



Working in 2050

A view of how changes on the work will affect society



UNIVERSIDADE FEDERAL
DO RIO DE JANEIRO

Table of Contents

Overview	1
1. Introduction.....	2
Part 1: Key Trends of Future Work	5
2. Increasing automation will impact your life	6
2.1. <i>Will we need policies to regulate advanced AI and Robots?</i>	6
2.2. <i>How Internet of Things (IoT) will impact us?</i>	8
3. Employment will be continuously changing.....	9
3.1. <i>My career no longer exists. What should I do now?</i>	10
3.2. <i>Will the globalized work overcome local work?</i>	11
3.3. <i>Will I have to work here all day long?</i>	12
3.4. <i>How about my labor rights?</i>	12
3.5. <i>Will trade unions lose their importance?</i>	14
4. Education will need to be updated.....	16
4.1. <i>Do we need new skills?</i>	16
4.2. <i>How will knowledge-intensive work change the Education?</i>	17
4.3. <i>Will self-employment save the world?</i>	18
4.4. <i>Will everyone receive Advanced Education and Training?</i>	19
5. We are slowly moving to a social welfare state	20
5.1. <i>Will we have to change our definition of old?</i>	21
5.2. <i>Are we entering in the equality era?</i>	22
5.3. <i>Is Universal Basic Income a solution?</i>	24
6. The economy will grow faster	24
6.1. <i>Is Knowledge the key?</i>	27
6.2. <i>Will Automation destroy or enhance the Economy?</i>	28
6.3. <i>Will the Advances in technology increase inequality?</i>	29
Part 2: A view of Future Work in 2050	31
7. Optimistic Scenario.....	33
7.1. <i>Automation</i>	33
7.2. <i>Employment</i>	33
7.3. <i>Education</i>	34
7.4. <i>Social Welfare</i>	34
7.5. <i>Economy</i>	35
8. Pessimist Scenario	35
8.1. <i>Automation</i>	35
8.2. <i>Employment</i>	36
8.3. <i>Education</i>	36
8.4. <i>Social welfare</i>	38
8.5. <i>Economy</i>	38
9. Likely Scenario	39
9.1. <i>Automation</i>	39
9.2. <i>Employment</i>	40
9.3. <i>Education</i>	41
9.4. <i>Social Welfare</i>	41
9.5. <i>Economy</i>	42
References	44

OVERVIEW

In this chapter we present the aim of this report.

Introduction

1. INTRODUCTION

Work has changed and it is changing, this could have been said at any time in history. The very meaning of the word “work” is multiple and changed throughout time. Etymologically, its origins go back to the Latin word *tripalium* which means a torture device [1].

In the Greek society, only slaves or second-class citizens used to work as it was mainly a physical activity considered undesirable by the upper-class people [2]. Work remained as an activity reserved for the unfortunate on the medieval ages as it was considered something terrible by the Catholic Church and the nobles [3]. The ethics of the religious denominations that derived from the Protestant Reformation went in direct opposition with the Catholic perspective of work by viewing it as a mean to salvation [4].

This change in the meaning of work was extremely important for the Industrial Revolution that was to follow for it provided the cultural and moral justification to keep people working for at least 16 hours per day. The industrial revolutions deserve special consideration in the history of work as they represent “profound changes in the means of production” [5], in these periods work suffered severe changes in a short period of time.

The 1st Industrial Revolution – which took place in the XVIII century – represented the shift from an artisanal production to the factory mode of production boosted by the new steam-powered machines [5]. Several intellectuals perceived the changes happening in this period and – even though their accounts differed in several ways – there are some points of convergence. For example, Smith and Marx saw how the work

done by the artisans was being replaced by a highly specialized work and that work organization was bringing several negative effects to the workers and positive economic results [6], [7].

During the 2nd Industrial Revolution, when electricity was applied in the production, work has also changed rapidly [5]. The characteristics of the factory system were further intensified by the works of entrepreneurs such as Taylor that brought the scientific administration to the factories and Ford that sought to intensify the division and specialization of work by the creation of the production lines[8], [9]. The electrification of production meant that machines substituted some of the work done by the people. Around that time, Fayol’s work helped to organize companies as the white-collar work was increasing[10].

The invention of Information and Computation Technologies (ICT) and its application on business around the 1970s represent the main event of the 3rd Industrial Revolution [11]. With the ICTs came new industries and new types of jobs, the main product of many companies became information and the third sector of the economy (services) represented – for the first time in history – the biggest share of GDP of several developed countries.

Robotics, Artificial Intelligence (AI), bio and nanotechnology are considered the tip of the iceberg of what might be called the 4th Industrial Revolution [12]. As these technologies are further developed, we will see even more changes to work. This report will discuss the main trends that are affecting work and present some scenarios that might be part of the next chapters in the history (of the future) of work.

Although it is not possible to predict the future, there are global trends showing us forthcoming changes in the society. In such dynamic world, changes occur on a continual basis – which makes us consider a long-term perspective for work. In this high-automation low-employment context, skills development becomes an important long-term issue [13]. Other long-term issues include AI regulation,

income transfer programs, and the Non-Standard forms of Employment (NSE).

This Report explores three possible scenarios for Work in 2050: a pessimist scenario, in which the development and new technologies will bring unemployment and economic crisis; an optimistic scenario, in which the development and new

The most likely scenario for work in 2050 presented in this report may be summarized in 13 key points:

1. Automation continues to advance in industry, in contrast to the governments increase regulations and laws on the subject, continuing projects of insertion of new forms of work in society.
2. Computerization will reduce the demand for low-skill and low-wage jobs. After facing a period of unemployment, most people will train to new careers while some will not be able to do so relying on the state to provide them a basic income. The employment will change to create new opportunities: some economies will reduce the working hours, avoiding unemployment of higher skilled people.
3. After a period of job insecurity and a series of disputes between Non-Standard forms of Employment workers and their employees, the new types of work contracts will be better regulated in order to provide minimum worker rights. Traditional unions will help workers in new NSEs to organize themselves in order to fight for their rights and for better working conditions.
4. A transition to a personalized education process will be possible by using new technologies, which takes into account personal needs, interests and pace of learning.
5. This personalized education and the trend of jobs automation will make reduce the workload to the workers, giving them more free time to study and learn new skills, keeping them updated and involved in a lifelong learning.
6. Workers will receive knowledge-intensive training, allowing their adaptation to the new types of jobs.
7. The collaboration and exchanges will increase, as well as the self-employment and entrepreneurship in the global labor market.
8. The society will demand more transparency and participation in political matters using new technologies, although keeping the traditional structures of governments. Minorities will use these new technologies and mediums to strengthen their movement for political empowerment.
9. The population will age and legislations will be amended so that pensions have increased ages. The government will play a more active and essential role in seeking a balance between the demand for jobs and supply, seeking to reduce the impact of unemployment.
10. Universal Basic Income will not reach its full potential, but income transfer programs will be implemented for the most vulnerable population. Inequalities will continue and the government will play an important social role by taxing large fortunes.
11. Knowledge-intensive work and services will become more advanced. These types of jobs are seen as an opportunity for developing economies to reap technological and social

technologies will bring wealth and a welfare state; and a likely scenario, in which the development and new technologies will bring some benefits for the society, as well as some new challenges. The importance of this report relies in addressing these challenges as soon as possible in order to produce efficient results in our society.

We took some assumptions while performing our analysis until 2050. The first one is that there will be no disruptive technological breakthrough. The second one is that there will be no large-scale war – although asymmetric conflicts will continue to exist. Finally, the third one is that there will be no global catastrophe.

Therefore, we pointed out the key themes that policy-makers, entrepreneurs and workers should discuss in the near future. Although there is no right model to be followed, we believe that these actors should debate these topics:

1. **Robots and AI Regulation:** should Robots and AI be limited or forbidden, highly taxed in order to support income transfer programs, or be left unregulated?

2. **Income transfer programs:** should the government create income transfer programs? If so, which model, Universal Basic Income, Universal Basic Assets or other?

3. **Non-Standard forms of Employment:** NSEs should be regulated? Should this regulation be left for each country to decide or a global effort should be made in this direction?

4. **Flexible Education:** with the rise of new forms of education, how will the governments recognize them? Should new kinds of degree separated from our current ones or as part of the current curricula, adapting them to accept these new forms of

education? Leave these new forms of education unregulated is an option?

The findings presented in this report reflect our mission to conduct interdisciplinary research to explore scenarios and to base solutions for governments, organizations and societies, helping them to move towards a more egalitarian, participatory and sustainable society.

PART 1:

KEY TRENDS OF FUTURE WORK

In this part, we analyze the key trends that drive the future of work.

Increasing automation will impact your life

Employment will be continuously changing

Education will need to be updated

We are slowly moving to a social welfare state

The economy will grow faster

2. INCREASING AUTOMATION WILL IMPACT YOUR LIFE

Since the last century, computers have been routinely performing physical activities in industries, performing better and being cheaper than humans. With new technologies, machines are getting closer to being able to make judgments and decision-making. Formerly, such capacities were impossible for something non-human [14].

Today only 5% of occupations are candidates for total automation, with total loss of human tasks [14]. Even so, almost all professions have partial automation potential. The impact of automation on workers is predictable in the production of physical products, especially in the retail and retail market. Collection and data processing are also fully automatable and as we see the latest assembly line operations and archivists suffer from the same problem.

Some key points have to be considered when talking about adopting automation [14]:

- **Technical feasibility:** The technique may be in the prototype phase, making it impossible to use it extensively.
- **Development and Implementation Costs:** The cost of automation cannot be higher than the cost of hiring labor for the same task.
- **Labor market dynamics:** Demand and costs related to human labor, which for social reasons may make the use of humans more favorable than automation itself.
- **Economic Benefits:** Government agencies fund projects in a given region can increase income according to labor laws. Tax reductions, among other incentives, stimulate the development of more productive and wealthier regions.

- **Social Acceptance:** Automation may be badly received by society since it can generate unemployment, and without popular acceptance, the automation adoption becomes more complex.

The effects of automation may be slow at the macro level in the economy, but at the micro level they can be very fast, with increasing unemployment in a particular region or monopoly of the market by companies with automated processes [14].

2.1. WILL WE NEED POLICIES TO REGULATE ADVANCED AI AND ROBOTS?

Artificial Intelligence is being developed for 60 years now, and over the last 20 years, remarkable progress has been made in this area. In 2011, Watson, a cognitive system designed by IBM, won in a series of questionnaires the champions of Jeopardy, Brad Rutter and Ken Jennings, being the first moment in which computers beaten humans in this type of competition. In 2016, AlphaGo, one of Google's artificial intelligence systems, was able to win a game challenge with Lee Sedol, one of the best professional Go players in the world [15].

The technological wave of automation is in process. The costs of processing, memory, bandwidth, sensors and storage have been falling exponentially. Cloud computing will provide all the necessary resources in a cheaper and clustered way. Data obtained from digital systems will become more accurate and refined, allowing for accurate experiments, theory testing, and more importantly learning to produce results without human supervision on an ever-increasing scale [16].

Billions of people across the world grow using the Internet, being more and more connected, expanding and absorbing

knowledge. This means that the global population of innovators, entrepreneurs and curious is growing rapidly and with it advances in technology [16].

With advances in AI, there will probably be more robots or smart programs that can help us as human assistants, such as reading emails, cleaning or even driving cars for us. However, this will also impact our privacy, security, and ethics. Many uncontrolled consequences can arise if we are unable to identify the previously related threats [15].

Building machines that can learn on their own is a key to this revolution, along with new regulatory policies. Historically, we have an automation problem: if, for any reason, no human could explain all the steps taken in completing a task, then no programmer could incorporate those rules into software. Recent advances shows that this is not a great obstacle to be overcome anymore. Machines can learn even when humans cannot teach them and can learn more efficiently, since they can generate new knowledge alone and faster than humans [16].

Technological advances have an impact on the way work is done. Such a radical reform of labor will require new policies to protect the vulnerable unprepared for the new age. The choices made now will be decisive in the direction to be followed. Erroneous interventions undermine the economic prospects of millions of people around the world, leaving underdeveloped nations out of the race against the machines of more developed nations, thereby creating economic, social and political inequality as technology advances [17].

We cannot work with policies that undermine innovations for the development of society. The solution then is to formulate

policies that allow a smooth transition to this new model of production [17].

Accepting this new model of production requires a pre-examination since not all jobs can be automated by a variety of economic, legal and regulatory advantages, such as police or medical, at least in the first stage of this new era. Jobs involving a high creativity load are not affected by automation yet, given there is a lack of technology and knowledge to imitate this human behavior in the area of artificial intelligence [17].

What we have as a fact is that mass automation will create new technologies in areas such as AI and robotics, creating entirely new jobs that will generate additional wealth and expense [17].

This discussion is delicate, especially for underdeveloped nations, which are at the margin of the discussion and of the focus of studies in the area. Most jobs have characteristics suitable for automation. In such cases, intervention from government is required to ensure that these nations are prepared for the new era and that they can share the potential gains of automation broadly with society through policies such as increased investment in education and vocational training [17].

Regarding the privacy issue, in recent years the concept of machine learning has grown, so the number and quality of data sets affect the results of the machine training. Therefore, the most successful applications will require a large amount of data. The privacy issue is a major threat of exploiting this data, inevitably there will also be privacy issues in applications that work with sensitive data [15].

2.2. HOW INTERNET OF THINGS (IOT) WILL IMPACT US?

One definition of Internet of Things is "the global network of interconnected objects exclusively addressable based on standard communication protocols" [18]. A more generic definition of IoT is that it is a concept of interconnected intelligent objects that work together to achieve common goals [19].

The advancement of technology has provided the rapid development of low-cost sensors, wireless technologies and the generation of more data with the Internet. The topics covered by the IoT include intelligent transportation and logistics, smart building, environmental monitoring, medical and health care, among others. [19].

Predictions for the number of connected devices on the Internet of Things for the year 2020 vary considerably, from Gartner 26 billion (Gartner) to 30 billion (ABI Research), to 50 billion (Cisco) to 75 billion (Morgan Stanley) [18].

The impact of IoT on industrial automation and control is increasingly present in society. The evolution of sensor technologies that define the Internet of Things will lead to lower cost automation systems and production maximization. The benefits of IoT include low-cost, high-performance processors, robust low-cost sensors, analytical software, vision systems, cloud computing, and highly distributed system architectures [20].

Many companies are seeking key knowledge to be applied for competitive advantage through Big Data analysis. Therefore, companies that possess the skills needed to analyze and generate business intelligence from several sources of data in

real time will take the lead in the market. This trend follows the flow of increasingly steady use of mobile devices, social media tools, and the IoT with its milestone in RFID (Radio Frequency Identification) technology [20].

Internet of Things will become increasingly present in the reality of society. This kind of ubiquitous computing will generate huge amounts of data that must be analyzed to generate value for individuals, organizations, entire industries and ultimately, the society [20].

The large volume of data produced by many sources defines the plan of governments and companies, focusing on the implementation of smart metering by improving the use of energy resources and efficiency in supply and consumption. Automation is present at all levels of society, in the case of IoT we can have smart meters that monitor the activities of patients, seniors or children [21].

Other implications such as privacy issues should be taken into account, especially in home automation and leakage of sensor data as a form of industrial espionage [21].

Security issues are low priority for mainly IoT device vendors, and this has led to a situation where numerous devices have critical security vulnerabilities at their core. Therefore, the security and privacy of location information is often exposed to attacks [19].

The 4th Industrial Revolution improves the global competitiveness and shifts of the production to the countries where the supplier company are expected [22]. This model is named Industry 4.0, and it is based on intelligent infrastructures such as smart mobility, the smart grid, smart cities and

smart buildings. All incorporated in the IoT concept, in a collaborative network.

The increase of automation based on new technologies is the core concept of Industry 4.0. Connectivity and inter-part interaction, integrated use of machines and human beings will make production systems 30% faster and 25% more efficient and raise product customization to a new scale [22].

Industrial processes increasingly adopt Information Technology (IT), with the development of digital circuits since the 1970s [22]. Since then, we watch a digital transformation in the production forms.

An example of such virtual circuits is the adoption of CPPS (CyberPhysical Production Systems) that are increasingly present. CPPS are online networks for communication between machines, linking mechanical and electronic components. RFID technology was an early form of this technology, until its evolution to the concept of IoT [22]. An RFID system, on the other hand, usually consists of readers and a large population of tags. In addition, each tag has a small memory to store its unique ID and some other information, for example, product price, expiration date, personal information, and so on. These labels may be managed through wireless network in real time, among other advantages over identification techniques such as magnetic stripe and bar code [23].

3. EMPLOYMENT WILL BE CONTINUOUSLY CHANGING

The world faces the 4th Industrial Revolution which has a widespread impact on society, affecting education, employment, and skills, requiring stronger partnerships between governments, educators, training providers, workers and employers [24]. The main drivers of this revolution are artificial

intelligence, machine learning, nanotechnology, 3D printing, robotics, biotechnology, and genetics each interacting in multiple directions and intensifying each other. While new technologies are expected to promote a better society and well-being they can also represent threats to jobs and shall be proactively observed and adapted by, societies, governments, corporations, and individuals [24].

In order to meet future job demands, there will be an adoption of more flexible work contracts, modifying the traditional relationship between employees and employers, with the popularization of part-time jobs and other types of hiring that are not common in the business model of large companies, e.g. crowdsourcing [25] [26]. Crowdsourcing involves the coordination of a crowd (a large group of people online) to do autonomously a fraction (small tasks) of a large work. Companies use crowdsourcing to accomplish their tasks, find solutions to problems or gather information [27].

In the future, gender equality will be natural and intrinsic in most societies, as well as the participation of aging people, returning from retirement or even delaying the exit from the job market. These scenarios tend to create a more powerful workforce, with a high work-life balance promoted by part-time jobs and home-office enhanced by virtual reality and augmented reality [24] [28].

As expected, the global economy will reduce the countries' borders promoting a global workforce able to be hired from anywhere in the globe. This is not a recent trend but tends to grow and consolidate as a solution in a future where automation will be widespread in the societies, substituting manual and repetitive tasks, and amplifying the creative economy. These trends will

require the adaptation of education to prepare the workforce to answer the market necessity as soon as it raises, not creating a gap and consequently a massive unemployment [29] [30].

In conformance with previously mentioned trends for employment, the way how people claim for labor rights tends to change, creating a movement of self-organized independent groups in contrast with the traditional trade unions. Given that regulation tends to strengthen employees' rights, collective agreements will become increasingly redundant.

3.1. MY CAREER NO LONGER EXISTS.

WHAT SHOULD I DO NOW?

There is a dispute between the technological unemployment and the job displacement thesis [31].

Technological unemployment can be defined as "unemployment due to our discovery of means of economizing the use of labor outrunning the pace at which we can find new uses for labor" [32]. Showing the present strength of this line of thought – that has defenders since the First Industrial Revolution – Strawn [33] lists seven books written since 2013 by authors that defend the technological unemployment thesis.

The job displacement theory states that automation will cause the extinction of certain careers but also the creation of new ones causing little to no harm to employment [34]. Even if this prediction seems more optimistic than the technological unemployment, it also has its dangers for society. For the last two centuries, economists defended that the job displacement theory have been right but there is no economic law guaranteeing that

most people automatically benefit from technological progress [35].

The occupations that are more likely to be computerized in the next decades are the ones with the lowest average median wages and the ones in which we are less likely to find people with a bachelor's degree or better [36].

This trend should be a concern for society because the people that are more likely to lose their jobs are also the ones with least resources to change careers given that it requires enrolling in courses to acquire new creative and social skills [36].

Another trend that is likely to help to destroy some careers is the rise of the knowledge economy. As the economy moves away from being dominated by the processing of materials towards a more information-intensive production [37] it can be expected that the careers related to this previous mode of production will no longer exist as happened in the past with the move from the farming sector to the industrial one [34].

Wide-spread skill-development policies will be required in the future along with some sort of universal basic income that would allow individuals to act as free and choosing agents [38].

If the trend of technological unemployment comes to fruition, society will have to find ways of coping with higher rates of unemployment and may face the impossibility of maintaining the traditional work week and hours which will lead to solutions that look to reduce the hours in the work week [33].

The end of careers can be an even bigger issue if considered from a more philosophical perspective. Voltaire [39] writes

that “work keeps at bay three great evils: boredom, vice, and need”. The solutions outlined above only address the evil of need, what to do of the other two? The end of careers puts pressure on humankind to look for other ways of filling the void left by the end of work (at least for a part of society) with something else that gives meaning to life.

3.2. WILL THE GLOBALIZED WORK OVERCOME LOCAL WORK?

Globalization is not a recent phenomenon, but it was accelerated by the increase of communication and the decline of electronic devices prices. Models based on outsourcing are also not recent, but their capillarity, quality, and availability tend to improve in the future [40] [41]. The globalization created two trends on markets: the remote worker hired without needing to migration and the immigrant that is hired and displaced from his original country to another.

Remote working is already a reality, even on traditional enterprises as IBM where only 42 percent of employees work at IBM location [42]. This internal remote allocation is only recently being adopted by big companies, but on startups it’s already a common practice. This approach to team formation allows the hiring of high-skilled workers and, in the future, considering the flexibilization of traditional employment contracts, a firm will be able to contract a part-time employee wherever he is without the need of displacing the worker [43] [44].

The evolution of technology and communication will allow the use of fast internet by a feasible price on small cities, which has a fraction of the cost of big metropolis[45] [26]. This cheap and fast Internet will enable a lower cost of life and

will engender the improvement of infrastructure on small cities, proving a fertile ground to a massive urban exodus.

Local work will be refreshed to provide value on another sort of occupations, mainly motivated by the automation and its consequences, which will generate in the medium term the extinction of manual jobs, as well as the dangerous, dirty and risky jobs. [26] [46]. Globalization will not overcome local work, but will promote modifications on how the work is done.

Considering the flexibility of where the worker can be, as mentioned previously, centralized offices with hundreds of people that ignore the travel time of employees tends to change. Distributed offices on multiple locations or even co-working spaces will promote a cost reduction to enterprises, becoming an alternative to central offices located on a fully commercial area [26].

Despite a global population of approximately six billion individuals, just the minority is considered part of the developed global workforce [47] [48]. It is estimated that 80 percent of the world’s population are at the bottom of the economic pyramid, and live predominantly in developing countries [49]. Meanwhile, the emerging hypercompetitive global economy is increasingly intolerant of any inability to keep pace with change, deliver less than foremost performance, or continue dependencies on slow legacy-based systems of workforce preparation.

Motivated by unemployment, lack of food, imminence of war, radiation and other extreme situations, a considerable number of people migrate illegally to neighboring countries [48]. Considering the global warming and polar ice sheets melting, some regions tend to disappear creating a massive

emigration to nearby countries, therefore the fight for jobs and against climate change requires complementary actions, not just to avoid more environmental refugees [50], but also to help people conquer a better quality of life [51] [28].

3.3. WILL I HAVE TO WORK HERE ALL DAY LONG?

In the past few decades, there was an increase in flexible and adaptable contract models which fostered the emergence of part-time jobs and crowdsourcing, enabling to the reformulation of the idea of jobs and the relationship between employee and employer [25] [26].

The trends for the future show increasing flexibility to workers, becoming possible to have a flexible portfolio of part-time jobs or casual jobs instead of one regular traditional job. Considering this scenario, virtual reality (VR) and augmented reality (AR) will be used to create an immersion and amplify the sense of collaboration, allowing the worker to be wherever is suitable for him [46].

The increase in part-time jobs will stimulate entrepreneurship, in a society where automation will handle manual jobs and creativity will be the human differential [46] [52] [45]. Currently, some nations, to avoid high rates of unemployment, are promoting a transition from regular to part-time jobs, reducing the salary and consequently the final cost to the employer [53] [54].

The traditional family structure is changing and tends to promote more gender equality, with an increasing participation of women in the domestic economy [24] [28]. Furthermore, the increase in part-time jobs and in home office, allows

women to work even during pregnancy or the early years of the baby [24].

Flexible contracts and the future necessity for more skilled workforce will create a new phenomenon: the return of older people to the workforce motivated by the interest in helping the society with their experience but also as a financial contribution to their retirement plans and domestic economy [55] [28]. This trend shall promote a significant impact on society as organizations will be able to keep on being competitive by having access to a bigger pool of skilled professionals thus reducing the shortage of specialists and the impact on social security systems [55] [25].

Considering the advances on Healthcare automation, increase in the use of continuous-health tracking devices, reduction of healthcare costs and human mistakes being extinguished due to automation, life expectancy and the time that an individual will be able to work and have an active participation in society will increase [56] [45].

3.4. HOW ABOUT MY LABOR RIGHTS?

According to the International Labor Organization (ILO) [57], "Non-Standard forms of Employment have become a contemporary feature of labor markets around the world". In South America, 6 out of 10 young people who get a job today do so in the informal economy [51]. This trend is not exclusive to countries in development; Petrie [58] predicts that 40% of the US labor force will be self-employed by 2020.

These new employment types share a common feature of deviating from the standard employment relationship (work that is full-time, indefinite, as well as part of a subordinate relationship between an

employee and an employer) and can be divided into four types [57]:

1. **Temporary:** fixed-term contracts, including project or task-based contracts; seasonal work; casual work, including daily work;

2. **Part-time and on-call work:** normal working hours fewer than full-time equivalents; marginal part-time employment; on-call work, including zero-hours contracts (no guarantee of a minimum wage);

3. **Multi-party employment relationship:** also known as 'dispatch', 'brokerage' and 'labor hire'. Temporary agency work; subcontracted labor;

4. **Disguised employment / dependent self-employment:** can involve masking the identity of the employer by hiring the workers through a third party, or by engaging the worker in a civil, commercial or cooperative contract instead of an employment contract and at the same time directing and monitoring the working activity in a way that is incompatible with the worker's independent status. Thus, workers are purposefully misclassified as independent, self-employed workers, even though they are, in fact, in a subordinate employment relationship.

The problem with some of these NSE can be summarized by saying that "there is no more connection between the worker and the employer than there might be between a consumer and a particular brand

of soap or potato chips" [59]. These NSE pose great risks to worker's security, particularly when they are not voluntary [57]. Table 1 summarizes the impacts of NSE.

On-demand economy (or gig economy) may represent an opportunity in connected and app-driven economies that could produce several benefits for society but this cannot happen at the cost of exploiting and degrading human dignity at work [60]. That said, replacing fixed employments with gigs can produce an economic boost, not only by allowing a better match of workers to jobs but also by freeing the energies of workers frustrated with their jobs [59].

Given the projected increase in these NSE and the impacts that are already being felt both by employees and by the society, we can expect to see more debates and policies concerning the flexibility of worker contracts and new worker classifications. McAfee & Brynjolfsson [16] give an example of a policy proposed by Harris & Krueger [61] to create a new "independent worker" designation which would not be eligible for overtime pay or unemployment insurance. However, they would enjoy the protection of federal antidiscrimination statutes, have the right to organize, and tax withholding [61]. Their employers, whether online or offline, would make payroll tax contributions [61].

Table 1. Summary of impacts of NSE, based on ILO [57].

Impact on	Description
Employment security	The greater the incidence of temporary employment in the country, the greater the likelihood that workers will transit between NSE and unemployment, with the possibility of transitioning to better jobs less likely.
Earnings	Wages tend to be substantially lower for workers in NSE when compared to those in standard employment.
Working hours	Working hours are more uncertain for workers in NSE resulting in lower work-life balance.
Occupational security and health	Injury rates are higher among workers in NSE.
Social security	Social security coverage law sometimes excludes NSE workers and, when they are covered, their employment arrangements tend to result in worse benefits.
Training	Workers in NSE are less likely to receive on-the-job training, which can have negative repercussions on career development, especially for young workers.
Representation and other fundamental rights at work	Workers in NSE may lack access to freedom of association and collective bargaining rights either for legal reasons or because of their more tenuous attachment to the workplace. They may also face other violations of their fundamental rights at work, including discrimination and forced labor.
Firms	Firms that rely heavily on NSE need to adapt their human resource strategies from training and development of in-house employees to identifying the sets of skills that the firm needs to buy from the market. An over-reliance on NSE can lead to a gradual erosion of firm-specific skills in the organization, limiting its ability to respond to changing market demand.

We should not expect gigs to replace traditional employments, even so the rise of the gig economy presents an opportunity to reconsider the social policy [59]. Following this line of thought, two issues that are likely to be of great concern for our society in the future must be considered [60]. The first one relates to the need to search for new sources of essential worker protection measures (e.g. vacation pay) traditionally guaranteed to ordinary employees. The erosion of such rights might threaten welfare in countries where the welfare system is strictly connected to a stable employment contract. The second one is that labor regulations must protect both clients and workers, the rules created to protect workers' rights cannot affect the dynamic potential of "collaborative forces" in the new economy.

3.5. WILL TRADE UNIONS LOSE THEIR IMPORTANCE?

The trends discussed in the sections 3.2 and 3.4, namely the intensification of globalization and increase in NSE, make it harder for workers on the new NSE to organize and to form unions. Crowdworkers, for instance, are facing a challenging goal due to their geographical distribution that makes it harder to create solidarity between the workers in this particular category [60]. On the other side, the very spread and growth of some companies in the gig economy could make it easier for worker's organizations to aim at them (i.e. by increasing vertical integration in some traditionally highly fragmented sectors such as car-hailing services) [62].

The labor movement survived recent changes in economy in two ways, and maybe these practices can be used in the future. The first one involves using the same technology that is partly responsible for the creation of some of the new NSE and for the intensification of globalization to help workers organize. This is already being done as shown by the following examples. App-Based Drivers Association¹ (ABDA) is a group from Seattle (United States) that aims to give a voice to app-based (e.g. Uber, Lyft) drivers. This association allows new members to join it by filling an online form on their website. This group had a major win in 2015 when a law was passed by the city of Seattle allowing the car-hailing app drivers to form unions [60] [62]. Turkopticon² is an initiative, with more than 10 years, created by the University of California San Diego that allows Amazon Mechanical Turk (AMT) workers to evaluate their Human Intelligence Tasks. This can be done by using either their Chrome or Firefox add-on [60] [62]. Dynamo³ is another type of worker organization that focuses on AMT. It works as a wiki for the community of AMT workers in which they can create campaigns and join discussions to improve their working conditions [60].

The second way to keep unions alive in the future of work is looking for support from traditional unions and other social actors. Unions can see workers in the on-demand economy as a huge pool of new members [60]. One case of the association of traditional unions with workers on NSE is the FairCrowdWork Watch⁴ – which was created by the IG Metall (dominant metalworkers' union in Germany) – that allows workers to rate platforms, compare their payment with

others and receive legal advisory [62]. Another example of digital workers being supported by traditional unions was the strike organized by the Huffington Post collaborators after the site was sold to AOL for over US\$ 300 million by its owner, Arianna Huffington, leaving the workers empty-handed. The movement was supported by the Newspaper Guild and by the National Writers Union – both traditional writers' unions. The group took its fight to the court demanding that Arianna paid them US\$ 105 million [63].

The Crowdsourcing Verband⁵ – a German association that brings together crowds, companies, and experts – is an example of a non-union social actor that is helping to improve working conditions for a group of new workers in NSEs. They are doing this by creating a code of conduct that aims to be a “guideline for a prosperous and fair cooperation between companies, clients, and crowdworkers” [62].

Given the plurality of examples of worker's organizations and the importance of unionization for workers in the future, it can be expected that unions will continue to exist. Besides, another trend that can be put forward is the increasing application of technology to help the organization of workers geographically dispersed. These trends show that we will probably see a change in the nature of unions due to the very change of the workers that constitute them but not a loss of their importance since the future of employment holds similar challenges to those faced by workers in the past [64].

¹ <http://www.abdaseattle.org>

² <http://turkopticon.ucsd.edu>

³ <http://www.wearedynamo.org>

⁴ <http://www.faircrowdwork.org>

⁵ <http://www.crowdsourcingverband.de>

4. EDUCATION WILL NEED TO BE UPDATED

With the big changes coming to work, education will need to adapt using advancements in technology to achieve this change. As work becomes more and more demanding of the skilled workforce with a deep knowledge of their skills, the education system will need to train new, more specialized workers, with some forms of work ceasing to exist and new jobs emerging [44].

Changes in education are usually reactive: there is a tendency to continue the process of training workers to (soon-to-be) old jobs in order to serve current job market, creating a gap for the new ones. The world will need to adapt to a new way of teaching so that people's competences are not outdated and lose job opportunities [44]. This is a major change in how we feel about work today, when an individual study during his youth and then chooses a career that tends to be kept the same during the life. In the future, we will have to keep on learning throughout life to adapt to different jobs. As it can be seen, the social impacts of this change can be very serious if we do not adapt in time [44].

Another important trend is how work will require less time from people [44], thus leaving them with more time to study and learn new skills, reinforcing the idea that people will be able to learn new skills while working. In addition, this means that education will need to keep updated on new job tendencies to be able to train workers to take on these new jobs. With the possible changes in the model of education we'll see a change in what teachers do, we might be seeing them turning from knowledge providers to guides through the massive amount of available knowledge [44]. As free

information becomes more prevalent in society, we might see teachers replaced by MOOCs if people become more autodidact.

With these many changes and an ever increasing freedom it's easy to see everything going out of control, thus comes the government, that might be responsible for applying incentives to these changes and also inspecting them to guarantee quality and fulfillment [65]. The government will then be key in keeping the education up to date with the new skills needed by workers, keeping those responsible for the education in close contact with those who hire the workforce; doing so will maintain attunement in creating new jobs and fulfilling them. With the government playing a role in education and the race of knowledge-based workforce [66], another possibility is to see investments in development of intelligence through drugs, genetics, viruses [65].

4.1. DO WE NEED NEW SKILLS?

The increasing use of technology is transforming industries and business models, changing the skills that employees need and reducing the life cycle of employees' skill sets [24]. This means that people will have to adapt quickly to different skills to supply the needs of the labor market [67]. For example, technologies such as robotics and machine learning automate specific tasks of jobs, allowing workers to focus on more complex tasks that might require different skills [24]. As it can be seen, due to automation, people will spend more time learning and will need education to transition to a new careers [68].

The new types of jobs require high skilled workers [67]. Higher level skills lead to innovation and entrepreneurship, bring flexibility and adaptability [69], and thus,

usually require higher level qualifications [67]. Higher skills are particularly needed to Science, Technology, Engineering, and Mathematics (STEM) subjects, which plays a fundamental role in the economic success of a country [69]. Building such high skills requires an investment in education of years.

The future worker will need a different set of skills when compared to the present ones: they need more cognitive skills, such as critical thinking and non-routine problem solving; interpersonal skills, such as presentation skills and conflict resolution; and intrapersonal skills, such as adaptability and self-development [70]. Jobs intensive in social and creative skills have a low risk of automation [67]. Thus, six important skills that students can develop are: collaboration, knowledge construction, skilled communication, self-regulation, real-world problem-solving, and use of information and communication technology for learning [71].

The rise in the demand of highly skilled workers tends to occur simultaneously to the rise in the demand of lower level jobs, especially in services – jobs requiring low or no skills are projected to grow [69]. Literacy and numeracy are fundamental skills [72], and team working and communication are important skills for most jobs [69].

4.2. HOW WILL KNOWLEDGE-INTENSIVE WORK CHANGE THE EDUCATION?

One of the biggest trends of the future of work is how it'll become more knowledge focused [44]. As commented earlier, with many jobs becoming automated, the jobs that remain will be knowledge-intensive, harder to automate. Then we face ourselves with the question of how to achieve this greater knowledge demanded for those new jobs, or else how to make the majority of the

population knowledgeable enough to occupy these future jobs?

Another trending change in education is the personalization of the education [73] [74]. Researchers consulted a group of specialists, and 78% of them agree that education “will have personalized learning plans that take into account individual needs, interests and preferences” [75]. Personalization might be one main driver for achieving more deepness in knowledge, by allowing the students to use most of their time learning a selected set of skills, therefore, providing a better understanding. This better understanding is later converted into better competitiveness in knowledge-focused jobs.

Another subject is that of how will advancements in technology affect education and maybe help with these needed changes. A new technology that could be able to help with the personalization of education is the Massive Open Online Courses (MOOCs) [74] [66] [76] and the digital school in which they will be the main providers of the learning process. New Information and Communication Technologies might be of great importance in future education [77],

One possible way of addressing the problem of improving education is to look at the knowledge management inside educational organizations [78]. While this may look like a short-term solution, it may prove invaluable in the creation of the education of the future, as the way we pass on knowledge to others change, we will need to know we are changing it in an effective way. Studies in the knowledge management area can play a main role in guaranteeing that we do not stray from the effectiveness on education.

A trend that might be of great importance to create a knowledge centered education is Open Access [66]. Sharing research to everyone provides easy and free access to new knowledge. Students – who already are or will be workers – benefit from this knowledge, and they are likely to keep themselves updated for life. Therefore, education organizations will need to consider this and teach students about this possibility. We also see this making an impact in another problem of the future workforce, which is the need to change your knowledge area many times during your lifetime, with Open Access everyone may learn of the newest discoveries as they are

job opportunities, but is also a chance for individuals searching for a different career path [79]. As a recent global trend in working practice, it is an option followed by many workers – according to OECD, self-employment rates were on average 15.4% in 2014, but data for individual countries show notable disparity, varying from under 7% in the United States to over 30% in Greece, Mexico and Turkey [80], as shown in Figure 1. These workers have different ages, races, physical and personality characteristics, and educational skills.

The collaborative economy (or “gig economy”) allows the sharing of good, space

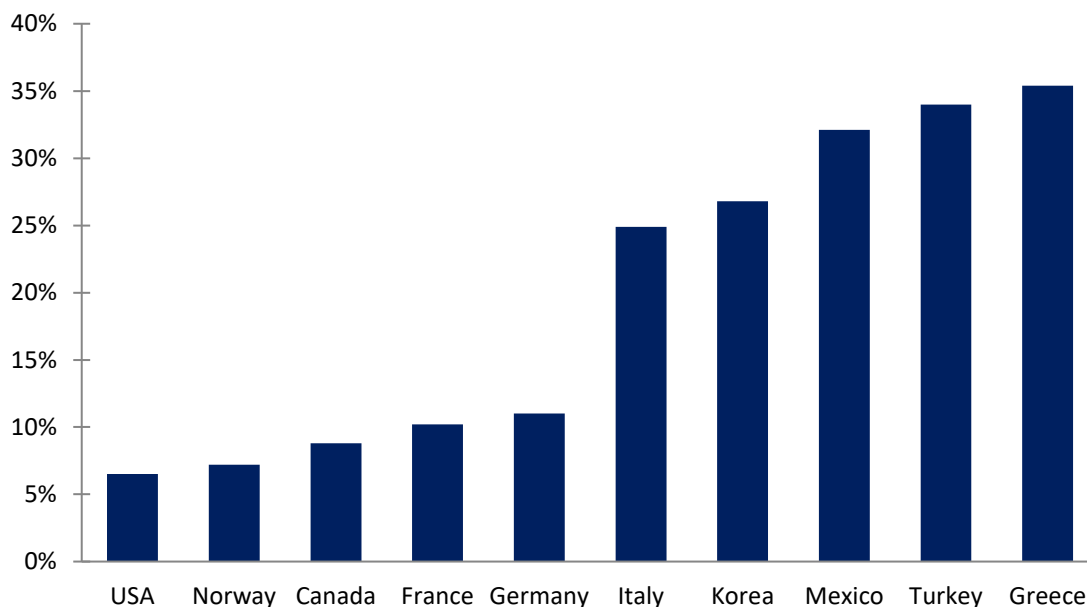


Figure 1. Self-employment rates by country in 2014 [80].

made, and then might be readier to change when needed.

4.3. WILL SELF-EMPLOYMENT SAVE THE WORLD?

The labor market has a significant presence of self-employed workers – small traders, doctors, basic manufacturers, lawyers, freelance handymen, smallholder farmers. Self-employment is not only a solution for individuals who have not found

and services [81]. Examples for this case are private transport services, such as Uber and Cabify, and rent-sharing rooms such as Airbnb. We identified contradictory trends – i.e., the collaborative economy depends on the economic growth. In a scenario of economic growth and declining unemployment, the collaborative economy complements the worker's monthly income. However, in a scenario of unfavorable economic or labor conditions [82], the

collaborative economy becomes the only possible option for income.

As an agent to support these changes, we are experiencing now a rich digital educational landscape, where can be included massive online resources produced for websites like YouTube⁶, Udemy⁷ or Udacity⁸ that enable learners to access information directly and on-demand, allowing learners and teachers to find each other outside formal educational methods [83]. Such websites have the power to increase educational training to self-employees, extends the possibilities of building relationships between teachers and learners, opening potential for everyone to teach for the new “always-online” generations.

However, it does not reduce the importance of traditional self-employment governmental programs that provide business training, technical support, and financial assistance, giving to freelancer workers a better understanding of all aspects of starting and operating a new business [84]. This training is an effective program for assisting unemployed workers interested in self-employment to start their own business, remain self-employed, and avoid unemployment for long periods [84].

4.4. WILL EVERYONE RECEIVE ADVANCED EDUCATION AND TRAINING?

As a part of these new, big changes, workers in the future will shift from having generalist ability to having specialist ability [44], at the higher levels of knowledge or at lower ones. As technology advances, educated workers tend to benefit more and

those less educated tend to have their jobs automated first [70]. For instance, the manufacturing industry went from craftsmanship to the factory system, changing dynamically from mechanized powered systems to the present-day trend towards application of advanced manufacturing technology (computerized design, planning, and manufacturing tools such as CAD, CAM and MRP). Parallel to these modifications in the production organization and technologies there have been dramatic changes in the skills required of the human component of this work system [85].

In fact, advanced education is more cost-effective for the employer: it is better to send employees outside to train specialized skills as needed, than permanently hire in-house trainers [86].

Important innovations are in progress and tend to become widely accessible, bringing the opportunity to get a good job, possibly with a higher starting income, as some short-term higher education credentials are worth as much as long-term ones [87]. Among these innovations we highlight the massive online training tools, where it is possible to teach and train a large number of workers on-demand, outside formal educational methods [83], and short-term higher education courses like associate’s degrees in USA, whose main difference to traditional bachelor’s degree is in the proposal: a vocational education, focused on a rapid insertion in the labor market [88].

Despite all this progress, advanced education will not reach a large part of the population in the near future. While many countries have enrolled upwards of 50% of the age cohort attending post-secondary education during the last few decades, many

⁶ <http://www.youtube.com>

⁷ <http://www.udemy.com>

⁸ <http://www.udacity.com>

countries still enroll only a small percentage – poorer nations are likely to enroll fewer students than wealthier nations. Additionally, even when enrollment has expanded, participation has rarely been representative of the society as a whole: within most nations, access to higher education is still the privilege of specific segments of society [89].

5. WE ARE SLOWLY MOVING TO A SOCIAL WELFARE STATE

The Welfare State is the type of state organization that seeks to provide society with basic public services and security, guaranteeing collective rights so that extreme economic and social differences do not occur between individuals. The discussion on social welfare involves a reflection on whether social policies should be directed or universal involving only the poor or including all people [90]. The provision of basic health, education and security in a broad and unrestricted manner are common in this type of organization. Intervention in labor relations is also part of the scope of the welfare state.

The technological progress until 2050 will modify the work demand in organizations in an extreme way. The reduction of the jobs available eventually reduces the population purchasing power. Consumption and production of information are being altered, with automation and learning [91].

This new service-based relationship creates a set of human, social, scientific and environmental complexities, including how people live, move, receive and deliver tasks and services on digital platforms. Servitization, Informatization, Digitalization, and Creativization will be new digital services [92].

Public services that provide social welfare as services for digital cities will be based on jointly resource-conscious, facilitating innovation and creativity, functioning as a service economy [93].

In fact, this transition from traditional models to more transparent and agile models is a symptom that covers many areas from software development to service exchanges and micro-pay according to the time you spend running a given demand. In addition, the idea of creative cities is also related to an agenda and progressive planning including aspects of sustainability and social inclusion [94].

New productive arrangements have been tested, mainly due to the relationship between supply and demand. The forms of production of various products have caused significant impacts within the market and the relations between employers and employees seem saturated by hierarchical models of decision-making, high taxes and ineffective results.

Collaborative practice communities, such as free software communities, associated with universities, hackerspaces, small businesses and other productive arrangements, are experimenting with and applying methodologies that combine art and fast deliveries for the development of software projects. As the artisan manifesto⁹ suggests of software, presenting different functioning of large software companies and showing a new way of building software where creativity, customer focus, quality and agility are fundamental values.

In the other hand, companies are moving to become Learning Organizations. Such organizations not only create, acquire,

⁹ <http://manifesto.softwarecraftsmanship.org>

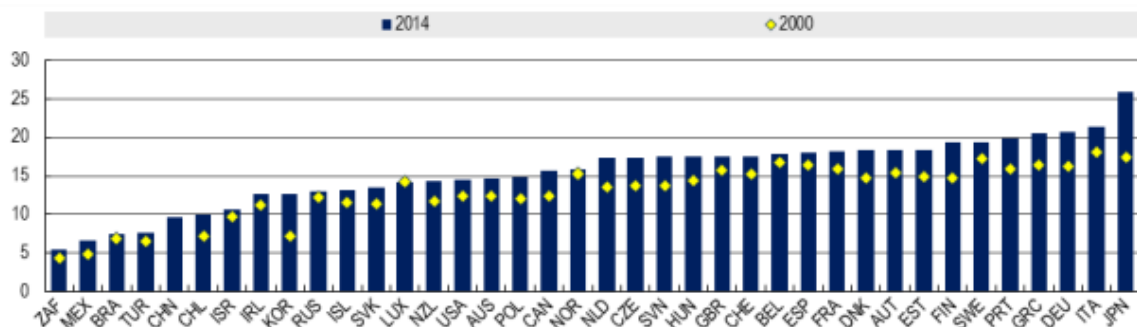


Figure 2. Elderly population, as a percentage of total population [80].

cultivate and transfer knowledge, but also to modify people and organizations based on the motivations of new knowledge, insights and brainstorming to improve task engagement [95].

Some developed countries in Europe began to hold debates on the notion of "social investment" from an agenda of the European Union in the early 2000s. The perspective of social investment intends to go beyond simply reinforcing policies and strategies in relation to the labor market and highlighting the return of care and early education, driven by many academic and policy-driven contributions. The social investment paradigm can be seen as the ideal institutional structure for the state, which generates reform efforts in the current structures and policies through a social investment strategy for the welfare state [96]. States can manage these resources in order to develop universal basic income programs adapted to their society needs.

The answers should be made taking into consideration what kind of game exists between the State and the Citizen and how will be the behavior of these players. This allows us to design important scenarios at the end of the analysis.

5.1. WILL WE HAVE TO CHANGE OUR DEFINITION OF OLD?

As we have seen previously, technological progress will change the relationship with work. In health, technology will promote an increase in the quality of the

diagnoses and improvement of the quality of life of the people. The population is getting proportionally older [80], as shown in Figure 2. With this, people's productive age will get larger, causing an increase in the economically active population. Thus, longer lives imply changes in pension systems, as well as workers going beyond the normal retirement age for better pension.

The delayed retirement is a phenomenon in which elderly population keeps their labor force participation. This is a recent phenomenon and is more noticeable in high-income workers and in less physically demanding occupations. Workers whom delay the retirement also may delay claiming Social Security benefits [97].

In general, rules for eligibility to retire and claiming a pension benefit are complex and vary according to each government objectives. According to OECD [98], in 2014, the average normal pension age was equal to 64.0 years for men and 63.1 years for women, assuming labor market entry at age 20. The normal pension ages varies from 58 (women in Turkey) to 67 (Norway). In 11 out of the 34 OECD countries, the pension ages differ between men and women.

The OECD predicts for 2054 an increase in the average normal retirement age, in more countries to set the normal retirement age to above 65 years and in the reduction in the retirement age gender gaps [98].

In the U.S., changes in Social Security rules have been encouraging workers to

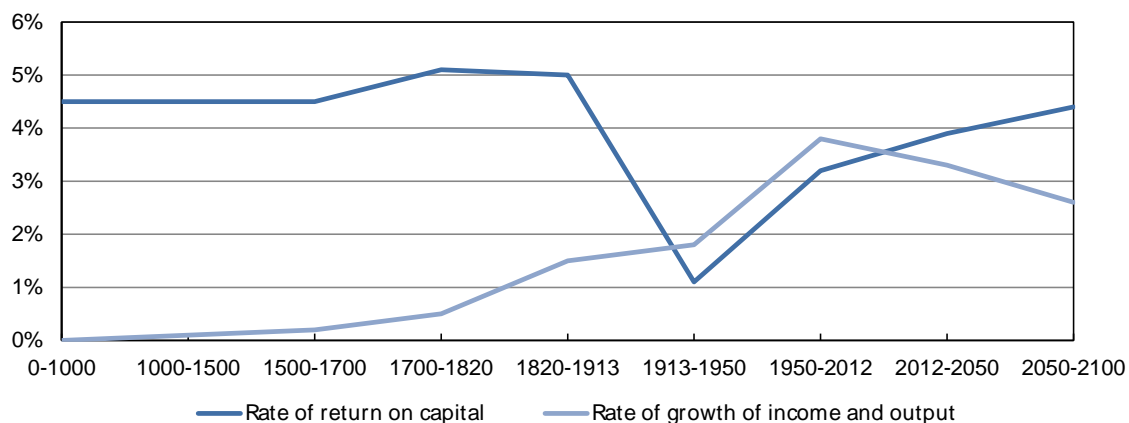


Figure 3. After tax rate of return on capital vs growth rate at the world level, until 2100 [99].

delay the full exit from the workforce. Using Current Population Survey (CPS) data, Bosworth et al. [97] show that the labor force participation for men over age 60 has a slowly falling pattern. This pattern reversed in the 1990s, indicating that older men have been delaying retirement.

5.2. ARE WE ENTERING IN THE EQUALITY ERA?

A market economy based on private property left to itself has powerful forces of convergence (such as diffusion of skills) and of divergence. The main divergence force is the inequality between the rate of return on capital and the rate of growth of income and output. Projections show that this inequality tends to increase in the future as depicted in Figure 3. This trend has serious negative consequences for wealth distribution as wealth previously accumulated grows faster than output and wages meaning that entrepreneurs tend to become rentiers increasingly dominant over those without properties but their labor [99].

Several factors impact the rate of return on capital and the rate of growth of income and output, one is the increase in gender equality. For instance, the changes to inheritance law that have been made throughout history that guarantee a more equal distribution both between primogenitors and younger children and between men and women tend to keep the pace of growth of the rate of return on

capital slower than otherwise over time. An increase in the participation of women in the economy also tends to give them more political power to demand a better work-life balance and to promote human capital investments thus increasing the rate of growth of income and output. In summary, if the trend in increase of gender equality sustains itself over the next decades, a reduction in the rate of increase of economic inequality can be expected [100].

Gender equality itself has been improving over the last decades but there is still a lot to be done for women rights in several countries with some critical cases as some countries in North Africa and Middle East. As shown by Figure 4, the gender gap has been slowly reducing with subindexes as health and education reaching values close to 1 (equality) but the economic and political subindexes are still far from equality. Considering the current trend, the gender gap would only close in 83 years [101]. Discrimination towards women happens throughout their lives, sometimes even before birth as some parents prefer to have a son rather than a daughter leading to strategies such as sex-selective abortions. It also happens intra-household via selective resource allocation (parents tend to invest more in the education of their son) and in the society (i.e. lower participation in paid work than men, lower wages than men for same positions) [102].

What about the role of technology in the economic equality? Some researchers defend that the exponential change in the technology that sustains the economic system is the main driver behind the growing inequality. Digital technology acts as a catalyzer of the economic payoff to the winners in our modern economy as the others become increasingly dispensable and receive fewer resources. The winners are those who accumulated the right capital assets, either nonhuman (e.g. equipment, real estate and financial assets) or human (e.g. training, experience and skills), or the superstars among us that have special talents (or luck) (e.g. famous soccer players, singers and CEOs) [103]. We cannot speak of inequality without considering the racial inequality. If we take the United States as an example, Native, African and Latin Americans have a Human Development Index value lower than that of Asian and White Americans. Taking the inequality between White/Asian and African Americans, the difference between the value of several social indicators such as life expectancy, wages, education, employment and incarceration show a startling disparity among these racial groups [102].

Some advances have been made in reducing racial inequality. In the US, for instance, the white-black gap in high school completion rates has been reduced. Meanwhile, other indicators show that little change or even a worsening of the inequality. This is clear in the case of household income: in 1967, the

median adjusted income for households headed by whites was US\$ 44,700 and by blacks was US\$ 24,700; 2014 data shows that this gap has widened as the first group income went up to US\$ 71,300 while the second raised to US\$ 43,300 [104].

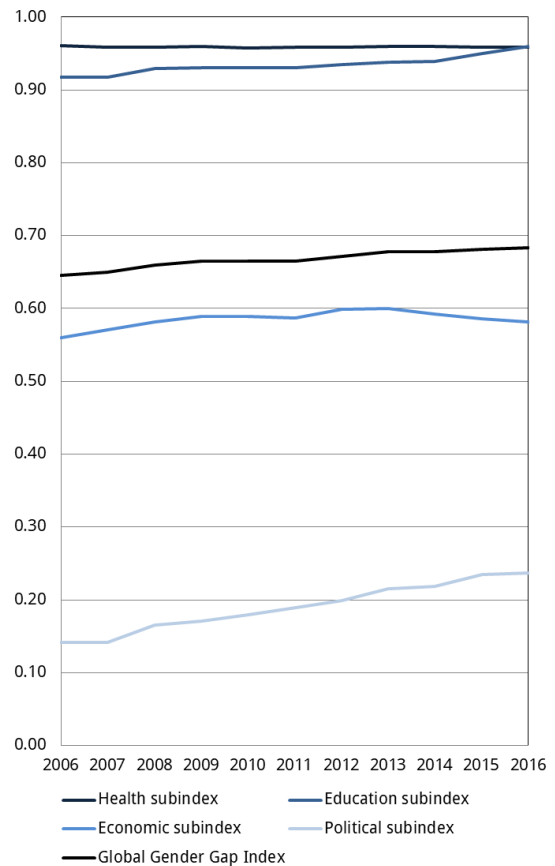


Figure 4: Global Gender Gap Index and subindexes [101].

Another minority that has been fighting for its rights is the lesbian, gay, bisexual, transgender and intersex (LGBTI). Since sexual orientation is still a taboo theme in several countries there is not much data about it making evidence-based

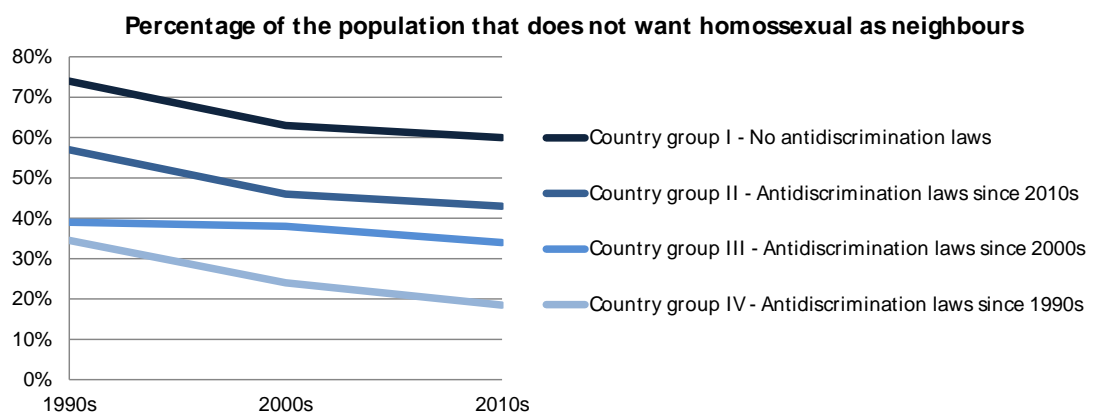


Figure 5. Advances in tolerance as countries establish antidiscrimination laws [102].

policymaking very hard. Still, what is known about this subject shows a bleak picture as only ten countries grant equal constitutional rights to the LGBTI group and 73 countries consider same-sex sexual acts illegal from which in 13 these acts are punishable by death. These facts show that there is still much to be done for LGBTI rights before we can call our society equal. Antidiscrimination laws provide a powerful tool in making people's attitudes towards the LGBTI community more tolerant as Figure 5 shows [102].

5.3. IS UNIVERSAL BASIC INCOME A SOLUTION?

Universal Basic Income (UBI) can be defined as an income paid by a political community to all its members on an individual basis, without the need for means or labor requirements [105]. This concept is also known as Unconditional Basic Income [106]. For McGahey [107], social welfare states face challenges of economic growth and employment, consequences arising from rising costs of benefits, demographic changes and job losses caused by information technology and computerization. Such a combination pressures societies to explore new ways of offering welfare benefits, or building a new outlet for this problem.

Faced with this scenario, McGahey suggests exists a path towards the introduction of a UBI as a floor to provide a basic level of subsistence as a complement to existing policies of the welfare state, or in some cases as a substitute for the welfare state [107].

Esping-Andersen advocates a classification into three categories of care states: Liberal; Conservative or Corporatist and Social Democrat [108]. Thinking of forms

of regimes, implemented by nations, UBI would play out differently in each of these regimes, and in relation to the diverse set of existing policies in each [107].

In the other hand, the Institute for the Future¹⁰ understands that Universal Basic Assets (UBA) is a fairer way of challenging inequality. The UBA is a core set of resources that everyone should have, including housing, education, healthcare and financial security and has been proposed as a way to avoid economic disasters by properly assessing and distributing our resources to meet the needs of each person. It can be seen as an evolution of the UBI concept, which gives each citizen a fixed amount of guaranteed money, regardless of how much they earn [109].

Recent UBI experiments include Finland, in which 2,000 unemployed people between the ages of 25 and 58 will receive a basic income of €560 a month for two years [110]; and Ontario (Canada), in which approximately 4,000 people will receive a complementary basic income up to C\$ 16,989 per year (C\$ 24,027 for couples) – while keeping other previous benefits [111]. Switzerland, in its turn, massively rejected a UBI proposal of CHF 2,500 monthly for every adult Swiss citizen in 2016 [112].

6. THE ECONOMY WILL GROW FASTER

The economy in 2050 will be highly influenced by demographic changes that are occurring right now. The world population is currently about 7.6 billion people and, by 2050, can reach about 10 billion people distributed across the five continents [113]. This increase in the world's population will represent a challenge to societies as

¹⁰ <http://www.iftf.org>

hundreds of millions of jobs will have to be created [113].

Following the demographic tendencies, a phenomenon called the "Rise of The Rest" is predicted by some studies [114] [115]. This phenomenon describes the shifting Gross Domestic Product (GPD) from developed countries to developing ones. Today, we already see the global economic activity shifting from the G7 to the G20, this means that developing countries are increasing at a larger rate their technology, capital and people [114] [115].

Countries like Brazil, China, India, Indonesia and Mexico are likely to grow their GDP an average of three to four percent per year [115]. Mexico and Indonesia are likely to be economically larger in terms of GDP than the United Kingdom and France while Pakistan and Egypt could overtake Italy and Canada on a Purchasing Power Parity (PPP) basis. In terms of growth per year, Vietnam, India and Bangladesh can be the fastest growing economies from now to 2050. Figure 6 shows the projected average GDP growth from 2016 until 2050.

The economic change of industries and manufacturing will progressively bring industrial services in retention, education, social welfare, business and financial services. The emergence of service systems

could be characterized by the low-paid low-skill manual job, with wage proportional to the production, especially in the private sector [92].

The development of emerging markets will create many business opportunities. These opportunities will arise as these countries progress into industries and engage the world with their growing population. Even on 2050, the population from developing countries will be younger than the ones in developed countries [115].

On developed countries, population ageing distribution is shifting towards older ages. In these countries, birth control methods are helping to reduce the number of born children and the elderly population is living even more because of the advances in technology. On developing countries, the effects of the population growth problem are much harder to observe, because this change is happening at a slower pace. As people live longer, they will have to continue working to make the pension schemes affordable and this will probably cause some negative effect on youth employment.

The number of people in the cities will also grow, for two main reasons. First, the total population on Earth is growing, and second, people living on rural areas are migrating to urban areas – large and

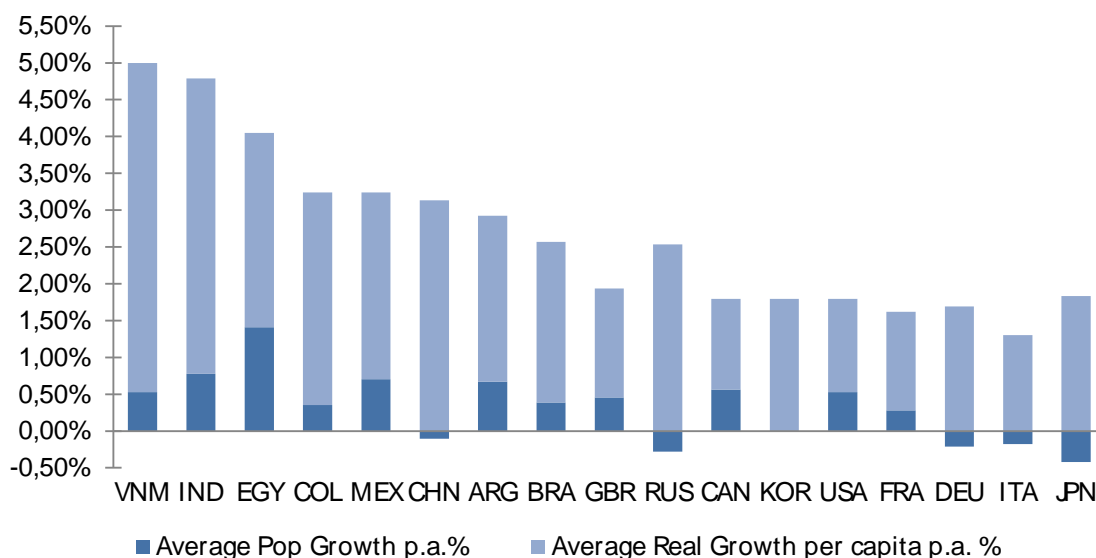


Figure 6. Projected average real GDP growth 2016-2050, from [115].

medium cities. By 2050, 86% of the developed countries' population, and 64% of the developing countries' population will be urbanized. This behavior shows some negatives and positives trends, urbanization may cause unplanned growth of cities, health hazards caused by air and water pollution and unemployment. On the other hand, urbanization can bring reduction to expenses on transports, education and create diversity [113].

By 2050, part of the workforce will be automated to better suit the new world market. Tasks like translation, legal research and low level journalism will be done by machines [115].

Most of the difficulties for automation today are the areas where the income wage is already low. For instance, areas such as fast food, retail and telemarketing keep automation at bay because of the prices of the automation equipment [116]. However,

the technology will become cheaper and the tradeoff will make sense. Table 2 shows the probability of automation of a set of jobs in the next decades [36].

The changes in work and technology derive another tendency for the future, the inequality [113] [116]. There are many types of inequality, like of rights, access, participation and protection. Some of them are widespread across the countries and others are more likely to be seen on non-democratic countries.

Income inequality is easy to perceive in the future of automation. Fewer jobs, combined with the higher skill level required for the existing ones, reduce the space for the "average worker". Also, while some countries are rapidly growing, some of them are not growing at all, increasing the gap between developed and underdeveloped countries [116].

Table 2. Jobs with higher probability to be automated, adapted from [36].

Job	Probability
Recreational Therapist	0,28%
Orthotists and prosthetists	0,35%
Athletic trainers	0,71%
Clergy	0,81%
Chemical engineers	1,7%
Civil engineers	1,9%
Lawyers	3,5%
Software developers	4,2%
Petroleum engineers	16%
Concierges	21%
Biological technicians	30%
Judges	40%
Historians	44%
Commercial pilots	55%
Librarians	65%
Bartenders	77%
Security guards	84%
Nuclear technicians	85%
Butchers and meat cutters	93%
Nuclear power reactor operators	95%

Inequality has significant implications on the macroeconomic stability on 2050 as it tends to concentrate the power in the hands of the few. Inequality can lead to suboptimal use of human resources, cause investment reduction, and political and economic instability [116].

6.1. IS KNOWLEDGE THE KEY?

The economy today is very labor intensive. A high number of firms and workers in Africa, Asia and Latin America are linked to the global economy on heavy export-oriented industries such as agriculture, clothing and technology [117].

In the information age, Internet and other Information and Communication Technologies are creating a network of information and knowledge. This allows workers to be more cooperative among them. The intellectual property is going to be less relevant in an environment in which innovative companies are getting their innovations from outside the firms and it has been based on the social cooperation [118].

On the other hand, some authors consent that in the twenty-first century, emerging countries, especially Brazil, Russia, India and China (BRIC), strengthen their own national system of innovation creating new Intellectual Propriety (IP) for problems that current technology-exporting countries find so daunting [119] [120]. Developing countries can find an opportunity to lead the creation of new IPs while exploiting technologies and challenges that developed countries and avoiding to commit the same mistakes of the developed countries [119].

The growing number of IPs in the developing countries can cause some harm too. The great number of new patents and IPs can cause a scenario of choking and blocking of the technology creation [119]. This phenomenon, caused by low standard IPs, can be avoided by the creation of new, and more rigid standards for registering a new patent, and causing an over-protection of the IPs a country currently holds [119].

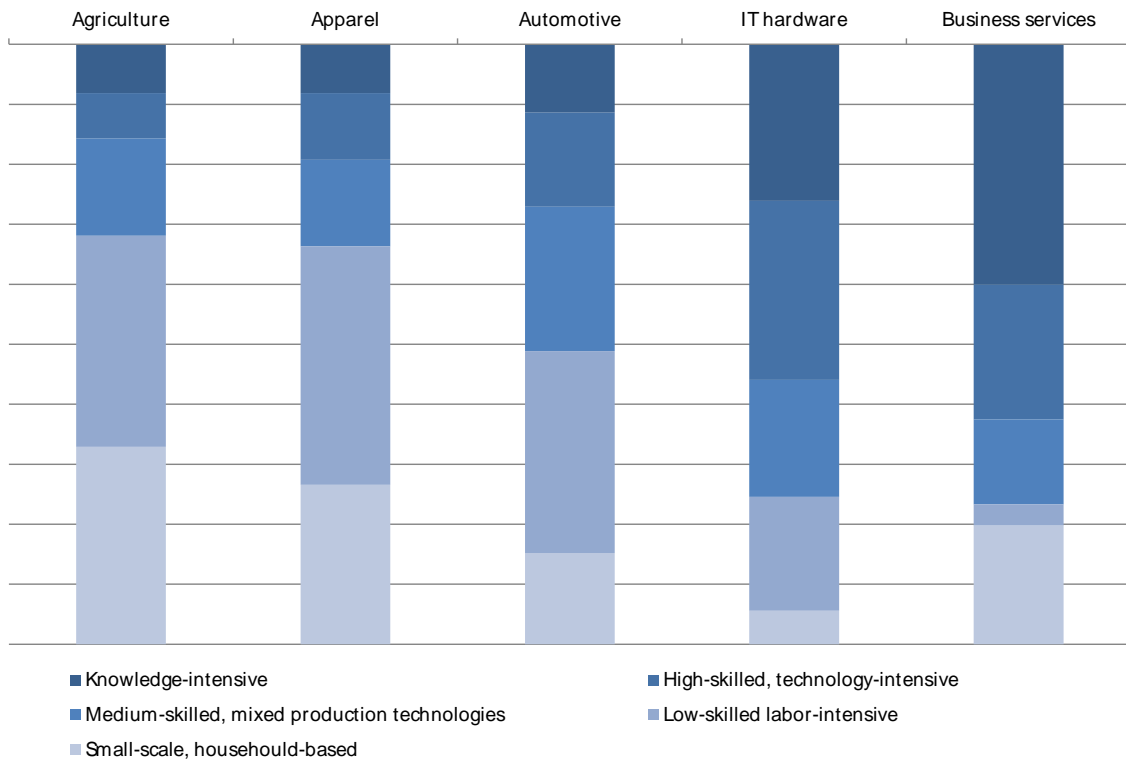


Figure 7. Workforce composition across different Global Production Networks, from [117].

The work, in the economy of 2050, changes from a high-skilled, technology-intensive work, which emerged in 1980, to a knowledge-intensive work. Knowledge-intensive services started with simple jobs, but now includes advanced business services, like finance, accounting, software, medical services and engineering [117]. These types of jobs are seen as an opportunity for developing economies to reap technological and social benefits from technological learning, knowledge spillover and higher incomes. Figure 7 shows the increasing share of knowledge-intensive works on different Global Production Networks.

Knowledge-intensive careers provide fewer jobs when compared to other types of work. They require very high skills and advanced degrees, mainly in the fields of science and engineering. The unskilled and less-educated majority in many countries is

excluded from the very desirable employment opportunities provided by the knowledge-intensive work [117].

6.2. WILL AUTOMATION DESTROY OR ENHANCE THE ECONOMY?

Technology alone will not determine economic results in terms of growth, inequality, or employment. All leading economies have had access to similar levels of technology, but have had very different outcomes throughout history because they have had different institutions and policies [121].

Although today less than 5% of the occupations can be fully automated [14], the increasing automation will affect almost all occupations, not only factory workers and employees, but also landscaping gardeners and dental laboratory technicians, stylists, insurance sales representatives and CEOs to a greater or lesser extent.

Technological progress is the main driver of *per capita* GDP growth, allowing output to rise faster than labor and capital. Increases in labor productivity generally translate into increases in average wages, giving workers the opportunity to reduce working hours and offer more goods and services [121].

These economic benefits, however, will not necessarily be evenly distributed in society. For example, the 19th century was characterized by technological changes that raised the productivity of less skilled workers relative to that of high-level workers [121].

In the United States, about 46% of the time spent on work activities in occupations and industries is technically automatable, based on current technologies. On a global scale, it is estimated that the adaptation of the currently developed automation technologies could affect 50% of the working hours in the global economy [14].

This automation potential corresponds to the equivalent of 1.2 billion workers and to US\$ 14.6 trillion in wages. Among countries, the potential ranges from 41 to 56 percent, with only four countries – China, India, Japan and the United States – accounting for just over half of all wages and workers [14].

The effects of AI will be felt unequally by the economy. New jobs will be created directly in areas such as the development of AI, as well as indirectly created in a variety of areas across the economy, as higher revenues lead to demand expansion [121].

The economy has repeatedly shown to be able to cope with this scale of change, although it depends on how quickly changes occur and on what concentrations of losses on specific tasks [121].

6.3. WILL THE ADVANCES IN TECHNOLOGY INCREASE INEQUALITY?

Advances in technology are going to change the dynamic in the labor market. Automation will increase unemployment and that will aggravate inequality [122]. On the other hand, there will be other ways to organize production. Alternative, sharing, social, green and creative economy will become more popular. Social banks will support these initiatives. For that reason, poverty is going to decrease and people will need to be able to reinvent themselves for finding alternative methods to make money [123].

The race between institutes and technology will force companies to reinvest money in expensive machines. The competition between small companies and big companies is going to be unfair due to investment power differences. In this scenario, small companies are going to close their doors and big companies are going to control the Market dynamics [124].

Academy and government are important pieces in that discussion. They have responsibility for creating and fomenting technology, respectively. New technologies may be used as a mechanism to reduce inequality between companies and between people. The Academy can invest in new ways of learning and the government may create regulation for the society and markets [99].

Basic income is a policy that may be created by a government in order to decrease inequality – minimum wage is a common example of this type of social policy. This subject is much debated among specialists in the area and is also controversial. In a very short and reduced explanation, some of them, more liberal,

consider that basic income and minimum wages can cause a disequilibrium in the labor market [125]. One of the consequences is inflation. In the other point of view, minimum wages and basic income are an important public policy to reduce wage inequality and to have more equality between people. Some studies consider that basic income and minimum wages can accelerate the market through stimulated aggregate demand [126].

PART 2:

A VIEW OF FUTURE WORK IN 2050

In this part, we develop three scenarios for the Future Work: the optimistic, which considers the best outcome for all trends; the pessimist, which considers the worst; and the likely, which considers the trends we judged most probable.

Optimistic Scenario

Pessimist Scenario

Likely Scenario

7. OPTIMISTIC SCENARIO

In this scenario, we present an optimistic foresight in how working will be in the year of 2050. Using the trending changes identified in the *Key Trends of the Future*, we present our view for the next years if the best of the changes come to be.

7.1. AUTOMATION

In this scenario we will not reach the singularity – a point where AI triggers an *intelligence explosion*, but on the other hand, we will absorb a strong impact on the way of processing data and information more quickly influenced by quantum computation. Artificial Intelligence will be controlled by global and democratic regulations among nations to prevent their undue use as the domination of humankind by machines. Artificial Intelligence will provide a scenario in 2050 of profound changes in work, replacing humans with robots and software in various areas, especially in tasks that do not use critical thinking and the accumulation of knowledge acquired by human learning experiences.

In this way, humans will adapt to a new reality of man-machine synergy in the workplace. The collaboration and co-creation of ideas and tasks will open up new opportunities for work with a deep balance in the management of natural resources.

The concept that automation eliminates jobs will disappear, since humankind could observe for at least a century that the death of most professions is usually related to the birth of new ones. And these new professions tend to have a better income, because they are often more knowledge-based than the previous professions. Therefore, the automation will produce increased production and consumption.

With the value saved in automation, the company can produce more and with more attractive products, inducing an increased consumption, which generates new jobs. More jobs opportunities will induce wage increase, which induce more consumption and investment. Finally, more consumption induces the production of goods, creating more jobs, in a virtuous circle.

With companies being able to earn more money from the same number of workers, they can theoretically increase the benefits for those workers. If they prefer to lower the prices, these workers can buy more goods with the same amount of money.

Automation does not come to make human work obsolete, but rather facilitate it, by replacing parts of jobs. In the future, we will have plausible metrics to help young people deciding between professions that will be ranked according to their automation potential.

7.2. EMPLOYMENT

In this scenario, both governments and companies will recognize the need to train workers that will lose their jobs due to automation and will find ways to do so predictively. This will allow society to reap the benefits of automation such as reduction of the cost of living and elimination of repetitive and risky jobs while reducing the impact of technological unemployment.

Companies will accept that reduction and flexibilization of working hours are necessary to keep most of the population employed. Governments will be prepared to educate people for new careers while providing a Universal Basic Income or Universal Basic Asset, which will allow people to have their most basic needs tended to even when not working. To assist both

workers in improving their employment conditions and adapting to new circumstances, unions will find ways to modernize themselves. The geographical separation between workers in the future economy and the rise of the Non-Standard Forms of Employment will be counteracted by ever improving worker organization that keep informed of the trends in employment and use the same technology that disrupt work for their benefit.

Globalization will reach its most beneficial potential with workers dispersed around the world collaborating via computational tools such as augmented and virtual reality. This computer-mediated work will allow people to do more homework bringing workers closer to their families and neighborhood lives and, more importantly for the globalization impact, they will not need to leave their home countries in order to find work.

7.3. EDUCATION

We can see as a consequence of the trending changes and advancements of education, learning will be mostly self-taught, there will be easy and fast access to high quality education, alas the education will be even more specialized and knowledge-intensive generating a deep improvement in the workforce that will be more qualified.

With the increasing personalization of education and its importance to the new jobs needs, self-taught provides a higher adaptability to the worker. Rather than having a teacher to guide the student's education, we will see most people searching for their own education by themselves. Technological advancements and its integration with education will provide easy access to knowledge for

everyone. These changes will not only be present they will be the base of future education. Another reason for this change is how people will have more free time, as jobs become less demanding in work hours, this will lead to people investing their free time in acquiring new knowledge to be ready for the changes in their work, and changes of job, which will be very much common.

As the world becomes increasingly more technology-dependent, the education will adapt itself to this new world. STEM education will grow with importance, as STEM jobs will be more common in the future world. Therefore, this technology integration would change education not only by grafting it on this new way of living, but by changing its core, and thus leading to the adaptation of the old education systems into new ones, that better fit this new core.

As this new education will be highly structured, there will be little need of regularization or incentive by governments. However, as we make the shift to this new education we still need the government to assert that the high quality of education remains.

7.4. SOCIAL WELFARE

In this scenario, people will be able to retire early and there will be income for people to spend on education and culture in their free time.

Natural and fundamental rights are preserved and expanded. With the use of technology, participatory democracy broadens and allows minorities to be protected, reducing social inequalities. The Universal Basic Income will be implemented. Countries are moving to cheaper and sustainable energy, allowing greater savings in the operation of machines, devices,

objects and computers. The population's income will provide the basic needs of food, housing, health and education and will allow investments in others such as leisure and fun.

Satisfaction and human well-being will be mediated through social networks. In this way, the government and society, together, will design a new Social Welfare and find the necessary balance through a game where learning, innovation, research and science are developed, generating a change in their mindset.

7.5. ECONOMY

In this scenario, developing countries start to grow even faster until 2050: countries on G20 grow their GDP at an average rate of three to four percent a year and the top economies of the world change. Countries like Brazil, Indonesia, India and Mexico closes their technology gap with the developed countries, increasing their GDP and creating a favorable environment for new business opportunities, allowing their population to engage on the new opportunities.

All this advancement in technology is extremely important for workers, as it helps them to develop and update their knowledge and skills. In a world where everyone will have access to the internet, the ability to learn new things from open and free learning platforms will reduce the unemployment impact, because people will acquire new skills, mitigating the technology unemployment. Thus, these technological advances will slow down the growth in inequality, the creation of new jobs and people having more free time to spend with family and to have fun.

In 2050, the rapid growth of the global population also starts to decrease and the population stabilizes around ten billion people. With the increased population number, more cities start to appear. People start to migrate from larger cities to smaller ones, with better living conditions. The urbanization tends to reduce transportation, health and infrastructure costs, which allows the government to provide better conditions to the people. New cities also tend to offer better job opportunities and allow most of people to get in touch with the emerging technologies.

8. PESSIMIST SCENARIO

In this scenario, we present a pessimist foresight of how working will be in the year of 2050. Using the trending changes identified in the *Key Trends of the Future*, we present our view of the upcoming decades if the worst is to happen.

8.1. AUTOMATION

In this scenario, technology will advance quicker than predicted by becoming increasingly cheaper resulting in a high unemployment rate as employers see the benefits of changing their expensive workers for more productive machines. Public policies to help citizens dealing with this scenario will not be created leaving a big portion of society out of the job market.

The owners of the robots and algorithms that caused technological unemployment will "own the world" selling their products to the elite that is able to work.

Therefore, new technologies such as IoT will not fulfill its expected growth because of the lack of demand, which raises its costs. Governments and companies will fail to realize such technologies' potential for the

improvement of productivity in industrial applications or for the betterment of cities by the use of smart sensors, for instance.

8.2. EMPLOYMENT

In this scenario, societies will face technological unemployment mainly due to computerization – advances in Artificial Intelligence and Robotics. As many careers cease to exist, most individuals rely solely on governments to prepare them for new jobs but this faith proves to be a wrong one as not even the government knows what can be done to create new occupations that are economically viable.

This will lead to the rise of an “extremely poor class” that is economically irrelevant to society in that they neither work nor consume. Meanwhile, the ones that control the machines that produce most of the wealth in the world will form a super elite, even richer and more powerful than the top 1% as we know it. The super elite will reap the benefits of automation and jobless growth making inequality even higher than in present with the increase of poverty.

As wars continue to be waged – mainly on the Middle East – and climate change makes few coastal regions uninhabitable. Thus, immigration is expected to increase causing impacts in the places that receive these fluxes such as higher unemployment rates and lower average wages.

Furthermore, the intensification of the globalization of the workforce will increase immigration from poorer countries to richer ones. In this scenario, the loss of jobs to foreign workers will be made easier by advances in IT, which will allow companies to hire workers from wherever they cost less.

Companies will not reduce working hours making some women feel that

working conflicts with their interest of having children and the elderly are unable to find jobs because they need more time than young workers to take care of their health, spend time with the family and rest.

The reluctance of changing working hours creates a phenomenon where a small group of people works 8 or more hours while a great number of people do not have a job or are neglected to gig to survive.

The rise of new Non-Standard forms of Employment will create a plurality of types of work contracts and many workers will not have any type of contract with their alleged employers. This will be a problem for labor rights, which will cover a smaller group of workers than it does today. The workers deprived of labor rights will see themselves in an insecure situation as their employers do not recognize them as part of companies but as independent contractors.

Few companies will dominate markets such as personal transportation and crowdsourcing allowing them to impose the rules above on (or supported by) any government power. As a result, workers in new NSEs will not be able to unionize themselves despite their attempts to do so. Being harder to fight for better working conditions will make these workers enter in a downward spiral with respect to their labor rights.

8.3. EDUCATION

In this scenario, education will not develop at the same pace as automation. Most new jobs will require knowledge and skills that very few people have. The personalization of the education will increase, but it will be insufficient for the students to receive an adequate education. The personalization will not work because

the schools will have not build the structure to treat the students with individual needs, interests and preferences.

The traditional model of education, which ignores the different needs of the students, will prevail. The schools that will be trying to use personalization will significantly fail. As result of this, the improvement of education will not be supported by the government creating insecurity and disbelief that it could work.

Furthermore, with the advances of automation and new jobs, news skills will be required. Most workers will not have developed skills such as managing people, solving problems, critical thinking, and the common cognitive skills. Self-employment becomes the principal and maybe the only, way for work due to the conditions economic and the demand of jobs.

The demand of skilled labor becomes a crucial element in the economy and the Government will not able to deal with this problem. Government will not guide workers to educate for new careers.

Due to the expected demand, the people will need to receiving appropriate education and training for work. The group of people with advanced education and training will be a part for all and they will not be able to occupy new jobs created. Despite the advances of technology, part of population will not receive the equal access for education and training because this advance will not achieve everybody. Some people will be to continue receiving a bad education either training or none of training to adapt for change jobs rapidly.

Open Access initiatives will fail due its high costs, increasing the number of people unprepared for to work. Besides, MOOCs will

be unsuccessful for part of population because for accept this kind of platform the technology must be integrated with people and Government needs to interfere. Only part of the population with a minimum technology are going to receive this accept and they will occupy the jobs, concentrating the labor with them. The MOOCs such other forms to learn will not be regulated from Government, decreasing the quality of the service.

This unfair access to information will hamper the knowledge acquisition process and reinforce the unpreparedness for most people. The knowledge-intensive jobs will be rare expensive because of this inducing the significantly difference between demand and offer. This cost raise will difficult the entrance of new competitors – reinforcing the existing elite. Although the delays of technology, the automation will change working hours, giving more free time for workers. They will not invest the new free time in education for being able to occupy new jobs and the changes of careers, increasing the inappropriate labor.

The area of STEM will grow up, especially the study of math and computers, but this process will not prepare people for all skills requirement for them work. Due to the delays of technology and poor regulation of Government in education, the professionals of this area will not receive appropriate training and education for act in jobs. Generally, this professionals are known for possess critical and innovative thinking but this skills will be forgotten, focusing only in technology. It will form disable professionals for developed products and services looking after the needs of the new economy and people.

8.4. SOCIAL WELFARE

In this scenario, advances in health combined with an abundance of products and services due to automation will allow the richest stratum of society to live longer and better lives. In contrast, the portion of the population that does not have access to this high-quality life will age with a poor health condition.

The inequality between these two groups will not stop there. As policy makers perceive the aging of the population, they will amend the legislation to increase the retirement age. As the elderly remain in the labor market longer to be eligible for a pension, it will be harder for young people to find job opportunities and will end up as part of the “extremely poor class”.

The trend of rising inequality that has been perceived in the past decades will continue in the future as governments do not raise taxes on heritages and regressive taxes keep on being adopted in some nations. The concentration of money and, consequently, power in the hands of the richest (1% and 0.1%) is aggravated by automation and jobless growth as a small portion of the population will own the means of production while some people will not even have a job.

Inequality between countries will also become worse as the Middle East is plagued by wars and most countries in the African continent do not participate in the new digital economy. Meanwhile, advanced economies such as England, Germany, Japan and the USA will control the technology being created and the data being produced worldwide allowing them to control the world economy.

Besides economic inequality, gender inequality will also increase as reactionary movements get in the power and seize the rights acquired by women in the past decades. Other minorities, such as afro-descendants, and immigrants, will suffer as alt-right, and supremacist movements get more support. In this wave of conservative thought, LGBTI community will also see almost no advancement of their rights – and possibly some regress. As countries face rising inequality, nationalist groups will increase in power and, as seen previously in history, immigrants will be pointed as responsible for all the evils in the developed countries. Wars, climate change and increasing poverty will intensify immigration adding more fuel to the xenophobic movement.

Ideas such as Universal Basic Income and Universal Basic Assets will not gain strength and will not be applied in most countries. This will only worsen the situation of the portion of society unable to find a job, which will be left to starve. Part of this “extremely poor class” will not accept their situation in the economy, creating a security problem for governments as crimes rates increase.

Machines will have a strong role in imposing rules on the population. Given the great social inequality, laws and security will be realized through machines. The game will have a major imbalance for the poorest as it will be developed by governments, which will be strongly influenced by the big corporations.

8.5. ECONOMY

In this scenario, the economy will continue growing faster; however HDI (Human Development Index) will not increase as GDP (Gross Domestic Product).

This will decrease the social equality, directly affecting public services in areas such as health, education and security. Inequality will reduce the macroeconomic stability and concentrate power in a – even smaller – minority.

The harder access to education will divide the society in two: those that can pay for education and those who cannot. The first group will be capable of competing for jobs in a shrinking market while the second group will have to fight for survival doing any kind of work that appears. This situation will further increase the inequality taking it to new records and testing the limits of governments to maintain society's order.

Some countries will grow up faster with the advances in technology but some of them will not grow up. That will increase the gap between developed and undeveloped countries. The undeveloped countries will not be able to invest in modern technology and the necessary education. Thus, they will not prepare the workers for new careers, creating a difficult obstacle to the development of these countries.

Urbanization will grow up in an unplanned way. The people living in rural areas will migrate for cities looking for a job and probably will not find them. As a result, people unemployment will increase in cities. The environment will be altered because of the advances of technology and industries without the correct regulation from the government. The quality of air and water pollution will cause health hazards.

9. LIKELY SCENARIO

In this scenario, we present a likely foresight in how working will be in the year of 2050. Using the trending changes identified in the *Key Trends of the Future*, we

present our view for working in 2050 if the most probable trends come to fruition.

9.1. AUTOMATION

In this scenario, the advancement of automation will result in the substitution of a portion of workers by machines and Artificial Intelligence. The benefits generated by these substitutions are considerable and will promote widespread improvements in society, e.g. healthcare and transportation costs reduction, safer roads, and fewer human-mistakes on health care treatments. Meanwhile, even considering the benefits provided by automation, the government will keep an eye on the unemployment rates in order to keep it controlled while promoting economic growth. The balance between automation and society demands is the key point to establish a virtuous circle in the automation expansion.

Governments will promote regulatory policies, in order to control the balance of the advancement in industry automation without locking it up and avoid the side effect of mass unemployment (or at least contain its fast growth). Such policies will aim at protecting vulnerable people who will not be ready for this transformation. In a first moment, only jobs that involve a high creativity load will remain unaffected because of the lack of technology to emulate this behavior on AI. Governments and institutions will be able to contain this effect by investment and strengthening of education, with the aim of teaching new jobs in areas that will emerge. Thus, governance institutions will be able to play a key role in this scenario as mediators between technology advances and people needs.

Technologies such as IoT will continue to grow along with its demand. The demographic change is one of their drivers.

People living on rural areas are migrating to urban areas. For that reason, there will be opportunities for IoT, Big Data and mainly for Smart Cities – topics already under discussion. Human, Smart and Sustainable will be keywords for cities in the future. Smart Cities is a term used since the 1990s when a big movement claimed new politics for urban planning. Companies have been using this term for the integration of the infrastructure and urban services, and will be a trend for the next 30 years. On one hand, automation will help cities to be more connected and smart.

9.2. EMPLOYMENT

In this scenario, new opportunities will arise from computerization, with better services and products being delivered but, at the same time, a portion of society will lose their jobs, being forced to look for new ones even if not prepared for it. Companies and governments will take precautionary measures to reduce the social cost of automation to society avoiding a collapse of the economy.

Computerization will cause the reduction of low-skill and low-wage jobs. Most of these people will face unemployment and companies will be stimulated to reduce the transition impact, training their workers in new skills before complete automation of these jobs. The government will provide them a basic income. This smoother transition will cause fewer damages to society, as people will keep consuming and the economy remains stable.

Communication will be improved globally as easier access to optic fiber extensions and wireless technologies will cheapen the access to internet in most countries. There will be a better integration

between international and national markets. More people in different countries will be able to work by the internet, but the quality of outsourcing job will not increase and the prices will be the same as it is today.

The most developed countries will be able to automate the low-skill jobs, but the most part of developing countries will not be at the same pace and they will use their low-skill workforce for outsourcing. Local markets in developed countries will keep their demand of medium and high-skilled people – however, computerization will replace most of low-skill jobs. On developing countries, the demands that require lower skills or repetitive work will be either outsourced to the international market – from even poorer countries – or computerized as soon the prices become affordable to these economies.

The government, motivated by the risk of reduction of the consumer market, will promote the flexibility of working hours, increasing the employment rate and the economic growth. The medium and low-skilled workers that keep their jobs will face a reduction from the traditional 40 hours to 32 hours per week, gaining more time to use as desired. This change will reduce the salaries. To high-skilled workers, the flexibility will be an option considering that they will be a scarce workforce and the wage will be open to negotiation.

After a period of job insecurity and a series of disputes between Non-Standard forms of Employment (NSE) workers and their employees, the new types of work contracts will be better regulated in order to provide minimum rights. These changes on regulation tend to improve the quality of services and reduce the conflicts between employers and employees on this job category

Considering the new forms of employment, workers will not necessarily be associated to traditional trade unions as the ones we know. It will take some time for these movements to be recognized by employers and by governments, but as soon as it happens, this movement will create ways most focused on the representation of workers and employers' interests, creating gains for both sides.

9.3. EDUCATION

In this scenario, the provision and diffusion of MOOCs will allow a transition to a "customized" status of the education process, taking into account individual needs and pace of learning; though it does not mean the complete dismissal of the teacher role, which can act as a tutor in this environment. Monitoring and regulation will be required for this new methodology, in order to avoid break or conflict with traditional educational models, and the government will take a key role in this function. This transition will be gradual, with technology serving and integrating with current methods — which already happens today, on a smaller scale — and progressively assuming its protagonist role in this future new schema.

Such progress will have consequences in the labor market. Training of workers will be deeper in knowledge, allowing their adaptation to knowledge-intensive jobs, which are the strongest trend for the future; again, governments can take a key role by helping and align the education with market needed skills. Additionally, personalization of education methods and trends of jobs automation will make possible a lower workload to the workers, allowing them free time to study and learn new skills, keeping them updated on new needs and opportunities in each time and continuously

in the future, as a movement of lifelong learning. Thus, a larger part of the population will be prepared to meet the needs of the new roles and jobs, however, the educational technology advances will not reach everybody, letting a small portion of workers marginalized from jobs that are more qualified.

Another important change is the influence of freedom of choice and learning versatility provided by the technology to the self-employment. In addition to a favorable scenario for collaboration and exchanges ("gig economy"), self-employment and entrepreneurship will increasingly take their place in the global labor market.

9.4. SOCIAL WELFARE

In this scenario, society will increase the demand for transparency and representativeness. The technological evolution in tools of information and communication will allow people to interact on the most diverse subjects discussed in the public field. Digital platforms, to provide discussion and voting spaces on issues related to social demands. This new model of participatory democracy will have to break with some barriers. The traditional structures of governments will use political power to resist change; legislative power (policy makers) will be the most impacted.

The most radical groups will polarize the discussions in the political arena. This phenomenon is a consequence of the greater dissemination of their ideas and convictions. Moderates, in contrast, will be attacked from both sides and, thus, losing part of their representativeness. Besides, minorities will also be able to join forces and empower themselves to confront social issues.

Broad dissemination of information and education will play important roles in promoting the protection of fundamental rights. The role of the government will be to promote discussions on the platforms and to provide citizens with the most impartial information as possible, so that digital democracy can be put into practice. In addition, it must execute, with the support and popular participation, the winning proposals.

With greater participation of the population in decisions, governments tend to increase the regulation of corporate actions, thus reducing the political power that large corporations have in the political arena.

The tendency for decisions to balance demand and supply will promote the reduction of working hours. Reducing the working day will have a major impact on how society will organize itself. Less working time will allow an increase in leisure time. People can use this time to stay informed and participate in the discussions of the various political agendas.

The population and organized groups will drive some adjustments and reforms in order to maintain the social balance. One example of legislation adjustment is the increased of the minimum retirement age, as the population ages. In this case, the government will play an important role in striking a balance between demand for jobs and supply.

Another important factor for the reduction of social inequality will be the distribution of income. By promoting increased taxation through progressive taxation in large corporations, in the great fortunes of the people and in the goods received by the heirs, the government can

distribute wealth to poorer sections of society, promoting a basic income for the most vulnerable. Because of its great impact on society, the Universal Basic Income should not reach its full potential and inequalities will continue to exist.

9.5. ECONOMY

In this scenario, countries like Brazil, China, India, Indonesia and Mexico are likely to grow their GDP an average of three to four percent per year. Mexico and Indonesia are likely to be economically larger than the United Kingdom and France while Pakistan and Egypt could overtake Italy and Canada on a Purchasing Power Parity (PPP) basis. In terms of growth per year, Vietnam, India and Bangladesh can be the fastest growing economies from now to 2050.

GDP will not be the best method to measure how fast a country is developing itself – others indexes are already being used, such as the Human Development Index (HDI). People will worry more about their quality of life. For that reason, HDI will be more relevant for the citizens. Some methods for measuring HDI, especially the ones that are related to well-being will be incorporated to the index. Developed countries might worry a bit more about well-being than the undeveloped ones. While developed countries will be on the top and worrying about well-being for their citizens, the rest will be still concerned about how fast they are growing their economies (based on GDP) per year.

In this scenario, the economy will be directly impacted by automation: it will increase unemployment and that fact may contribute to increase inequality. The government will be the main responsible in this role. The definition of new ways of working, basic income and new public

policies will be decisive tasks to the government. Countries that are prepared to it will succeed; the rest of them must learn how to deal with it. There is not a recipe. For that reason, the rules related to create new ways of employment and diversities of public policies does not apply to all countries.

Governments have to find ways to reinvent themselves, adapting to their specificities and building their own public policies, possible mitigating the automation effects. In addition, free market may also help society. There will be other ways to organize production. Alternative, sharing, social, green and creative economy will become more popular. Social banks will be important allies for that process. They can finance these initiatives, so that is important to create new jobs, moving economy and mitigating poverty.

Although a worldwide-growth scenario is positive, this scenario is the one that slow down the inequality increase. Inequality may be considered the gap between the richest people and the poorest people. In the future, government will have an important role in this discussion. It is the only responsible to regulate that. As GDP grows, if it stays in the hands of the market, it tends to concentrate in the hands of richest people. The government has to find out ways to deal with that. On one hand, government cannot be an impediment for market's growth. On the other hand, it deserves regulation and mechanisms to redistribute GDP among people. It is a fine line; each country will have to make your own policies according to their specificity. The one that insists in an extreme liberal economy could grow its GDP, but will increase its inequality and reduce other index like HDI.

The number of people in the cities will also grow, for two main reasons. First, the

total population on Earth is growing, and second, people living on rural areas are migrating to urban areas. By 2050, 86% of the developed, and 64% of the developing world will be urbanized. This behavior shows some negative and positive trends, urbanization may cause unplanned growth of cities, health hazards caused by air and water pollution and unemployment. On the other hand, urbanization can reduce expenses on transports, education and create cultural diversity.

Cities will be smarter and more connected. It will create a new market, which is already possible to see. Solutions for connected and smart cities are today a kind of a shy market. In addition, people will start working at home more than nowadays, heating the economy of home-office products. People on rural areas will migrate to urban areas. The opposite will also happen, but in a smaller level. Big cities will be crowded and some people will look for rural areas for retiring, for example. For that reason, rural areas are not going to be only for agriculture. Actually, this migration movement for rural areas will stimulate the local economy and will help to increase GDP and quality of life on rural areas.

REFERENCES

- [1] S. Albornoz, *O que é trabalho*, vol. 171. Brasiliense, 1988.
- [2] D. De Masi and M. S. Palieri, *O ócio criativo*. Sextante Rio de Janeiro, 2000.
- [3] P. Lafargue, *The Right to be Lazy: And Other Studies*. CH Kerr, 1907.
- [4] M. Weber, *The Protestant Ethics and the Spirit of Capitalism, republished with a new introduction by Anthony Giddens*. London: Allen and Unwin, 1930.
- [5] D. S. Landes, *The Unbound Prometheus: Technological Change and Development in Western Europe from 1750 to the Present*. Cambridge University Press, 1969.
- [6] A. Smith, *The Wealth of Nations*. Virginia: Thrifty Books, 2009.
- [7] K. Marx, *Capital*, vol. 1. Penguin Books, 1990.
- [8] F. Taylor, *Princípios de Administração Científica*. São Paulo: Atlas, 1995.
- [9] H. Ford, *My Life and Work*. CreateSpace Independent Publishing Platform, 2017.
- [10] H. Fayol, *General and Industrial Management*. Martino Fine Books, 2013.
- [11] M. Castells, *The information age: Economy, society, and culture. Volume I: The rise of the network society*. Oxford, UK: Blackwell, 1996.
- [12] K. Schwab, *The fourth industrial revolution*. Crown Business, 2017.
- [13] UKCES, "The Future of Work: Trends and disruptions," UK Commission for Employment and Skills, UK, Full Report, 2014.
- [14] McKinsey Global Institute, *A future that works: Automation, employment, and productivity*. San Francisco, California: McKinsey Global Institute, 2017.
- [15] X. Li and T. Zhang, "An exploration on artificial intelligence application: From security, privacy and ethic perspective," in *2017 IEEE 2nd International Conference on Cloud Computing and Big Data Analysis (ICCCBDA)*, 2017, pp. 416–420.
- [16] A. McAfee and E. Brynjolfsson, "Human Work in the Robotic Future: Policy for the Age of Automation," *Foreign Aff.*, vol. 95, p. 139, 2016.
- [17] J.-H. Chang and P. Huynh, "ASEAN in transformation: The future of jobs at risk of automation," *International Labour Organization Bureau for Employers' Activities, Working Paper*, no. 9, 2016.
- [18] J. Gubbi, R. Buyya, S. Marusic, and M. Palaniswami, "Internet of Things (IoT): A vision, architectural elements, and future directions," *Future generation computer systems*, vol. 29, no. 7, pp. 1645–1660, 2013.
- [19] L. Chen *et al.*, "Robustness, Security and Privacy in Location-Based Services for Future IoT: A Survey," *IEEE Access*, vol. 5, pp. 8956–8977, 2017.
- [20] F. J. Riggins and S. F. Wamba, "Research directions on the adoption, usage, and impact of the internet of things through the use of big data analytics," in *System Sciences (HICSS), 2015 48th Hawaii International Conference on*, 2015, pp. 1531–1540.
- [21] J. Crump and I. Brown, "The societal Impact of the Internet of Things," in *BCS workshop on the Internet of Things, the Chartered Institute for IT*, 2013, vol. 14.
- [22] R. C. Schlaepfer, M. Koch, and P. Merkofer, "Industry 4.0 Challenges and solutions for the digital transformation and use of exponential technologies," *Audit Tax Consulting Corporate Finance*, 2015.
- [23] X. Liu *et al.*, "Pinpointing Anomaly RFID Tags: Situation and Opportunities," *IEEE Network*, vol. PP, no. 99, pp. 1–8, 2017.
- [24] World Economic Forum, "The future of jobs: Employment, skills and workforce strategy for the fourth industrial revolution," 2016.
- [25] Roosevelt Institute, "Technology and the Future of Work: The State of the Debate," *Open Society Foundations*, 2015.
- [26] E. Störmer *et al.*, "The future of work: jobs and skills in 2030," 2014.
- [27] X. Chen and K. Xiong, "A Payment Scheme in Crowdsourcing," in *Communications (ICC), 2017 IEEE International Conference on*, 2017, pp. 1–6.
- [28] J. Mortensen and M. Vilella-Vila, "The future of employment supply and demand in social Europe," *Futures*, vol. 44, no. 7, pp. 671–677, 2012.
- [29] B. J. Taber and M. Blankemeyer, "Future work self and career adaptability in the prediction of proactive career behaviors," *Journal of Vocational Behavior*, vol. 86, pp. 20–27, Feb. 2015.
- [30] Y. Guan *et al.*, "New job market entrants' future work self, career adaptability and job search outcomes: Examining mediating and moderating models," *Journal of Vocational Behavior*, vol. 85, no. 1, pp. 136–145, Aug. 2014.
- [31] Y. Lima and Jano Moreira de Souza, "The future of work: insights for CSCW," in *Proceedings of the 2017 IEEE 21st International Conference on Computer Supported Cooperative Work in*

- Design (CSCWD)*, Wellington, New Zealand, 2017.
- [32] J. M. Keynes, "Economic Possibilities for Our Grandchildren," in *Essays in Persuasion*, Palgrave Macmillan UK, 2010, pp. 321–332.
- [33] G. Strawn, "Automation and Future Unemployment," *IT Professional*, vol. 18, no. 1, pp. 62–64, 2016.
- [34] A. Finkel, "Reflecting on the future of work in Australia: Pessimism, optimism and opportunities," in *Journal and Proceedings of the Royal Society of New South Wales*, 2015, vol. 148, p. 125.
- [35] E. Brynjolfsson and A. McAfee, *Race against the machine: How the digital revolution is accelerating innovation, driving productivity, and irreversibly transforming employment and the economy*. Brynjolfsson and McAfee, 2012.
- [36] C. B. Frey and M. A. Osborne, "The future of employment: how susceptible are jobs to computerisation?," *Technological Forecasting and Social Change*, vol. 114, pp. 254–280, 2017.
- [37] D. Bell, *The coming of post-industrial society: A venture in social forecasting*. New York: Basic Books, 1976.
- [38] G. M. Hodgson, "The Future of Work in the Twenty-First Century," *Journal of Economic Issues*, vol. 50, no. 1, pp. 197–216, 2016.
- [39] Voltaire, *Candide*. Simon and Schuster, 2005.
- [40] S. Khallash and M. Kruse, "The future of work and work-life balance 2025," *Futures*, vol. 44, no. 7, pp. 678–686, 2012.
- [41] European Commission European Political Strategy Centre, "The future of work: skills and resilience for a world of change." 2016.
- [42] E. Galinsky and K. Matos, "The future of work-life fit," *Organizational dynamics*, vol. 40, no. 4, pp. 267–280, 2011.
- [43] ANZ Chartered Accountants, "The Future of Work: How Can We Adapt to Survive and Thrive," 2016.
- [44] L. Gratton, "The future of work," 2010.
- [45] I. Stewart, D. De, and A. Cole, "Technology and People: The great job-creating machine," *Deloitte, London: UK*, 2015.
- [46] D. Tuffley, "Can intelligent machines in the workforce lead to a net gain in the number of jobs?," *Ecodate*, vol. 31, 2017.
- [47] A. J. Murray and K. A. Greenes, "Building the enterprise of the future," *VINE*, vol. 36, no. 1, pp. 38–44, 2006.
- [48] G. S. Franco Filho, "Mobilidade Humana e Futuro do Trabalho: Efeitos da Globalização," *Revista Direito UFMS*, vol. 1, no. 1, 2015.
- [49] C. K. Prahalad, *The Fortune at the Bottom of the Pyramid*. Pearson Education India, 2006.
- [50] N. Myers, "Environmental refugees: a growing phenomenon of the 21st century," *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, vol. 357, no. 1420, pp. 609–613, 2002.
- [51] G. Ryder, "The International Labour Organization: The next 100 years," *Journal of Industrial Relations*, vol. 57, no. 5, pp. 748–757, 2015.
- [52] White House, "Artificial Intelligence, Automation, and the Economy," *Executive office of the President*, 2016.
- [53] L. Drutman and Y. Mounk, "Will Robots Kill Democracy?," *The National Interest*, pp. 18–31, 2016.
- [54] N. Srnicek and A. Williams, "The future isn't working," *Juncture*, vol. 22, no. 3, pp. 243–247, 2015.
- [55] L. Maxin and J. Deller, "Activities in retirement: individual experience of silver work," *Comparative Population Studies*, vol. 35, no. 4, 2011.
- [56] M. O. Qureshi and R. S. Syed, "The impact of robotics on employment and motivation of employees in the service sector, with special reference to health care," *Safety and health at work*, vol. 5, no. 4, pp. 198–202, 2014.
- [57] ILO, "Non-standard employment around the world: Understanding challenges, shaping prospects," Report, Nov. 2016.
- [58] C. Petrie, "Predictions about the Future (of Work)," *IEEE Internet Computing*, vol. 19, no. 6, pp. 77–79, 2015.
- [59] G. Friedman, "Workers without employers: shadow corporations and the rise of the gig economy," *Review of Keynesian Economics*, vol. 2, no. 2, pp. 171–188, 2014.
- [60] A. Aloisi, "Commoditized Workers: Case Study Research on Labor Law Issues Arising from a Set of on-Demand/Gig Economy Platforms," *Comparative Labor Law & Policy Journal*, vol. 37, 2016.
- [61] S. D. Harris and A. B. Krueger, "A Proposal for Modernizing Labor Laws for Twenty-First-Century Work: The 'Independent Worker,'" *the Hamilton project, Discussion paper*, vol. 10, 2015.
- [62] V. De Stefano, "The Rise of the Just-in-Time Workforce: On-Demand Work, Crowdfwork, and Labor Protection in the Gig-Economy," *Comparative Labor Law & Policy Journal*, vol. 37, p. 471, 2016.
- [63] A. Ross and T. Scholz, "In search of the lost paycheck," in *Digital labor: The Internet as playground and factory*, 2013, pp. 13–32.
- [64] M. W. Finkin, "Beclouded Work, Beclouded Workers in Historical Perspective," *Comparative Labor Law & Policy Journal*, vol. 37, p. 603, 2016.

APPEAR HERE.

- [65] The Millennium Project, "Future of Education 2030," 2007. [Online]. Available: <http://www.millennium-project.org/millennium/Education-2030.html>. [Accessed: 20-May-2017].
- [66] M. Hall, M. Harrow, and L. Estelle, *Digital Futures: Expert Briefings on Digital Technologies for Education and Research*. Chandos Publishing, 2015.
- [67] Citi GPS, "Technology at work V 2.0: The future is not what it used to be," *Citi GPS: Global Perspectives & Solutions*, 2016.
- [68] M. Brundage, "Economic Possibilities for Our Children: Artificial Intelligence and the Future of Work, Education, and Leisure," in *Workshops at the Twenty-Ninth AAAI Conference on Artificial Intelligence*, 2015.
- [69] R. Wilson, "Skills anticipation—The future of work and education," *International Journal of Educational Research*, vol. 61, pp. 101–110, 2013.
- [70] B. P. Woolf, H. C. Lane, V. K. Chaudhri, and J. L. Kolodner, "AI Grand Challenges for Education," *AI Magazine*, vol. 34, no. 4, p. 9, 2013.
- [71] ITL Research, "21st Century Learning Design: Learning Activity Rubrics." 2012.
- [72] S. Leitch, *Prosperity for all in the global economy-world class skills: final report*. The Stationery Office, 2006.
- [73] K. Facer and R. Sandford, "The next 25 years?: future scenarios and future directions for education and technology," *Journal of computer assisted learning*, vol. 26, no. 1, pp. 74–93, 2010.
- [74] F. S. Tsai, "Engineering the Future of Education," *Proceedings of the IEEE*, vol. 101, no. 6, pp. 1268–1270, 2013.
- [75] C. Redecker and Y. Punie, "The Future of Learning 2025: Developing a vision for change," *Future Learning*, vol. 2, no. 1, pp. 3–17, 2013.
- [76] K. Harman and A. Koohang, "MOOC 2050: a futuristic tour," *Issues in Information Systems*, vol. 14, no. 2, pp. 346–352, 2013.
- [77] J. Slowinski, "What Will the Future of Education Look Like?," *BOOK REPORT-COLUMBUS-*, vol. 20, no. 4, pp. 18–21, 2002.
- [78] W.-L. Wu, Y.-C. Lee, and H.-S. Shu, "Knowledge management in educational organizations: A perspective of knowledge spiral," *International Journal of Organizational Innovation (Online)*, vol. 5, no. 4, p. 7, 2013.
- [79] N. Simões, N. Crespo, and S. B. Moreira, "Individual determinants of self-employment entry: What do we really know?," *Journal of Economic Surveys*, 2015.
- [80] OECD, *OECD Factbook 2015-2016*. Paris: OECD Publishing, 2016.
- [81] I. E. McDermott, "The Gig Economy: Working the Side Hustle," *Online Searcher*, vol. 41, no. January/February, 2017.
- [82] P. Glavin and T. Filipovic, "Reexamining the Pushed-Pulled Debate: The Antecedents and Consequences of Wage Workers' Transitions into Self-Employment," McMaster University, 2016.
- [83] K. Facer, "Taking the 21st century seriously: young people, education and socio-technical futures," *Oxford Review of Education*, vol. 38, no. 1, pp. 97–113, 2012.
- [84] M. Michaelides and J. Benus, "Are self-employment training programs effective? Evidence from Project GATE," *Labour Economics*, vol. 19, no. 5, pp. 695–705, 2012.
- [85] A. Mital et al., "The need for worker training in advanced manufacturing technology (AMT) environments: A white paper," *International Journal of Industrial Ergonomics*, vol. 24, no. 2, pp. 173–184, 1999.
- [86] S. D. Carter, "The growth of supply and demand of occupational-based training and certification in the United States, 1990-2003," *Human Resource Development Quarterly*, vol. 16, no. 1, p. 33, 2005.
- [87] M. Schneider, "Does Education Pay?," *Issues in Science and Technology*, vol. 30, no. 1, pp. 33–38, 2013.
- [88] R. C. Moraes, "Short-term higher education: the united states' community colleges' experience," *Cadernos de Pesquisa*, vol. 44, no. 152, pp. 450–464, Jun. 2014.
- [89] P. G. Altbach, L. Reisberg, and L. E. Rumbley, *Trends in global higher education: Tracking an academic revolution*. UNESCO Pub.; Sense, 2009.
- [90] W. Korpi and J. Palme, "The paradox of redistribution and strategies of equality: Welfare state institutions, inequality, and poverty in the Western countries," *American sociological review*, pp. 661–687, 1998.
- [91] F. J. Carrillo, *Knowledge cities: Approaches, experiences and perspectives*. Routledge, 2006.
- [92] A.-V. Anttiroiko, P. Valkama, and S. J. Bailey, "Smart cities in the new service economy: building platforms for smart services," *AI & society*, vol. 29, no. 3, pp. 323–334, 2014.
- [93] J. M. Eger, "Smart growth, smart cities, and the crisis at the pump a worldwide phenomenon," *I-WAYS-The Journal of E-Government Policy and Regulation*, vol. 32, no. 1, pp. 47–53, 2009.
- [94] M. Sasaki, "Kanazawa: a creative and sustainable city," *Policy Science*, vol. 10, no. 2, pp. 17–30, 2003.

- [95] U. Eriksson-Zetterquist, T. Müllern, and A. Styhre, *Organization Theory: a practice based approach*. Oxford University Press, 2011.
- [96] B. Nolan, "What use is 'social investment'?", *Journal of European Social Policy*, vol. 23, no. 5, pp. 459–468, 2013.
- [97] B. Bosworth, G. Burtless, and K. Zhang, "Later retirement, inequality in old age, and the growing gap in longevity between rich and poor," *Economic Studies at Brookings*, p. 87, 2016.
- [98] OECD, *Pensions at a Glance 2015*. OECD Publishing, 2015.
- [99] T. Piketty and A. Goldhammer, *Capital in the twenty-first century*. Cambridge Massachusetts: The Belknap Press of Harvard University Press, 2014.
- [100] H. Boushey, J. B. DeLong, and M. Steinbaum, *After Piketty: The Agenda for Economics and Inequality*. Harvard University Press, 2017.
- [101] World Economic Forum, "The Global Gender Gap Report," World Economic Forum, 2016.
- [102] UNDP, Ed., *Human development for everyone*. New York, NY: United Nations Development Programme, 2016.
- [103] E. Brynjolfsson and A. McAfee, *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*. W. W. Norton & Company, 2014.
- [104] Pew Research Center, "On Views of Race and Inequality, Blacks and Whites Are Worlds Apart," 2016.
- [105] P. V. Parijs, "Basic Income: A simple and powerful idea for the 21 st century," *Redesigning Distribution: Basic Income and Stakeholder Grants as Cornerstones for an Egalitarian Capitalism*, London & New York: Verso, 2005.
- [106] L. Haywood, "Unconditional Basic Income: An Economic Perspective," DIW Roundup: Politik im Fokus, 2014.
- [107] R. McGahey, "Universal Basic Income and the Welfare State," Social Science Research Network, Rochester, NY, SSRN Scholarly Paper ID 2863954, Oct. 2016.
- [108] G. Esping-Andersen, *The three worlds of welfare capitalism*. John Wiley & Sons, 2013.
- [109] T. Ward, "There Is a Solution to Our Broken Economy Besides Universal Basic Income," *Futurism*, 10-May-2017. .
- [110] S. Sodha, "Is Finland's basic universal income a solution to automation, fewer jobs and lower wages?," *The Observer*, 19-Feb-2017.
- [111] Government of Ontario, "Ontario Basic Income Pilot," 2017. [Online]. Available: <https://www.ontario.ca/page/ontario-basic-income-pilot>. [Accessed: 29-Oct-2017].
- [112] R. Minder, "Guaranteed Income for All? Switzerland's Voters Say No Thanks," *The New York Times*, 05-Jun-2016.
- [113] J. Schwettmann, "Cooperatives and the Future of Work," 2015.
- [114] U. Dadush and B. Stancil, "The world order in 2050," Carnegie Endowment for International Peace, 2010.
- [115] J. Hawksworth, *The world in 2050: how big will the major emerging market economies get and how can the OECD compete?* PricewaterhouseCoopers, 2006.
- [116] M. R. Ford, *The lights in the tunnel: Automation, accelerating technology and the economy of the future*. Acculant Publishing, 2009.
- [117] S. Barrientos, G. Gereffi, and A. Rossi, "Economic and social upgrading in global production networks: A new paradigm for a changing world," *International Labour Review*, vol. 150, no. 3–4, pp. 319–340, 2011.
- [118] Y. M. Boutang, S. Albagli, and M. Maciel, "Wikipolitics and the economy of the bees: information, power, and politics in a digital society," *Information, Power, and Politics: Technological and Institutional Mediations*, Lexington Books, Lanham, MD, 2010.
- [119] J. H. Reichman, "Intellectual property in the twenty-first century: will the developing countries lead or follow?," *Houston law review/University of Houston*, vol. 46, no. 4, p. 1115, 2009.
- [120] R. C. Bird, "Defending intellectual property rights in the BRIC economies," *American Business Law Journal*, vol. 43, no. 2, pp. 317–363, 2006.
- [121] White House, "Artificial Intelligence, Automation, and the Economy," *Executive office of the President*. <https://obamawhitehouse.archives.gov/sites/whitehouse.gov/files/documents/Artificial-Intelligence-Automation-Economy.PDF>, 2016.
- [122] T. Piketty, *The economics of inequality*. Harvard University Press, 2015.
- [123] S. Abranches, *A era do imprevisto: A grande transição do século XXI*. Editora Companhia das Letras, 2017.
- [124] F. Lai, X. Zhao, and Q. Wang, "The impact of information technology on the competitive advantage of logistics firms in China," *Industrial Management & Data Systems*, vol. 106, no. 9, pp. 1249–1271, 2006.
- [125] M. Christl, M. Köppl-Turyna, and D. Kucsera, "Revisiting the employment effects of minimum wages in Europe," *German Economic Review*, 2017.
- [126] F. Serrano and R. Summa, "Aggregate demand and the slowdown of Brazilian economic growth in 2011-2014," *Nova Economia*, vol. 25, 2015.

REFERENCES ERROR! USE THE HOME TAB TO APPLY TÍTULO 1 TO THE TEXT THAT YOU WANT TO APPEAR HERE.

This work is published on the responsibility of the Director of the Laboratório do Futuro. The resulted analysis herein does not necessarily reflect the official views of the PESCC, COPPE or the Universidade Federal do Rio de Janeiro.

Acknowledgements

This work was coordinated by Carlos Eduardo Barbosa under the supervision from the Laboratório do Futuro Director, Jano Moreira de Souza. Five groups studied key trends, formed by Leon Augusto and Técia Duarte (Automation); Yuri Lima and Eduardo Miotto (Employment); Airine Carmo, Jonathan Augusto da Silva and Joshua Kritz (Education); Luis Felipe Coimbra and David Almeida (Social Welfare); and, finally, Alessandro Caetano Beltrão and Pedro Henrique Kleinpaul Bruno (Economy).

Please cite this publication as:

Barbosa, C.E.; Lima, Y.; Miotto, E.; Costa, L.F.C.; Carmo, A.; Silva, J.A. da; Kritz, J.; Almeida, D.W.S.; Beltrão, A.C.; Bruno, P.H.K.; Augusto, L.; Duarte, T.; Souza, J.M. de; 2017. Working in 2050: A view of how changes on the work will affect society. Laboratório do Futuro – UFRJ, Rio de Janeiro.