Memo

To: Chris Derosier

From: Michael Johnesee

Subject: Feasibility Report

Date: 6 May 2016

In response to the class assignment, I have written a report on the feasibility of rapid automation causing large scale unemployment. Research was done on current industry specific businesses as well as analysis of new technological developments. The report concludes with a summary of the findings. The title page contains an abstract for conciseness.

If you have any questions, please feel free to contact me.

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Title

Feasibility Study of Technological Unemployment:

Will rapid automation cause the unemployment rate to pass that of the Great Depression?

By

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Abstract

As technological developments push machines to become faster and cheaper, there is a growing trend for companies in a wide variety of industries to automate as much of their business as possible. This report analyzes the occupations in the U.S with the largest number of workers and any relevant technological advances to see if there are strong arguments for automating current human labor. Strong emphasis is put on improvements in speed, cost, and precision as well as how soon new technology can be implemented. The report looks to see if current trends will push unemployment past 25% in the next few decades. The conclusion found that depending on how quickly new technology is adopted and if there was no change economic policy, then unemployment could reach up to 45% within the next two decades.

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There have been two great technological revolutions. The agricultural revolution began in the 8th century and started in the Middle East. Over several centuries, civilization shifted away from hunter/gatherer behavior towards settled agriculture. The next major technological advancement came during the industrial revolution, less than 200 years ago. Production techniques have since reached most of the world and the dissemination of information has lead to widespread industrialization.

We are currently within a new era of industrial transition, one which is advancing much more quickly than its predecessors, and which has the potential to have major financial repercussions. Until now, economic resources have been distributed based on contributions to production, with machines and humans competing for employment on somewhat equal terms. With current trends in automation, potentially unlimited output can be achieved by systems of machines which will require very little cooperation from human beings. As machines take over production, they will absorb an increasing proportion of resources while the workers who are displaced become dependent on government assistance. The current industrial system was designed to produce an ever-increasing quantity of goods as efficiently as possible, not to ensure ample jobs for humans.

The impact of computers on the labor market is marked by the decline of employment in routine intensive occupations. For example, studies by Charles, et al.(2013) and Jaimovich and Siu (2012) emphasize that the ongoing decline in manufacturing jobs and the disappearance of other routine jobs is causing the current low rates of employment. John Maynard Keynes predicted widespread technological unemployment “due to our discovery of means of economizing the use of labor outrunning the pace at which we can find new uses for labor” (Keynes, 1933).

In Figure 1, the 34 occupations in the table comprise 45% of the U.S. workforce. Only

one new profession has been created in the last 60 years, computer software engineers. The rest are at risk of automation. The following sections will cover the majority of the chart, comparing current industry standards against upcoming technological developments as well as empirical examples to predict the probability of unemployment through automation for that industry.

Retail

Vending machines are a primitive type of robot. Their function is very simple. They keep an inventory, have an electronic display, accept money, and provide you with the item you purchased. It is old technology, and while it has not progressed much in the U.S., in Japan, where they have high population density, limited space, high cost of labour, low rates of vandalism and petty crimes, and people shop mostly by bicycle or on foot, vending machines are taken very seriously.

In Japan there are about 8.6 million vending machines, one for every 14 people, the highest number per capita in the world. These robots are widespread and commonly used for all sorts of goods. In addition to newspapers, snacks, and drinks, Japanese vending machines dispense books, DVDs, condoms, ice cream, hot instant noodles, rice, magazines, glasses, boiled eggs, umbrellas, neck ties, sneakers, vegetables, iPods, and even live lobsters. The days when there was a little shop just around the corner are quickly disappearing.

No longer are retail staff needed. Current technology can provide a shopping experience that requires no human involvement. For example, a store has an interactive map for a cell phone showing where all the items are. You can search for items, filter them by categories, and get information on each item that goes beyond nutrition facts, read reviews and compare products based on your search criteria, just like on Amazon.com. To pay, the

Occupation	Number of workers	Percentage of workers%
Driver/sales workers, bus and truck drivers	3,628,000	2.61%
Retail salespersons	3,286,000	2.36%
First-line supervisors/managers of retail sales workers	3,132,000	2.25%
Cashiers	3,109,000	2.24%
Secretaries and administrative assistants	3,082,000	2.22%
Managers, all other	2,898,000	2.08%
Sales representatives, wholesale, manufacturing, real estate, insurance, advertising	2,865,000	2.06%
Registered nurses	2,843,000	2.04%
Elementary and middle school teachers	2,813,000	2.02%
Janitors and building cleaners	2,186,000	1.57%
Waiters and waitresses	2,067,000	1.49%
Cooks	1,951,000	1.40%
Nursing, psychiatric, and home health aides	1,928,000	1.39%
Customer service representatives	1,896,000	1.36%
Laborers and freight, stock, and material movers, hand	1,700,000	1.22%
Accountants and auditors	1,646,000	1.18%
First-line supervisors/managers of office and administrative support workers	1,507,000	1.08%
Chief executives	1,505,000	1.08%
Stock clerks and order fillers	1,456,000	1.05%
Maids and housekeeping cleaners	1,407,000	1.01%
Postsecondary teachers	1,300,000	0.93%
Bookkeeping, accounting, and auditing clerks	1,297,000	0.93%
Receptionists and information clerks	1,281,000	0.92%
Construction laborers	1,267,000	0.91%
Child care workers	1,247,000	0.90%
Carpenters	1,242,000	0.89%
Secondary school teachers	1,221,000	0.88%
Grounds maintenance workers	1,195,000	0.86%
Financial managers	1,141,000	0.82%
First-line supervisors/managers of non-retail sales workers	1,131,000	0.81%
Construction managers	1,083,000	0.78%
Lawyers	1,040,000	0.75%
Computer software engineers	1,026,000	0.74%
General and operations managers	1,007,000	0.72%
Total of Occupations Listed Above	63,383,000	45.58%
All Other Occupations	75,681,000	54.42%
Total Employment	139,064,000	100.00%

Figure 1: List of U.S. Occupations by Number of Workers

check out is a zone that receives signals from RFID chips in the merchandise and sends a payment request on your cell phone. The whole process takes less than ten seconds. No queues or waiting time. Every piece of technology needed to make this happen already exists.

The lowly stocking person is also on the way out. Some warehouses are already completely automated, and require only operators to work and handle the entire task. Pallets and product move on a system of automated conveyors, cranes, and automated storage and retrieval systems coordinated by programmable logic controllers and computers running logistics automation software. Their accuracy and productivity far exceeds that produced by human labor. These machines are faster, can lift huge weights, and do not require much maintenance. Amazon recently made a $775 million purchase of Kiva Systems, a manufacturer of robots that zip around warehouses filling orders (Amazon). Hundreds of robots transporting merchandise around immense warehouses, with clockwork precision and perfect timing. They are intelligent enough to put items in the most convenient location, based on how frequently they are needed, how heavy they are, etc. They work 24/7 and never make mistakes. The application of similar automated systems to supermarkets and shopping malls is a minor engineering issue, one that can easily be solved.

Tesco is the third-largest retailer in the world measured by revenues and the second-largest measured by profits. Tesco has a large market in South Korea (where they are branded as “Home plus”), second only to E-Mart. In an effort to increase profits over competitors, they opted for a strategy that uses more automation and less workers. Posting large wall adds in transportation hubs, they allowed customers to place grocery orders by cell phone. After scanning QR codes and checking out electronically, the groceries were then delivered to their home. The results were online sales between November 2010 and January

2011 increased by 130%, with the number of registered members rising by 76%. “Home plus” became the number one online store(Tesco).

Manufacturing

Automation in manufacturing has been around for decades. The assembly line developed by Ford Motor Company between 1908 and 1915 made automated assembly widespread and mass production brought unprecedented social transformations. This process transformed long and difficult tasks into many small and simple mechanical operations. This approach worked well with machines which, for the last century, integrated well with humans.

Foxconn is the largest maker of electronic components in the world (Circuits Assembly) Without counting national public services, Foxconn comes out as the third largest employer in the world with an impressive 1.2 million workers (BBC). It has contracts with Amazon, Apple, Hewlett-Packard, Intel, Microsoft, Motorola, Nintendo, Nokia, Samsung, Sony, and Toshiba to name a few. They are an electronics giant that is responsible for nearly half of all technological production in the world (Apple). Recently, in 2011, Foxconn announced that they intended to deploy an army of robots in order to “replace some of its workers with 1 million robots in three years to cut rising labor expenses and improve efficiency.” said Terry Gou, founder and chairman of the company(Foxconn). It still remains unclear how many workers would be displaced by this initiative, but the company has already constructed a Research and Development facility along with a factory in Taiwan to build their own robots. Foxconn is committed to the automation of their business, and it should come as no surprise. Robots are cheaper and more reliable than human workers, they do not ask for vacation, they do not commit suicide, they do not protest for more rights, and they can ensure the company’s profits – which is what matters for a multinational corporation and its stakeholders.

If this sounds callous, Foxconn first became known in the western world after a wave

of suicides were reported by the news. After fourteen workers were found dead in 2010, some twenty Chinese universities compiled a report in which they described Foxconn factories as labor camps and detailed widespread worker abuse and illegal overtime. Stories of overcrowding, tiny living accommodations, as well as impossibly long and exhausting work hours. Ironically, Foxconn actually provides higher wages, better working conditions, and has a lower suicide rate than the average Chinese company (Economist). There is nothing to be surprised about, however, as it is simply the nature of the current social-economic system, efficiency and profits are more important than human lives.

Construction

Currently, it can take between 6 weeks to 6 months to build a 2-story house in the U.S. due to dozens of humans doing all the work. However, in China, they can construct a 30-story skyscraper with all modern comforts in 15 days. The building is made from prefabricated parts and can withstand earthquakes, has excellent insulation, is five times more efficient than a regular hotel, and has smart systems for air circulation and quality control. It is a system that can be built anywhere, to construction tolerances of +/- 0.2 mm, in just a few days (The Blaze).

However, greater strides are being made with large scale 3D printing. Contour crafting is a construction process that uses a computer-controlled crane or gantry to construct buildings rapidly and efficiently without manual labor. The ultimate goal is to upload the design specification to a computer, press print and have massive robots spit out a concrete house in less than a day. No humans required, with the exception of a few supervisors and designers. The idea is just like current 3D printers, just the scale and the materials differ.

Contour crafting is now under development by Behrokh Khoshnevis of the University of Southern California’s Information Sciences Institute. It was originally conceived as a method

to construct molds for industrial parts, but was adapted for rapid home construction as a way to rebuild after natural disasters (Viterbi). The system could build a complete home in a day, and its electrically powered crane would produce very little construction material waste in contrast to the standard home construction project, which creates 3 to 7 tonnes of waste, exhaust fumes from machinery and the thousands of deaths each year which result from workplace accidents (Bureau of Labor Statistics). Contour crafting could reduce costs, lessen our environmental impact, and save materials and lives. Of course, many jobs would disappear, too.

Journalism

Below are the opening lines of three story pieces written about a baseball game. One of the stories was written by a computer algorithm.

a) The University of Michigan baseball team used a four-run fifth inning to salvage the final game in its three-game weekend series with Iowa, winning 7-5 on Saturday afternoon (April 24) at the Wilpon Baseball Complex, home of historic Ray Fisher Stadium.

b) Michigan held off Iowa for a 7-5 win on Saturday. The Hawkeyes (16-21) were unable to overcome a four-run sixth inning deficit. The Hawkeyes clawed back in the eighth inning, putting up one run.

c) The Iowa baseball team dropped the finale of a three-game series, 7-5, to Michigan Saturday afternoon. Despite the loss, Iowa won the series having picked up two wins in the twinbill at Ray Fisher Stadium Friday.

While none of them will win a Pulitzer Prize, story b) was generated by a computer (Business Week). Narrative Science and other companies like them already have many customers in big media that make use of this technology. The identity of the media firms is unknown, but there

existence can be inferred because the companies that created the algorithms have earned millions of dollars in a short time period. This software is used mostly for data intensive articles such as sports, finance, business, market, and real estate reporting. While computer algorithms clearly cannot replace all journalists, to disrupt an industry, all jobs need not be replaced, just a significant percentage. An example within the industry, when Google news started collating articles into categories and personalizing news feeds for users faster and better than any human, dedicate news sites saw a drastic reduction in visitors.

A.I. Assistants

The two dominant themes of modern cognition and artificial intelligence are calculating probabilities and producing complex behavior from the interaction of many small, simple processes. These represent more closely what the human brain does, and they have been used in a variety of real-world applications: Google's autonomous cars, search results, recommendation systems, automated language translation, personal assistants, cybernetic computational search engines, and IBM's newest super brain Watson.

Natural language processing was believed to be a task that only humans could accomplish. A word can have different meanings depending on the context, a phrase could not mean what it says if it is a joke or a pun. One may infer a subtext implicitly or make cultural references specific to a geographical or cultural area. The television show Jeopardy! Is a good example of the intricacies and nuances of the English language. In February 2011, IBM's team decided to take on Brad Rutter, the biggest all-time winner, and Ken Jennings, the longest running champion, in a historic match between humans and machine. Watson dominated both humans, bringing home the prize of $1 million, while Jennings and Rutter received $300,000 and $200,000, respectively.

Although impressive, Watson had access to 200 million pages of structured and

unstructured content, consuming four terabytes of disk storage, including the full text of Wikipedia. The hardware is 2,880 processor cores, running on parallelism that allows Watson to answer Jeopardy! questions in less than three seconds. The total cost of the hardware is about $3 million. Watson's brain uses 80 kilowatts of electricity and 20 air conditioners, while a human brain fits in a shoebox and can be powered by a glass of water and a sandwich.

Watson's computational power and advanced Natural Language Processing, Information Retrieval, Knowledge Representation and Reasoning, Machine Learning, and open domain question answering are already being put to better use as a clinical decision support system to aid the diagnosis and treatment of lung cancer(Watson). With advancements in hardware and cloud computing becoming more prevalent, technologies like Watson will become accessible to everyday individuals.

Transportation

The idea of self-driving vehicles has been around for a while thanks to science fiction writers and television shows. But for the first time, we have the engineering, the mathematical and the computational ability to transform this idea into reality. Autonomous driver-less cars developed by Google, are one example of how jobs in transport and logistics may soon be automated.

Developments in the field have been fast moving. Less than a decade ago, critics pointed at the difficulties of replicating perception, asserting that driving in traffic is impossible to automate: "But executing a left turn against oncoming traffic involves so many factors that it is hard to imagine discovering the set of rules that can replicate a driver's behavior" (Levy 2004). Six years later, Google announced that it had modified several vehicles to be fully autonomous (Brynjolfsson 2011). Today, we have a working technology that has been thoroughly stress-tested under normal and extreme conditions, and all the data suggests that

this technology is reliable. More to the point, it is more reliable than any human as well as being safer to use and faster to operate. The biggest hurdle to implementing social acceptance. As a result, just because a technology exists and it helps us live better, it will not necessarily be adopted right away because of many social factors.

Conclusion

Since the industrial revolution, automation was displacing human workers. In the past, workers were able to recover due to having time to adjust and learn new skills. There were also jobs that were too complex or costly for machines to do. Human labor had the comparative advantage of being cheaper and easier, however that is no longer the case. According to estimates, around 47 percent of total U.S. employment is at high risk for automation, possibly within the next decade. Most at risk are workers in transportation and logistics occupations, the bulk of office and administrative support workers, and labor in production occupations. Even in service occupations, where most U.S. job growth has occurred over the past decades (Autor 2013), there is movement towards computerization.

As a real world example, Walmart is the largest retailer on the planet. They could initiate an aggressive automation strategy by implementing some of the examples e.g automated restocking, electronic shopping and delivery, and automated transportation, easily running its business with less than 100,000 employees. The consequences to the 2.1 million current employees would be disastrous. It would be almost impossible for most of them to find another job, since they are mostly uneducated and unskilled workers. In the past, when automation reduced the workforce, unskilled workers all gravitated towards places like Walmart to find an easy, but unsatisfying job. Companies in the manufacturing sector have already been automating and the statement that “people will find something else to do” does not look at the reality of the situation. Change is happening too fast for most workers to have

the time to learn new skills, even assuming that there will be enough new jobs equivalent to the number of displaced workers.

In conclusion, as long as companies are driven by profit, which is the current status quo, machines don't have to be perfect, only better than their human counterpart. Therefore, the issue is not that automation could happen, but that automation is inevitable. The greater crisis comes with how quickly businesses adopt new technology, and how quickly our economy can adjust. There is a possibility for the future that a large percent of the population will become unemployable.

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