Final Research Project Report

Team Name	CompuTerps
Individual Student Names	Cameron Hewitt, Reed Fodge, Jordan Samson, Kene Nwankwo

Introduction

The subject of focus for our project relates to the reasons why labor in manufacturing fluctuates so often and what could cause these trends? There are many factors that influence the availability of jobs. This influence is not limited by the manufacturing realm of industry. Many companies and modes of occupations have depleted and thrived as a result of the numerous factors in job availability. Two of the main determinants of whether an industry can prosper or not is the economic stability of the nation and the demand of that product. When economic stability is not established, then allocation of funds can be neglected causing a business to suffer and potentially go out of business. The same is true about the demand of that product. When consumers desire something, they go out of their way to buy the product, creating a domino effect. That domino effect follows: consumers purchase the product, profit from those items are put back into the company funds, those funds are allocated to the maintenance of the physical building and the workers, workers make the product, and then the cycle begins all over again. In this study, we explore the different reasons to why manufacturing employment fluctuates, increases, or decreases and analyze the overall trend. In order to make our efforts more concrete, we plan to create a series of visual representations, depictions, and graphs to emphasize our findings.

Manufacturing is an industry that has featured some of the most rapid changes in the history of the United States. Industrialization in America began towards the end of eighteenth century and has expanded exponentially. Different inventions and innovations bolstered this progression and (inevitably) progressed the pace of interest in manufacturing industries. Furthermore, manufacturing has driven how fast and effectively products and desired goods are created. The question as to why is this important and interesting? The concept of manufacturing has remained a constant in the history of the United States; however, by analyzing positive and negative trends within employment we can develop an overall image for the infrastructure to communicate to the general public. Manufacturing has impacted a plethora of aspects of life. Without modern manufacturing and the integration of technology, common goods and items would not be as readily available. As mentioned before, technology is being integrated into manufacturing and it itself is also growing at and exponential rate. Assumptions are being made that we are going through a technological revolution. With the up and rising technological revolution, a variety of questions are being posed such as will technology replace jobs, or will industries become solely mechanized? These questions may suggest information towards our focus, but there could be many different modes influencing employment in the manufacturing sector of industry.

In reference to modern times, manufacturing is a key component to many industries. Manufactured goods are pivotal to the way that goods are produced and exported to their

intended audiences. Employment trends in manufacturing have the potential to reveal relationships in neighboring industries and from that we can carry out statistical tests to evaluate societal trends in capita and the interests of consumers. During the modern age, unemployment is becoming oddly apparent and fluctuates constantly. As a result of this trend, American politicians have concerned themselves with issues regarding labor statistics to explain and correlate other national problems. Therefore, this topic has a wide variety of relevance to issues that the masses face on a daily basis and can be used to compare logistical structures.

There are a myriad of groups that would be interested in analytics surrounding manufacturing; the most prominent of these would be manufacturing companies. Companies such as Foxconn and Samsung use manufacturing data and analytics to determine how best to maximize their operations for their own profit. Using analytics, these companies can see the most efficient way to assemble their products and organize their logistics network and supply chain. Analytics would also provide these companies with ways to reduce overhead, track production, and predict required maintenance, all of which is integral to maximizing their profits. In addition, employment data would allow these companies to determine the most logical spot to open new factories and plants, such as in places where the job market is undersaturated. Manufacturing analytics is also important to consumers, since it often affects them daily. For example, the manufacturing of high-speed flash storage used to be very inefficient and costly until manufacturing companies began investing in analytics to adopt new ways of manufacturing. This allowed the price of flash storage to drop dramatically, improving the storage capabilities of smartphones, digital cameras, and other electronic devices. This ponders back to the idea that consumers drive industry and control the demands of the products that are to be issued.

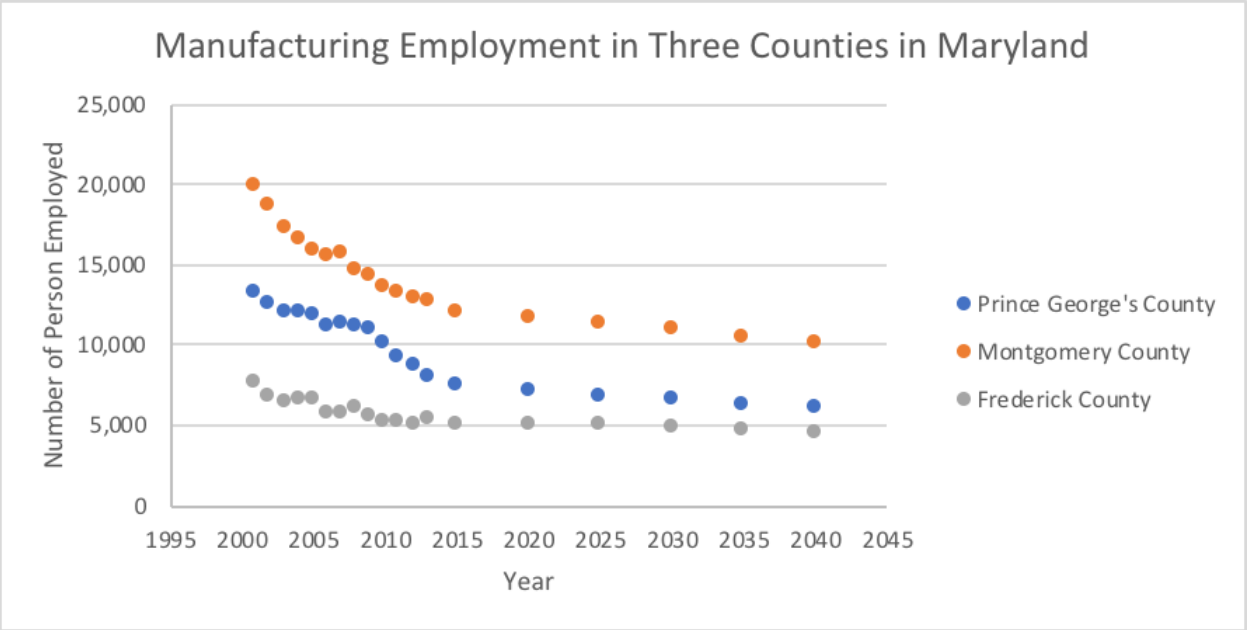
Analytics tracking the progress of the United States' labor force have existed for more than a hundred years. The U.S. Bureau of Labor Statistics, a unit of the Department of Labor, was founded in 1884 to amass data pertaining to employment and labor. Of all of the data that the BLS tracks, the most relevant would be employment rates, salary, and labor productivity. Employment rates of nearly every industry are updated monthly and track how many employees are currently employed in a given field. This data is crucial to understanding how manufacturing employment is affected by various external forces. The Bureau of Labor Statistics also tracks labor productivity, the rate of economic output per labor hour. This data is important to understanding trends in manufacturing employment as it tracks how effective the labor force is. Since this organization has been long established, this data can be assumed to be well-established. There are other organizations of this caliber referenced later in the Data Sources section of this research. Overall, analytics are well-established within this field as the data has been tracked for over one hundred years.

Data Sources

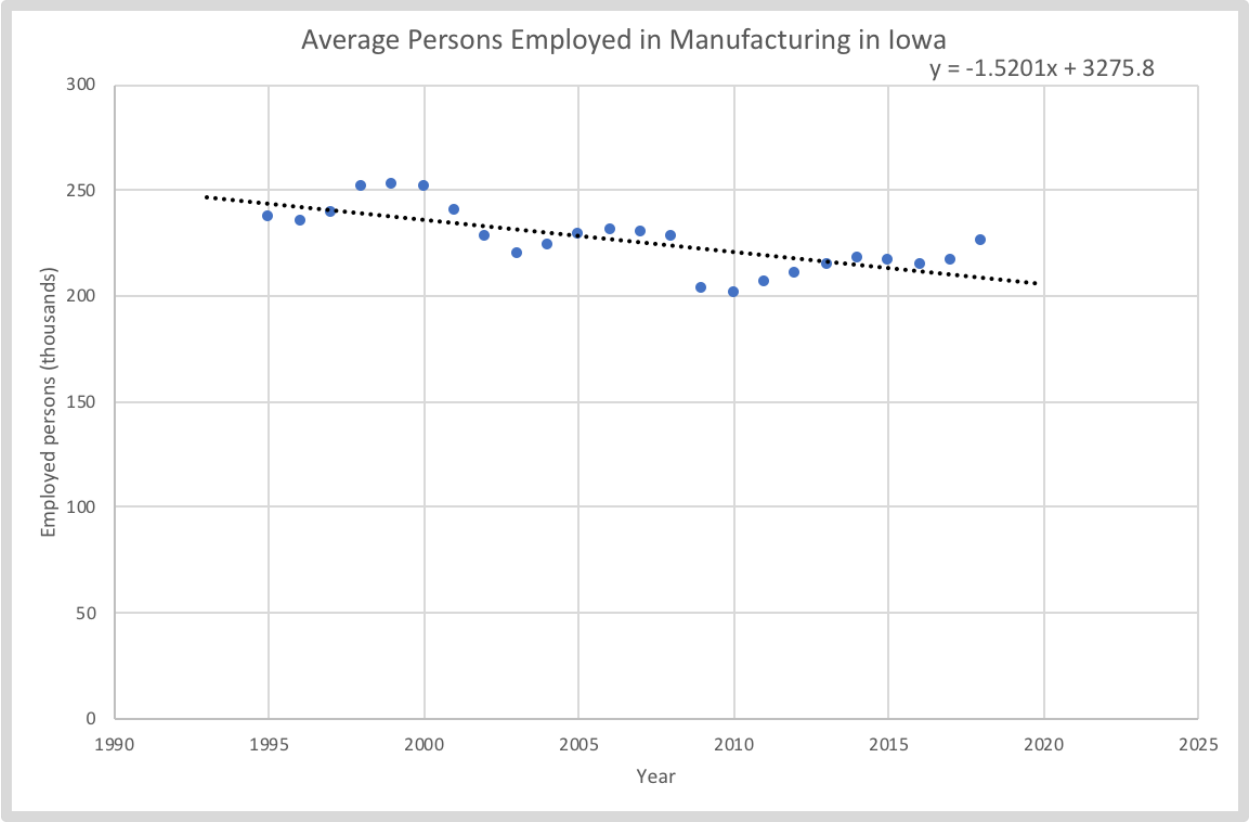
Maryland Open Data Portal	This data is collected by the state of Maryland and hosted by Socrata Data. The data was last updated in February of 2015. It was updated annually from 2001-13. The data is of the number of manufacturing jobs each year from 2001-15 and shows the projected number of manufacturing jobs form 2015-2040. There are 14 rows of data.	https://data.maryland.gov/Planning/Prince-George-s-County-Full-and-Part-Time-Jobs-By-/r3cz-swpf/data
US Bureau of Labor Statistics	Mining productivity and mining and logging employment from 1987 to 2017. This data is hosted by the Bureau of Labor Statistics. The government agency responsible for collecting economic and labor statistics. The data was updated quarterly from 1949 -2003. The data shows the output per person in mining and logging employment. There are 16 rows of data and 270 columns.	https://www.bls.gov/lpc/data.htm https://www.bls.gov/lpc/#tables
Data.gov	Annually adjusted employment rates of various industries in Iowa from 1990 to 2018. The data was created on March 17, 2016 and last updated on November 8, 2018. It was also created by the State Data Administrator. There are several rows of data pertaining to several different fields of work.	https://catalog.data.gov/dataset/iowa-seasonally-adjusted-non-farm-employment-by-month-and-industry

Bureau of Economic Analysis	Self-employment reports for a cluster of years. This data uses different categories ranging from employment rates, productivity, hours worked, compensation, and more. Data in certain tables are estimates from the 1942 Standard Industrial Classification (SIC). This data does not have traditional rows, but has reported years that totals to a collective 32 rows of collapsed data. It was last revised in July, 2018.	https://apps.bea.gov/iTable/iTable.cfm?reqid=19&step=2&isuri=1&1921=survey
US Bureau of Labor Statistics Bureau of Economic Analysis	Data from the Bureau of Labor Statistics showing the national unemployment rate in the US from 1947-2017 graphed alongside data from Bureau of Economic Analysis showing GDP growth from 1929-2017. The file size is 23363 bytes. It is constantly updated and modified as it was modified on December 3, 2018. It is owned by the Bureau of Labor Statistics.	https://www.bls.gov/cps/tables.htm#annual https://www.bea.gov/national/xls/gdplev.xls https://docs.google.com/spreadsheets/d/13l2hHD6oCSaIY7bwuGrn2lFbl24SLBTqX9MZD2L-nPo/edit?usp=sharing

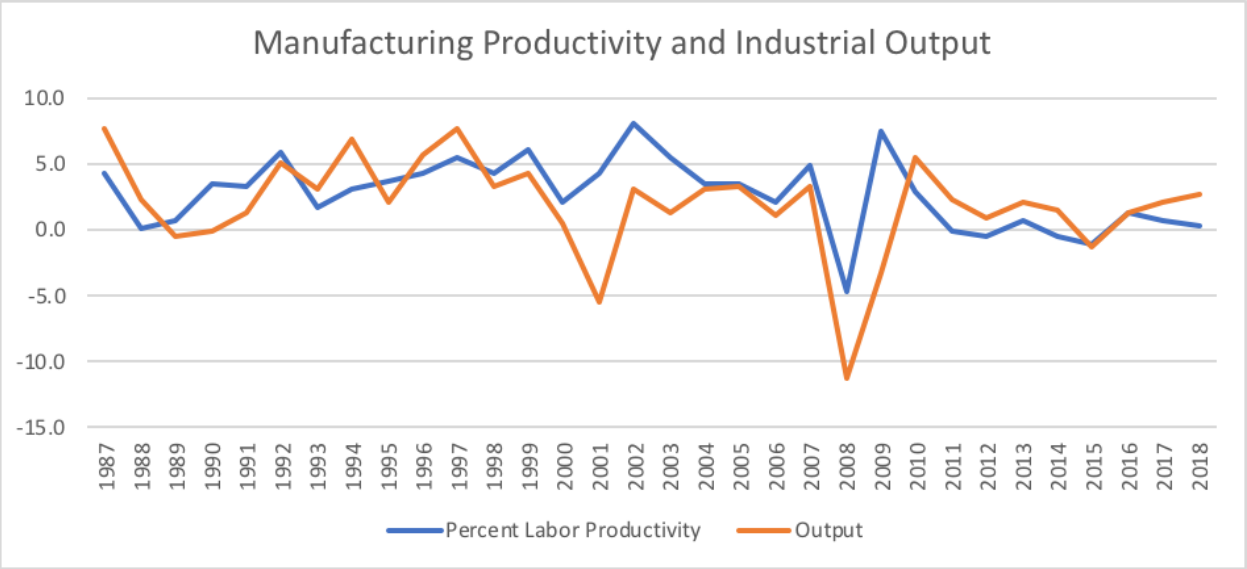
Results Achieved



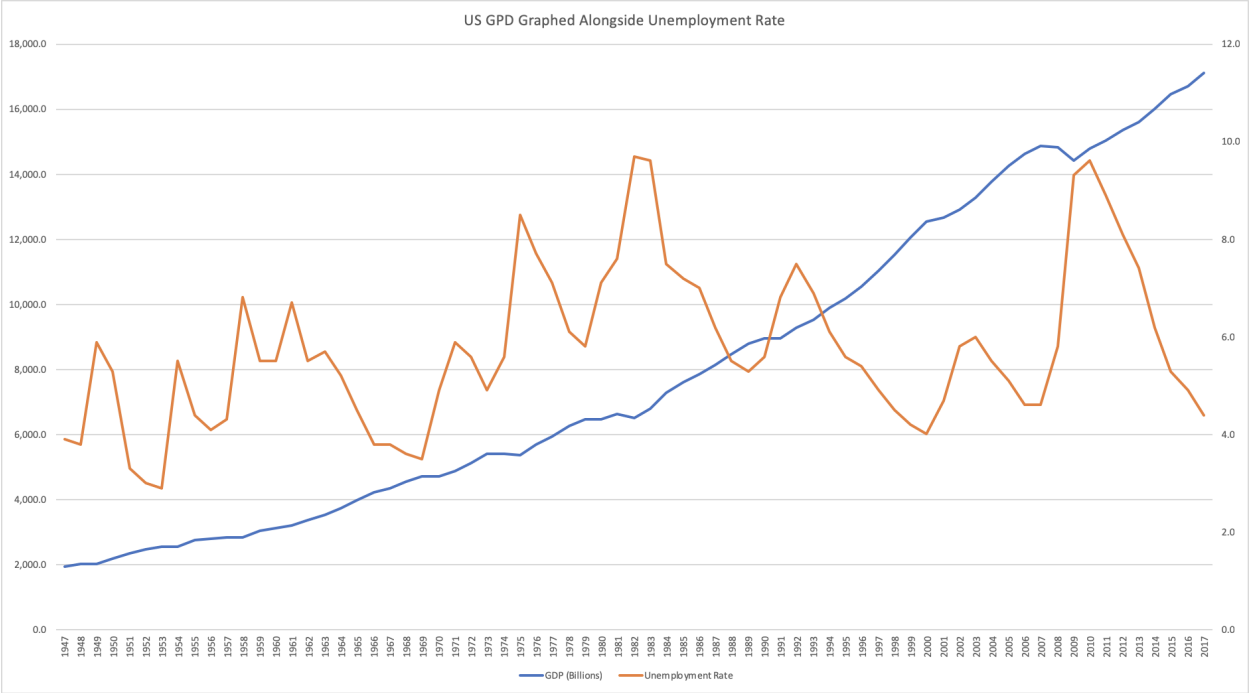
In the graph above, the points plotted represent the number of persons employed in manufacturing in Prince George's County, Montgomery County, and Frederick County. Seen in the graph is a trend towards a decline in manufacturing employees. Within each case, as time passes, there is a decline (negative slope) in the number of people employed. In each of the counties, they begin with a large number of employees; however, looking more closely at the type of trend, the line resembles that of an exponential decay model. So with this information, we can see that the projected amount of workers for 2030-2040 plateau. With this plateau, jobs are remaining a constant meaning that there is some kind of influence on the amount of workers in manufacturing (for Maryland counties).



Shown in the model, the data presents the average number of people employed in manufacturing in the state of Iowa from 1995-2018. The data was presented monthly and was averaged to produce yearly reports. Noticeable in the data is the oscillating nature of the employment. This oscillation is different than that of Maryland counties. Whereas in Iowa the data seems to decline and then is rejuvenated to a peak (not to its previous capacity), in Maryland there is an overall decline in the labor in manufacturing. Drawing from previous evidence and knowledge, Iowa is known to be manufacturing driven. It draws this drive from the Industrial Revolution, but it is also a result of its location. Maryland, on the other hand, is not as rural and industrial based as that of Iowa. These data make sense in relation to one another. In comparison to the productivity and output chart, both models feature a sudden drop around 2008. We can say that one of the known facts around this time was that the economy had crashed and unemployment skyrocketed. This crash is more likely to influence more rural industrial areas than that of urban due to a top-down trickle effect (bigger companies suffer but not as much as that of smaller companies). Regardless, the Iowan employment rates have remained periodic and revolve around a constant. Similar to Iowa, Frederick County experienced the same relatively constant trend, we can assume that this is due to the location of both these places. Iowa and Frederick County are both relatively rural which can factor into the grand scheme of manufacturing.



Shown above is a line plot comparing the productivity rates and output rates of firms. This data was condensed from quarterly data to annual and the averages of each year was taken. In this comparison, one can notice there are extreme fluctuations. The most prominent change is noticeable in 2008 where the rate of labor productivity (%) declined drastically. Also noticeable is the output decrease in 2001. This drastic measure could have been from the automation aspect of the company and technological implementation. Regardless, the percentages above present empirical data to suggest that decline in employment may be correlated to output and productivity. This decline can be seen in this model as both productivity and output rates fluctuate by smaller percentages. In comparison to the Maryland Counties graph, years after 2000 there was a decline in the amount of persons employed in manufacturing. In analyzing both raw datasets, we can look directly at the overarching trends of the data. In this graph, manufacturing productivity and industrial output both remain relatively constant (with the metaphorical outliers of 2001 and 2008. This is similar to the counties graph, except there is a constant decrease in the data. There is data to support the conclusion that productivity and output influence manufacturing employment in the Maryland area.



This graph uses data collected from the United States Bureau of Labor Statistics and the Bureau of Economic Statistics to show changes in the United States unemployment rate along side changes in its GDP. The blue line representing GDP shows that the US has experienced constant economic growth over the past one hundred years. This is only possible because there have been technological advancements allowing workers to be more efficient and productive, ultimately allowing people to produce more goods and services. On the other hand the orange line represents unemployment rate or the percentage of people who have actively searched for a job in the last 4 weeks who could not get one. Unlike the the GDP it has fluctuated; varying seeming randomly since we began recording it. The unemployment rate is affected by many different variables from the short term state of the economy to change in government policy. However, unemployment does not seem to have an upward sloping linear trend meaning technological development which drives economic growth does not have any long term effects on the unemployment rate.

We can assume that these trends are not the only factors that play into the effects of unemployment and employment rates in the manufacturing sector. These factors attribute to the overall trends in manufacturing; however, we can speculate other factors such as implementation of technology, economic influxes, money provided by government facilities, and a variety of other causes. Overall, from the data we have found thus far, we can draw conclusions from the factors tested: location, productivity and output rates, and gross domestic products.

Literature Support

Provide the **scholarly** literature references related to your proposed field of study. For **each reference**, provide a short paragraph summarizing the paper.

Use this format:
First author last name, first name initial(s)., second author last name, first name initial(s)., & last author last name, first name initial(s). (year). *The title of the article.*Journal Name, *volume*(issue), page-numbers.

Scholarly Article 1: Dubey, R., Gunasekaran, A., Childe, S. J., Wamba, S. F., & Papadopoulos, T. (2015, August 30). *The impact of big data on world-class sustainable manufacturing.* International Journal of Advanced Technology, *volume* 8, 631-645. https://link.springer.com/content/pdf/10.1007%2Fs00170-015-7674-1.pdf

In this study, researchers explored the role of Big Data Analytics (BDA) in World Class Sustainable Manufacturing (WCSM). BDA in this case is defined as datasets that have/reap large volume, velocity, variety, and veracity; whereas WCSM is defined as practices that lead to exceptional sustainability and performance. The goal of this opportunity is to evaluate the effect of BDA on manufacturing techniques. In doing so, the group looks to find some type of relationship between BDA and WCSM. Data was collected through social media outlets such as LinkedIn, Facebook, and Twitter to gauge various variables that could influence the study. The researchers suggest that there was correlation between the two main variables tested and it was positive. The role that BDA plays within WCSM can be used to enhance a company and their performance. Regardless of their findings, there should be more information and investigation into this subject, this is something that the researchers convey. In relation to our project, this information shows the integration of big data processors and their influence on the world of manufacturing.

Scholarly Article 2: Iacovou, Charalambos L., Benbasat, Izak and Dexter, Albert S. (Dec. 1995). *Electronic Data Interchange and Small Organizations: Adoption and Impact of Technology.* MIS Quarterly, Vol. 19, No. 4, 465-485. https://www.jstor.org/stable/pdf/249629.pdf?refreqid=excelsior%3Ad93f413fe65565d9f5ef5bce9128ab7e

This case evaluates the impact of electronic data interchange on the workplace. Companies are racing to obtain this supplement because of a few factors: perceived benefits, organizational readiness, and external pressure. Each of these components are encouraging the progression of a company and its goals. In a empirical study of seven companies in 1993, researchers focused on the internal and external pressures of the system. In the study, researchers noticed that it reduced the costs of information management, paper use, and more. Oppositely, it increased timeliness, accuracy, and accessibility to information. In evaluating the results of these effects on a company, the data collected leads the viewer to assume that companies that were able to implement the EDI technology had a larger amount of employees than companies that did not. This investigation is providing more information on the workforce and technological impact overall. In relation to our study, EDI applications can enhance job opportunities as someone needs to understand the technology and interpret it. Therefore, in a sense, EDI does not necessarily mean that jobs are being removed.

Scholarly Article 3: Deva Rangarajan, Eli Jones, Wynne Chin. *Impact of sales force automation on technology-related stress, effort, and technology usage among salespeople*. Industrial Marketing Management, Volume 34, Issue 4, 2005, Pages 345-354, ISSN 0019-8501. https://doi.org/10.1016/j.indmarman.2004.09.015

Sales Force Automation is expanding parallel to automation in manufacturing. Researcher in this case study project a focal point on the integration of technology into the businessworld and analyze the psychological response to this implementation. Moreover, the group evaluated a person against the Technological Acceptance Model-measures how eager a person or company is to integrate new technology. The purpose of this study was to shed light on sales force automation problems and address them by looking at the technological user. This study found that people were stressed by the implementation because they were unsure of their role or not comfortable with the system, coming to the conclusion that technological innovation makes people uncomfortable. In response to this, a control that was not foreseen was that the informational resources were not readily available leading to this uncomfort. Connecting this to our project, this technological enhancement may have driven people out of their jobs or forced their hand to resign due to the lack of comfortability. This may increase the amount of unemployment as a result of technology

Scholarly Article 4: Pierce, J., Schott, P., (2016). *The Surprisingly Swift Decline of US Manufacturing Employment*. American Economic Review, *106*(7), 1632-1662 https://pubs.aeaweb.org/doi/pdfplus/10.1257/aer.20131578

A change to US trade policy in 2000 led to a sharp drop in US manufacturing employment. This policy eliminated potential tariff increases on Chinese imports. This led to a loss in employment, increased imports from China, and higher entry by US importers and foreign-owned Chinese exporters. Imports from foreign economies such as China are subject to relatively high tariff rates originally set under the Smoot-Hawley Tariff Act of 1930. These tariff rates (non-NTR or column 2) are often larger than the NTR or column 1 rates the US offers fellow members of the WTO. In 1980, US granted China NTR tariff rates and kept rates applied to Chinese goods low. After the US enacted PNTR legislation, there was a production shift out of the US and into China. Between October 1, 2000 and April 30, 2001 more than eighty corporations announced their intentions to shift production to China, with the number of announced production shifts increasing each month from two per month in October to November to nineteen per month by April. They measure the effect of PNTR as the gap between the high non-NTR rates to which tariffs would have risen if annual renewal of China's NTR status had failed and the lower NTR tariff rates that were locked in by PNTR. Then they generalized the data to show that industries with higher NTR gaps experience larger employment declines, along with disproportionate increases in US imports from China, the number of US firms importing from China and the number of Chinese firms exporting to the United States, especially foreign-owned Chinese firms.

Scholarly Article 5: Frey, Carl Benedikt, and Michael A. Osborne. "The Future of Employment: How Susceptible Are Jobs to Computerisation?" Technological Forecasting and Social Change, *volume* 114, 254-280. https://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf?link=mktw

This article details the susceptibility of various occupations to computerisation. Using a Gaussian process classifier, the researchers were able to determine the probability in which automation would consume any given industry. The researchers determined three specific bottlenecks to computerisation, features of an occupation that would limit a computer's ability to do specific tasks. The first of these bottlenecks was perception and manipulation and included occupations that require finger dexterity, manual dexterity, and often include cramped and awkward work spaces. The second bottleneck was creative intelligence, which included occupations that require originality and creativity as well as occupations in the fine arts. The third bottleneck was social intelligence, which include occupations involving social perceptiveness, negotiation, persuasion, and assisting and caring for others. By weighing over 700 occupations based on these features, the researchers were able to create a probabilistic model to determine how likely a given

occupation is to be automated. Their findings showed that occupations that require consistent and repetitive labor, such as telemarketers, data entry keyers, cashiers were considerably more likely to be automated compared to occupations that require more human interaction such as teachers, physical therapists, and clergy. In addition, occupations that require more creativity, such as photographers, engineers, and sales agents were ranked consistently unlikely to be automated.

Scholarly Article 6: McDermott, Christopher M. Stock Gregory N. (1998). *Organizational culture and advanced manufacturing technology implementation.* Journal of Operations Management.
https://ac.els-cdn.com/S027269639900008X/1-s2.0-S027269639900008X-main.pdf?_tid=a3486dde-2a54-44ab-90e8-9fe2342ebb5a&acdnat=1541970758_432efe21a57b605b3cab0e262b4b1ec2

Advanced Manufacturing Technology (AMT) has a variety of potentials in a company. For instance, it can increase and permit furtherment in the flexibility and efficiency in a manufacturing firm. The goal of AMT is to enhance a company or firm, but noted by the researchers, not all will take to this technological stepping stone. In this study, the researchers evaluate the effect of the integration on a designated field. Overall, the technology provides improvement in speed and quality, but the investigators took their findings one step further and looked at the external and internal cultures of a company. In their analysis, the group used regression analysis and principal component analysis to deduce a variety of findings. They found a positive relationship between rationale culture and competitive performance with a company, but they found a negative relationship between internal orientations and competitive benefits. In relation to this study, our study can use this information to support our findings. Although it does not directly address our question specifically, it shows the implementation of technology in manufacturing firms and then expected results. Furthermore, showing a distant relationship to the employment in a company.

Scholarly Article 7:
Shukla, A., Karki, H., (2015). *Application of robotics in onshore oil and gas industry—A review Part I*. Robotics and Automated Systems, *volume 75*, 490-507
https://ac.els-cdn.com/S0921889015002006/1-s2.0-S0921889015002006-main.pdf?_tid=df33f2c3-2a47-44b0-8d8c-b78d584522dc&acdnat=1541974278_61a5c4017791aeeca8b2007af459bf63

As fossil fuels like petroleum, coal, and natural gas are depleting, its industries are looking for automated solutions to increase their productivity and safety. Even with an annual depletion rate of 8%, the energy industry is largely dependent on fossil fuels as they make up

80% of energy demands, out of which 50%-60% come from oil and gas alone. With many of the safer deposits drying up, in order to keep up with demands, drilling companies must extract oil from extreme conditions such as hot deserts, deep water, and arctic zones. These locations pose a challenge to the health of the employees and the protection of the environment as shown by the Exxon Valdez and Deepwater Horizon oil spills. Most of the technology that is currently being used by the oil and gas industry are mainly focused on inspection, maintenance, and repair. Since there is a large risk in this industry with using full automation as it is largely unproven, semi-autonomous are a more realistic solution. Semi-autonomous robots perform their own actions but leave cognitive decisions to a skilled operator. In the onshore oil and gas industry, robots are used in many processes such as site survey, drilling, production, and transportation.

Scholarly Article 8: Reijnder, L.S.M. ., Vries, G.J. ., (2018). *Technology, offshoring and the rise of non-routine jobs*. Journal of Development Economics, *volume* 135, 412-432 https://www.sciencedirect.com/science/article/pii/S0304387818304991

This paper uses a cross country occupation data from 37 seven different countries from the years 1999-2007 to analyze how advancements in technology had lead to an increase to the number of non-routine jobs in relationship to routine occupations in all countries. Offshoring and automation have been able to replace certain tasks that involve codifiable information and routine non-cognitive tasks. They in combination have reduced the demand for labor these routine job markets. Automation has been found to reduce the demand for workers with an occupation that is intensive in repetitive tasks. Offshoring has relocates onshore jobs that require transforming standardized information to other countries with cheaper labor markets. This paper documents the subsequent increase in non-routine jobs; jobs that require tacit knowledge or technical skill. The increase in these types of jobs coinciding with the decrease in routine jobs showed that as technological advancements cause routine jobs to be lost they were replaced by non-routine jobs without a substantial increase in unemployment.

FINAL REPORT

ASN11 – Draft Research Project Report

Team Name	**CompuTerps**
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Introduction

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overall image for the infrastructure to communicate to the general public. Manufacturing has impacted a plethora of aspects of life. Without modern manufacturing and the integration of technology, common goods and items would not be as readily available. As mentioned before, technology is being integrated into manufacturing and it itself is also growing at an exponential rate. Assumptions are being made that we are going through a technological revolution. With the up and rising technological revolution, a variety of questions are being posed such as will technology replace jobs, or will industries become solely mechanized? These questions may suggest information towards our focus, but there could be many different modes influencing employment in the manufacturing sector of industry.

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that are applicable to that job. As an employee, you are expecting some type of compensation for your work. If there is no job available, then there is no reaping.

Analytics tracking the progress of the United States' labor force have existed for more than a hundred years. The U.S. Bureau of Labor Statistics, a unit of the Department of Labor, was founded in 1884 to amass data pertaining to employment and labor. Of all of the data that the BLS tracks, the most relevant would be employment rates, salary, and labor productivity. Employment rates of nearly every industry are updated monthly and track how many employees are currently employed in a given field. This data is crucial to understanding how manufacturing employment is affected by various external forces. The Bureau of Labor Statistics also tracks labor productivity, the rate of economic output per labor hour. This data is important to understanding trends in manufacturing employment as it tracks how effective the labor force is. Since this organization has been long established, this data can be assumed to be well-established. There are other organizations of this caliber referenced later in the Data Sources section of this research. Overall, analytics are well-established within this field as the data has been tracked for over one hundred years.

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US Bureau of Labor Statistics	**Mining productivity and mining and logging employment from 1987 to 2017. This data is hosted by the Bureau of Labor Statistics. The government agency responsible for collecting economic and labor statistics. The data was updated quarterly from 1949 -2003. The data shows the output per person in mining and logging employment. There are 16 rows of data and 270 columns.**	**https://www.bls.gov/lpc/data.htm https://www.bls.gov/lpc/#tables**

Data.gov	**Annually adjusted employment rates of various industries in Iowa from 1990 to 2018. This data was collected by the state of Iowa and is hosted by Data.gov. It was updated monthly from 1990 to 2018. It was last updated in 2018. The data set has 6 rows and 5200 columns. The data was created on March 17, 2016 and last updated on November 8, 2018**	**https://catalog.data.gov/dataset/iowa-seasonally-adjusted-non-farm-employment-by-month-and-industry**

Bureau of Economic Analysis	**Self-employment reports for a cluster of years. This data uses different categories ranging from employment rates, productivity, hours worked, compensation, and more. Data in certain tables are estimates from the 1942 Standard Industrial Classification (SIC). This data does not have traditional rows but has reported years that totals to a collective 32 rows of collapsed data. It was last revised in July 2018.**	**https://apps.bea.gov/iTable/iTable.cfm?reqid=19&step=2&isuri=1&1921=survey**

US Bureau of Labor Statistics & Bureau of Economic Analysis	**Data from the Bureau of Labor Statistics showing the national unemployment rate in the US from 1947-2017 graphed alongside data from Bureau of Economic Analysis showing GDP growth from 1929-2017. The file size is 23363 bytes. It is constantly updated and modified as it was modified on December 3, 2018. It is owned by the Bureau of Labor Statistics.**	**https://www.bls.gov/cps/tables.htm#annual https://www.bea.gov/national/xls/gdplev.xls https://docs.google.com/spreadsheets/d/13l2hHD6oCSaIY7bwuGrn2lFbl24SLBTqX9MZD2L-nPo/edit?usp=sharing**

Results Achieved

In the graph above, the points plotted represent the number of persons employed in manufacturing in Prince George's County, Montgomery County, and Frederick County. Seen in the graph is a trend towards a decline in manufacturing employees. Within each case, as time passes, there is a decline (negative slope) in the number of people employed. In each of the counties, they begin with a large number of employees; however, looking more closely at the type of trend, the line resembles that of an exponential decay model. So with this information, we can see that the projected amount of workers for 2030-2040 plateau. With this plateau, jobs are remaining a constant meaning that there is some kind of influence on the amount of workers in manufacturing (for Maryland counties).

Shown in the model, the data presents the average number of people employed in manufacturing in the state of Iowa from 1995-2018. The data was presented monthly and was averaged to produce yearly reports. Noticeable in the data is the oscillating nature of the employment. This oscillation is different than that of Maryland counties. Whereas in Iowa the data seems to decline and then is rejuvenated to a peak (not to its previous capacity), in Maryland there is an overall decline in the labor in manufacturing. Drawing from previous evidence and knowledge, Iowa is known to be manufacturing driven. It draws this drive from the Industrial Revolution, but it is also a result of its location. Maryland, on the other hand, is not as rural and industrial based as that of Iowa. These data make sense in relation to one another. In comparison to the productivity and output chart, both models feature a sudden drop around 2008. We can say that one of the known facts around this time was that the economy had crashed, and unemployment skyrocketed. This crash is more likely to influence more rural industrial areas than that of urban due to a top-down trickle effect (bigger companies suffer but not as much as that of smaller companies). Regardless, the Iowan employment rates have remained periodic and revolve around a constant. Similar to Iowa, Frederick County experienced the same relatively constant trend, we can assume that this is due to the location of both these places. Iowa and Frederick County are both relatively rural which can factor into the grand scheme of manufacturing.

Shown above is a line plot comparing the productivity rates and output rates of firms. This data was condensed from quarterly data to annual and the averages of each year was taken. In this comparison, one can notice there are extreme fluctuations. The most prominent change is noticeable in 2008 where the rate of labor productivity (%) declined drastically. Also noticeable is the output decrease in 2001. This drastic measure could have been from the automation aspect of the company and technological implementation. Regardless, the percentages above present empirical data to suggest that decline in employment may be correlated to output and productivity. This decline can be seen in this model as both productivity and output rates fluctuate by smaller percentages. In comparison to the Maryland Counties graph, years after 2000 there was a decline in the number of persons employed in manufacturing. In analyzing both raw datasets, we can look directly at the overarching trends of the data. In this graph, manufacturing productivity and industrial output both remain relatively constant (with the metaphorical outliers of 2001 and 2008. This is similar to the counties graph, except there is a constant decrease in the data. There is data to support the conclusion that productivity and output influence manufacturing employment in the Maryland area.

This graph uses data collected from the United States Bureau of Labor Statistics and the Bureau of Economic Statistics to show changes in the United States unemployment rate alongside changes in its GDP. The blue line representing GDP shows that the US has experienced constant economic growth over the past one hundred years. This is only possible because there have been technological advancements allowing workers to be more

efficient and productive, ultimately allowing people to produce more goods and services. On the other hand, the orange line represents unemployment rate or the percentage of people who have actively searched for a job in the last 4 weeks who could not get one. Unlike the GDP it has fluctuated; varying seeming randomly since we began recording it. The unemployment rate is affected by many different variables from the short-term state of the economy to change in government policy. However, unemployment does not seem to have an upward sloping linear trend meaning technological development which drives economic growth does not have any long-term effects on the unemployment rate.

We can assume that these trends are not the only factors that play into the effects of unemployment and employment rates in the manufacturing sector. These factors attribute to the overall trends in manufacturing; however, we can speculate other factors such as implementation of technology, economic influxes, money provided by government facilities, and a variety of other causes. Overall, from the data we have found thus far, we can draw conclusions from the factors tested: location, productivity and output rates, and gross domestic products.

Literature Support

Provide the scholarlyliterature references related to your proposed field of study. For each reference, provide a short paragraph summarizing the paper.

Use this format:
First author last name, first name initial(s)., second author last name, first name initial(s)., & last author last name, first name initial(s). (year). ***The title of the article.*****Journal Name,** ***volume*****(issue), page-numbers.**

Scholarly Article 1: Dubey, R., Gunasekaran, A.,
Childe, S. J., Wamba, S. F., & Papadopoulos, T. (2015, August 30). ***The impact of big data on***
world-class sustainable manufacturing. **International Journal of Advanced Technology,** ***volume*** **8, 631-645.**
https://link.springer.com/content/pdf/10.1007%2Fs00170-015-7674-1.pdf

In this study, researchers explored the role of Big Data Analytics (BDA) in World Class Sustainable Manufacturing (WCSM). BDA in this case is defined as datasets that have/reap large volume, velocity, variety, and veracity; whereas WCSM is defined as practices that lead to exceptional sustainability and performance. The goal of this opportunity is to evaluate the effect of BDA on manufacturing techniques. In doing so, the group looks to find some type of relationship between BDA and WCSM. Data was collected through social media outlets such as LinkedIn, Facebook, and Twitter to gauge various variables that could influence the study. The researchers suggest that there was correlation between the two main variables tested and it was positive. The role that BDA plays within WCSM can be used to enhance a company and their performance. Regardless of their findings, there should be more information and investigation into this subject, this is something that the researchers convey. In relation to our project, this information shows the integration of big data processors and their influence on the world of manufacturing.

Scholarly Article 2: Iacovou, Charalambos L., Benbasat, Izak and Dexter, Albert S. (Dec. 1995). *Electronic Data Interchange and Small Organizations: Adoption and Impact of Technology.* MIS Quarterly, Vol. 19, No. 4, 465-485.
https://www.jstor.org/stable/pdf/249629.pdf?refreqid=excelsior%3Ad93f413fe65565d9f5ef5bce9128ab7e

This case evaluates the impact of electronic data interchange on the workplace. Companies are racing to obtain this supplement because of a few factors: perceived benefits, organizational readiness, and external pressure. Each of these components are encouraging the progression of a company and its goals. In a empirical study of seven companies in 1993, researchers focused on the internal and external pressures of the system. In the study, researchers noticed that it reduced the costs of information management, paper use, and more. Oppositely, it increased timeliness, accuracy, and accessibility to information. In evaluating the results of these effects on a company, the data collected leads the viewer to assume that companies that were able to implement the EDI technology had a larger number of employees than companies that did not. This investigation is providing more information on the workforce and technological impact overall. In relation to our study, EDI

applications can enhance job opportunities as someone needs to understand the technology and interpret it. Therefore, in a sense, EDI does not necessarily mean that jobs are being removed.

Scholarly Article 3: Deva Rangarajan, Eli Jones, Wynne Chin. *Impact of sales force automation on technology-related stress, effort, and technology usage among salespeople*. Industrial Marketing Management, Volume 34, Issue 4, 2005, Pages 345-354, ISSN 0019-8501. https://doi.org/10.1016/j.indmarman.2004.09.015

Sales Force Automation is expanding parallel to automation in manufacturing. Researcher in this case study project a focal point on the integration of technology into the business world and analyze the psychological response to this implementation. Moreover, the group evaluated a person against the Technological Acceptance Model-measures how eager a person or company is to integrate new technology. The purpose of this study was to shed light on sales force automation problems and address them by looking at the technological user. This study found that people were stressed by the implementation because they were unsure of their role or not comfortable with the system, concluding that technological innovation makes people uncomfortable. In response to this, a control that was not foreseen was that the informational resources were not readily available leading to this discomfort. Connecting this to our project, this technological enhancement may have driven people out of their jobs or forced their hand to resign due to the lack of comfortability. This may increase the amount of unemployment as a result of technology

Scholarly Article 4: Pierce, J., Schott, P., (2016). *The Surprisingly Swift Decline of US Manufacturing Employment*. American Economic Review, *106*(7), 1632-1662 https://pubs.aeaweb.org/doi/pdfplus/10.1257/aer.20131578

A change to US trade policy in 2000 led to a sharp drop in US manufacturing employment. This policy eliminated potential tariff increases on Chinese imports. This led to a loss in employment, increased imports from China, and higher entry by US importers and foreign-owned Chinese exporters. Imports from foreign economies such as

China are subject to relatively high tariff rates originally set under the Smoot-Hawley Tariff Act of 1930. These tariff rates (non-NTR or column 2) are often larger than the NTR or column 1 rates the US offers fellow members of the WTO. In 1980, US granted China NTR tariff rates and kept rates applied to Chinese goods low. After the US enacted PNTR legislation, there was a production shift out of the US and into China. Between October 1, 2000 and April 30, 2001 more than eighty corporations announced their intentions to shift production to China, with the number of announced production shifts increasing each month from two per month in October to November to nineteen per month by April. They measure the effect of PNTR as the gap between the high non-NTR rates to which tariffs would have risen if annual renewal of China's NTR status had failed and the lower NTR tariff rates that were locked in by PNTR. Then they generalized the data to show that industries with higher NTR gaps experience larger employment declines, along with disproportionate increases in US imports from China, the number of US firms importing from China and the number of Chinese firms exporting to the United States, especially foreign-owned Chinese firms.

**Scholarly Article 5: Frey,
Carl Benedikt, and Michael A. Osborne. "The Future of Employment: How Susceptible Are Jobs to Computerisation?" Technological Forecasting and Social Change, *volume*
114,
254-280.
https://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf?link=mktw**

**This article details the
susceptibility of various occupations to computerisation. Using a Gaussian process classifier, the researchers were able to determine the probability in which automation would consume any given industry. The researchers determined three specific bottlenecks to computerisation, features of an occupation that would limit a computer's ability to do specific tasks. The first of these bottlenecks was perception and manipulation and included occupations that require finger dexterity, manual dexterity, and often include cramped and awkward work spaces. The second bottleneck was creative intelligence, which included occupations that require originality and creativity as well as occupations in the fine arts. The third bottleneck was social intelligence, which include occupations involving social perceptiveness, negotiation,**

persuasion, and assisting and caring for others. By weighing over 700 occupations based on these features, the researchers were able to create a probabilistic model to determine how likely a given occupation is to be automated. Their findings showed that occupations that require consistent and repetitive labor, such as telemarketers, data entry keyers, cashiers were considerably more likely to be automated compared to occupations that require more human interaction such as teachers, physical therapists, and clergy. In addition, occupations that require more creativity, such as photographers, engineers, and sales agents were ranked consistently unlikely to be automated.

Scholarly Article 6: McDermott, Christopher M. Stock Gregory N. (1998). *Organizational culture and advanced manufacturing technology implementation.* Journal of Operations Management. https://ac.els-cdn.com/S027269639900008X/1-s2.0-S027269639900008X-main.pdf?_tid=a3486dde-2a54-44ab-90e8-9fe2342ebb5a&acdnat=1541970758_432efe21a57b605b3cab0e262b4b1ec2

Advanced Manufacturing Technology (AMT) has a variety of potentials in a company. For instance, it can increase and permit furtherment in the flexibility and efficiency in a manufacturing firm. The goal of AMT is to enhance a company or firm, but noted by the researchers, not all will take to this technological stepping stone. In this study, the researchers evaluate the effect of the integration on a designated field. Overall, the technology provides improvement in speed and quality, but the investigators took their findings one step further and looked at the external and internal cultures of a company. In their analysis, the group used regression analysis and principal component analysis to deduce a variety of findings. They found a positive relationship between rationale culture and competitive performance with a company, but they found a negative relationship between internal orientations and competitive benefits. In relation to this study, our study can use this information to support our findings. Although it does not directly address our question specifically, it shows the implementation of technology in manufacturing firms and then expected results. Furthermore, showing a distant relationship to the employment in a company.

Scholarly Article 7:
Shukla, A., Karki, H., (2015). ***Application of robotics in onshore oil and gas industry—A review Part I*****. Robotics and Automated Systems,** ***volume 75*****, 490-507**

https://ac.els-cdn.com/S0921889015002006/1-s2.0-S0921889015002006-main.pdf?_tid=df33f2c3-2a47-44b0-8d8c-b78d584522dc&acdnat=1541974278_61a5c4017791aeeca8b2007af459bf63

As fossil fuels like petroleum, coal, and natural gas are depleting, its industries are looking for automated solutions to increase their productivity and safety. Even with an annual depletion rate of 8%, the energy industry is largely dependent on fossil fuels as they make up 80% of energy demands, out of which 50%-60% come from oil and gas alone. With many of the safer deposits drying up, in order to keep up with demands, drilling companies must extract oil from extreme conditions such as hot deserts, deep water, and arctic zones. These locations pose a challenge to the health of the employees and the protection of the environment as shown by the Exxon Valdez and Deepwater Horizon oil spills. Most of the technology that is currently being used by the oil and gas industry are mainly focused on inspection, maintenance, and repair. Since there is a large risk in this industry with using full automation as it is largely unproven, semi-autonomous are a more realistic solution. Semi-autonomous robots perform their own actions but leave cognitive decisions to a skilled operator. In the onshore oil and gas industry, robots are used in many processes such as site survey, drilling, production, and transportation.

Scholarly Article 8: Reijnder, L.S.M. ., Vries, G.J. ., (2018). ***Technology, offshoring and the rise of non-routine jobs*****. Journal of Development Economics,** ***volume*** **135, 412-432**
https://www.sciencedirect.com/science/article/pii/S0304387818304991

This paper uses a cross country occupation data from 37 seven different countries from the years 1999-2007 to analyze how advancements in technology had led to an increase to the number of non-routine jobs in relationship to routine occupations in all countries.

Offshoring and automation have been able to replace certain tasks that involve codifiable information and routine non-cognitive tasks. They in combination have reduced the demand for labor these routine job markets. Automation has been found to reduce the demand for workers with an occupation that is intensive in repetitive tasks. Offshoring has relocated onshore jobs that require transforming standardized information to other countries with cheaper labor markets. This paper documents the subsequent increase in non-routine jobs; jobs that require tacit knowledge or technical skill. The increase in these types of jobs coinciding with the decrease in routine jobs showed that as technological advancements cause routine jobs to be lost they were replaced by non-routine jobs without a substantial increase in unemployment.