

Industrial Robotic Systems & International Human Rights

Abbas Basiri¹ & Reza Mousazadeh²

¹ Payame Noor University, Tehran, Iran

² International Relations School, Tehran, Iran

Correspondence: Abbas Basiri, Payame Noor University, P.O. Box 19395-3697, Tehran, Iran. E-mail: Basiriabbas3@yahoo.com

Received: May 23, 2016

Accepted: June 27, 2016

Online Published: February 23, 2018

doi:10.5539/jpl.v11n1p53

URL: <https://doi.org/10.5539/jpl.v11n1p53>

Abstract

The development and growth of industrial robots started in 1947. The velocity of this process has increased as a result of development technology. Now, industrial robots have broad applications. They can be substituted for human force in different industries. The ever increasing growth and development of robotic technology in the field of industry was always challenging. One of these important challenges emphasizes on the negative effect of robotics on employment rate. As a result of cost reduction and production improvement, industrial countries have been motivated to employ robots and substitute them for workers in production lines. However, the broad use of robotic systems in the field of industry can have negative consequences in different societies. One of the common and negative effects of these systems is the reduction of employment opportunities which increases unemployment for those who look for jobs and for employed individuals. It can lead to employment insecurity and threat the health and safety of workers. These matters violate the human rights regarding the security and health of individuals, equality of opportunity, and particularly the employment rate. It also violates the employment standards supported by the international human rights instruments.

Keywords: employment opportunities, International human rights, Industrial robots, robotic technology

1. Introduction

World standard organization which is an international organization has presented the following definition for industrial robots: "An industrial robot is a multi-objective and programmable robotic arm which can move or stand in at least three different directions. It can be controlled in an automatic manner or reprogrammed." 1947-1981 can be considered as the initial period of industrial robots' development (Edward, 2013: 1). During this period, the first industrial robot known as "Unimate" was designed by George Devol (1954). In 1956, George Devol and Joseph Engel Berger arranged a meeting to discuss about entrepreneurship. Therefore, Unimate robot was manufactured and developed and the initial industrial robot industry was formed (Wallen, 2008:8).

1982-1996 has been called the middle age of robotics. A remarkable number of new and different robotic systems was invented and developed during this period (Op.cit.Edward:2). The velocity of robotic technology has increased in 21th century. These changes will continue in a consistent manner (BrynJolfsson,2011:48). The new era of industrial robot industry started when the industrial robots were used in montage line and factory production. New industrial robots have been equipped with sensors that enable them handle a wide range of tasks. Also, their application is simpler compared to the previous ones (Blackeshwar et al., 2013:763). Modern industrial robots have different applications in production system because they are flexible and programmable. The mentioned sensors help industrial robots to hear, see, and feel their surrounding environment (Ibid: 765). Using industrial robots in car body montage process of automobile factories is one of the important applications of these robots. After car body montage and analysis processes using a specific robot, they are transferred to dyeing factory. The car body dyeing process is done by a robot. This industrial robot can also handle the process of installing different parts of an automobile (Hagele & Nilsson, 2008:970-972). The velocity and quality control of production process increases as a result of using industrial robots. The weight and form of different parts of an automobile plays an important role in this process (Ibn-al-Tourab, 2013:47). Nowadays, the independency of industrial robots in production lines has increased. All the tasks of a robotic arm can be done in an automatic manner now. Two or even more robots can also do these tasks in a collaborative form (Op.cit.Edward:5-6).

According to specialists' declarations, now 60% of these tasks can be done by robots in an automatic manner. This value increases in 2050 and reaches to 80%. In 2050, 70% of all industrial tasks in other fields of industry such as petrochemical, oil, coal, plastic and metal products, shoe, and textile industries will be done by robots in an automatic manner. This value reaches to 60% in food and drink industry (Pelaez, 2008:1182). Now, I want to see whether industrial robot industry violates the human right especially the right for employment mentioned in international human rights instruments or not.

This paper has answered the above-mentioned question in two different ways. First, it analyzes the legal challenges about industrial robots and their related legal matters. Then it investigates the legitimacy of using these robots in the field of industry based on international human rights instruments.

1.1 First Discourse: The Legal Challenges about Industrial Robots and Their Related Legal Matters

The development of technology in the field of computer and robotics has led to remarkable changes in robotic industry which is called third industrial revolution or robotic revolution that affects social institutes and economic activities (Rifkin, 1995:56). The ever increasing and constant use of robotic technology in different industries has formed various challenges about the negative consequences of it. One of the important challenges is about the negative effects of using industrial robots on employment rate (Dicarlo, 2013:23). The constant development of robotic technology had a remarkable effect on employment rate. Industrial robots can do daily tasks of most workers in production sections (Benedikt, 2013:20).

Cost reduction and production improvement has motivated industrial countries to employ robots and substitute them for workers in production lines (Ibid: 14). Reduction in the price of industrial robots has increased their rate of use. Over the last decade, the annual price of industrial robots has been reduced for about 10% and it is predicted that the velocity of price reduction process increases in the future (Ibid: 21). David Atour, MIT's professor, has analyzed the relationship between technology and employment variables. He concluded that computer technology is changing different occupations. However, these changes are not always useful and efficient (Rotman, 2013:3). Changes in the field of robotics can't necessarily increase employment rate but they can result in production development without increasing the employment rate in a relative manner (Diponio, 1985:639). According to the statistical analysis and results regarding the use of robots in the U.S.A., this technology has removed 20000 jobs till 1980. 30-40 % of this event can be allocated to automobile industry (Zidich, 1984:919-920). In 1980, the U.S.A. steel industry employed 120000 workers. In 1990, the number of these workers reduced (20000). Therefore, the steel industry continued with that limited number of workers. This process continued. The reduction rate was remarkable (Op.cit.Rifkin:134). According to the international labor organization's report, the employment rate reduced for about 50% in steel industry of member states of development organization (1974-1989). More than 1 million jobs were omitted during these years. However, changes in employment rate had no effect on production rate and in other words these changes were beneficial for production rate (Ibid: 135). According to the International federation of robotics, the improved employment rate is now decreasing in most countries including Brazil, China, South Korea, Germany, and America. It means that the employment rate has decreased in production section of developed countries. It is simultaneous with production improvement and the use of robotic systems (Owais, 2014:199). Foxconn is the biggest electronics contract manufacturing company that produces Apple electronic components. Foxconn has announced that it is going to make an efficient plan to employ 1 million robots in this company (Muller, 2012: 186). In 2013, the researchers of Oxford University have predicted that these machines (robots) have the ability to do half of all the tasks of employees in different industrial sections of America during the next two decades (Derek, 2015). The Geneva-based international metal worker's federation has predicted that during the next 30 years, less than 2% of the present human force will be needed in production sections. Yoneji Masuda who is one of the main designers of automation in Japan says the complete automation of companies will occur during the next 20 to 30 years. These factories won't need human force (Op.cit. Rifkin: 8). Brian Jolson and Mc Afee believe that the rate of technological changes in employment reduction process is faster than that in employment improvement. This matter can reduce income and increase inequality in societies. In 2000, despite of the technological development and profits, the America's employment rate decreased in a remarkable manner. In 2011, the gap between profits and employment rate increased. They believe that robotic technology can increase profits and income. It leads to the formation of a wealthy society. However, this technology has some disadvantages. It eliminates some occupations, creates a worse condition for workers, and decreases the rate of demands for employing human force (Op.cit. Rotman, 2013:1). The results indicate that digital technology threats employment condition throughout the world. W. Brian Arthur, an intelligent systems' researcher and one of the former teachers in Stanford University believes that digital technology enables us to do different tasks with limited number of individuals. This matter is called digital technology's attacks and "independent or self-regulating economy". It

increases economic benefits without increasing employment rate in a remarkable manner (Ibid: 2). Therefore, robotic-based industry threatens the situation of workers in a society. As a result of technological development, employment rate will be reduced. However, most workers will handle the new tasks resulted from technological development including repairmen, protection, and programming. On the other hand, the administrators claim that the number of these tasks is less than the number of eliminated jobs. The long-term effect of robotic-based industry is unemployment of most novice and skillful workers. In fact, these workers can't be employed because they haven't passed technical courses (Moon, 1987: 405-406). Some have concluded that the fact that technological development can create new jobs for skilled workers and destroy these opportunities for novice ones can be allocated to the past. According to the results, it is not a permanent fact. The reason is almost too simple. Machines and computers (robots) have advanced applications and they can even violate the right those who have received higher education degree. In most cases, those who have recently graduated from universities and graduated traditional workers who have lost their jobs and can't find similar jobs again encounter with unemployment. As a result, employment opportunities have been decreased at all skill-based levels (Ford, 2009:91-92). Now, digital technology can handle the mental and intellectual tasks of human. This technology has been related to 60% of human force's tasks and it is predicted that it will be related to the other 40% in the near future. As this technology develops, its application increases in different sections. It can affect the employment rate and condition and finally the human force will face unemployment problem more than before (Op.cit.BrynJolfsson:48). Public economists and officials hope that through eliminating and discharging workers from industrial sections, services section employs millions of unemployed workers who look for a job. However, they don't consider the fact that all services and employment sections also the tasks of white-collar workers will be robotic based. Nowadays, robotic systems and automation have been substituted for human force in services section. These robots can do most of the tasks which was previously done by human forces (Owais, 2014:9).

Therefore, the ever-increasing use of robotic systems in industries may have negative consequences in societies. Robotic systems affect human rights. The common consequences of using these technologies are elimination of employment opportunities and development of unemployment for those who look for a job and for employed individuals mentioned in the international human rights instruments. Also they can threaten the health and safety of workers. Increasing the robotic potentials and applications can threaten the health and employment security of workers (Dicarlo, 2013:23). The international labor organization has expressed his concern over the effects of using industrial robots on the health and safety of workers and the potential dangers of this technology. It has announced that the rate of technological development is more now so employers and employees may encounter with different health and safety based dangers. Most investigations didn't consider these matters (Linsen, 1985:46).

Analyzing the potential dangers of using industrial robots is too difficult and this process inhibits producers or employers from using industrial robots based on safety and security regulations. As the independency of robots increases, their functions and acts become more unpredictable. The hidden danger of using robots is uncovered when someone starts using them. It is not possible to eliminate the destructive acts and functions of these robots (Christophe, 2012:44). Different experts have focused on two important issues regarding the development of robotic based industry. 1- Workers will face mental and spiritual pressures as a result of industrial robots' invention because they should be able to do different forms of tasks. 2- Employment insecurity, the worse condition of employment, and reduction in workers' salary can be considered as other negative effects of robotic-based industry (Op.cit.Pelaez:1186).The employment condition is even worse in countries which were successful in the process of developing robotics during the recent ten years. Especially changes in employment condition of European Union and the development of robotic technology in the field of industry has increased the mental pressures of workers. As a result of development of independent robotic systems in factories, the number of stressful jobs has increased without changing the employment condition. Also it is predicted that workers will face employment insecurity and mental pressures in a constant manner. Therefore, these workers can never get rid of the mentioned forms of pressures and stress (Ibid: 1187). The international labor organization has emphasized on job stress as a serious ever-increasing health and safety based issue. It has concluded that robots are the main source of these stresses (Op.cit.Linsen:45). It has emphasized on this fact that the nature of industrial robots affects the formation of these dangers. For example, the unpredictable aspect of motion model or design of robotic arm can violate the health and safety based right of individuals at workplaces. Most of the studies in Europe, Japan, and America have analyzed the potential and real dangers of robots (Ibid). In some cases, these dangers had lethal effects. The first lethal event resulted from using industrial robots occurred in America in 1984. As a result of this event, one of the robot operators was killed. These destructive events also happened in 1999, 2000, 2001, 2005, and 2006 (Danzhang, 2014:10-13).

According to the results of the scientific research done by researchers in strategic research center (2013), development of technology can lead to employment duality and lack of compatibility in skills needed for each job. On the other hand, those who are skilled are employed and all the jobs that need no specific skill or experience are eliminated and robots will be substituted for human force (Usanov, 2013:9). Also the rate of demands for employing human force will be reduced. These changes can lead to income duality and change in both above-mentioned groups (Ibid: 40). Employment duality is the most important factor in developing income inequality in societies (Ibid: 9). As a result of income inequality, the opportunity equality is destroyed in a society (Ibid: 10). The investigations indicate that changes in robotic technology affects the demands for employing skilled individuals and inequality in a direct manner (Acemoglu, 2003). Therefore, the new technology (robotics) leads to the formation of two groups: winner and loser. It also results in inequality in a society (Op.cit.Usanov:11). According to the studies of James A. Baker III institute in Rice University (U.S.A, 2015), different effects of robots on employment and inequality still continues. In America, the employment rate which was 14.3 million in 2004 has been reduced. It was 12 million in 2013. Also most of the workers have been discharged as a result of using robots in montage lines (Brito, 2015:7). According to the statistical results of international federation of robotics, the demands for using industrial robots increased in 2010. As a result, the process of developing automation-based industry and promoting technical aspects of industrial robots still continues. Between 2010 and 2014, the average rate of industrial robots' sale was 17%. This value has increased every year. However, the velocity of manufacturing and developing these robots was not remarkable. Between 2005 and 2008, the average annual number of robots sold was about 115,000 units. This value has increased for about 171000 units between 2010 and 2014. At least 48% of this change was the result of increasing demands for using industrial robots throughout the world. Chart 1 indicates the rate of demands and the annual price of industrial robots throughout the world. Chart 2 has predicted and analyzed the annual price of industrial robots in 2013 and 2014 and the rate of demands between 2015 and 2018 in Asia, Australia, Europe, and America continents. Chart 3 shows the value allocated to active industrial robots and their rate of development in 2013 and 2014 also between 2015 and 2018 in Asia, Australia, Europe, and America continents (International federation of robotics, 2015). These statistics and values indicate the development and growth of industrial robots in different industries throughout the world and their effects on employment rate.

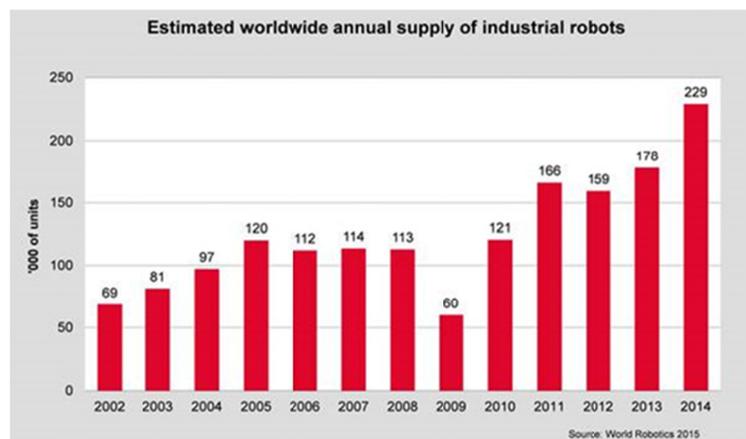


Chart 1.

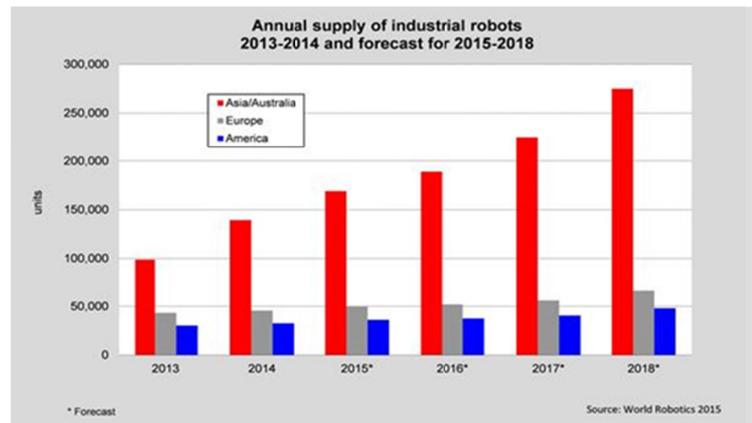


Chart 2.

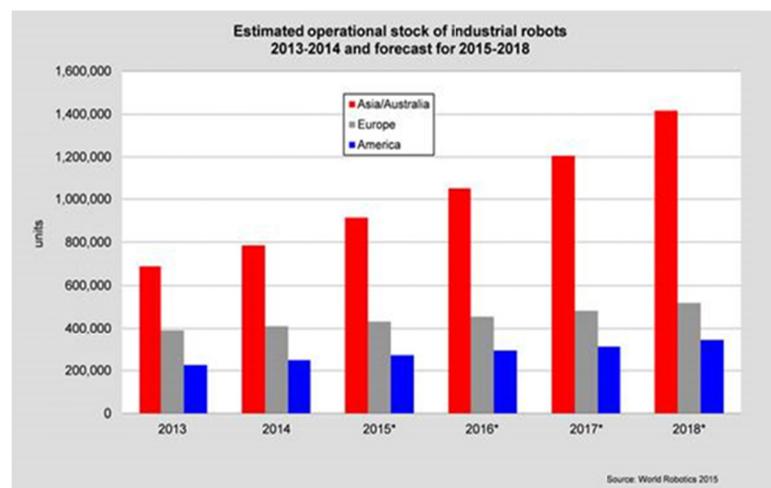


Chart 3.

Despite of the positive effects of industrial robots on manufacturing process optimization, manufacturing cost reduction, improvement of profits and final quality of manufacturing section (Music, 2013:82) and manufacturing industries' tendency toward substituting robots for workers in production section, this technology can violate the principle of human rights and employment standards also threat the safety and health of workers (international human rights instruments).

1.2 Second Discourse: The Legitimacy of Using Industrial Robots Based on International Human Rights Instruments

1.2.1 First Clause: Industrial Robots and Declaration of Human Rights

In 1948, the declaration of human rights was approved by the United Nations general assembly. The first Article of this declaration has emphasized on the equality of individuals' rights. According to the Article 7 of the mentioned declaration, law considers everyone equal. Also, the Article 23 has emphasized on the fact that every person has the right to work and to select his/her job in a free manner. It is necessary to satisfy those who look for a job by creating a fair employment conditions and support them when they are unemployed. According to the Article 22, every individual has the right to receive social security as a member of a society and he/she can defend his/her economic, social, and cultural rights through national attempts and international cooperation that are consistent with the objectives of states' organizations and sources in order to gain self-esteem and freedom. According to this fact, the development of industrial robots reduces the employment opportunities for those who look for a job and even for employed individuals and leads to employment insecurity. It can also make the employment condition worse compared to the past and increase inequality in societies. Therefore, all the

mentioned factors can violate the international human rights instruments.

1.2.2 Second Clause: Industrial Robots and International Covenant on Economic, Social and Cultural Rights

According to the international covenant on economic, social, and cultural rights (1966), member states should guarantee the economic, social, and cultural rights of every individual.

Considering the Article 6 of this covenant, every person has the right to select his/her job in a free manner and member states have the responsibility to take legal measures to support their rights. Also the Article 7 of this covenant has emphasized on the authenticity of guaranteeing the safety and health of individuals at workplace. Article 12 has focused on providing each individual with the best condition of physical and mental health, environmental and industrial health. According to the results of investigations and international organization's report, working with industrial robots increases the mental pressures and stress of workers and threat the health and safety of employers and their employees. As a result, they will encounter with different dangers. This technology reduces employment rate and leads to unemployment, elimination of some skills and jobs, and development of poverty, deprivation, and inequality in societies. Robotic technology violates Articles 6, 7, and 12 of international covenant on economic, social and cultural rights.

1.2.3 Third Clause: Industrial Robots and International Covenant on Employment Security and Health

This covenant was approved by the international labor organization in 1981 and performed in 1983. According to the Article 3 of this covenant, employment health doesn't solely refer to the non-existence of diseases at work but it refers to the physical and mental factors that affect individuals' health. These factors are related to the safety and health of them in a direct manner. Article 12 has emphasized on the fact that member states should analyze the possible dangers of the manufactured and designed equipment and guarantee the safety and health of individuals. According to the Article 16 of this covenant, employers should monitor and control these devices and equipment and analyze their possible threats for the safety and health of individuals.

Considering the previous parts of this paper and international labor organization's concerns about the negative effects of using industrial robots on safety and health of workers and the potential dangers of this technology for them, it can be concluded that the nature of industrial robots affects the formation of these dangers. It is not possible to omit the destructive functions of these robots. It seems that industrial robots violate the human right regarding employment security and health. Therefore using them is contradictory to Articles 12 and 16 of the covenant.

1.2.4 Forth Clause: Industrial Robots and International Covenant on Developing Employment and Supporting Individuals against Unemployment

This covenant was approved by the international labor organization in 1988 and performed in 1991. Article 2 of this covenant has emphasized on the role of member states in taking efficient measures to increase unity among public institutions in order to support individuals and employment policy against unemployment. These states should monitor the decisions and acts of public institutes in the process of supporting unemployed individuals to help them develop employment and selection of jobs in a free manner. According to the Article 7 of this covenant, member states should consider the mentioned matters as their first objective which is superior to other decisions. Article 28 has emphasized on the fact that member states have been obliged to take legal measures based on the principles of this covenant.

Considering the previous parts of this paper, one of the results of using robotic systems in different industries is that they reduce employment opportunities and lead to unemployment and employment insecurity. They can even make the employment condition worse compared to the past. These systems violate the principles of Articles 2, 7, and 28 of the covenant.

1.2.5 Fifth Clause: Industrial Robots and the European Social Charter

In 1961, the European social charter was approved. It was performed in 1965. This charter consists of a protocol which was approved in 1988. In 1996, the European charter was revised and put into action in 1999. The European charter is an efficient international covenant. The total rights guaranteed by this charter (1961), its protocol (1988), and modifications have been gathered in a document (Moradzadeh, 2008: 377-378).

This charter has emphasized on the authenticity of providing workers with fair employment conditions, safety, and health and increasing employment rate without violating worker's rights at workplaces. According to the Article 1 of this charter, the most important responsibility of these states is guaranteeing individuals' employment right, achieving the best rate of employment, and preserving it in order to improve employment condition. Article 2 of this charter has confirmed the development of fair employment condition and elimination

of possible risks of hard and harmful jobs. Article 3 has emphasized on the right of safety and health at work and improvement of employment safety and health also prevention of destructive events and damages resulted from or related to jobs especially minimizing the causes of these inevitable dangers at work. Article 26 has focused on the generosity of individuals at work. According to this Article, it is necessary to guaranteeing the right of workers regarding their generosity at work. Article 30 of this charter is about supporting workers' rights against poverty and social isolation.

According to the previous parts of this paper, industrial robots reduce employment opportunities and increase unemployment and employment insecurity. They threat workers' safety and health at work and increase inequality in societies. As a result of income inequality, the opportunity equality is destroyed in a society and finally poverty is formed. The destructive effects of using these robots violate the Articles 1, 2, 3, 26, and 30 of the social charter.

1.2.6 Sixth Clause: Industrial Robots and Protocol of American Covenant on Human Rights in the Field of Economic, Social, and Cultural Rights

In 1969, the American covenant on human rights was approved in American states conference in San José, Costa Rica. It was performed in 1978. The protocol of economic, social, and cultural rights of this covenant was confirmed in 1988 and performed in 1999.

According to the protocol 6 of this covenant, every individual has the right to work and select his/her job in a free manner in order to guarantee his/her future. Therefore, member states should take legal measures to support their rights especially the right of achieving best employment condition. Article 7 emphasizes on employment equality and satisfaction. Article 10 has focused on the authenticity of safety and health rights and the right of achieving the highest level of mental and physical health. According to the previous parts of the recent paper regarding industrial robots, these robots can threat the safety and health of workers. In particular, this technology violates the Article 6, 7, and 10 of the protocol of American covenant on human rights.

1.2.7 Seventh Clause: Industrial Robots and African Charter on Human and People's Rights

African charter on human rights is considered as one of the most important regional instruments and covenants in human rights based African system. Article 15 emphasizes on the equality of employment condition and individuals' satisfaction. As mentioned in Article 16 of this charter, every person has the right to have the best condition of physical and mental health. The member states should take legal measures in order to support the safety and health of individuals. Considering the fact that industrial robots have negative effects on employment rate and threat safety and health of individuals, using these robots may lead to unemployment and formation of physical and mental pressures for workers. Therefore, this technology violates Article 15 and 16 of African charter on human and nations' rights.

1.2.8 Eighth Clause: Industrial Robots and Islamic Declaration of Human Rights

In 1990, The Islamic declaration of human rights was approved in Cairo conference by the foreign ministers of member states of the organization of Islamic cooperation. According to the Article 13 of this declaration, these states should guarantee the individuals' right to work. Every worker has the right to have the best condition of physical and mental health. Considering the legal challenges regarding the use of industrial robots, they violate the Article 13 of Islamic declaration of human rights that emphasize on the safety and health of workers.

2. Conclusion

Now, most of small-scale and large-scale industries use robots in their production processes. These robots have various applications in different industries. They can be substituted for human forces. Employers have been motivated to employ these robots not only because they are cheap and beneficial but also for some other reasons. For example, they never complain or get tired. Robots don't need any holiday and they are on time and never waste time. The principles and regulations of employment and taxation can't be allocated to robots (Snyder, 2013). However, the ever-increasing use of robotic systems in different industries can have negative consequences in societies. For example, these systems reduce the employment opportunities and increase unemployment for those who look for a job and for employed individuals. The development of this technology can result in employment insecurity. Other challenges are related to the dangers and threats of industrial robotic systems for workers at workplaces that affect their safety and health. Also, employment duality and income inequality are the results of using this technology. These systems violate the right of developing fair employment conditions supported by the international human rights instruments.

References

- Acemoglu, D. (2003). *Technology & Inequality*. Retrieved from <http://www.nber.org/reporter/winter03/technology& inequality.html>
- Additional Protocol to the American Convention on Human Rights in the Area of Economic, social & cultural rights" Protocol of San Salvador. (1988). Retrieved from <http://www.oas.org/juridico/english/treaties/a-52.html>
- African (BANJUL) Chapter on Human & Peoples' right. (1981). Retrieved from http://www.achpr.org/files/instruments/achpr/banjul_charter.pdf
- Benedikt, F., Osborne, C., & Michael, A. (2013). *The Future of Employment: How susceptible are jobs to computerization?* Retrieved from http://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf
- Brynjolfsson, E., & McAfee, A. (2011). *Race against the Machine: The Digital Revolution Is Accelerating Innovation Driving productivity & Irreversibly Transforming Employment & the Economy*, Massachusetts, Digital Frontier Press.
- Cairo Declaration on Human Rights in Islam. (1990, August 5). Retrieved from <https://www1.umn.edu/humanrts/instree/cairodeclaration.html>
- Convention Concerning Employment Promotion & Protection against Unemployment. (1988). Retrieved from http://www.ilo.org/dyn/normlex/en/f?p=1000:12100:0::NO:12100:P12100_INSTRUMENT_ID:312313
- Convention Concerning Occupational Safety & Health & the Working Environment. (1981). Retrieved from http://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_ILO_CODE:C155
- Derek, T. (2015). *A World Without work*. Retrieved from <http://www.theatlantic.com/magazine/archive/2015/07/world-without work/395294/>
- Di, C. A., & Nacco, L. (2013). Robotic Technologies & fundamental Right: Robotics Challenging the European Constitutional Framework. *International Journal of Techno-ethics*, 4(2), 15-35. <https://doi.org/10.4018/jte.2013070102>
- Diponio, J., & Salvendy, G. (1985). *Handbook of Industrial Robotics*. New York, John Wiley & Son publication.
- Edward, Y. L. (2013). *A Journey from Robot Analysis to Digital Human*. Publisher: Springer Berlin Heidelberg.
- Esmail, N. H. (2014). *Collection of Most Important Instruments of International Law*. Tehran, Jangal press.
- Ford, M. R. (2009). *The Light in the Tunnel: Automation, Acceleration, & the Economy of the Future*. Published in the United States by Acculant™ Publishing.
- Hagele, M., & Nilsson, K. (2008). Springer Handbook of Robotics.
- Ibn-abu-Torab, S. E. (2013). Application of Industrial Robots in Different Industries. *Journal of manufacturing engineering*, (46).
- Industrial robots. <http://www.ifr.org/industrial-robots/>
- International Federation of Robotics. (2015). *Industrial Robot Statistics*. Retrieved from <http://www.ifr.org/industrial-robots/statistics/>
- Leroux, Ch., & Labruto, R. (2012). *Ethical Legal & Societal issues in robotics, eu-Robotics. The European Robotics Coordination Action*. Retrieved from http://www.eurobotics-project.eu/cms/upload/PDF/euRobotics_Deliverable_D.3.2.1_ELS_IssuesInRobotics.pdf
- Linsen, M. T. (1985). ILO examines impact of technology on worker safety & health. *Monthly Labor Review*, 108(8), 46.
- Moon, Ch. A. (1987). Technology, Robotics, & the Work Preservation Doctrine: Future Considerations For Labor & Management. *Pepperdine Law Review*, 14(2).
- Moradzadeh, H., & Navvabzadeh, Z. S. (2009). The European social charter, revised form of the third ratified law, 1996. *Journal of international law*, (40).
- Muller, S., & Zouridis, S. (2012). *The Law of the Future & the Future of Law*, Hague, Academic E-publisher.
- Music, S., & Dolecek, V. (2013). *Application & Classification of Industrial Robots in the Wood working*

- Production. *Journal of Trends in the Development of Machinery & Associated Technology*, 17(1), 85-88.
- Owais, Q. M., & Sajjad, S. R. (2014). The Impact of Robotics on Employment & Motivation of Employees in the Service Sector, with Special Reference to Health Care, Safety & Health at Work, Volume 5, Issue 4, Pages 198–202.
- Pelaez, L. A. (2008). Robots, genes, & bytes: technology development & social changes towards the year 2020. *Technological Forecasting & Social Change*, 75(8), 1176–1201. <https://doi.org/10.1016/j.techfore.2008.01.002>
- Riefkin, J. (1995). *The End of Work*. New York: Published by G. P. Putnam's Sons.
- Rotman, D. (2013). How Technology Is Destroying Jobs. *MIT Technology Review Magazine*, 116.
- Usanov, A., & Chivot, E. (2013). *The European Labor Market & Technology: Employment, Inequality, & Productivity*, The Hague Centre for Strategic Studies & TNO. Retrieved from https://www.researchgate.net/publication/270104902_The_European_Labor_Market_&_Technology_Employment_Inequality_&_Productivity
- Wallen, J. (2008). *The history of the industrial robot*. Retrieved from <http://liu.diva-portal.org/smash/get/diva2:316930/FULLTEXT01.pdf>
- Zhang, D., Cui, G. H., & Rosen, M. A. (2014). *Robotics Safety: An Engineering Teaching Module*. Retrieved from http://safetymanagementeducation.com/wp-content/uploads/2015/09/Robotics_Safety-Teaching_Module-Supplemental_Report_140730_FINAL_REV-with_logos.pdf
- Zidich, D. J. (1984). Robotics in the Workplace: The Employer's Duty to Bargain over Its Implementation & Effect on the Worker. *Santa Clara Law Review*, 24(4).

Copyrights

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).