

Artificial Intelligence and the future of employment; a systematic review of the state of the art literature

Saada Khadragy

Assistant professor

City University College of Ajman, Management Information Systems Department

Abstract. Artificial Intelligence is defined in different places and by many researchers as a group of theories and techniques that develop complex computer programs that are able to simulate certain traits of human intelligence. Employment is also defined as a sub-field of the interdisciplinary field of human resources. The relationship between AI and Employment came obvious in the research literature which produced a huge database of research papers in this area. The current research study is a systematic review of the state of the art literature which is published in 2018 about the topic. The major purpose of this study is to present a general over view for the readers and prospective researchers about the relationship between AI and employment. After selecting some related keywords, searching with the keywords on different search engine such as Google Scholars, SAGE, and Research Gate, 47 articles were found according to their relationship with the topic. After reading the articles abstracts with introductions, the filtration process had been done, 24 articles are excluded. 23 articles were mostly relevant to the topic. The 23 articles were divided according to their ideas and main variables. Analysis steps were done, discussed, and the future directions are presented.

Keywords. Artificial Intelligence, Employment, AI systems, AI applications, Machine Learning, Deep Learning, and Neural Networks

1. Introduction:

The replacement of individual workers by artificial intelligence and robots is an extremely deliberated topic. Some people argue that a significant part of jobs is at risk, while others claim that computers and robots will guide to product revolutions and hence to incredible new professions. From this perspective, a strong relationship came between both of Artificial Intelligence (AI) and Employment. Therefore, both of the two terms; AI and Employment will be emphasized in the present article in order to give the reader an overall view about what is cited in the literature about this relationship even positively or negatively.

Fernald (2014) stated that from the date of 1995, productivity progress has accelerated in the US according to the Information Technology (IT) Revolution. But, the productivity outcomes of traditional kinds of IT were consumed by mid-2000 (Fernald, 2014). Recently, the influence of artificial intelligence (AI) and robotics—is known as the Fourth Industrial Revolution—on the future economy and society is drawing attention, and many hypothetical arguments have appeared regarding the probable impacts of the Fourth Industrial Revolution. Particularly, the replacement of individual workers by AI and robots is being passionately debated.

2. Research objectives:

The current research study aims for the following objectives:

- Systematically review the relationship between AI and Employment
- Provide a well-organized systematic review for the state of the art of the two fields; AI and Employment
- Recommend a set of new topics those could be a new research database for future research and the prospective researchers as well.
- Stand on clear definitions for the study key words and offer the past research results for the readers.

3. Research questions:

All of the above is considered as an indicator for the recent study about the existence of a strong relationship between AI and the future of employment. So, the present study aims for investigating the relationship between AI and the future of employment through the literature. In order to achieve the study objective, the following questions are addressed:

1. Is there any relationship between artificial intelligence and the future of employment in the literature?
2. What is effect of artificial intelligence on the future of employment?

4. Literature Review:

Technology and its development have a major impact on the work force. Reviewing this impact will be essential for instructing new roles and polices that can support efficient labor markets for the value of employee, employers, and their institutions as well

(Tambe, 2014). While this fast technological development can endanger employment which is not a new story, this development can influence the employment field in two ways:

- Directly by replacing employees from tasks they used to perform (Moull, 2017).
- Indirectly by expanding the labor market demands due to the technological development (Ndyali, 2016)

At this time, the need for some certain jobs which require a set of cognitive skills and routine manual will disappear. According to Bessen (2017), technology has dramatically decreased careers in recent ages. But before that, for more than 100 years, employment raised, even in industries with a fast technological revolution. The question here is; what is the difference between now and then? Demand was extremely flexible in the beginning and then became inflexible. The impact of artificial intelligence (AI) on careers will likewise depend significantly on the nature of the labor market needs.

On the other hand Agrawal, Gans and Goldfarb (2019) reviewed a framework to investigate the inferences of automation and AI on the need for workforce, salaries, and employment. Their task-based framework highlighted the association impact that automation produces as engines and AI replace workers in tasks that they used to achieve. The authors stated that movement impact tends to decrease the need for workers and salaries. But it is countered by a productivity impact, rising from the cost savings produced by automation, which surge the need for workers in non-automated jobs. The productivity effect is accomplished by additional capital growth and the extending of automation; both of them further increase the need for labor. These impacts are imperfect. Even when they are solid, automation expands production per worker more than salaries and decreases the share of labor in national income. One more point is highlighted in the same research paper is that more influential force against automation is the production of new set of labor-intensive functions, which returns workers to new tasks and tends to expand the labor share to compensate the effect of automation.

Additionally the authors highlighted the limitations and deficiencies that reduce the modification of the economy and the workforce market to automation and deteriorate the producing productivity improvements from this alteration: incompatibility between the skill needs of a set of new technologies, and the probability that automation is presented at an extreme rate, possibly at the cost of other productivity- enriching technologies.

Another group of research papers presented a type of inconsistency on the employment era. Unemployment is at historic lows, which means companies are searching for workers who have the ability to keep things achievable. At the same time, implementation of digitalization, artificial intelligence, and automation warns to displace many workers. Another idea is also stated in the same group of research papers is; institutions managers are starving for high level of both services and productions. At the same time they will be starving for all of the services with technology-based skills to drive new business in a short time and great amount of accuracy. With this scenario, employees will be keen on gaining these skills. However, organizations administrators do not have the complete image of that idea yet. McKendrick (2018) stated that 46% from employees who are working on their skills acknowledge that their employers do not value employees who have not updated their technological skills.

Despite its extensive deficiency of familiarity, AI is a technology that is changing every walk of life (Au-Yong-Oliveira et al., 2019). It is a wide-spreading instrument that allows people to reconsider how they assimilate information, analyze data, and use the findings to develop the process of decision making. So, the general aim of this comprehensive impression is to clarify the concept of AI to the audience of decision makers, view leaders, interested spectators, and reveal how AI already is altering the world and raising important questions for society, the economy, and governance.

As a result, the idea of this research paper came to give different definitions for AI and reveal the relationship between it and the future of employment field. In order to achieve this goal, AI would be discussed from different research visions and to be tightening the ideas not only for the researchers but also for people who are not specialized in the fields of AI and employment as well.

4.1 AI history and definitions:

The concept of “artificial intelligence” dates back to the mid-1950s, when mathematician John McCarthy, extensively acknowledged as the father of AI, applied it to describe machines that do tasks people might call intelligent. He and Marvin Minsky, whose work was just as significant in the AI field, arranged the Dartmouth Summer Research Project on Artificial Intelligence in 1956. After few years, with McCarthy on the faculty, MIT started its Artificial Intelligence Project, then the AI Lab. It combined with the Laboratory for Computer Science (LCS) in 2003 and was retitled the Computer Science and Artificial Intelligence Laboratory, or CSAIL (Nilsson, 2013).

Recently, as ubiquitous part of modern society, AI refers to the ability of any machine to imitate human cognitive skills, such as problem solving and decision making (Buchanan, 2005). Over the second half of the 20th century, machine learning came as a powerful AI approach that enables computers to learn from input data without having to be explicitly programmed (Ghahramani, 2015). One of the implemented techniques in machine learning is a neural network that takes inspiration from the biology of the human brain, conveying data between layers of so-called artificial neurons (Arel, Rose and Karnowski, 2010). The very first artificial neural network was created by Minsky as a graduate student in 1951 (Intelligence, 2010), but the approach was limited in the beginning, and even Minsky himself soon changed his focus to other new approaches for developing intelligent machines.

Adding to all of the above, Artificial intelligence is a broad concept which is defined by many researchers and scientists. One of these definitions came as; AI is to find statistical patterns in large datasets to a level that approximate human intelligence in certain aspects, so it is very popularly perceived something in a very scientific model, generalized human intelligence and or neural human levels of robotics (Lele, 2019). AI is also defined as the theory and development of computer systems to be able to achieve tasks normally require human intelligence, such as visual perception, speech recognition, decision-making, and translation between

languages (Andreou, 2017). Additionally, AI can be used in many different fields to help decision makers taking a decision or solving a problem (Parker and Forster, 2018). In this regard, many people cannot differentiate between AI, ML, NN, and DL (see table 1).

Artificial Intelligence	Machine Learning	Neural Networks	Deep Learning
An element of machines that represent a form of intelligence, rather than simply achieving computations that are input by human users (Stefik, 2003).	An approach to AI by which an algorithm has the ability to make predictions with different models from data that is supplied by the system (Stefik, 2003).	An approach of machine learning by which algorithms process signals through interconnected nodes called artificial neurons (Neapolitan and Neapolitan, 2018).	A procedure of machine learning, which often uses a network with many layers of computation—a deep neural network—allowing an algorithm to effectively analyze the input data (Bengio, 2009).
There are many applications of AI with machines that could play games such as checkers and chess with programs that could analyze and reproduce language (Li et al., 2017).	It is widely used in most of the developed countries in many fields from personalized news feeds to traffic prediction maps (Harrington, 2012).	Because they imitate the construction of biological nervous systems, artificial neural networks are the recognizable method of choice for modeling the brain (Liu et al., 2017).	Deep neural networks are used in many fields and it is responsible for self-driving vehicles, which learn to recognize traffic signs, as well as for voice-controlled virtual assistants (Ahmad, Farman and Jan, 2019).

Table1. Definitions of AI, ML, NNs, DL

4.2 Artificial Intelligence systems:

Artificial Intelligence can be categorized in many different ways. The first categorizes AI as either weak AI or strong AI (‘Frontiers in Artificial Intelligence and Applications’, 2018). Weak AI also defined as limited AI (Wirth, 2018), is an AI system that is considered and accomplished for a certain type of tasks. The second type is Strong AI, also defined as artificial general intelligence, and is an AI system with comprehensive human cognitive abilities so it is provided for unfamiliar tasks, it has enough intelligence to find solutions (Deng, 2018). The second classification had been presented by Arend Hintze, an assistant professor of integrative biology and computer science and engineering at Michigan State University (Hintze, Olson and Lehman, 2016). He classified AI into four types as follow:

- Reactive machines: this type of AI systems focuses on recognizing pieces such as Deep Blue, an IBM chess program that can distinguish pieces on the chess board and can build predictions accordingly (IBM, 2018). But the major fault with this is that it has no memory and cannot use old experiences to give future ones. It also investigates possible moves of its own and its challengers. Deep Blue and AlphaGO (Wang et al., 2016) were designed for limited reasons and cannot easily be used for any other purposes.
- Limited Memory. These AI systems can use old experiences to give future decisions. Most of the decision-making tasks in the autonomous vehicles have been deliberated with these systems (Weston et al., 2016).
- Theory of mind: This is a psychology term, which discusses the understanding of the others have in their own attitudes and plans that influence the decisions they make. Recently this type of artificial intelligence systems is not existed (Crowder and Friess, 2012).
- Self-awareness. In this type, AI systems have awareness of self, have consciousness. Machines with self-awareness recognize their recent state and can employ the information to assume what others are feeling (Jha et al., 2017). This type of AI is not yet existed

4.3 AI applications:

Artificial Intelligence has several applications in today's society. It is becoming essential for today's time because it can solve complex problems with an efficient way in multiple industries, such as Healthcare, entertainment, finance, education, etc. AI is making our daily life more comfortable and fast.

Following are some sectors which have the application of Artificial Intelligence:

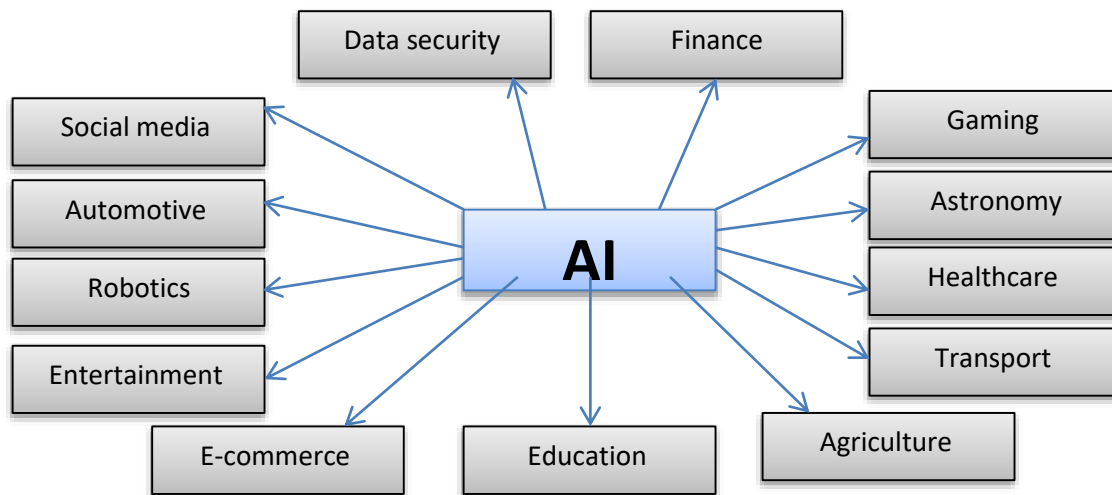


Figure1. AI and different fields (Pannu and Student, 2008)

4.4 The impact of AI in the employment different fields:

The influence of the digital information revolutions has, certainly, been considerable on practically all features of our societies, life, organizations and employment sectors. By investigating similar inventions of the industrial, digital and AI revolutions, some articles claimed that the last one is on target and it would get extensive changes which will also impact all features of our societies and life. Additionally, its impact on organizations and employment will be significant, resulting in fully intersected institutions with decision making according to the analysis and management of “big” data and strengthened, international debates among organizations (Makridakis, 2017).

Nations will be able to buy goods and getting services from all over the world using the Internet, and utilizing the unrestricted, extra benefits that will open through the extensive usage of AI different inventions. A number of papers stated that substantial competitive advantages will last to accumulate to those employing the Internet widely and keen on take industrial risks in order to change advanced products/services into international commercial success levels. On the other hand, a number of authors found that the extreme challenge tackling societies and organizations would be employing the benefits of applying AI different technologies, offering massive chances for both new products/services and huge efficiency developments while avoiding the risks and drawbacks in terms of improved unemployment and better wealth disparities (Makridakis, 2017).

5. Methods:

The literature has a great number of research papers in the field of AI and its relationship to employment. This paper aims for reviewing the 2018 research papers in a number of referred journals all over the world. Systematic review is considered as one of the most implemented procedures in the literature, also it is one of the essential tools for evaluating all research studies those had been written in a particular era using a certain criteria in order to recommend number of topics for the future research (O’Connor, Sargeant and Wood, 2017).

Therefore, research literature has a great number of research papers is generated yearly, frequently with incompatible results. This is caused by the differences between the research papers; they could be the sample variation, study procedures, or study techniques and methods. In this case, it could not be clear what the general picture is or what are the most reliable results to be used as the basis of taking a certain decision (Athanasakis, 2016).

Systematic reviews aim to tackle these issues by recognizing, assessing and combining the findings of all related, high-quality original research papers referring to one or more research questions (Gough, Thomas and Oliver, 2012). Furthermore, systematic literature review is defined as an approach which produced in the medicine area (Scutiero *et al.*, 2017), human resources and social sciences as well (Marin-Garcia and Tomas, 2016). All in all, systematic literature review is recognized by many researchers as one of the most widespread techniques of reviewing a certain topic in the literature in order to come up with new set of future topics (Siddaway, 2014).

5.1 The procedures for selecting articles of AI and the future of employment:

In order to come up with a reliable result and recommend a set of research topics for prospective researchers, the researcher selected the reviewed articles according to the following steps:

- ✓ The first step is to determine a set of keywords those can link both of AI and the field of employment.
- ✓ The second step is to make an online search with the determined keywords
- ✓ The third step is to decide the required titles of the articles and their relationships with the selected topic “AI and the future of employment”

✓ The fourth step is to ascertain the contribution of the journal and how it is ranking in both of the two fields; AI and employment as a subfield of human resources.

In order to achieve the study objectives, the researcher tried to use different browsers and applications such as Google Scholar, SAGE, and Research Gate to reach the biggest relevant number of research papers about the determined keywords. The selected electronic database came from different journals all over the world (see table2)

No	Journal name
1	Journal of service research
2	ScienceDirect
3	Special issue on big data and open education
4	Journal of management and organization
5	Psychosociological Issues in Human Resource Management
6	Elsevier
7	SCIENDO (The IZA Journal of Labor Policy)
8	SAGE (journal of sociology)
9	RIETI (Research Institute of Economy, Trade, and Industry)
10	Electronics Science Technology and Application
11	Atlantis Press (Advances in Social Science, Education and Humanities Research (ASSEHR))
12	Journal of International Scientific Publications
13	ARKANSAS daily journal
14	NBER (NATIONAL BUREAU of ECONOMIC RESEARCH)
15	American Economic Association (AEA Papers and Proceedings)
16	IEEE, Robotics and Automation Research and Practice Ethics Committee (RARPEC)
17	Emeraldinsight
18	Harvard Business Review
19	International Journal of Mechanical Engineering and Technology (IJMET)
20	International Labour Organization ILO
21	Indira Gandhi Institute of Development Research, Mumbai (IGIDR)

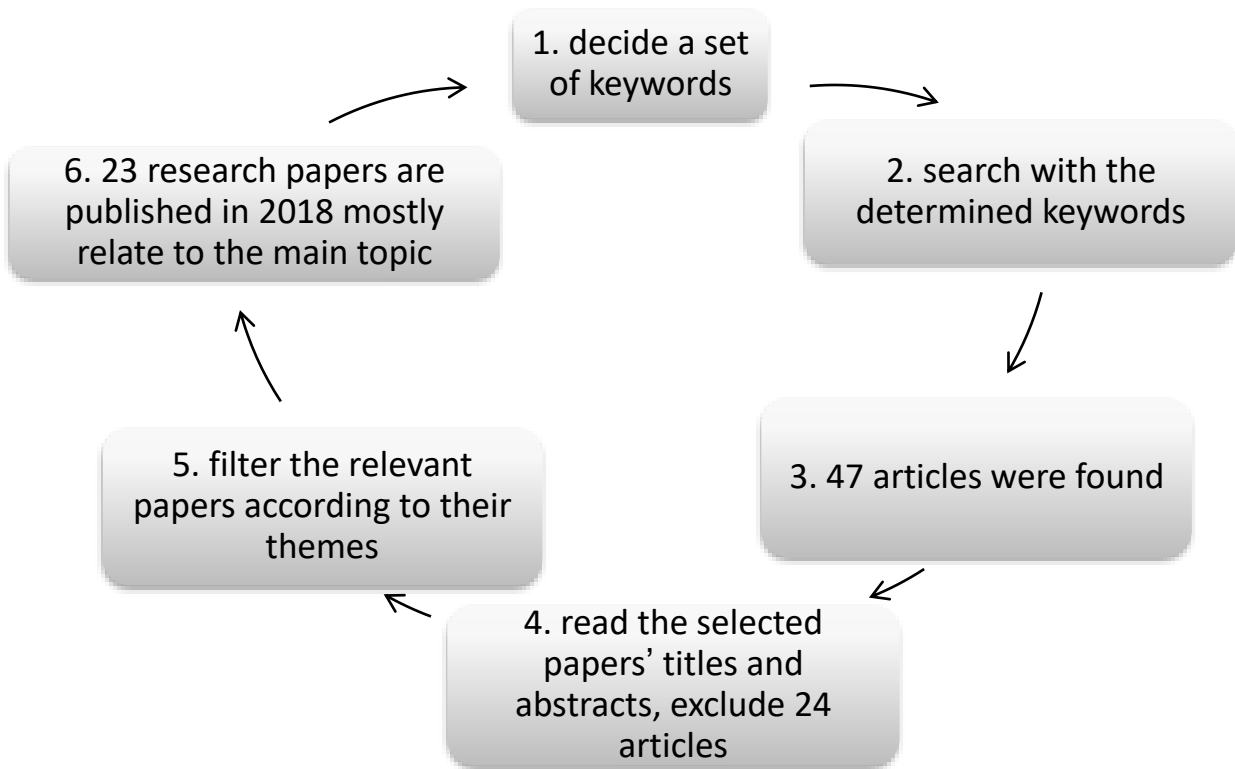
Table2. Online database cited the relation between AI and the future of employment

After searching for the keywords, the researcher tended to apply some screen settings to reach the total number of articles which had been published in 2018 in different ranked journals and institutions in the field of AI and the future of employment. 47 studies were obtained in the two fields, 23 articles were excluded as they were reports and notes. At the end, 24 articles were selected by the researcher as the most relevant and closed topics to AI and the future of employment (see figure2). The selected number of research papers is reviewed by titles and place of publication (see table1 &2). The majority of the papers were published in highly ranked journals, while few of them are not published in journals those are not highly ranked.

In the third phase of the current research study, the researcher started to review the selected articles' titles and abstracts. The purpose of this step is to decide the relevance of the selected papers to the topic of AI and the future of employment. The selected papers are filtered according to their methodologies; either they classify or predict the future of employment and AI. With this filtration two articles were excluded as they were not closed to the topic. 21 articles were published in the year of 2018 and they are the most relevant to the topic to be analyzed.

Figure2 presents the systematic review phases for the recent topic. The researcher employed the search engine to decide the current research studies with an automated online search. The results of this step came up with 47 articles those are appropriate to the topic. The second step came as reading the selected articles' abstracts. The results of the second step came up with excluding 24 irrelevant research papers to the topic between reports and notes. Moreover, the selected articles are classified between papers used AI to classify employment and papers predict the future of employment. Accordingly, two papers are excluded.

Figure2. Research phase and articles selection process



5.2 Articles categorization

In this sub-section, we would explain the categorizing articles process. Classifying the online databases that had been published in the era of AI and the field of employment is considered as the most important step in the present study. Figure2 presents the classification cycle and table 3 includes the steps of filtering the published papers in 2018 about AI and the future of employment.

Systematic review steps	The relationship between AI and the future of employment			All articles selected for this study were published in the year of 2018
Step1	Select keywords	AI, Employment, automation, labor market, soft skills		
Step2	Search about the keywords	Use different search engines such as Google Scholar and SAGE	47 articles were found	
Step3	Filter the found articles	Find the relevant and irrelevant articles to the topic of AI and the future of employment	Exclude notes and reports, 23 articles became suitable for this study	

Table3. Study framework

6. Results and discussion:

This section explains what is cited in the literature about the relationship between Artificial Intelligence and the future of employment. In order to ease this task, the researcher divided what is written in this era into two groups; the first group of research papers came up with the idea of the recent wave of technological movement based on AI which has created an extensive fear of jobs with a great amount of inequality. The second group came up with a new idea by which AI with networking will help employers and decision makers to develop the process of hiring new employees. Also different variables are stated in the literature through the selected research papers; these variables affect the relation between AI and the future of employment (see table4 and figure3). Age, gender, soft skills, social skills, and nationality (Freddi, 2018).

	Age	Gender	Soft skills	Social skills	Nationality
Number of papers	6	8	5	3	1

Table4. The selected papers distribution according to the variables.

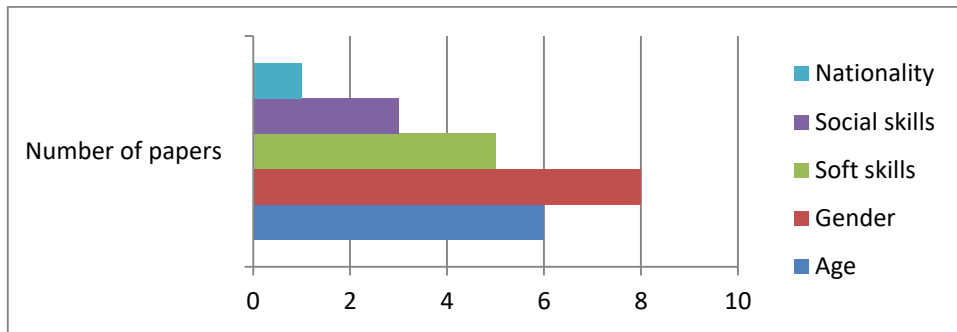


figure3. The selected papers distribution according to the variables.

A group of research studies investigated employment risk triggered by new technologies, such as artificial intelligence (AI) and robotics, applying the possibility of computerization by international employment data. The new idea of this type of research studies is the consideration of regional heterogeneity in labor markets according to the rough geographical distribution of professions, which is especially observed between male and female workers. The researchers found that female workers are subjected to higher risks of computerization than male workers, since they will be involved in jobs with a high probability of computerization. This propensity is more evident in big cities. The findings of such research studies recommend that providing extra human capital investment alone is not enough as a challenge mitigation strategy against new technology, and representatives want to decide structural labor market challenges, such as gender biases for career progression and contribution in decision-making tasks, in the AI era to mitigate unequal risk of computerization between employees (Nobuaki and Keisuke, 2018).

On the other hand and because of the fact that there is an enormous technological advancement and automation trend in the work force world in this 21st century, Artificial Intelligence (AI) is not only classified as a recent advanced product of technological development for people but it also supposed as a new severe threat for employees in the new industrial revolution in the computer-age. From this perspective, another group of research studies came up to explore the impact of AI on working conditions, environments and skills at workstations. The majority of these research studies are considered as an exploratory research or qualitative research, data is collected by interviewing some employees in industrial sectors who gave some serious opinions on Industrial Revolutions, robotic trend and AI. As the result of the mentioned process, it became evident to say that AI has a great impact on employment condition in the computer-age. One of those impacts is that AI directly and indirectly affects human-being relationships in the workplace. Another impact stated in different research studies is to affect the working knowledge and skills which are required for a job in any working world. Also, AI will negatively affect institutional engagement and organizational identity. Aside from these unexpected impacts, AI is commonly considered as a main reason for such a serious unemployment growth in many societies. In this regard and to tackle these new challenges which may be produced by AI and fast technological investment at workplaces, some significant recommendations are suggested including AI is made for growing the ability of employees rather than substituting human workers, giving obligations and requirements on AI which is deliberately made and used to substitute human workers and control enforcement on the places which should be a real support for improving Artificial Intelligences and which subdivisions cannot be provided to be controlled by AI is essential (Saithibvongsa and Yu, 2018)

On the other hand, with the excessive consideration of governments and the gradual formation of the industrial structure, artificial intelligence is in the level of fast development. Innovation in the development of artificial intelligence came from three elements: the increase of massive volumes of data, the appearance of numerous excellent algorithms, and the marvelous improvement in the performance of computer hardware. Additionally, any new technology and new application have two wings. The artificial intelligence technology and its application not only get suitability to people, but also manage security risks (Xiong, 2019).

One more paper projected the influence of industrial robots on employment, salaries, and the arrangement of occupations in German work force between 1994 and 2014. The authors found that the acceptance of industrial robots had no impact on the field of employment in national labor markets focusing on industries with high robot usage. Also, Robot implementation led to job losses in manufacturing which were counterweighing by improvements in the business service field. The authors of the same paper investigated the effect on individual workers and find that robot adoption has not added the risk of substitution for present manufacturing workers. The companies will stay with their individual employers, and many workers regulate by switching jobs at their unique workplace. While the loss of industrial occupations is solely pushed by fewer new jobs for young labor market applicants, in areas with higher experience to automation, labor productivity increases and the labor portion in total income declines (Chiacchio, Petropoulos and Pichler, 2018)

7. Conclusion and future directions:

The previous sections explored the reviewed research papers of the relation between AI and the field of employment. This section provides a summarization of the study different phases and answers the research questions with a number of future recommendations. The reviewed papers were divided according to two different directions; the first direction is their ideas between people encourage AI as a development tool to hire new employees and people state AI as substituted tools that will take the individual jobs. The second direction is the variables discussed in the papers and affected AI and employability.

From all of the above, we realized that AI is considered as an effective tool to improve the work for field with few concerns cited in a number of research papers. As the majority of the reviewed papers stated that Artificial intelligence (AI) will have many deep social impressions. It assures prospective benefits (and may also cause risks) in the field of employment.

All in all, the future of labor market should be a combination between automated workers such as robots and machines along with the human workers. This direction started to be cited in different research papers in 2019 (Rai, Constantinides and Sarker, 2019)

8. References:

- Agrawal, A., Gans, J. and Goldfarb, A. (2019) 'Artificial Intelligence, Automation, and Work', in *The Economics of Artificial Intelligence*. doi: 10.7208/chicago/9780226613475.003.0008.
- Ahmad, J., Farman, H. and Jan, Z. (2019) 'Deep Learning Methods and Applications', in *SpringerBriefs in Computer Science*. doi: 10.1007/978-981-13-3459-7_3.
- Andreou, E. J. (2017) *Artificial Intelligence- Benefits, Challenges and Ethical Issues*, Zenodo. doi: 10.5281/ZENODO.1054567.
- Arel, I., Rose, D. and Karnowski, T. (2010) 'Deep machine learning-A new frontier in artificial intelligence research', *IEEE Computational Intelligence Magazine*. doi: 10.1109/MCI.2010.938364.
- Athanasakis, E. (2016) 'Systematic reviews', *Nursing standard (Royal College of Nursing (Great Britain))*: 1987). doi: 10.7748/ns.30.50.64.s45.
- Au-Yong-Oliveira, M. et al. (2019) 'The role of AI and automation on the future of jobs and the opportunity to change society', in *Advances in Intelligent Systems and Computing*. doi: 10.1007/978-3-030-16187-3_34.
- Bengio, Y. (2009) 'Learning Deep Architectures for AI', *Foundations and Trends® in Machine Learning*. doi: 10.1561/2200000006.
- Bessen, J. E. (2017) 'AI and Jobs: The Role of Demand', *SSRN Electronic Journal*. doi: 10.2139/ssrn.3078715.
- Buchanan, B. G. (2005) 'A (very) brief history of artificial intelligence', *AI Magazine*. doi: 10.1609/aimag.v26i4.1848.
- Chiacchio, F., Petropoulos, G. and Pichler, D. (2018) *The Impact of Industrial Robots on EU Employment and Wages: A Local Labour Market Approach*, Bruegel. doi: 10.3390/su10020490.
- Crowder, J. A. and Friess, S. (2012) 'Artificial psychology: The psychology of AI', in *3rd International Multi-Conference on Complexity, Informatics and Cybernetics, IMCIC 2012 - Proceedings*.
- Deng, L. (2018) 'Artificial Intelligence in the Rising Wave of Deep Learning', *IEEE Signal Processing Magazine*. doi: 10.1109/MSP.2017.2762725.
- Fernald, J. G. (2014) 'Productivity and potential output before, during, and after the great recession', *NBER Macroeconomics Annual*. doi: 10.1086/680580.
- Freddi, D. (2018) 'Digitalisation and employment in manufacturing: Pace of the digitalisation process and impact on employment in advanced Italian manufacturing companies', *AI and Society*. doi: 10.1007/s00146-017-0740-5.
- 'Frontiers in Artificial Intelligence and Applications' (2018) *Frontiers in Artificial Intelligence and Applications*.
- Ghahramani, Z. (2015) 'Probabilistic machine learning and artificial intelligence', *Nature*. doi: 10.1038/nature14541.
- Gough, D., Thomas, J. and Oliver, S. (2012) 'Clarifying differences between review designs and methods', *Systematic Reviews*. doi: 10.1186/2046-4053-1-28.
- Harrington, P. (2012) *Machine Learning in Action*, *Machine Learning*. doi: 10.1007/s10994-011-5249-4.
- Hintze, A., Olson, R. S. and Lehman, J. (2016) 'Orthogonally evolved AI to improve difficulty adjustment in video games', in *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*. doi: 10.1007/978-3-319-31204-0_34.
- IBM (2018) *IBM100 - Deep Blue*, Ibm.
- Intelligence, A. (2010) 'Fundamentals of Neural Networks Artificial Intelligence Fundamentals of Neural Networks Artificial Intelligence', *Fundamentals of Neural Networks : AI Course lecture 37 – 38*, notes, slides.
- Jha, S. K. et al. (2017) 'Renewable energy: Present research and future scope of Artificial Intelligence', *Renewable and Sustainable Energy Reviews*. doi: 10.1016/j.rser.2017.04.018.
- Lele, A. (2019) 'Artificial intelligence (AI)', in *Smart Innovation, Systems and Technologies*. doi: 10.1007/978-981-13-3384-2_8.
- Li, B. et al. (2017) 'Applications of artificial intelligence in intelligent manufacturing: a review', *Frontiers of Information Technology & Electronic Engineering*. doi: 10.1631/fitee.1601885.
- Liu, W. et al. (2017) 'A survey of deep neural network architectures and their applications', *Neurocomputing*. doi: 10.1016/j.neucom.2016.12.038.
- Makridakis, S. (2017) 'The forthcoming Artificial Intelligence (AI) revolution: Its impact on society and firms', *Futures*. doi: 10.1016/j.futures.2017.03.006.
- Marin-Garcia, J. A. and Tomas, J. M. (2016) 'Deconstructing AMO framework: A systematic review', *Intangible Capital*.

doi: 10.3926/ic.838.

36. Moull, K. E. (2017) Exploring the use of biomechanical metrics in the validation of physical employment standards, ProQuest Dissertations and Theses.
37. Ndyali, L. (2016) 'Higher Education System and Jobless Graduates in Tanzania', Journal of Education and Practice.
38. Neapolitan, R. E. and Neapolitan, R. E. (2018) 'Neural Networks and Deep Learning', in Artificial Intelligence. doi: 10.1201/b22400-15.
39. Nilsson, N. J. (2013) The Quest for Artificial Intelligence, The Quest for Artificial Intelligence. doi: 10.1017/cbo9780511819346.
40. Nobuaki, H. and Keisuke, K. (2018) 'Regional Employment and Artificial Intelligence in Japan', Discussion papers.
41. O'Connor, A., Sargeant, J. and Wood, H. (2017) 'Systematic reviews', in Veterinary Epidemiology: Fourth Edition. doi: 10.1002/9781118280249.ch19.
42. Pannu, A. and Student, M. T. (2008) 'Artificial Intelligence and its Application in Different Areas', Certified International Journal of Engineering and Innovative Technology.
43. Parker, W. and Forster, B. B. (2018) 'Artificial intelligence in sports medicine radiology: What's coming?', British Journal of Sports Medicine. doi: 10.1136/bjsports-2018-099999.
44. Rai, A., Constantinides, P. and Sarker, S. (2019) 'Next generation digital platforms : toward human-AI hybrids', MIS Quarterly.
45. Saithibvongsa, P. and Yu, J. E. (2018) 'Artificial Intelligence in the Computer-Age Threatens Human Beings and Working Conditions at Workplaces', Electronics Science Technology and Application. doi: 10.18686/esta.v5i3.76.
46. Scutiero, G. et al. (2017) 'Oxidative Stress and Endometriosis: A Systematic Review of the Literature', Oxidative Medicine and Cellular Longevity. doi: 10.1155/2017/7265238.
47. Siddaway, A. (2014) 'What is a systematic literature review and how do I do one?', University of Stirling.
48. Stefik, M. J. (2003) 'Machine learning: An artificial intelligence approach', Artificial Intelligence. doi: 10.1016/0004-3702(85)90005-0.
49. Tambe, P. (2014) 'Big data investment, skills, and firm value', Management Science. doi: 10.1287/mnsc.2014.1899.
50. Wang, F. Y. et al. (2016) 'Where does AlphaGo go: From church-turing thesis to AlphaGo thesis and beyond', IEEE/CAA Journal of Automatica Sinica. doi: 10.1109/JAS.2016.7471613.
51. Weston, J. et al. (2016) 'Towards AI-complete question answering: A set of prerequisite toy tasks', in 4th International Conference on Learning Representations, ICLR 2016 - Conference Track Proceedings.
52. Wirth, N. (2018) 'Hello marketing, what can artificial intelligence help you with?', International Journal of Market Research. doi: 10.1177/1470785318776841.
53. Xiong, X. (2019) 'Analysis of the Status Quo of Artificial Intelligence and Its Countermeasures', in. doi: 10.2991/erss-18.2019.99.