Robots and Society: Robots Influence on Manufacturing

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Introduction

The landscape of work in America is changing with the introduction of ever improving technology. This technology has introduced new and improved methods for production. However, with all the improvements in technology comes with a cost to the American worker. Carl Frey and Michael Osbourne predicted in 2013 that 47 percent of jobs in the United States are at risk of computerization (Frase, 2016). These computer calculations are no longer a virtual threat and are being brought into the real world by robots. To study the risk of robots on the American worker, the automotive industry, a longstanding American manufacturing industry is being used to display the potential positive and negative impact of robots. Furthermore, robots' impact on the economy and society. The reasoning behind the automotive industry for the study is a detailed manufacturing history and the early adoption of robots. Therefore, the automotive industry will provide an insight on the way that society and robots interact on a daily basis.

Background

The first mass automotive manufacturing operation started in Michigan with the introduction of the Model T Ford, and the now synonymous assembly line. The assembly line implemented by Henry Ford uses the principles of interchangeable parts and constant workflow (Hounshell, 1985). In essence the assembly line broke down the complex task of building a car into a series of simple repeatable tasks. This repeatable nature is the basis of robots and manufacturing as the two complete tasks efficiently. Robots are defined by Institute of Electrical and Electronics Engineers (IEEE) as a machine that is capable of sensing the environment around it and make actions based on those calculations (Guizzo, 2019). Therefore, the alure of introducing robots into manufacturing is obvious as robots increase profits, reduce costs, and

increase production all in less time. In fact, by the 1970's robots had done exactly what was expected and changed the automotive landscape with the introduction of programmable machines. The American companies leveraged this economic advantage to create more jobs in the following decades.

However, this relationship is coming into question with the progress of artificial intelligence (AI) and machine learning. Robots are no longer limited to the simplest of tasks, but to high precision work at an efficient rate. In addition, AI is not labor intensive like the original robots introduced into the automobile industry in the late 1970's. This change is because the machines will no longer need as much supervision or assistance. Therefore, the study of the impact of robots on society and economy must be studied. The study will focus on how to maximize positive economic benefits with the integration of robots into manufacturing. Furthermore, the processes must minimize the negative societal impacts on the communities. To understand who is affected by robots the specific stakeholders are the focus of this research question and include factory workers, roboticists, manufacturers, and American society. The factory workers and manufacturers will represent the most focal portion as their jobs and profit margins are at risk. Impoverished workers are a subset of the factory workers, and are another stakeholder that the integration of robots may affect more than other stakeholders. The next indirect link is the roboticists, and how the field will design robots for certain tasks and respective outcomes. Automotive industries support large communities with their job opportunities. In addition, the industry represents the state of manufacturing in American society. The stakeholders all operate in a symbiotic relationship that uses each other to prosper, and the integration of robots will cause a new dynamic between the groups.

Research Question & Methods

Robots and Society: How to manage the integration of robots into manufacturing? The research conducted used online data base Elton B. Stephens Company (EBSCO) for peer reviewed articles. Newspaper articles used in the historical case study of Ford were gathered from Journal Storage (JSTOR). First, a historical case study exhibits a previous scenario of a modern problem. This case study includes analysis of newspaper articles during the early introduction of robots into Ford. The goal is to understand the societal perspectives related to simple robots in the manufacturing world. Finally, discourse analysis and documentary research into the modern situation to understand the benefits and costs to implementing robots. Furthermore, the end goal of the research is how to implement and adapt to robot's impact on the new labor environment.

STS Framework

This conundrum of capitalism and economics is quite complex. The introduction of artificial intelligence as the technology has many benefits to companies, but may create unintentional consequences with society. Therefore, there needs to be an investigation in how to maximize the economic benefits of the company while minimizing the negative outcomes of this new technology. Thomas Kuhn's paradigm shift is a useful method to investigate the labor market in an evolutionary period when the previous solutions are no longer enough to measure economic success (Kuhn, 1962). This method is well suited for this study as paradigms offer a unique method to discuss current changes to science by redefining the solution. Paradigm shift consists of five specific phases consisting of normal science, model drift, model crisis, model revolution, and paradigm shift. These five components describe a process of adopting a new

model when the previous model is no longer relevant. The understanding of the effects of robots and society is important because there is a symbiotic relationship of society to the success of a company finically. Simply, because people need jobs to buy products from the companies in American societies. However, Walker talks about the perils of using paradigms shifts to study social sciences as it limits the focus of the subject by proposing a solution (Walker 2010). This point may be true, but in order to get to a solution there needs to be a level of decision and action. The process of improving on the previous solution is integral to paradigm shifts so in sense the scope is narrow, but it is focused on improvement.

Overview

In this study of robot's impact on society the answer is a multiple pronged approach by using strategies from fields of economics, education, and policy. The purpose is to get stakeholder understanding and commitment towards a certain solution that progresses society forward in the best manner possible. This would shift educational institutions focus from traditional methods of memorization and methodologies to a focus on creativity and creation (Bakhshi & Windsor 2015). In addition, to broadly enforce a code of ethics for roboticists in order to create valuable products for societies. The end goal is to create a professional environment like the engineering fields that have personal responsibilities for their work. Implementing strong labor unions to retrain employees as their jobs become obsolete. Finally, regulating innovation in a way that that is not restrictive on the science and allows robots to achieve profound accomplishments.

Historical Case Study

The Ford Motor Company first saw the economic and productivity impacts of the assembly line taking the production time of a Model T car from twelve hours per car to about

one and half hours per car. This is an 87.5 percent decrease in the production time of a Model T Ford. The assembly line allowed Ford to increase their production and profitability. This method was widely adopted across all manufacturing practices in the following years, and is still a basis of modern manufacturing. The main draw to the assembly line is the economic advantage of using the average total cost theory by increasing the production while keeping all fixed costs the same. Furthermore, robots in production seek to do the same to the manufacturing process by increasing the production with minimal impact to the fixed costs of the company. This nature of work is the basis for modern robotics as machines are now programmed to complete simple tasks efficiently.

The Ford motor company introduced robots into the production in 1962 with the introduction of the Versatran which had 25 unique programmable movements (McKenzie 2015). The Versatran was Ford's first attempt at implementing robots in manufacturing. Furthermore, the Versatran adhered to the normal science of the average total cost theory by increasing production with little impact on fixed costs. In addition, the Versatran led to the same outcome of increased production, profits, and growth for Ford. This productivity increase at Ford led to an increase in employment over the next few decades.

Societal Implications Case Study

To understand the social implications of the introduction robots during this time period a few newspaper articles were investigated to understand the values and concerns of society during the introduction of robots into manufacturing. First, to gain a sense of the public's perception of robots in general. Second, was to get expert opinions on robots during their introduction into Ford's manufacturing process. Both of these are important to understanding the current situation

of artificial intelligence and the differences between then and now. The information gathered here will lay the foundation to the proposed solution.

First, the Ludington Daily News in 1986 tackled the growing debate if robots were good or bad (Reed 1986). This article takes multiple viewpoints on automation being introduced into the American economy such as, job displacement, company performance, workforce input, and future considerations. Ludington Daily News offers a neutral report on the impacts that robots will have specifically on the automobile industry and the general economy. In the article Reed mentions a study from the University of Michigan which predicted an 18 percent of jobs would be displaced in the automobile industry by 1995. This is a significant displacement of jobs over the next ten years. However, the Ludington Daily News juxtaposes the job displacement with the need for growth in companies that otherwise would not be competitive without the introduction of robots. In addition, the viewpoint of a United Auto Workers (UAW) worker Joyce that hopes innovation in robotics is focused on making tasks safer and easier. Finally, a Ford executive quote on the introduction of automation was the second version of the assembly.

These concepts portray the complex nature of robotics both in economic and social terms. The companies need to increase productivity in order to compete with many international companies weighted against the displacement of factory workers jobs. UAW union member Joyce displays a reasonable argument on ways to implement robots in a way that are beneficial to both companies and UAW workers. The most important bit of information in the article is a Ford executive stating that the introduction of robots into the manufacturing space would be a second version of the assembly line. Meanwhile, that the factory worker would still be vital to the manufacturing process. The statements would imply that it would have the same beneficial impact on people and Ford. Therefore, it gives a notion of increased profit margins and

employment, which creates a symbiotic environment for both to create success. However, this is one of the first cases of model drift as perception about previous methodologies no longer seem to fit.

Second, the Telegraph-Herald goes into detail about the current impact of robots on the labor market in the 1980s (Taylor 1990). Dr. Hunt from the W.E. Upjohn Institute for Employment Research states that the institute believes that the impact has been minimal on the job market so far. This statement shows that there was not a negative impact from the introduction of robots into the overall job market. However, over half of the robots introduced into the U.S. economy was in the auto industry. Furthermore, it discusses the different levels of autonomy in robots, and the respective impact on the labor market. Carnegie-Mellon University Professor Ayres that Level 1 robots, which have the lowest level of autonomy, could perform 13.6 percent of jobs. Level 2 robots, machines that complete tasks with input, could replace 39.5 percent of existing jobs. This translates to 1.3 million jobs for Level 1 and 3.8 million jobs for Level 2 robots. The article predicted that Level 2 robots would not be implemented until after the early 2000's.

The Telegraph-Herald grapples with several important issue of job displacement with the advancement of robotics. Robots progression to interpret the surrounding environment and act in a manufacturing space illustrates the possible disruption to the labor market. The article also highlights the disparity of robot's autonomy introduced into the auto industry to the corresponding impact. Most importantly, the article displays the model crisis expected with the introduction of level 2 robots and beyond. This is because the current model of economic theory will no longer account for such a large percentage of the workforce to be displaced.

The Observer-Reporter takes a contrasting stance on robots. The article takes a more nationalist approach to robotics (Bergstrom 1991). It discusses the United States unwillingness to adopt robots compared to countries such as Germany and Japan. The statistics show that Japan had 176,000 robots to the United States' 37,000 in 1991. The article states that to be competitive with the other industrialized countries that an increase in investment in robots was needed.

The Observer-Reporter shows a major shift in the perception of robots compared to the articles in the previous decades. The general attitude had changed from a position of fear to that of a necessity. Companies needed robots in order to compete in a global market place. This meant that companies needed robots to keep people employed for this reason. This displays model revolution and paradigm shift of people in the 1990's to become less fearful of robots.

To summarize the history of robots and Ford in the late twentieth century it was one that was brought by reckoning fear then a calm acceptance of robots. It showed the need for robots to be introduced in order for companies and American society to enjoy the benefits of the productivity. However, as the articles eluded that there is a tipping point in automation where the benefits of robots are no longer symbiotic. The unstable relationship with labor markets and robots is a possibility. In addition, it showed the process and steps that the paradigm shift needed to go through to reach a conclusion. In this case the science did not change it did come into question since its creation during the assembly line.

Discourse Analysis

The culmination of artificial intelligence and robotics progress has created a new scenario were the concerns of the late twentieth century have reappeared. A Yale Law Journal discusses that the new technology is not as simple as the previous versions (Estlund 2018). The expected macro-economic theory no longer conforms to the principles of increased production that create

increases in profit, growth, and employment. This prediction alludes to model drift of the current economic theory as scholars are challenging the previous macro-economic theory. First, the jobs impacted by robotics are expected to be mostly mid-skilled jobs, which creates a chasm between the low skill and high skill jobs. The skill chasm poses a problem with job progression because it hampers the ability of people to move vertically in a company over time. Therefore, the chasm reduces the lifetime earnings of an employee. The chasm also creates an increase in competition on low skilled human jobs therefore, driving down wages in this sector. Second, that the general prediction that artificial intelligence will destroy more jobs than it creates. The prediction claims that since artificial intelligence is not labor intensive it takes fewer people to do the same jobs. The negative job growth threatens to disrupt the economy by reducing money input into the overall economy. In addition, if this prediction goes as stated the model crisis will occur during this section as it will become clear the methodologies of the past are obsolete. This is where the previous macro-economic theories and social understanding of automation will come into question. The advancement robots will create an uncertain environment where new solutions will be discovered.

The model revolution will begin where new theories of the artificial intelligence phenomena will appear. Hence the most common solution to the problems posed to robotics is to stop innovation. Stopping innovation would negate the good that will come from robots in the future. The country would lag behind in technology and competitiveness in the global market. Furthermore, Stevens takes a stance saying "Technological innovation should not, and arguably cannot, be curtailed.", which portrays the need for continued innovation (Stevens 2016). However, the author states the need for alternative solutions to the growing difficulties related to robotics.

In *The Changing Nature of Work* the report analyzes how the nature of work changes to meet the current market needs (Djankov & Saliola 2018). The article displays that jobs that require nonroutine cognitive and social behavioral skills increased 19 to 23 percent in emerging economies and 33 to 41 percent in advanced economies. This statistic underlines the change in focus of economies shifting from the repeatable tasks to that of non-routine skills. Therefore, adapting to the current market place by becoming harder for automation to replace. The point the authors make is that robots are beneficial to our economy and society by creating new services. The byproducts of the robots increase wealth and prosperity in a community and those surrounding the company.

Documentary research

The above articles highlight the innovation in robotics and the respective impacts on society. Robots definitely offer positive benefits, but the experts warn of the possible deterrents of implementing robots poorly. The model revolution must take into account more than just economics as the impact of robots has many stakeholders. This is where the integration of robotics in an ethical manner were people and corporations create a symbiotic relationship. Boden proposes a set of ethical regulations that are set for a guideline in robotics that focus on the safe use of robots (Boden et al 2017). In addition, the societal impact of robots, and working with other industry professionals. The code of ethics if implemented would be an integral step in achieving an ethical implementation of robots in manufacturing. Second, to focus more on human capital as Stevens explains that the chasm between low skill and high skill jobs increases the need for strong labor unions (Stevens 2016). An example from the Ludington Daily states that the UAW would adopt the new technology and retrain the employees displaced by the robot's introduction. This mitigates the negative impact on the economy and society by

diminishing productivity. Furthermore, Stevens also states the need for an increase in human capital to combat the changing work culture which values the non-routine skills. To support the need for changing skills in the job market a United Kingdom study states that there is an inverse relationship of creativity and computerization (Bakhshi & Windsor 2015). In fact, the study states 87 percent of highly creative jobs are at little to no risk versus 40 percent of other jobs in the United Kingdom. Therefore, the change needs to start with changing education objectives to focus more on jobs that coexist with the new labor environment. Finally, using dynamic regulation which uses trial and error regulations that can be just as agile as the products (Kaal et al 2017). This regulation technique allows institutions to stay agile and effective with innovative technology.

To analyze this research on robots using the Paradigm Shift from Thomas Kuhn consists of five separate portions. First, the normal science of the previously accepted more production means more benefits for corporations and society. Second, model drift which started in the 1980's with the first realization that robots could change the work culture. Now with the current research and analysis, and the corresponding predictions suggest that the previous labor model is obsolete thus creating a model crisis. The next step is using model revolution to create expert strategies on education, regulation, and a code of ethics to create a new paradigm of labor markets and economics. The paradigm shift is dependent on the success and trial and error method of finding a way that supports both society and companies.

The limitations in this research paper are that the results of this research will take a long period of time before accurate observations and data can be collected. In addition, the research project was only allowed six months for research. No research after spring 2019 was considered as the publishing and reviews were not yet available during the research. The limited scope of

the project based on the integration of robots into manufacturing neglects other cost benefits that may arise from the introduction of robots into other sectors.

Further research should be conducted on the implementation and success of the methods proposed in the documentary research. The results of this study will take many years to complete and should be followed closely. The results will be important to changing regulations and practices in the American economy and society to adapt to the change in nature of work. This should be studied by labor specialist, economists, and social researchers to understand the prolonged impact of mass automation in broad sectors of the economy. These impacts could take form in economic, educational, and labor regulations. In addition, the use of strategies set forth in the research to minimize negative outcomes on people that support the economy.

Conclusion

The answer to the research question is to combine multiple areas of research to create a new paradigm to produce the best impact of robots on society. First, is to limit the impact of robots on humans with dynamic regulation and labor unions. Second, is humans adapting robots by changing education practices and creating more human capital. Third, is creating an ethical standard for roboticists to create and innovate around. This is significant as the welfare of a society is tied to the economic performance of the country. In addition, the issues stated with robotics can become detrimental to society if not implemented in an effective way. Therefore, it is important to use these methods discussed to continue the symbiotic relationship of automation and society.

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