most work processes draw upon a multifaceted set of inputs: labour and capital; brains and brawn; creativity and rote repetition; technical mastery and intuitive judgment; perspiration and inspiration; adherence to rules and judicious application of discretion. Typically, these inputs each play essential roles; that is, improvements in one do not obviate the need for the other. If so, productivity improvements in

one set of tasks almost necessarily increase the economic value of the remaining tasks. When automation or computerization makes some steps in a work process more reliable, cheaper, or faster, this increases the value of the remaining human links in the production chain.

History shows that workers are more likely to benefit directly from automation if they supply tasks that are complemented by automation, but not if they primarily (or exclusively) supply tasks that are substituted. A construction worker who is expert with a shovel but cannot drive an excavator will generally experience falling wages as automation advances. Similarly, a bank teller who can tally currency but cannot provide “relationship banking” is unlikely to fare well at a modern bank.

Also, the elasticity of labour supply can mitigate wage gains. If the complementary tasks that construction workers or relationship bankers supply are abundantly available elsewhere in the economy, then it is plausible that a flood of new workers will temper any wage gains that would emanate from complementarities between automation and human

labour input. While these kinds of supply effects will probably not offset productivity-driven wage gains fully, one can find extreme examples that new entry into the real estate broker occupation in response to rising house prices fully offsets average wage gains that would otherwise have occurred.

The output elasticity of demand combined with income elasticity of demand can either dampen or amplify the gains from automation. In the case of agricultural products over the long run, spectacular productivity improvements have been accompanied by declines in the share of household income spent on food. In other cases, such as the health care sector, improvements in technology have led to ever-larger shares of income being spent on health.

Even if the elasticity of final demand for a given sector is below unity—meaning that the sector shrinks as productivity rises—this does not imply that aggregate demand falls as technology advances; clearly, the surplus income can be spent elsewhere. As passenger cars displaced equestrian travel and the myriad occupations that supported it in the

1920s, the roadside motel and fast food industries rose up to serve the new mobility.

Rising income may also spur demand for activities that have nothing to do with the technological vanguard. Production of restaurant meals, cleaning services, haircare, and personal fitness is neither strongly complemented nor substituted by current technologies. But demand for these goods appears strongly income-elastic, so that rising productivity in technologically leading sectors may boost employment nevertheless in these activities. Ultimately, this outcome requires that the elasticity of substitution between leading and lagging sectors is less than or equal to unity (Autor and Dorn 2013)".

Over the very long run, gains in productivity have not led to a shortfall of demand for goods and services: instead, household consumption has largely kept pace with household incomes. We know this because the share of the population engaged in paid employment has generally risen over (at least) the past century despite vast improvements in material standards of living. An average US worker in 2015

wishing to live at the income level of an average worker in 1915 could roughly achieve this goal by working about 17 weeks per year. Most citizens would not consider this trade-off between hours and income desirable, however, suggesting that consumption demands have risen along with productivity. Of course, citizens in high-income countries work fewer annual hours, take more vacations, and retire earlier (relative to death) than a century ago, implying that they choose to spend part of their rising incomes on increased leisure. This is clearly good news on many fronts, but does it also imply that consumption demands are approaching satiation? We think not. In high-income countries, consumption and leisure appear to be complements; citizens spend much of their leisure time consuming, shopping, traveling, dining, and, less pleasantly, obtaining medical care.

Other essential point is that, even if automation does not reduce the quantity of jobs, it may greatly affect the qualities of jobs available. For the three decades or so from the end of World War II and up through the late 1970s, the US

experienced rapid automation and technological change inspiring, for example, the TIME magazine story in 1961 and Lyndon Johnson's 1964 National Commission.

It is historically clear that, physically demanding, repetitive, dangerous, and cognitively monotonous work was receding, ushered out by extraordinary productivity gains in agriculture.

To understand the role that new technologies has played (and may play), it is useful to start from first principles: What do these technologies can do? And how does their widespread adoption change what workers do?

Specially on last decades the offer of most products have been superior to the demand thus, firms needs to reduce costs to compete in the market and therefore they have strong economic incentives to substitute ever-cheaper new technologies for relatively expensive human labour. What are the effects? One first-order effect is, of course, displacement of people.

Routine tasks are characteristic of many middle-skilled cognitive and manual activities: for example, the

mathematical calculations involved in simple bookkeeping; the retrieving, sorting, and storing of structured information typical of clerical work; and the precise executing of a repetitive physical operation in an unchanging environment as in repetitive production tasks. Because core tasks of these occupations follow precise, well-understood procedures, they are increasingly codified in computer software and performed by machines. This force has led to a substantial decline in employment in clerical, administrative support, and to a lesser degree, in production and operative employment. But the scope for this kind of substitution is bounded because there are many tasks that people understand tacitly and accomplish effortlessly but for which neither computer programmers nor anyone else can enunciate the explicit "rules" or procedures. I have referred to this constraint as Polanyi's paradox, named after the economist, philosopher, and chemist who observed in 1966, "We know more than we can tell" (Polanyi 1966; Autor 2015).

Polanyi's paradox also suggests why high-level reasoning is straightforward to computerize and certain sensorimotor skills are not. High-level reasoning uses a set of formal logical tools that were developed specifically to address formal problems: for example, counting, mathematics, logical deduction, and encoding quantitative relationships. In contrast, sensorimotor skills, physical flexibility, common sense, judgment, intuition, creativity, and spoken language are capabilities that the human species evolved, rather than developed.

Because jobs that are intensive in either abstract or manual tasks are generally found at opposite ends of the occupational skill spectrum -in professional, managerial, and technical occupations on the one hand, and in service and labourer occupations on the other- this reasoning implies that computerization of "routine" job tasks may lead to the simultaneous growth of high-education, high-wage jobs at one end and low-education, low-wage jobs at the other end, both at the expense of middle-wage, middle education

jobs—a phenomenon that Goos and Manning (2003) called "job polarization."

A large body of US and international evidence confirms the presence of employment polarization at the level of industries, localities, and national labour markets (Autor, Katz, et al. 2006, 2008; Goos and Manning 2007; Autor and Dorn 2013; Michaels, Natraj, et al. 2014; Goos, Manning, et al., 2014; Graetz and Michaels 2015; Autor, Dorn, et al. 2015). (Autor, 2015, p.12).

Automation, complemented in recent decades by the exponentially increasing power of information technology, has driven changes in productivity that have disrupted labour markets. This essay has emphasized that jobs are made up of many tasks and that while automation and computerization can substitute for some of them, understanding the interaction between technology and employment requires thinking about more than just substitution. It requires thinking about the range of tasks involved in jobs, and how human labour can often complement new technology. It also

requires thinking about price and income elasticities for different kinds of output, and about labour supply responses. Polanyi's paradox—"we know more than we can tell"—presents a challenge for computerization because, if people understand how to perform a task only tacitly and cannot "tell" a computer how to perform the task, then seemingly programmers cannot automate the task—or so the thinking has gone. But this understanding is shifting rapidly due to advances in machine learning. Machine learning applied statistics and inductive reasoning to supply best-guess answers where formal procedural rules are unknown. Where engineers are unable to program a machine to "simulate" a nonroutine task by following a scripted procedure, they may nevertheless be able to program a machine to master the task autonomously by studying successful examples of the task being carried out by others. Through a process of exposure, training, and reinforcement, machine learning algorithms may potentially infer how to accomplish tasks that have proved hauntingly challenging to codify with explicit procedures.

Major newspaper stories offer fresh examples daily of technologies that substitute for human labour in an expanding—although still circumscribed—set of tasks. The offsetting effects of complementarities and rising demand in other areas are, however, far harder to identify as they occur. My own prediction is that employment polarization will not continue indefinitely (as argued in Autor 2013). While some of the tasks in many current middle-skill jobs are susceptible to automation, many middle-skill jobs will continue to demand a mixture of tasks from across the skill spectrum. (Autor, 2015, p.26).

We follow with some valuable information extracted from McKinsey Global Institute (2017).

In their latest research on automation, they examine work that can be automated through 2030 and jobs that may be created in the same period. They draw from lessons from history and develop various scenarios for the future. While it is hard to predict how all this will play out, their research provides some insights into the likely workforce transitions that should be expected and their implications.

Summary of their key findings: Automation technologies including artificial intelligence and robotics will generate significant benefits for users, businesses, and economies, lifting productivity and economic growth. The extent to which these technologies displace workers will depend on the pace of their development and adoption, economic growth, and growth in demand for work. Even as it causes declines in some occupations, automation will change many more—60 percent of occupations have at least 30 percent of constituent work activities that could be automated. It will also create new occupations that do not exist today, much as technologies of the past have done.

While about half of all work activities globally have the technical potential to be automated by adapting currently demonstrated technologies, the proportion of work actually displaced by 2030 will likely be lower, because of technical, economic, and social factors that affect adoption. Our scenarios across 46 countries suggest that between almost zero and one third of work activities could be displaced by 2030, with a midpoint of 15 percent. The proportion varies

widely across countries, with advanced economies more affected by automation than developing ones, reflecting higher wage rates and thus economic incentives to automate. Even with automation, the demand for work and workers could increase as economies grow, partly fuelled by productivity growth enabled by technological progress.

Rising incomes and consumption especially in developing countries, increasing health care for aging societies, investment in infrastructure and energy, and other trends will create demand for work that could help offset the displacement of workers. Additional investments such as in infrastructure and construction, beneficial in their own right, could be needed to reduce the risk of job shortages in some advanced economies. Even if there is enough work to ensure full employment by 2030, major transitions lie ahead that could match or even exceed the scale of historical shifts out of agriculture and manufacturing.

Our scenarios suggest that by 2030, 75 million to 375 million workers (3 to 14 percent of the global workforce) will need to switch occupational categories.

Moreover, all workers will need to adapt, as their occupations evolve alongside increasingly capable machines. Some of that adaptation will require higher educational attainment or spending more time on activities that require social and emotional skills, creativity, high-level cognitive capabilities and other skills relatively hard to automate.

Income polarization could continue in the United States and other advanced economies, where demand for high-wage occupations may grow the most while middle-wage occupations decline— assuming current wage structures persist. Increased investment and productivity growth from automation could spur enough growth to ensure full employment, but only if most displaced workers find new work within one year. If reemployment is slow, frictional unemployment will likely rise in the short-term and wages could face downward pressure.

These wage trends are not universal: in China and other emerging economies, middle-wage occupations such as service and construction jobs will likely see the most net job growth, boosting the emerging middle class.

To achieve good outcomes, policy makers and business leaders will need to embrace automation's benefits and, at the same time, address the worker transitions brought about by these technologies.

Ensuring robust demand growth and economic dynamism is a priority: history shows that economies that are not expanding do not generate job growth. Mid-Career job training will be essential, as will enhancing labour market dynamism and enabling worker redeployment.

These changes will challenge current educational and workforce training models, as well as business approaches to skill-building. Another priority is rethinking and strengthening transition and income support for workers caught in the crosscurrents of automation.

Priorities for policy makers and business leaders:

- Economic Growth: Ensuring robust demand growth and economic dynamism; economies that are not expanding don't create jobs

- Skills Upgrade: Upgrading workforce skills, especially retraining mid-career workers, as people work more with machines
- Fluid Labor Market: The shifting occupational mix will require more fluid labour markets, greater mobility, and better job matching
- Transition Support: Adapting income and transition support to help workers and enable those displaced to find new employment.

Number of people who may need to switch occupational categories by 2030, under different scenarios we calculate between 75M–375M people in developed Countries.

Workforce transitions: Switching occupations; Demanding new skills; Changing educational requirements.

### 1.3.1. What have we learned from history about the relation between technology changes and employment?

Technology has always displaced many jobs, but the global employment has increased over the time, especially on different jobs than the ones displaced. However, the

transition has not always been smooth: for example, real wages stagnated for nearly 50 years in 19th century in England during the Industrial Revolution, and only picked up again at a time of substantial social policy reforms. Today, in year 2020, our society is not prepared to admit a so long transition period, therefore we need strong strategies, decisions and actions to foster and accelerate jobs creation. Businesses and policymakers will need to act to keep people working as automation is adopted.

Many of the new jobs are in occupations that cannot be envisioned at the outset. To know the tasks more likely to be displaced we have to understand what the new technology can do -and will be able to do on next years- that today is done by human beings.

Rising productivity in technologically leading sectors may boost employment also in other sectors. Robust aggregate demand and economic growth are essential for enough jobs creation.

Over the long term, productivity growth enabled by technology has reduced the average hours worked per week

and allowed people to enjoy more leisure time. It is generally accepted that leisure businesses will be the most growing as well economically as like jobs creator in twenty first century.

Another reason to foster and accelerate jobs creation on next years is that, although the historical record is largely reassuring, some people worry that automation today -specially with AI systems- will be more disruptive than in the past. First, if technological advances continue apace and are adopted rapidly, the rate of worker displacement could be faster. Secondly, if many sectors adopt automation simultaneously, the percentage of the workforce affected by it could be higher.

The Polanyi's paradox, will be surpassed with AI's applications, what will increase jobs displacement.

Other challenge will be ensuring that workers have the skills and support needed to transition to new jobs.

If displaced workers are not reemployed quickly, and we fail managing this transition, countries will face rising

unemployment and depressed wages, with very damaging social consequences.

It will be necessary to improve business and labour market dynamism including mobility, providing income and transition support to workers displaced.

To facilitate voluntary part time work will also help jobs creation. In the past decade, the number of people in the United States and Europe who earn money in the independent workforce -as freelancers, independent contractors, self-employed, and workers in the "gig" economy- has grown, to an estimated 162 million. Many of these individuals work less than a full-time schedule. As leisure time increases, people spend money on hobbies, entertainment, and other personal services, giving rise to entire new industries that in turn create jobs. Skiing, golfing, tourism, crafting, and do-it-yourself home projects are a just a few industries that have sprung from the new leisure economy.

The number of jobs involved is significant: globally, as many as 292 million people are employed directly or indirectly by tourism, one in every ten jobs on the planet.

We cannot delay the application of new technologies because we have evidence of the economy-wide positive correlation among technology, productivity, and employment.

We conclude that in many respects, the impact of automation on employment today is not likely to be different than in the past, particularly if we look back centuries, to the First Industrial Revolution in the late 1700s. But we have identified two ways in which automation, robotics, and other AI systems could diverge from earlier waves of technology disruption: The speed at which scientific advances is being made, if the accelerated rate of progress in machine learning and AI continues, and the potential to displace a higher share of the workforce in a relatively short period of time, particularly if automation is rapidly adopted across multiple sectors of the economy.

A final dimension on which technological change could be different today is its impact on workers at different wage levels. One of the frequently cited concerns about automation is that machines could replace activities of high-wage jobs previously considered “safe,” including experts in financial services, some types of doctors, and lawyers.

### 1.3.2. Gap in the academic world, proposition and personal motivation

Our proposition is that -on any AI application- there is an automatic relationship between the application of AI and the displacement of tasks but there is not automatic relationship with global employment (difference among displacement and creation of jobs) because jobs creation needs many actions on several variables, both internal -which depend on decisions made inside C+I- (companies and institutions where AI is applied), and external -which depend on public political and social policies- that have a very important role on the global effects of application of AI on employment.

**Those variables are not fully explored -in quality and quantity- in the academic world, and, in consequence, there is not any relevant research about what decisions we should make -internal and external of C+I- about them, to improve the global employment with the massive application of AI systems.** We consider that, to fill this gap in the academic literature, it is absolutely fundamental to better understand and control the effects on society of the potential negative effects on employment and wages with the application of AI.

We have a good knowledge of the mathematical models based on System Dynamics concepts (from now SD), and we consider that this methodology could be very adequate for this research, because it permits to model complex realities with many variables involved in its evolution, with effects that depend on their concatenated decisions with different rhythms and values. We will try to prove that this method is perfectly suited to better understand the reality we want to research.

**In order to make the most of the good and to avoid the bad from History we would like to propose solutions to the next gaps on Academy in relation with AI and Employment:**

- To fully understand the phenomenon between AI and employment
- To find and propose which are the most influential variables and their relationship
- To discern the more and the less likely jobs/tasks to be displaced by AI
- To recognize the new jobs that may be created with AI applications and the actions to increase, accelerate and improve these jobs creation to avoid or reduce the unemployment and wages gap between displacement and creation of jobs.
- To make proposals about what to do with people displaced in order to train them to become active jobs in few months and without leaving the labour market

**Personal motivation**

The first author is highly motivated, and he think that has the appropriate methodology to fill this gap, because in his more than 45 years as businessman, managing director, president or CEO, mostly in private companies and institutions but also in public service, he has always been very concerned about employment, not only in the C+I in which he participated in, but also in his environment.

The only time in his life when he had to close down a company leaving almost 100 people without a job, he was so worried that the Unions decided to help him to close the company -of course with the support of all the employees- without neither relation problems nor any negative noise. It was very hard and painful for him but a very satisfying experience too, since his people fortunately very soon found new jobs.

Since the employment crisis of the 1990s, he decided to analyse and propose solutions to the unemployment problem dedicating many hours to give lectures, host conferences,

write articles and write and publish his book (Zaldo; Maura; 2000).

The proposals of his lectures, conferences, articles and books have been important contributions to solve the unemployment problems in Spain in the last two economic crises, in 1994 (he started his research in 1994) and in 2008, still not totally solved. Now, in May 2020, we are confronted with a new very grave unemployment perspective caused by Covid-19 virus and it is our intention to actualise the measures that he proposed in his book of 2020, in spite that he is sure that most of them are still valid for this new crisis.

He believes that the new challenge to employment, because of the application of AI, will be very different, and we will need more variables and new measures to avoid large unemployment because of AI applications.

He intends to research these new variables and measures using mathematical models based on System Dynamics concepts (SD) as one well-suited method to qualify and quantify the policies and actions to be taken by decision makers. The reason of which we will later explain.

For these reasons, he is extremely motivated -and he feels very capable and with the appropriate technology- to contribute to solve this gap in the academic world -which could become a very serious problem for the European society if it is not properly solved-.

#### 1.4. Problem Statement

As we want to contribute to avoid a new unemployment and wages crisis because of the application of AI systems, the problem is to discover, through this research, the most influential variables that will affect the quantity and quality of employment with the application of AI; to discover their qualitative and quantitative relations; and to propose the best decisions to be taken on those variables, in order to apply AI improving employment in quantity and quality. As you can see when we write about displacement we use the combination jobs/tasks, because rarely AI displace full jobs but some tasks included in each job, therefore increasing the productivity of the job and consequently needing less jobs for the same work.

#### 1.5. Research questions and objectives

Main research questions:

RQ1. Which effects of the application of AI on employment have been identified in the academic literature? Which are the more and the less likely jobs/tasks to be displaced by the application of AI? What are the expected jobs to be created by the application of AI? And what solutions have been given in the academic world to the potential negative effects of application of AI to employment?

Auxiliary research questions:

RQ2. The application of mathematical models, based on System Dynamics concepts, will be an effective method to qualify and quantify this phenomenon, to better understand the variables that influence on it and to have a better understanding of it?

RQ3. What are the most influential variables, and the decisions to be made about them, to improve the effects on employment of the application of AI?

Main objectives:

To know the state of the art of the literature

Including as main points:

A.- More likely jobs/tasks to be displaced by the application of AI.

B.- Less likely jobs/tasks to be displaced by the application of AI

C.- Most likely jobs to be created by the application of AI.

D.- Solutions given in the academic world to the potential negative effects of application of AI to global employment.

E.- Proposition of actions to be taken by decision makers to improve employment -in quantity and quality- with the application of AI.

As auxiliary points:

F.- Most influential variables on this phenomenon between AI and employment.

G.- The most adequate methodology to study the phenomenon.

## 1.6. Expected contribution to the literature

Our expected contribution is to propose models to identify, qualify and quantify the most important variables to be considered by decision makers such as managers, boards, companies, institutions and governments to contribute to accelerate and consolidate the application of AI with better consequences for competitive -therefore sustainable- employment in quantity and quality.

These models will include:

A.- The most important variables affecting AI applications, competitiveness and employment and their interrelation.

B.- Conditions for having available the most competitive AI applications, trying to have them earlier and cheaper than out competitors.

C.- Conditions to fulfil and constraints to overcome in order to apply AI efficiently.

D.- How to know and calculate the displaceable and non-displaceable tasks on any job on any AI application.

E.- How to know and calculate the increase of competitiveness on any AI application.

F.- How to foster the creation of new jobs on any AI application.

G.- How to train and integrate as active jobs the people displaced by AI applications.

H.- How to know and follow the current situation any time knowing what to do on any deviation -especially if it is negative-.

I.- How to answer “what if” questions any time.

## 1.7. Conceptual framework

### 1.7.1. Section 1: Academic debates and what is missing in actual literature?

General academic debate:

- What is the state of the art of the literature about the effects to employment with the application of AI and the solutions given by the authors?

Specific debates:

- First academic debate: Which type of jobs we know or expect to be more likely to be displaced by AI systems?

- Second academic debate: Which type of jobs we know or expect to be less likely to be displaced by AI systems?

- Third academic debate: What new jobs do we know or expect to be created because of the application of AI systems?

- Fourth academic debate: What solutions are proposed to solve the potential employment problems with AI applications?

**What is missing in actual literature?:** Many authors recommend to take actions to be prepared for the large global unemployment -case of the techno pessimists- or for the changes in types of jobs and for the gap -on employment and wages- between displacement and creation of jobs -case of the techno optimists-, because of the massive application of AI; but there is not any research that, accepting both positions, allows to understand all the variables that will decisively affect the results on employment, and the important effects that decision makers can have through their policies and actions, over employment any time that AI is applied on any reality.

**Proposition 1:** There is an automatic relation between the application of AI systems and the tasks displacement but not with jobs creation and therefore neither with Global Employment, because many important variables have a decisive influence in the jobs creation; therefore taking the correct decisions on the correct variables, we will get much better employment rates and we can avoid -or at least reduce- an unemployment -and wages- crisis because of the application of AI systems.

1.7.2. Section 2: What is the state of the art of the literature about the use of SD, mathematical models based on System Dynamics concepts, as research method for similar phenomenon?

**Proposition 2:** Using the SD as qualitative and quantitative method we will better understand the interactions among AI, competitiveness and employment. With this method we will make important contributions to the academic debate about the solutions for employment with the application of AI. We will also make proposals for actions and policies by decision makers about the important variables to improve

employment with the AI application. And finally, we want to give a tool to answer to “what if” questions on any application.

## 1.8. Focus and scope

### 1.8.1. Current realities to research

Our research is about C+I (companies and institutions), which could be independent or in a group, sector, cluster, region,...but we know that several variables external to C+I, which depend on governments, unions and the social situation, of each territory, will have a very important effect on the application of AI and the consequences for employment; therefore, we will include in the research those variables that depend mostly of the territory where the C+I are. On this step of the research we will develop models for C+I -Companies and Institutions- in which competitiveness is a critical factor to grow because they have to compete in the open market. Unfortunately, this is not the case of most of public service in Spain -and the same on other European Countries- for which competitiveness seems not to be important at all.

We expect that the results of the research should be valid for different economic, social and political realities in Spain, but also applicable in Europe and even to other realities in other areas of the world. The only condition, besides the competitiveness of jobs, is that the applier controls the reality where AI is applied. For example, the president of a group of different companies can apply our models to each company or to the global group; the Mayor of a City can apply to the whole City; the president of a Region to the whole region or by sector or cluster, etc.

#### 1.8.2. Space and period

The space is Spain, Europe, North Africa and the world with some adaptations.

The period is from 2010 to 2030 (past and future). Why this period? because before 2010 there is almost nothing about the current development of AI, and to go beyond 2030 will probably be too distant in time and scope for this technology -AI- that is advancing so fast that many human beings have neither yet understood nor assimilated what it can do for us.

#### 1.8.3. Scope of Analysis

C+I, corporations and institutions. To be expanded to any reality controlled by the applier. (the president of a group can apply our proposition in his group, the Mayor of a city in the city, the president of a region in the region, the president of a State in the State...).

#### 1.8.4 Hypotheses/propositions

With the correct policies and actions, on the correct variables, the application of AI systems could improve employment in quantity and quality, on any reality controlled by the applier.

### 1.9. Conferences and publication contributions from the author of this Thesis

The first author of this Thesis, the doctoral student, has actively participated on next events, valid for his doctorate:

**First Conference with presentation: 31<sup>st</sup> October and 1<sup>st</sup> November 2019.**

Conference: ECIAIR 2019 held at EM-Normandie Business School, Oxford, UK.

Subject of the Conference: Impact of Artificial Intelligence and Robotics.

**Given first conference:**

- Title: Proposition to use System Dynamics for Assessing the Impact of new Technologies on Employment.
- Date of acceptance: 25<sup>th</sup> June 2019.
- Date of attendance certificate: 31 October – 1 November 2019.
- Date of publication of proceedings: 1 November 2019.

**Second Conference with presentation: 14<sup>th</sup> November 2019**

Conference: AMENET by Jean Monnet Network; Tangier 14-15 Nov. 2019 at Abdelmalek Essaâdi University

Subject of the Conference: Acting to approaching regional integration: Africa, Mediterranean and European Union in a global age

**Given second conference:**

- Title: Europe, Africa and the digital revolution, a common future.
- Date of acceptance: 23<sup>rd</sup> June 2019.
- Date that I host my Conference: 14<sup>th</sup> November 2019.
- Date of attendance certificate: 14<sup>th</sup> November 2019.

**Paper published in Journal JCR**

Journal: DYNA.

Impact factor JCR 0.629 on 2018.

**Written paper:**

- Title: Digitalization, Competitiveness and Employment. A Systemic View Through System Dynamics” DYNA, Bilbao, Spain; DOI: <http://dx.doi.org/10.6036/9147>.
- Date of acceptance: 8<sup>th</sup> July 2019.
- Date of publication: 1st July 2020.

## Chapter 2. Literature Review

### 2.1. Introduction

Our major objective is to review the academic literature to better understand the actual debates in the Academy about the effects that applying AI will have on employment.

There are two recent literatures reviews about the future of work: One is from Chuang and Graham, (2018). This paper and its bibliography has had some contribution to this research, but its focus and scope are different than ours. Anyway, all its main conclusions and findings with some relation with AI and employment are included in this research specially its main finding: “The study concludes that HRD professionals should promptly re-examine their social responsibility relative to the technological influence on workers by focusing developmental efforts on employees’ human skills while assisting workers’ transition to a skill-polarized workplace. HRD professionals should play a major role in facilitating employees’ coexistence with robots in the workplace.” We fully agree with this statement.

The other existing literature review is from Balliester and Elsheikhi (2018). This paper and its bibliography have been also an interesting help for this research, but its focus and scope are different from ours because they are more global, as, for example, we have the next statement “More concretely, technology, climate change, globalization, and demography are seen as key megatrends within the context of the world of work and are projected to play a defining role in the upcoming years”.

Our selected bibliography is only a good sample of the ample ones written specially on last years. We have refused to include studies that scratch the fiction science and we have only included the most solid authors which base their opinions on evidences or previous studies.

### 2.2. Methodology for Literature Review

As methodology we have adapted the SLR method (Structured Literature Review) developed in 2016 by

Massaro, et al. in their paper “On the shoulders of the giants” to this research domain.

We divide this literature review on next main academic debates that we have identified.

#### 2.2.1. First academic debate

Which type of jobs are more likely to be displaced by AI?

Our first step to select the bibliography is to go to Google Scholar (not only because Massaro recommends it, but also because on the beginning of year 2018 we found just a few papers about AI and employment from other sources as WoS and Scopus) and look for papers about the first academic debate that we want to study.

We are initially using the key words: Artificial Intelligence, Robot, Employment. we limited our selection to publications from the year 2010, because we have noticed that most of the articles written before 2010 treat the AI very differently as we know it now, because then almost nobody knew the enormous evolution of AI on next years, and we limited our search to papers with the exact sentence “job displacement”.

We found 55 papers and we maintained the order of relevance established by Google Scholar.

#### 2.2.2. Second academic debate

Which type of jobs are less likely to be displaced by AI?

The bibliography for this second debate is the same as the one for the first debate because all authors writing about jobs displacement approach the more and the less likely jobs’ displacement. Anyway we used the sentence “jobs non displaced” and found 4 new papers that we also included.

#### 2.2.3. Third academic debate

Creation of new jobs because of the application of AI.

We continue using the key words: Artificial Intelligence, Robot, Employment.

We limit our selection to publications from year 2010 with the exact sentence “jobs creation”. We found 44 papers and we maintained the order of relevance established by Google Scholar.

#### 2.2.4. Fourth academic debate

Very connected with the previous ones: Solutions given in the academic world to the potential unemployment that could be created with the application of AI.

We are initially using the same key words: Artificial Intelligence, Robot, Employment in Google Scholar.

We limited our search to publications from year 2010, with the exact sentence “solutions given to unemployment”. We found 54 papers and we maintained the order of relevance established by Google Scholar.

After studying the more relevant articles and books selected for the four debates, the next ones stop offering new contributions to this research and then, we started to include articles and books from other sources specialists on employment and with the key words “The Future of Work” and “The Future of Jobs”, written on last years, mostly after 2016, because all of them treat the impact of the new technologies (notably robotics and artificial intelligence) on employment. We included also many bibliographic citations from the articles that most contributed to this research and

we focused on identifying a comprehensive structure for understanding this state of the art.

During the three years of the research many papers were published about the four debates, we studied most of them and we included in our bibliography the ones with new contributions to our debates.

### 2.3. Results from the Literature Review

#### 2.3.1. First debate: The more likely jobs to be displaced by the applications of Artificial Intelligence

It is generally accepted that AI applications will have a disruptive effects on employment, negative ones -displacing jobs- and positive ones -creating jobs- but being the debate of this point about displacement, we fully accept the definition of Frey and Osborne (2013; 2018) -accepted also by many other authors- assessing that any task that we can structure with rules and conditions that can be recognised by AI -currently we can include speaking, writing, noise, recognition of faces and of any other object or animal- will be displaced from humans and made by AI systems in machines, robots, drones or in any other device. We want to

highlight that the key word for a task to be displaceable is not anymore only routine -as it was before the current development of AI systems- but structure. In 2013 Frey and Osborne wrote “occupations mainly consisting of tasks following well-defined procedures that can be easily performed by algorithms are susceptible to computerization”. Taking in account that the current development of AI on year 2020 is much more than algorithms -we have advanced programs like Python, machine learning, reinforce learning, etc- we can expect that AI will displace more tasks that the ones calculated by Frey and Osborne.

We want also to highlight that the displaced are not full jobs -some will surely disappear- but the tasks inside each job which can be structured and therefore made by AI systems faster, cheaper and more accurately.

There are so many tasks that the humans have decided to structure -we show some occupations which will be more affected on next pages- that the cited Frey and Osborne arrived to the conclusion that in EEUU around 47% of tasks

made by humans in 2013 will be displaced by AI systems in around ten to maximum twenty years, that means by around 2030.

It does not mean that the more affected jobs will disappear -some will surely disappear- but the set human-AI will increase so much its productivity that we will need much less people for the same quantity of work. Besides increasing radically the productivity, very often the use of AI will become disruptive increasing also the competitiveness much more than just the productivity -we want to remember that competitiveness include not only productivity, but also quality of products, quality of services and trust and all of them can be disruptively improved by AI applications-.

This figure around 47% of tasks to be displaced is the comparative between the situation in 2013 and the situation around the year 2030; therefore it will happen gradually with a probably peak point around 2025, consequently we have time to manage the situation creating more and better jobs than the ones displaced as we will later explain.

It is clear that from 2013 to current 2020 many tasks have been already displaced and therefore we can expect that the percentage from 2020 to 2030 will be lower, but the current and expected development of AI till 2030 and our experience on jobs and tasks made in C+I, advises us to be cautious and maintain the expectations that around 50% of tasks made in 2020 by humans will be displaced by AI systems in around ten years.

We have also to accept that this time the displacement will affect to very well paid occupations like for example Radiologists -the best ones have more than ten years of study and training- in which, many tasks are based on data and are already being displaced by AI systems with more accurate results. We will see that increasing numbers of university-educated workers in the financial industries are being replaced by software that can do their jobs faster. That is a huge difference from past paradigm shifts. Opposite to this, many non-routine manual tasks that make up many of the unskilled jobs -such as cleaning of hotel rooms- will not

be likely affected by AI systems, because are very difficult to structure. (Thomson, 2017, p. 28).

The occupations at high risk of being automated -because they have many tasks easy to structure- are in trades, transportation and equipment operation, natural resources and agriculture, sales and service occupations, manufacturing and utilities, office support and general administration, and technical occupations in health, natural and applied sciences, as we later explain with more detail.

Opposite, jobs requiring higher levels of human skills, such as in the arts and culture, management and supervision, education, law and healthcare, are supposedly at lowest risk of being affected by AI applications.

The displacement will happen whether we like it or nor; the challenge for society is making it happen smoothly and evenly. In general, the question is not whether (or not) jobs will change but how they transition smoothly to new (and better) jobs. Forecasting models or systems which identify the risk of computerization and feasible pathways to another job for individuals, professions, industries and regions may

provide a powerful mechanism for proactive planning and managed transitions. Workers who have time, and options, to plan for change are likely to secure better outcomes. (Ford, 2015).

We must accept that the reality today with AI systems is far different. While lower-skill occupations will no doubt continue to be affected, a great many college-educated, white-collar workers are going to discover that their jobs, too, are squarely in the sights as software automation and predictive algorithms advance rapidly in capability. The fact is that “routine” may not be the best word to describe the jobs most likely to be threatened by technology. A more accurate term might be “predictable” or “structurable”. Could another person learn to do your job by studying a detailed record of everything you’ve done in the past? Or could someone become proficient by repeating the tasks you’ve already completed, in the way that a student might take practice tests to prepare for an exam? If so, then there’s a good chance that an algorithm -or better any AI system- may someday be able to learn to do much, or all, of your job.

It is also clear that to avoid applying AI system is not good for employment because that decision means to decrease competitiveness and therefore to reduce sales and employment likely more than because of displacement.

For the U.K., Deloitte (2014) finds that about 35 percent of jobs might disappear due to new technologies in the next two decades, but in the same study they highlight the following positive from the recent past:

- Over the last 15 years, the UK has benefitted from a technology-driven shift from low skill, routine jobs to higher-skill, non-routine occupations.
- Over 800,000 jobs have been lost but nearly 3.5 million new ones have been created.
- On average, each job created is paid approximately £10,000 per annum more than the lower-skilled, routine jobs they replace, resulting in a £140 billion net boost to the economy.
- Every region has benefitted from employment growth in higher-skilled occupations.

- Almost three-quarters of UK businesses surveyed, say that they will employ more people in future and most of them think that technology will have a significant or very significant impact on their businesses.
- In the future, businesses will need more skills, including: digital know-how, management capability, creativity, entrepreneurship and complex problem solving.
- The UK's continued success will rest on the ability of businesses and organisations, educators and government to anticipate correctly future skills requirements and provide the right training and education.

In a Delphi study conducted by the Bertelsmann Foundation, experts anticipate unemployment to continuously rise in both advanced and emerging economies,

reaching more than 20 per cent in Europe, and over 25 per cent in Latin and North America by 2050. With this research we try to prove that it is possible to avoid this unemployment.

We accept that there are studies and papers that arrive to different figures of displacement, -some much lower and other higher- as we show in our table 1.

There are also authors which think than the displacement process will be slower going further than 2030. (Balliester and Elsheikhi, 2018, p.10) -we do not agree with them-.

Table 1. Different studies in different Countries about the percentage of jobs at high risk of automation by AI systems

Research made by	Country	% of jobs at high risk of automation
ING-Diba conducted in 2015	EE.UU	89
ILO study 2016	ASEAN Countries	65

World Bank 2016	Developed Countries	66
Arntz Gregory and Zierahn (AGZ). 2016, 2017	OECD Countries	9
Frey and Osborne, FO. 2013, 2018	EE.UU	47
Deloitte 2014	U.K.	35
McKinsey 2015	EE.UU	45
PricewaterhouseCoopers 2017	EE.UU	38
PricewaterhouseCoopers 2017	U.K.	30
PricewaterhouseCoopers 2017	Japan	21
PricewaterhouseCoopers 2017	Germany	35
International Labour Organisation ILO 2016	ASEAN	56
Bowles 2017	EE.UU	47
Bowles 2017	Europe	54
Berriman and Hawksworth, 2017	EE.UU	38
Berriman and Hawksworth, 2017	U.K.	30
Berriman and Hawksworth, 2017	Germany	35

To know the effects of AI on employment it is totally essential to know if AI will likely displace 9% of current tasks made by human beings -as assures Arntz, Gregory and Zierahn (AGZ)- or will likely be 47% -as assures Frey and Osborne (FO)- both studies made for US (in Table 1 you can see studies with even larger differences).

We asked ourselves: ¿How so big differences are possible? ¿Is it because of the methodology or any other subjective variable?. Because one thing is clear: Both cannot be right.

After studying both propositions, meeting many specialists and doing advanced courses about what AI systems can do, we arrived to the conclusion that the key point is to understand and very well define what AI can and cannot do in its current development and in their development in next ten years, displacing tasks that today are made by humans. We arrived to the firm conclusion that Frey and Osborne FO -and all their supporters- have better than nobody else in the Academy, understood what the AI systems, current and the near future of next ten years, can and cannot do.

As FO wrote in 2018, “Our study wasn’t even a prediction. It was an estimate of how exposed existing jobs are to recent developments in artificial intelligence and mobile robotics. It said nothing about the pace at which jobs will be automated away. What it did suggest is that 47% of jobs are automatable from a technological capabilities point of view. As we pointed out back then: we focus on estimating the share of employment that can potentially be substituted by computer capital, from a technological capabilities point of view.”. There are even studies, besides the ones in table 1, that estimate extremely low the figures of displacement from FO. (Gulyas, Pytka, 2019). But they do not give their figures.

Frey and Osborne, that in 2018 ratified and explained their figures of displacement made on 2013, just gave a solid and realistic definition of jobs more likely to be displaced by new technologies -mainly AI systems- and explain that this displacement will happen regardless of the will of the people, because the new technologies will make the job/task much better, faster and cheaper than humans improving

disruptively the productivity and the competitiveness, therefore -as happened in agriculture or textile- everybody will apply the new technologies to survive.

Opposite than Frey and Osborne (FO), Arntz Gregory and Zierahn (AGZ) include the next corrections in their calculations arriving to only 9% of displaceable jobs/tasks in EE.UU.

“First, the utilisation of new technologies is a slow process, due to economic, legal and societal hurdles, so that technological substitution often does not take place as expected. Second, even if new technologies are introduced, workers can adjust to changing technological endowments by switching tasks, thus preventing technological unemployment. Third, technological change also generates additional jobs through demand for new technologies and through higher competitiveness”. (AGZ, p.6). As we deduce from this paragraph AGZ are correcting the calculations of FO with speed of applications, constraints, training and creation of new jobs; what they write is correct but FO and us think that we must not mix these points with

displaceability of jobs/tasks by new technologies. Also reading the full paper of AGZ we deduct that they think that displaceability will almost only affect to low qualified workers what means, in our opinion that they are not well aware about what AI can do and will be able to do on next years..

The displaceability of any task depends only of its structurability, therefore we accept that usually employees in high-skill occupations engage typically in less displaceable cognitive tasks but also employees in low-skill occupations perform no likely displaceable manual tasks (e.g., cooks and waiters, retail workers, protective services, personal care, groundskeepers, janitors).

It is truth that the labour market is becoming polarized with a growing concentration in high-skill level (cognitive non-routine) jobs and low-skill level (manual non-routine) jobs. Middle-skill jobs that involve structurable manual works are more likely to be replaced by machines and automations.

There are still authors that think that Polanyi's paradox -we can know more than we can tell- will still be valid in AI systems but it is not the reality because we can develop machines that infer tacit rules from context, abundant data, and applied statistics

Among chess experts, one of the most surprising things about AlphaZero is that it has learned strategies that extend beyond how humans play. Humans taught Deep Blue to play chess, but AlphaZero developed its own approach -one that humans could learn from- just giving it the rules to play chess. The software used is called Reinforce Learning RL and has been a very important advance to displace tasks which follow rules - for example many public jobs that by law have to follow strict rules-. Progress in RL is significant because it decouples system improvement from the constraints of human knowledge. RL is well suited for creating agents that perform autonomously in environments for which we lack training data but we know the rules.

Other very significant advance in AI has been transfer learning (TL) which enables programmers to apply elements

learned from previous challenges to related problems. TL can deliver stronger initial performance, more rapid improvement and better long-term results. By learning fundamental properties of language, TL powered models are improving the state of the art in language processing – in areas of universal utility. 2018 was a breakthrough year for the application of TL to language processing.

Generative Adversarial Networks (GANs) is reshaping content creation, media and society. Being an emerging AI software technique, GANs enable the creation of artificial media, including pictures and video, with exceptional fidelity. GANs will deliver transformational benefits in sectors including media and entertainment, while presenting profound challenges to societies -unfortunately is also being used to spread fake news through videos that seems very real-.

McKinsey Global Institute (2019) estimate that, compared to the industrial revolution of the XIX century, automation and AI's disruption of society is happening 10 times faster and at 300 times the scale. This kind of potentiality might affect

each job and every task, even if, in the case of AI, ‘matching tasks’ are the most prominent group (as, for instance, Uber, Airbnb, LinkedIn, Amazon). Indeed, automation is not confined to agriculture and manufacturing, but spreads to services. If, for instance, the regulated taxi service is considered, a ‘conventional’ taxi-driver is now challenged by more spread services (Uber) and, in turn, a Uber-driver might be (or will be) feat by self-driving machines making the Uber-driver job at risk.

It should be clear that not only occupation and education are relevant, but indeed the ‘routine/structure dimension’ comes into play. The routine/structure nature of jobs and tasks is the dimension that as to be considered. This evidence has induced to revise the SBTC “Skill-biased technical change” into the new ‘Task-biased Technological Change’ (TBTC) or ‘Routine-biased Technological Change’ (RBTC) or ‘Routine-replacing Technological Change’ (RRTC).

In general, most of the papers studying the role of automation on employment consider developed countries. However, also developing economies might be involved in

the direct adoption of AI systems or in an indirect effect connected to re-shoring of some production process phases back to developed countries. Indeed, much of the work available in developing countries is relatively unskilled and routine, repetitive and predictable in nature. These works are at high risks of being automated. In this regard, firms in developed countries may find it cheaper to automate certain processes instead of running the production abroad. The implication would be a further detrimental effect on employment in middle and low-income countries. For this reason, UNCTAD (2017) -United Nations Trade and Development- recommends that developing countries invest in digital technologies, if not the risk of lagging further behind might increase. Automation could lead the developing world into a low or middle-income trap, and even, according to Rodrik (2016), to a ‘premature deindustrialization’ in many of those countries.

The combined effects of multiple new technologies such as multi-functional sensors, learning robotics, the Internet of Things or 3D printing, are expected to be deep, wide in

scope and large scale and therefore, to generate unprecedented loss of jobs.

**Many authors support our assessments about this point, as the following ones:** (Frey and Osborne, 2013, 2018); (Smith and Anderson, 2014, p.26, 47, 52, 53, 59); (Chang and Hyunh, 2016); (Nübler, 2016, p.8, 13); (Pistono, 2014, p.47, 48, 67); (LaGrandeur and Hughes, 2017; p.5,6); (Thomson, 2017, p.27, 35); (Hajkowicz et al., 2016, p.20, 98); (Ford, 2015, p.16, 17); (Wisskirchen et al., 2017, p.31, 32, 36, 48); (Chuang and Graham, 2018, p.7, 9, 14); (Balliester and Elsheikhi, 2018, p.9, 11); (Roland Berger, 2016); (McKinsey Global Institute, 2016); (PwC, 2017); (World Bank, 2016); (Chang and Huynh, 2016); (The future of jobs, WEF 2018; p.24, 29); (Bowles, 2017); (Gries and Naudé, 2018, p.1); (Berriman and Hawksworth, 2017, p.30, 32, 34); (Brynjolfsson and McAfee, 2014, p.14); (Fari, 2018, p.11); (Eric Dahlin, 2019; p.6); (Autor, 2015, p.3, 5, 11, 23); (Autor et al. 2003, p.1); (Daugherty and Wilson, 2018, p.1); (Davenport and Kirby, 2016, Abstract); (WEF, 2016, p.3); (Barro and Davenport, 2019, p.4, 5); (Torres, R.

2019 article); (Barbieri, et al. 2019, p.4, 8, 11, 12, 14, 17); (Gallo, 2019, article in 60 minutes magazine); (Kelnar and Kostadinov, 2019, p.12, 13); (Anderson, J. 2018); (Antonescu, 2018); (Arntz et al. 2016); (Autor, 2015); (Autor et al. 2017); (Barbieri et al. 2019); (Bessen, 2016); (Cheatham et al. 2019); (Chuah et al. 2018); (Chui et al. 2018); (Czarniswka et al. 2020); (Dekker et al. 2017); (Fekry, 2019); (Grace et al. 2017); (Grosz et al. 2016); (Gumbel, 2018); (Hazan et al. 2018); (Ilyas et al. 2020); (Kaakandikar et al. 2020); (Leduc et al. 2019); (Madhavi, 2019); (Marengo, 2019); (ÖZCAN, 2019); (Santana et al. 2020); (Shewan, 2017); (Teng et al. 2019); (Vidyadevi, 2020); (Wolf, 2015); (Gulyas and Pytka, 2019).

**What is the author's' position about the occupations more likely to have a high percentage of tasks entering on this definition of displaceable tasks?**

**All kind of manufacturing and construction**

In direct manufacturing everything is structured, therefore likely almost 100% of tasks are displaceable and therefore the tendency is to have very few employers in manufacturing. In general all the companies that manufacture have also other occupations with less structurable tasks as management, sales, RRHH, I+D,... Which will continue having employees; consequently manufacturing on next years is going to have very few direct jobs but many indirect jobs creating high value to society.

Automation in manufacturing is something happening since centuries ago displacing all the repetitive jobs; but with AI systems, any structured task, it does not matter how sophisticated it is, is going to be displaced. We are soon having smart factories with no employees in manufacturing, but only AI systems -robots, drones, 3D/4D printing machines,...-.

3D/4D printing is a way for software to send design plans to specialty printers and have those devices make exact copies of those goods or products. They can send the specifications by Internet anywhere around the globe and have machines

make a copy for the customer and have the product immediately available to that person or organization. It is evident that fewer design people and factory workers will be needed in this situation.

Construction will also be very affected because we have already available robots that can lay bricks 20 times faster than a human, cranes with AI and besides, many elements for the construction are produced by 3D/4D printing machines with AI.

The fragmentation of production processes is another form of process innovation which facilitate the displacement of jobs. Fragmentation is achieved by dividing the process into different tasks to be performed by different workers, firms or countries. This long-term trend of expanding and deepening fragmentation of production systems has enhanced efficiency through economies of specialization and agglomeration, but it has the potential to destroy jobs.

A good example of this problem is the clothing industry, in which garments are still often produced by hand in

low-labour-cost countries, although the work could easily be done by machines because much of it is very easy to structure. The AI machines producing garments will displace many jobs but not in developed countries but in low labour cost countries. This will be a very grave problem for countries with many jobs specialised in low cost structured tasks.

**Most relevant authors supporting our assessments about manufacturing and construction:** (Smith and Anderson, 2014, p.22, 31, 66, 77); (Darrell, 1985, p.6, 8); (LaGrandeur and Hughes, 2017, p.4); (Kozubíková, 2016, p.218, 220); (Nübler, 2016, p.14); (Pistono, 2014, p.63); (Hajkowiec et al., 2016, p.60); (Wisskirchen et al., 2017, p.16, 119); (Chuang and Graham, 2018, p.3); (Balliester and Elsheikhi, 2018, p.13); (Hammer, 2019).

#### **Transportation and logistics in general**

We already know fully automated logistic warehouses giving non stop services 365 days/24 hours with no mistakes; this is an unstoppable tendency.

Also the autonomous driving is very advanced, already used in closed areas and in trial in several cities. This is also an unstoppable tendency that we think that will be generalised not later that year 2030, starting by urban areas and overall because of accidents reduction.

Those two tendencies will displace millions of jobs all over the world -truck drivers, delivery people, and taxi operators- but especially in developed areas like Europe, EEUU, Japan,...

We do not must forget the drones, not only for moving and delivering thins but also for people mobility.

#### **Most relevant authors supporting our assessments about displacement in transportation and logistics in general:**

(Smith and Anderson, 2014, p.1, 11, 57); (Darrell, 1985, p.3); (Thomson, 2017, p.55); (Ford, 2015, p.36); (Wisskirchen et al., 2017, p.11, 58, 59); (Balliester and Elsheikhi, 2018, p.12); (Frey and Osborne, 2013, p.45); (WEF, 2016, p.5).

**Service sector in general.**

From the previous decades, we got habituated that the unemployment can be dissolved in the service sector, but it will also change. Fewer jobs will be e.g. in supermarkets, where the human work will be gradually replaced by vending machines or computer systems, for example by the automatic cash or by internet sales. Either work in traditional stores will become progressively automated in reason of competitiveness. If Walmart starts an aggressive automation strategy can be displaced around two million unskilled people.

The structurable services will be displaced by AI systems but many expensive non structurable services could be outsourced to low cost countries with many trained people, specially in new technologies. This is an additional risk for jobs in services, besides the displacement.

The production of fast food -like hamburgers- is very easy to automate and displace many jobs in fast food chains all over the world.

The new AI systems can be used for any structurable service in any sector as legal, engineering, etc.

While many retailers may choose to bring automation into traditional retail configurations, others may instead elect to entirely redesign stores—perhaps, in essence, turning them into scaled-up vending machines. Stores of this type might consist of an automated warehouse with an attached showroom where customers could examine product samples and place orders. Orders might then be delivered directly to customers, or perhaps even loaded robotically into vehicles. Regardless of the specific technological path ultimately followed by the retail industry, it's difficult to imagine that the eventual result won't be more robots and machines—and significantly fewer jobs for people.

The before automated technology can perform tasks that were once done by gas station attendants, bank tellers, travel agents, farmers, call service centres, and grocery store cashiers, while AI systems are capable of performing more complex tasks and can replace assembly line workers, surgeons, baristas, and legal practitioners.

Academic world, where the replacement robots are in clear sight will also be affected by displacement. The Massive Open Online Courses (MOOCs), which allow students anywhere in the world to download lectures produced by video experts, with access to chat rooms for discussions, are very positive for global education and training but, for sure will also displace jobs.

AI will have had a substantial impact on white-collar jobs, particularly back-office functions in clinics, in law firms, like medical secretaries, transcriptionists, or paralegals.

The field of lawyers currently employs many thousand people to review documents. They are already being replaced by predictive coding algorithms. By 2025, those jobs will not exist for any but the opaquest documents and thus there will be many thousands of lawyers out of work. I find it difficult to imagine any industry which more knowledge is and thought intensive than law and we are already being replaced by AI systems.

We see already many consumer services (banking, food, retail, etc.) moving to more and more self-service delivery via automated systems.

Virtually all customer service work involving telephonic and online contact with human beings will be rendered unnecessary by better communications and computing services and by AI.

We understand that many customer service are not possible to structure, e.g. Detecting complaints is an AI problem. Sending the complaints to the correct customer service entity is an AI problem. But customer service itself is very often a human problem which should be solved by humans.

**Most relevant authors supporting our assessments about displacement in service sector in general:** (Kozubíková, 2016, p.218, 219); (Fráguas Nobre, 2018, p.21); (Nübler, 2016, p.16); (Pistono, 2014, p.56, 67); (Ford, 2015, p.32, 35, 39, 69); (Wisskirchen et al., 2017, p.10, 26); (Chuang and Graham, 2018, p.10); (Smith and Anderson, 2014, p.1, 12, 28, 30, 47, 55, 56, 57, 62, 63, 77); (Darrell, 1985, p.4, 5, 9); (Wisskirchen et al., 2017, p.10, 36); (Frey and Osborne,

2013, 2015, 2018); (Balliester and Elsheikhi, 2018, p.12, 13, 14); (Freeman, 2015; p.7); (Berryhill et al. 2019); (Bharadwaj, 2019); (Teng and Huafeng, 2019).

### **Health care.**

In the healthcare industry, AI and Robotics will also displace jobs across the sector, from MDs -Minimum Data set- , to nursing staff, to allied health professionals and support staff.

The biggest impact from AI on MD's will likely be medical diagnosis. Today, AI tools have already shown better accuracy at diagnosis than MD's. Medical research completed by MDs will also be supported by AI which can scan thousands of documents and identify trends for further analysis.

For nurses and allied health professionals, most of the routine and structure tasks will be replaced by AI systems, as will happen in all other sectors. The focus for human employees will shift towards caregiving roles and away from repetitive or easy to structure tasks.

When it comes to privacy of medical data, of course people don't want their records hacked by criminals. But consumers are ready to share their information when it's in their clear interests to do so, and when it's shared with the right people. More and more people are turning to wearable health devices connected with AI systems that will make diagnosis faster, easier, cheaper and more accurate, but of course needing less people for the same work.

When it comes to the impact of AI systems on jobs, we see ample evidence to put hopes over fears. Take the question of potential worker displacement through automation. Accenture Research in 2018 concluded a study of future workforce trends, including in health care, and the data point to significant growth for the industry, both in terms of jobs and revenues, as AI moves beyond rudimentary automation and enables greater collaboration between humans and machines. The data predict that, from 2018 to 2022, employment in health care will increase by 15% while revenues will surge by 49%.

Much of that growth will come from three new ways in which smart machines will enable humans to improve performance.

The first is by amplifying people's natural abilities, enhancing their insight and intuition through the use of powerful analytics and copious historical data. A Harvard-based team of pathologists, for example, recently developed an AI-based technique to identify breast cancer cells with greater precision. Using the new method, they were able to increase their accuracy from 96% to 99.5%.

The second way is by interacting with people through novel types of interfaces such as voice, emotion, or gesture recognition. In elder care, robots can help overburdened caregivers by reminding patients to take medication, lead them through physical and cognitive exercises, and provide them with companionship. Chatbots can help mental health professionals serve many more patients a day. Machine learning tools can help with the screening and treatment for autism. Philips has developed an AI-based tool, Illumeo, for radiologists. One of the tool's features is that it displays contextual information about a patient alongside the images, so a radiologist doesn't have to hunt for that information. It can also anticipate the radiologist's needs. It might, for

example, recognize the anatomy of the radiological images and automatically suggest the correct tool set such as one that can measure and analyze blood vessels.

The third way that smart machines are helping humans is by embodying physical attributes that work to extend people's capabilities beyond their natural limits. A good example of embodiment in the healthcare field is robot-assisted surgery: Instead of using a scalpel, the surgeon sits at a console and nudges a joystick that controls robotic arms. This AI-assisted technology has been a huge asset for certain types of surgeries that require incredible precision — for instance, when a doctor has to remove an overgrown retina membrane that's only a hundredth of a millimeter thick. By eliminating human jitters and involuntary tremors, robot-assisted surgery can help significantly improve the success rate of such operations.

The above examples are just a few of the many that illustrate the power of human-machine collaborations in which each party does what it does best: people's intuition, creativity, teamwork, and social skills combined with a machine's

precision, speed, scalability, and quantitative capabilities. Such collaborations are the future, enabling companies to reimagine their work processes, and this transformation is happening in one industry after another. That's cause for considerable optimism.

For example, home health aides only have an eight percent automation potential by 2030, while registered nurses have a 29 percent automation potential and medical assistants have a 54 percent automation potential.

Additionally, healthcare practitioners and technical occupations have a 33 percent current-task automation potential and healthcare support occupations have a 49 percent potential.

We will see more and more robots in health care and care of the elderly. But probably these may not be humanoid robots, but devices designed to work in specialized spaces designed for them.

We expect basic telemedicine applications/robots serving a significant portion of healthcare needs for rural and poor populations by 2025, with robot-doc-in-a-box pods dispersed

throughout the country that can automatically take blood pressure, draw blood, and other simple diagnostic procedures.

According to medical professionals, we've been able to show significant reduction in hospital admissions through these and other kinds of wireless devices. There also are devices that measure "biological, chemical, or physical processes" and deliver "a drug or intervention based on the sensor data obtained.

Companion robots attempt to improve quality of life through interactivity and social ability. In conjunction with wired "smart homes", it is possible integrate robots into the day-to-day lives of senior citizens and improve their medical treatment.

Women traditionally have entered positions that focus on caregiving. The sick and infirm no longer require a human being to measure certain conditions but can do so through "intelligent family care assistants" that track their health.

In some cases, machines are able to work faster, more accurately, and more efficiently than the best humans. It will

no longer be possible to imagine hospitals without robots in the future. Their tasks will be, for example, to move people out of their wheelchairs or their beds or even help the doctors to perform surgery on people. Additionally, software technology based on artificial intelligence, called ‘Watson Health’, will help doctors to diagnose various illnesses by reconciling patient data with medical knowledge collected in a cloud.

AI robots are already able to assume assistive functions and to work together with humans. This will be particularly important in the nursing care sector. Whereas many people refuse to be nursed by a robot for ethical reasons, it is assumed in practice that it won’t be possible to imagine hospitals without nursing robots in the future. Their tasks are, for example, to move people out of their wheelchairs or beds or to help blind people find their way.

The developments of robots to aid surgical procedures and health care have proven -as in all other sectors- that AI systems can do structured jobs better than humans. A growing concern related to the effect of the escalated use of

computers, robotics and artificial intelligence on employment structure and technological unemployment, as well as their effects on the economy and society, was strongly emphasized in the literature.

**Most relevant authors supporting our assessments about displacement in health care:** (Smith and Anderson, 2014, p.1, 31); (Darrell, 1985, p.5, 6, 9, 10); (Wisskirchen et al., 2017, p.37, 54); (Chuang and Graham, 2018, p.10); (LaPointe, Jacqueline, 2019); (Wilson and Daugherty, 2018); (Suarez, David, 2018); (Accenture Strategy, 2018); (Javaid and Haleem, 2019a, 2019b); (Jesus, 2019).

### **Translators**

Will be one of the occupations more affected by displacements as AI systems are radically improving the recognition of human speech and the automatic translation from one language to any other, specially to the most used languages.

Children learn language by listening to others and detecting patterns in the language. Similar to children, pattern

recognition is used in the form of AI called Neural Machine Translation (NMT). NMT uses an electronic, neural network trained to recognize patterns in the input data set and translate it into a desired output data set. For example, for Mandarin to English translation, the network would be trained by receiving input of millions of Chinese Mandarin and English language pairs.

The computer would receive a Mandarin sentence and then will guess what the English sentence would be. It will then be told how accurate its translation was relative to the correct English translation pair. Repeated millions of times, the computer will learn how to be more and more accurate. Human engineers would then test the system with a new sentence not used during training to see if the system had learned how to generalize.

Google Translate uses NMT and it's not bad for widely spoken and written languages like Mandarin and English. However, if you expand to less widely used languages like Samoan, you can get inaccuracies. It's estimated that by 2022, most business translations will be done by NMT with

human editors to come in after to clean up the text. This is not hard to believe as NMTs can translate materials at very low to no cost as well as go through a much higher volume of text at a faster rate than humans.

Aside from text to text translation, there have also been incredible advancements in live speech translation, also known as interpretation. Items like Google's Pixel Buds, Waverly Labs' Pilot, and Bragi are hearables (electronic ear buds) that can translate speech of one language live and play the audio back to you in your native language. Though not perfect--hearables have issues isolating human voice in a noisy environment and are still not close to the level of a professional interpreter--they're still good enough to assist millions of travelers and businesses each year.

Humans may soon get to a point, through the help of AI in the form of an NMT system, a hearable, or some other technology, where every language is understood.

Of course these advances mean that many human translators will be displaced by AI systems no later than 2030.

References: (Shih, 2019); (Downie, Jonathan; 2019).

### **Prostitution**

As most of clients of prostitution are looking only for sexual pleasure and not for human feelings, this is a sector very easy to be displaced by AI robots equipped with everything that clients are looking for.

**Most relevant authors supporting our assessments about displacement in prostitution:** (James J. Hughes, 2014; p.3,4); (Chuang and Graham, 2018, p.10).

### **Real estate, agriculture, entertainment, and wildlife management:**

AI Drones are being used in real estate, agriculture, entertainment, and wildlife management. People employ them to detect and photograph property monitor pest infestations in crops and manage wildlife sanctuaries. These tasks are being made by people, therefore will be totally displaced.

The agricultural sector is also affected by AI systems displacement of tasks, particularly in developed countries. In the United States, for instance, agriculture, forestry, fishing

and hunting is expected to eliminate 223,000 jobs by 2022, even if the employment in these sectors is not very high.

The Internet of Things is being applied to agricultural processes and is being developed an Internet of Living Things. This contains sophisticated sensors embedded in fields, waterway, and irrigation systems that connect with AI systems which are set to maximise production in an environmentally friendly manner. Many of these future agricultural technologies require little labour: The Japanese company Spread, for instance, has recently announced that modern technologies will carry out all, but one activity required to grow tens of thousands of lettuces each day in its indoor automated farm.

**Most relevant authors supporting our assessments about displacement in real estate, agriculture, entertainment, and wildlife management:** (Darrell, 1985, p.6); (Balliester and Elsheikhi, 2018, p.13).

### **People working in journalism because of automated journalism:**

As of now the automated journalism is mainly used for sports, finance, business, market, and real estate reporting. We will not go so far as to say that the algorithms developed today can displace many journalists.

Really we do not expect software to write an editorial about the lack of human rights in China any time soon. But we must remember that to disrupt an industry you do not need to replace all jobs within it, just a significant fraction.

We have already seen how Google news has already affected news sites by collecting articles into categories and creating personalized news feeds, faster and better than any human could.

In January 2016, the Associated Press (AP) revealed that a software program called Wordsmith has been rolling out content since July 2014 without any human intervention. This Wordsmith software has been generating 1000 stories per month, mostly about financial matters, which is 14 times more than the previous manual output of AP's reporters and editors.

**Most relevant authors supporting our assessments about displacement in journalism:** (Pistono, 2014, p.65, 66); (LaGrandeur and Hughes, 2017, p.5,6).

**AI assistants:**

AI assistants are used in a variety of real-world applications: Google's autonomous cars, search results, recommendation systems, automated language translation, personal assistants, cybernetic computational search engines, and IBM's super brain Watson.

Intelligent assistant systems can simplify or even perform a part of the employees' daily work. This applies to individual physical and cognitive working steps to the same extent.

**Most relevant authors supporting our assessments about displacement in AI assistants:** (Pistono, 2014, p.66); (Wisskirchen et al., 2017, p.10, 17, 18, 49); (Nübler, 2016, p.12, 14); (Thomson, 2017, p.36); (Chuang and Graham, 2018, p.7, 11, 13, 14); (Grace et al., 2017; p.1); (Hajkowiec et al., 2016, p.17); (Smith and Watson, 2018; p.7); (Balliester and Elsheikhi, 2018, p.15).

**Personal summary and conclusions about the first academic debate: The more likely tasks to be displaced by Artificial Intelligence**

Till recently -year 2019- the automatic systems, robots and machines have displaced only routine tasks, but from nowadays and growing on next years, the AI systems will make any task that we are able to put under rules and then to make the algorithms to follow those rules.

But with Reinforcement learning (RL), we do not even need to make the algorithms, because just giving the machine the rules of the system, it is able to create their own algorithms and find the best solution faster, without mistakes and cheaper than humans. For example, with RL AlphaGo Zero in only 40 days surpasses all other versions of AlphaGo and, arguably, becomes the best Go player in the world. It does this entirely from self-play, with no human intervention and using no historical data, just giving the system the rules of the game.

Modern Artificial Intelligence (AI) -‘machine learning’- enables software to perform difficult tasks more effectively

by learning through training instead of following sets of rules. Deep learning, a subset of machine learning, is delivering breakthrough results in fields including computer vision and language processing, surpassing the capacity of human in specific tasks which need vision and language.

Transfer learning (TL) enables programmers to apply elements learned from previous challenges to related problems. TL can deliver stronger initial performance, more rapid improvement and better long-term results.

By learning fundamental properties of language, TL powered models are improving the state of the art in language processing in areas of universal utility. 2018 was a breakthrough year for the application of TL to language processing.

TL is also: enabling the development of complex systems that can interact with the real world; delivering systems with greater adaptability; and supporting progress towards artificial general intelligence, which remains far from possible with current AI technology.

Generative Adversarial Networks (GANs) will reshape content creation, media and society. An emerging AI software technique, GANs enable the creation of artificial media, including pictures and video, with exceptional fidelity. GANs will deliver transformational benefits in sectors including media and entertainment, while presenting profound challenges to societies -not only positives but also negative as fake news very difficult to detect as fake-.

**Therefore:**

**We fully accept the definition of Frey and Osborne -accepted also by many other authors cited in this thesis- and therefore we assume that around 47% of current tasks made by humans in developed countries will be displaceable by AI systems, progressively from 2020 to 2030. It does not mean that the jobs displaced disappear -some will surely disappear- but the set human-AI will double its productivity and therefore we will need half the people for the same quantity of work. Besides**

**doubling the productivity, very often the use of AI will become disruptive increasing the competitiveness much more than just the productivity. This figure around 47% to be displaced is the comparative between the current situation -at January 2020- and the situation around the year 2030; it will happen gradually with a probably peak point around 2025, then we have time to manage the situation creating more and better jobs than the ones displaced.**

**The Frey and Osborne short definition of displaceable tasks is: Any task that we can structure with rules and conditions that can be controlled by AI -currently we can include speaking, noise, recognition of faces and of any other object or animal- will be made by AI in machines, robots, drones or any other device (notice that the key word to be displaceable is not anymore routine but structure).**

**We finally add that any job made by any person has some structured tasks, logically some occupations more than others, but it does not depend neither on studies and titles, nor on experience or the high or low paid occupation, it only depends if the tasks developed in the occupation by the job are more or less likely to be structured or not.**

2.3.2. Second debate. The less likely jobs to be displaced by the applications of Artificial Intelligence (less displaced does not means non-affected):

There is general agreement that jobs/tasks that require uniquely human characteristics such as empathy, creativity, judgment, critical thinking, synthesizing, problem-solving, inspiration, compassion, creativity and innovation -including abilities to negotiate, persuade, and care- will not be displaced by AI systems, at least before 2030 -in our personal opinion, likely never-. An AI system can dial Mom's number and even send flowers, but it can't do that most human of all things, emotionally connect with her.

AI devices calculate better than human beings, but they are not creative and don't have judgment. They operate according to laws, and law has from the beginning needed human intervention to prevent it from behaving like an idiot. Humans will always have the need for affective and embodied interactions with other humans, which can never be replaced by robots. This will particularly be the case in the context of healthcare, education, childcare and the care of the elderly. The attempted introduction of too many robotic devices may well lead to a backlash, in which humans who can provide care and education will become valued. There are always going to need to be areas that need a human's touch.

Many tasks are and will be immune to displacement by AI systems besides the uniquely human tasks we have some service works -sometimes not highly paid- that require flexibility and adaptability to unexpected events and therefore very difficult to structure.

We expect some improvement on income distribution that can be explained by what is known as Moravec's Paradox after Moravec (1988) who wrote: "very often high-level reasoning requires very little computation while low-level sensor-motor skills require enormous computational resources" and also "It is comparatively easy to make computers exhibit adult level performance on intelligence tests or playing checkers, and difficult or impossible to give them the skills of a one-year-old when it comes to perception and mobility".

A good example of this paradox is that highly paid radiologists are being easily displaced by AI systems while low paid people cleaning hotel rooms are very difficult and expensive to be displaced. Similarly will be hardest for AI systems to replace the tasks and jobs that some workers in the lower-skill level occupations perform, such as security staff, cleaners, gardeners, receptionists, chefs, and the like. A second positive impact of AI on income distribution may be, as Acemoglu and Restrepo (2017a) illustrated, that AI

may lead reduce the wage gap due to high-skill automation.

High-level reasoning uses a set of formal logical tools that were developed specifically to address formal problems: For example, counting, mathematics, logical deduction, and encoding quantitative relationships. In contrast, sensorimotor skills, physical flexibility, common sense, judgment, intuition, creativity, and spoken language are capabilities that the human species evolved, rather than developed.

We can predict a truncation in the current trend towards labour market polarisation, with computerisation being principally confined to low-skill and low-wage occupations. The findings of Frey and Osborne imply that as technology races ahead, low-skill workers will reallocate to tasks that are non-susceptible to computerisation -i.e., tasks requiring creative and social intelligence-. For workers to win the race, however, they will have to acquire creative and social skills. Proponents of the job polarization view also would expect industrial robots to have a negative effect on middle-skill jobs, especially routine middle-skill jobs, and no effect

necessarily on many low-skill jobs such as a line cook or a hotel housekeeper because these jobs involve variable manual tasks that are difficult to automate.

For us it is evident that AI will create complementarities between humans and robots, and these interdependencies will make human labour more valued, not less valued.

In Autor, Levy, and Murnane (2003), we distinguish two broad sets of tasks that have proven stubbornly challenging to computerize. One category includes tasks that require problem-solving capabilities, intuition, creativity, and persuasion. These tasks, which we term “abstract,” are characteristic of professional, technical, and managerial occupations. They employ workers with high levels of education and analytical capability, and they place a premium on inductive reasoning, communications ability, and expert mastery. The second broad category includes tasks requiring situational adaptability, visual and language recognition, and in-person interactions, which we call “manual” tasks. Manual tasks are characteristic of food preparation and serving jobs, cleaning and janitorial work,

grounds cleaning and maintenance, in-person health assistance by home health aides, and numerous jobs in security and protective services. These jobs tend to employ workers who are physically adept and, in some cases, able to communicate fluently in spoken language. While these activities are not highly skilled by the standards of the US labour market, they present daunting challenges for automation. Equally noteworthy, many outputs of these manual task jobs (haircuts, fresh meals, housecleaning) must be produced and performed largely on-site or in person (at least for now), and hence these tasks are not subject to outsourcing. The potential supply of workers who can perform these jobs is very large.

We definitely think that AI is incapable of building trust between two people (or between customers and a company). It cannot inspire teamwork, show passion or exhibit empathy because it has no imagination.

**Most relevant authors supporting our assessments about the less likely jobs to be displaced by AI systems:** (Smith, Anderson, 2014; p.6, 11, 46, 47, 48); (Pistono, 2014,

p.80); (Chuang and Graham, 2018, p.9); (Acemoglu and Restrepo, 2018; p.12); (Wisskirchen et al., 2017, p.57); (Balliester and Elsheikhi, 2018, p.12); (The future of jobs, WEF 2018; p.21, 24); (Van de Gevel and Noussair, 2013, p.17); (Acemoglu and Restrepo 2019a, 2019b); (Gries and Naudé, 2018, p.5); (Berriman and Hawksworth, 2017, p.39); (Frey and Osborne, 2013, p.45); (Dahlin, 2019; p.2, 5); (Daugherty and Wilson, 2018); (Autor, 2015, p.4, 11, 12, 27); (Autor, Levy, and Murnane 2003); (Gallo, C.; 2019, article in 60 minutes magazine); (Manzo, 2019); (AI Finland. (2019); (Aleryani, 2019).

**Following we show examples of occupations with less likely displaced tasks.**

**Personal services in which human characteristics are very important as: Aged care, working with babies, rehabilitation, disability services, many businesses related with leisure as quality hotels, restaurants, cruises, etc., personal training, housemaid (very complicated and**

**expensive task for AI systems).** (Smith and Anderson, 2014, p.6, 44, 45, 46, 47, 48, 62, 63, 76); (West, 1985, p.8); (Pistono, 2014; p.49, 76); (Thomson, 2017; p.53); (Ford, 2015; p.18, 36); (Wisskirchen et al., 2017; p.26, 35, 36); (Chuang and Graham, 2018, p.7, 13); (Brynjolfsson and McAfee, 2014, p.112); (David and Dorn. 2013, p. 38).

**Other areas that will be resistant to displacement of jobs are all kind of sports competitions, symphony orchestras, craft brewing, ballet, fine art.** (Smith and Anderson, 2014, p.46, 54, 58); (Wisskirchen et al., 2017; p.34).

**Personal summary and conclusions about the second debate: The less likely tasks to be displaced by Artificial Intelligence**

**Jobs/tasks that require uniquely human characteristics such as empathy, creativity, judgment, critical thinking, synthesizing, problem-solving, innovating, intuition, compassion, inspiration, human communication, entrepreneurship, emotional and relational work, are**

**much less probable to be displaced because are very difficult to be structured -in our opinion these tasks will never be made better than humans-.**

There are many jobs with a high percentage of tasks with these characteristics as we explained before.

There are many estimates about the percentage that each group represents -more and less likely to be displaced- but we can probably accept that the global percentage is around 50% in the economically advanced countries like EEUU and Europe. Does that means that around 50% of actual jobs will be displaced by AI? No, it does not, because many jobs affected by displacement will remain but the 50% of tasks made currently by humans will be made by machines -more rapidly, efficiently and cheaply- and the humans will have twice as much time for human activities doubling their productivity, therefore doing twice more with the same people. This process will be gradual and will take around 10 years from now -January 2020- then we have time to react creating jobs and improving employment on quantity and quality.

People will be empowered by AI, but people must understand and interpret correctly what machines can and cannot do. Not everybody must study STEAM, but everybody must understand what AI can do for them and must use the AI for all their possible structured tasks based on data -or any other way of information that can be controlled by AI, as sounds, words and vision,- and not on human feelings.

### 2.3.3. Third debate. New jobs creation because of AI applications

There is an important debate about the jobs that will be created thanks to the application of AI; in this debate it is almost a general agreement about the kind of jobs that will be created but not about when and how many, compared with the displaced ones. This is the reason why we have techno-optimists and techno-pessimists authors.

Grouping the different authors' positions about jobs' creation, we make the next groups.

**New jobs created for the research, production, application, maintenance and improving of new technologies, which we call jobs created by AI technology companies.** These new jobs are already being created and the creation will grow a lot with the massive application of AI.

First, people make technology, and since technology becomes obsolete at an increasingly accelerated pace, the need for people who make it will only grow; second, people are required to maintain technology, technology is notoriously poor at taking care of itself; third, people are also required to assist other people in using technology; and fourth, most technologies require new labour forms. Also, the new AI systems -robots, learning machines etc.- need to be developed, designed, built, maintained and repaired. Moreover, the rise of digital technologies require software and the development of algorithms. The Internet of Things and the collection and commercial use of Big Data will require fundamentally new software development activities,

as well as major activities in research and development. These new activities in the R&D and capital industries have high potential to create new jobs and occupations.

While advances in technology might displace jobs, these losses will be more than made up for by new jobs designing, building, servicing, and utilizing the same technologies that are displacing other types of work.

Already there are and will be tremendous demand for experts to design, test, implement, and refine smart automated AI systems, generating more jobs in the future. We do not forget the need of more and more people to produce, sell, train and improve the new AI systems.

Technology local companies must adapt basic AI research to the current needs of local companies and this is also an important local research that will create many jobs.

The employee should also be able to understand machines and software critically. There is an increasing demand for employees who can work in strategic and complex areas. It is not necessary only to oversee machines, but also to coordinate them. The interfaces between humans and

machines and the overlaps in the area of responsibility among the more flexible humans must also be coordinated. There is thus likewise an increasing demand for future executive staff with social and interdisciplinary competence. The sector 'teaching professions' covers not only the areas of school, university and vocational training, but in particular, possibilities of further and advanced training for adults. This professional group benefits from the need of companies to spend more money on the education of employees and the achievement of further key qualifications for new and existing employees.

**Most of the authors agree that this type of jobs creation is, and will be, very important but we think not enough to compensate for the displaced jobs.** (Smith, Anderson, 2014; p.39, 42, 43, 44, 45); (Nübler, 2016, p.13, 17, 18); (Kozubíková, 2016; p.218); (Wisskirchen et al., 2017; p.20, 21, 34); (Wilson, et al., 2017, p.4); (Shewan, 2017, journal article).

**New jobs created because of the development of new businesses with the new technologies, mainly AI systems.**

We think, with many authors that this group will be one of the most important new jobs creator on next ten years, because most of the new AI systems are created not for displacing tasks but for improving competitiveness by making better products and services and even making disruptive new products and services creating new markets and blue oceans.

It is a large agreement that many of the new jobs will be related with STEAM (Science, Technology, Engineer, Arts, Mathematics) and based in AI, Robotics, Drones, 3D/4D printing, IoT, autonomous driving (as remote-controlled vehicle operators), open-source big data technologies, distributed systems, machine learning, based in modern data analytics tools to apply in all sectors and activities.

Many authors support that creating one high-tech job will create between 2.5 to 4.4 other jobs in the local area, mostly in low-skilled and medium-skilled in-person services. The same forces that displace certain jobs create entirely new

types of employment, some of which we can only imagine today. These AI systems will, however, change the kind of work people do, AI will replace many service and manufacturing jobs, but will open up more possibilities in tech and development.

Applications of AI may enable the educational system to become more customized, and in the process create more jobs for education professionals to monitor, design and implement individualized education programs. Similar prospects exist in health care and elderly care services.

Increasingly, people don't hire a company to mow their lawn or configure their new computer but instead hire an expert directly through online platforms. In this new talent-as-a-service model, the traditional employer/worker relationship is replaced by a client/supplier relationship where we are all both employers and workers, depending on what service we need or are offering. Many jobs are being created and will be created through online platforms.

According to the World Economic Forum (2015), advances in 3D printing might reduce the amount of labour needed in

production and logistic, but these negative employment effects are likely to be outweighed by the birth of a new industry around 3D/4D printing. Also their analysis finds extensive evidence of accelerating demand for a variety of wholly new specialist roles related to understanding and leveraging the latest emerging technologies: AI and Machine Learning Specialists, Big Data Specialists, Process Automation Experts, Information Security Analysts, User Experience and Human-Machine Interaction Designers, Robotics Engineers and Blockchain Specialists. While the Fourth Industrial Revolution's wave of technological advancement will reduce the number of workers required to perform certain work tasks, responses by the employers surveyed for this report indicate that it will create increased demand for the performance of others, leading to new job creation. Moreover, while the current popular discourse is often fixated on technology that substitutes for humans, technology will also create new tasks -from app development to piloting drones to remotely monitoring patient health- opening opportunities for work never

previously done by human workers, highlighting that different types of new technology may bring about very different outcomes for workers. Proficiency in new technologies is only one part of the 2022 skills equation, however, as ‘human’ skills such as creativity, originality and initiative, critical thinking, persuasion, and negotiation will likewise retain or increase their value, as will attention to detail, resilience, flexibility and complex problem-solving. Emotional intelligence, leadership and social influence as well as service orientation also see an outsized increase in demand relative to their current prominence.

**The most relevant authors that support these assessments are:** (Wisskirchen et al., 2017; p.31); (Smith and Anderson, 2014, p.42, 44, 69, 71, 74); (West, 1985, p.10); (Nübler, 2016; abstract and p.8, 12, 13, 15 to 19, 28); (Glenn and Florescu, 2016, p.2); (Rejeski, Bezold, Glenn; 2015; p.29 to 32); (Hajkowicz et al., 2016; p.83, 84, 85, 87, 88); (Wisskirchen et al., 2017; p.11, 20, 21, 22, 27, 28, 31, 33, 48, 54, 107); (Chuang and Graham, 2018, p.14); (The future of jobs, WEF 2018; p.20, 21, 23, 24, 30); (Berriman

and Hawksworth, 2017, p.44); (Brynjolfsson and McAfee, 2014, p.117); (Özcan, 2019, p.4,9); (Hazan E. et al, p.14,16); (Gil Gomez, J. et al. 2019, p.2,7,8); (WEF, 2016, p.3,5); (Acemoglu and Restrepo, 2018, p.10); (Pennel, 2018; p.1,2); (Balliester and Elsheikhi, 2018, p.15); (Ananasso et al. 2018); (Anderson, J. 2018); (Antonescu, 2018); (Asare, 2015); (Asein et al. 2019); (Barro and Davenport 2019); (Betti et al. 2020); (Bharadwaj, 2019); (Bharadwaj, 2020); (Brock et al. 2019); (Bughin et al. 2019); (Burkhardt et al. 2019); (Carter et al. 2017); (Cearley et al. 2019); (Ceruti et al. 2017); (Ceruti et al. 2019); (Charalambous et al. 2019); (Chojecki, 2020); (Chuah et al. 2018); (Chui et al. 2018a, 2018b); (Coyne et al. 2019); (Dahlqvist et al. 2019); (Davenport et al. 2018); (Daugherty et al. 2018); (Davenport et al. 2016); (Davenport et al. 2018); (Didion et al. 2019); (Dosi et al. 2019); (Eckertz et al. 2020); (Esposito, 2019); (Francis and Boyer 2019); (Friedland, 2019); (Froes et al. 2019); (Furman, 2016); (Gaub, 2019); (Gil Gomez et al. 2019); (Gordon, 2019); (Groshen and Holzer, 2019); (Grosz et al. 2016); (Hazan et al. 2018); (Hollinger, 2016); (Johari,

2020); (Kamal and Rizza, 2019); (Kenney and Zysman, 2019); (Kiron and Schrage, 2019); (Krafft et al. 2019); (Kritzinger et al. 2018); (Lee, BN et al. 2019); (Lemu, 2019); (Luftman et al. 2017); (Mandolla et al. 2019); (Marr, 2019, 2020); (Matos and Godina, 2019, 2020); (Matos and Jacinto, 2019); (Navale et al. 2020); (Ng, 2019); (OECD Employment Outlook, 2019); (Peyton-Jones, 2014); (Plastino and Purdy, 2018); (Qi et al. 2019); (Ramanathan and SaiGanesh, 2020); (Ransbotham et al. 2019); (Reim et al. 2020); (Sakpal, 2019); (Salama et al. 2019, 2020); (Sapre, 2019); (Sennaar, 2019); (Shestakofsky, 2017); (Smuha, 2019a, 2019b); (Soon, 2019); (Tarafdar et al. 2019); (Tubaro and Casilli, 2019); (Vidyadevi, 2020); (Wakefield, 2019); (Walker, 2017); (Wankhade et al. 2020); (Westerheide, 2019); (Wilson et al. 2017); (World Employment Confederation. 2016); (World Employment Confederation-Europe. 2018); (Zaldo and Maura, 2000); (Zaldo et al. 2019a, 2019b); (Zhu et al. 2018).

**New jobs created because of improvements in competitiveness as a direct consequence of the application of AI.** There are many authors defending this theory based in what happened in previous disruptive technological innovations.

The fact is that automation will reduce the costs of production and thus create a productivity effect, the induced capital accumulation, and the deepening of automation will bring technological advances that increase the productivity of machines in tasks that have already been automated. Jobs will be displaced, but the improvements in efficiency and quality of life will lead to the emergence of more and better jobs elsewhere in the economy.

Could also happen that AI systems will reduce costs so much that we see a movement to bring jobs back home creating some jobs -very automated- in developed countries but displacing many jobs -previously not automated- from developing countries.

The potential productivity and producer Welfare gains are believed to act as a catalyst for such changes in production

processes. For example, there are estimates that companies with more automated activities are several times more likely to experience substantial revenue growth compared to companies with low automation, which is a very logical consequence of increasing competitiveness.

These new jobs elsewhere in the economy are more likely to be created due to a rise in the demand for products, which may be the result of new technological innovation establishing new products that consumers want, or making products much cheaper so that the demand for them rises sufficiently to spur production, and hence, labour demand.

**These assessments are supported by the next relevant authors:** (Acemoglu, Restrepo, 2018; p.32); (Smith, Anderson, 2014; p.44, 70); (Nübler, 2016, p.13, 15, 16, 17, 19, 20); (Wisskirchen et al., 2017; p.18, 26); (Eric Dahlin, 2019; p.3); (Özcan, 2019, p.5); (Autor, 2015, p.5,7,8); (Samuelson, 2017, p.1); (Smith, Noah. 2018, article); (Balliester and Elsheikhi, 2018, p.9,12,14); (Gries and Naudé, 2018, p.4).

### **Creation of new jobs by investing and growing in sectors with tasks less susceptible to be displaced by AI.**

As we wrote in debate two point, there are many tasks that robots simply will likely never be able to do, no matter how advanced they become; these tasks will always be an opportunity to create new jobs. In this point we want to highlight the opportunities of jobs creation around leisure businesses which generally is agreed to be the most growing sector on next 20 years at least; and it likely will be the most jobs creator as this sector has many human non displaceable tasks.

**Other authors supporting these assessments are:** (Smith and Anderson, 2014, p.44 to 48, 58, 69); (West, 1985, p.8); (Nübler, 2016, p.14, 17, 18); (Kozubíková, 2016; p.221); (Hajkowicz et al., 2016; p.60, 61, 62, 87, 88, 98); (Wisskirchen et al., 2017; p.20, 31, 37); (Chuang and Graham, 2018, p.14); (Balliester and Elsheikhi, 2018, p.15,16); (The future of jobs, WEF 2018; p.31); (Berriman, Hawksworth, 2017; p.30,44).

**We need actions to increase and accelerate the creation of jobs in our environment.**

We support, and most authors defend, that the creation of jobs is not deterministic but needs to be shaped and we need to understand the link between structural change in production and changes in employment. Consequently, we and them propose actions, public and private, to accelerate and improve the creation of jobs.

We must not forget that freelance work will likely increase exponentially therefore we must support it with the necessary rules to respect freedom and labour rights.

The emphasis is no longer put on the description of achieved qualification, but on the acquired knowledge, skills and competencies. Both, the public decision makers as well as the enterprises have an acute interest in investing in human capital and improving their human resource management.

**The most relevant authors supporting these assessments are:** (Nübler, 2016; abstract, p.19, 20, 23 to 30); (Kozubíková, 2016; p.221); (Ananasso et al., 2018; p.7); (Hajkowicz et al., 2016; p.58); (Wisskirchen et al., 2017;

p.25); (World Employment Confederation, Europe, 2016; p.3,6); (Tubaro P., Casilli A. 2019,p.8); (Balliester and Elsheikhi, 2018, p.16,19); (Shestakofsky, Benjamin. 2017, p.1); (WEF, 2016, p.6 to 9); (Glenn and Florescu, 2016, p.1, 2, 3); (Rejeski, Bezold, Glenn; 2015; p.29).

**Personal summary and conclusions about the third debate: New jobs' creation debate:**

As we have seen, the new jobs creation debate in the academy is divided into the following groups:

- New jobs created by AI technology companies
- New jobs created because of the new business with the new technologies based on AI
- New jobs because of improvements in competitiveness because of the application of AI
- Creation of new jobs by investing and growing in sectors with tasks less susceptible to be displaced by AI

**Finally we must highlight that we need actions -private and public- to increase and accelerate the creation of jobs in our environment.**

**Our conclusions are that, opposite to the jobs' displacement -which can be forced by competitors-, we need clear and strong actions made by decision makers, public and private, to create as many jobs -or more- and better ones than the ones displaced and to do it inside our environment to avoid definitive unemployment. We also need to do it very fast to avoid the temporary unemployment and wages decrease because of the time gap between displacement and creation.**

#### 2.3.4. Fourth debate. Solutions given in the academic world.

The last and strong debate in the academic literature is about the solutions given in academic world to the potential employment problems that could be created by the application of AI.

As this debate is complex, with no general agreement, we divide this point in different categories:

Authors that propose that we have previous questions to answer and ideas to think about, in order to find the correct solutions.

- Solutions based on accelerating AI's applications and new jobs' creation.
- Solutions related with training and education.
- Solutions based in research and innovation to stimulate new business with new AI technologies.
- Solutions based in increase of productivity and lower costs and prices because of AI's applications.
- Solutions based in general regulations about AI's applications.
- Solutions related with new social safety system and social agreement about AI's applications.
- Solutions based in the BIG (Basic Income Guarantee) and similar solutions to treat the potential unemployment and wages problems.
- Solutions based on happiness of people, more than on employment.

**Questions to answer and ideas to think about, in order to give the correct solutions.**

Several authors think that, before giving solutions, the society has to clarify important questions as: Ownership of AI; special taxes to AI; power of AI vs humans; new economic order; distribution of the advantages of AI; will the economy be for the well-being of humans?; ethical principles for AI applications; decentralization and crowdfunding; low or no cost online education for self-actualization; supporting self-generated jobs; employment and/or happiness; peer-to-peer networks; Human Intelligence Technological Augmentation?; sustainable development.

Most relevant authors: (Glenn and Florescu, 2016, p.4 to 10); (Rejeski, Bezold, Glenn; 2015; p.6); (Gil Gomez, J. et al. 2019, p.2 to 7).

**Solutions based on accelerating AI's applications and new jobs' creation to avoid the unemployment problem.**

These solutions are generally based in the next ideas: We accept that AI applications will displace jobs but also will increase competitiveness with which we can grow creating jobs and also, knowing what AI systems can do, we can launch new businesses, creating many more new jobs. The main idea is that being pioneers -or at least applying AI before than our main competitors- our relative increase of competitiveness in the market will be higher and hence we will grow more creating more jobs, and also launching new businesses based on AI systems before our competitors will give us a competitive advantage to grow more creating more jobs also in these new businesses based on AI. WE advance that these ideas are basic for our propositions in this Thesis.

Bughin et al., 2019, p.7 found that companies applying new technologies faster and better than competitors have a three year revenue-growth rate more than 60% higher.

The authors give successful practices to implement AI, which we fully agree, as: Act Monthly or Weekly better than Annually; Use multiple sources of customer data to assess their unmet needs; Business leaders dedicate time to learn

about digital technologies; Share test-and-learn findings across organization; Assess business model for digital productivity opportunities; Use scenarios to time and size potential shifts in industry economics; Evaluate portfolio for opportunities to add/divest businesses, in light of digital; Reallocate digital talent among business units or functions; Evaluate profit pools based on competitive-landscape shifts; Reallocate capital expenditures across business units; Use rigorous process to defund underperforming initiatives.

Engaging with data: From monthly to weekly. Nearly half (44 percent) of digital leaders collect and analyse customer data weekly (or more frequently) to identify new ways of winning over buyers, compared with just 16 percent of laggards, which, on average, dig into customer data only monthly.

Another essential point is talent reallocation: From yearly to quarterly. On average, leading companies reallocate digital talent more than five times faster than their peers do, doing so on a quarterly or faster basis.

The agility in action: From every two months to every two weeks.

Bughin et al., 2019, p.6 to 9, found in their survey that digital leaders undertake big strategic initiatives more often—and more successfully—than their peers do. They are more likely to develop entirely new digital offerings or to launch new businesses.

Rather than inundate business leaders with educational material, one organization launched a cross-functional initiative to discover jointly how AI-supported robotic process automation could boost productivity, drive down cost, and expand strategic options. Cross-functional teams co created pilots and shared their models, assumptions, and findings in monthly meetings attended by the business leaders, including those whose headcounts were in question. This practical and open approach simultaneously gave key leaders a valuable education in the potential of digital and crafted consensus around resource reallocation.

To be successful C+I that apply AI systems must be sure to align all the stakeholders with the new products to avoid constraints which will weaken the application.

Currently, the technology vendors are conceiving and producing innovations ranging from self-driving cars and trucks to the “self-driving enterprise,” but very few would-be adopters have begun to envision how AI will change jobs in their companies and what new skills must be developed. Because many new AI technologies are appearing now or will be here in the near future, organizations have no time to waste in planning for them and creating work design innovations that parallel the technological innovations.

How can companies use intelligent technologies to innovate?: They can automate products, processes, and business models to support users’ needs. They can redesign tasks and jobs to facilitate human machine cooperation at work. They can integrate intelligent technologies into their organizations.

Organizations will need to place both adoption of technology and human capital development at the centre of their innovation strategies. As time goes on, how companies deploy technology and human capital will have a tremendous impact on their competitiveness and their very survival.

Rather than simply looking at automation as a way to cut costs, successful companies create innovative products, services, processes, and business models by implementing intelligent technologies, redesigning jobs, acquiring new skills through hiring, and training their existing workers to create an unbeatable set human-AI system.

We should start with management education. The best starting point is to invest in training for the executives charged with making the strategy decisions about AI technologies. Executive ignorance often leads to two opposite but equally negative behaviours: If leaders underestimate the potential of these technologies, their companies will miss opportunities to benefit from them. On the other hand, if they overestimate it and initiate projects

that are too ambitious and costly, they will waste resources and perhaps even generate a bias within the company against new projects, even those that are reasonable.

At Amazon, CEO Jeff Bezos says that many of the company's investments in AI are focused on "quietly but meaningfully improving core operations."

The objective should be clear; even in cases where the goal is automating tasks previously performed by workers, key workflows should be designed or redesigned, focusing on the division of labour between humans and smart machines. The aim throughout should be innovative and effective work design, not just cost reduction.

To innovate around AI systems, you should plan to train -the best way- or hire your own people as opposed to only borrowing them from consulting firms or vendors.

Business solutions powered by AI will reduce costs and improve productivity. However, we expect that the greatest impact will be to drive innovation deeper into the business and for that to happen, people and machines must be partners in the innovation process. Investing in intelligent

technologies and in human resources capable of using them, cooperating with them, and innovating from them may be costly. But failure to do so will be much more costly.

AI systems applications must always improve the most strategic KPIs -Key Performance Indicators- of any organisation. To have more data and more information is not enough, those are means and not objectives.

Machine learning, like transportation and communication, is a means to an end. What needs to be transported? What needs to be communicated? What needs to be optimized? Artificial intelligence and machine learning can, in principle and practice, offer actionable answers to these questions. The true strategic opportunity and impact of these technologies is the chance to rethink and redefine how the enterprise optimizes value for itself and its customers.

Very often just optimizing known KPIs is important but not strategically sufficient. When appropriately used, AI systems can learn to identify and recommend novel or emergent KPIs that can improve disruptively our competitiveness.

What's more, the gains they made in competitiveness inspire others in the company to seek out their own use cases and build their own capabilities. Creating this virtuous cycle of continuous organizational learning has mitigated the risks of the company's AI investments and positioned the company to make AI applications a competitive advantage.

The digital inquisitiveness of the entire workforce should be harnessed, too. We need to crowdsource ideas from employees. It encourages them to envision and suggest new AI applications, evaluating the ideas for their potential contribution to top-line growth, bottom-line profits, customer satisfaction, or employee satisfaction. It's a virtuous cycle: The capabilities enable employees to execute the practices, and the practices themselves exercise and strengthen the capabilities. This cycle helps companies become ever more adept at developing and using AI applications that improve operations and create business value.

We have to avoid some important risk when AI systems do better than us the structured tasks. The main risks to be avoided are:

Increased passivity. As we accept assistance to complete a task, we require less effort to carry it out. We may become spectators rather than active participants. When we let AI systems to determine our options, we rarely confront perspectives that might challenge our preconceptions and biases. Gradually, we may become less prepared to expend the effort needed to think deeply and critically, thereby disengaging long-term memory.

Emotional detachment. Diminished participation leads to emotional disengagement. Consequently, our actions can become insincere or deceptive. Think of a customer call centre, where an AI system in a help desk or sales context aggressively coaches' agents in real time as they respond to customers' emotional cues. Such software, ideally designed to train operators to become more sensitive to customers' concerns, could have the reverse effect, making us increasingly inured to emotional cues because we will have

less practice picking up these cues ourselves and have less interest in doing so.

Decreased agency. Disengagement reduces our power to make our own decisions by lessening our awareness of actions we might take.

Decreased responsibility. In ceding control over a decision-making process, we can become less accountable for results -whether they are good or bad- because responsibility is diffused across the entire AI-based system, from design to delivery.

Increased ignorance. AI translates our wants into algorithmic shorthand or mechanical processes that may end up functioning differently than we would ourselves. Of course, that can make up for deficiencies in our knowledge but it can also reinforce those deficiencies.

Deskilling. Depending on an intermediary for completing structured tasks can dull many of the trained skills we rely on to interact with the physical world around us. We may forget how to perform basic tasks or become less proficient at doing them unaided. Using only navigation apps lulls us

into forgetting how to use a conventional map or, in a future era of autonomous vehicles, even how to drive without the apps. We may also lose motivation to acquire new skills, opting instead for evermore outsourcing solutions.

AI systems provide people with extraordinarily powerful tools for controlling and managing their daily lives, activities, and interactions. Such technology, if designed carefully and conscientiously, also holds the power to alter human behaviour for the better on a massive scale. But if designed short-sightedly, with few if any features for counteracting its own negative habit-forming effects, it could instead foster passivity, dependency, ignorance, and vulnerability. Applied to millions, these forces undermine the systems of liberal democracy and capitalism. It is essential that companies working in this area formulate clear and cogent design strategies to allow customers to make informed choices regarding their own patterns of online behaviour.

After several decades of progress, AI technology is now poised to become a significant source of value for a wide

range of businesses. However, companies are not yet realizing the value from AI, according to a major new study released by MIT Sloan Management Review (MIT SMR) and Boston Consulting Group's BCG GAMMA and BCG Henderson Institute. The study reveals that although executives consider AI to be a critical business opportunity, many leaders are increasingly worried about the strategic risks associated with AI.

The data from this study reveals:

Nine out of ten agree that AI represents a business opportunity for their company.

Seven out of ten companies report minimal or no impact from AI so far. Among the 90% of companies that have made investments in AI, fewer than two out of five report obtaining any business gains from AI in the past three years.

In 2019, 45% perceived some risk from AI -an increase from 37% in 2017-.

The study reinforces that AI is an urgent issue for executives across all industries. "While some companies have clearly figured out how to be successful, most companies have a

hard time generating value with AI" said report co-author David Kiron.

How can executives exploit the opportunities, manage the risks, and minimize the difficulties associated with AI?

The report shows that companies that capture value from their AI activities exhibit a distinct set of five organizational behaviours: They integrate their AI strategies with their overall business strategy. They unify their AI initiatives with their larger business transformation efforts. They take on large, often risky, AI efforts that prioritize revenue growth over cost reduction. They invest in talent, internal and external making all their people and stakeholder to collaborate because the new situation is better for all of them.

AI is a significant strategic opportunity and a major strategic risk if companies don't act thoughtfully. There is already a gap between winners and losers, and this gap will only get larger in the years to come. But to get value, technology and algorithms are not enough. Companies have to seriously

integrate AI into their core business strategy and their core business processes.

Most digital transformations -up to 2019- don't yield the benefits that leaders expect. New research from Bughin et al., 2019, shows that five practices maximize the chance of extraordinary outcomes.

The first is to lay out clear priorities in AI transformations focusing on a few clear themes that are tied directly to measurable business outcomes.

The second is investing in talent with strong digital and analytics capabilities. To name good CDO -chief digital officer- and CAO -chief analytics- officer to leader the change is also very important.

The third is committing time and money.

The fourth is embracing agility, revisiting and rearranging their priorities more often than ever.

And the fifth is empowering people reinforcing digital enablement importance for employees at all levels, not just in the upper ranks.

Ryder, (2019) highlights three best practices to implement AI.

The first is using the technology to enhance your company's existing differentiators, which could provide an opportunity to create new products and services to interest your customers and generate new revenue.

The second is using AI to optimize decision making adding transparency.

The third is focusing AI applications to increase competitiveness and profits much more than in cost reductions, always connecting AI to organizational strategy.

Incorporating AI into business strategy requires that everyone understands it enough, wants it, and is bought into it.

**Most relevant authors supporting these ideas:** (Bughin et al., 2019, p. 2 to 11); (Bughin and Catlin 2019, article HBR); (Barro and Davenport, 2019, p.4, 5, 7, 8 , 9); (Kiron and Schrage, 2019, p.11 to 30); (MIT Sloan Management Review-Boston Consulting Group Study, 2019); (Bughin et

al., 2019, p.1 to 5); (Ryder, A., 2019); (Dotscience, 2019, p.4, 5, 8, 11, 13, 14).

### **Solutions related with training and education.**

Several authors think that training and education will be the best solution for successful AI implementations, they develop ideas as: free education for all; disrupt our educational system; STEM and CS (Computer Science) education at all levels; training people in how to be self-employed; examine the role of STEM education vs to Education for Sustainability (Efs); design thinking method; interaction between robot systems and employees; data science; governments are responsible; lifelong learning progress; HRD's role and challenge of assisting technology-replaced employees; current educational practices; use of The European funds, and in particular the ESF+ and EGF.

We think that training and education are fundamental for a successful AI application, but the official education in most Universities and other educational centers is usually so slow

reacting to innovations that, in the first stage of AI application -probably from 2019 to 2022- we will need internal training supported by technology companies and training centers created for AI.

**Most relevant authors supporting these ideas:** (Smith and Anderson, 2014; p.64, 65, 66, 67); (Bundy, 2016; p.3); (Glenn and Florescu, 2016, p.5); (Kozubíková, 2016; p.217, 218, 219, 221); (Ananasso et al., 2018; p.7); (Nübler, 2016, p.24, 30); (Smith and Watson, 2018, p.1, 5, 7 to 14); (Hajkowicz et al., 2016; p.20, 21, 22, 92); (Wisskirchen et al., 2017; p.20, 24, 25, 38, 43, 44); (Chuang and Graham, 2018, p.8, 9, 11, 13, 14, 15); (Acemoglu and Restrepo, 2018, p.13, 14, 33); (Austrian Presidency of the Council of the European Union, 2018; p.1, 2); (Balliester and Elsheikhi, 2018, p.17,18); (The future of jobs, WEF, 2018, p.7, 8, 11, 25 to 27, 29, 30, 34, 35); (Berriman and Hawksworth, 2017, p.30, 44); (Brynjolfsson and McAfee, 2014, p.110); (Fari, 2018, p.8); (Özcan, 2019, p.12 to 14); (Lund S. et al. 2019, briefing).

**Solutions based in increasing productivity and lower the costs and prices because of AI's applications.**

Several authors think, and we agree, that the productivity effect, resulting from the cost savings generated by automation, will increase the demand -therefore the investment- for labour in non-automated tasks.

**Most relevant authors supporting these ideas:** (Acemoglu and Restrepo, 2018, abstract); (Bundy, 2016; p.3); (Glenn and Florescu, 2016, p.8); (Nübler, 2016, p.17); (Balliester and Elsheikhi, 2018, p.28); (The future of jobs, WEF 2018; p.15); (Berriman, Hawksworth, 2017; p.45); (Brynjolfsson and McAfee, 2014, p.70).

**Solutions based in research and innovation to stimulate new business with new technologies based on AI.**

We partially treated this theme in the point “Solutions based on accelerating AI's applications and new jobs' creation to avoid the unemployment problem”.

At this point we want to highlight some authors assessments as: The challenge for public policies is to foster the dynamics of societal learning and economic transformation. Governments, enterprises, workers and society need to develop a new consensus, better understanding of the job-creating process, peer-to-peer (and freelancer) economy, entrepreneurial skills and aptitudes, intelligent systems, alternative working time models. HRD professionals have a responsibility to embrace and lead, to avoid the adjustment process to be slow and painful.

We must recognize that the future of labour depends on the balance between automation -tasks displaced by AI- and the creation of new tasks. These transformations, if managed wisely, could lead to a new age of good work, good jobs and improved quality of life for all, but if managed poorly, pose the risk of widening skills gaps, greater inequality and broader polarization.

Central and local government bodies also need to support digital sectors that can generate new jobs, for example through place-based strategies centred around university

research centres, science parks and other enablers of business growth. This place-based approach is one of the key themes in the government's new industrial strategy and its wider devolution agenda. It also involves extending the latest digital infrastructure beyond the major urban centres to facilitate small digital start-ups in other parts of the country.

**Most relevant authors supporting these ideas:** (Nübler, 2016; abstract and p.4); (Bundy, 2016; p.3); (Fráguas Nobre, 2018; p.22, 23); (Ananasso et al., 2018; p.6,10,11,13); (Nübler, 2016; abstract, p.4,17,19,21,23,25,27,29,30); (Thomson, 2017; p.81, 82); (Grace et al., 2017; p.1, 4); (Hajkowicz et al., 2016; p.22, 47); (Wisskirchen et al., 2017; p.49, 50, 55, 70, 80, 116, 117, 118); (Chuang and Graham, 2018, p.3); (Acemoglu and Restrepo, 2018, p.15, 24, 26, 32, 33); (The future of jobs, WEF 2018; p.9,16,18,22); (Berriman and Hawksworth, 2017, p.44).

#### **Solutions based in general regulations.**

There are authors that think that the application of AI should be regulated in order to improve employment. They propose

ideas as: Measures are needed to maintain equality and spread the economic benefits broadly. Propose re-distributing employment with job-sharing. Lower mandatory retirement ages. More vacations. A shorter work week. Making new work with public employment. And other similar ideas.

They also propose ethical principles to be applied to AI applications in order to avoid unemployment: Human dignity. Autonomy. Responsibility. Justice, equity, and solidarity. Democracy. Rule of law and accountability. Security, safety, bodily and mental integrity, Data protection and privacy.

Most of the proposals are difficult to be against but many of them can provoke more unemployment if they delay or prevent AI applications which improve radically the competitiveness. We notice that most of the authors supporting these propositions are techno-pessimists.

**Most relevant authors supporting these ideas:** (Bundy, 2016; p.3); (Hughes, 2014; p.1,2); (Smith and Anderson, 2014, p.70); (Freeman, 2015; p. 2,6,7,8,9); (Nübler, 2016,

p.24,25); (Hajkowicz et al., 2016; p.22,96); (Wisskirchen et al., 2017; p.42, 43, 44); (Chuang and Graham, 2018, p.10,11); (Acemoglu and Restrepo, 2018, p.34); (European Group on Ethics in Science and New Technologies, 2018; p.10, 11, 15 to 20); (World Employment Confederation-Europe, 2018, p.1,2,3); (Balliester and Elsheikhi, 2018, p.31,33,35); (Berriman and Hawksworth, 2017, p.45); (Brynjolfsson and McAfee, 2014, p.134); (Fari, 2018, p.10).

#### **Solutions related with new social safety system and social agreement about AI's applications.**

We agree with several authors that there will have to be a new social safety net for those that are simply unable to earn more than a poverty wage.

Their main proposals are: Negative income tax-based system. Advance human welfare. Building a world in which every individual has an opportunity to thrive. Employees should buy the robots. To introduce a 'made by humans' label. Subsidies for innovative start-ups creating new jobs.

**Most relevant authors supporting these ideas:** (Smith and Anderson, 2014, p.61, 62, 63, 74); (Ng, 2016; p.3); (Glenn and Florescu, 2016, p.3, 5, 7); (Kozubíková, 2016; p.220); (Wisskirchen et al., 2017; p.39, 40); (Balliester and Elsheikhi, 2018, p.23,25).

#### **Solutions based in the BIG (Basic Income Guarantee), Universal Basic Income (UBI) and similar solutions.**

Many authors, specially the techno-pessimists, thinks that BIG will be necessary, but we have ideas pro and con, and some pros, give ideas to finance it.

The most important ideas from these authors are the following.

From pros: They propose a Value-added tax to pay BIG. With the basic income, people will have less fear and stress, people may create more self-employment, will allow people to think and plan their future better, the alternative is social collapse, is the surest way to better education, better health, lower crime, better quality of life.

From cons: Basic income guarantee would have corrosive effect on the social fabric. Will create immense immigration problems. Government must not give money for nothing, it will provoke no motivation to work.

**Most relevant authors supporting these ideas:** (Hughes, 2014; p.1, 2); (Glenn and Florescu, 2016, p.2, 7); (Rejeski, Bezold, Glenn; 2015; p.33); (Nübler, 2016, p.25); (Thomson, 2017; p.81); (Wisskirchen et al., 2017; p.39); (Berriman and Hawksworth, 2017, p.30,45); (Balliester and Elsheikhi, 2018, p.25); (Brynjolfsson and McAfee, 2014, p.130,132).

#### **Solutions based on happiness more than in employment.**

The author Pistono (2014) says that his purpose is not to convince us that automation will make us obsolete, but rather what to do about it.

Pistono start by writing about employment and happiness with phrases as: “Would people be just as happy if they had the same income, but without having to work? What if all those things were provided for, would they be just as happy?

The answer is a resounding...NO”; “unemployment makes people very unhappy”.

Arriving to the conclusion that AI will inevitably create large unemployment and thinking that there is not any good public solution, Pistono gives, since page 129, practical advice for everyone to be happy, even without what we call now a good job.

The most relevant author, besides Pistono, supporting this idea to look for happiness more than for employment is (Smith and Anderson, 2014, p.70).

#### **Personal summary and conclusions about the solutions given in academic world to the potential employment problems that could be created by the application of AI.**

As this debate is complex, with no general agreement, we have divided it in different categories:

Authors that ask questions to answer and ideas to think about, as: Ownership of AI; taxes on AI applications; ethical principles to apply; power of AI vs humans; employment and/or happiness.

**We found authors -most of them techno-optimists- that propose immediate solutions to try to avoid the potential unemployment problem as:**

- Solutions based on accelerating digitalization -AI application- and new jobs' creation.
- Solutions based in research and innovation to stimulate new business with new technologies based on AI.
- Solutions based in growing -the C+I and therefore the jobs- by increasing productivity and lowering costs and prices with the application of AI.

**Authors that propose medium-long term solutions -both optimists and pessimists-:**

- Solutions related with training and education -on our models the in-company training is very important but on this case our proposal is a short-term solution accepting the importance of medium and long term training and education-.

**Finally, authors -most of them techno-pessimists- that propose solutions, not to solve but to deal with the unemployment that they consider unavoidable with the application of AI:**

- Solutions based in general regulations.
- Solutions related with new social safety system and social agreement.
- Solutions based in the BIG (Basic Income Guarantee) and similar solutions.
- Solutions based on happiness of people, more than in employment.

As our intention is to propose solutions to apply AI systems avoiding unemployment and wages problem, we are not taking in consideration the solutions proposed by the techno-pessimists.

#### [2.4. Summary and conclusions from the literature review](#)

There is a general agreement that the application of AI will displace many tasks -not only routine ones-, most of them that we can now structure -put under rules- and make with machines -with or without devices as robots, drones,...- with

algorithms or even without algorithms, just with the rules, when we have the RL - Reinforcement Learning- software.

Many tasks that we cannot structure today we will soon be able to structure with ML -Machine Learning-, just with the software and enough data in quality and quantity.

With DL -Deep Learning- accelerated with TL -Transfer Learning- we are already able that machines surpass the capacity of humans in many specific tasks related with vision and language -not in general-.

GANs -Generative Adversarial Networks- enable the creation of artificial media, including pictures and video, with exceptional fidelity.

There are so many tasks that today, or in very few years, will be made -better, faster and cheaper- by AI systems that we expect that almost 50% of tasks that today are made by humans will be made by AI systems from now -January 2020- to the year 2030. But we must not worry too much about that because the estimated 50% of tasks displaced will take place in ten years' time -at least- and therefore we have time for creating new jobs at the same time -or even before-

than the displacement, but we have to act as soon as possible, the sooner the better.

As we wrote before, the tasks that require uniquely human characteristics as: All kind of personal feelings and relations; sports and arts and any task difficult or expensive to structure -many related with leisure business- are the less likely to be displaced by AI.

Does that means that almost 50% of jobs will disappear from now to 2030? No, it does not, but that means that the same quantity of people, using AI systems, will be able to do twice -or more- of what they do today -in some activities very regulated they will tripled , quadrupled or more, his/her productivity, but in others (with more human tasks) it will be much less-.

In our opinion, it is very important that we accept this assessment about displacement to concentrate our efforts on the creation of new jobs in our environment and to do it as soon as possible to compensate for the displaced ones. We still have time, but we must start immediately.

As we have seen, the new jobs' creation debate in the academy is divided on next groups:

- New jobs created by technology companies.
- New jobs created because of the new business with the new technologies, mainly AI.
- New jobs because of improvements in competitiveness because of the application of AI.
- Creation of new jobs by investing and growing in sectors with tasks less susceptible to be displaced by AI. Like e.g. in leisure business.

And we have to remember that we need very active decisions and actions -private and public- to increase and accelerate the creation of jobs in our environment.

Our conclusion in relation with displacement and creation of jobs is that jobs displacement can be forced by competition on the market but we need clear and strong actions made by decision makers, public and private, to create as many jobs -or more- than the ones displaced and to do it inside our environment to avoid definitive unemployment. We need also to do it very fast to avoid the temporary employment

and wages problems because of the time gap between displacement and creation.

We do not know how many jobs we can create in our environment, but in our opinion, the quantity has no limit and depends fundamentally on our decisions and actions -public and private- and the quality will also depend on our actions. The earlier and better we start applying AI systems, the more jobs we will create following our proposals.

In relation with the solutions given in the Academic world, we found authors -most of them techno-optimists- that propose immediate solutions to try to avoid the potential unemployment problem as:

- Solutions based on accelerating digitalization -AI application- and new jobs' creation.
- Solutions based in research and innovation to stimulate new business with new technologies based on AI.
- Solutions based in growing -the C+I and therefore the jobs- by increasing productivity and lowering costs and prices with the application of AI.

We found other authors that propose medium-long term solutions -both optimists and pessimists-:

- Solutions related with training and education -on our models the in-company training is very important but on this case our proposal is a short-term solution accepting the importance of medium and long term training and education- Finally, authors -most of them techno-pessimists- that propose solutions, not to solve but to deal, with the unemployment that they consider unavoidable with the application of AI.
- Solutions based in general regulations.
- Solutions related with new social safety system and social agreement.

- Solutions based in the BIG (Basic Income Guarantee) and similar solutions.

- Solutions based on happiness of people, more than in employment.

As our intention is to give solutions to avoid the unemployment - and wages- problem, we are not taking in consideration the solutions proposed by the techno-pessimists.

On the next chapter will start our main contribution to better understand and control the phenomenon between AI and global employment on any reality controlled by us.

## Chapter 3. Methodology and models

### 3.1. Introduction

Being our objectives clear and having the required information from the Literature Review, we asked ourselves: What methodology should we use to study and get conclusions from the complex phenomenon among AI, Competitiveness and Employment?

There is a bibliography on ways to approach the analysis of complex systems formed by qualitative variables, within the scope of the company. Two works can be cited that show the two representative approaches of many others. Luftman work gives us a list of elements to take into account, with weights relative to their influence on output, these weights are based on the statistical analysis of responses to a questionnaire, but Luftman (2017) does not include the relationships that exist between the elements. Thus it becomes an ordered checklist, of little methodological and practical use.

The second approach is provided by the work of Novianto Budi (2013), which is essentially a sequential scheme of the process within the organization, but the elements thus defined do not allow causal relationships to be defined, and therefore it is impossible to make a sensitivity analysis that allows calibrating the effectiveness of possible alternatives.

The fact of being confronted with so complex a problem, makes us aware that a holistic view of the whole system is needed in order to capture both perspectives: The positive interrelations between AI and employment as well as the negative ones.

Among the alternatives we found was highlighted System Dynamics Methodology. In the literature review we collect the most relevant opinions of the authors participating in the debates that we are interested and these opinions are a very valuable contribution based on their prestige and professional experience.

The use of SD-System Dynamics as analytical methodology allow us: Firstly to integrate the set of elements which relate AI, competitiveness and employment **using all our conclusions from the literature review**; secondly we can quantify the variables used in the analysis with current values obtained from the **C+I -Companies and institutions-** applying our models.

It is sufficiently demonstrated that System Dynamics is a very good tool for ordering the contributions from the many selected articles and authors, because of the recognised speciality in our field; SD also faces the need to quantify the selected variables **to validate the hypothesis of this thesis**. This methodological novelty has been very positively evaluated in our article in DYNA (Zaldo et al. 2019b) and in our ECIAIR conference in Oxford (Zaldo et al. 2019a), both based on this thesis. It seems to be very well evaluated by publishing houses and journals asking for books and articles based in our cited papers and conference.

Our references from the **Literature Review** are based on arguments which can be summarised in causal relations,

therefore in order to synthesize the bibliography we use the **Causal Loop Diagrams**.

The next step is natural because passing from a CLD to a SFD -Stock and Flow Diagram- is only a mechanical transformation just identifying some variables as stocks -levels- and flows. This step allowed us the possibility to build a simulation model giving coherence and validity to the CLD, including all the variables needed to understand the phenomenon.

Does not exist, as on other fields of knowledge, some methodologies which we can compare with our technology - System Dynamics- because in the best case it is only made a sample of different opinions about a theme and the arithmetic average is calculated.

The reason for the lack of analytical methodologies is evident because we are debating about a futuristic without experiences or precedents; with no relevant historical data. We should understand that we are confronted with a change of paradigme where the historical data are not enough to

understand what the AI applications will challenge our future.

### 3.2. What is System Dynamics?

System Dynamics is a methodology developed by Forrester at Massachusetts Institute of Technology MIT (1961, 1969, 1971) and later actualised and improved by other authors as Barlas 1996, 2014; Sterman 2000, 2001, 2002, 2010; Santanu and Pratap 2000; Krishnan 2000; Qudrat-Ullah 2005; Morecroft 2007; Radzicki, M. J. and Taylor, R. A. 2008; Pruyt 2013.

**“System Dynamics is a methodology and mathematical modelling technique to frame, understand, and discuss complex issues and problems. Originally developed in the 1950s to help corporate managers improve their understanding of industrial processes, System Dynamics is currently being used throughout the public and private sector for policy analysis and design.” (Radzicki and Taylor, 2008).**

System Dynamics is a methodology extensively used to understand the dynamic behaviour of complex systems with multiples relations among the different variables that intervene, as it is happening on the phenomenon that we are researching.

The different steps on this method are: Defining the more influential variables; building the qualitative CLDs -Causal Loop Diagrams-; continuing with the quantitative SFDs -Stock and Flow Diagrams-, also called Forrester diagrams; and finishing with the application of these latter SFD diagrams –which is a quantitative mathematical model- to current situations to verify that, both variables and diagrams, describe the reality and can be used to understand and to plan the future.

As Martin Garcia (2018), resumes:

A –Creating a causal diagram

1. Define the problem
2. Identify the most important elements
3. Identify the elements of a secondary importance
4. Identify the elements of a tertiary importance

5. Define the relations
6. Identify the feedbacks
7. Eliminate the irrelevant elements
8. Imagine possible solutions to solve the problem

#### B- Creating a flow diagram

9. Characterise the elements
10. Write the equations
11. Assign values to the parameters
12. Create a first version of the model
13. Stabilize the model
14. Identify the key elements
15. Simulate

#### C- Writing the conclusions

Most of the authors accept that we cannot forget some of the undoubted value of the causal diagram. The most important of these values is that it is a simple method to order ideas that can seem unclear at the beginning of the study. Secondly, seen as a simple preliminary stage, it allows the modeler to easily pass the elements and relations from the system to the flow diagram. Thirdly, it allows a clear and

fluent communication with the final user, even if he is not used to mathematical equations.

Resuming, in topics like the one in this thesis, creating a CLD has many advantages, since:

1. Facilitates the dialogue with the experts of the companies.
2. It offers the thesis reader a clear summary of the bibliographic synthesis carried out.
3. Save time in the subsequent creation of the SFD -Stock and Flow Diagram- simulation model, since it has the same elements and structure as the CLD.

Without any doubt the SFD is much more explicit and useful as it shows the curves that exist in the system with clarity, which definitively are the regulated elements over which we should have control.

Therefore, our chosen methodology for representing the impact of AI on competitiveness and employment through all the variables, is System Dynamics.

System Dynamics is very similar to Systems Thinking, both methodologies are based on the same causal loop diagrams of systems with feedback. A system

dynamic model allows the understanding of complex, circular and nonlinear, relations among variables, in a very conceptual and powerful way, as this issue requires.

But the power of System Dynamics is that it allows through SFD -Stock and Flow Diagram-, quantifying the impact of those interactions from a specific initial situation that would be transformed in different scenarios of evolutionary trends, but also of decisions such as "what if" questions that the model will be able to answer.

As we have written, the system dynamic methodology requires the identification of variables that intervene in the process between AI, competitiveness and employment. Many of the variables are extracted from the literature review but other variables and their relation are our novel contribution to the research.

**We can state that none of our variables are opposed to our conclusions from the literature review** but, the way we use the variables and their relations are our contributions to the literature based on what we learned from the literature

and also from our personal experience and knowledge about AI, management and employment.

### **3.3. How System Dynamics will contribute to our research?**

The models that we will make with SD we expect that will contribute as in terms of Quantification, Validation, Coherence and Sensitive analyses.

**Quantification:** The CLDs will permit a fluid dialogue with the management of each C+I, which can verify that their reality, visions and expectations are reflected in the CLDs. With the SFDs we will be able to quantify the results getting a bigger collaboration and implication from each management as they will understand the practicality of the models.

**Validation:** As the management will be easily able to analyse inputs and results on each model, we hope that they will validate them -CLDs and SFDs-

**Coherence:** As we expect that the results obtained on the simulations will give very realistic figures, each

management will likely accept that the variables and the models are realistic and coherent.

**Sensitivity analyses:** As we are analysing the future of employment, the sensitivity analysis to the most important variables are essential and could not be made without simulation models as the ones we have proposed.

We used Vensim program and the models were built in Vensim DSS for windows, Version 5.8d (Ventana System, Inc., 2009).

References: (Bala et al. 2017); (Barlas, 1996, 2014); (Forrester, 1961, 1969, 1971); (Krishnan, 2000); (Martin Garcia, 2018); (Meadows, 2008); (Morecroft, 2007); (Pruyt, 2013); (Qudrat-Ullah, 2005); (Radzicki and Taylor, 2008); (Rahim et al. 2017); (Randers, 1980); (Richardson, 1986); (Roberts, 1978); (Santanu and Pratap, 2000); (Sterman, 2000, 2001, 2002, 2010); (Zaldo, 2019a, 2019b).

### 3.4. Global Causal Loop Diagrams among Artificial Intelligence, Competitiveness and Employment.

The Global Causal Loop Diagram (CLD) among Artificial Intelligence, Competitiveness and Employment explains the variables, used to build this global diagram, and its relationships (Figure 2). In the CLD the variables are always connected by arrows, the origin of the arrow is the variable cause and the tip is the variable effect. At the tip of the arrow we put the sign plus (+) or minus (-) meaning the plus that the relation cause-effect is positive (the more the origin the more the effect) and the sign minus means that the relation is negative (the more the origin the less the effect). No sign at the tip means that the relation could be positive or negative.

We divide the variables of the global diagram into several groups, as follows.

### 3.4.1. Group of variables related with Artificial Intelligence technology companies

**Suppliers of basic AI research:** This variable is self-explained.

**Suppliers of basic AI research** has a positive relation with **Local AI technology companies** which receive the AI basic research and they research for **Solutions giving value to local companies and institutions (C+I)** -positive relation-, logically for a **Price of solutions** -normally negative relation because the more the research the less the cost, but not necessary the less the price-.

Both variables, value and price, make the **Available solutions to increase the competitiveness of C+I**, having value a positive relation and price a negative one -the more the price the less available the solution-.

The technology companies must make **Actions to convince C+I to apply solutions** till **Management of C+I is**

**convinced that the proposition will increase their competitiveness**, with a positive relation. With this last variable we connect the Group of variables related with AI technology companies with the Group of variables affecting to AI application rate.

But before going to the next group we must highlight the very important variable **New jobs in AI technology companies** with positive connexions with **Local AI technology companies** and **Actions to convince C+I to apply solutions**.

The technology companies are already and will continue globally growing and creating jobs on next years but, besides the importance of creating jobs, they are fundamental for the rapid and good applications of solutions based on AI to local companies, specially to **Small and Medium Enterprises (SME)**.

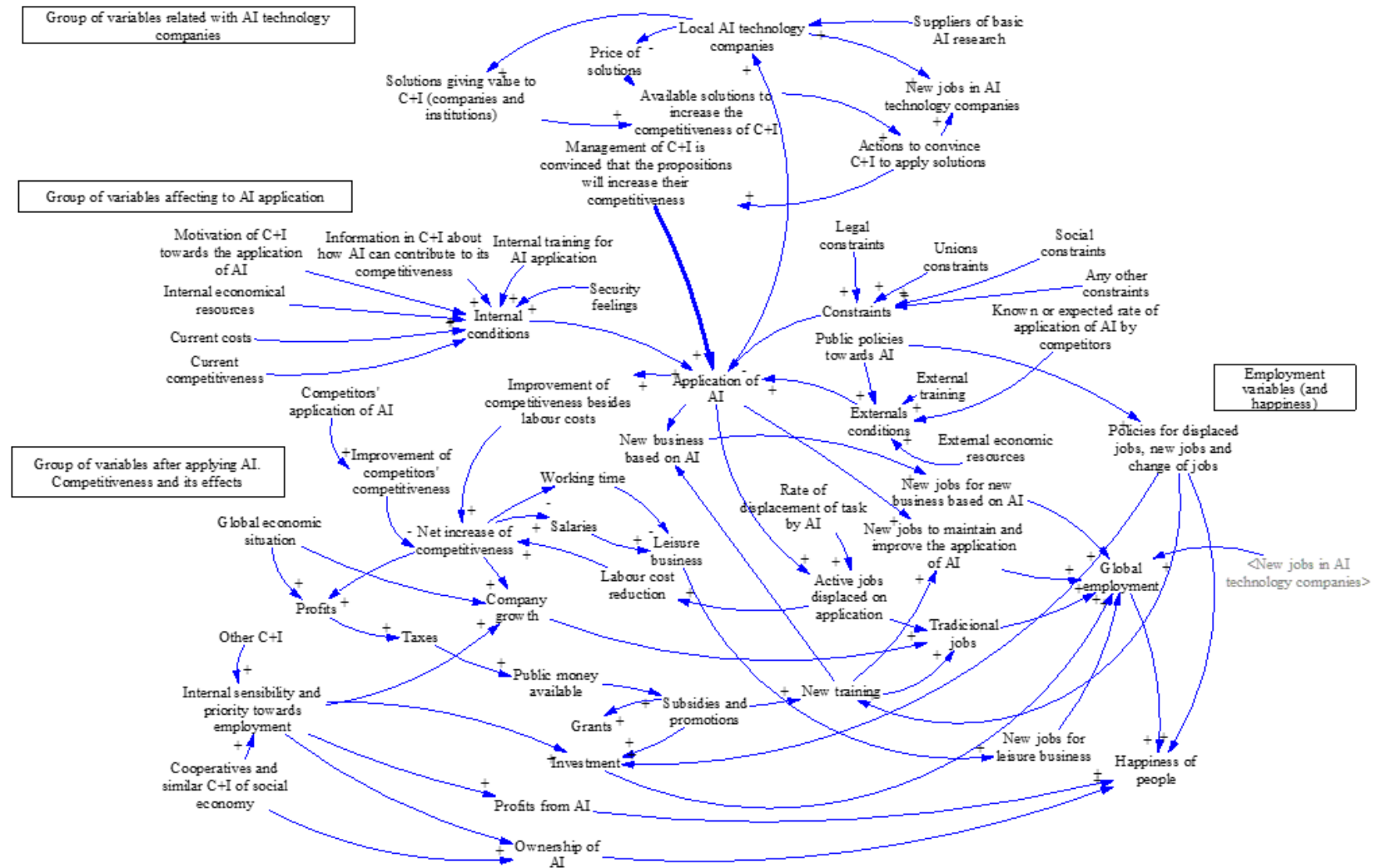


Figure 2. Global Causal Loop Diagram among Artificial Intelligence, Competitiveness and Employment

### 3.4.2. Group of variables affecting to Artificial Intelligence application

As soon as management of C+I is convinced that the proposition received from the technology company will increase their competitiveness, they should not directly go to **Application of AI**, because if they want to be successful in the application they must before deal with **Internal conditions, External conditions and Constraints**.

**We have found that the most important variables affecting the Internal conditions are:**

**Security feelings** that we consider with positive relation with Internal conditions, because, if the security feelings are high, the people in the C+I will not be afraid of losing their jobs (but we have to admit that we have found C+I in which the security feelings act as a restraint to apply AI because people are afraid to lose the security, on this case this variable has a negative relation with internal conditions).

**Internal training for AI application** with clear positive relation with Internal conditions.

**Information in C+I, about how AI can contribute to its competitiveness** with positive relation always that it is well explained that not to apply AI will means not to be competitive which always will reduce employment.

**Motivation of C+I towards the application of AI**, with very positive relation.

**Internal economical resources**, with clear positive relation.

**Current costs**, with positive relation because, the more the costs the more the motivation to apply AI systems to reduce costs or/and to increase sale prices by improving products and services.

**Current competitiveness**, that we have considered with neutral relation as we have met many C+I not yet interested on applying AI because they are already very competitive and do not want any risk with new experiences. Otherwise the competitive companies are normally the ones very opened to innovation.

The relation between **Internal conditions** and **Application of AI** is positive because the better the conditions the better

the application. But if one or several internal conditions are not favourable, is the management who must decide if applying or delaying the AI solutions, because applying with conditions against the application can weaken or even avoid the success of the application.

**We have found that the most important variables affecting the External conditions are:**

**Public policies towards AI**, which could be positive, negative or neutral. The relation with external conditions is positive.

**External training** with positive relation. This variable could have high importance if the internal training is not enough.

**External economic resources**, with positive relation and could also be important if the internal resources are not enough.

**Known or expected rate of application of AI by competitors**, with positive relation because if we know that competitors are applying AI, we should accelerate our application for not losing competitiveness in the market.

**We follow with the constraints to apply AI, that have a negative relation with the application because de more the constraints the less the application.**

We have found that the most important variables affecting the Constraints are:

**Legal constraints** to apply AI.

**Unions constraints** to apply AI.

**Social constraints** if, for any reason, the people in our environment are against AI.

Any other constraints like, for example, the members of the board or the ownership which could be against AI -it is rare but it happens when the information about AI is not correct-

Only the few C+I in which the management is convinced to apply AI and besides is able to overcome the internal and external conditions and the constraints, go to next step which is **Application of AI**, that as we can see is positively influenced by Management is convinced., Internal and External conditions, and negatively by Constraints. Evidently nor the intensity neither the speed of the

application of AI will be the same if the application starts with unfavourable conditions or constraints.

### 3.4.3. What happens with the application of Artificial Intelligence?

The immediate effects are:

**Active jobs are displaced**, the quantity depending on the **Rate of displacement of task by AI**, being the consequences **Active jobs displaced on application**, with **Traditional jobs** reduction and **Labour cost reduction** which increase the **Net increase of competitiveness** -on our final model proposition you will that there is not labour cost reduction because we propose to maintain the displaced people in the C+I in training till we transfer them to active jobs, but it will be later explained-.

**Improvement of competitiveness besides labour** costs always happens -it is really one of the most important effects of AI applications-, otherwise it means that the application of AI is not correct. But we must accept that some **Competitors' application of AI** will happen with

**Improvement of competitors' competitiveness** which will reduce the **Net increase of competitiveness** on our C+I who apply AI. This is a very good reason to be pioneers on AI applications.

There are **New jobs to maintain and improve the application of AI**, normally few jobs but good ones in quality.

The C+I launches **New business based on AI** creating **New jobs for new business based on AI**. This is one of the most important jobs' creation on next ten to twenty years.

Because of the **Net increase on competitiveness**, the C+I increase the **Salaries** and reduce the **Working time**, and both increase the **Leisure business**, creating **New jobs for leisure business**. We think, with many other authors, that leisure business will be the most important global jobs creator on next 20 years at least, not only for the important current and future growth prevision, but also because leisure jobs have many human tasks non displaceable by AI.

Another consequence of **Net increase of competitiveness** is the **Company growth** and the increase of **Profits**, both affected by the **Global economic situation**.

#### 3.4.4. Jobs creation because of AI applications

The **Company growth** will, for sure, increase the **Traditional jobs**, mostly the no-displaceable tasks, because why are we going to increase jobs that we know will be displaced when we apply AI in the area?

Growing the **Profits** will grow the **Taxes**, then there will be more **Public money available** which should be used to create a virtuous circle with **Subsidies and promotions** for **New Training, Grants and Investment** on AI that accelerate the jobs' creation faster than the jobs' displacement.

We have found out that there are many C+I with **Internal sensitivity and priority towards employment**, most of them **Cooperatives and similar C+I of social economy**, but not only because there are many **Other C+I** with the same sensibility. This sensitivity makes them to share the **Profits**

**from AI** and even the **Ownership of AI** what, of course, increase the **Happiness of people**, also increased by the **Global employment** and the **Policies for displaced jobs, new jobs and change of jobs**.

As you can see the **Global employment** is the addition of the variables: **New jobs in AI technology companies** (it is shaded because it belongs to the technology area); **New jobs for new business based on AI; New jobs to maintain and improve the application of AI; Traditional jobs; New jobs for leisure business; and Investment**.

We have accepted in this diagram the variable **Happiness of people**, because some authors, propose not only to worry about employment but also about happiness, accepting that the unemployment has a very negative effect on happiness. Happiness is also influenced by Public policies towards AI through Policies for displaced jobs, new jobs and change of jobs, and sharing Profits from AI and Ownership of AI.

With this global CLD diagram of Figure 2 we try to explain the most relevant variables with its cause - effect relations of the phenomenon among AI application, Competitiveness and

Employment and on next pages we will focus this research in the different areas of the phenomenon from the basic AI research to the application on C+I and its effects on competitiveness and employment on each C+I applying AI.

### 3.5: Focusing on CLD diagrams from the Artificial Intelligence technology to the Global employment in each C+I applicant

The Technology companies' area in the Global Diagram CLD of Figure 2 is the next in Figure 3:

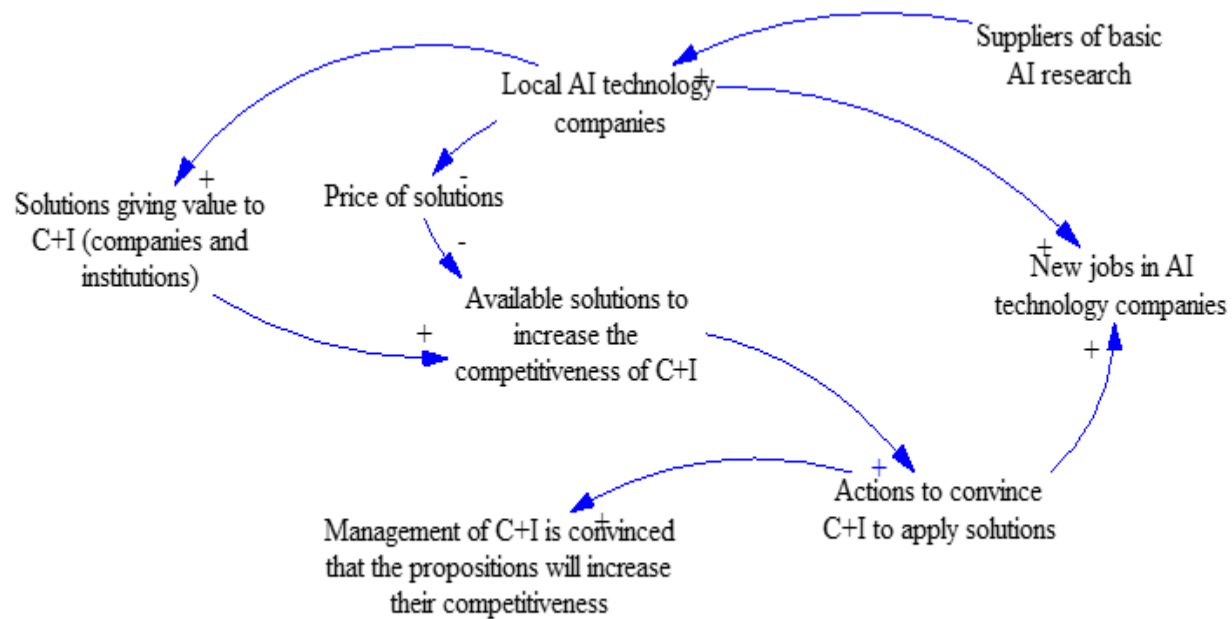


Figure 3. Focus on Technology companies' area in the Global Causal Loop Diagram among Artificial Intelligence, Competitiveness and Employment

But this diagram is simplified for not to overcharge the global CLD of Figure 2. Following, we show the CLD Figure 4 of technology companies with all the variables that represent them and their relations.

In Figure 4, we have added new variables or rename them to better represent the technology companies since they receive the Basic AI research till, they convince the managers of C+I to apply their solutions.

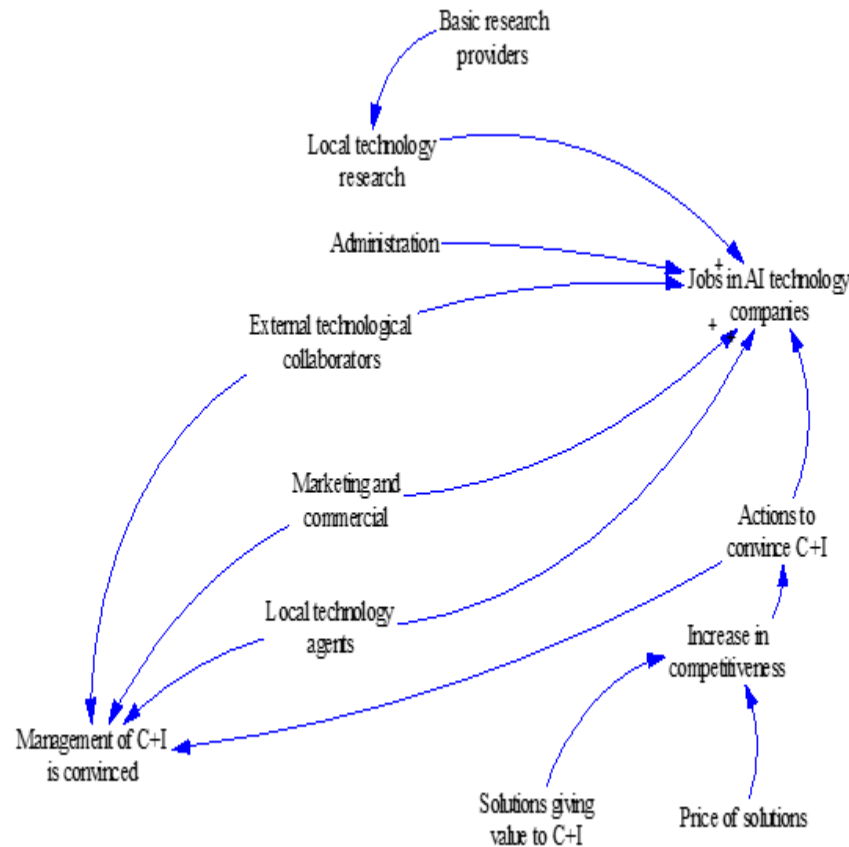


Figure 4. CLD of technology companies

The renamed variables in Figure 4, are:

**Basic research providers**, instead of Suppliers of basic AI research.

**Local technology research**, instead of Local AI technology companies.

**Jobs in AI technology companies**, instead of New jobs in AI technology companies.

**Actions to convince C+I**, instead of Actions to convince C+I to apply solutions. Which increase the variable Jobs in AI technology companies.

**Management of C+I is convinced**, instead of Management of C+I is convinced that the propositions will increase his competitiveness.

**Solutions giving value to C+I** and **Price of solutions** maintain the name but affect only to Actions to convince C+I.

And the new ones are:

**Administration:** Of AI technology companies that also creates new jobs.

**External technological collaborators:** That technology companies normally have for special projects and because of technical or geographical reasons. It creates new jobs.

**Marketing and commercial:** People specialise on those tasks. It creates new jobs.

**Local technology agents:** People nearer to clients than the technology company people, who collaborate on research, selling and application of AI. It also creates new jobs.

The next area in the global CLD of Figure 2 is the area of decision since the management of C+I is convinced till they decide the Application of AI, shown in Figure 5.

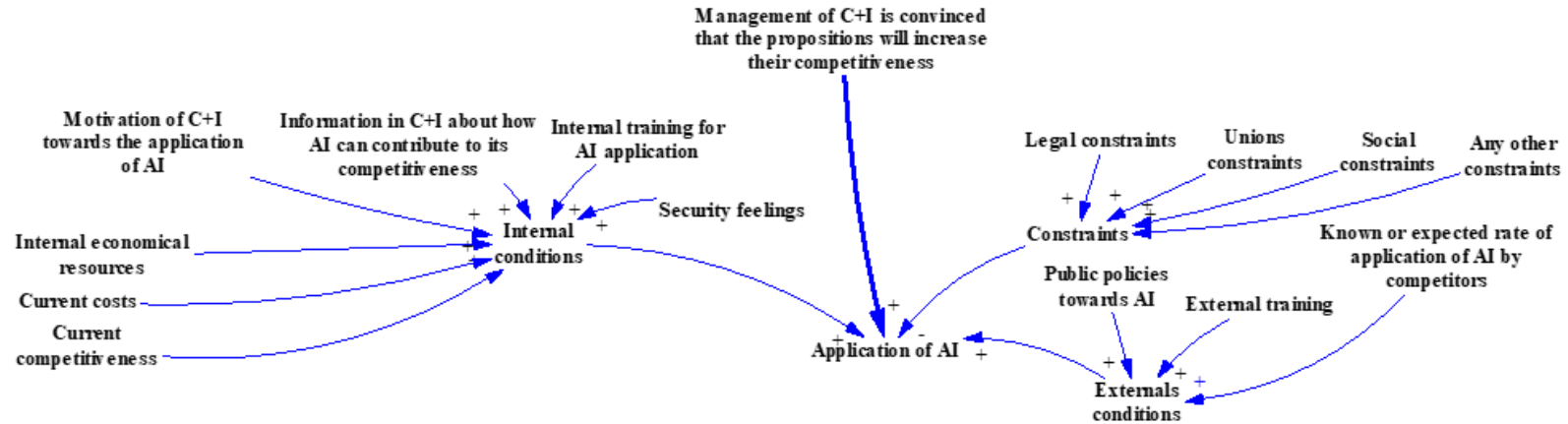


Figure 5. Focus on the area of decision to apply AI since the management of C+I is convinced till they decide the Application of AI; in Global Causal Loop Diagram (Figure 2)

On the following page we show the CLD of Figure 6 of decision to apply AI in C+I with all the variables that represent them and their relations.

We have added new variables to better represent the decision to apply AI since they are convinced till the application of AI.

The new variables in Figure 6, are:

**Impact of internal conditions on application of AI:** This variable depends on **Internal conditions** and **Actual impact of internal condition**, the first one representing what we know now about the internal conditions being favourable or not; and the second one is our feeling about our capacity to solve the internal conditions, even if they are unfavourable, in parallel with applying AI.

**Actual impact of internal conditions:** Already explained.

**Impact of external conditions on application of AI and**

**Actual impact of external conditions:** The same explanation.

**Impact of constraints on application of AI and Actual**

**impact of constraints.** The same explanation.

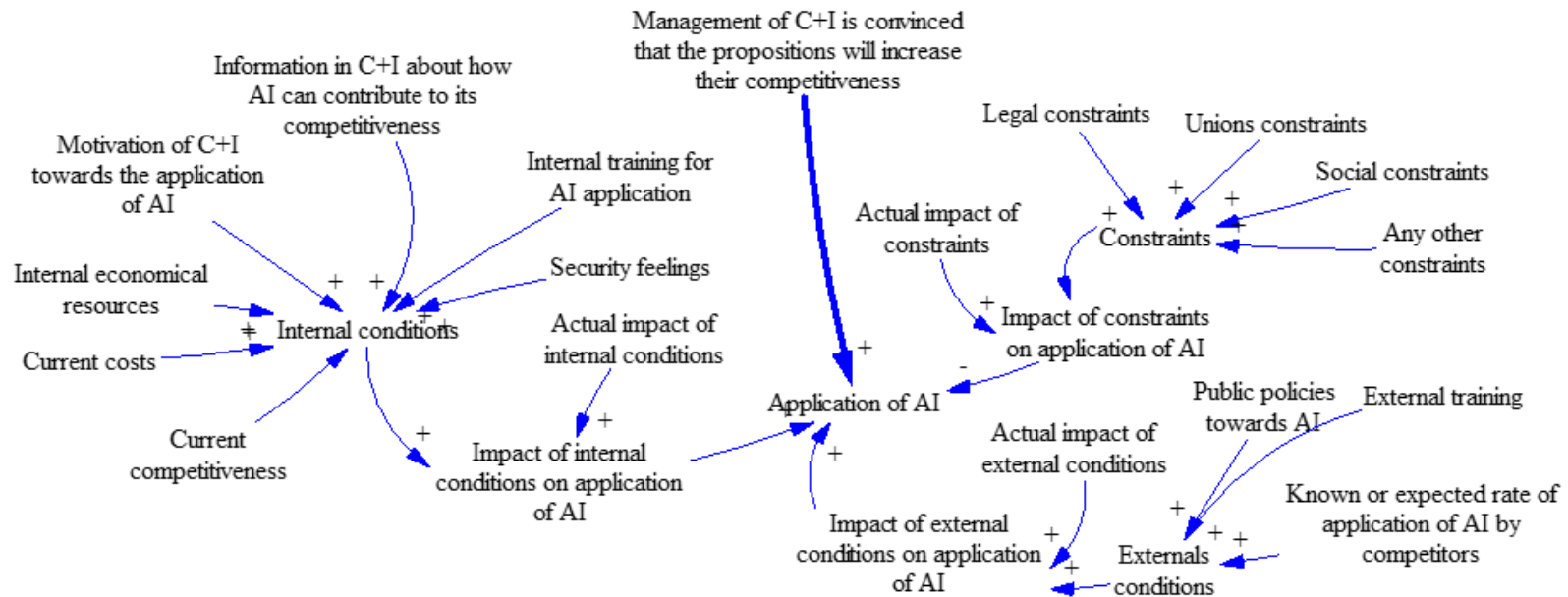


Figure 6. CLD focusing on decision to apply AI in companies and institutions (C+I) with all the variables that represent them and their relations.

The few C+I that, as on December 2019, can solve internal and external conditions and constraints, go to the Application of AI.

For practical reasons to improve the understanding of the phenomenon, we represent what happens since the **Application of AI in Companies and Institutions (C+I)** to final global employment, with three diagrams:

**Figure 7. CLD focusing since the application of AI to competitiveness and displacement of jobs inside the company or institution (C+I) applicant.**

**Figure 8, CLD focusing since the application of AI to final employment inside the company or institution (C+I) applicant.**

**Figure 9, CLD focusing since the application of AI to final global employment inside and outside company or institution (C+I) applicant.**

In the next CLD of the Figure 7. since application of AI to competitiveness and displacement inside the C+I applicant,

we have included the next variables to better understand the phenomenon:

With the **Application of AI**, the immediate effects are the **Improvement of competitiveness besides costs** and the **Area of application**, because normally the AI is applied area by area in C+I and each area has its own **Rate of displacement on area**.

**Total initial jobs, inside the C+I applicant:** Are the jobs in the company or institution applicant before applying AI.

The Total initial jobs are divided into **Total displaceable jobs** and **Total non-displaceable jobs**, both depending of the variable **Rate of global displacement** to be calculated on any C+I applicant using the explanation given before about the more likely and less likely displaceable jobs.

**Jobs' reduction** (normally in %) to measure the **Cost -reduction or increase-** with the variables **Relative weight of salaries on area, Cost of application and Grants**. The cost change will affect, with a negative relation (the more the

costs the less the competitiveness), the **Total improvement of competitiveness**.

As written before the **Net improvement of competitiveness on the market** will affect the increase of **Salaries** and the decrease of **Working time** increasing both the **Leisure business**

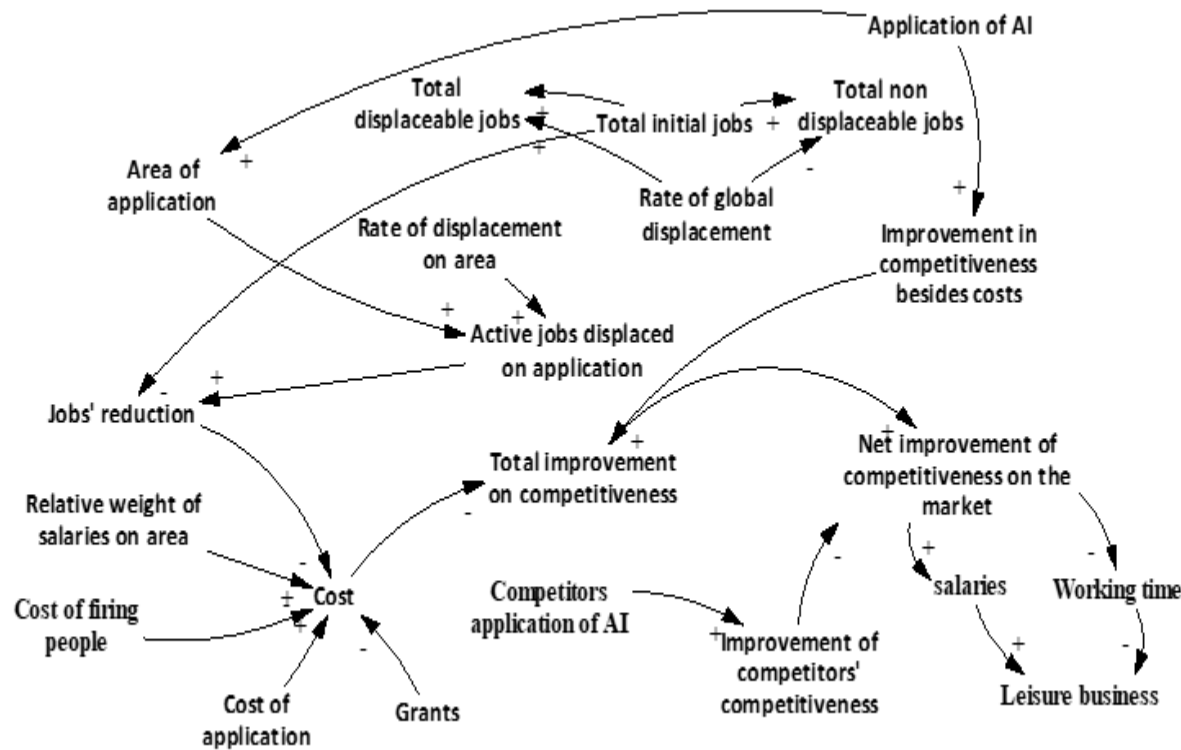


Figure 7. CLD focusing since the application of AI to competitiveness and displacement of jobs inside the company or institution (C+I) applicant of AI

Following we show the Figure 8, CLD focusing since the application of AI to final employment inside the company or institution (C+I) applicant.

In the CLD of the Figure 8 we have included the next variables to better understand the phenomenon:

**Growth on traditional jobs**, coming from **Company growth** and **Total non-displaceable jobs** because the C+I should not increase jobs that will be displaced. Of course the influence of variable **Global economic situation** is very important.

**Growth on new jobs for new business based on AI**, because, this new business, will have their own competitiveness and growth on the market.

**Growth of new jobs to maintain and improve the application of AI**, that depends from future applications.

And finally, we have divided **Leisure business** on Internal and External, only the first ones affecting to the **Jobs for leisure business inside the applicant C+I**. This internal leisure business will have their own Growth.

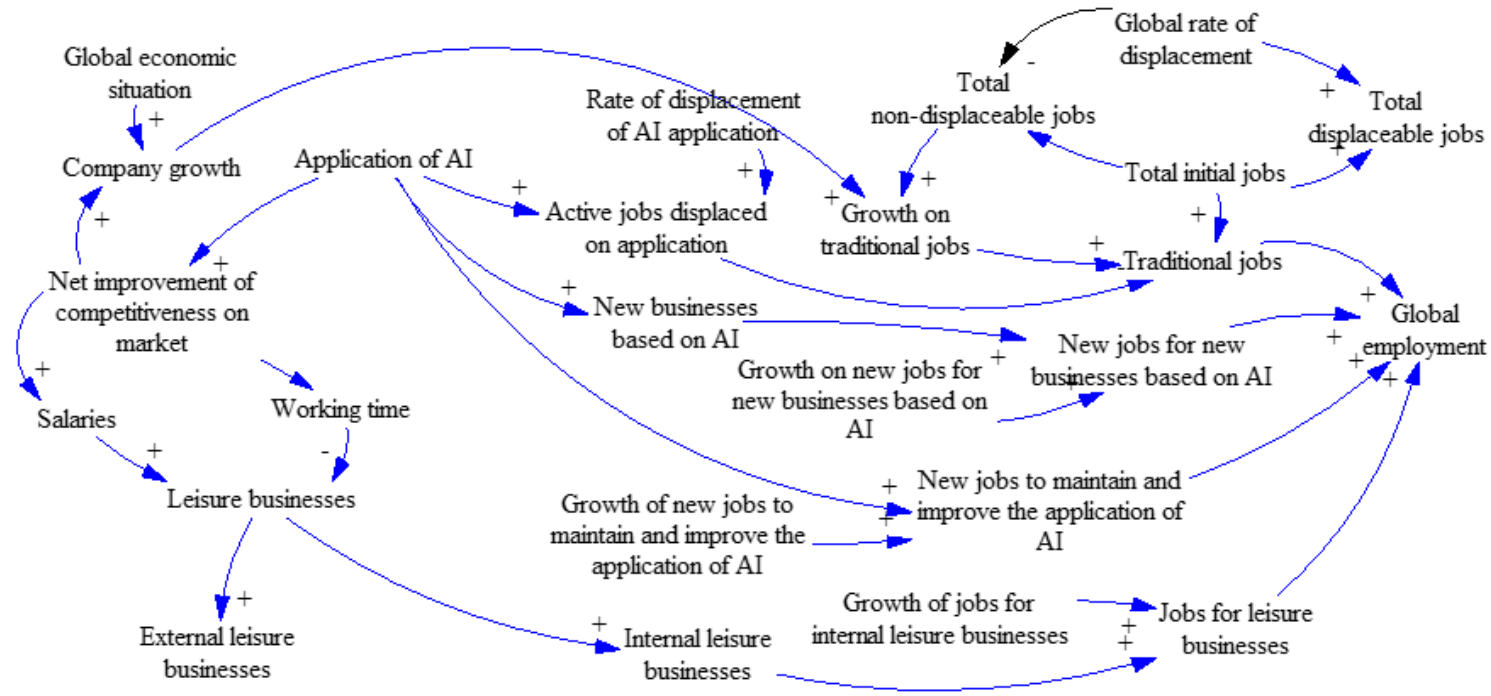


Figure 8. CLD focusing since the application of AI to final employment inside the company or institution (C+I) applicant

Now we go to build and show the Figure 9, CLD focusing since the application of AI to final global employment inside and outside company or institution (C+I) applicant.

On this CLD of Figure 9 we include the effects on employment, inside and outside the C+I anytime that one C+I (Company and Institution) apply AI.

In relation with previous CLD models we want to highlight the next variables: **Active jobs inside** which is the global employment inside the C+I applicant the AI system, variable that substitute **Global employment** that now is the addition of **Active jobs inside** plus **Global employment outside**, being this last one the addition of **Jobs for external leisure business** and new **Investments** because of **Subsidies and promotions** with the **Taxes and public money** available because the C+I applicant of AI has more **Profits** because of its **Net improvement of competitiveness on market**, corrected positively or negatively by the **Global economic situation**.

We also highlight in this CLD the variable **Happiness of people** fundamentally influenced by the **Global**

**employment** (not having a job is the source of great unhappiness) and also by the **Policies for displaced jobs, new jobs and change of jobs**.

And we do not want to forget that there are in the market **Cooperatives and other C+I of social economy** and **Other C+I** of no social economy that that have **Internal sensibility and priority towards employment** and happiness of his people and therefore they share the **Profits from AI** and even **The ownership of AI** to increase the Happiness of his people.

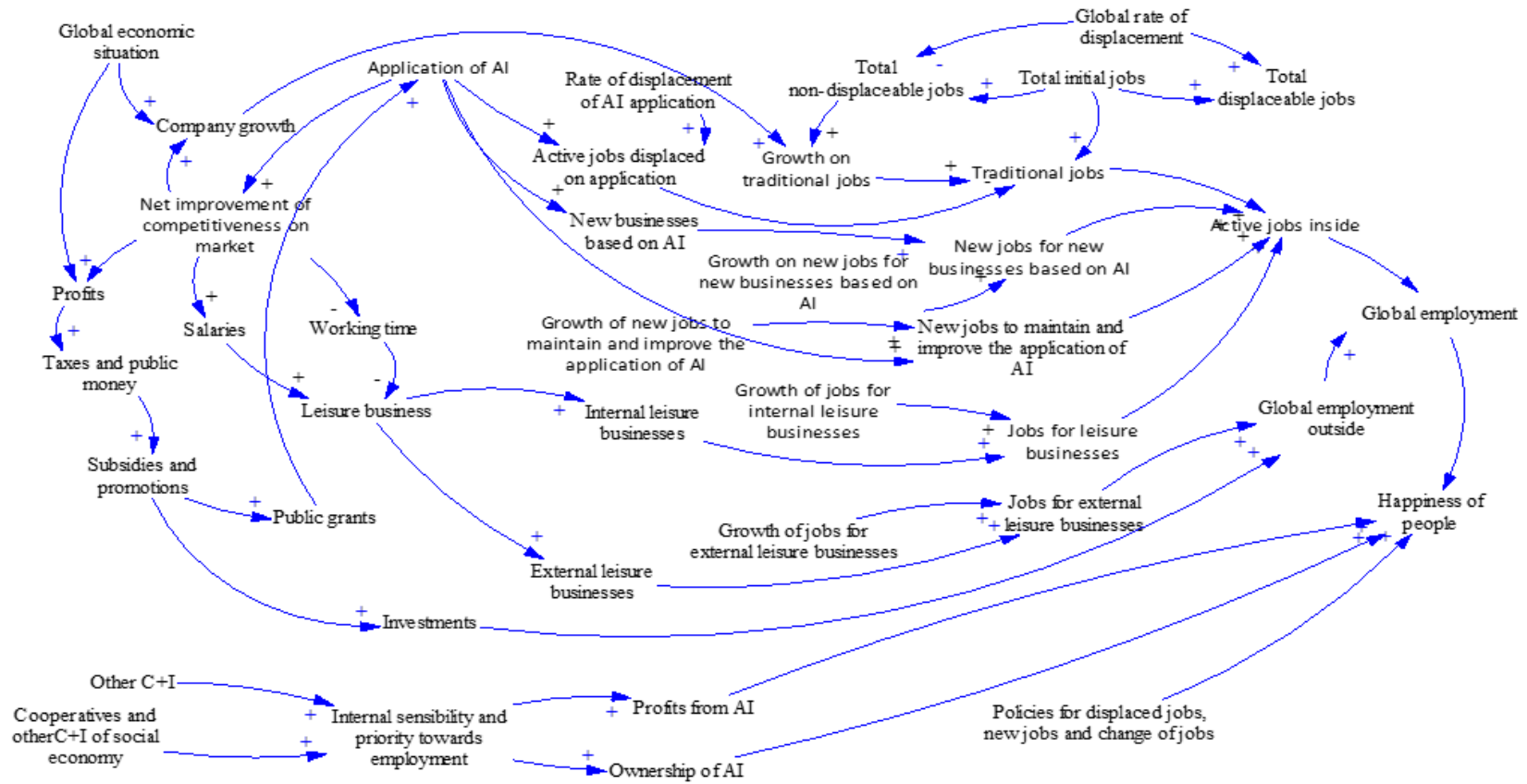


Figure 9. CLD focusing since the application of AI to final global employment inside and outside company or institution (C+I) applicant

### 3.6. Stock and Flow Diagrams (SFDs) . Our new model propositions

As we have seen, the CLDs are causal diagrams essential for understanding the phenomenon among the application of AI, the competitiveness and the global employment; and to know the main variables that intervene and the relations among them, positive or negative feedback loop..

But we do not only want to contribute to understand the problem but also to solve the problem, in other words: To contribute on what the decision makers must do to apply AI systems having more and better jobs on any reality after we apply AI.

Apply or not AI is it an option? Our statement is IT IS NOT. Why?

Because the application of AI not only reduces costs -in our new models propositions only reduces costs after one or two years after AI application- but much more important is that it improves -very often disruptively- the competitiveness of the C+I applicant in the way that sooner or later the C+I which

do not apply AI will disappear or at least will reduce the size and therefore the employment.

The sooner, the more and the better we apply AI systems, the more we will increase our competitiveness and the more employment we will create, reducing also the gap between displacement and creation of jobs. This is our first statement.

To apply sooner, more and better the AI, every C+I -but specially the SME- need to have, the nearest possible, technology companies to give them available solutions based on AI adapting for their needs the best basic AI technology. This is our second statement.

To apply successfully AI the C+I need to solve properly the internal and external conditions and the constraints. This is our third statement.

For sure the AI's application will displace many tasks, augmenting disruptively the productivity of people and therefore reducing jobs for doing the same work. This is our fourth statement.

But the application of AI systems, with all the new technologies around AI, will create many jobs, much more than the ones displaced. As we want these new jobs to be in our C+I -the best- or near us, in our environment -at least- and we also want to reduce the time gap between displacement and creation of jobs; all the decision makers, inside and outside each C+I, private and public ones, must make the correct decisions for maintaining or improving the global jobs' creation. This is our fifth statement.

It is much easier to train and re-employ people if they do not leave the job market. This is our sixth statement.

Then we will build and show the Stock and Flow Diagrams (SFDs) to apply all these statements except the last one that will be included in our new model propositions.

**Following we show four Stock and Flow Diagrams (SFDs):**

- 1.- SFD Technology AI companies (Figure 10).
- 2.- SFD Companies and Institutions (C+I) appliers, area of conditions and constraints (Figure 11).

- 3.- SFD Companies and Institutions (C+I) appliers, area of competitiveness and tasks' displacement inside C+I (Figure 12).

- 4.- SFD Companies and Institutions (C+I) appliers, area of jobs' creation inside C+I (Figure 13).

WE start with the Figure 10 SFD Technology AI companies.

In this SFD the following variables are already explained in the equivalent CLDs: Basic research providers; Local technology research; External technological collaborators; Administration; Marketing and commercial; Local technology agents; Jobs in AI technology companies; Actions to convince C+I; Management of C+I is convinced; Increase in competitiveness; Solution giving value to C+I and Price of solutions.

What variables are new in Figure 10 SFD?:

The most important novelties are the variables that become accumulative as: **Local technology research; Administration; External technological collaborators; Marketing and commercial; Local technology agents.**

All those accumulative variables have an initial quantity of jobs, corresponding to the initial year before applying AI, and the jobs in any year among the years selected, normally in our applications between 2018 and 2025, but we can select any other range of dates.

**Jobs in AI technology** companies accumulate the total jobs on any year as addition of the other five accumulation variables creating jobs.

Each of the other five variables has the total jobs in its function as the addition of the initial jobs in the selected as initial year and the growing in every year over the previous one, in the year we want to measure the quantity of jobs.

The annual growth comes from different Rates of every year's growing, using the known quantities for the past years and the expected ones for the future.

It is clear that the growing will depend on how successful the technology company is giving available solutions and convincing the C+I, but even after convincing they have to

wait for the C+I to be able to apply AI overcoming all the conditions and constraints, as we will explain later.

We want to highlight again that the technology companies are already and will continue globally growing and creating jobs in future years but, besides the importance of creating jobs they are fundamental for the rapid and good applications of solutions based on AI to local companies, specially to SME.

The other quantitative but not accumulative variables are the following.

Basic research providers with value between 0 and 1, influencing directly in Annual growth local technology research, therefore in the essence of the technology company.

The technology company offers **Solutions giving value to C+I** of course at a **Price of solutions** both with value between 0 and 1, having the opposite effect on the **Increase of competitiveness** for C+I -the more the value and the less the price the better de competitiveness of the solution-. With

their solutions they make **Actions to convince C+I** with the collaboration of the people in the company and sometimes with additional people that increase the Jobs in AI technology companies.

We cannot give a value to the variable Management of C+I is convinced, til they decide to apply the AI solutions and is for that for measuring the Jobs in AI technology companies we have to measure its sensitivity to AI application in each of its clients.

But we know that the better the Basic research providers, the better the Local technology research, the better the Increase in competitiveness and the better the Actions to convince C+I, the more the possibilities that Management of C+I is convinced and this variable is sine qua non but not enough to guarantee the AI application, as we will see on next SFD.

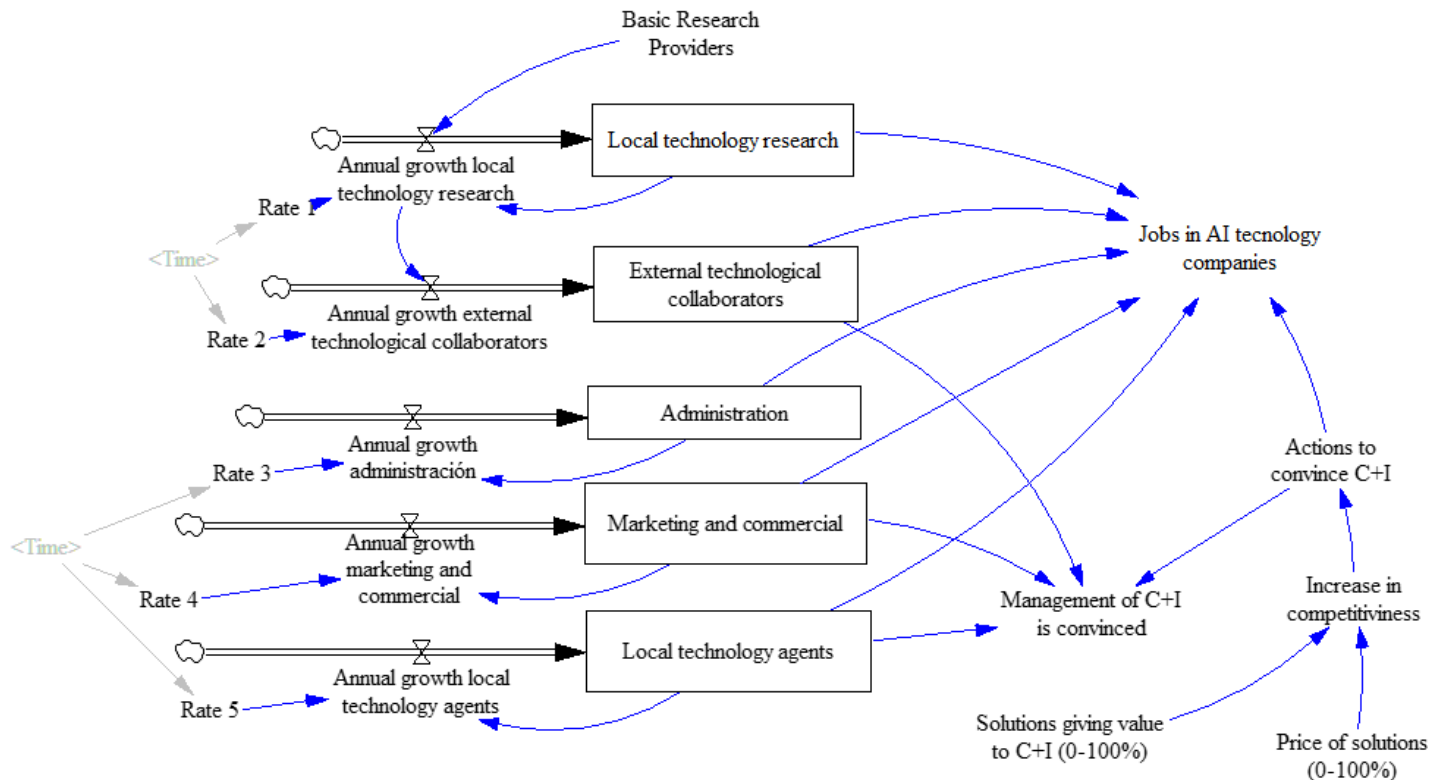


Figure 10.  
Stock and Flow  
Diagram  
Technology AI  
Companies

Following we show the Figure 11 Stock and Flow Diagram C+I appliers, area of conditions and constraints.

**What is new in this Figure 11 SFD C+I appliers, area of conditions and constraints?**

The most important novelty is that all the variables have a level, we mean a quantity. The variables that influence on Internal, External conditions and Constraints have a value between 0 and 1. This value is given normally by the internal teams of each C+I but can also be given by external supplier specialists for this purpose. Some technology companies are giving this service to help the C+I to be successful applying AI (we will later show that the more AI is applied by C+I the more the technology AI companies are growing).

The value of each of the variables Internal conditions, External conditions and Constraints could be the medium value of all the variables influencing each of these three, but only if the value of each variable on each group is the same or very similar; but if one or several variables are very different and against application -low value on conditions or high value on constraints- the value of those variables should

be predominant to evaluate each of the three internal, external conditions and constraints.

The final impact is always corrected by **Actual impact of internal condition**, which is our feeling about our capacity to solve the conditions and constraints even if they are unfavourable, in parallel with applying AI.

These valuations are very subjective therefore we recommend the C+I to use external specialists to improve the quality of the valuations and to be successful on AI application. Anyway on any application we will always measure the sensitivity to these subjective variables.

All the three impacts of conditions -internal and external- and constraints affect the new variable Global impact on AI application, also with a value between 0 and 1 and with same criterium, being predominant the one that more negatively could affect the **Application of AI** which is the only accumulative variable in this diagram.

Finally, the **Application of AI** is affected by **Global impact on AI application** and **Management of C+I is**

**convinced...**being predominant the lowest one between 0 and 1, meaning the 1 that the application of AI will be fast and the maximum priority on the C+I; and decreasing the speed and the priority of the application as the value decrease.

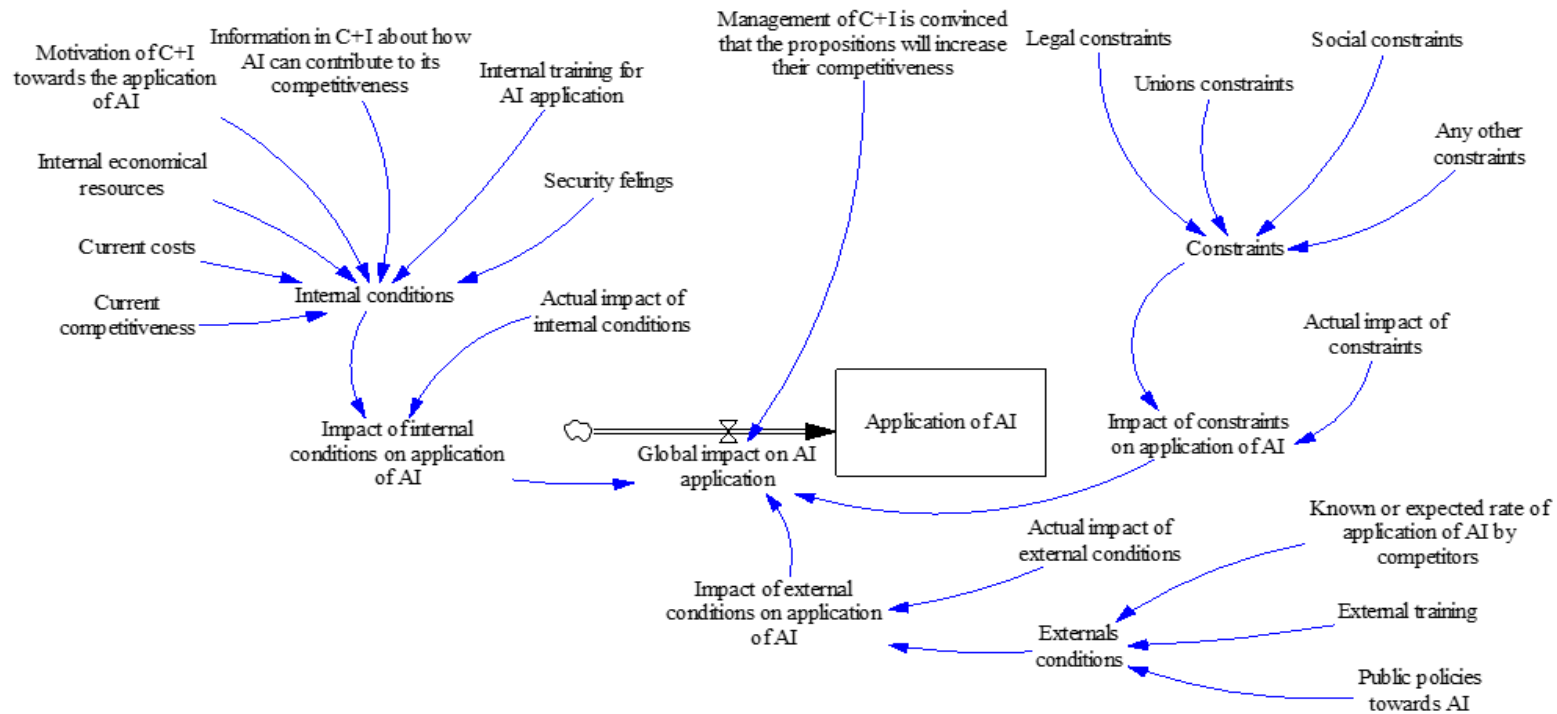


Figure 11. Companies and Institutions appliers of AI, area of conditions and constraints

We follow by building and showing the Stock and Flow Diagram for companies and institutions appliers, area of competitiveness and tasks' displacement inside C+I (Figure 12).

What is new in this Figure 12. C+I appliers, area of competitiveness and tasks' displacement inside C+I, in relation with previous CLDs?

**Total initial jobs** are the quantity of jobs in the C+I when we start our application of AI, which can be the current year or any previous year, if it is the case. **The rate of global displacement** is calculated by the internal people in each C+I, area by area, and frequently with the support of the technology company helping them to apply AI; this rate is the medium global rate. With the total jobs and the global rate, the calculation of **Total displaceable and no-displaceable jobs** is mathematically calculated, both measured in number of jobs.

The application is always made area by area of the C+I, the **Area of application** with a table, made by the C+I, giving to each area the initial jobs and a rate of displacement. With both figures we calculate the **Active jobs displaced on application**, also a quantity of jobs; with this figure and Total initial jobs we have the **Jobs' reduction** in percentage with a number between 0 and 1 -0% to 100%-; with this percentage, the **Total initial labour cost** and the **Relative weight of salaries on area**, we calculate the labour cost reduction, but to calculate the change on **Cost** because of the application we have to add the **Cost of firing people**, the **Cost of application** and to subtract the **Grants**.

If the Cost is a positive or a negative number-that means that the cost increase or decrease- it will affect in the opposite way the **Total improvement on competitiveness**; but, as the cost is measured in money -euros for example- and the competitiveness in capacity of growing, is the management of each C+I who must estimate the effect of cost increasing or reducing the competitiveness. If the change in cost is

small compared with the total costs in the C+I the effect on competitiveness will be insignificant, anyway if we have any doubt we should calculate the sensitivity to this variable.

With the application of AI the **Improvement on competitiveness besides costs** always happens -improvements on products, services and trust- which must be estimated by the management as the capacity of growing in percentage with a number between 0 and any number as the improvement could be as disruptive that we can estimate to be able to grow more than 100% -for 100% the number is

1-. The **Net improvement of competitiveness on the market** will be always negatively affected by the **Improvement of competitors' competitiveness** which depends of the **Competitors application of AI**.

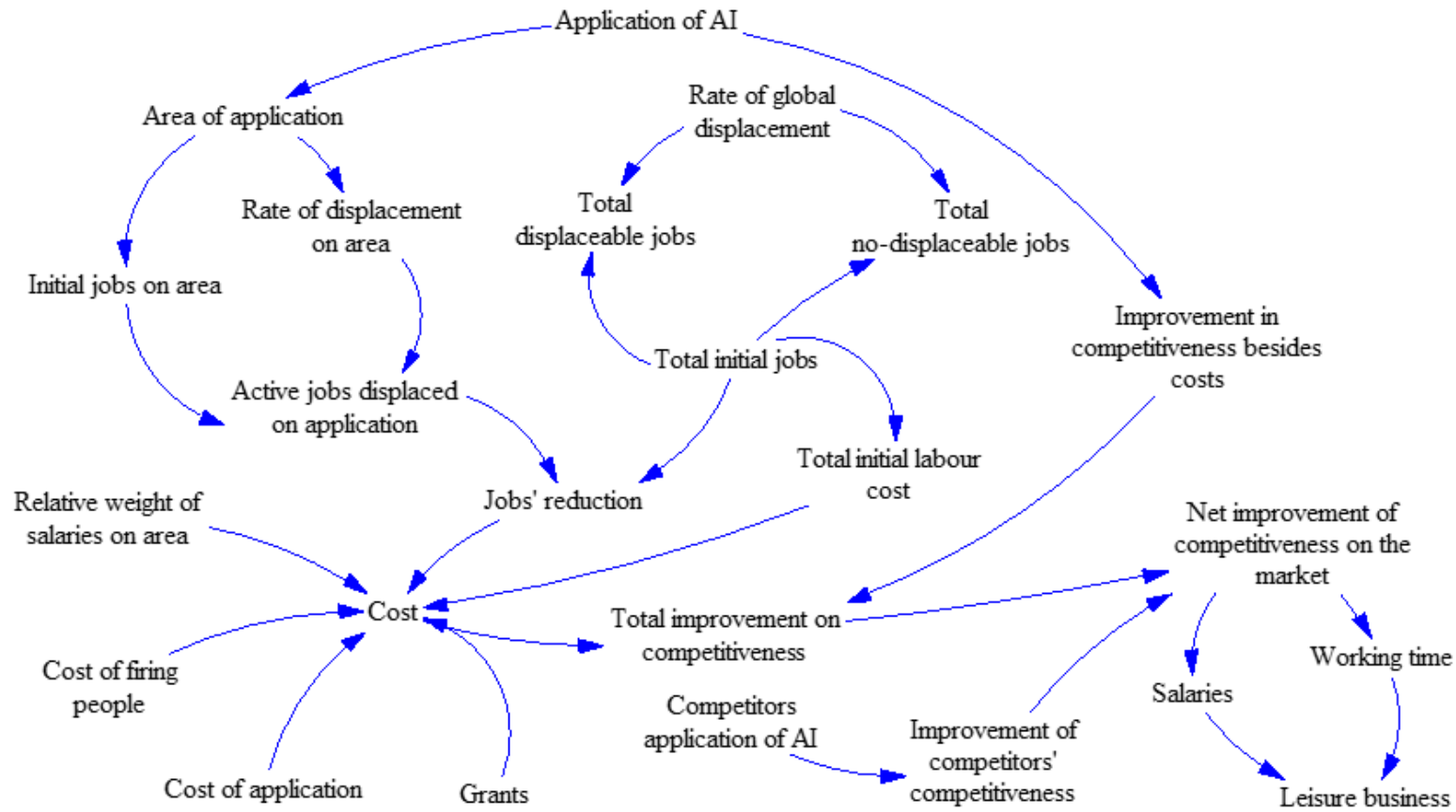


Figure 12. C+I appliers of AI, area of competitiveness and tasks' displacement inside C+I

Now we build and show the next Stock and Flow diagram C+I appliers, area of jobs' creation inside C+I (Figure 13).

The most important novelty is that all the variables have a level and some of them have yearly accumulation.

Some levels come from the SFD Figure 12 as Application of AI, Active jobs displaced on application, Total initial jobs, Total no-displaceable jobs, Net improvement of competitiveness on the market, and Active jobs displaced on application.

The variables with accumulation are: **Traditional jobs** which is the accumulation of **Total initial jobs** plus every year percentage **Growth on traditional jobs**, applied on **Total no-displaceable jobs** as we propose no increasing the displaceable jobs -sometimes we should do it but with temporary people-. The percentage every year growth on traditional jobs come from **Company growth** as a percentage affected by **Net improvement of competitiveness on the market** and by **Global economic situation**, this latter measured as positive, negative or neutral -if the value is 0 means no growth at all, if it is 1

means that is maintained 100% of net improvement of competitiveness on the market, between 0 and 1 the net improvement is reduced and above 1 the net improvement is augmented- by international organisations and affecting positively or negatively to every year growth according to the feeling of C+I management.

Every year's jobs accumulated in Global employment are divided – as in previous diagrams- into four groups:

**Traditional jobs** that has initial value of **Total initial jobs**, on the moment of application we subtract **Active jobs displaced on application**, and every year we accumulate the **Company growth** of every year multiplied by **Total no-displaceable jobs** which also grow every year with the same percentage as Company growth.

**New jobs for new business based on AI**, has an initial value coming from **New business based on AI** which is a decision of the management of how many people they dedicate for this very important and often disruptive jobs' creation. The quantity and quality of people should be important, and the annual Growth estimated very high,

usually no less than 100% annually – the growth annual figure would be 1 or more but can be different every year-.

**New jobs to maintain and improve the application of AI** has an initial quantity that we know on the moment of application and the annual growth depends on future applications, then we do not need to make any estimation and just put every year the current figure. The quantity on this variable is not big but the quality of people knowing the business is fundamental.

With the **Application of AI** -coming the number from figure 11- the immediate effects are the **Active jobs displaced on application** and **Net improvement of competitiveness on the market**, this latter calculated in SFD Figure 12. But always the application of AI allows the C+I to launch **New business based on AI** creating **New jobs for new business based on AI**. This is one of the most important new jobs' creation in quantity and in quality, because of AI applications.

There are creation of **New jobs to maintain and improve the application of AI**, normally few jobs but good ones in quality.

Because of the **Net increase on competitiveness**, the C+I increase the **Salaries** and reduce the **Working time**, and both increase the **Leisure business**, creating **New jobs for leisure business**. We think, with many other authors, that leisure business will be the most important global jobs creator on next 20 years at least, not only for the important current and future growth prevision, but also because leisure jobs have many human tasks non displaceable by AI.

We have divided **Leisure business** on **Internal and External**, only the first ones affecting to the **Jobs for leisure business** inside the applicant C+I. This **Internal leisure business** will have the growth rate for the **Growth of jobs for internal leisure businesses** affecting the **Jobs for leisure businesses** with an initial number of people decided by the decision makers in each C+I.

Other consequence of **Net increase of competitiveness** is the **Company growth** also affected by the **Global economic situation**.

The **Company growth** will, for sure, increase the **Traditional jobs**, mostly the no-displaceable jobs, because if the displaceable jobs also grow it will be temporary till AI is applied in the respective area.

As you can see the **Global employment** is the addition of the variables: **Traditional jobs**; **New jobs for new business based on AI**; **New jobs to maintain and improve the application of AI**; and **New jobs for leisure business**.

New jobs for leisure business include a number of initial jobs and a percentage annual growth being both a strategic decision of management, but they have to take into account the next factors: Leisure business are already the most global growing jobs' creation not only because the leisure business in general are the fastest growing ones but also because

leisure jobs in general have many human tasks, therefore they are less likely to be displaced by AI. Accordingly any C+I interested in creating employment has to think about leisure business, not only as independent business but besides because more and more, in the international very competitive market, the competitiveness is an essential condition but not enough as the best clients are also looking for very grateful experiences working with us. The same thing happens with the talented people if we want them to work with us and to retain them; the same with our best suppliers and finally as well with the people in our environment if we want them to support us. **Leisure business** could solve all these important needs on any reality we work. Accordingly, it is important to put on **Internal leisure business**, enough and good people and to estimate a reasonable annual growth.

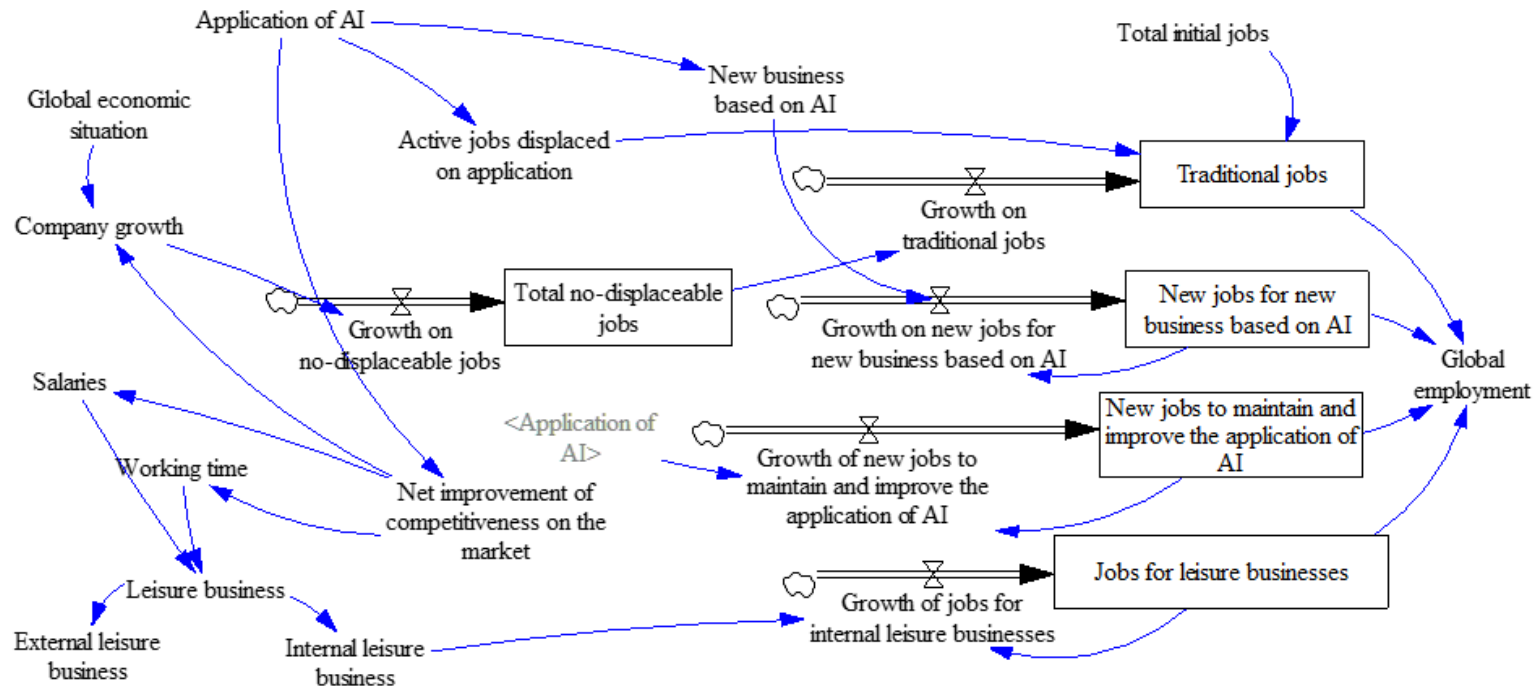


Figure 13. SFD C+I appliers of AI, area of jobs' creation inside C+I

### **Our new model propositions**

Our SFD, Figures 10 to 13, models show clearly what each C+I has to do to create more jobs than the ones displaced by each application of AI, but in our opinion these models -in spite of clearly representing the current reality- have a weak point that has to be solved and this weak point is the variable **Active jobs displaced on application** which could reach gradually up to 50% of the active jobs on the area applied and finally the same percentage on the global C+I employment.

When we apply such a disruptive technology as AI we must be very honest and transparent informing all the stakeholders -especially to our own employed people- that our AI applications will displace many jobs but it is our intention to recuperate all displaced jobs with new and better jobs in less than two years. The big problem in our models is that the displacement takes place before the creation and the people who suffer the displacement could be not the same people that enjoy the creation. This problem being an important social problem will also be a problem for the AI application

because it will affect negatively to internal and external conditions and to constraints, therefore always weakening and often preventing the AI application.

Therefore, our current models – Figures 10 to 13 that describes what is going to happen with AI applications- have the next problems to be solved:

We cannot hide that, immediately after almost any application of AI, many tasks will be displaced by AI systems increasing the productivity of the jobs in the area of application and therefore reducing the need of people -active jobs- around 50% (could be more or less depending how much it is possible to structure the tasks in the specific jobs of each C+I).

We can explain that the application of AI will allow us to create many jobs and, that it is our intention and our promise to achieve in two years, more and better global jobs than before any AI application.

But our people, the society, the unions and the politicians will ask us: What happens to the people displaced? How will

they find another job as the task they did before AI applications will probably disappear? What happens with the unemployment gap between displacement and creation of jobs? Even if we comply our promise to recuperate the jobs in two years it will be too long for the current society in Europe.

Consequently, based on our experience as business decision maker worried for employment for more than 40 years, we make the next new model proposition: **The people displaced must remain as employed in the same C+I** -or any other reality controlled by the AI applicator- in one area called **People in training** with the same labour conditions as before the displacement.

People in training must be trained to become active jobs in less than two years in the same reality where we apply AI, giving priority to the growth on traditional jobs restricting the growth to no-displaceable jobs to absorb the people in training, as it is much more easier the training and the people adaptation because is inside the C+I they already know and we know before the kind of training that they need. Of

course if the growth on no-displaceable traditional jobs is not enough to absorb the people displaced in less than two years, we will use the other growths of new jobs, training not only the displaced but also the non-displaced to occupy the new jobs leaving traditional jobs free and available for the displaced.

### **In what skills must we train these people in training?**

Exactly for the jobs that each C+I applicant of AI is working to create, we mean:

With total priority the **No-displaceable traditional jobs** created because of the growing of the C+I that applies AI and consequently increases its competitiveness.

**New jobs for new business based on AI** developed by the C+I that applies AI. In this case, if it is difficult to adapt the displaced people we can train the best non displaced people which will leave free traditional jobs to the displaced people.

**New jobs to maintain and improve the application of AI**, inside the same reality where we applies AI. These ones are also difficult for the displaced people and are usually

occupied by the best no-displaced with good training normally made inside the C+I by the AI technology companies specialists or by companies specialist in training.

**New jobs for leisure business inside the C+I** that applies AI.

Our new model propositions are developed in three diagrams: Figure 14 instead of Figure 11; Figure 15 instead of Figure 12; and we finally propose the model of Figure 16 only for special cases that we will explain.

On following pages, we build the next SFD:

1.- New model PROPOSITION, stock and flow diagram for companies and institutions appliers, area of competitiveness and tasks' displacement inside C+I, (Figure 14).

2.- New model PROPOSITION, stock and flow diagram for companies and institutions appliers, area of jobs' creation inside C+I, (Figure 15).

3.- New model PROPOSITION, stock and flow diagram for companies and institutions appliers, area of effects inside and outside C+I, (Figure 16).

**Going to our new model propositions.**

**What have we changed in Figure 14 in relation with Figure 11?**

**We have cancelled the variable Jobs' reduction** and substituted it by the new variable **People in training**, which at the moment of the application of AI, has the same initial value as Jobs' reduction and change every year as we will explain later (increasing by new AI applications and decreasing by new jobs creation).

If all people displaced go in training and remain inside C+I **we do not need the variables Relative weight of salaries on area, Cost of firing people and Total initial labour cost and the three disappear from our new diagram.**

The **People in training** affect positively to the variable **Cost** -more cost- which to be calculated needs the new variable **Unit cost of people in training**. But of course, the quantity

of **Grants** will increase at least on the same quantity as will cost in public money if they were to be unemployed, as in previous models.

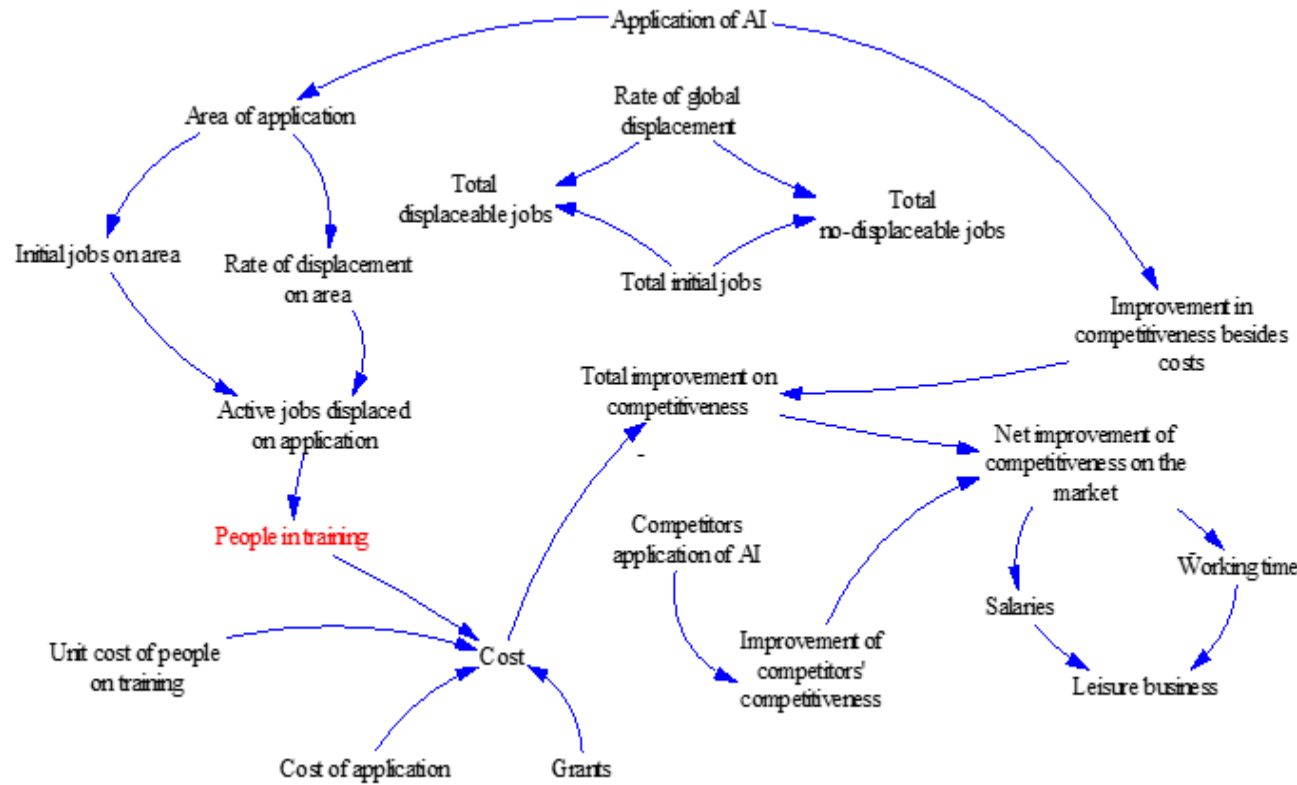


Figure 14. New model PROPOSITION, stock and flow diagram for companies and institutions appliers of AI, area of competitiveness and tasks' displacement inside C+I

Going to the next SFD Figure 15.

What have we changed on SFD Figure 15 in relation to SFD Figure 13, besides the changes on SFD Figure 14 in relation to SFD Figure 12?

**Global employment** is now **Active jobs** and **Global employment** become the addition of **Active jobs** plus **Net annual people in training**, which quantify the people that are still in training waiting to be transferred to active jobs.

The quantity of people in training is reduced every year – subtracting the variable **Active jobs displaced on application** and adding up the growth on no-displaceable jobs, that means only on traditional jobs because are much more easier to train and to transfert. If we have several AI applications in different years -what often happens- in any application we be people displaced increasing the Active jobs displaced on application.

As in any SFD, all variables are quantitative and several are accumulative, following we are explaining all of them.

As written before we create several **New businesses based on AI** -in our diagram we show three but could be any quantity- anyone with its initial people -decided by the managers of each C+I- and its expected **Rate of Growth**, creating all of then **New jobs for new businesses based on AI**.

The **Active jobs displaced on application**, which in diagram of Figure 13 reduced the **Traditional jobs**, now increase the **Growth of people in training** which is decreased by the **Growth on no-displaceable jobs**, giving the number of **Net annual people in training**. Then as the Growth on no-displaceable jobs grow the Net annual people in training decrease. Obviously this latter number in included in **Global employment**.

We include the variable **Working on line** as a new accelerator of **Leisure businesses**.

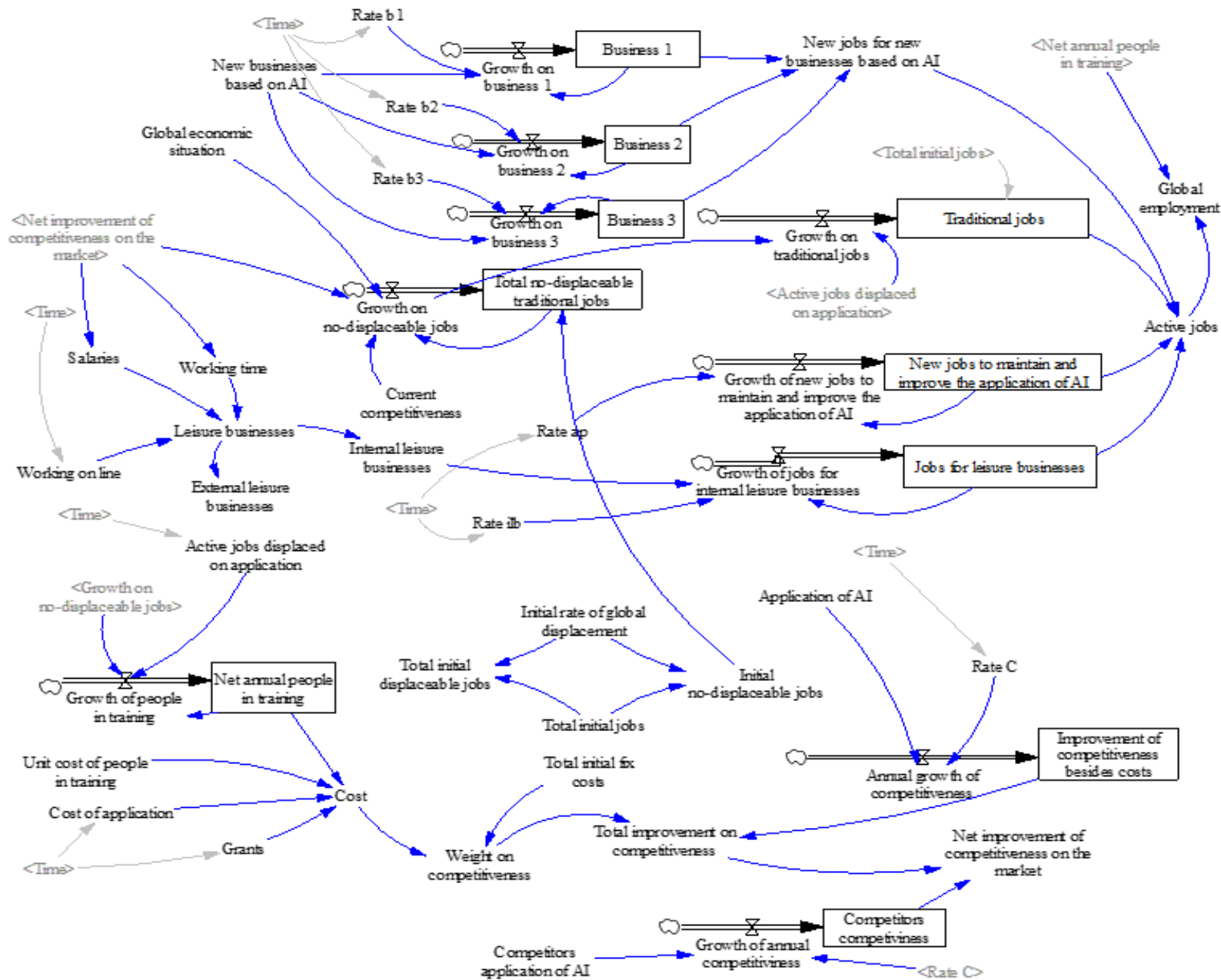


Figure 15. New model PROPOSITION, stock and flow diagram for companies and institutions appliers of AI, area of jobs' creation inside C+I

Then, the set of the SFDs which we will use to apply on any C+I and having to account only of the employment displaced and created inside the C+I in which we apply AI are:

SFD Figure 10, if technology companies are inside C+I.

SFD Figure 11, to calculate the effects of conditions and constraints on AI application.

SFD Figure 14, to calculate competitiveness and tasks displacement inside C+I.

SFD Figure 15, to calculate the creation of jobs, the global employment and the net people in training every year inside C+I.

Contributions and advantages of our models:

They explain clearly the complex phenomenon from AI's application to global employment inside each C+I that applies any AI system.

Explain the important role of technology AI companies and how they work.

Explain the importance of knowing and controlling the internal and external conditions and the constraints that we will have to confront applying AI.

Give a methodology to calculate the tasks' displacement and the competitiveness applying AI and, besides propose the variable People in training, which makes the next very important contributions: Solves the significant personal and social problem of people displaced becoming unemployed with an uncertain future; avoids many negative conditions and constraints from our people, from the Unions and from the society; does away with the potential bad image of AI's application and turns it into something positive not only for global employment but also for each C+I employment; drives and accelerate the jobs' creation to integrate soon the people in training to active jobs what is excellent for them, for the C+I and for society; and finally it is good for society and politicians that do not increase unemployment; opposite to that, our models propose to improve employment on quantity and quality in any reality applying AI.

They also give a methodology to foster, drives and accelerates the creation of new jobs, not only to transfer the people in training to active jobs but also to increase competitiveness creating a virtuous circle that will create more and better jobs in the future.

You have for sure noticed that we accept the assessments of Frey and Osborne (2013, 2018) -and many other authors as we wrote on the literature review- about jobs' displacement even being among the most pessimistic calculating that will be displaced around 47% of actual tasks made by human beings in developed countries -EE.UU and Europe mostly-. We accept their assessments because we believe that they are realistic because we are sure that all the tasks that they describe as likely to be displaced, can be done and will be done by AI systems, if not all of them now in the year 2020 they will on next years and never later than 2030 for the most sophisticated tasks.

Accepting these large jobs' displacement, we must foster, drive and accelerate the jobs' creation to have more and better global employment.

We know people that refuse to accept this large tasks displacement -and consequently the jobs' displacement- and they prefer to think that it will be much lower; we say to these people that if we work to create around 50% of new jobs and only 15% are displaced we will have excess jobs, if this happens, where is the problem?

Our last diagram is Figure 16 New model PROPOSITION, stock and flow diagram for companies and institutions appliers, area of effects inside and outside C+I; which we will only use if we are sure that the new variables, external to C+I, on this SFD will have important effects on jobs creation and therefore on transferring people in training to active jobs.

What is different on SFD Figure 16?:

We include the external variables affected by the application of AI on any C+I, as:

**Profits** every year with **Growth of profits** every year affected by **Net improvement of competitiveness on the market** and by **Global economic situation**.

With profits we know **Taxes** that we pay and the **Public money available** thanks to our application of AI in C+I. Our proposal is to dedicate this money to subsidies and promotions to increase and accelerate the Application of AI, through **Grants** and **Investments**.

**Profits**, as a cumulative variable fed by **Growth of profits**, every year, and this has affected by Global economic situation and Net improvement of competitiveness on the market.

Profits affect directly to **Taxes and public money** that we propose to dedicate for **Subsidies and promotions** -related with AI-, this latter is quantified on the variables **Public grants and Investments**: the first affecting to Application of AI and consequently to growth on traditional jobs and the second to **Global employment outside**.

We also include the **Jobs for external leisure businesses** as a cumulative variable estimating the **Growth of jobs for**

**external leisure businesses** with a different rate which we call **Rate elb**.

We include the **Cooperatives and other C+I of social economy** as well as **Other C+I** with similar policies. Both groups are normally open to share the **Profits from AI** and the **Ownership of AI** with his people in C+I and even with society. These last variables affect to **Investments** but fundamentally to the new variable **Happiness of people**, also affected by **Global employment** and **Policies for displaced jobs new jobs and change of jobs**.

Other new variables are:

**Global employment outside** are fed by external **Investments** and **Jobs for external leisure businesses**, this last fed by the annual **Growth of jobs for leisure businesses outside**.

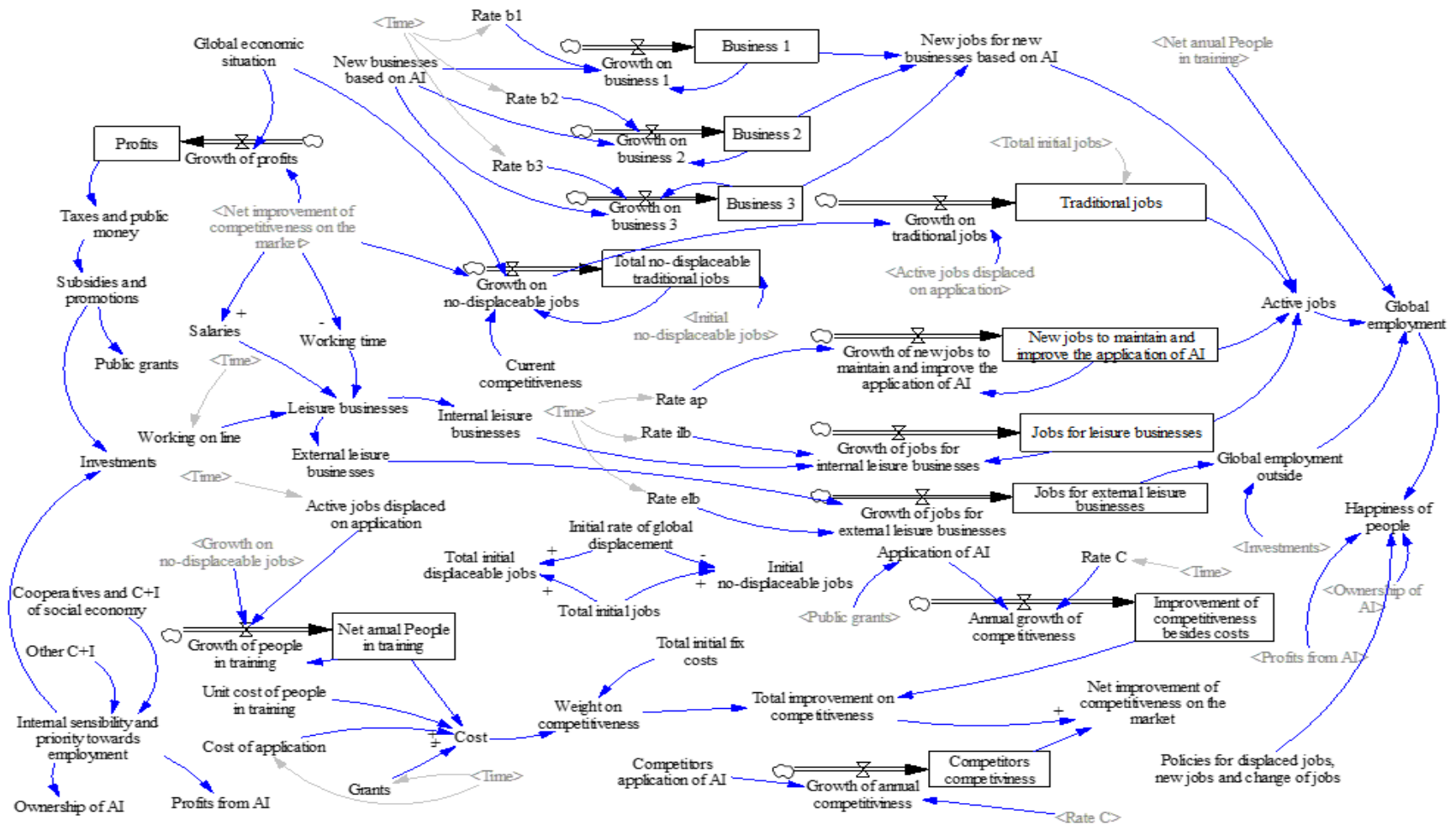


Figure 16. New model PROPOSITION, stock and flow diagram for companies and institutions appliers of AI, area of effects inside and outside C+I

## Chapter 4. Applications and validations of the models

### 4.1. Introduction

Following the instructions of the best specialists in SD -System Dynamics- we had two types of validations: Validation by specialists and validation by application of the models to current realities.

### 4.2. Validation of the models by specialists.

#### 4.2.1. How were the specialists chosen?.

As this Thesis is about AI, Competitiveness and employment and the methodology is SD, we selected specialists on, at least, one of these areas, but better if they have some understanding about all. With those premises and with the help of all our good relations in CEOE -Spanish business organization- APD -Association for Progress of Directors- ILO -International Labour Organization- professors experts in competitiveness and employment or AI using SD; we received 15 specialists proposals to discuss the models and validate them.

How we made the final selection?. Because we considered the ones selected as the best in their field, they belonged to well known and reputed organizations and also because of their interest and disponibility. On each case we explain later the speciality of the people we met, and following we explain all the followed procedure.

#### 4.2.2. Validations' methodology

The validation with specialists has been made having in-depth meetings with specialists on AI, Competitiveness Employment and System Dynamics.

On all meetings we have discussed the most critical points of our models.

**We started by explaining our clear idea about the tasks that will -or not- be displaced by the new technologies around AI** and for us it is beyond doubt that this displacement will happen regardless of our will; because, in

very few years, not applying AI on many tasks will be as not being competitive.

We fully agree with Frey and Osborne -and many other authors- about the jobs -really tasks- more likely to be displaced by AI systems.

We are sure that the technology will displace many current tasks that have the next features: Jobs based on structured decisions, predictable, decisions based only on data, following known rules. Also, jobs requiring, for example, cognitive skills as medical diagnosis, legal analysis or financial services.

We explained that on this definition most of the jobs inside factories are included, as well as logistic centres, administration -specially the public administration which must follow strict rules- many legal jobs, engineering, medical, etc. It does not matter how sophisticated the job is, neither the titles nor the years of experience, if the task have the cited features, it will be displaced by AI.

We also agree with Frey and Osborne (2013, 2018) that in developed countries around 47% of tasks currently made by humans and entering our definition of displaceable tasks will be displaced. That is already gradually happening with a peak point around 2025. But to avoid any fearful position against AI, we want to clarify that this figure -around 47% of tasks displaced by AI- is the difference between the current situation at January 2020 and the final situation with AI totally applied to all displaceable tasks and, of course, this will happen in many years, probably more than 10 years, therefore this problem will be solved gradually with our propositions or other similar propositions to create more and better jobs as they are displaced.

We also agree with Smith and Anderson (2014) that the tasks that will not be displaced by AI are the ones with human contribution, that means: Empathy, creativity, judgement, critical thinking, synthesis, innovation, intuition, compassion, inspiration, human communication, emotional relation. Opposite to the displaced ones, these tasks will increase their value.

Almost all jobs have tasks with human contribution, some have very high percentage of tasks with human contribution and not only the currently very valuable jobs as high management but even many jobs that today are not highly paid as care for the sick and aged people and many leisure jobs, arts, sports, games are also included in this group.

About the question: That means that almost 50% of current jobs will disappear? Our answer is: No, it does not, many jobs affected by displacement will not disappear because most of them have no-displaceable tasks. But the people working with AI systems will be at least twice more productive, therefore we will need much fewer people for the same results or -as we propose- the same or more people for much better results.

**First question to be discussed and validated: Do you agree with those statements about displaced and nondisplaced tasks, estimation of quantity displaced and time? Why yes or not?**

They agreed with small differences about percentages -higher or smaller- and time -earlier or later- but, in general they agreed on the principal and our current models and assessments include their main proposals.

**Then we went to the next point about jobs creation with AI systems applications.**

We explained them that for us it is also conceptually clear the many new jobs will be created with the new technologies around AI systems; but in this case we must make important decisions and actions to have these new jobs in our environment instead of far away.

About the creation of jobs with AI, we explained that the consensus in Academy is not so general, but we can resume the positions that we agree with, in the following groups:

New jobs in technology companies, which will increase with the massive application of AI systems. We explained the great importance of these technology companies not only as jobs' creator but, essentially as facilitators and accelerators of AI application in all kind of C+I but especially in SME

which have more difficult access to the companies creating the basic AI systems..

Growing of non-displaceable traditional tasks due to the increase of competitiveness with AI. Growing also because of the creation of new companies to respond to the increase of competitiveness in the sector that applies AI.

New jobs to maintain AI which should be internal with good training.

New jobs for the new products and services with the new technologies around AI. This group should be the most important new jobs' creator in quantity and quality.

New jobs for leisure business that can be new businesses or leisure actions to give new positive experiences to our people, our clients, our suppliers, our environment and our shareholders. It is generally accepted that leisure business will be the most important jobs' creator on next 20 years at least. But, in order to avoid any confusion with this assessment, we do not want to transmit that we have to give priority to leisure sector over other sectors as agriculture,

industry and other services not related with leisure; we only try to highlight that we have never to forget leisure, as jobs' creator and also as a very important human need anywhere but fundamentally in developed areas as Europe.

**Second question to be discussed and validated: Do you agree with our statements about jobs' creation with AI's applications?**

They agreed with small differences about importance of each group -higher or smaller- and time creation -earlier or later- but, in general our current models and assessments include their main proposals.

**Following, we explain them the methodology called System Dynamics**, developed and very used at MIT, with which we have built several CLDs qualitative diagrams and several quantitative models called SFD (Stock and Flow Diagram), but for simplification we are showing them only our final SFD models.

**We started by the model "Figure 10. Stock and Flow Diagram Technology AI Companies"** and we explained to

them that all the technology companies are already creating many jobs, though with different growth rates; also it is very important to have technology companies in our environment, not only because of the many jobs they are creating and will continue creating, but also because having them nearby our C+I, the application will be faster and cheaper, therefore more effective, especially for SME.

We explained to them that local AI technology companies are the ones that, with suppliers of basic AI research (in January 2019, the main suppliers of AI basic research are Apple, Amazon, Facebook, Google, IBM, Microsoft and Salesforce) adapt the new technologies to the real needs of our companies – specially the SMEs- and convince the managers of C+I to implement the AI as soon as possible and even accompany them to be successful in the application.

We want them to notice on this SFD for AI technology companies:

The importance of having the best basic AI research with the last updates.

The importance of updating constantly the AI.

The importance of having the AI solutions fast and at competitive prices.

The importance of making them available to our SMEs for a reasonable competitive price.

The importance of convincing the managers of C+I -specially SME- to apply AI as soon as possible.

**Third question to be discussed and validated: Do you agree with our statements about technology AI's companies?**

The experts fully agreed with small nuances that we have included in this Thesis.

**Following, we explained that it is not enough by convincing the management of C+I because they must deal with internal and external conditions and with**

**constraints.** Otherwise the application will be weak or even it will not happen.

We showed this phenomenon with our Figure 11. Companies and Institutions appliers, area of conditions and constraints.

To highlight in this SFD :

The conviction of managers is not enough.

Because other strengths -conditions and constraints- can fail or even prevent, the application.

We explained that we have found lack of motivation also in internal teams, even among members of the boards.

It is a mistake to think that the competitors will not apply AI

We highlighted the most important conditions and limitations that currently prevent most of the companies from applying digitalization:

Lack of motivation to apply AI.

Lack of knowledge and training.

Security feelings -people are afraid about their jobs-.

Lack of support by board and shareholders.

Unions constraints.

Quite often the lack of real public support is a strong constraint.

Finally, it is fundamental to remark the great importance of having excellent relations and trust among shareholders, managers, employees and unions for applying AI fast and effectively.

**Fourth question to be discussed and validated: Do you agree with our model and statements about conditions and constraints about AI applications?**

It was a total agreement giving some of them ideas which are included in this final versión.

The companies that pass this stage, still very few, -confirmed not only by our experience but mostly by McKinsey surveys in 2019- go to the application of AI systems.

**Following we show to the experts the Figure 14. New model PROPOSITION, stock and flow diagram for**

**companies and institutions appliers, area of competitiveness and tasks' displacement inside C+I.**

In this diagram we highlight to them that the immediate effects of AI applications are the tasks displacement -and therefore we have jobs displaced because we need less people for the same quantity of work- and also we have the improvement of competitiveness -all applications of AI systems must have an important improvement of the competitiveness, otherwise something is not well done or either too late in relation with our competitors-.

The net improvement of our competitiveness in the market will always depend of what the competitors do and therefore they also improve their competitiveness.

The initial cost reduction or increase when we start AI applications depends on public grants, but in no more than two years we have always cost reductions transferring the people in training to active new jobs.

Our proposition is that all the displaced people go to training and should be maintained inside the company or institution

till they are transferred to active new jobs created, as we will show on next last diagram. This very important action together with the great importance of having excellent relations and trust among shareholders, managers, employees and unions for applying AI fast and effectively are probably the most important strategies to be very successful on AI application improving competitiveness and employment -and of course profits-.

**Fifth question to be discussed and validated: Do you agree with our statements about competitiveness and displaced people to remain inside the company on AI application?**

They fully agreed but highlighting that it is difficult to achieve because it needs the implication of the main decision. makers -internal and external- of the C+I applicant of AI and also some external conditions as the global economic situation. This point will be subject to sustainability analyses.

**The final model to discuss and validate with the specialists** is the SFD diagram which explains the actions to create new jobs and to transfer people in training to active jobs, as we can see on next **Figure 15. New model PROPOSITION, stock and flow diagram for companies and institutions appliers, area of jobs' creation inside C+I.**

To highlight in this model:

These actions need a firm internal consensus decision -only possible with good relations and trust among the stakeholders- and external public help and collaboration.

We must dedicate all competitiveness' increase to the company growth transferring the people in training to active jobs -mainly to no displaceable traditional jobs which are similar to the jobs made before by the displaced people-. Training is needed but is not difficult because we give priority to transfer the people in training to the growth on traditional jobs.

We must train all our people **to know what the new technologies can do** and will be able to do over the next years.

We need a global brainstorming to launch new products and services with the new technologies.

We need a global brainstorming to create new tasks based on leisure, profitable for us, increasing our competitiveness, offering experiences to our clients, our people, our suppliers, our environment and our shareholders.

**Sixth question to be discussed and validated: Do you agree with our model about actions for creating new jobs to transfer displaced people in training to active jobs?**

They fully agreed but highlighting again that it is difficult to achieve because it needs the implication of the main decision makers -internal and external- of the C+I applicant of AI and also some external conditions as the global economic situation and, in this model, we need also the implication of our people which will not be difficult to get as we guaranty them the employment and training without

leaving the company. They consider this last proposition very clever.

**Conclusions to be discussed and validated by the specialists.**

For sure that the AI will displace many jobs (AI really displace tasks that increase the productivity of the jobs and therefore we need fewer jobs for the same work) gradually and along the application of AI over the next years.

But if we apply AI sooner and better than our competitors we can grow -creating many no-displaceable jobs inside C+I- and creating also new jobs for maintaining AI, for new businesses with the new technologies and for new leisure business to increase our competitiveness increasing our profits and jobs.

Those actions, with training, can recuperate the people displaced in less than two years.

There must be a firm decision, private and public, for the people displaced never to leave the job market

Doing the training inside each company or institution. The training will be specific to any C+I and the contribution of the technology companies and of external specialised companies and institutions will be essential.

**Seventh question to be discussed: Do you agree with our conclusions?**

In our 100% of in-depth meetings the specialists have validated all our models and assessments, only giving, most of them, advices to improve both, and all the advices are included in the final version of this Thesis and models.

### 4.2.3. Specialists which validated our models and statements

The given code is random just for not giving their full name.

#### 1. Specialist with code X70

He is one of the best European specialist on employment, he knows very well SD and is becoming one of the best specialist on the effects of AI on employment, leading the agreements with European Unions on this field.

He was appointed Director of Business Europe's Social Affairs department in January 2012. He is responsible for a diverse portfolio of social affairs and labour market policy issues as well as the day-to-day management of the department. He also coordinates BusinessEurope engagement as a social partner in the context of the European social dialogue. He joined BusinessEurope in November 2007 as social affairs adviser. Prior to this, he worked between 2005 and 2007 as a policy officer at the European Youth Forum in Brussels. He started his professional career with a six-month internship at the French

ministry of Foreign Affairs in Paris, where he followed the work of the EU Council on Employment and Social Affairs.

Graduated in European law and political science, he holds a Master degree from Sciences Po Paris, a double law degree from the university of Bordeaux in France and the university of Canterbury in the UK, and he participated in a summer session at the University of California at Berkeley in the United States. His mother tongue is French. He speaks English fluently, is at ease in Italian, and is a basic user of German and Spanish.

The Confederation of European Business, shortened BusinessEurope, is a lobby group representing enterprises of all sizes in the European Union (EU) and six non-EU European countries. Members of the confederation are 40 national industry and employers' organizations.

Based in Brussels, the confederation is officially recognised as a social partner at European level, is involved in a range of economic and social decisions and cooperates with a number of stakeholders and business partners. It promotes

the interests of corporate citizens to ensure that public policy supports the European economy. It is generally considered the strongest interest organisation in Brussels and represents 20 million companies through its member trade associations in 35 European countries.

## 2. Specialist with code X71

He is recognized as the best specialist on SD in Spain and one of the best in Europe, has made courses about AI and is very interested on employment.

He is Ph.D. Industrial Engineer by UPC (Spain). Worldwide recognized expert in System Dynamics, with more than 30 years of experience in this field. Postgraduate studies of System Dynamics at Massachusetts Institute of Technology MIT Sloan School of Management. Currently Director of ATC, a management consulting firm that develops strategic plans for corporate executives. Collaborator of several Spanish and Latin-American universities. Author of books about modelling with System Dynamics, with preface of John Sterman (MIT).

## 3. Specialist with code X72

Being Caixabank the third largest Spanish bank and this expert and his team the technology specialists in the group, they know very well what AI can and cannot do and the effects on employment. He and some member of his team know also about SD.

On our meeting participated also the next people belonging to his team: Specialist code X72.1, General Manager of Technology Innovation at SILK.

Specialist code X72.2, Director of AI Systems in CaixaBank.

Specialist code X72.3, Director of Innovation and Corporate Mobility at SILK.

We discussed the questions explained above and we agree that they represent the reality and can be applied to any company or institution controlled by the applicant.

What is CaixaBank?

It is a Spanish Bank with operational siege in Barcelona and Social siege in Valencia. Was funded in Barcelona on 2011, for the Caja de Ahorros y Pensiones de Barcelona, which

contributed with all its actives and passives to create CaixaBank.

What is SILK? It is the technological subsidiary of CaixaBank to supply technology services to the group all over the world, as strategic element for the innovation and technology.

#### 4. Specialist with code X73

He is one of the best European specialist on employment and therefore on the effects of all technologies on employment, of course included AI systems.

He is president of ASEMPLEO which is the Association of all Companies of Temporary jobs and Employment Agencies in Spain. Up to 70% of current employment in Spain is arranged through Asembleo companies.

#### 5. Specialist with code X74

He is specialists on the effects of new technologies -being AI the most relevant- on employment. He knows little about SD but he rapidly understood our diagrams.

He is Director of the Journal «Coyuntura y Economía Internacional» and Director for Macroeconomic and International Analysis de Funcas.

What is Funcas? Is a Think Tank for Social and Economy Research, belonging to the social activities of CECA and being CECA a banking association which compromise is to share, defend and represent the interest of their members, fostering their mission in the society.

#### 6. Specialist with code X75

As he and his team are managing the Center for Innovation of one of the most important technology consulting firm in the world, they are among the best specialist on AI and on what AI can do in Companies and Institutions. They also know something about SD and very soon understood our diagrams.

In our meeting also participated the next people belonging to his team:

Specialist code X75.1, Senior AI Consultant at Wavespace.

Specialist code X72.2, Senior Manager and leader of Augmented Intelligence in Wavespace Madrid.

#### 7. Specialist with code X76 and X76.1

Being he and her the responsible of the Area of Employability and Educative Innovation in one of the largest Spanish company, they are excellent specialists on anything affecting employment and innovation, therefore AI is one of the areas they are more interested.

We had a longer list of specialist people to meet but having unanimity we stopped the meetings.

### **4.3. Validation by application of the models to current realities.**

**Because of the long business history of the author of this thesis**, we have access to almost any company or institution in Spain and Morocco, then initially we had many meetings with many companies and organisations and even we

thought -with the collaboration of CEOE- to make a survey to all Spanish SME.

But finally we arrived to the conclusion that we have only to prove that our diagrams run smoothly in several different realities that we want to be included in this thesis.

As the only limitation we wanted for this thesis were that we only have to create competitive -therefore sustainable- employment we have to choose only companies and institutions competing on the market, does not matter the sector or the size.

The author gave several conferences and met many companies but, unfortunately, most of them wanted us to solve their problems applying AI or other technology and, at this stage of this thesis, we only could make for them a strategic plan to apply AI, calculating with little error the quantity of people that will be displaced and explaining our proposition for actions to maintain these displaced people in training inside the company and to transfer them to active employees in less than two years.

The initial agreement was given by more than 20 companies in different sectors and with different sizes, then we started we application/validation with them.

**Among all the companies that we met we had three main groups:**

The **first group where technology companies**, very interested in collaborating because all of them had problems applying AI systems to their clients and were interested to discuss our models with us. We proposed them not only to discuss our models for applying AI but also to discuss their businesses models and the growth they expected till the year 2025 - growth very related with AI applications by their clients-. Most of them accepted and in the following section “Validation of the models by technology companies”, we explain the application that we did with six of them. All their contributions are already included in our current models.

The **second group where C+I appliers** that fully collaborated and we could finish with them the strategic plan to implement AI improving employment -and of course

profits because all the new employment is competitive giving value- and not leaving any employee outside of the labour market. Later we explain with detail the work we did with two of them. Now they are in contact with technology companies to apply the strategic plan that we did together.

The **third group** were the companies, unfortunately very numerous, were the companies in which we could not finish our strategic plan with our models even having the agreement of the high management, but they were not enough motivated to apply AI systems overcoming their conditions and constraints. As we have all the information of these companies we have made with them a group called “NO applying C+I”, to which we applied our models with different hypothesis of application by competitors accepting the assessment that “for sure neither 100% nor 0% of our competitors will apply AI”.

But, as the first group -technology companies- is very related with the other two groups, because it is obvious that the companies applying AI will accelerate the growth of the technology companies, opposite than the NO appliers that

could slow down their growth, **we have made an application mixing technology and non technology companies applying or not AI systems.**

#### **4.3.1. Validation of the models by applications in technology companies**

We had in-depth meetings with technology companies with the following objectives:

The first objective has been to validate the diagrams describing the contribution of technology companies to the phenomenon between AI and Employment. In our case it corresponds to the diagrams Figure 10. Stock and Flow Diagram Technology AI Companies.

We will later use this diagram to represent the projected growth with the expectative of each technology company participating on our validations. We will also include sensitivity analyses which we will later explain.

The second objective has been to validate the diagrams describing all the variables and their relations since they convince the management of C+I till they apply the digital solutions proposed by technology companies. In our case corresponds to our Figure 11. Companies and Institutions appliers, area of conditions and constraints.

The third objective has been to discuss and validate our diagrams about the effects on displacement on competitiveness and employment after the AI application which corresponds to the next diagrams:

Figure 14. New model PROPOSITION, stock and flow diagram for companies and institutions appliers, area of competitiveness and tasks' displacement inside C+I.

Figure 15. New model PROPOSITION, stock and flow diagram for companies and institutions appliers, area of jobs' creation inside C+I.

The four SFD were discussed with each technology company participating on our validation and their proposals are already included in current diagrams.

About our description of displaceable and no-displaceable tasks we had large discussions but our current proposal was finally accepted but without full agreement about the period during which it will happen -the discussion has been between five and 15 years- and our current position is not more than ten years.

We had long discussions about our description of jobs' creation with AI application, the current ones are already improved thanks to their contributions.

Finally, we discussed about our proposition to maintain the people displaced inside the C+I applicant as "People in training" as explained on our diagrams. After the discussions we agree on the advantages of our proposition for accelerating the AI application and therefore the increase of

competitiveness and the jobs' creation, as explained on our dissertation.

We have the list of the technology companies participating on our in-depth meetings, but we do not have the explicit authorization to write their names in this dissertation, therefore we are only giving a short description and growth of some technology companies just to make to know how different they are in size and expected growth.

#### **4.3.1.1. Application and validation in Technology company code X21**

Technical data:

Date of validation: June 5th, 2019.

Year of company creation: 1995 with 2 people.

People at year 2008: 120

At year 2012 they changed to the current name having still 120 people because of the economic crisis from 2008.

At the end of year 2018 they had the next people in each department:

Local technology research	154 people
Administration	7
Marketing and commercial	9
External technological collaborators	20 people
representing 13% of local technology research.	
Local technology agents	0 because they worked only to nearby companies.
Total on December 2018	190 people

We introduce these real data at the end of 2018 in our Stock and Flow Diagram Technology AI Companies (Figure 10) as initial jobs on each group of activity; then they gave us the expected annual growth of each group, which we introduce as the respective rates 1 to 5.

Initially, with the agreement of the managers of company X21, we value as 1 the variable Basic research providers; we give the value of 0.8 to solutions giving value to C+I and the same to Price of solutions, meaning that the initial value of Increase in competitiveness is 1 because the value is the division the value and price, giving the same value to Actions to convince C+I and therefore not changing initially the quantity of Jobs in AI technology companies which are the addition of jobs in each of the five departments.

With these data inside the SFD Figure 10 and using Vensim program we get the next Table 2. Expected yearly growth and jobs from 2019 to 2025 of company code X21.

Table 2. Expected yearly growth and jobs from 2019 to 2025  
of company code X21

<b>Expected yearly growth on</b>	2019	2020	2021	2022	2023	2024	2025
Local technology research	100%	100%	70%	50%	30%	20%	10%
Administration	10%	10%	10%	10%	10%	10%	10%
Marketing and Commercial	50%	50%	35%	25%	15%	10%	5%
External technological collaborators (% on tech. research)	13%	13%	13%	13%	13%	13%	13%
Local technology agents	0%	10	70%	50%	50%	50%	50%
Expected people at end of each year	2019	2020	2021	2022	2023	2024	2025
Local technology research	308	616	1047	1571	2042	2450	2695
Administration	8	8	9	10	11	12	14
Marketing and commercial	14	20	27	34	39	43	45
External technological collaborators	40	80	136	204	265	319	350
Local technology agents	0	10	17	26	38	57	86
Total people	369	735	1237	1845	2396	2882	3191

With the same data and with Vensim program we get the next Figure 17.

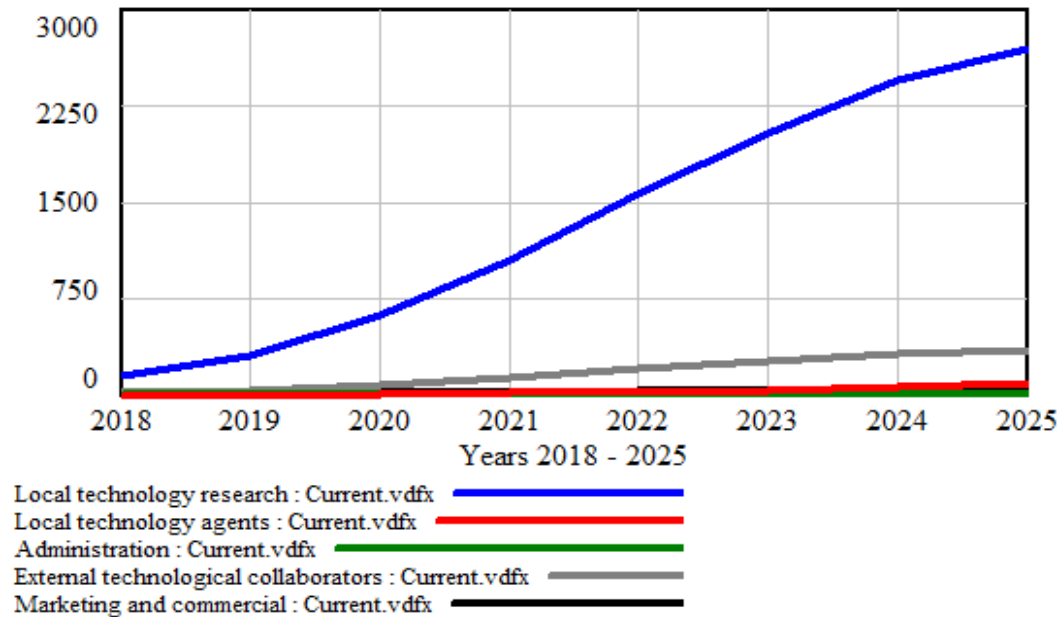


Figure 17. Simulated evolution of quantity of people in each department of company code X21

This graph has been obtained with the SD methodology and the Vensim program introducing the data from X21 in the SFD Figure 10.

The evolution of the quantity of people of course depends on the initial quantity of people and on the expected growth but the expected growth depends of other variables which, as they are difficult to evaluate, we have considered a fix

quantity between 0 and 1 (for us 1 is 100% that means the best possible).

Three very important fix variables are:

Basic research providers (**BRP**) that we have initially evaluated at 1, supposing that X21 has the best basic research suppliers.

Solutions giving value to C+I (**SGV**) that we have evaluated at 0.8, supposing that X21 is giving 80% of the best possible value.

Price of solutions (**PoS**) that we have evaluated at 0.8, supposing that X21 is giving 80% of the best possible price for his clients.

How these three variables influence on the Jobs in AI technology companies (**JAITC**), therefore on growth:

Basic research providers multiply the annual growth local technology (**AGLT**) research, therefore is the quantity is below 1 reducing the growth.

Solutions giving value to C+I divided by Price of solutions give the value to Increase in competitiveness (**IiC**), who gives the value to actions to convince C+I (**ACCI**) and this last multiply the Jobs in AI technology companies. The fix value that the company has given to these variables has no influence neither on growth nor on jobs because they gave the value 1 to BRP -then no influence on AGLT- gave the

value 0.8 to SGV and also 0.8 to PoS, then the value is 1 in IiC and also 1 in ACCI and therefore with no influence on JAITC.

But we consider very interesting to evaluate the sensitivity of the JAITC if these three currently fix variables change, for example:

Basic research providers oscillate between 0.7 and 1 -current is 1-

Solutions giving value to C+I between 0.7 and 0.9 -current is 0.8

Price of solutions between 0.6 and 0.9 -current is 0.8-

We calculate the results using Random Uniform (which provides a uniform distribution between the minimum and the maximum value) and we have the next graphic representing: The yellow colour stripe the 50% more centred results on JAITC, the green colour the 75%; the blue the 95%; and the grey stripe 100% of the results.

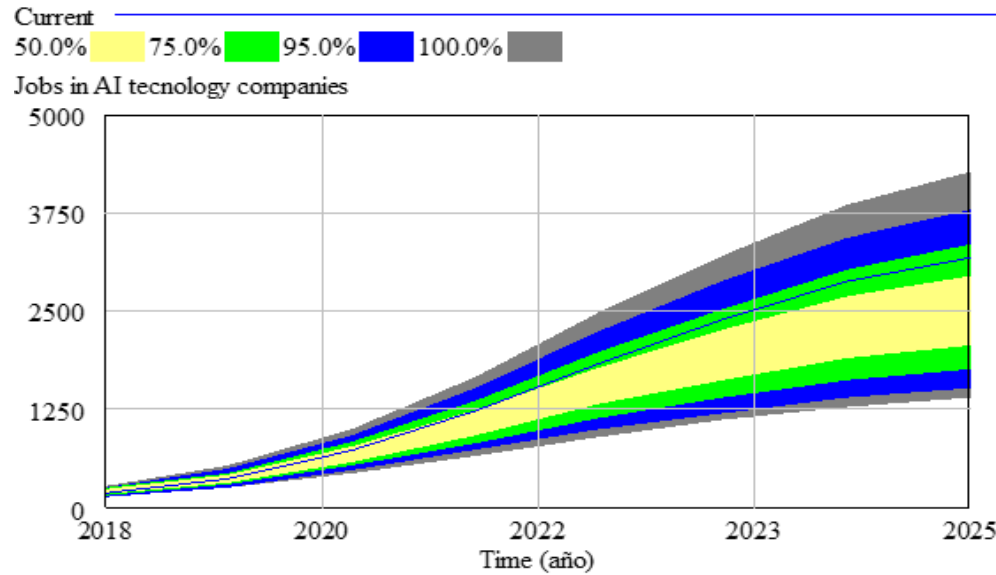


Figure 18. Sensitivity analysis of simulated and projected number of people of company code X21 and confidence bounds of the variable Jobs in artificial intelligence technology companies

We confirmed that the sensitivity, as we could expect, is very high, therefore these three variables are very essential to have as high as possible.

**4.3.1.2. Application and validation in Technology company code X22**

Technical data:

Date of validation: June 6th, 2019

Year of company creation: 2002 with 2 people

At the end of year 2018 they had the next people:

Local technology research 30 people

Administration 2

Marketing and commercial 8

External technological collaborators 1

Local technology agents 0 because they worked only to nearby companies

Total on 31st December 2018 41 people

We leave the table with expected rates of growth in the Annex, use the same SFD Figure 10 as in company X21 and the same initial values, to get the next figure.

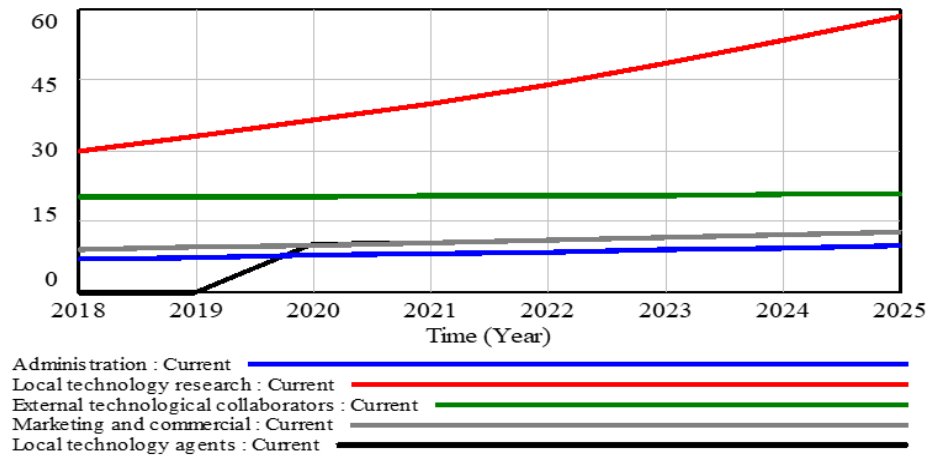


Figure 19. Simulated evolution of quantity of people on each department of company code X22

For the sensitivity analysis of the JAITC to the fix variables change, we use the same values as for company X21, that means:

Basic research providers oscillate between 0.7 and 1 -current is 1-

Solutions giving value to C+I between 0.7 and 0.9 -current is 0.8

Price of solutions between 0.6 and 0.9 -current is 0.8-

And we get the next Figure 20

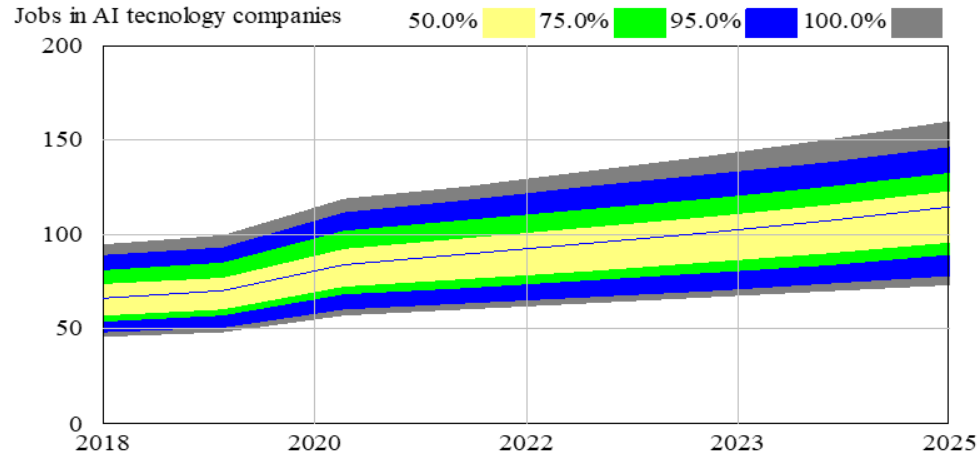


Figure 20. Sensitivity analysis of simulated and projected number of people of company code X22 and confidence bounds of the variable Jobs in artificial intelligence technology companies

**4.3.1.3. Application and validation in Technology company code X28**

Technical data:

Date of validation: June 2019

Year of company creation: 1999 with 20 people

At the beginning of year 2019 they had the next people:

Local technology research	3077 people
Administration	352
Marketing and commercial	1055

External technological collaborators	703	
Local technology agents	1758	
Production	1846	New
variable only on this technology company.		
Total on January 2019	8792 people	

We cannot use the same SFD Figure 10 for validation of technology companies because the X28 technology company has an unusual activity in these companies as it is **Production** specialised in technology related with AI. Then we have to change the Figure 10 for the new Figure 21.

Stock and Flow Diagram for validation of company code X28 in which we have only added the new department **Production** with its **Rate 6** and its **Annual growth production**.

We use the same initial values for the fix variables as in previous technology companies.

Following we show the new Figure 21 for validation of X28, the Figure 22 for the annual quantity of people by department and the Figure 23 for the Random Uniform sensibility analyse with the same variations in the fix variables as in previous technology companies.

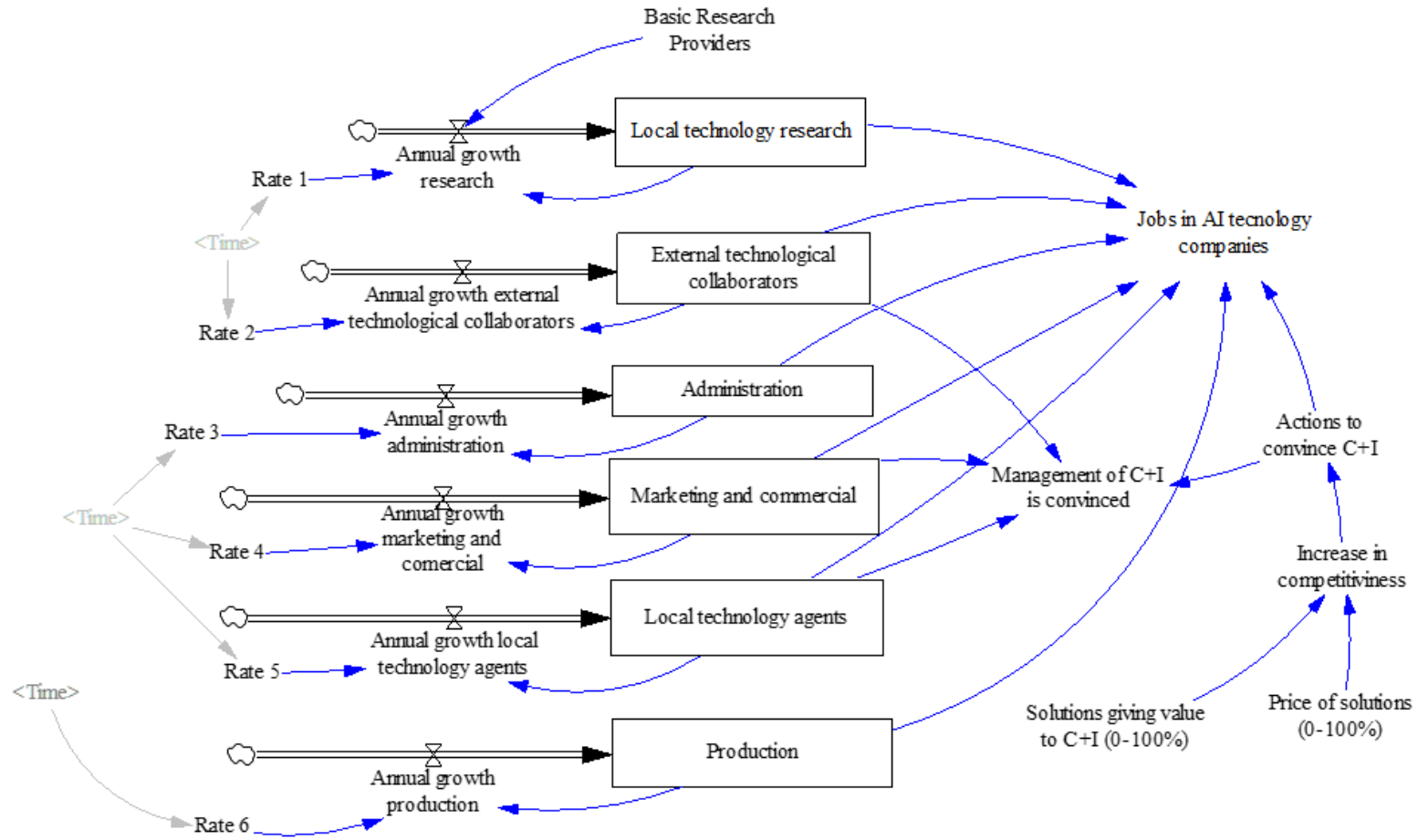


Figure 21. Stock and Flow Diagram for validation of company code X28

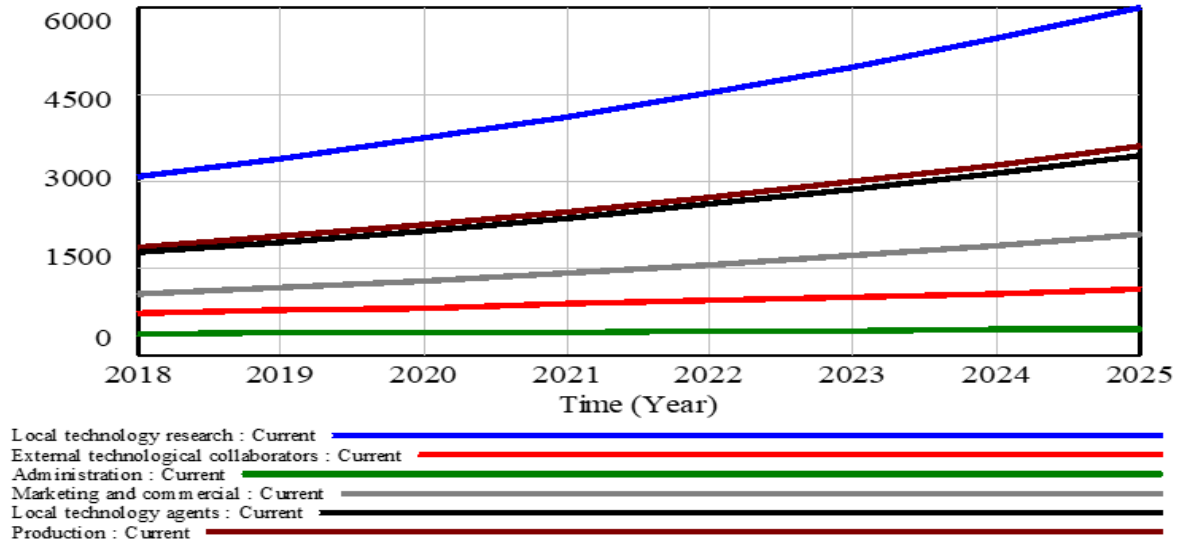


Figure 22. Simulated evolution of quantity of people on each department of company code X28

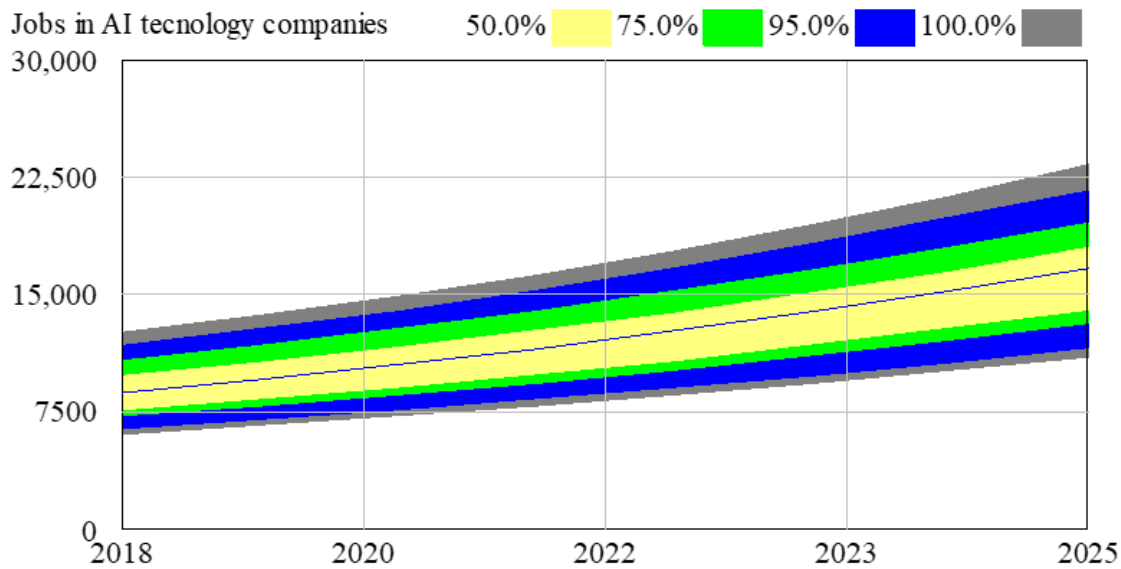


Figure 23. Sensitivity analysis of simulated and projected number of people of company code X28 and confidence bounds of the variable Jobs in artificial intelligence technology companies

#### 4.3.1.4. Application and validation in Technology company code X30

Technical data:

Date of validation: September 17th, 2019

Year of company creation: 1995 with 4 people

At the end of year 2018 they had the next people:

Local technology research	8 people
Administration	4
Marketing and commercial	4
External technological collaborators	7
Local technology agents	0 because they worked only to nearby companies

Total on 31st December 2018

23 people

We use the same SFD Figure 10 for validation of technology companies used for X21 and incorporate the figures of expected people and Random Uniform sensitivity, (we leave the expected growth in the Annex).

We use the same initial values for the fix variables as in previous technology companies.

Following we show the new Figure 24 for the annual quantity of people by department and the Figure 25 for the Random Uniform sensibility analyse with the same variations in the fix variables as in previous technology companies.

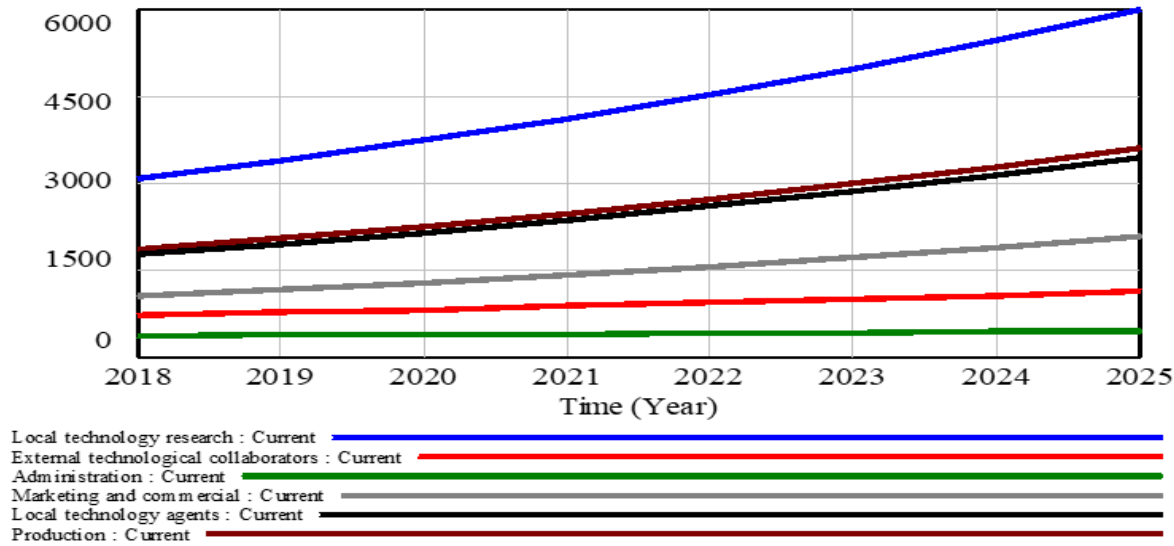


Figure 24. Simulated evolution of quantity of people on each department of company code X30

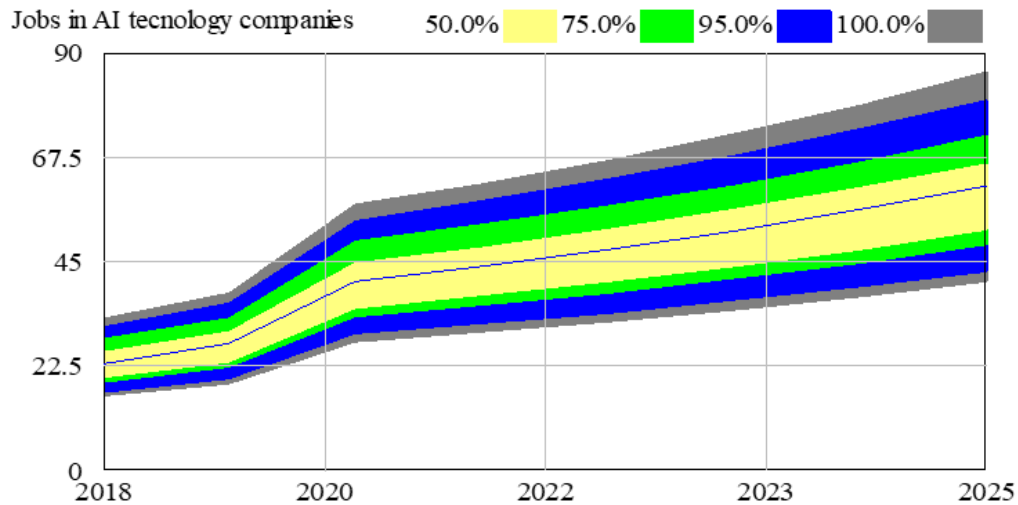


Figure 25. Sensitivity analysis of simulated and projected number of people of company code X30 and confidence bounds of the variable Jobs in artificial intelligence technology companies.

#### 4.3.1.5. Application and validation in Technology company code X31

Technical data:

Date of validation: September 17th, 2019

Year of company creation: 1966 with 2 people

At the end of year 2018 they had the next people:

Local technology research	260 people
Administration	30
Marketing and commercial	30
External technological collaborators	100
Local technology agents	80 because they worked only to nearby companies

Total on 31st December 2018

550 people

We use the same SFD Figure 10 for validation of technology companies used for X21 and incorporate the figures of expected people and Random Uniform sensitivity, (we leave the expected growth in the Annex).

We use the same initial values for the fix variables as in previous technology companies.

Following we show the new Figure 26 for the annual quantity of people by department and the Figure 27 for the Random Uniform sensibility analyse with the same variations in the fix variables as in previous technology companies.

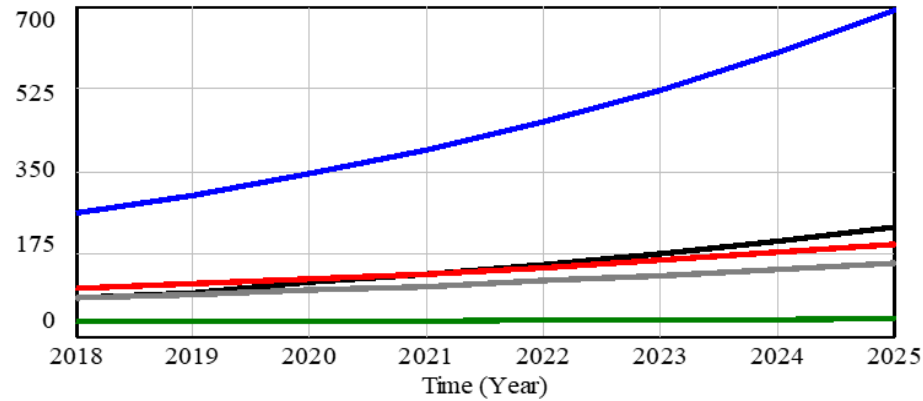


Figure 26. Simulated evolution of quantity of people on each department of company code X31

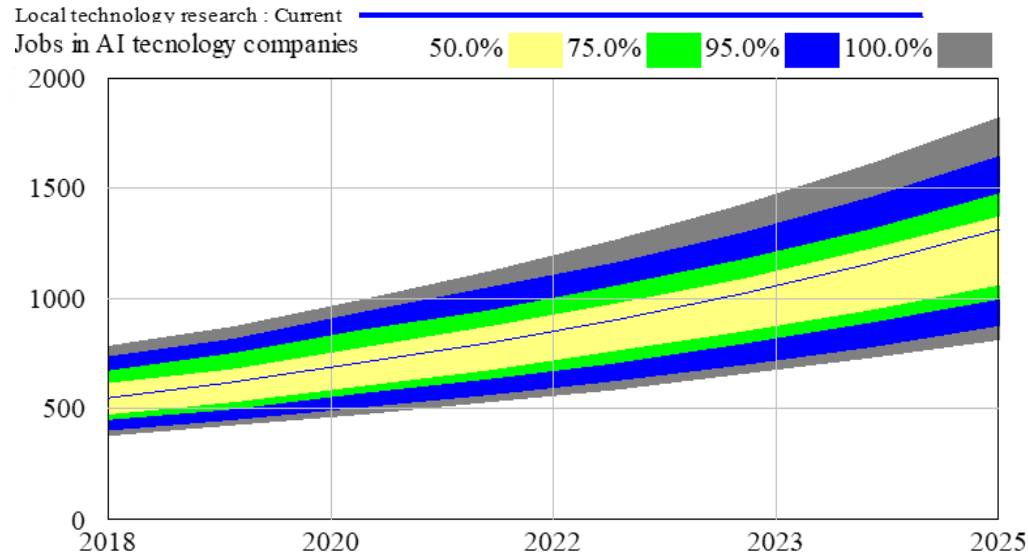


Figure 27. Sensitivity analysis of simulated and projected number of people of company code X31 and confidence bounds of the variable Jobs in artificial intelligence technology companies.

#### 4.3.1.6. Application and validation in Technology company code X32

Technical data:

Date of validation: September 17th, 2019

Year of company creation: 2007 with 6 people

At the end of year 2018 they had the next people:

Local technology research	10 people
Administration	8
Marketing and commercial	12
External technological collaborators	3
Local technology agents	0 because they worked only to nearby companies.

Total on 31st December 2018

33 people

We use the same SFD Figure 10 for validation of technology companies used for X21 and incorporate the figures of expected people and Random Uniform sensitivity, (we leave the expected growth in the Annex).

We use the same initial values for the fix variables as in previous technology companies.

Following we show the new Figure 28 for the annual quantity of people by department and the Figure 29 for the Random Uniform sensibility analyse with the same variations in the fix variables as in previous technology companies.

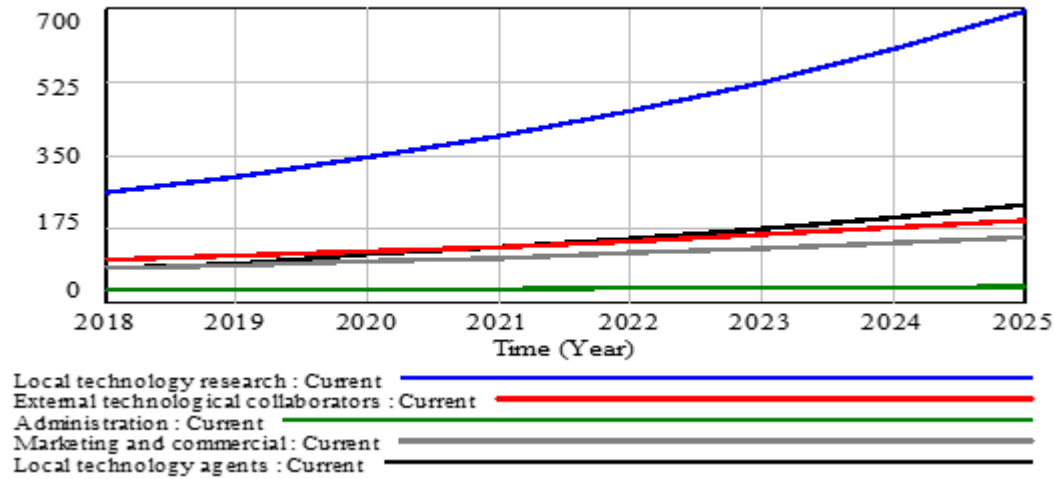


Figure 28. Simulated evolution of quantity of people on each department of company code X32

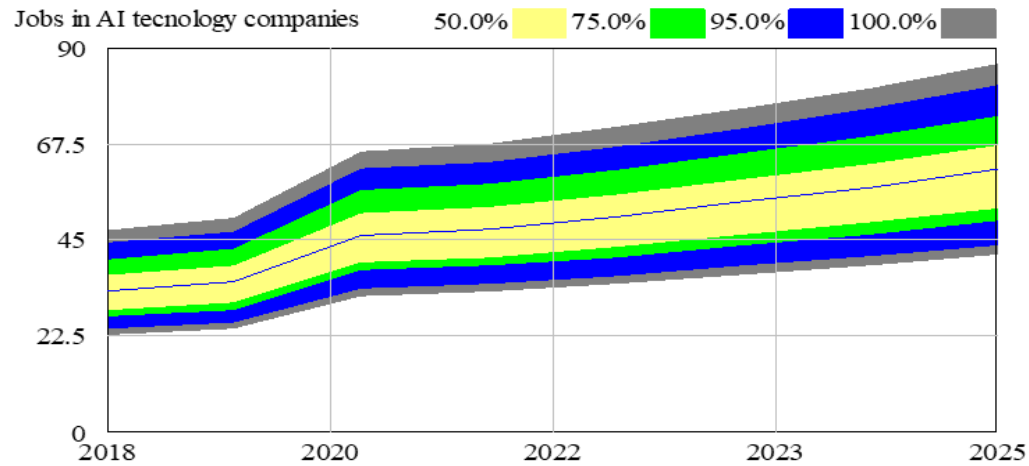


Figure 29. Sensitivity analysis of simulated and projected number of people of company code X32 and confidence bounds of the variable Jobs in artificial intelligence technology companies

### **4.3.2. Validation of the models by application on C+I -Companies and institutions-**

We have more than 20 applications of our models, but very few which we could totally finish for several reasons being the most important one the lack of motivation of the managers -top and medium managers- because we have more than 10 cases which, after having the acceptance of the main shareholders, the managers did not send the correct information and were not interested in coming to the meetings, therefore we qualified those companies as No interested and, being most of them big companies we could easily collect their information and analyse with our models their future with different hypothesis which we will show on the next section.

We have another group, all small and medium companies (SMEs) that fully collaborated on analysing with our models their future till 2025 applying AI, two of which we will show in this thesis.

Following we will explain the strategy that we made together - the people of each company and us- in order to apply AI improving employment on quantity and quality - and of course improving largely sales and profits- all of them are now in contact with technology companies to help them to apply practically the strategy but anyway we promised them that on the future we will help them to be successful with the applications of AI.

In next paragraph we explain with all detail how we applied our diagrams and each variable of the diagrams to the company X1 and the same methodology is valid for any application just with some small adaptations as we will see.

#### **4.3.2.1. Application on company code X1**

We start by describing the information of the company that we have permission to show.

Technical data:

Area of activity: Logistic and transport

People at end 2018: 532, distributed in the following areas:

General management: 2

Continuous Innovation: 4

Commercial: 3

Finances: 16

Logistic: 84

Operations: 331

Human Resources: 13

Purchase, supplies and maintenance: 25

Transit: 54

The logic of our diagrams is that are the technology companies who should convince the managers to apply AI, but in most of the cases they had not received any proposition to improve competitiveness applying AI and the few that received something and accepted the proposal were

very disappointed because, as they said “we have much more data and information but sales and profits have not improved” on these cases we even met the technology companies to explain them how to better focus their services of AI; they listened us carefully and we hope that they are doing better now.

Then not having yet done their job the technology companies our first step was to convince the high management that AI is arriving to them and to their competitors more sooner than later, that their effects will be disruptive and to be pioneers is very important for the future of X1. When high management was fully convinced, we did the same with the medium management and later with most of the influential people in the company to avoid any position against AI. Of course we explained clearly that, on the time period of AI application, many tasks will be displaced and therefore we will need less jobs for the same activity, but we also explained that, on our models already accepted by the high management, the people displaced by AI will go in training -continuing as employees with the

same conditions as before- to be trained and become newly active in less than two years with the same or even better labour conditions.

As soon as most of the influential people on X1 were convinced that AI application will be positive for the company and for them, we started the application with our models.

We create, together with the management, a team -including people from all the areas but always people influential and interested- to start the application -variable by variable- and step by step we would add the necessary people as we need them.

We showed the global model to the team only to make them understand that the process is very complex, but we will apply it gradually in order that they will understand everything we do.

Then we were directly to the SFD models starting by technology companies only to make them understand how

they work and the importance of working with the best specialists. They asked me: Specialist on what?, and we told them we will concentrate in the capacity of AI of making any task, now made by people, that we can structure and put under rules only depending on information that we know, because we will start the application of AI only with the information and data that we already have and later we will incorporate new data and information to improve the system. What do we want to get with these applications? That the structured tasks will be made faster, better and cheaper leaving people free for most valuable new tasks that we will later explain.

At this moment, before analysing conditions and constraints, we thought that was the moment to explain well the concept of displaceable and non-displaceable tasks by AI.

We read and explained a summary of our conclusions about displaceable tasks, as follows: Till recently, the automatic systems, robots and machines have displaced only routine tasks, but from nowadays and growing over the next years

the AI will make any task that we are able to put under rules and then to make the algorithms to follow those rules.

But with Reinforcement learning (RL), we do not even need to make the algorithms, because just giving the machine the rules of the system, it is able to create their own algorithms and find the best solution faster, without a possible mistake and cheaper than humans. For example, with RL AlphaGo Zero in only 40 days surpasses all other versions of AlphaGo and, arguably, becomes the best Go player in the world. It does this entirely from self-play, with no human intervention and using no historical data, just giving the system the rules of the game.

Then we also read and explained a summary of our conclusions about non displaceable tasks, as follows: Jobs/tasks that require uniquely human characteristics such as empathy, creativity, judgment, critical thinking, synthesizing, problem-solving, innovating, intuition, compassion, inspiration, human communication, entrepreneurship, emotional and relational work, are much less probable to be displaced.

We gave several examples and we discussed till we were convinced that all the team understood the displaceable and non-displaceable tasks.

I gave them a week to review and analyse all the tasks made by all occupations to send their conclusions. In less than one week we received their work and were very well done, then we summoned another event to discuss their results shown in next Table 3 which the following information.

The area in the company already cited before.

The occupations in each area.

The initial people in each occupation.

The displaceability in quality, total or partial.

The displaceability in percentage, calculated with out definition.

The hours worked initially per people and per year.

The total hours worked in each occupation.

The total displaceable hours by occupation.

The total no-displaceable hours by occupation.

Table 3. Company code X1. Initial occupations in each area, with quantity of people, displaceability of each occupation and total annual hours displaceable and no-displaceable by occupation.

Area	Occupation	Initial People	Displaceable (qualitative)	Displaceable (%)	hours/people/year	Total hours/occupation	Displaceable total hours/occupation	No-displaceable total hours/occupation
General Management	CEO	1	partial	20	2000	2000	400	1600
	Gen. Man.	1	partial	20	2000	2000	400	1600
Continuous Innovation	Manager	1	partial	20	1900	1900	380	1520
	Digital	1	partial	40	1900	1900	760	1140
	IT	2	partial	40	1900	3800	1520	2280
Commercial	Manager	1	partial	20	1900	1900	380	1520
	Sales	2	partial	40	1900	3800	1520	2280
Finances	Manager	1	partial	50	1900	1900	950	950
	Accounting manager	1	partial	50	1900	1900	950	950
	Invoicing	1	partial	30	1900	1900	570	1330
	Administrative	9	total	100	1900	17100	17100	0

	Accountant	1	total	100	1900	1900	1900	0
	Man control	1	partial	50	1900	1900	950	950
	Treasury	2	partial	50	1900	3800	1900	1900
Logistic	Administration	1	total	100	1900	1900	1900	0
	Exploitation	1	total	100	1900	1900	1900	0
	Warehouse	65	total	100	1900	123500	123500	0
	Operator	3	total	100	1900	5700	5700	0
	Computing	1	partial	30	1900	1900	570	1330
	Storekeeper	10	partial	90	1900	19000	17100	1990
	Manager warehouse	2	partial	20	1900	3800	760	3040
	Logistic manager	1	no	0	1900	1900	0	1900
Operations	Administration	1	total	100	1900	1900	1900	0
	Tracking	15	total	100	1900	28500	28500	0
	Traffic	3	total	100	1900	5700	5700	0
	Exploitation	3	total	100	1900	5700	5700	0
	Commercial	10	partial	20	1900	19000	3800	15400
	Truck drivers	273	no	0	1900	518700	0	518700
	Clerk	1	total	100	1900	1900	1900	0
	Operations manager	1	no	0	1900	1900	0%	1900
	Account manager	1	partial	20	1900	1900	380	1540
	Traffic manager							
	Textile security	1	no	0	1900	1900	0	1900
	Exploitation supervisor	17	total	100	1900	32300	32300	0

	Commercial technician	1	total	100	1900	1900	1900	0
		4	no	0	1900	7600	0	7600
Human resources	Administration	1	total	100	1900	1900	1900	0
	Security	1	total	100	1900	1900	1900	0
	Tracking	2	total	100	1900	3800	3800	0
	Exploitation	1	total	100	1900	1900	1900	0
	Driver	1	total	100	1900	1900	1900	0
	Messenger	2	total	100	1900	3800	3800	0
	Maid	1	total	100	1900	1900	1900	0
	Nurse	1	no	0	1900	1900	0	1900
	Manager	1	no	0	1900	1900	0	1900
	Training	1	no	0	1900	1900	0	1900
	Exploitation supervisor	1	total	100	1900	1900	1900	0
Purchase, supplies and maintenance	Gasoil	3	total	100	1900	5700	5700	0
	Maintenance	14	partial	50	1900	26600	13300	13300
	Workshop manager	1	partial	50	1900	1900	950	950
	Team boss	1	total	100	1900	1900	1900	0
	Technical manager	1	no	0	1900	1900	0	1900
	Purchasing manager	2	no	0	1900	3800	0	3800
	Maintenance manager	1	no	0	1900	1900	0	1900
	Exploitation supervisor	1	total	100	1900	1900	1900	0
	General							

	technician	1	partial	50	1900	1900	950	950
Transit	Administration	9	total	100	1900	17100	17100	0
	Maintenance	2	total	100	1900	3800	3800	0
	Security	1	total	100	1900	1900	1900	0
	Exploitation	6	total	100	1900	11400	11400	0
	Transit assistant							
	Customer service	4	total	100	1900	7600	7600	0
	Clerk	2	partial	20	1900	3800	760	3040
	Messenger	23	total	100	1900	43700	43700	0
	Customs	2	total	100	1900	3800	3800	0
	Exploitation supervisor	2	partial	50	1900	3800	1900	1900
	Commercial technician	2	total	100	1900	3800	3800	0
			1	partial	50	1900	1900	950

As we can see in table 3, just explaining correctly what AI systems can and cannot do -from 2019 to the year 2030- the decision makers in the company X1 are able to know that 40% of the occupations made in their company are displaceable with the current AI technology and they understood that not to apply is not a good alternative because they also understood that applying AI X1 will improve

disruptively its competitiveness. It is truth that autonomous driving technology will be very soon ready but we do not think that will be permitted to be applied to trucks till around 2030 and for that time the company will be very different from now and will be able to gradually manage this new situation.

The areas more likely affected by displacement from 2020 to 2025 in X1 are:

Logistic, with 95% of its hours displaceable affecting to 84 initial people, then around 79 displaceable.

Transit, with 94% of its hours displaceable affecting to 54 people, then around 50 displaceable

The management think that it is better to start the AI applications by logistics because it will more affect to competitiveness as with AI systems the company X1 will be able to guaranty 100% reliability (now is 97% with humans) and to give non-stop service 24/365 (now the service out of working hours time is limited). The cost is not considered as essential for the competitiveness, as they even will apply our model maintaining all the displaced people in training to occupy the new jobs as we will see later.

Then the plan of the managers of X1 to apply AI is:

They expect to grow 6% on 2019 because of the current competitiveness without AI -as we know, the increase of

competitiveness can be used to increase prices or to grow- in our model we use all the competitiveness only to grow which will increase profits and overall employment that is essential to re-employ the displaced people.

We plan to start on 2020 applying AI systems to the tasks of the 65 people in the warehouse that will be fully displaced and will go to training.

The managers of company X1 think that this AI application will increase the competitiveness of X1 more than 20%, and they put this quantity on its strategy for 2020.

They know they have 212 people displaceable in 2019 then applying AI in 2020 in the warehouse, on January 2021 will remain (212 minus 65) 147 displaceable people still active and their intention is to finish all the AI applications on current reality on the year 2025 applying every year AI where it more improves the competitiveness and therefore estimating to displace around 30 people each year from 2021 to 2024 and the last 27 on 2025.

It is too early to confirm but they estimate that 20% growth on competitiveness every year is likely to achieve thanks to AI applications, so they put these quantities in its strategy from 2020 to 2025.

These are initial strategies that will be reviewed as we advance in our applications of AI, the model allow the revision when we want; daily, weekly, monthly or quarterly, the shorter the time the better to avoid large deviations difficult to correct.

Next step is to know if we will be able to solve internal and external conditions and constraints which can weaken and even stop the applications.

For this analyse we use the already known SFD diagram Figure 11. Companies and Institutions appliers, area of conditions and constraints.

On this case we start by “Management is convinced...” because we have already convinced the management of X1

to proceed with AI applications as soon as they find competitive technology suppliers.

We analysed, one by one, all the internal conditions and we arrived at the conclusion that we can evaluate the impact as 1, which means 100% favourable without negative impact.

Then we went to analyse the external conditions, also one by one, and we arrived newly that we qualify the impact as 1, again 100% favourable.

Finally, we analysed the constraints arriving to the conclusion that we can also evaluate as 1, then we had no constraints.

Then the final value of Application of AI for X1 is 1. But we must not worry for this optimistic prevision because, at the end of our exercise we will calculate the sensitivity of the model to this factor to make to know the management of X1 how can be reduced the results if finally the number to Application of AI is less than 1, in order that they should be very careful about it.

Then we pass to the next model to calculate displacements and competitiveness and we initially we worked with Figure 14. New model PROPOSITION, stock and flow diagram for companies and institutions appliers, area of competitiveness and tasks' displacement inside C+I with the Vensim program, giving the quantity and formula to each variable.

But we had to adapt this Figure to the new SFD Figure 30, because:

Application of AI (AoAI) is initially 1 as we agreed.

But Area of application (AoA), Initial jobs on area (IJoA), and Rate of displacement on area, are variables that have no value on this case of company X1 because the Figure 14 diagram is though for a company applying AI in only one area but as in this case we apply on different areas in different years we have to adapt the Figure 14 to the new Figure 30 and go directly to Active jobs displaced where we put the next agreed Table 4, including the people to be displaced every year and the accumulated people displaced.

Table 4. Projected people to be displaced by artificial intelligence applications in company code X1 from year 2018 to 2025

Year	2018	2019	2020	2021	2022	2023	2024	2025
People displaced	0	0	65	30	30	30	30	27
Accumulated	0	0	65	95	125	155	185	212

As we expected and have explained we had to adapt the general SFD on Figure 14 to each case because this case X1

is more complex as we apply AI to different areas each year, then the adapted diagram to the one in Figure 30.

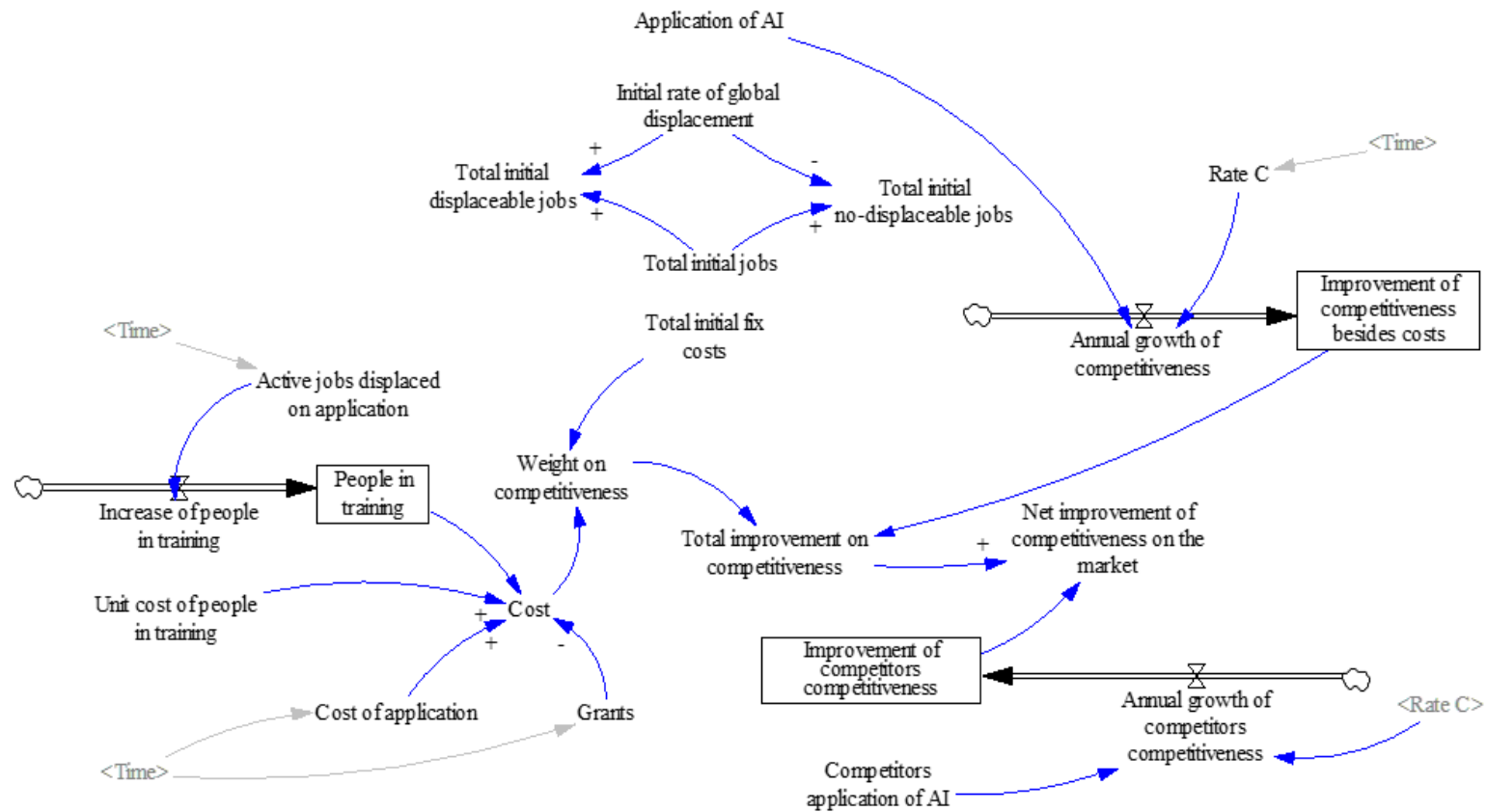


Figure 30. Stock and Flow Diagram adapted from figure 14 for the application of displacement and competitiveness in company code X1

Changes in Figure 30 over Figure 14:

The main reason for the changes is that on X1 we apply AI on different areas and years and therefore we need levels and growth for the next variables: Improvement of competitiveness besides costs (ICBC); People in training (PiT); and Improvement of competitors competitiveness (ICC).

We met the Unit cost of people in training that multiply for People in training, will increase each year -only at this stage of our analyse because we will prove that most of the people becomes active in less than two years- and the Cost will also be increased by each year Cost of application and will be reduced by Grants. Just because of our decision to maintain the people in training inside the company the cost will for sure increase increase, but the company X1 accepts the increase of this cost. The management of company X1 accepts that, if the increase of Costs is not more than 10% of Total initial fix costs, the weight on competitiveness is 1 what means that it is no reducing the Total improvement on competitiveness.

Net improvement of competitiveness on the market is the subtraction of Total improvement least Improvement of competitors; and this last we have calculated supposing that competitors have the same Rate C of annual growth as we have but they only have 0.1 application when we have 1 -we will later calculate the sensitivity of these variables-.

We show these provisional results as follows on next graphs.

The first one (Figure 31) shows the simulated and projected company code X1 evolution of people in training, that of course will be reduced every year as we start creating new jobs that will be mostly occupied by people in training, then reducing its quantity till arriving to zero. In this case the people in training increase any year that we have an AI application, as explained before.

The second (Figure 32) is the simulated and projected company code X1 improvement of competitiveness besides costs, that will be corrected by the variable Cost if they surpass the 10% of current fix costs to get the Total improvement on competitiveness that, in this case, has not

changed as Weight on competitiveness (of Cost) is 1 in this application as we have decided with the management of X1.

The third graph (Figure 33) is a Simulated and projected comparative between our increase of competitiveness and the one of competitors for company code X1

We must remember that we have estimated our application as 1 and the competitors as 0.1, therefore we should later

measure the sensitivity of Net improvement on the market to these two variables using random uniform and supposing that X1 application can oscillate between 0.7 and the current 1; and the competitors application can oscillate between the current 0.1 and 0.3. We show the results on fourth graph (Figure 34) Sensitivity analysis of simulated and projected competitiveness on the market changing percentage of artificial intelligence application of company code X1 and the one of competitors.



Figure 31. Simulated and projected company code X1 evolution of people in training

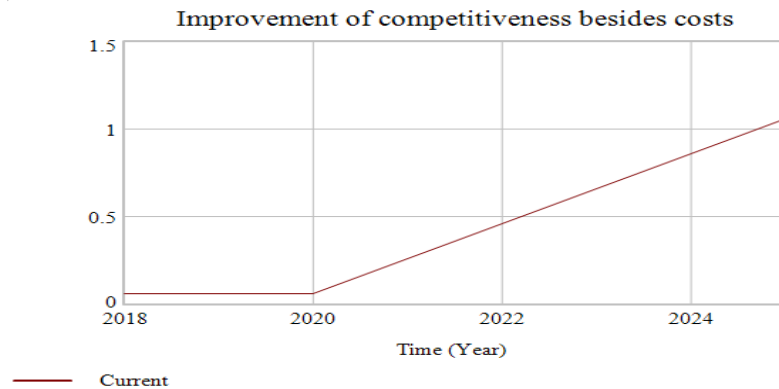


Figure 32. Simulated and projected company code X1 improvement of competitiveness besides costs

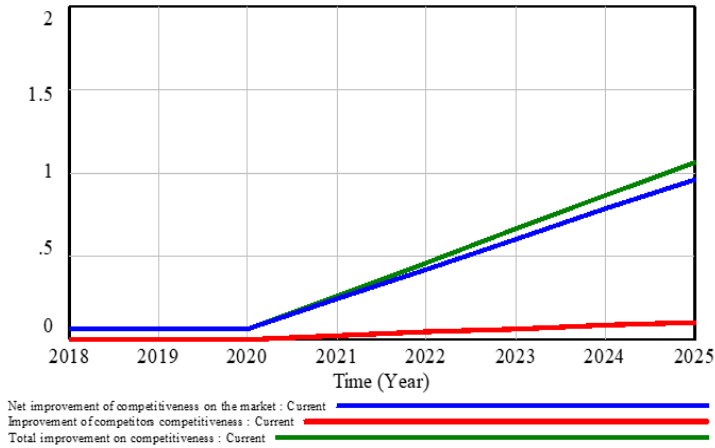


Figure 33. Simulated and projected comparative between our increase of competitiveness and the one of competitors for company code X1

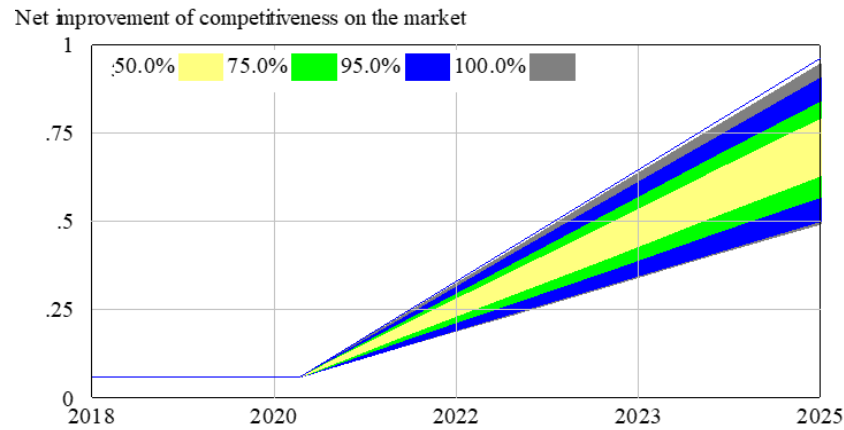


Figure 34. Sensitivity analysis of simulated and projected competitiveness on the market changing percentage of artificial intelligence application of company code X1 and the one of competitors

On this last graph (Figure 34) we verify the enormous sensitivity of X1 competitiveness on the market to the grades of application by competitors and by ourselves, to the point that it could decrease from 0.94 to 0.5 which can delay too much the growth and therefore the new creation of jobs to pass the in training people to active ones.

Understanding these very important variables, presents the right time to bring the most important diagram which is the one for jobs creation transferring the people in training to active jobs.

We used the general diagram shown on Figure 15, adapted to the case of company X1 as shown in Figure 35, where we have only change the specific names of the new business based on AI that X1 is going to launch which, as we later explain are: 3D/4D printing; Drones and Others.

We want to highlight the values of the next variables on this case (Figure 35):

The value of Company growth on no-displaceable jobs (CGNDJ) is the Net improvement of competitiveness on the

market (NICM), multiply by Global economic situation (GES), with the initial value of Current competitiveness (CC). We have initially evaluated GES as 1, what means that we expect that it will have no influence in GNDJ (we will analyse the sensitivity of different variables to GES).

We apply the growth only to no-displaceable jobs because if, temporary we need some displaceable jobs because we have not yet applied AI in that area, those displaceable jobs could be temporary occupied by people in training till the jobs are displaced when we apply AI in that area.

Then, the growth because of competitiveness is applied only on Total no-displaceable jobs (TNDJ) whose initial value is Initial non-displaceable jobs (INDJ), which increase Traditional jobs (TJ) through growth on traditional jobs (GTJ) which is subtracted by Active jobs displaced on application (AJDA).

Management of company X1 gives the same value -initially 1- to New business based on AI (NBBAI) which after an intense session explaining most of the people in X1 what the new technologies can do and will soon be able to do, we did

a brainstorming obtaining many ideas for new business based on new technologies, all around AI.

**Among all the ideas we selected two:**

To launch new businesses based on drones to supply the last mile where drones are permitted, especially in Africa where X1 is strong.

And to launch new businesses based on 3D/4D printing to give service to the multiple Europeans clients of AI to supply urgent orders far away, essentially in Africa.

They also expect to launch other businesses since the year 2021, selected for a list to be renovated with the advance of the technologies and the needs of the clients.

The strategy for drones and printing is to start in 2020 with 8 people on each activity and then to grow 50% in 2020, 70% in 2021 and 80% per year from 2022 to 2025. The strategy for others is to start in 2021 with 10 people -for several new businesses- to grow on average 60% every year till 2025. And the addition of the three are the New jobs for new businesses based on AI (NJBIAI).

We need new jobs to maintain and improve the application of AI (NJMIAI).and the strategy of company X1 is to start in 2020 with 4 people and incorporate 1 more each year, probably all external (it does affect to our model as we do not use the NJMIAI to be occupied by the people in training).

Now we go to the interesting variable Jobs for leisure businesses (JLB), which comes from the next assessments:

Leisure businesses are the most growing businesses -globally speaking, not on any C+I- and will continue being so for the next 20 years at least.

Besides being the most substantially growing businesses they are also -and will continue to be- the ones creating more jobs because leisure businesses has many jobs with human tasks and therefore no-displaceable.

It does not matter if we are not implicated on leisure business, it will affect us because more and more every day, being competitive is fundamental but not enough because our stakeholders are asking us positive experiences; the

clients to continue with us; our people to work with us; our suppliers to give us preference on their new products; our environment to like us to stay longer with them and our shareholders to continue investing. Everybody likes positive experiences and most of them come from leisure business.

Finally, our people will spend every day more time and money on leisure, then we have many reasons to be involved on leisure business to be more competitive, to grow and to create more employment in our environment.

Company X1 want to explore these leisure businesses with the next strategy: Internal leisure business (ILB) will start with 3 people in 2020; and to grow 50% every year from 2021 to 2025. ILB is affected by an annual growth percentage coming from Leisure business (LB) which is the addition of the annual increase of Salaries (S), plus annual increase of Working online (WoL), plus annual decrease of Working time (WT). Company X1 considers that S will increase 5% of annual NICM (net improvement of competitiveness on the market) from 2019 to 2025; WoL

will increase 3% annually from 2019 to 2025; and WT will decrease 5% of annual NICM from 2019 to 2025.

Active jobs (AJ) is the addition of the four groups of jobs: TJ; NJNBAI; NJMIAI; and JLB.

Global employment (GE) is the addition of AJ plus People in training (PiT) because these people are still full employees of X1.

With priority the PiT will be trained to become active traditional jobs (TJ) because it is the simplest training for the people and for the company, but in case that the growing of TJ is not enough to absorb the displaced people -exactly the same quantity as PiT- we have several possibilities as: To hire some temporary people for the growing of previous years on traditional jobs; to train internal people - leaving jobs for people in training- or people in training to the other jobs' growing as NJNBAI; NJMIAI; and JLB. The really important novelty in our model is that people displaced go to training and become active as soon as possible -always less

than two years- and in the same company -or the same group or the reality where AI is applied-

Then we apply all the quantities and formulas to the next Figure 35.

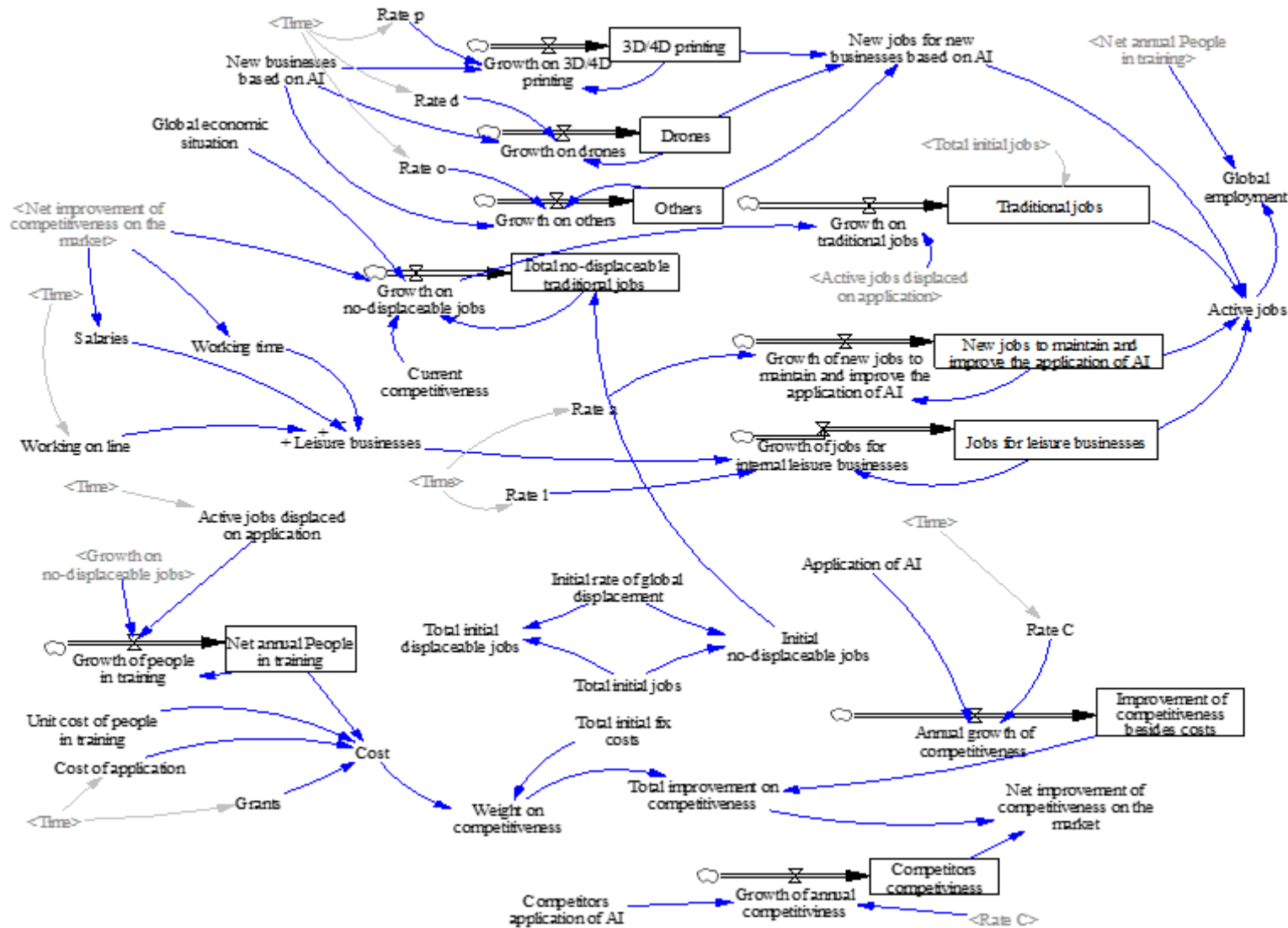


Figure 35 Stock and flow diagram adapted for Jobs creation in company code X1

From this SFD Figure 35, with quantities and formulas decided with the people of company X1, we get the next graphs.

The initial competitiveness of company X1 is estimated by the management as 6% and is measured as capacity of growing. The same as the Net improvement of competitiveness on the market (NICM) that we also measure as growth capacity. We will make it more difficult the jobs creation supposing that we are able to grow only on the

non-displaceable traditional jobs to avoid growing on jobs that we know that will be displaced as soon as we apply AI in the area.

On the next graph Figure 36, we show the improvement of competitiveness of company X1 on the market with the hypothesis given before -later we will analyse the sensitivity to different variables-:

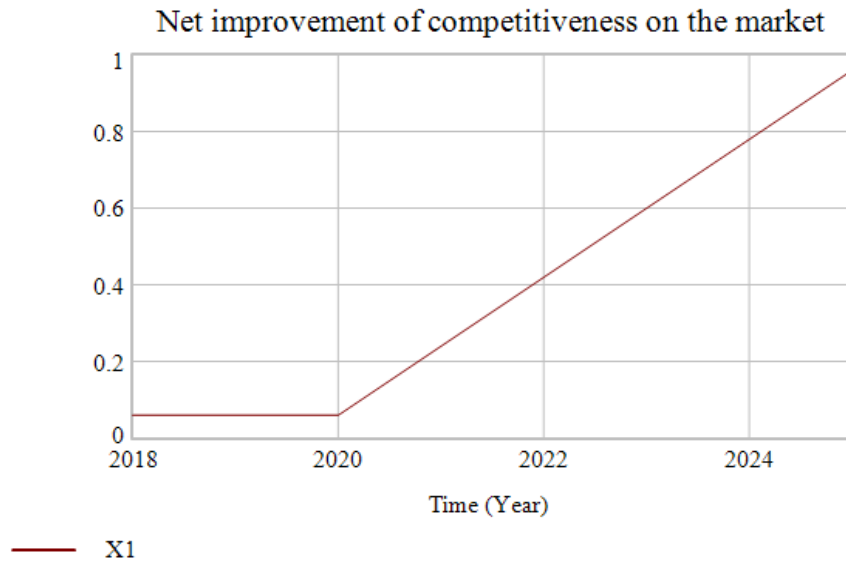


Figure 36. Simulated and projected net improvement of competitiveness on the market of company code X1

On next graph Figure 37 we show the traditional expected traditional jobs creation measured through growth on no-displaceable jobs

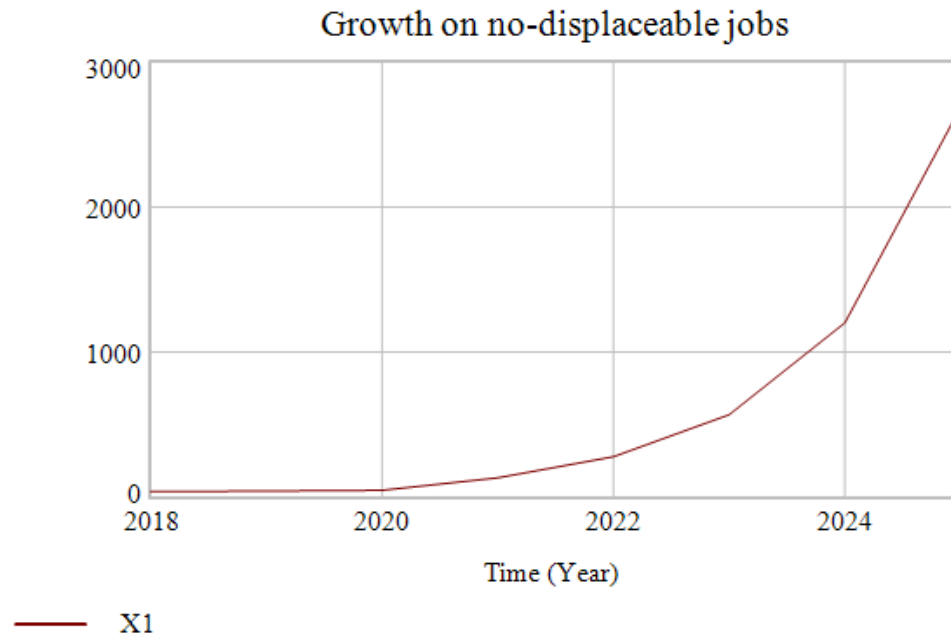


Figure 37. Simulated and projected Growth of no-displaceable jobs in number of people of company code X1

As we see in the graph Figure 37 the non-displaceable jobs starts in 38 people in end 2018, arrive to 134 in 2021, to 569

in 2023 and to 2688 in 2025, but these figures are obtained with the optimistic forecast of company X1.

On next graph Figure 38 we show the annual active jobs displaced on application.

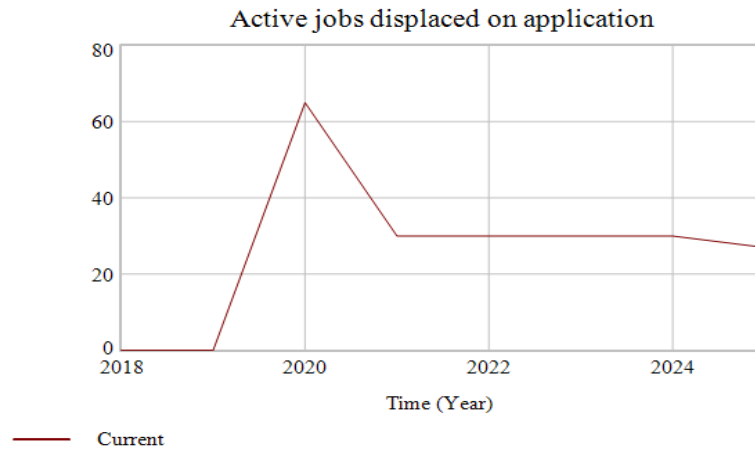


Figure 38. Simulated and projected Active jobs displaced on application of AI in company code X1

We conclude that: In 2018 and 2019 we create - we already have created- 38 and 43 -total 81- traditional jobs and we know that still we do not have people displaced -we start AI applications in 2020- then we hire people, most of them temporary, because we know that on 2020 we will have 65 displaced in training and the traditional jobs creation will be

48. On the other hand we know that in 2021 we are having 30 displaced and 134 created; in 2022 the displaced will be 30 y the created 279; in 2023, 30 vs 569; in 2024, 30 vs 1203 and in 2025, 27 vs 2688. Then we see how easy the training will be and make the people displaced become active only within one year, maximum two. And we also

have the other three groups of jobs creation. This effect is shown on next graphs Figure 39 and 40, showing this last one that we only have no active people in training from 2020 to 2022.

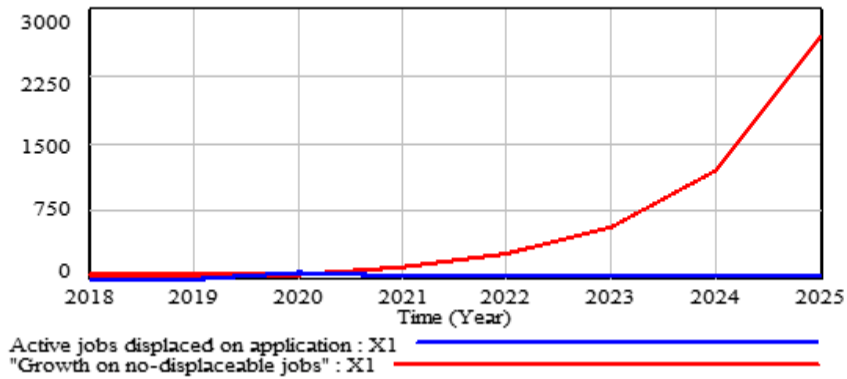


Figure 39. Simulated and projected Jobs displaced vs growth of no-displaceable jobs in company X1

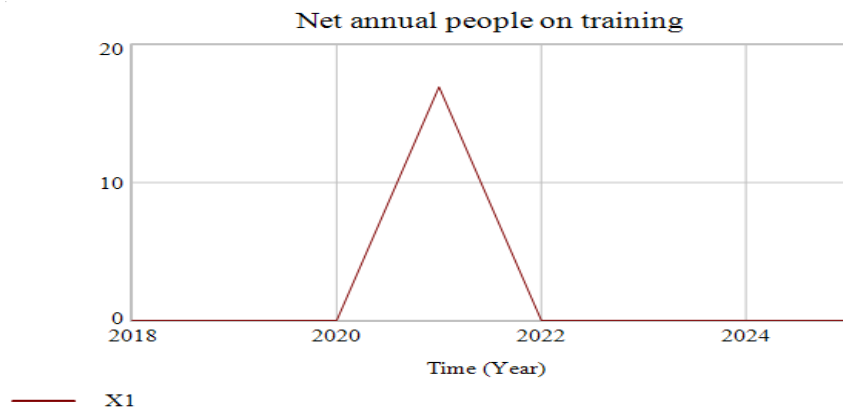


Figure 40. Simulated and projected Annual evolution of net people in training in company code X1

Evolution of new jobs for new business based on AI in company code X1. Figures 41, 42 and 43

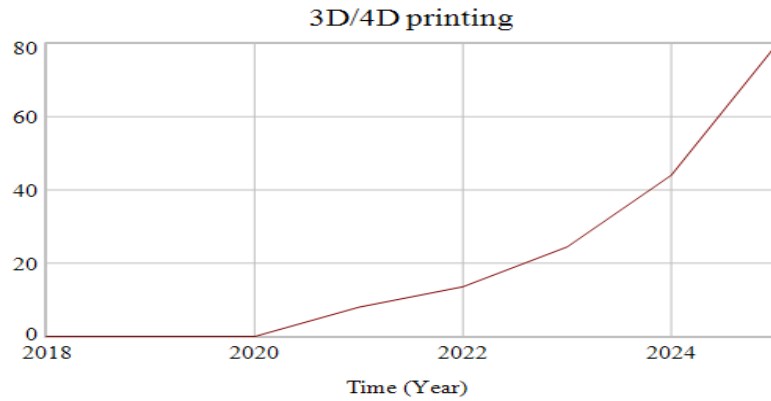


Figure 41. Simulated and projected Jobs for 3D/4D printing

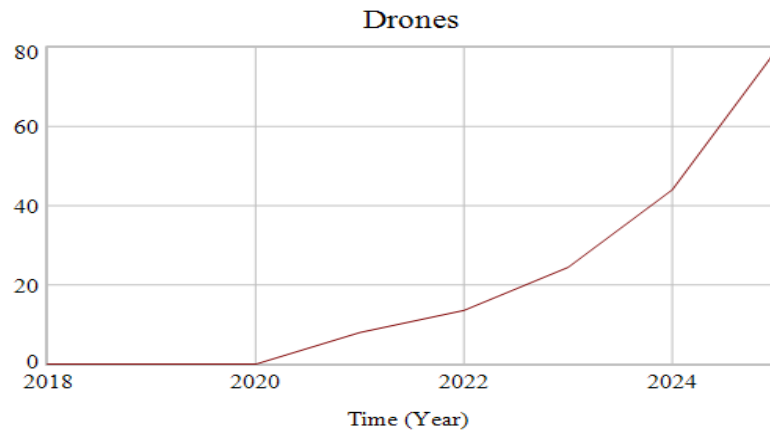


Figure 42. Simulated and projected Jobs for drones

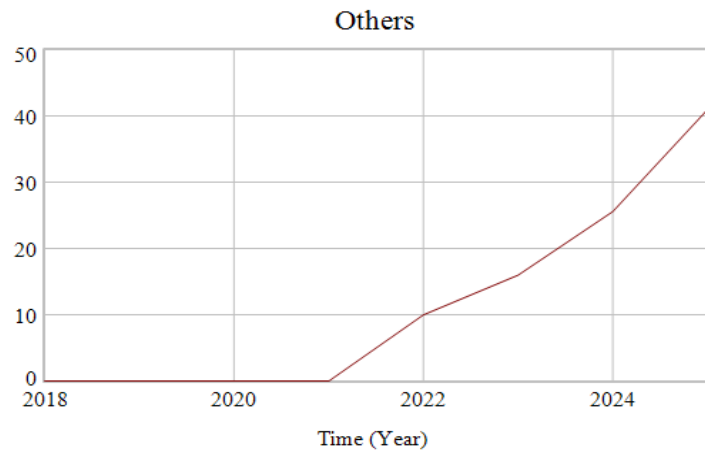


Figure 43. Simulated and projected Jobs for other new business based on AI

On next graph Figures 44 to 49 we show all the jobs creation variables with the initial hypothesis of company code X1.

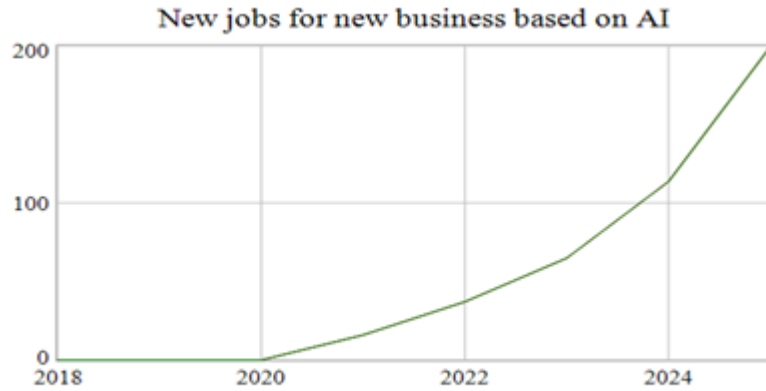


Figure 44. Simulated and projected Jobs for new business based on AI

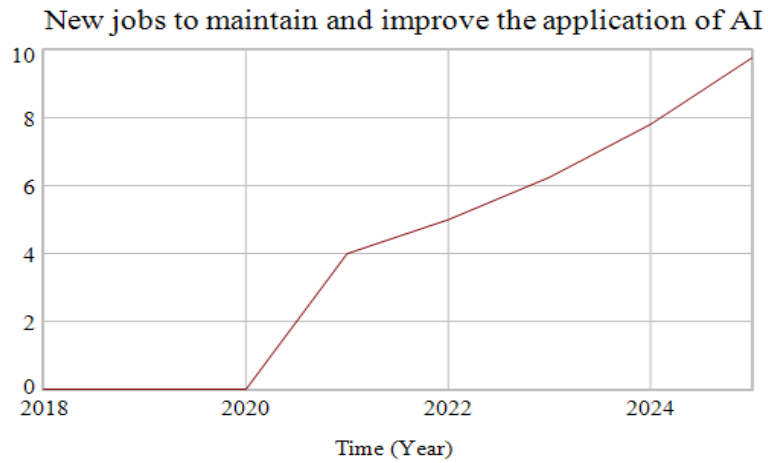


Figure 45. Simulated and projected New jobs to maintain and improve the application of AI

— X1

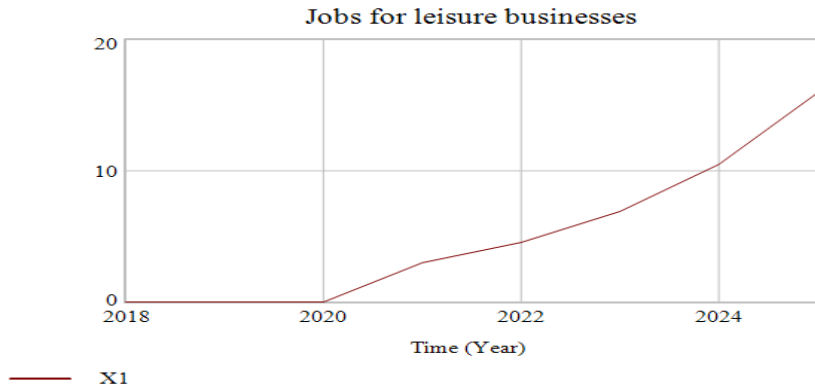


Figure 46. Simulated and projected Jobs for leisure business

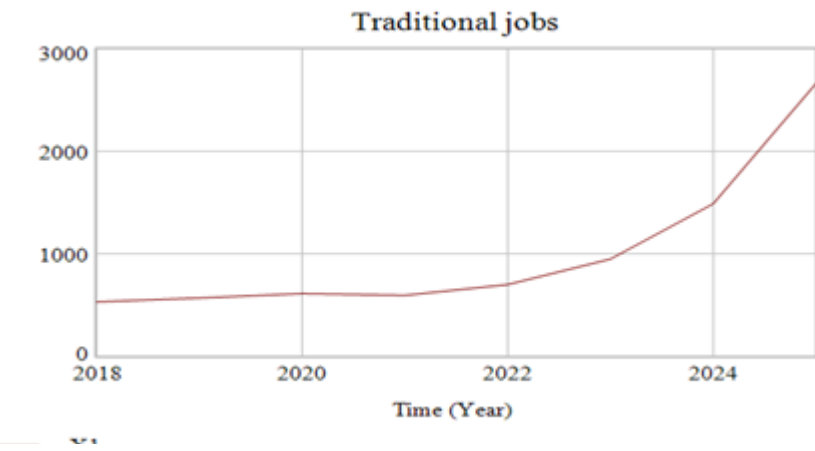


Figure 47. Simulated and projected Traditional jobs

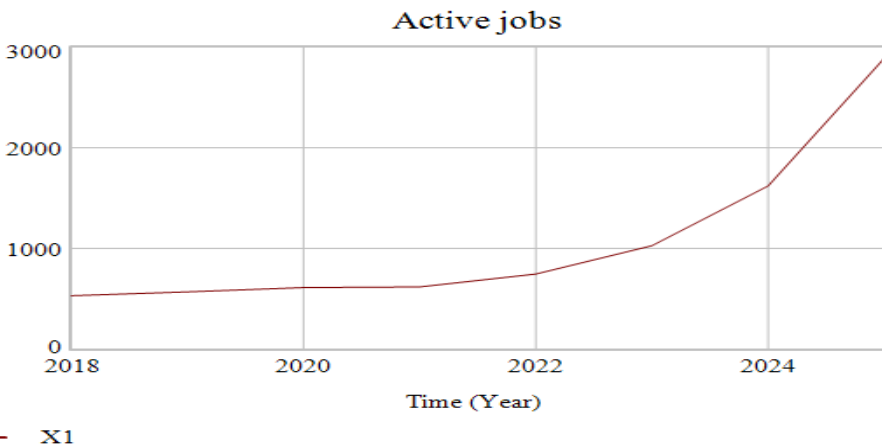


Figure 48. Simulated and projected Evolution of active jobs

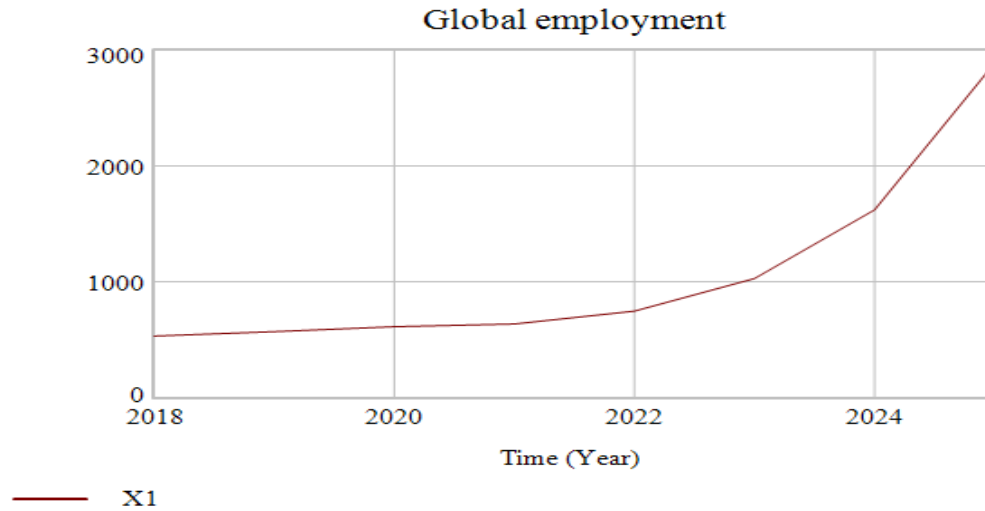


Figure 49. Simulated and projected Evolution of global employment

With the hypothesis and strategy of X1 they can train and transfer to active jobs all the displaced ones in less than 1 year except the year 2020 when they have an excess of 17 people displaced for which they have several possibilities, being the easier one to occupy these 17 people the temporary employment made on 2019 -42 jobs- and the longest to wait for the net jobs creation the next year only on traditional

jobs; on this case the 17 people in the year 2020 will be in training less than one year.

We must not forget that X1 is giving priority to the growing on traditional jobs to transfer the displaced to active just because the training is much easier but we have also the rest of jobs creation to train and transfer the displaced, either directly or training the best no-displaced employees for the

most sophisticated new jobs, who will leave traditional jobs available for the displaced which are temporary in training.

The expected growth of X1 is very impressive and the expected increase of profits is even more impressive (the profits are not shown in our diagrams and graphics, because this thesis is about employment, but of course profits are also measured in the diagrams of the companies), because the growth on traditional business is due to improvement on competitiveness compared with the one of competitors then they are growing normally selling at the same prices then the profits will grow more than proportionally. New business based on AI are expected to be the most profitable ones as X1 will normally have fewer competitors and these businesses are expected to grow exponentially. It is another important reason to expect an excellent increase of profits which will also allow X1 to invest more and to grow even more. The strategy based on AI implementation seems to be very successful and with no risk for employment neither on quantity nor on quality, as long as we follow our model

application by application and never the displaced people leave the job market.

But as we think that the X1 thinking that the Rate C of annual increase of competitiveness is very exaggerated and it is also very optimistic to expect them to have a rate of application of AI of value 1 and the competitors only 0.1. These assessments could be discussed and we should analyse the sensitivity of the results on X1 to these variables, separated and together.

X1 has also evaluated the global economic situation as 1 thinking that this variable, in this case will not affect them, but we think it necessary also to analyse the sensitivity to this variable.

#### **4.3.2.2. Analyses of sensitivity, company code X1**

We explored four analyses of sensitivity for company code X1 in order to know the robustness of previous results to variables as: Rate C (measuring annual growth because of increase of competitiveness for AI applications); AI

application of X1; AI application of competitors; mixing AI application of X! And competitors using Random Uniform;

**Analyse 1:** We descend the Rate C from 20% to 10% annually and maintain the value of the rest of variables. Shown in Figure 50.

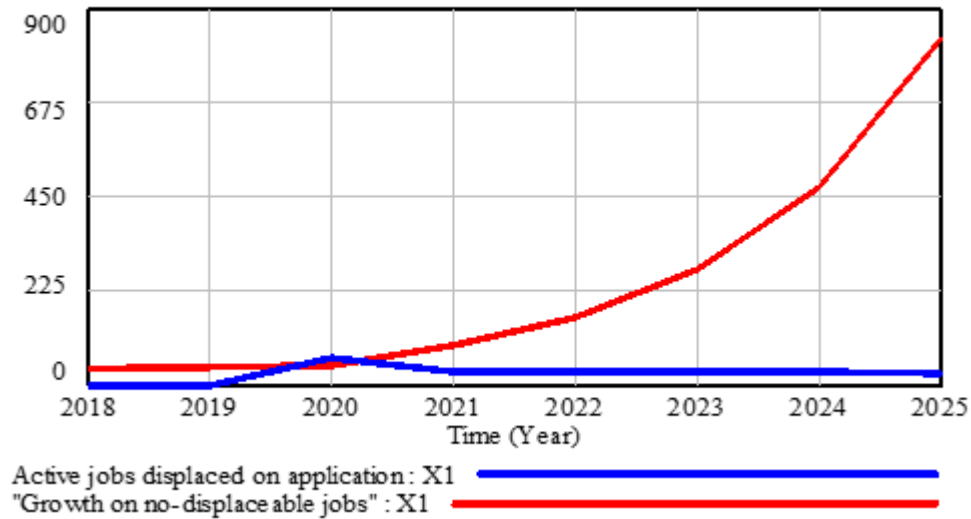


Figure 50. Simulated and projected Jobs displaced vs growth of no-displaced jobs with annual Rate C at 10% for company code X1

We see in graph of Figure 50 that the final jobs creation in X1 is much lower but does not affect to the time that the displaced people, after in training, are transferred to active jobs.

**Analyse 2:** X1 decrease AI application from current 1 to 0.7 maintaining the Rate C at 10% and the competitors AI application at 0.1. Shown in Figure 51.

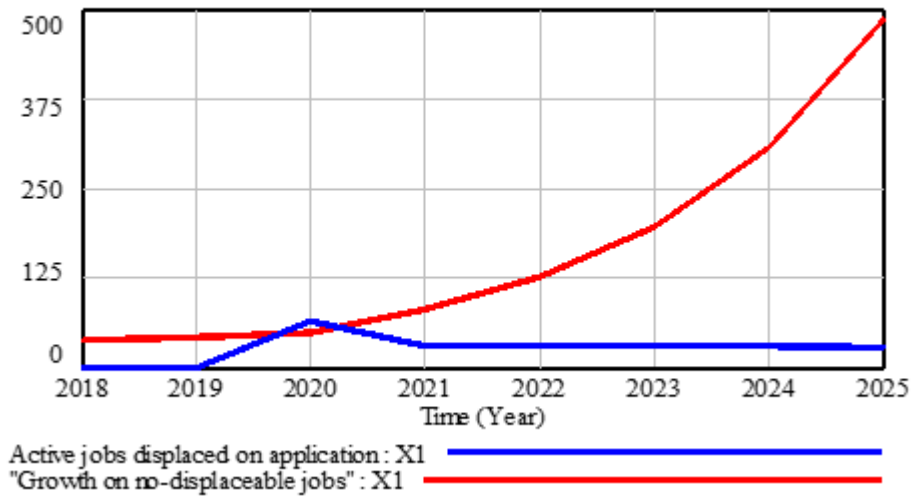


Figure 51. Simulated and projected Jobs displaced vs growth of no-displaced jobs with Rate C at 10% annually and X1 application of AI at 0.7

We see that, in spite of a very important decrease of growth on no-displaceable jobs, it still is enough to respect our

guaranty of the recuperation of displaced jobs in less than two years.

**Analyse 3:** Besides the previous changes we increase the competitors application of AI from 0.1 to 0.3. Shown in Figure 52.

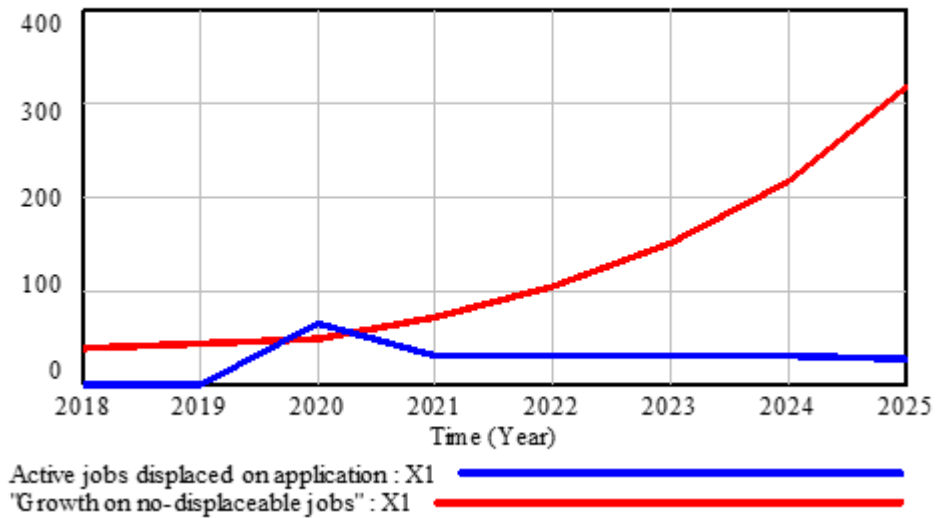


Figure 52. Simulated and projected Jobs displaced vs growth of no-displaced jobs with Rate C at 10% annually, X1 application of AI at 0.7 and competitors AI application at 0.3

We see that, in spite of a new very important decrease of growth on no-displaceable jobs, it still is enough to respect our guaranty the recuperation of displaced jobs in less than two years.

**Analyse 4:** We maintain the Rate C at 10% and we oscillate the X1 application of AI -now 1- between 0.7 and 1 and the competitors application of AI -now 0.1- between 0.1 and 0.3 using Random Uniform. Shown in Figure 53 and Figure 54.

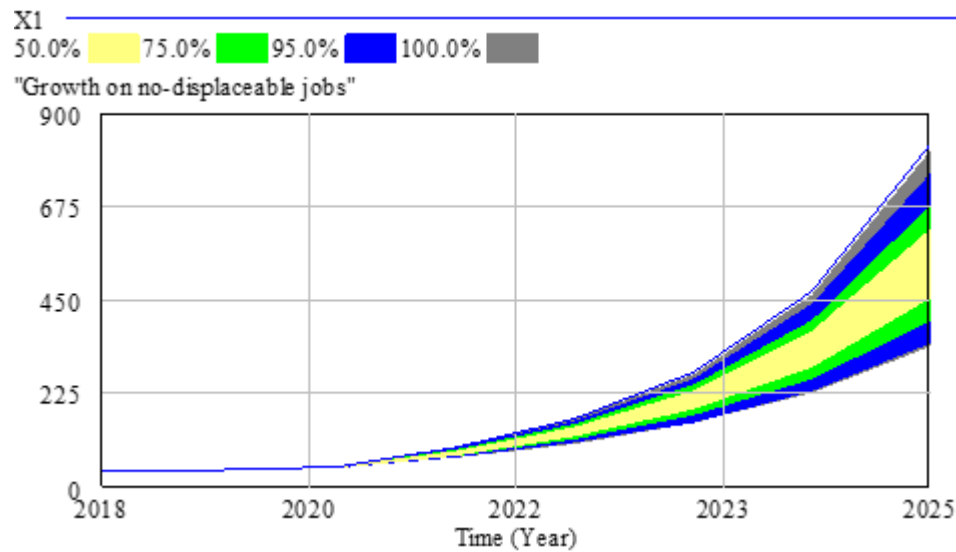


Figure 53. Simulated and projected sensitivity of growth of no-displaced jobs with Rate C at 10% and X1 application of AI oscillating between 0.7 and 1 and competitors AI application oscillating between 0.1 and 0.3 with Random Uniform

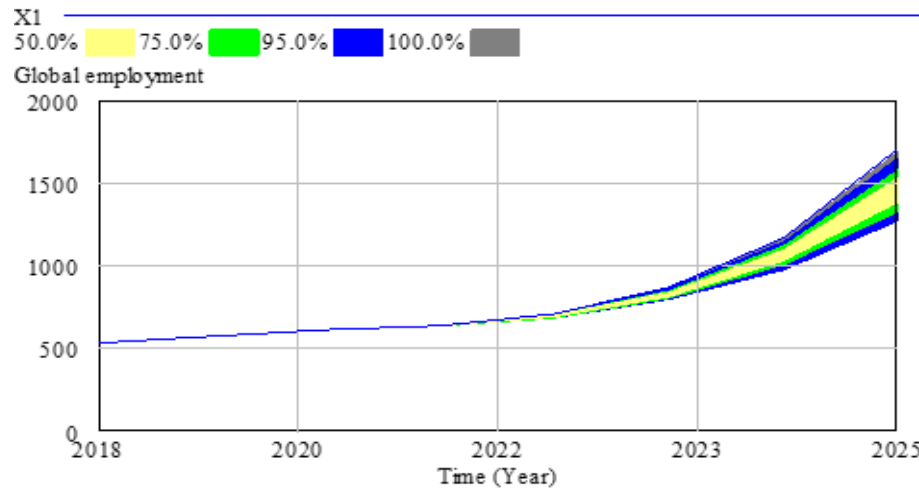


Figure 54. Simulated and projected sensitivity of Global employment with Rate C at 10% and X1 application of AI oscillating between 0.7 and 1 and competitors AI application oscillating between 0.1 and 0.3 for company code X1

As we expected and see on Figure 53 the rates of AI applications are variables with a huge influence on growth on no-displaced jobs -differences between 800 and 300 from 2020 to 2025- but have no important influence in our decision to maintain the displaced people as people in

training till we create new traditional jobs because on any case the growth is enough to pass the displaced to active jobs in less than two years.

But, as shown on Figure 54, the impact on global employment is smaller because the rest of jobs creation is

practically no affected by the rate of AI application -of course always that it is any AI application-.

#### **4.3.2.3. Application on company code X50**

Technical data:

Activity: Animals for food and feed.

People at end 2018: 91, distributed on following occupations:

General management:	1
Human Resources and Innovation:	3
Administration	4
Production	77
Commercial:	2
Technicians	4

The first step was to convince the high management that AI systems are arriving to them and to their competitors more sooner than later, that their effects will be disruptive and to be pioneers is very important for the future of X50. When high management was fully convinced, we did the same with the medium management and later with most of influential people in the company to avoid any position against AI. Of course we explained clearly that, on the time period of AI application, many tasks will be displaced and therefore we will need less jobs for the same activity, but we also explained that, on our model already accepted by the high management, the people displaced by AI will go in training - continuing as employees with the same conditions as before- to be trained and become newly active in less than two years on the same or even better conditions.

As soon as most of the influential people on X50 were convinced that AI application will be positive for the company and for them, we started the application with our models.

We create, together with the management, a team -including people from all the areas but always people influential and interested- to start the application and step by step we would add the necessary people as we need them.

We showed the global model to the team only to make them to understand that the process is very complex, but we will apply it step by step in the way that they will understand everything we do.

Then we were directly to the SFD models starting by technology companies only to make them to understand how these companies work and the importance to work with the best AI specialists. They asked us: Specialist on what?, and we told them we will concentrate in the capacity of AI of making any task, now made by people, that we can structure and put under rules only depending on information that we know, because we will start the application of AI only with the information and data that we already have and later we will incorporate new data and information to improve the system. What do we want to get with these applications?

That the structured tasks will be made faster, better and cheaper leaving people free for most valuable new tasks that we will later explain.

At this moment, before analysing conditions and constraints, we thought that was the moment to explain well the concept of displaceable and non-displaceable tasks by AI.

We read and explained a summary of our conclusions about displaceable tasks, as follows: Till recently, the automatic systems, robots and machines have displaced only routine tasks, but from nowadays and growing on next years the AI will make any task that we are able to put under rules and then to make the algorithms (or any other program) to follow those rules.

But with Reinforcement learning (RL), we do not even need to make the algorithms, because just giving the machine the rules of the system, it is able to create their own algorithms and find the best solution faster, without a possible mistake and cheaper than humans. For example, with RL AlphaGo Zero in only 40 days surpasses all other versions of

AlphaGo and, arguably, becomes the best Go player in the world. It does this entirely from self-play, with no human intervention and using no historical data, just giving the system the rules of the game.

Then we also read and explained a summary of our conclusions about non displaceable tasks, as follows: Jobs/tasks that require uniquely human characteristics such as empathy, creativity, judgment, critical thinking, synthesizing, problem-solving, innovating, intuition, compassion, inspiration, human communication, entrepreneurship, emotional and relational work, are much less probable to be displaced.

We gave several examples and we discussed till we were convinced that all the team understood the displaceable and non-displaceable tasks.

We gave them a week to review and analyse all the tasks made by all occupations to send their conclusions. In less

than one week we received their conclusions and were very well done, then we summoned another event to discuss their results and together we built the next Table 5 which has the following information.

The area in the company already cited before.

The initial people in each area.

The displaceability in quality, total or partial.

The displaceability in percentage, calculated with our definition.

The hours worked initially per people and per year.

The total hours worked in each area.

The total displaceable hours by area.

The total no-displaceable hours by area.

Table 5. Initial occupations in each area, with quantity of people, displaceability of each occupation and total annual hours displaceable and no-displaceable by occupation.

Area	People	Displaceable quality	% Displaceable	hours/people/year	Total hours/area	Displaceable Hours/area	Non displaceable Hours/area
General Management	1	partial	40	2000	2000	800	1200
Human Resources and Innovation	3	partial	50	2000	6000	3000	3000
Administration	4	partial	70	2000	8000	5600	2400
Commercial	2	partial	30	2000	4000	1200	2800
Technicians	4	partial	50	2000	8000	4000	4000
Production	77	partial	50	2000	154000	77000	77000
TOTAL	91		50.33	2000	182000	91600	90400

Accepting our definition of displaceable and no-displaceable jobs, the decision makers in company code X50 accepted that on 2019 more than 50% of tasks in their company were displaceable with the current AI technology, then applying

AI systems they can do the same as today with around 46 people, being 45 displaceable.

The area more likely affected by displacement from 2020 to 2025 is administration but only affects to 4 people.

Otherwise, in quantity of people is more affected production with 50% displaceable affecting to 77 people, then around 38 displaceable.

The management thinks that it is better to start the AI application on 2020 and gradually by production because it will more affected its competitiveness as with AI the company will be able to guaranty 100% reliability - now is 92% with humans- and also can give non-stop service 24/365 -now the service out of working time is limited-. The cost is not considered as essential for competitiveness -as soon as it decrease in a short time-, as they even will apply our model maintaining all the displaced people in training to occupy the new jobs as we will see later.

Then the plan of the management of X50 to apply AI is:

They expect to grow 5% on 2019 because of its current competitiveness without AI -as we know, the increase of competitiveness can be used to increase prices or to grow- in our model we use all the competitiveness only to grow

which will increase profits and overall employment that is essential to re-employ the displaced people.

We plan to start on 2020 applying AI systems to the 77 people in production on 2020 and 2021, then displacing 19 each year.

The management of X50 thinks that this AI application will increase his competitiveness more than 10% each year and they put this quantity on its strategy for 2020 and 2021.

The rest of AI systems in the rest of the areas will be applied between 2022 and 2023 expecting that from 2022 to 2025 the competitiveness will increase other 5% each year, displacing the rest 7 people on 2023.

These are initial strategies that will be reviewed as we advance in our applications of AI, the model allow the revision when we want; daily, weekly, monthly or quarterly, the shorter the time the better to avoid large deviations difficult to correct.

Next step is to know if we will be able to solve internal and external conditions and constraints which can weaken and even stop the applications.

For this analyse we use the already known SFD diagram Figure 11. Companies and Institutions appliers, area of conditions and constraints.

On this case we start by “Management is convinced...” because we have already convinced then to proceed with AI applications as soon as they find competitive suppliers of AI -they expect on 2020-.

We analysed, one by one, all the internal conditions and we arrived at the conclusion that we can evaluate the impact as 1, which means 100% favourable without negative impact.

Then we went to analyse the external conditions, also one by one, and we arrived newly that we qualify the impact as 1, again 100% favourable.

Finally, we analysed the constraints arriving to the conclusion that we can also evaluate as 1, then we had no constraints.

Then the initial value of Application of AI for X50 is 1. But we must not to worry for that because, at the end of our exercise we will calculate the sensitivity of the model to this factor to make to know the management of X1 how can be reduced the results if finally the number is less than 1 in order that they should be very careful about it.

Then we pass to the next model to calculate displacements and competitiveness and we worked directly on SFD model with the Vensim program, giving the quantity and formula to each variable.

For the same reasons as on X1 we use the same diagram on Figure 30. Stock and Flow Diagram adapted from Figure 14. Let us see the values for company X50 in this diagram.

Application of AI -AoAI- is 1 as we agreed.

We met the Unit cost of people in training that multiply for People in training, will increase each year -only at this stage of our analyse because we will prove that most of the people becomes active in less than two years- and the Cost will also be increased by each year Cost of application and will be reduced by grants. Just because of our decision to maintain the people in training inside the company the cost will for sure increase, but the company X50 accepts that always that the increase of this cost because of our decision on application is not more than 10% of Total initial fix costs, the weight on competitiveness is 1 what means that it is no reducing the Total improvement on competitiveness.

Net improvement of competitiveness on the market is the subtraction of Total improvement least Improvement of competitors; and this last we have calculated supposing that competitors have the same Rate C of annual growth as we have but they only have 0.1 application when we have 1 -we will later calculate the sensitivity to these variables-.

The improvement of competitiveness besides costs, that will be reduced by the variable Cost if they surpass the 10% of

current fix costs to get the total improvement of competitiveness that, on this case, is theoretically reduced to 0.9 since 2023, but it is not real as we will see later.

We show the results as follows on next Figures 55 to 57.

The first one (Figure 55) shows the evolution of people in training that of course will be reduced every year as we start creating new jobs that will be mostly occupied by people in training, then reducing its quantity till arriving to zero. We will see this effect on next SFD application.

The second (Figure 56) is the improvement of competitiveness besides costs, that is corrected by the variable Costs if it surpass the 10% of current fix costs.

The third (Figure 57) is a sensitivity analysis of Net improvement on the market to the variables AI application by company X50 and by Competitors using random uniform and supposing that X50 application can oscillate between 0.7 and the current 1; and the competitors application can oscillate between the current 0.1 and 0.3.

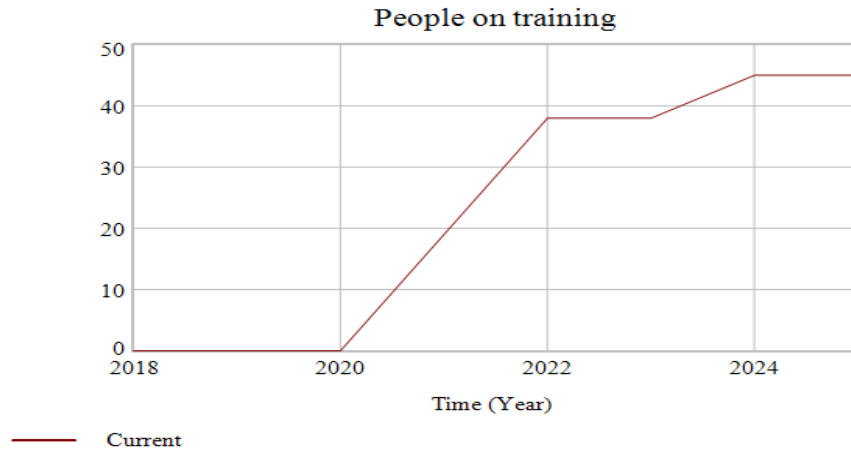


Figure 55. Simulated and projected evolution of People in training in company code X50

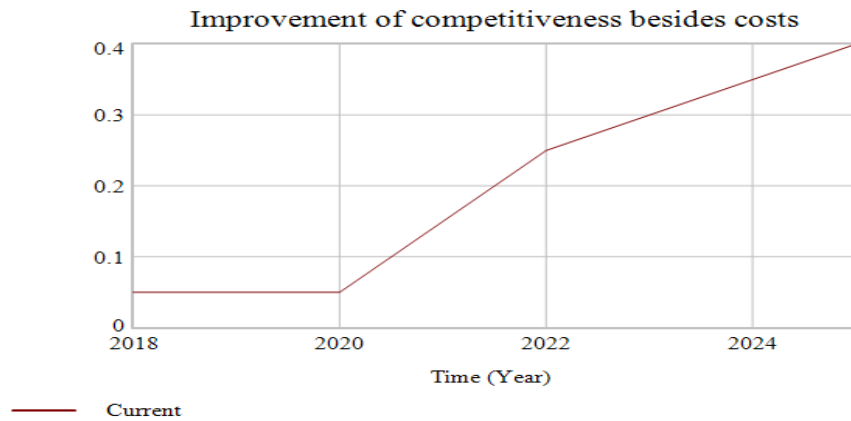


Figure 56. Simulated and projected Improvement of competitiveness besides costs on company code X50

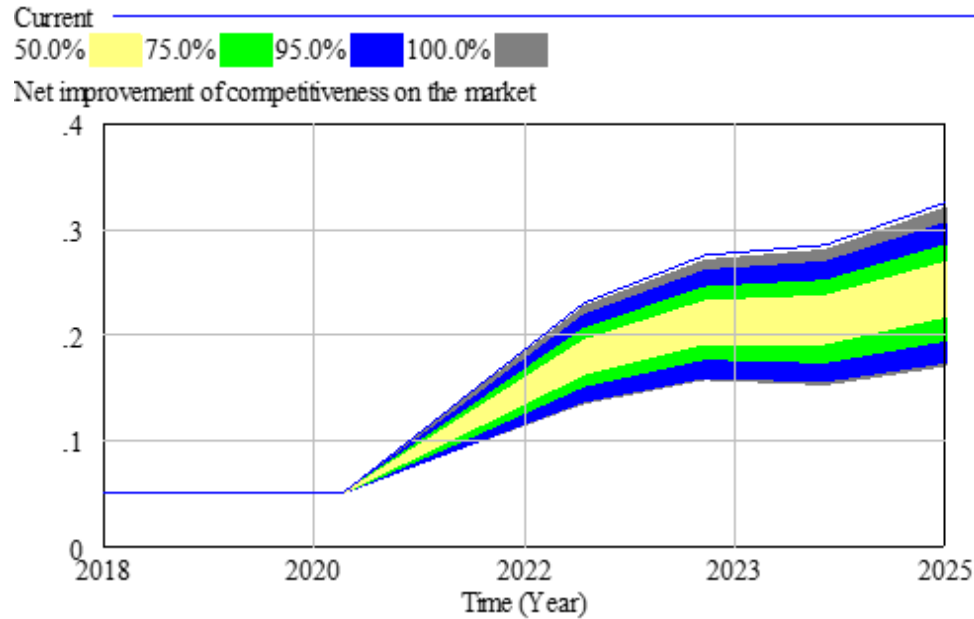


Figure 57. Simulated and projected sensitivity of net improvement of competitiveness on the market to AI application of company code X50 and AI application of competitors

On this graph (Figure 57) we verify the enormous sensitivity of X50 competitiveness on the market to the grades of application of AI by competitors and ourselves, to the point that it could decrease from 33% to 18% on 2025 which can delay too much the growth and therefore the new creation of jobs to pass the training people to active ones.

Understanding these very important variables, it arrived the moment to go to the most important diagram which is the one for jobs creation. We use the Figure 15. New model PROPOSITION, stock and flow diagram for companies and institutions appliers, area of jobs' creation inside C+I.

We only want to highlight the values of the next variables in SFD Figure 15 for company code X50:

The value of Company growth CG) is the Net improvement of competitiveness on the market (NICM) multiplied by Global economic situation 8GES), which we have evaluated as 1, what means that we expect that will have neither influence in X50 competitiveness nor on growth - we will also analyse the sensitivity to the variable GES-.

We apply the growth only to no-displaceable jobs because if temporary -till we apply AI- we need to grow on some displaceable people they will be occupied by people in training, also temporary, then we do not count these ones as jobs creation because will be soon displaced.

Then the growth because of competitiveness is applied only on Total no-displaceable jobs (TNDJ) which initial value is Initial non-displaceable jobs (INDJ) which increase the Traditional jobs (TJ). through Growth on traditional jobs (GTJ) which is subtracted by Active jobs displaced on application (AJDA) to obtain the Traditional jobs every year.

We give the initial value 1 to New business based on AI (NBBAI) which after an intense session explaining most of the people in X50 what the new technologies can do and will be soon able to do, we did a brainstorming obtaining many ideas for new business based on new technologies, all around AI.

Among all the ideas -they gave around ten different ideas- we decided to launch three of them on 2020: Business 1, Business 2 and Business 3 that will start with 3 people each of them on 2020 expecting to grow 100% every year from 2021 to 2025.

The addition of the three are the New jobs for new business based on AI (NJNBAI).

We need new jobs to maintain and improve the application of AI (NJMIAI).and the strategy of X50 is to start on 2020 with 2 people and incorporate 1 more each year, probably all external.

Now we go to the interesting variable Jobs for leisure businesses (JLB), which comes from the next assessments:

Leisure businesses are the most growing businesses and will continue being for the next 20 years at least.

Beside the most growing it is also -and will continue to be- the most creating jobs because leisure businesses has many jobs with many no-displaceable tasks.

It does no matter if we are not implicated on leisure business, it will affect us because every day more, being competitive is fundamental but not enough because our stakeholders are asking us positive experiences; the clients to continue with us; our people to work with us; our suppliers to give us preference on their new products; our environment to like us to stay longer with them and our shareholder to continue investing. Everybody likes positive experiences and most of them come from leisure business.

Finally, our people will spend every day more time and money on leisure, then we have many reasons to be involved on leisure business to be more competitive, to grow and to create more employment in our environment.

X50 want to explore these leisure businesses with the next strategy: Internal leisure business (ILB) will start with 1 people on 2020; and to grow 50% every year from 2021 to 2025. ILB is affected by an annual percentage coming from Leisure business (LB) which is the addition of the annual increase of Salaries (S), plus annual increase of Working online (WoL), plus annual decrease of Working time (WT).

X50 considers that S will increase 5% of annual NICM from 2019 to 2025; WoL will increase 3% annually from 2019 to 2025; and WT will decrease 5% of annual NICM from 2019 to 2025.

Active jobs (AJ) is the addition of the four groups of jobs: TJ; NJNBAI; NJMIAI; and JLB.

Global employment (GE) is the addition of AJ plus People in training (PiT) because these people are still full employees of X50.

With priority the PiT will be trained to become active traditional jobs (TJ) because it is the simplest training for the people and for the company, but in case that the growing of

TJ is not enough to absorb the displaced people -exactly the same quantity as PiT- we have several possibilities as: To hire some temporary people on traditional jobs for the growing of previous years to AI applications; to train internal people no-displaced -leaving jobs for people in training- or to train people in training to the other jobs' growing as NJNBAI; NJMIAI; and JLB. The really important in our model is that people displaced become active as soon as possible and in the same company -or the same group or the reality where AI is applied-.

Let us now calculate the traditional jobs that we can create annually with the initial competitiveness of 5% -which we measure as capacity of growing- and the Net improvement of competitiveness on the market (NICM) that we also measure as growth capacity. We will put more difficult the

jobs creation supposing that we are able to grow only on the non-displaceable traditional jobs to avoid growing on jobs that we know that will be soon displaced.

On next graph Figure 58, we show the difference between the people annually displaced and the growth of no-displaceable jobs -later we will analyse the sensitivity to different variables-:

We notice that, because of our decision to give priority to the growth on no-displaceable traditional jobs on 2020 and 2021 we will have some people in training, exactly in 2020 we displace 19 and create 7, remaining 12 in training; in 2021 the displaced are 19 and the creation 13 then other 6 in training; but on 2022 we displace 0 and create 23 when all the displaced people in less than two years go to active jobs

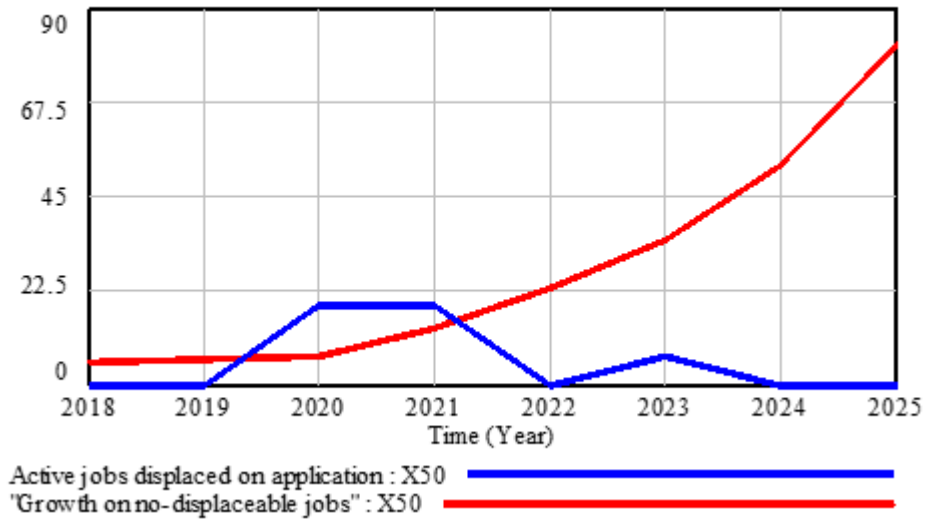


Figure 58. Simulated and projected comparative between displaceable vs creation of no-displaceable jobs in company code X50

On next graph Figure 59 we see the evolution of active, global and traditional jobs on X50; the small difference between active and global for two years is because of people in training no yet gone to active.

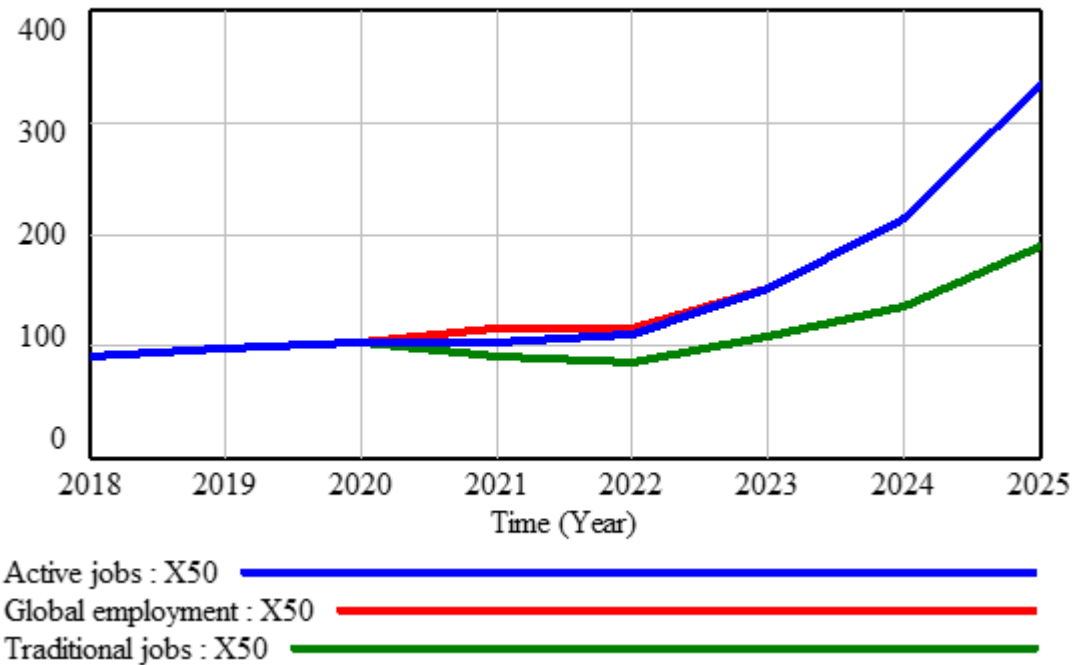


Figure 59. Simulated and projected evolution of Active, global and traditional jobs of company code X50

#### 4.3.2.4. Sensitivity analysis on company code X50

Let us verify what happens if we maintain the displaced jobs but decrease the growth of X50 going the AI application from 100% -value 1- to 70% -value 0.7- maintaining the AI application of competitors on 10% -value 0.1-

As we see in Figure 60 we have more people in training but still nobody is more than two years without having an active job and besides we have 11 no-displaceable jobs created on 2018 and 2029 which could be temporarily occupied by the displaced in training.

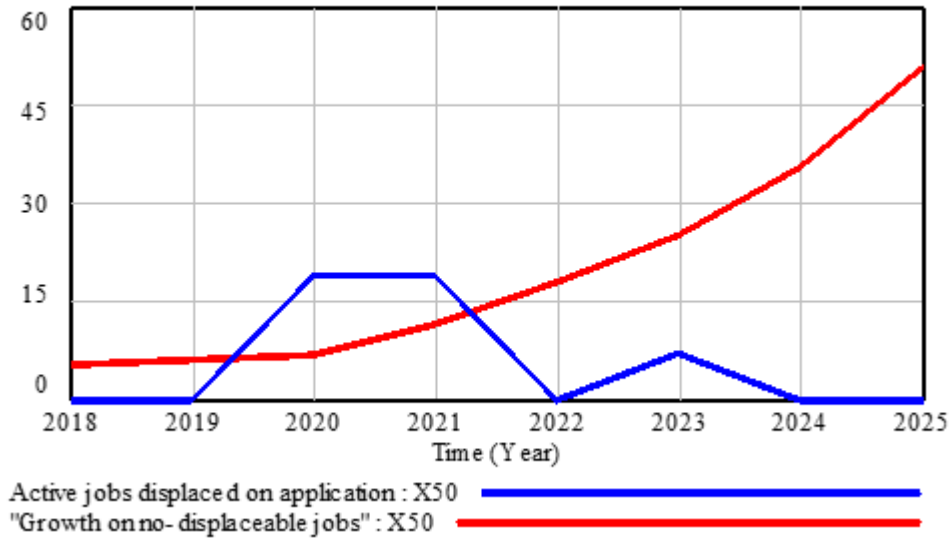


Figure 60. Simulated and projected comparative between active and growth of no-displaceable jobs, maintaining displaced but reducing AI application from 1 to 0.7 in company code X50

The last sensitivity analysis with X50 is a Random Uniform analyse moving AI application between 0.7 and 1 and the competitors AI application between 0.1 and 0.3, maintaining the displaced people which we can always delay.

On next Figure 61 we verify that on any case we can maintain the displaced and guaranty that they are becoming active jobs in less than two years.

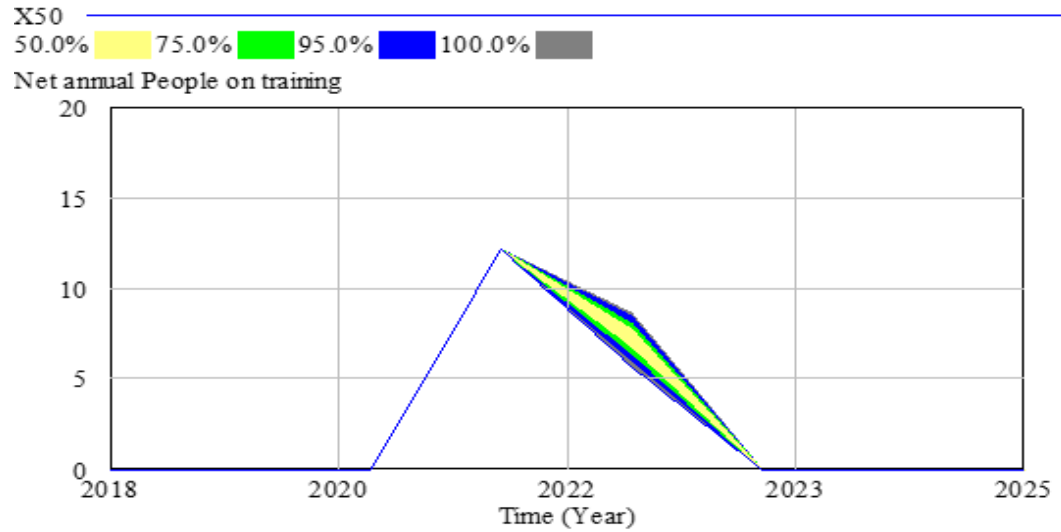


Figure 61. Simulated and projected random uniform sensitivity analysis of Net annual people in training moving AI application and maintaining displaced people in company code X50

On next figure 62 we verify the sensitivity to traditional jobs growth by the rate of AI application.

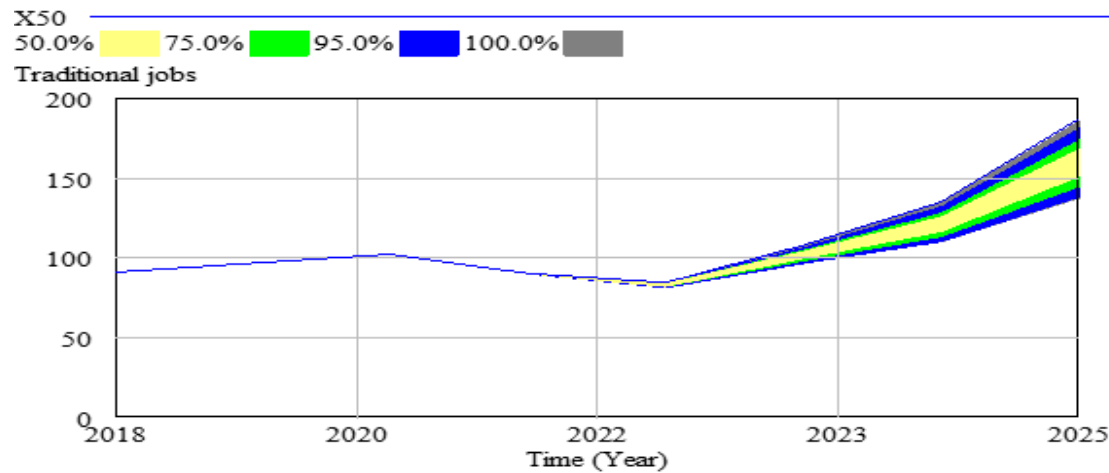


Figure 62. Simulated and projected random uniform sensitivity of traditional jobs moving AI application and maintaining displaced people in company code X50

On next figure 63 we verify the sensitivity to active jobs growth by the rate of AI application.

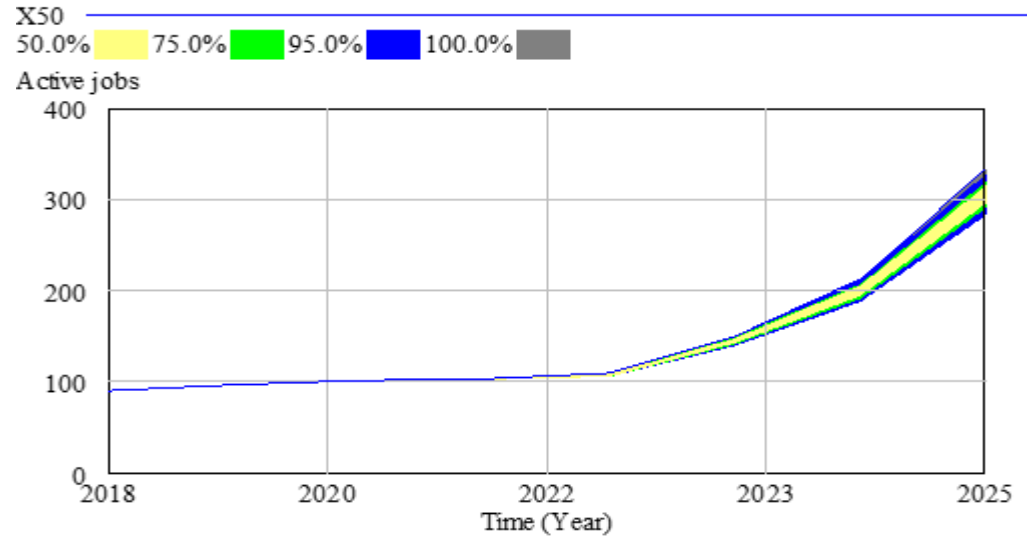


Figure 63. Simulated and projected random uniform sensitivity of active jobs to AI application maintaining displaced people in company code X50

### 4.3.3. Application of our models on companies not interested on applying AI in the year 2019

We have met more than 10 companies not interested, by the moment, to apply AI and they gave the next reasons:

They are already very competitive and they do not want to dedicate their time on “fashion” projects like AI, they say that they need their people to be 100% involved in their current growing all over the world.

In general they follow a defensive strategy to AI believing that, as soon as they verify the importance of AI to improve disruptively their competitiveness, they think that they will be able to apply it better than the competitors because they can hire the best AI technology suppliers in the world.

Most of these companies had also bad experiences with previous AI applications as in more than two years expending a lot of money and time on -theoretically- good AI applications they told us: “With AI applications we got a lot of information - too much information- but not improvements of the profits at all”.

Logically the C+I want better results and short pay backs that we are sure that very soon will be possible for most of AI applications not only on big companies but also on SME. This will be our main objective after defending this Thesis, to prove that many AI applications on SME are not expensive, have a very short pay back, improve the competitiveness and improve employment on quantity and quality.

Not all the companies not interested are alike but most of them have in common the following characteristics:

- They are big companies, most of them with more than one thousand five hundred people.
- All of them are now very profitable.
- Most of them are on the stock exchange.
- All are international companies but most of them with the headquarters in Spain.

We have the information of each company but we think more practical to analyse all together with the next almost common parameters:

- Current annual growth around 8% -we consider for our analyse that growth is equivalent to competitiveness-.
- Average initial employees 5000 people.
- Average turnover 1000 million euros.

In these cases our hypothesis to test with our models are:

Hypothesis 1: They decide not to apply AI -I know that this is a wrong decision which will be changed as soon as they verify that AI applications are very important for increasing its competitiveness-.

Hypothesis 2: The competitors apply AI neither 0% nor 100%, then we suppose that they apply only 20% of available AI which applied at 100% could give an increase of competitiveness at least 10% annually (as we saw on company code X1 the increase of competitiveness can be even higher). Later we will analyse the sensitivity to this variable moving the competitors AI application from current 20% to 100%.

Hypothesis 3: Neither our C+I nor the one of competitors launch new business or both launch the same quantity of them, please notice that we have decided this factor to have no influence on our analyse but we want to highlight that this hypothesis damage the competitiveness of competitors because applying AI they have more opportunities for launching new business based on AI systems.

We apply the new SFD diagram of Figure 64 adapted and simplified from Figure 15.

The NO applying companies have 0 Application of AI and competitors initially 0.2 from year 2020 that means that the change of net competitiveness on the market of NO from 2020 is negative decreasing the competitiveness from the current initial one that we calculate - generously- at 8%.

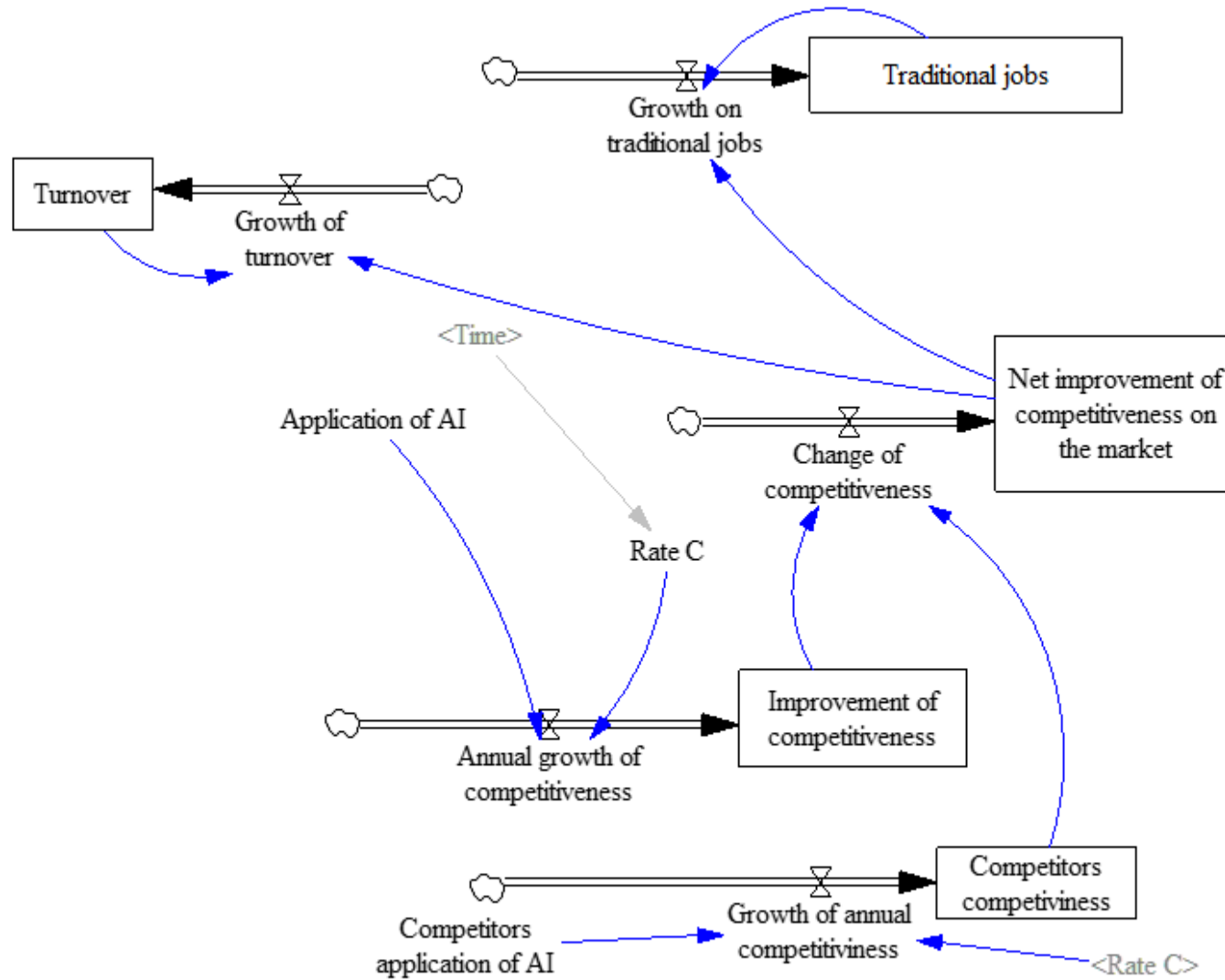


Figure 64. Stock and Flow Diagram for companies and institutions not interested on applying artificial intelligence in the year 2019 -adapted from Figure 15 and simplified-

When applying AI it is rational to apply the growth only to non-displaceable jobs - because the other will be sooner or later displaced- but not applying AI and therefore reducing the competitiveness the reduction has to be applied to Total initial jobs which we estimate on 5000 people on average.

The Rate C is 0 on 2018 and 2019 and then 10% from 2020 when competitors could start the AI application

(The Rate C measures the annual growth because of increase of competitiveness on AI applications).

On next graph Figure 65 we see that the competitiveness on the market of C+I no applying AI is reduced annually till arriving to negative after year 2023, decreasing on people and of course on turnover and profits.

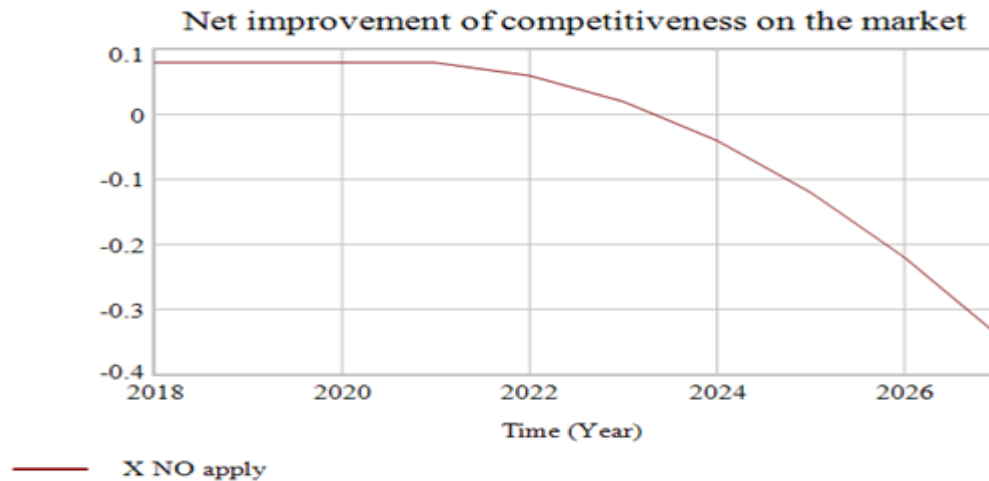


Figure 65. Simulated and projected evolution of Competitiveness of NO applying artificial intelligence companies and competitors applying at 20%

On next graph Figure 66 we measure the evolution of jobs and turn over of companies NO applying AI.

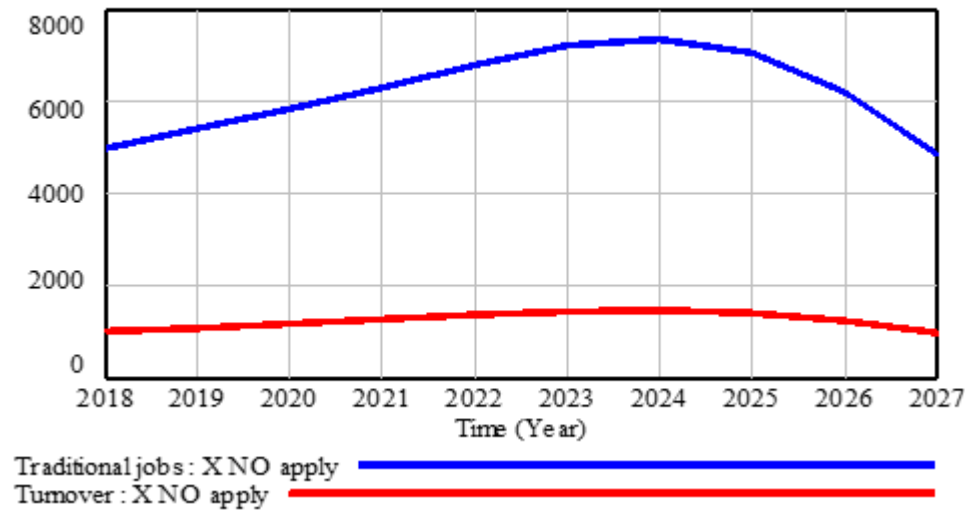


Figure 66. Simulated and projected evolution of Jobs and turnover of NO applying AI and competitors applying at 20%

We notice that after 2023 the simulated competitiveness starts to be negative, therefore decreasing jobs and turnover from 2024.

But as we have been very generous with no applying C+I we have to follow with the sensitivity analyses.

#### 4.3.4. Sensitivity analysis to No applying Companies and Institutions

Next Figure 67 measure the sensitivity going the AI application of competitors from current 20% application to 100% (that means that initially the competitors applied only 20% of the potential applications available in the market and

now we measure the sensitivity Random Uniform if they apply from the initial 20% to 100%.

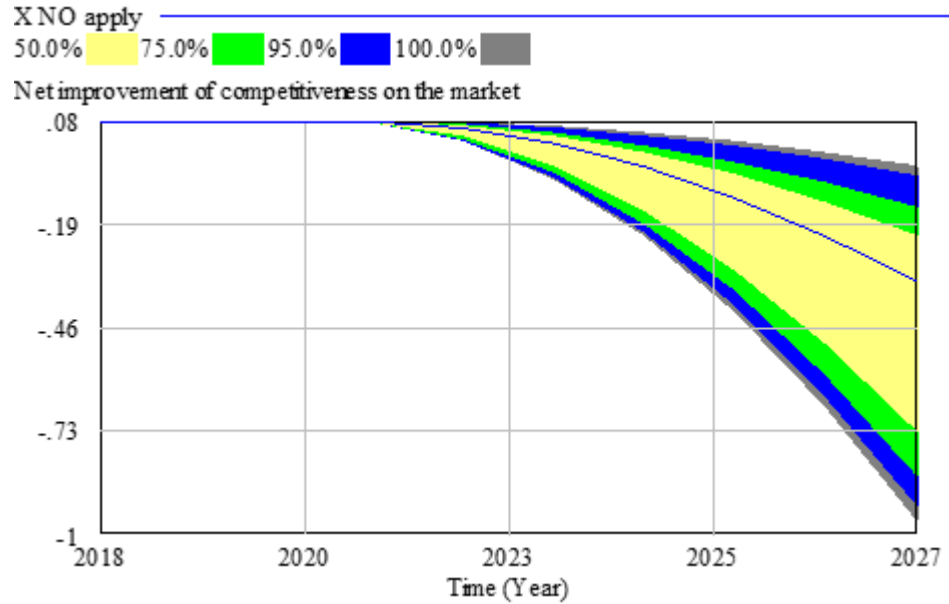


Figure 67. Simulated and projected sensitivity of competitiveness of NO applying AI companies and competitors moving from 20% to 100% (Random Uniform)

We can see how fast the competitiveness of NO applying decrease even arriving to a negative competitiveness on the market of almost 100% if on 2027 we continue not applying and the competitors apply up to 100%. Of course that means closing the company and losing all the jobs. Till the year

2025 we can lose near to 30% of competitiveness. On next figures 68 and 69 we can see that jobs and turnover could be near zero on 2027.

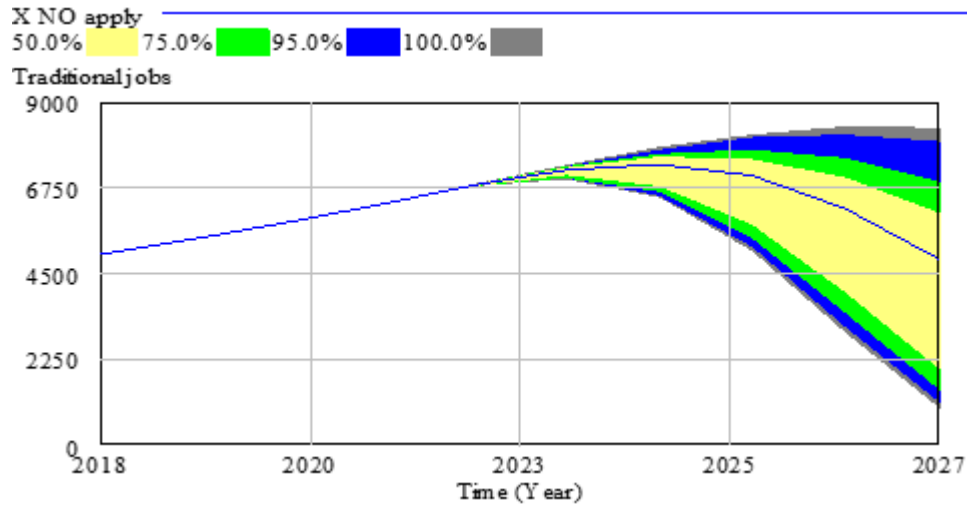


Figure 68. Simulated and projected sensitivity of jobs in companies NO applying AI and competitors applying from 20% to 100%

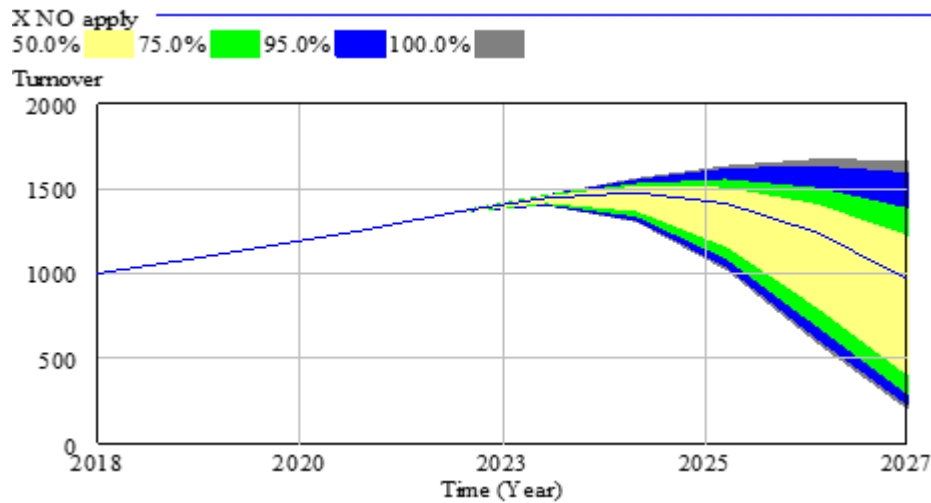


Figure 69. Simulated and projected sensitivity of turnover of companies NO applying AI and competitors applying from 20% to 100%

#### **4.3.5. Analysis of sensitivity of jobs creation by technology companies, to appliers and NO appliers of Artificial Intelligence**

We remember that we applied the sensitivity analysis to the employment created in technology companies only changing three initially fix variables: Basic research providers oscillating between 0.7 and 1 -current is 1-; Solutions giving value to C+I oscillating between 0.7 and 0.9 -current is 0.8-; and Price of solutions oscillating between 0.6 and 0.9 -current is 0.8-.

This analysis is correct because this three variables are fundamental ones to convince C+I to apply AI and if the clients apply our solutions we will increase our growth, but it is also important to measure how the applying of AI by C+I will affect the growth - and therefore the employment- in the technology company, creating a virtuous circle of jobs creation between technology and non-technology companies.

The best way to measure correctly this relation is to make that AI application has an effect on the growth of the

technology company as we show on next diagram Figure 70 adapted from Figure 10. Stock and Flow diagram Technology AI companies just adding the variable AI application by C+I, acting proportionally on Jobs in AI technology companies.

As we have seen the AI application can go from 0 for NO applying companies to 1 for fully applying ones. Then on Figure 71 we measure the sensibility of jobs creation in X21 (just as an example) to AI application.

As expected, the relation between AI application and the jobs created in AI technology companies is very direct showing a broad uncertainty about the jobs in AI technology companies.

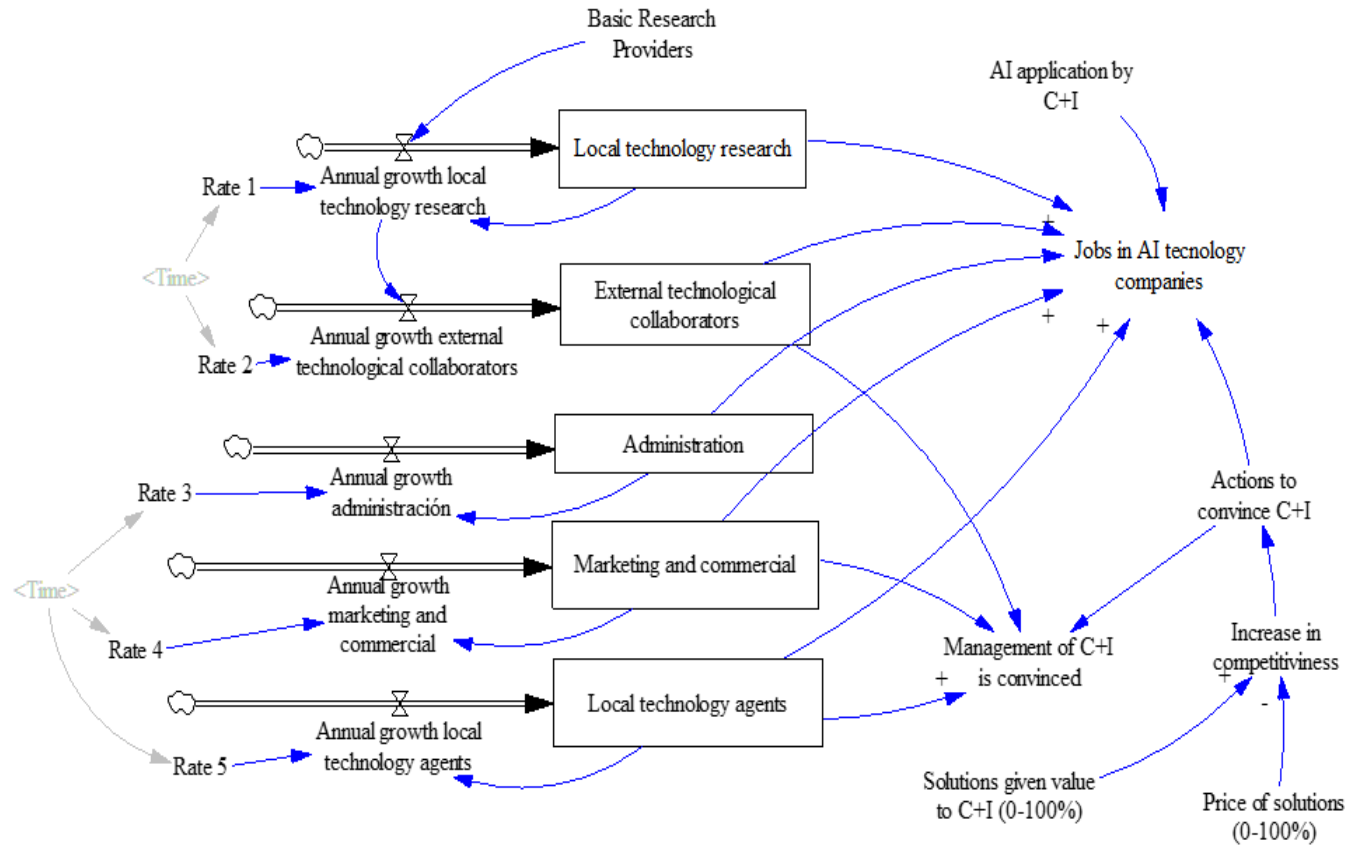


Figure 70. Stock and Flow diagram for company code X21 to measure the sensitivity of jobs creation to AI application

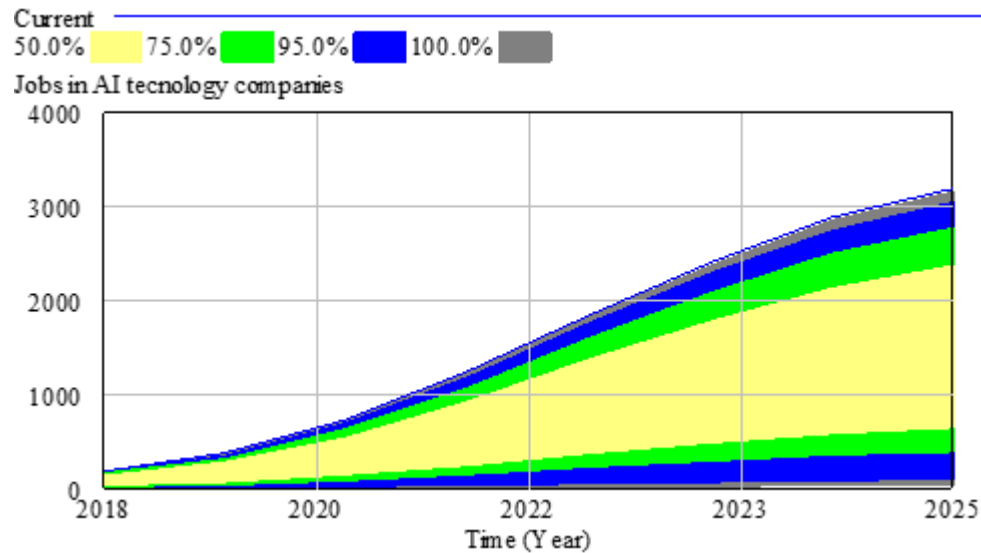


Figure 71. Simulated and projected sensitivity of Jobs in AI technology companies to AI application moving from 0 to 1. Example applied to company code X21

#### 4.4. Lessons learned from applications and validations of the models

**From the validations by specialists** we know that our models represent the reality of the phenomenon from AI systems to the final effects on employment; we know that the process is not automatic but has to be promoted by decision makers, being the most important variables to be considered in the phenomenon: Basic AI research (without it

AI systems do not exist); Technology companies (to adapt the basic AI to the local needs -fundamentally to SME- and convince the managers to apply the solutions based in AI systems); Conditions and constraints to be solved (to apply AI rapidly and effectively); AI application (this variable has two automatic effects which are displacement of tasks and

increase of competitiveness); People in training (with the people displaced which remain inside the company with the same rights and training to become active employees in less than two year in any AI application); New jobs creation, specially the growth of traditional jobs and the Jobs for new businesses based on AI systems (both, but specially the first, to transfer the people in training to active jobs).

**From the validations by application of the models to currents realities we learned the following.**

From the application to technology companies we confirmed again la validity of our models to represent the reality, and also: The great importance to have good technology companies in our environment; the large quantity and quality of jobs that technology companies are and will create; the importance to give solutions increasing as much as possible the competitiveness, not only displacing jobs.

From the applications to companies and institutions appliers of AI our lessons are: They need excellent relations among all the stakeholders to avoid negative conditions and

constraints; our new model proposition to maintain the displaced people inside with the same rights will help a lot to the previous point; they have to apply AI systems giving priority the the increase of competitiveness and use this increase to growth; they have to foster all jobs creations but specially the new businesses with new technologies, without forgetting the leisure businesses; they have to make the AI applications with the guaranty than in less than two years all people displaced in training are transferred to active jobs.

From the companies and institutions not applying AI we learned: For sure some competitors will apply AI systems and the not applying ones will lose competitiveness and destroy jobs, therefore they have to react as soon as possible and we are sure that they will react and the expected jobs destruction will not happen.

We want to highlight the enormous sensitivity of our models to variables as: Level and quality of AI applications (solving properly conditions and constraints affects directly to AI applications); improvement of competitiveness compared with the improvement of competitors (to apply earlier and

better AI systems is essential); Basic research providers;  
Solutions giving value and price of solutions.

And finally we want to highlight the effects of Global  
economic situation to our models and specially now, at May

2020, that we are immersed in the COVID-19 sanitary and  
economic crisis.

We dedicate a point on next chapter 5 to this variable.

## Chapter 5. Conclusions: Answer to research questions, fulfillment of main objectives and expected contribution to the literature

As we will explain on next points we have totally fulfilled the main objectives of this research, we have also totally answered to research questions and achieved the expected contribution to the literature.

### 5.1. Answer to research questions

As we wrote our research questions are:

Main research question:

**RQ1.** Which effects of the application of AI on employment have been identified in the academic literature? Which are the more and the less likely jobs/tasks to be displaced by the application of AI? What are the expected jobs to be created by the application of AI? And what solutions have been

given in the academic world to the potential negative effects of application of AI to employment?

Auxiliary research questions:

**RQ2.** The application of mathematical models, based on System Dynamics concepts, will be an effective method to qualify and quantify this phenomenon, to better understand the variables that influence on it and to have a better understanding of it?

**RQ3.** What are the most influential variables, and the decisions to be made about them, to improve the effects on employment of the application of AI?

Our answers are:

To RQ1. Which effects of the application of AI on employment have been identified in the academic literature?. Our answers are in point 1.3. titled “Academic motivation” where we explain the historical effects of new technologies on employment and the expected equal and different effects expected from AI systems.

Which are the more and the less likely jobs/tasks to be displaced by the application of AI? Our answer to the more likely jobs/tasks to be displaced by the application of AI is in point 2.3.1. titled “First debate: The more likely jobs to be displaced by the applications of artificial intelligence”, where we explain our conclusions from the literature review and give our conclusions and definition about this point, explaining why we have chosen that definition.

Our answer to the less likely jobs/tasks to be displaced by AI is in point 2.3.2. titled “Second debate: The less likely jobs to be displaced by the applications of Artificial intelligence (less displaced does not means non-affected)”, where we explain our conclusions from the literature review and give

our conclusions and definition about this point, explaining why we have chosen that definition.

What are the expected jobs to be created by the application of AI? Our answer is in point 2.3.3. titled “Third debate: New jobs creation because of AI applications”, where we explain the more supported theories in the academy and the ones that we support as the more important for AI applications.

Solutions given in the academic world to the potential negative effects of application of AI to global employment. Our answer is in point 2.3.4. titled “Fourth debate: Solutions given in the academic world”, where we explain the more supported solutions in the academy and the ones that we support as the more positives to improve employment with AI applications.

To RQ2. The application of mathematical models, based on System Dynamics concepts, will be an effective method to qualify and quantify this phenomenon, to better understand the variables that influence on it and to have a better

understanding of it? Our answer is in chapter 3. titled “Methodology and models” and more specifically in points 3.1., 3.2. and 3.3. Where we explain the contribution of System Dynamics to our research making models with the interrelated variables that intervene in the phenomenon that we research.

To RQ3. What are the most influential variables, and the decisions to be made about them, to improve the effects on employment of the application of AI? Our answer is in point 3.4. titled “Global Causal Loop Diagrams among Artificial Intelligence, Competitiveness and Employment”, where we present models in System Dynamics with all the variables that reproduces the effects that AI applications have in the phenomenon among Artificial Intelligence, Competitiveness and Employment, from the basic AI research to final employment on each AI application.

## 5.2 Fulfillment of main objectives

As we wrote in point 1.6. “Research questions and objectives” our main objectives are:

To know the state of the art of the literature, defining:

Including as main points:

A.- More likely jobs/tasks to be displaced by the application of AI.

Our answer to the more likely jobs/tasks to be displaced by the application of AI is in point 2.3.1. Already explained.

B.- Less likely jobs/tasks to be displaced by the application of AI.

Our answer to the less likely jobs/tasks to be displaced by AI is in point 2.3.2. Already explained.

C.- Most likely jobs to be created by the application of AI.

Our answer is in point 2.3.3. Already explained.

D.- Solutions given in the academic world to the potential negative effects of application of AI to global employment.

Our answer is in point 2.3.4. Already explained.

E.- Proposition of actions to be taken by decision makers to improve employment -in quantity and quality- with the application of AI.

Our propositions are in point 2.3.4. Already explained and our final propositions are in our models Stock and Flow Diagrams Figures 10, 11, 14 and 15.

As auxiliary points:

F.- Most influential variables on this phenomenon between AI and employment.

Our answer is in point 3.4. Already explained and our definitive variables are in our models Stock and Flow Diagrams Figures 10, 11, 14 and 15.

G.- The most adequate methodology to study the phenomenon.

Our answer is in chapter 3. titled “Methodology and models” and more specifically in points 3.1., 3.2. and 3.3. Already explained.

### 5.3. Achievement of expected contribution to the literature

Our expected contribution is to propose models to identify, qualify and quantify the most important variables to be considered by decision makers such as managers, boards, companies, institutions and governments to contribute to accelerate and consolidate the application of AI with better global consequences for competitive -therefore sustainable- employment in quantity and quality.

Our final most important models are the Stock and Flow Diagrams in Figures 10, 11, 14 and 15.

These models are including:

A.- The most important variables affecting AI application, competitiveness and Employment and their interrelation.

B.- The conditions for having available the most competitive AI applications, trying to have them earlier and cheaper than our competitors.

C.- The conditions to fulfil by any company or institution in order to apply AI efficiently.

D.- How to calculate the displaceable and non-displaceable tasks on any job on any application.

E.- How to calculate the increase of competitiveness on any AI application.

F.- How to foster the creation of new jobs on any application.

G.- How to train and integrate as active jobs the people displaced.

H.- How to know and follow the current situation any time knowing what to do on any deviation -especially if it is negative-.

I.- How to answer “what if” questions any time

Everything is included in point 3.6. Stock and Flow Diagrams. Our new models propositions and in Chapter 4. “Applications and validations of the models” we have the practical application of the models.

The most important diagrams are the ones in Figures 10, 11, 14 and 15, all together constitute our global proposition to apply to any Company and Institution with some adaptations to any case as we explained in the validations

#### 5.4. Conclusions

After our three years of research, we decided to support the assessments of the most pessimists authors about tasks displacement because, with our meetings, courses, studies and validations with SD we have proven that those authors represent much better what AI can and cannot do. Therefore:

- 1.- We have demonstrated with this research and our methodology, that AI applications will displace many tasks, most of them the ones that we can or we will be able to structure and put under rules, even including very sophisticated tasks now made by very well experienced and well paid people. We believe -supported by this research- that in ten years' time from 2020 to 2030 around 50% of tasks that now are made by human beings will be made by AI systems in different devices -robots, drones, or similar- always with AI. But it will happen gradually and in ten years at least, consequently we have time to make decisions in order to avoid to have a large unemployment because of AI applications.

- 2.- We have also demonstrated that, at least as many tasks as the ones displaced by AI systems will not be displaced at least in the next 20 to 30 years -in our opinion likely never- which are the tasks that require uniquely human characteristics such as empathy, creativity, judgment, critical thinking, synthesizing, innovating, intuition, compassion, inspiration, etc. These tasks will not only not be displaced but they will increase their value in our society.

That means that in the near future the productivity of the set human-AI will double the actual one and therefore -in around ten years- we will need half the actual jobs for doing the same work as today.

- 3.- Other clear consequence from this research is that AI applications will be unavoidable and unstoppable, because if our competitors apply AI systems and we do not do it, we will become non competitive and will destroy more jobs than the ones displaced by AI applications because many of AI application have a disruptive positive effect on competitiveness.

4.- But this research also proves that the AI applications will give opportunities to create many new jobs, most of them enhancing the human capabilities therefore with more human quality.

But the displacement will happen whether we like it or not and the creation needs clear and strong decisions, otherwise they can be created out of our company and even very far from our environment.

5.- We confirmed that other important problem to solve is the time gap between displacement and creation of jobs/tasks because during the gap we could have unemployment and wages decrease and the fact is that historically the gap has been too long to be supported by the current European society.

Then we need the new jobs to be created near -better inside as in our proposition- our C+I that applies AI and also to be created before, at the same time or never much later than the

jobs displacement -we put a limit of two years on any application-.

6.- Our models solve all the problems and prove that, for AI applications, the sooner the better because the increase of competitiveness that we have to get with AI applications will allow us to grow enough on no-displaceable traditional jobs to absorb in less than 2 years all the displaced people. But to get enough growth we must apply AI solutions earlier and better than our competitors otherwise the growth could be not enough to create more jobs than the ones displaced.

7.- The application of our models guaranty that on each AI application on any reality we can improve employment in quantity and quality always that AI is applied better and earlier than most of our competitors, but we cannot know what will happen with the employment outside of the reality that we control; because if there are many C+I applying AI worse or later than their competitors, or even not applying, they can destroy many jobs.

Our models start with “Figure 10. Stock and Flow Diagram Technology AI Companies” by explaining the importance to have good and competitive technology companies in our environment for receiving the best available AI solutions faster and cheaper than our competitors; also the models highlight the important of these technology companies to convince the managers of C+I -Companies and institutions- to apply the proposed solutions to improve the competitiveness and therefore the profits and the employment. And we have never to forget that technology local companies are very important jobs creator, most of them of high quality.

The second SFD model is the “Figure 11. Companies and Institutions appliers, area of conditions and constraints” explain the importance for C+I appliers to deal with conditions -internal and external- and constraints in order to apply AI rapidly and effectively, because for a successful AI application it is not enough that the management is convinced because it is needed the implication and positive

attitudes of anybody -internal and external- that could influence in our application.

The third model is the “Figure 14. New model PROPOSITION, Stock and Flow Diagram for companies and institutions appliers, area of competitiveness and tasks' displacement inside C+I” which explain the jobs displacement -really the displaced are tasks that consequently, displace jobs- using our definitions in this Thesis about the more likely tasks to be displaced by AI and about the less likely tasks to be displaced by AI. This model also explain that if AI application does not improve importantly the competitiveness it is not worth to apply it; we clearly recommend to never apply AI just to reduce jobs and labour costs because that is nothing -even negative- compared with the disruptive improvements that we can get with the application of good AI systems. We are so sure about the validity of this statement that our proposition in our models is to maintain inside the company all the people displaced by AI, with the same salary and conditions as before and besides with training to have a better active job in

the same C+I; we call this collective People in training which we think is a very important contribution from this research because it solves all the main problems between AI and employment always that we are able to be successful transferring these people in training to active jobs in less than two years, as we explain in our model.

The fourth model is the “Figure 15. New model PROPOSITION Stock and Flow Diagram for companies and institutions appliers, area of jobs' creation inside C+I”, in this model we explain the jobs creation that will absorb the people in training. When we initially created this model we thought that we would need all kind of jobs creation to absorb the people in training but when we applied the model in different realities we verified that in all of them just the growth of traditional jobs in the company, because of the increase of competitiveness, is usually enough to overcome the people displaced every year or in less than two years. If the company grows in areas where still has not applied AI, the displaceable jobs in this area will also grow till AI is applied, but these jobs should be temporary jobs to be soon

displaced, which can also be occupied by people in training till they are displaced. Then we have decided not to count the growth on these temporary jobs to be displaced and to consider only the growth on no-displaceable jobs for people in training as these last are definitive jobs. Of course if in one specific case we need them we can use not only those temporary jobs but also the jobs created before AI application and the other new jobs after the application, but in general will not be necessary.

We have also a fifth model “Figure 16. New model proposition Stock and Flow Diagram for companies and institutions appliers, area of effects inside and outside, C+I” only to be used when the effects outside the C+I applicant are necessary to absorb all the people displaced or they are very important, for example when the application is in a city, region or country.

### 5.5. . Contribution of System Dynamics to this research

The models that we have made with SD have contributed -as we expected- as follows.

**Calibration and Validation:** As the management has been easily able to analyse inputs and results on each model, they have validated them -CLDs and SFDs-.

**Quantification:** The CLDs have permitted a fluid dialogue with the management of each C+I, which have verified that their reality, visions and expectations are reflected in the CLDs. With the SFDs we have been able to quantify the results getting a bigger collaboration and implication from each management as they have understood the practicality of the models.

**Coherence:** As the results obtained on the simulations give very realistic figures, each management have accepted that the variables and the models are realist and coherent.

**Sensitivity analyses:** As we are analysing the future of employment, the sensitivity analysis to the most important

variables are essential and could not be made without simulation models as the ones we have proposed.

### 5.6. Outline of the research process

**Following we present the outline of the research process in three schemes in Figures 72, 73 and 74.**

We add a little explanation starting by the Figure 72. Scheme followed in this research from the beginning until the conclusions from the literature review.

Everything started for us around January 2017 when articles, books and films showed us a dystopian future with large unemployment because of AI; that increased our concern and started a first research which confirmed us that the dystopian future can become truth and we must contribute to avoid or solve this problem. We decided that to do a PhD could be a good contribution and this research plan was approved on May 2018 exposing our clear objective to contribute to avoid a new unemployment crisis because of AI. As the unemployment because of AI could happens because AI displace more jobs that create we concentrate

this research and literature review in displacement and creation of jobs because of new technologies and specifically because of AI systems. About displacement we found a large divergence with quantities between 10 and 60% or even more; and about jobs creation agreement of type of jobs but disagreement in quantities and time. We arrived to the conclusion that the divergence in displacement was because of the understanding about what AI systems can and cannot do up to the year 2030. After studying AI and meeting with specialists we arrived to the conclusion that around 50% of tasks now made by humans will be made by AI systems nor later than year 2030. Thanks to literature review we were able to find a good definition of displaceable tasks by AI very helpful to calculate the displaceable tasks on any specific job. Then, accepting that a large displacement will

happen we focused on jobs creation to accelerate and increase them. The main conclusions from literature review were that AI systems not only will displace many tasks, but also could disruptively improve competitiveness giving the opportunity to grow creating many jobs and AI will also create opportunities for new businesses with new valuable jobs. Then to delay AI applications is not a solution because we can lose competitiveness destroying more jobs than the potentially displaced; therefore we have to accelerate AI applications and jobs creation, being as important the quantity, as the quality as the time to avoid the gap between displacement and creation. With all these elements we decided to propose solutions.

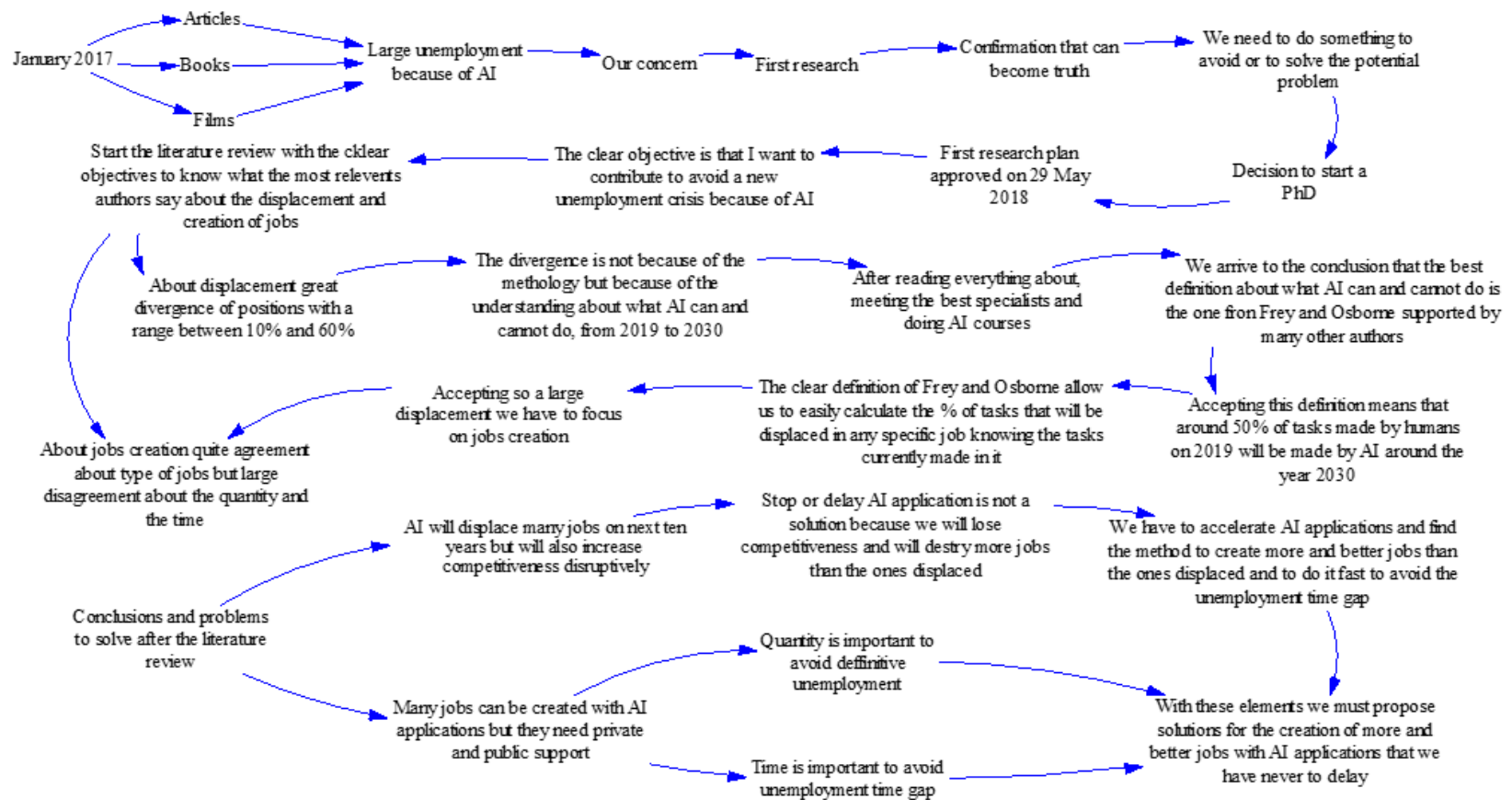


Figure 72. Scheme followed in this research from the beginning until the conclusions from the literature review

Now we add a little explanation about the Figure 73. Scheme followed from conclusions literature review to SFD -Stock and Flow Diagrams- models.

We start the figure 73 where we finished the figure 72, with the decision to propose solutions for the creation of more and better jobs than the ones displaced by AI and to do it rapidly. We choose System Dynamics as methodology with which we built Causal Loop Diagrams with all the variables and their relations to better understand the phenomenon between AI and employment. Then we introduced the variable competitiveness to create only competitive and sustainable jobs. We explain how technology companies work and how important they are, specially for SME and also how important is to solve conditions and constraints for

an efficient application of AI systems. We highlight the effects of AI applications on displacement and competitiveness and how we can create many and good jobs with AI.

To quantify the effects we built the Stock and Flow Diagrams and we arrived to the following conclusions: In Spain we have enough technology companies; we must improve the conviction of managers to apply AI; we must improve conditions and constraints; we have to foster and accelerate the jobs creation; and, in summary we have to make actions for all displaced people have a competitive job in less than two years from displacement.

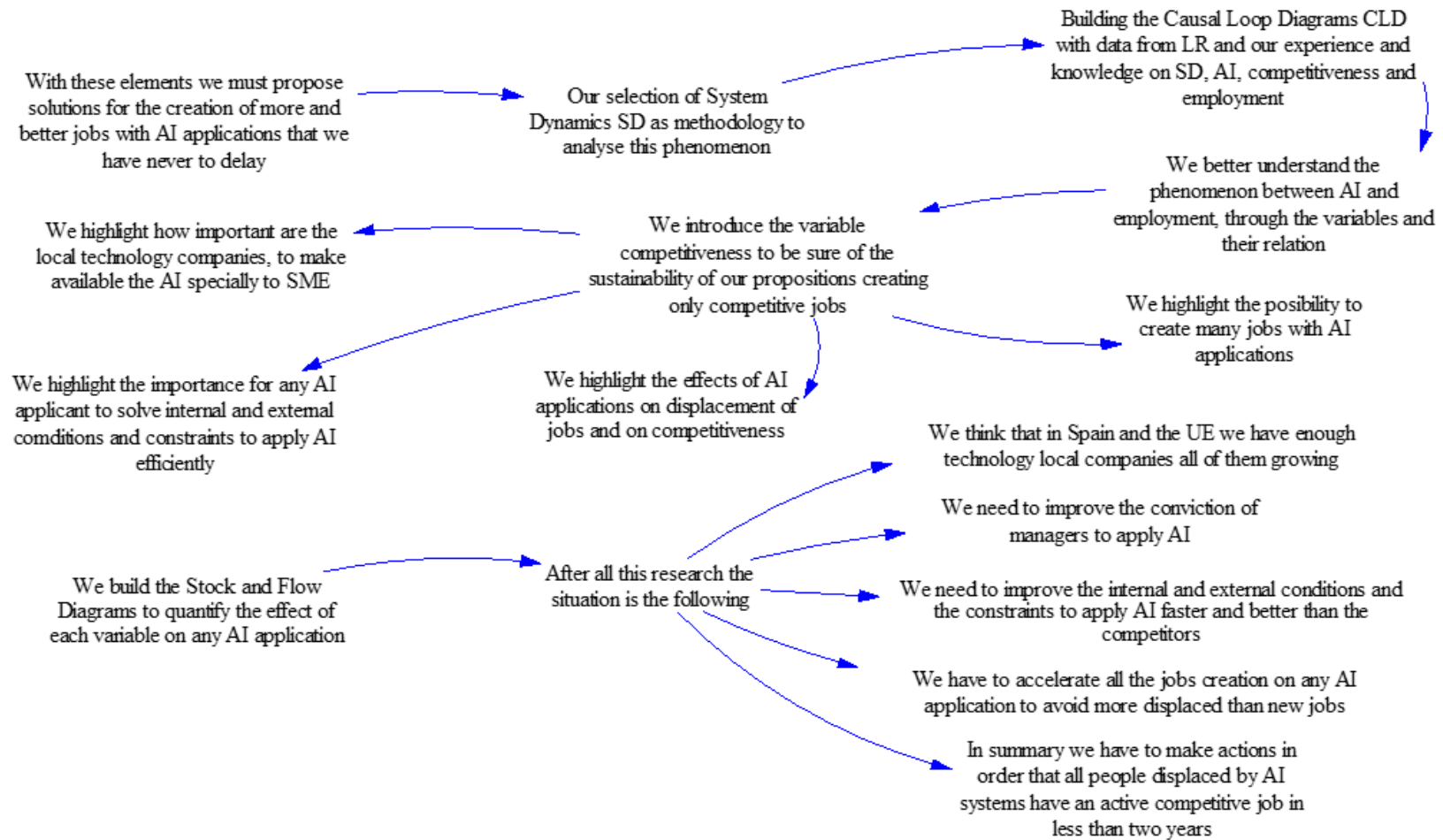


Figure 73. Scheme followed from conclusions from literature review to SFD -Stock and Flow Diagrams- models

Now we finish with a little explanation about Figure 74. Scheme of our proposition to improve employment in companies and institutions with the application of Artificial Intelligence Systems.

Our final proposition is: All people displaced remains inside the company with the same conditions but in training; we use all increase of competitiveness to growth to create active jobs for people in training in less than two years; we train the people displaced in company to be efficient in their new active jobs; we involve 100% of our people on creating jobs with new businesses to improve growth, jobs and profits on any AI application.

Remaining the people displaced inside the company we get: Avoiding negative conditions and constraints; we get favourable positions towards AI systems applications; avoid that the displaced people become unemployed; accelerate new jobs creation; guaranty that people in training become active in less than two years.

And therefore: We apply AI faster and better than competitors; we guaranty more jobs creation than displaced: we improve growth and profits on any AI application.

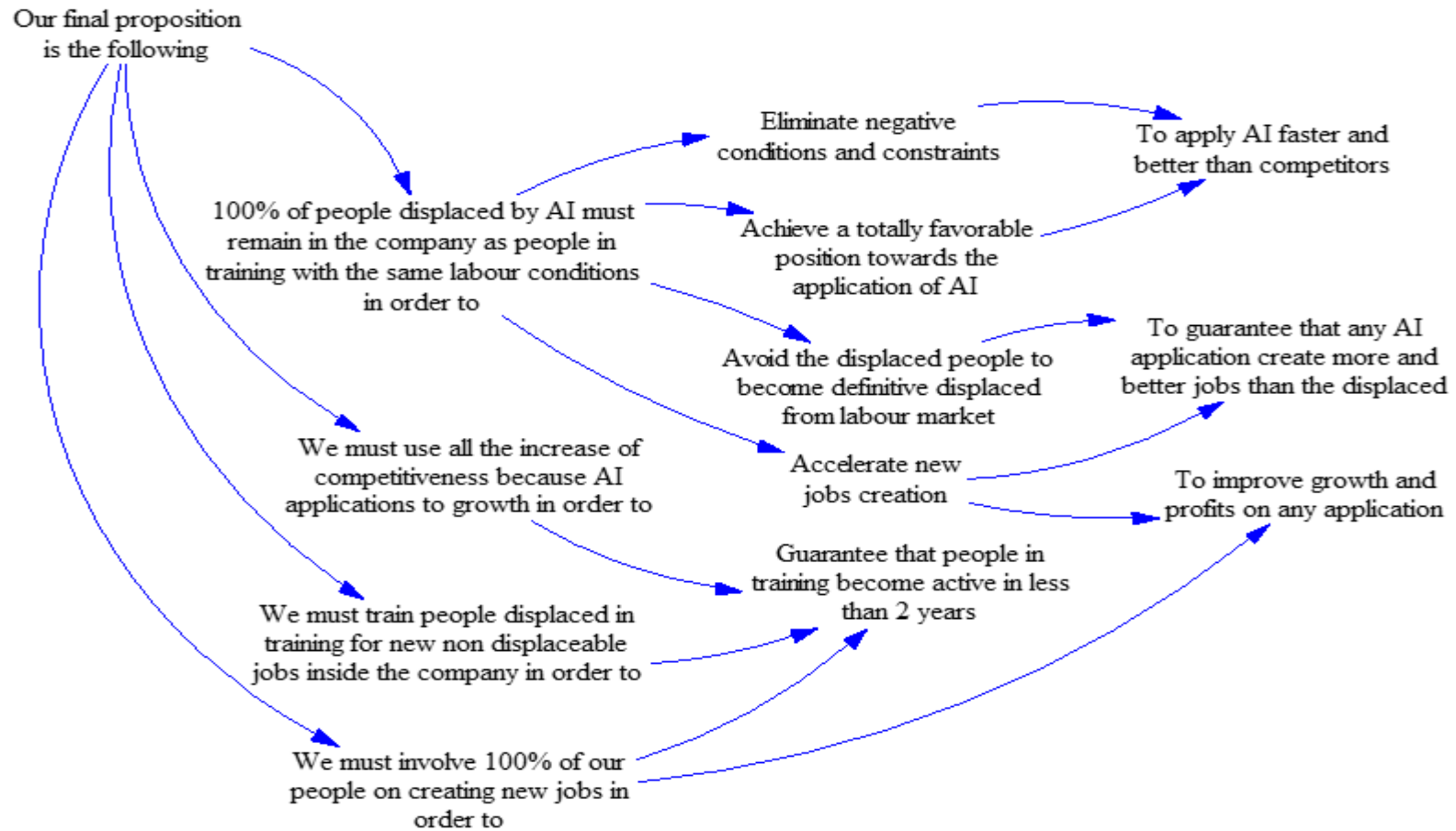


Figure 74. Scheme of our proposition to improve employment in companies and institutions with the application of Artificial Intelligence Systems

## **5.7. General effects of Global economic situation in our models and effects of specific economic situation provoked by COVID-19 sanitary crisis**

### 5.7.1. General effects of Global economic situation in this Thesis

If we see our Stock and Flow Diagram in Figure 15 where we show the area of jobs creation and transfer of people in training (PiT) to active jobs, we notice that Global economic situation (GES) has a direct effect in growth on no-displaceable jobs (GNDJ) -what means in growth in general because was our decision to calculate only the growth in no-displaceable jobs to transfert people in training to definitive jobs- therefore if GES is zero the growth is null and do not have any tradicional active job free to transfert the PiT. That does not mean that our model has no validity if GES is zero because we have still the very important growth in New jobs for new businesses based on AI (NJNBAI) and we have never to forget the Jobs for leisure businesses (JLB) very important in some cases but less important than NJNBAI in most of applications of AI systems. Both new jobs NJNBAI and JLB will be very affected if GES is zero but not so radically as GNDJ which is going also to zero. Our proposition is that, even if GES is very low to continue applying AI systems with our models, specially when the improvement of competitiveness because of AI applications is disruptive, in which case, even if the market is in very low situation we will have important advantages to grow or, at least, not to have a negative growth; the worst that could happen to us is to need more than two years to transfer people in training to active jobs but even in this case it is worth to apply AI systems, never only to reduce labour cost reducing jobs, but mostly to increase competitiveness.

### 5.7.2. Effects in this Thesis of specific economic situation provoked by COVID-19

The sanitary problem, itself, not necessary should have a negative effect in this Thesis, but the real problem is the economic consequences, and specially the long term economic consequences. Our opinion is that the debate “dead or unemployed” is a false and mediocre debate because being both effects so graves for the society -specially for people losing their jobs- that the decision makers must compulsory be able to find a balance to solve both. How is being managed this problem in Spain is probable the worst example of confronting the crisis, because giving total priority to not to have dead people, they have almost totally stopped the economy -specially the most important sector in Spain as it is the tourism- and besides Spain has the world record of dead by inhabitants. Doing things so badly Spain will also have world record of unemployment what is the worst that could happen to the people.

We insist on what we wrote in previous point and maintain that even in the worst scenario going GES to zero we have to continue with AI systems applications but never only to reduce labour cost reducing jobs, but mostly to increase competitiveness.

Having our position clear about AI applications we would like to contribute to avoid the potential unemployment, at least in Spain, because if our models and propositions are for avoiding unemployment because of AI applications and the global unemployment is very high for other reasons foreign to AI, we will not very happy as unemployment has always been a big concern for us.

As the already dead people have no solution, we must focus our actions on avoiding large unemployment, because the lack of jobs affects negatively to all sectors of the economy and their negative social effect are very dramatic for people and families.

The GES depends of what most decision makers do internally and externally but we will start by proposing what to do internally in Spain to avoid large unemployment and later we will analyse what others are doing to present different scenarios.

In our opinion the solution is never to forbid to work but to encourage to work the maximum possible in each company and institution (each company has different situation) taking all the necessary measures to avoid new infections, giving general instructions and tools but leaving the responsibility to each company with its stakeholders and specially with his people, who are the most interested in maintaining their jobs with the minimum infection risk (zero risk does not exists for anything).

In our book (Zaldo, Maura, 2000) we gave solutions to unemployment that are still valid for this COVID-19 crisis (not for AI applications) and following we explain some of the propositions in our book.

We want to start telling clearly that the solution to unemployment has to come from private sector because the high public debt in Spain and other Countries, will have no choice but to be reduced increasing the efficiency of public sector to reduce radically its cost with much better management and using artificial intelligence to increase efficiency and to reduce costs, because the public debt will be the most grave problem to be confronted on next years and to try to solve this problem only with taxes, the total economy will lose competitiveness which means more unemployment that, as usual, will suffer the more needed.

The general focus of our book, to solve unemployment, is the following.

We only create stable and sustainable jobs creating new private companies or making the current ones to grow; the new companies are only born in competitive environments and the current ones only grow if they are competitive, offering better products and services at competitive prices and making profits. Only making the decision makers the necessary to have

environments and companies competitive we will solve the unemployment and to have enough taxes to maintain an efficient public sector, giving better services with less costs with excellent management and using the last technologies.

There are many measures that we propose in our book to avoid unemployment in a crisis like the one from COVID-19, but being the touristic sector so important for the economy and employment in Spain and in all Europe, we want to give ideas of what to do in Canary Islands (as an example) to recuperate the tourism in few weeks after the Europeans are allowed fly to the Islands (we hope that very soon).

Everybody agrees that the touristic sector in Canary is very competitive -really in all Spain the sector is very competitive- but always the competitiveness can be improved, then our recommendation is to start now, with the current inactivity to improve, if possible, its competitiveness, giving to the world the image of improvement with a communication plan.

But this action being very important will not be enough because Canary has to transmit to the world that in its Islands the people will be safer from infection than at home, doing the following actions controlled by international organisations: first 100% of population will be controlled and the ones who can infect will be confined; second, giving total guaranty that neither in hotels or restaurants nor in any other touristic place will not be anybody who can infect by Covid-19; third, people arriving in Canary will be controlled and only confined or be returned -without any cost- the ones that could infect others.

Doing these actions with international credibility, the economy and the employment in Canary Islands will be recuperated in few weeks, giving also credibility to other touristic zones in Spain for doing similar actions.

Following, we take some ideas from other article from McKinsey & Company signed by Baig et al. on May 2020 about the digital consequences of Covid-19 crisis: Companies will need to ensure that their digital channels are on par with or better than

those of their competition to succeed in this new environment; new data and completely rebuilt analytical models will be essential to steer operational decisions; remote ways of working have, at least in part, driven the faster execution drumbeat that we're all experiencing in our organizations. And this step change in remote adoption is now arguably substantial enough to reconsider current business models.

The article offers suggestions for a 90-day plan to realign the digital agenda and implement the enablers for acceleration during the recovery and beyond.

- It is clear that consumers are accelerating adoption of digital channels, a trend seen across global regions.
- Based on data from countries already in the recovery phase, consumption patterns will be uneven and unlikely to return to pre-COVID-19 levels quickly.
- The levels of remote working have skyrocketed during lockdowns and are likely to remain higher than pre crisis levels for some time

The digital agenda for recovery for many companies: Customers have already migrated to digital; employees are already working fully remotely and are agile to some degree; companies have already launched analytics and artificial-intelligence (AI) initiatives in their operations; IT teams have already delivered at a pace they never have before.

But for most companies, the changes to date represent only the first phase of the changes that will be necessary. We have laid out an agenda that focuses on four efforts: Refocusing and accelerating digital investments in response to evolving customer needs, using new data and AI to improve business operations; selectively modernizing technology capabilities to boost development velocity; and increasing organizational agility to deliver more quickly.

For each one, we outline a practical 90-day plan to make it happen: Refocus digital efforts toward changing customer expectations; many companies are accelerating their shifts toward digital-first models—at warp speed; one European variety-store chain, for example, established a fully functioning e-commerce business in just three months; the online business was interconnected across all functions (warehousing, merchandising, marketing, customer support, et cetera) and improved basket size over physical stores by three times as well as delivering nearly 3 percent like-for like revenue growth in its main market.

But it's not just about digitizing. Companies must also reimagine customer journeys to reduce friction, accelerate the shift to digital channels, and provide for new safety requirements. For example, an automobile manufacturer now handles functions traditionally performed by dealers, such as trade ins, financing, servicing, and home delivery of cars. Airlines are rapidly reinventing the passenger experience with contactless journeys focused on traveler health and safety to make customers feel comfortable flying again. In the next 90 days, CEOs should ask their business leaders to assess how the needs and behaviors of their most important customers have changed and benchmark their digital channels against those of their competition. This information should form the basis of a renewed digital agenda that should take no longer than 30 days to establish. Chief digital officers and chief information officers (CIOs) can then quickly stand up (or refocus) agile teams to execute the most urgent priorities. A consumer-electronics company, for example, recently launched an agile war room to improve conversion rates on its website traffic. That type of project can deliver meaningful results in weeks. Changes that require more fundamental work, like setting up a new e-commerce channel, will typically take longer.

Continually measuring digital-channel performance during the 90 days will be critical so that companies can quickly adapt as they learn more. Consider setting up a weekly forum for senior business and technology leaders to process the learnings coming in and drive the full agenda at pace and in a coordinated fashion. Use new data and artificial intelligence to improve business

operations Hundreds of operational decisions get made on daily, weekly, and monthly bases. Take an airline, for example, that must make many decisions: Which routes should we operate? What crew size is optimal for each flight? How many meals should we order? What staffing level is necessary in the contact center? Modern businesses have several forecasting and planning models to guide such operational decisions. Organizations will need to validate these models. In the same way that many companies had to rebuild risk and financial models that failed during the 2008 financial collapse, models will similarly need to be replaced because of the massive economic and structural shifts caused by the pandemic. For example, models that use time series, oil-price, or unemployment data will need to be rebuilt entirely. The data must be reevaluated as well.

As companies construct these models, analytics teams will likely need to bring together new data sets and use enhanced modeling techniques to forecast demand and manage assets successfully. One automotive-parts supplier, for example, developed a forecasting model that incorporated previously unused third-party data. The model will help the supplier spot potential issues with its own suppliers' ability to deliver needed items, offering a chance to reach out to its suppliers to work out logistics or find another source. Other business areas can benefit from more sophisticated modeling as well. A leading financial services provider, for example, stood up an AI-powered solution to generate leads for its sales agents, with models calibrated to handle the current environment.

In the next 90 days. As a first step, the chief analytics officer (or equivalent) should mobilize an effort to inventory core models that support business operations and work with business leaders to prioritize them based on their impact on key operations and their efficacy drift. This assessment is urgent and should be completed as quickly as possible. It will essentially define a program of quick fixes that the data and analytics team can undertake, working hand in hand with business and functional leaders. Once the situation stabilizes, CEOs and business leaders should push their data and analytics teams to develop next-generation models that leverage new data sets and modeling techniques better suited for fast-changing environments. The more advanced companies

are already creating synthetic data sets using advanced machine-learning techniques, such as generative adversarial networks (GANs) to train new analytical models when historical data are of little use.

Successfully executing the described agenda requires investment capacity and development velocity. CIOs can contribute to both by rightsizing the IT cost structure to new demand levels and reinvesting the freed-up resources into customer facing digital solutions and critical decision-support systems, first and foremost. Companies can also dedicate some of the savings to modernizing selectively the technology stack and software development tooling. Many companies have found they have the potential to free up as much as 45 percent of their IT costs over the course of a year. Our experience suggests that roughly two-thirds of this potential can be achieved through measures such as extending hardware- and software-refresh cycles, rapidly re-negotiating vendor contracts, and restricting cloud workloads by turning off noncritical jobs. Additional cuts get deeper into the cost structure and risk hamstringing future growth. The right balance will vary by industry, but under any scenario, rightsizing should expose much needed investment capacity as quickly as possible to fund the 90-day plan. As CIOs consider upgrading their tech stacks, two features of a modern technology environment are particularly important and can be rapidly implemented: a cloud-based data platform and an automated software-delivery pipeline (commonly called “continuous integration and continuous delivery”). Without these, development velocity stalls and becomes mired in complexity. The good news is that cloud technologies make it possible to deploy these quickly and at relatively low cost. In the next 90 days. First, develop the plan to rightsize and create a more variable cost structure— the faster the better to free up resources for the digital agenda.

In the second 30-day sprint, choose your cloud partners. While speed is of the essence, CIOs should thoughtfully consider the contractual structures offered by technology providers. Carefully review those that appear too good to pass up to ensure that the providers aren’t capturing all the value. And remember to launch appropriate internal efforts to train and prepare teams to operate in the new environment. During this sprint, it’s also time to modernize the tech stack selectively—“selectively” being the

operative word. Most companies won't have the management bandwidth and resources to take on a full-scale modernization in the next 12 to 18 months. By focusing on setting up or enhancing a cloud-based data platform and equipping agile teams with automated software delivery, CIOs can double, or even triple, development velocity in the short term.

In the final sprint, it's a no-brainer to launch the recruiting of additional digital talent and accelerate digital upskilling of the entire organization. These steps will prepare organizations well for a more substantive modernization of their application landscapes after recovery. Finally, continue to pay attention to cybersecurity. Much of the rapid IT work carried out during the COVID-19 crisis might have created new cyber risk exposures. Increase the organizational drumbeat The current crisis has forced organizations to adapt rapidly to new realities, opening everyone's eyes to new, faster ways of working with customers, suppliers, and colleagues. Many CEOs wonder what it will take to maintain the quickened organizational drumbeat. Companies that have led the way in adopting flatter, fully agile organizational models have shown substantial improvements in both execution pace and productivity. This has held true during the crisis, as we see a direct correlation between pre crisis agile maturity and the time it has taken companies to launch a first crisis-related product or service. While many companies have at least a few agile teams in place, few have successfully scaled to hundreds of teams staffed with many more "doers" than "checkers," which is what's needed to drive the accelerated organizational pace the crisis—and even the next normal—demands.

What can realistically be done in 90 days to increase the organizational drumbeat? Standing up a digital factory is largely the best approach right now because it can be constructed and scaled in three months or less. Many organizations, from banks to mining companies, have accelerated and scaled their digital delivery by establishing these internal factories, with interdisciplinary teams aligned to businesses' digital priorities. One large global bank, for example, built five such factories to support several locations across the Americas. As previously mentioned, remote working can also help organizations move at a faster clip as companies tap into new labor pools and specialized remote expertise. (And, yes, agile can be executed remotely.) Remote working can also

enable new productivity opportunities, especially for companies with large field forces. One leading provider of residential solar services recently documented record sales using a more remote sales model.

In the next 90 days. During the first sprint, identify the business areas where digital-execution velocity is needed and map out plans for digital factories to support them. In parallel, assess where remote work models could unleash productivity benefits. These two lenses should set the table for targeted changes to the operating model. In the second 30-day sprint, design the new models with consideration for staffing level, expertise mix, governance, and operating procedures. Finally, in Remote working can help organizations move at a faster clip as companies tap into new labor pools and specialized remote expertise. (And, yes, agile can be executed remotely.)

The COVID-19 recovery will be digital: We know from experience that three months is sufficient to implement and scale a digital factory. We have also seen banks, pharmaceutical companies, and insurance companies pivot entire field forces to a remote model in a few weeks. Leaders who want to succeed in the digital-led recovery must quickly reset their digital agendas to meet new customer needs, shore up their decision support systems, and tune their organizational models and tech stacks to operate at the highest effective speed. In other words, C-level executives must point their digital firepower at the right targets and quickly execute against them. It's essential to set these targets at the outset and regularly measure progress against them. Achieving parity or better across digital channels to win the revenue race, rebuilding the most critical decision-support models, and doubling development velocity are goals that are all within reach. The 90-day plan will help organizations get there.

## Chapter 6. Limitations and future research

### 6.1. Limitations

The most remarkable limitation is that this research is only focussed on the effects of AI on **competitive employment**, leaving for other researchers the other aspects of the relations between AI and employment but also the many other effects of AI applications as we will see in the point of future research.

The limitation -that we put to ourselves because we want to contribute to a sustainable society with competitive jobs- is that our models are only valid if the C+I who applies AI systems are guided by competitiveness, that means that it must apply AI to improve competitiveness and must create jobs because they are competitive.

In our opinion all jobs should be competitive giving value to society but unfortunately when the companies or institutions do not have to compete on the market, very often the decision makers forget the concept of competitiveness allowing and even encouraging and promoting the waste of all kind of resources. That is what, in our opinion, happens in monopolies and in many public services in Spain and other Countries. Then to apply our models to this kind of companies and institutions we must previously define very well the concept of competitiveness to apply, which we would like to be very near the one that we have used in this research.

We do not see any geographical limitation, neither current costs limitations because in our models even we give up to apply any jobs reduction; on the contrary we propose to

maintain the people displaced as people in training with the same conditions as before they were displaced, because acting on this way we will avoid many conditions and constraints against AI applications, and will accelerate the jobs creation; and those factors are much more important than the immediate reduction of labour costs that we can obtain with AI application but losing qualified people that in few months can be transferred to new active jobs.

Does it mean that our models are not valid for public or protected companies that do not care about competitiveness? Effectively our models are not made for these cases, because:

It is sure that the medium rate of displacement by AI on public companies is likely higher than on the private ones, because many tasks in public companies are subject by law to very strict rules, which means that their tasks are very easy to be structured and therefore made by AI systems, much better, much faster, cheaper, without neither mistakes nor corruption. That means that AI application on these tasks

will allow us to improve the public services reducing costs in high percentage, which is what we have to do to have a sustainable society because to increase public debt will probably be very soon unsustainable with the risk of creating an unimaginable crisis that, as usual, will affect to the most needy through unemployment.

The problem on public jobs where competitiveness is not an important factor is the creation of competitive jobs, because, how do we know that they are competitive? It is something to be researched in the near future. The best advice we can give to the decision makers of public jobs is to apply AI as soon as possible and not replenish the people who are retiring, maintaining the displaced people in training for new competitive jobs that we must try to define and find.

Other limitation of this research is that applying our models we can only guarantee the improvement of employment in the reality that we control -company, group, City, Country,...- but always that we apply AI better and earlier than most of

our competitors for sure that we contribute to improve the global employment.

## 6.2. Future research

The most important fact related with this research between AI, competitiveness and employment is to **study the effects of AI application to public jobs** -and similar jobs where competitiveness is not valued- improving services and reducing drastically the costs. We propose to find a way without damaging people, similar to our proposal for competitive jobs; but having very clear that, gradually on next ten years, we can give much better service with much lower cost applying AI systems as soon and as well as possible

But it is clear that AI has many other aspects to be researched besides the effects on employment as:

**Technical aspects of AI systems and their influence in our society** as: Large-scale machine learning; Reinforcement learning; Robotics; Computer vision; Natural Language

Processing; Collaborative systems; Crowdsourcing and human computation; Algorithmic game theory and computational social choice; Internet of things (IoT); Neuromorphic Computing.

**New definitions of AI and human intelligence** better adapted to the new technological developments.

**New regulations for some new jobs related with AI**, as platforms, but never forgetting that will probably be very important for next years employment.

**Solutions to radical effects in several sectors** like transport, where likely human drivers can likely be displaced by AI systems with millions of jobs lost.

**The disruptive effects effects in healthcare**, positive because will allow to be extended to much more people, but also negative displacing many jobs.

Aspects as **“Do we give priority to privacy or to security?”**.

The many **ethical aspects of AI applications**.

The **disruptive effects of AI on Education** at all levels.

The **disruptive effects on entertainment**. For example, to compose music or to choreograph dance using an avatar.

**AI public policy**, to make AI systems available to most of people and to avoid misuse of them.

In summary, we are sure that AI systems will change our society and not only the economically developed societies as

EE.UU, Europe and Japan, but also the less economically developed areas of the world as Africa will be very affected and it is our responsibility to contribute to make it better for most people and not only because Justice but also to have our Planet sustainable at least during this twenty first century.

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# ANNEX

## Annex 1: Data of models applied to technology companies

Table 6. Company code X22 expected annual growth

X22 Expected annual growth	2019	2020	2021	2022	2023	2024	2025
Local technology research	10%	10%	10%	10%	10%	10%	10%
Administration	5%	5%	5%	5%	5%	5%	5%
Marketing and commercial	5%	5%	5%	5%	5%	5%	5%
External technological collaborators	3%	3%	3%	3%	3%	3%	3%
Local technology agents	0	10	10%	10%	10%	10%	10%

Table 7. Company code X28 expected annual growth

X28 expected annual growth	2019	2020	2021	2022	2023	2024	2025
Local technology research	10%	10%	10%	10%	10%	10%	10%
Administration	3%	3%	3%	3%	3%	3%	3%
Marketing and commercial	10%	10%	10%	10%	10%	10%	10%
External technological collaborators	7%	7%	7%	7%	7%	7%	7%

Local technology agents	10%	10%	10%	10%	10%	10%	10%
Production	10%	10%	10%	10%	10%	10%	10%

Table 8. Company code X30 expected annual growth

X30 expected annual growth	2019	2020	2021	2022	2023	2024	2025
Local technology research	25%	15%	10%	10%	10%	10%	10%
Administration	3%	3%	3%	3%	3%	3%	3%
Marketing and commercial	25%	15%	10%	10%	10%	10%	10%
External technological collaborators	15%	15%	15%	15%	15%	15%	15%
Local technology agents	0%	0%	0%	0%	0%	0%	0%

Table 9. Company code X32 expected annual growth

X32 expected annual growth	2019	2020	2021	2022	2023	2024	2025
Local technology research	5%	3%	3%	10%	10%	10%	10%
Administration	3%	0%	3%	0%	3%	0%	3%
Marketing and commercial	10%	5%	5%	10%	10%	10%	10%

External technological collaborators	5%	3%	3%	10%	10%	10%	10%
Local technology agents	0%	0%	0%	0%	0%	0%	0%

[Annex 2. Data of other companies on which we applied our models with similar results to the ones shown](#)

People at end 2018 in company code X8 distributed by occupations,

Table 10. Information about people displacement on company code X8 application

Occupation	People 2019	Displaceability	Displaceable	No-displaceable
Reception	8	50%	4	4
Commercial	6	50%	3	3
Maintenance	8	30%	2.4	5.6
Cleaning	25	20%	5	20
Food service	14	20%	2.8	11.2
Kitchen	14	50%	7	7
Administration	8	70%	5.6	2.4
Clients satisfaction	8	20%	1.6	6.4
Total	91	35%	31.4	59.6

People at end 2018 in company code X5 distributed by occupations,

Table 11. Information about people displacement on company code X8 application

Occupation	People 2019	Displaceability	Displaceable	No-displaceable
Management	2	30%	0.6	1.4
Finance	5	50%	2.5	2.5
Commercial administration	5	40%	2	3
Purchases	5	40%	2	3
Sales	3	30%	0.9	2.1
Marketing	2	30%	0.6	1.4
Management digital	1	0%	0	1
Quality management	4	50%	2	2
Exports	1	30%	0.3	0.7
Production	20	50%	10	10
Total	48	43.54%	20.9	27.1

People at end 2018 in company code X10 distributed by occupations,

Table 12. Information about people displacement on company code X10 application

Occupation	People 2019	Displaceability	Displaceable	No-displaceable
Management	8	30%	2.4	5.6
Commercial	10	50%	5	5
Marketing	30	50%	15	15
Production	200	50%	100	100
Warehouse	20	80%	16	4
Quality	10	40%	4	6
Administration	30	80%	24	6
Engineering	14	30%	4.2	9.8
Design	8	20%	1.6	6.4
Total	330	52.18%	172.2	157.8

Table 13. Information about people at end 2018 in technology company code X51 application

People at end of 2018	People
Local technology research	8

Administration	1
Marketing and commercial	2
External technological collaborators	4
Local technology agents	4
Total	19

Table 14: Expected annual growth in technology company X51

X51 expected annual growth	2019	2020	2021	2022	2023	2024	2025
Local technology research	0%	1%	1%	0%	0%	1%	1%
Administration	0%	0%	0%	0%	1%	0%	0%
Marketing and commercial	1%	0%	1%	0%	1%	0%	1%
External technological collaborators	1%	0%	1%	0%	1%	0%	1%
Local technology agents	0%	1%	1%	0%	0%	1%	1%

**Annex 3: List of validators**

Table 15. List of validators Experts, Companies and Institutions

<b>CODE</b>	<b>GROUP</b>	<b>SECTOR</b>	<b>PEOPLE JAN. 2019</b>	<b>DISPLACE ABLE %</b>	<b>DISPLAC ED 2019-2025</b>	<b>MIN PEOPLE 2025</b>	<b>MAX PEOPLE 2025</b>	<b>EXPERT IN</b>
<b>X1</b>	<b>AI APPLICANT</b>	<b>LOGISTIC</b>	<b>532</b>	<b>40%</b>	<b>212</b>	<b>1300</b>	<b>2800</b>	
<b>X50</b>	<b>AI APPLICANT</b>	<b>FEEDING</b>	<b>91</b>	<b>50%</b>	<b>45</b>	<b>280</b>	<b>330</b>	
<b>X10</b>	<b>AI APPLICANT</b>	<b>PERFUME</b>	<b>330</b>	<b>52%</b>	<b>172</b>	<b>374</b>	<b>550</b>	
<b>X8</b>	<b>AI APPLICANT</b>	<b>HOTEL</b>	<b>91</b>	<b>35%</b>	<b>31</b>	<b>94</b>	<b>110</b>	
<b>X5</b>	<b>AI APPLICANT</b>	<b>CLEANING PRODUCTS</b>	<b>48</b>	<b>44%</b>	<b>21</b>	<b>120</b>	<b>162</b>	
<b>X21</b>	<b>TECHNOLOGY</b>		<b>190</b>			<b>1260</b>	<b>3800</b>	
<b>X22</b>	<b>TECHNOLOGY</b>		<b>41</b>			<b>70</b>	<b>160</b>	

<b>X28</b>	<b>TECHNOLOGY</b>		<b>8792</b>			<b>12000</b>	<b>23000</b>	
<b>X30</b>	<b>TECHNOLOGY</b>		<b>23</b>			<b>40</b>	<b>80</b>	
<b>X31</b>	<b>TECHNOLOGY</b>		<b>550</b>			<b>800</b>	<b>1800</b>	
<b>X32</b>	<b>TECHNOLOGY</b>		<b>33</b>			<b>43</b>	<b>85</b>	
<b>X51</b>	<b>TECHNOLOGY</b>		<b>19</b>			<b>60</b>	<b>120</b>	
<b>X33</b>	<b>TECHNOLOGY</b>		<b>60</b>			<b>160</b>	<b>300</b>	
<b>X34</b>	<b>TECHNOLOGY</b>		<b>20</b>			<b>70</b>	<b>130</b>	
<b>X35</b>	<b>TECHNOLOGY</b>		<b>400</b>			<b>600</b>	<b>1500</b>	
<b>X36</b>	<b>TECHNOLOGY</b>		<b>50</b>			<b>110</b>	<b>200</b>	
<b>X37</b>	<b>TECHNOLOGY</b>		<b>20</b>			<b>50</b>	<b>100</b>	
<b>X38</b>	<b>TECHNOLOGY</b>		<b>40</b>			<b>90</b>	<b>200</b>	
<b>X39</b>	<b>TECHNOLOGY</b>		<b>25</b>			<b>70</b>	<b>120</b>	

<b>X40</b>	<b>TECHNOLOGY</b>		<b>15</b>			<b>50</b>	<b>80</b>	
<b>X41</b>	<b>TECHNOLOGY</b>		<b>12</b>			<b>40</b>	<b>70</b>	
<b>X70</b>	<b>EXPERT</b>	<b>BUSINESS ORG. EUROPE</b>						<b>AI AND EMPLOYMENT</b>
<b>X71</b>	<b>EXPERT</b>	<b>SERVICE</b>						<b>SD</b>
<b>X72</b>	<b>EXPERT</b>	<b>BANKING</b>						<b>AI AND EMPLOYMENT</b>
<b>X73</b>	<b>EXPERT</b>	<b>EMPLOYMENT</b>						<b>AI AND EMPLOYMENT</b>
<b>X74</b>	<b>EXPERT</b>	<b>ACADEMIC</b>						<b>AI, EMPLOYMENT AND COMPETITIVE NESS</b>
<b>X75</b>	<b>EXPERT</b>	<b>TECHNOLOGY SERVICES</b>						<b>AI, EMPLOYMENT AND</b>

								<b>COMPETITIVE NESS</b>
<b>X76</b>	<b>EXPERT</b>	<b>IT SERVICES</b>						<b>AI AND EMPLOYMENT</b>
<b>X60</b>	<b>NO APPLICANT</b>	<b>EDITORIAL GROUP</b>	<b>12000</b>			<b>12000</b>	<b>14000</b>	
<b>X61</b>	<b>NO APPLICANT</b>	<b>AUTOMOBILE</b>	<b>23000</b>			<b>23000</b>	<b>25000</b>	
<b>X62</b>	<b>NO APPLICANT</b>	<b>MARITIME</b>	<b>2400</b>			<b>2400</b>	<b>2600</b>	
<b>X63</b>	<b>NO APPLICANT</b>	<b>AUTOMOBILE</b>	<b>43000</b>			<b>43000</b>	<b>46000</b>	
<b>X64</b>	<b>NO APPLICANT</b>	<b>AUTOMOBILE</b>	<b>3400</b>			<b>3400</b>	<b>3700</b>	
<b>X65</b>	<b>NO APPLICANT</b>	<b>ENERGY</b>	<b>12700</b>			<b>12700</b>	<b>13500</b>	
<b>X66</b>	<b>NO APPLICANT</b>	<b>ENERGY</b>	<b>1800</b>			<b>1800</b>	<b>2000</b>	
<b>X67</b>	<b>NO APPLICANT</b>	<b>TEXTILE</b>	<b>500</b>			<b>500</b>	<b>600</b>	
<b>X68</b>	<b>NO APPLICANT</b>	<b>SERVICES</b>	<b>1500</b>			<b>1500</b>	<b>1700</b>	

