

Technological unemployment and Industry 4.0: A discussion

Tuba Ulusoy*, Esra Yaşar⁺, Mehmet Aktan*

^{*}Necmettin Erbakan University, Turkey

ulusoytuba@gmail.com, maktan@konya.edu.tr

⁺KTO Karatay University, Turkey

esrayasaarr@gmail.com

Abstract— Industry 4.0 is a concept that was firstly mentioned in Germany. Also, it is a new era that started by usage of new digital technologies and advanced robots in manufacturing. These technologies provide advantages such as flexibility, productivity and profitability to firms; on the other hand, there are some concerns about technological unemployment as a result of Industry 4.0. In this study, it is aimed to present opinions about the relationship between technological unemployment and Industry 4.0. A survey will be conducted to investigate the opinions of professionals from industries and academy in Turkey.

Keywords— Technological unemployment, Industry 4.0, Turkey, survey, manufacturing industry

I. INTRODUCTION

The introduction of water- and steam-powered mechanical manufacturing at the end of the 18th century started the first stage of Industrial Revolution. The starting point of the second stage was laying the foundations of electrically-powered mass production based on the division of labor at the beginning of the 20th century. At the 3rd stage of the Industrial Revolution that commenced in the 1970s, application of electronics and Information Technologies (IT) became widespread to increase the automation of manufacturing [1]. After the 3rd Industrial Revolution, Westerns countries needed new technologies to compete with eastern countries' low-labor cost, so that 4th Industrial Revolution arise in 2011 [2]. Nine basic technological developments are started to be used in manufacturing by the effect of Industry 4.0 [3].

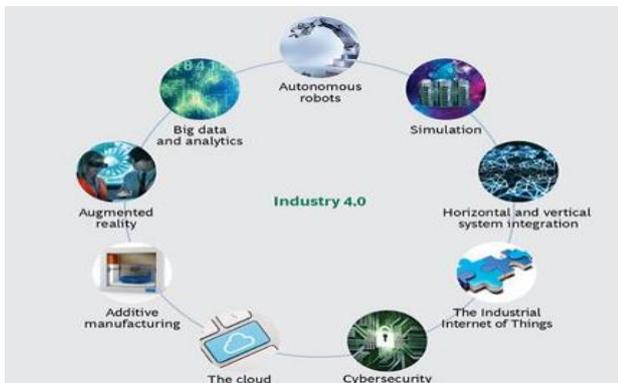


Fig.1. Industry 4.0 is the vision of the industrial production of the future [4]

Among the nine technological developments, the most important development is autonomous robots. During face-to-face human-robot interaction, robots often employ multimodal communication mechanisms similar to those used by humans, like speech production, speech recognition, gesture production, and gesture recognition. [5]. Robots are like humans and they can take people place. Developing technology has started to frighten people in some ways. Regarding this issue, some scientists and some executives, such as Bill Gates and Stephan Hawking, come up with an explanation. Bill Gates said "A few decades after that though the intelligence is strong enough to be a concern. I agree with Elon Musk and some others on this and don't understand why some people are not concerned." [6]. Stephan Hawking also said, "Humans, who are limited by slow biological evolution, couldn't compete, and would be superseded." . Elon Musk, chief executive of rocket-maker Space-X, thinks that robot technology is our biggest existential threat. [7].

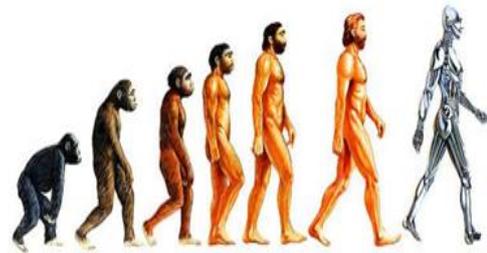


Fig.2. Robots are taking human place [8]

A. What is unemployment?

Unemployment is a social phenomenon. It occurs when the population of working-age wants to work, but cannot find a job [9]. Since this study is based on technological unemployment, we explain only involuntary unemployment. Involuntary unemployment is basically divided into six part.

- Temporary unemployment: Temporary unemployment is as paid employment relations other than those with unlimited duration, including fixed-term and subcontracted jobs, as well as work is done on projects, on call and through temporary-help agencies [10].

- Seasonal unemployment: Industries in which regular shifts in the demand for labor are present are called seasonal; others are called nonseasonal. Farming, construction, and tourism are seasonal; the industrial sector is nonseasonal [11].
- Structural unemployment: Since the structural characteristics and demand of the economy can change, it arises. Generally, it is seen in developing countries or less developed countries.
- Cyclical unemployment: It is the type of unemployment that arises due to fluctuations in the economy during the periods of depression and stagnation. [12]
- Concealed unemployment: There is no definite definition. If a person achieves less efficiency, despite he is working, we can say that there was concealed unemployment.
- Technological unemployment: It arises when machines started to do work that people do. It is based on the development of technology.

A significant part of the unemployment that is happening today is caused by technological unemployment [13]. The root cause of this situation is that development in the technology leaves the human behind. In this regard, Keynes made his famous warning in 1931. He said, "That we have discovered the tools to save workforce is outweighing speed to find new uses for it." [14]. In that time, it is not truth, but now correctness of it is argued.

B. What are the pros and cons of using robots in manufacturing?

Effectiveness of a robot is more than a person, because robots don't need to motivate and rest. They can even work in an environment without light. This situation makes factories started to use cyber-physical systems in their manufacturing process.

Robots are inventions that scientists continuously work on and are renewed with the technology that evolves day after day. Currently, there are robots that were developed via artificial intelligence. The greatest expectation of future is robots that are with cognitive artificial intelligence learned from their own experiences. Those robots have advantages and disadvantages given as follows:

Advantages:

- While some implementations cannot be tried on people because of its risks, they can be tried on robots.
- They can contribute to the economy of the country.
- They can work non-stop, not motivated and in dark environment
- They can be cost saving for firms.

Disadvantages:

- They can get corrupted unexpectedly, this can put the process into a difficult situation.
- They can cause environmental pollution.

- Technological unemployment may increase.
- They may get out of the control.

In a study by Oxford Martin School, workplaces which are under the threat of computerization of artificial intelligence and robotics were viewed. The result of this study shows that it was estimated that in the US, approximately 47% of current workplaces in 2010 are likely to be computerized within the next 10 to 20 years [15].

One of the most impressive and most controversial side of using robots in manufacturing is technological unemployment. When we searched social media and literature and analyzed the survey results, we encountered three foresight.

The first of them is Industry 4.0 will not cause unemployment that is called as technological unemployment. The second is Industry 4.0 will cause technological unemployment. The third is Industry 4.0 will cause temporary technological unemployment.

There are a lot of surveys about this subject. Because people have concerns about technological unemployment and worry about losing their jobs. According to these survey results, the general consensus of the executives is the third foresight.

Also, some companies search future jobs that is emerged by Industry 4.0 effect. When we examined studies about this subject, "industrial data scientists, data coordinator, IT/IoT solution architect, industrial computer engineer/programmer, industrial UI/UX designer, chief digital officer, digital manufacturing engineer, augmented reality system specialist, worker experience designer, wearable technology designer, cloud computing expert" are seen as future jobs [16,17,18].

In this study, it is aimed to present opinions about the relationship between technological unemployment and Industry 4.0. A survey is conducted to investigate the opinions of professionals from industries and academy in Turkey. and key findings are presented in the next section named as Analysis of Survey Results.

II. ANALYSIS OF THE SURVEY RESULTS

The survey that comprises of 9 questions is sent to over 500 academicians that work at the various department of Turkey universities. Also, another survey that includes some questions that are related to the topic of this study is sent to over 100 firms from different sectors in Turkey. The questions and responses are given as follows:

1) What is your title?

This survey is answered by 102 academicians and 2 graduate students. Most of the respondents of the survey are research assistants.

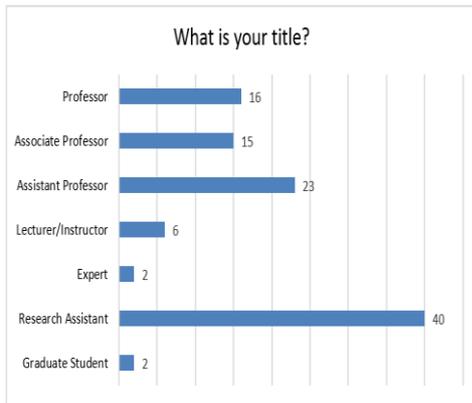


Fig. 3 Split of surveyed academicians

2) Do you have knowledge of Industry 4.0 and its technologies?

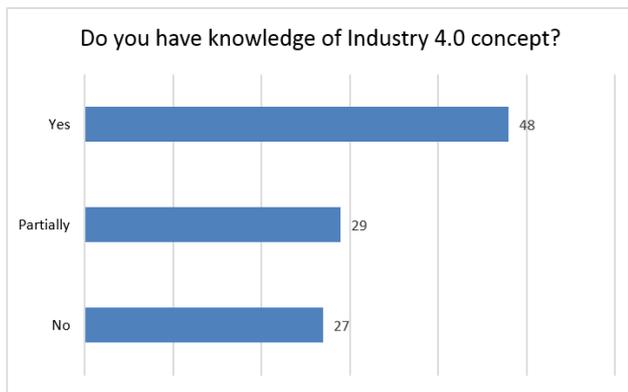


Fig. 4 Split of the responses of the second question

26% of the surveyed academicians do not have knowledge of Industry 4.0 concept.

3) In your opinion, what are the benefits of digitized production? [19].

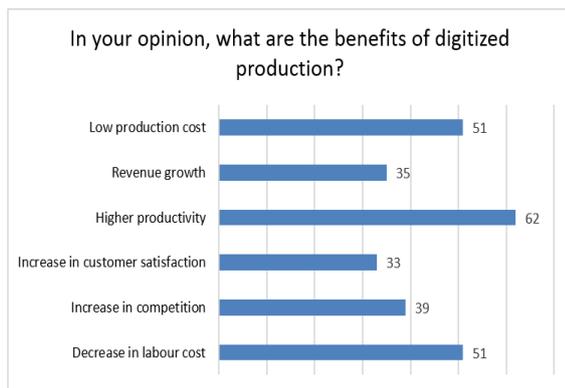


Fig. 5 Split of the responses of the third question

According to the survey results, higher productivity, low production cost, and decrease in labour cost are assumed as

benefits of digitized production. Some respondents have different opinions as given as follows:

- These are not the direct results of digitized manufacturing. If you choose right strategy and use efficient applications, you can get these results.
- It does not have any benefits.
- None of them
- Higher quality
- Higher flexibility and short lead times

4) Do you think that digitized manufacturing has disadvantages? If your answer is "Yes", would you like to tell these disadvantages briefly?

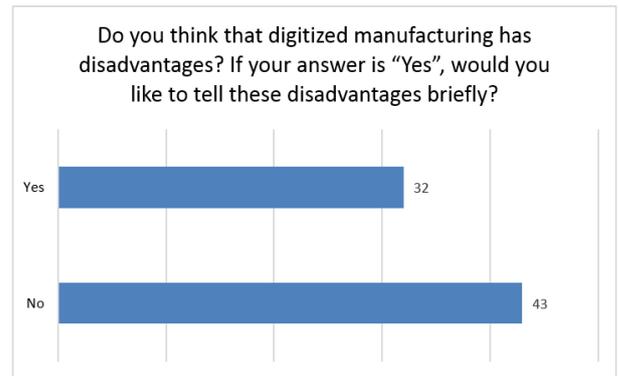


Fig. 6 Split of the responses of the fourth question

Most of the academicians think that the digitized manufacturing has some disadvantages whose examples are given as follows:

- Not doing anything about the social problems, such as unemployment and disappeared occupations, in the background is a little scary.
- A decline in the employment of the workforce can cause unemployment which is a problem that results in income imbalances and social problems.
- More educated customers will be needed.
- As in the case of Rolls Royce, since fully automated systems cannot take human intelligence and human rigor place, some problems may occur in the future. So, the manual processes may be preferred again.
- This concept may weaken production control mechanisms over time.
- If digitized production became more prevalent, some occupations may be disappeared.
- It will cause an increase in unemployment rate.
- It will decrease the unqualified workforce demand, so this will cause unemployment.
- Since the data produced in digital environment is used to make decisions, the customer preferences may not be understood correctly.

This situation increase the risks of not meeting customer preferences.

- How can the unemployment problem be overcome in a developing country, like Turkey? We need well-trained employees that also have programming skills. The education system has not been prepared yet for these needs.
- Some problems may occur, like security vulnerabilities, coordination problems, and bugs arising from complex design.
- It will lead to reduce in potential customer's purchasing power.
- It increases the risk of being hacked.
- It can cause unemployment and create social unrest.

5) Do you think that Industry 4.0 technologies can cause problems that related to unemployment since labour-intensive manufacturing is reduced?

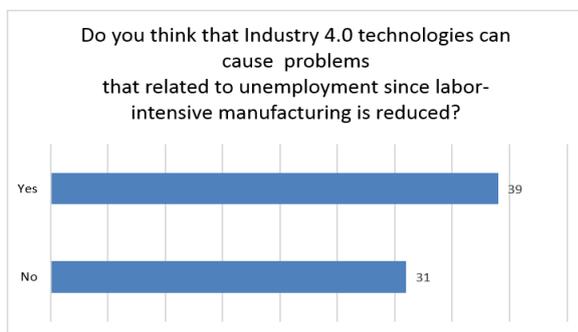


Fig. 7 Split of the responses of the fifth question.

Most of the surveyed academicians think that Industry 4.0 technologies can cause problems that related to unemployment since labor-intensive manufacturing is reduced.

Some explanations that are made for this question are given as follows:

- In the grand scheme of things, the capitalist system will solve this problem in a different manner.
- Employment will increase in reverse engineering.
- Unemployment will be a problem for unskilled workers. But qualified workers demand will increase in the high technology environment.
- This issue was also discussed when printing press was invented. It is an unnecessary concern.
- Yes, unemployment will increase, but the solution to this problem should not be staying away from digitized manufacturing.
- Of course, but it is possible to take precautions to minimize this problem during the transformation process.

6) Do you think that Industry 4.0 would have a positive effect on the issues that are related to society like environment and health?

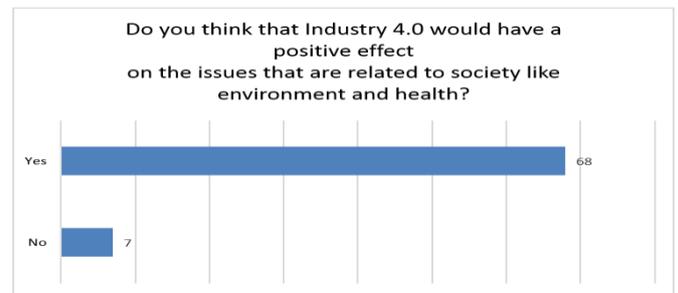


Fig. 8 Split of the responses of the sixth question.

According to the survey results, most of the respondents think that Industry 4.0 would have a positive effect on the issues that are related to society like environment and health. One of the respondents says that using robots in heavy work and unhealthy environments can prevent occupational health problems and accidents. Another respondent says that because of the adverse effects of this concept, positive effects will be ignored.

7) Are there any studies at your university to make that the students have knowledge of Industry 4.0 technologies?

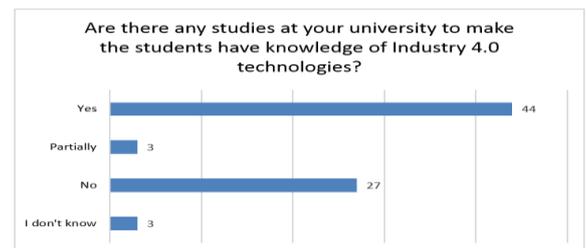


Fig. 9 Split of the responses of the seventh question.

The survey results show that studies that related to Industry 4.0 have been carried out in some universities

Graduate dissertation related to Industry 4.0 concept have been completed and effects of digitalization on the supply chain are taught in SCM courses.

8) Do you think new occupations will emerge with Industry 4.0 revolution? If your answer is "Yes", would you like to give examples of them?

The responds that given to this question are given as follows:

- New occupations that will make life easier and increase the standard of living level will emerge.
- New occupations will emerge in electronics and automation
- Data Security Expertise, Intelligent Network Development Engineer, Cloud Computing Specialist, Data Scientist will be new professions.
- Industrial Security Specialist and System operators will be needed.
- Big data scientist, Machine-to-Machine Specialist, Robot programmers, Data collection specialist, Digital designers, Digital production planners, and Software engineering will be new occupations.

- Occupations that focused on the development of decision-support systems and the analyzing data at the intersection of business administration, engineering, and statistics science.

9) Do you have any comments that are not mentioned in the survey?

Just three of the surveyed academicians answered this question. Their answers are given as follows:

- As always, we are late for Industry 4.0
- Internet of Things (IoT), communication of sensors, robot technologies, and coding should start to be taught in high schools.
- Artificial Intelligence needs to be emphasized in such a survey.

III. CONCLUSIONS

Totally 102 academicians from Turkey responded this survey. When the survey results are analyzed it can be seen that most of the academicians have knowledge of Industry 4.0 concept and they think that Industry 4.0 technologies can cause problems that related to unemployment since labor-intensive manufacturing is reduced.

58% of the firms that responded the survey think that Industry 4.0 technologies can cause problems that related to unemployment since labour-intensive manufacturing is reduced.

Also, 57% of the surveyed academicians say that the studies have been done to inform students about Industry 4.0 concept. This can be seen a precaution to prevent technological unemployment.

REFERENCES

- [1] H. Kagermann, J. Helbig, A. Hellinger, and W. Wahlster, "Recommendations for implementing the strategic initiative industry 4.0: Securing the future of German manufacturing industry", Final report of the Industrie 4.0 Working Group, 2013.
- [2] S. Pfeiffer, "The Vision of 'Industrie 4.0' in the Making—a Case of Future Told, Tamed, and Traded," *Nanoethics*, vol. 11, no. 1, pp. 107–121, 2017.
- [3] Rübmann, M., Lorenz, M., Gerbert, P., Waldner, M., Justus, J., Engel, P., & Harnisch, M. Industry 4.0: The future of productivity and growth in manufacturing industries. Boston Consulting Group, 9, 2015.
- [4] M. Lorenz, D. Küpper, , M. Rübmann, A. Heidemann, A. Bause, "Time to Accelerate in the Race Toward Industry 4.0", Available: <https://www.bcgperspectives.com/content/articles/lean-manufacturing-operations-time-accelerate-race-toward-industry-4/>, 2016
- [5] Mead, R., & Mataric, M. J. Autonomous human–robot proxemics: socially aware navigation based on interaction potential. *Autonomous Robots*, 41(5), 1189-1201,2017.
- [6] <http://www.bbc.com/news/31047780>
- [7] <http://www.bbc.com/news/technology-30290540>
- [8] http://www.bbc.com/turkce/haberler/2014/12/141202_hawking_yapay_zeka
- [9] M. Gök, *İşgücü Piyasası ve Kobiler*,1.Basım, Ankara: Roma Yayınları, xx, s.34, 2004.
- [10] Virtanen, M., Kivimäki, M., Joensuu, M., Virtanen, P., Elovainio, M., & Vahtera, J. Temporary employment and health: a review. *International journal of epidemiology*, 34(3), 610-622,2005.
- [11] Mourdoukoutas, P. Seasonal employment, seasonal unemployment and unemployment compensation: The case of the tourist industry of the Greek islands. *American Journal of Economics and Sociology*, 47(3), 315-329,1988.
- [12] Abraham, K. G., & Katz, L. F. Cyclical unemployment: sectoral shifts or aggregate disturbances?. *Journal of political Economy*, 94(3, Part 1), 507-522,1986.
- [13] B. C Ataman, İşsizlik sorununa yeni yaklaşımlar. *Ankara Üniversitesi SBF Dergisi*, 53(01), 1998.
- [14] J. M. Keynes, "Economic Possibilities for our Grandchildren", *Essay in Persuasion*, Harcourt Brace, 1931.
- [15] C.B.Frey and M. A. Osborne. "The future of employment: how susceptible are jobs to computerisation?." *Technological Forecasting and Social Change* 114,254-280,2017.
- [16] <http://www.engineering.com/AdvancedManufacturing/ArticleID/15520/5-Future-Jobs-that-Could-Solve-the-Manufacturing-Skills-Gap.aspx>
- [17] <https://iot-analytics.com/top-5-new-industrial-iot-jobs/>
- [18] <http://www.endustri40.com/endustri-4-0-ile-birlikte-gelecek-10-yeni-meslek/>
- [19] R. Geissbauer, J. Vedso, S. Schrauf, "Industry 4.0: Building the digital enterprise", Available: <https://www.pwc.com/gx/en/industries/industry-4.0.html>, 2015.