U.S. Manufacturing: History and Current Status

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Abstract

The United States manufacturing sector has managed to remain an impressive and productive sector in the country and globally owing to the U.S. government's support in matters of manufacturing. Due to the increasing use of sophisticated technological advancements that streamline operations and standardize product quality and quantity, the manufacturing sector in the U.S. produces exceptional output. Technological advances in the U.S. manufacturing sector enable manufacturers to remain competitive in an aggressive business environment and profitable amid stiff competition. Moreover, technological advances streamline communication processes along supply chains, enabling manufacturers to better serve their customers. The enormous potential of these technologies to rescue economies from recession and other economic obstacles makes it almost inevitable that the future of manufacturing in the U.S. will be promising. However, automation and innovative technologies have not been easy on the manufacturing workforce for the obvious reason that they tend to replace human labor. As a result, people who have been integrated into the manufacturing sector are either laid off or completely frustrated, and those who are still integrated receive low wages. Because of this, the manufacturing industry's employment prospects appear dim because machines receive more attention than human resources. The Covid-19 pandemic had crippling effects on U.S. manufacturing by dramatically hiking prices of raw materials and finished goods, altering delivery schedules and demand patterns. Manufacturers resorted to low inventory to avoid losses. The sudden demand spike caused by the pandemic caught manufacturers off guard, disrupting supply chains and weakening the sector. That said, it is critical that the government of the U.S. increase its efforts to enhance the manufacturing sector and protect it from unforeseen occurrences that could jeopardize the sector's progress to date, both locally and internationally.

Keywords

U.S. Manufacturing, Technology advancement, COVID-19 impact, Global economy, Manufacturing jobs.

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Introduction

The term "manufacturing" refers to the physical, mechanical, or transformation of raw materials into new goods. Manufacturing has always played a significant role in the U.S. GDP. Prior to being overtaken by China in 2010, the U.S. had the largest manufacturing sector in the world. China takes first place in manufacturing, accounting for 28.4% of global manufacturing, according to the US Statistics Division. U.S. manufacturing accounts for 16.6% of global manufacturing, following China. The United States' history of manufacturing can be traced back to the 19th-century Industrial Revolution. There were new manufacturing techniques introduced. The process of producing goods by hand was replaced by machine-aided manufacturing during the industrial revolution.

During the Industrial Revolution, more finished goods were produced because more people used machines. The world has experienced four industrial revolutions from the 19th century to the present. The fourth industrial revolution (IR 4.0) is still ongoing which includes the digital, biological, and physical worlds. The first industrial revolution was marked using water and steam power to mechanize production. Several notable productions made use of electric power during the second revolution. During the third industrial revolution, electronics and information technology were used to automate production. The digital revolution, also known as IR 4.0, began in the middle of the 20th century. It enabled remarkable technological advancement, including the Internet of Things (IoT), robotics, artificial intelligence

(AI), and 3D printing. These technologies have resulted in several products and services that are rapidly becoming essential to modern life.

According to Levinson (2018), value-added rather than sales are the most common indicators of a nation's manufacturing sector's size. Value added aims to quantify the economic value that the manufacturing sector brings to the design, manufacturing, and retailing of the goods they produce. When calculating value-added items, adjustments are made if the manufacturing process necessitates the importation of components to design the goods. The United States share of global manufacturing value added has decreased over time, from 29% in the early 1980s to 18.1% in 2015 and 2016 (Levinson 2018). Like the U.S., Germany's and Japan's global shares have decreased significantly since their 1900s peak. Unlike these wealthy countries, China's share of global manufacturing has remained stable since 2014 accounting for 25% and 26% of global manufacturing (Levinson 2018).

A higher standard of living for individual families and global communities can be achieved through manufacturing (McNelly 2015). Manufacturing has the potential to address a wide range of difficult problems, ranging from an increase in GDP to a decrease in unemployment to an improvement in quality of life. In approximately 500 U.S. countries, manufacturing is the primary employer and root of the economy (Padhi 2022). Manufacturing is the industry with the highest multiplier effect of any, with $2.79 added to the economy for every dollar spent, according to the U.S. Department of Defense. U.S. manufacturers add over $2.35 trillion to the US economy. Despite its impact, many agree that manufacturing in the U.S. is not what it used to be. There has been a decline in U.S. manufacturing since the turning of the millennium. Supply chain issues and labor shortages are just two of the many obstacles the industry has encountered in recent years. The U.S. is trying to face these difficulties and recover from the pandemic recession in its manufacturing sector.

Statement of the Problem

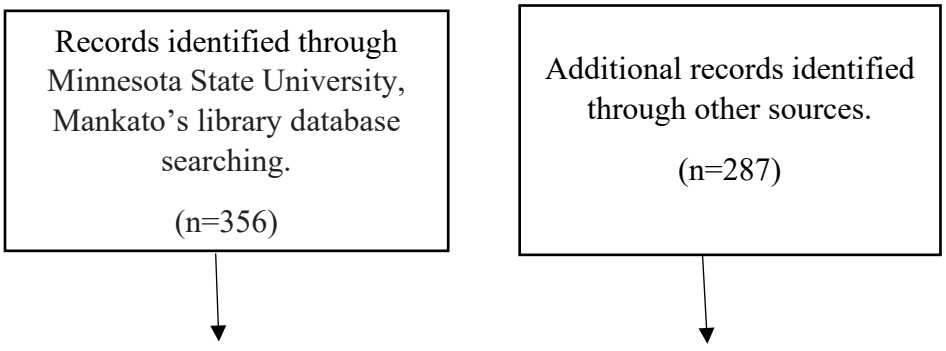
The manufacturing sector in the United States will be the subject of a critical retrospective and progressive examination in this research paper. This is important because it makes it possible to think about ways to make the industry better than it is now. By looking at how manufacturing affects the economy and the workforce, this paper will also make predictions about manufacturing in the U.S. The proposed research questions below were formulated with the intention of precisely identifying the trends influencing the U.S. status of manufacturing.

Research Questions

Q1: Technology advancement and its impact on U.S. manufacturing jobs?
Q2: How did COVID-19 impact U.S. manufacturing?
Q3: How is U.S. manufacturing contributing towards the growth of the global economy?

Methodology

The Literature Screening process was used to select the relevant articles for this study. Online database of Minnesota State University, Mankato's library search was used. As a result, this study is somewhat unstructured in the literature search. Keywords '*U.S. manufacturing, manufacturing trends, and industrial revolution*' were used to shortlist the articles first. And then, for the final analysis, a select group of published articles was chosen based on their relevance to the topic and various filters as shown in Figure 1.



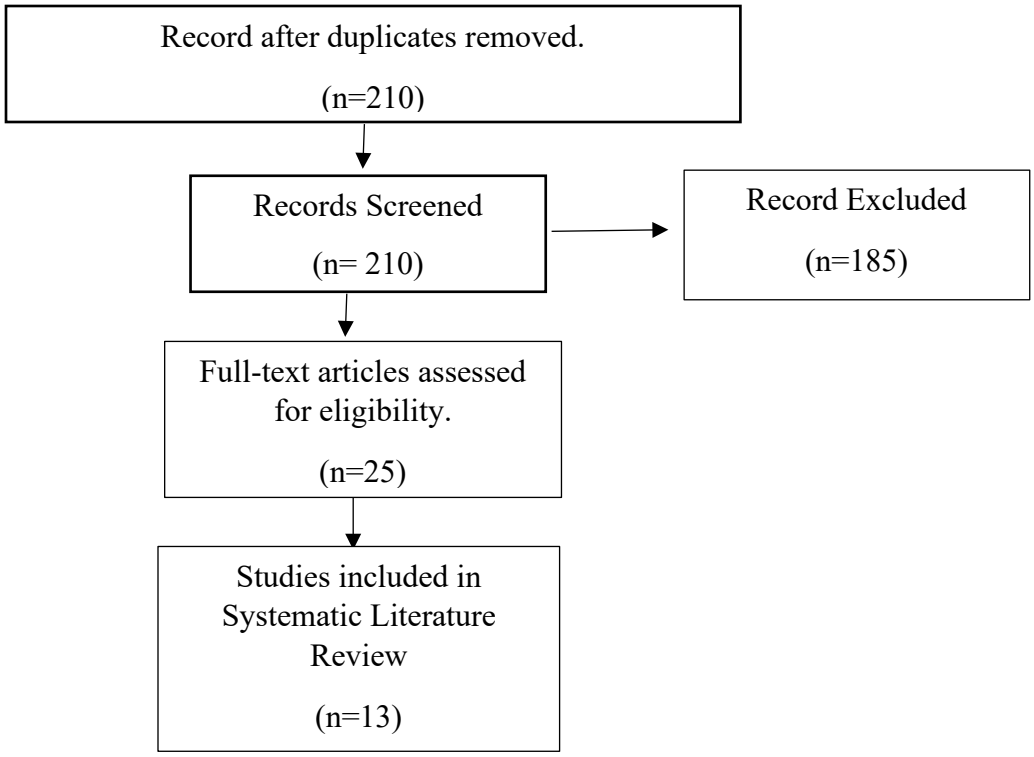


Figure 1. Screening process for the articles selected for the review.

Findings

Technology Advancement U.S. Manufacturing

The industrial revolution transformed manual production methods to the use of machines in product manufacturing. Since then, U.S. manufacturing has been a highly competitive sector and paid significant attention to technological advancement. Technological advancement allowed large-scale production in a specific location. Several inventions happened during the industrial revolution which made the U.S. move forward tremendously. Over the past decade, manufacturing has been impacted significantly by technological advancement. With the increased use of the internet and mobile devices, manufacturers had to modify numerous functions. U.S. manufacturing embraced technological advancement and benefited highly from it. Supply chain communication has improved globally, meeting customers' needs.

Every human being's life is significantly influenced by technology. Through technological advancement, the world is moving at a fast pace. It can be agreed that each daily process in any sector requires some sort of technology to process. The U.S. manufacturing sector compared to other nations has improved due to its technological advancement. Currently, most manufacturing in the U.S. is primarily driven by technologies such as automation, 3D printing, IoT (Internet of Things), and AI (Artificial Intelligence). The use of these technologies in the U.S. manufacturing industry helped the improvement of quality, predictive troubleshooting, reduce production time, optimized productivity, and significant consumer engagement.

Impact of Automation and New Technologies on the U.S. Manufacturing Workers

It is worth noting that machines replacing human labor have remained a perpetual concern since the inception of the Industrial Revolution because many people were aware of the policy implications of this (Brown 2020). Since the onset of the full-gear technological era, employers did not waste any time integrating machines into workplaces and dismissing employees because they felt that the machines could do more than everything human labor could achieve (Jadhav & Gawande 2020). Automation and innovative technologies have gone a long way toward displacing human labor because machines have been incorporated to replace people. Granted, this event has devastated many households because it infers that employees are laid off from work, which affects income flows for families. Many employees

attest to frustration when this happens, as the result is always declining economic affluence and financial barriers that keep them from meeting their needs (Zickuhr 2021a).

Automation and innovative technologies also result in lower wages for U.S. manufacturing workers because their employers feel that the automated technological resources do more work than human labor. With this kind of attitude, employers are compelled to revise their employees' wages downwards, and only pay them a meager salary that barely enables the workers to satisfy their myriad needs. Empirically speaking, it has been found that for every robot added per 1,000 U.S. workers, wages decline by 0.42% (Brown 2020). It can be argued that some employers resort to such methods to avoid laying off their workers because they are aware of the legal ramifications behind that. Hence, instead of dismissing their employees, they end up paying them minimum wages so they can quit their jobs and absolve their employers from any liability (Zickuhr 2021b). It is trite knowledge that the manufacturing industry entails a lot of work that needs to be completed to ensure a seamless production process. Tentatively, automation and innovative technologies cannot achieve all this without the contribution of human labor, but employers tend to believe that "their machines" can achieve everything and more (Jadhav & Gawande 2020). Considering the high regard held for automation and innovative technologies by employers, it is unfortunate that employees must pay the price for this kind of technology glorification by their employers.

Automation and innovative technologies also result in workers' discrimination because innovative technology adopted into manufacturing firms can incorporate diverse worker biometrics that treats workers differently. Ideally, such technologies promote algorithmic discrimination based on employees' age, race, ethnicity, disability status, gender, religion, etc. With this kind of radical workplace discrimination, U.S. manufacturing workers become subjected to toxic work environments that are hard to perform in. In the same vein, automation and innovative technologies also contribute immensely to violating workers' rights, e.g., the right to privacy. With automation comes intensive privacy violation because innovative technologies have the habit of requiring workers to avail all their confidential information, which later becomes prone to invasion by third parties who may have ill intentions. When this happens, U.S. manufacturing workers feel overwhelmed with their work, disincentivizing them from performing properly (Zickuhr,2021c).

How did COVID-19 Impact U.S. Manufacturing?

COVID-19 has had ghastly effects on U.S. manufacturing, such as reduced profits and sales, unstable prices of raw materials, and the constrained distribution of raw materials and finished goods. The global pandemic has profoundly disrupted supply chain levels, forcing manufacturers to seek alternative suppliers. When this happens, higher costs are incurred, which manufacturers are forced to pass along to customers. Increased costs are also attributable to the high standards of living which have caused the costs of raw materials to skyrocket to satisfy the high economy. When the costs of raw materials are high, the production costs also go up, thereby increasing the overall prices of finished goods to the subsequent detriment of customers, who are forced to bear the burden borne by their manufacturers (Sulistiyani & Riyanto 2020a).

There is a low demand for some manufactured goods due to the high standards of living, which results in staggering losses for manufacturers due to low sales. This is because of the increased costs that are also passed on to consumers of finished goods. It is important to note that the patterns of demand vary depending on the nature of the goods, with some having a decline in demand while others have the opposite effect. When Covid-19 was in full swing, goods like medical supplies and equipment were in high demand because everyone wanted to buy face masks and hospitals needed ventilators to help patients who were critically ill (Sulistiyani & Riyanto 2020b). As a result, while others thrived despite the Covid-19 pandemic, some manufacturers suffered greatly while attempting to maintain their operations, particularly luxury goods manufacturers. Although luxury goods are considered wants rather than needs, many people have chosen to focus on satisfying their initial needs to survive the global pandemic.

Manufacturing companies suffered because of Covid-19's disruption of delivery patterns due to unexpected delivery patterns caused by lockdown measures. Given the robust lockdown mechanisms across the U.S. States, delivery patterns have been verily affected, forcing manufacturers to incur additional costs to streamline this essential part of the supply chain process. When consumers are unable to get their goods on time as anticipated, they become devastated and reconsider their affiliation with culpable manufacturing companies because they fail to understand the challenges posed by Covid-19 to manufacturers globally. The delivery delays were also caused by spiked demand for some goods on supply chains that were already weakened by labor shortages, which is why some consumers were subjected to long wait periods before they could have their goods delivered. On the other hand, the lockdown measures also result

in delivery delays of essential raw materials that are required to kick-start production processes (Ardolino et al. 2022a). With such unprecedented delays, manufacturers are forced to start the production process later, which is a loss to them because it frustrates the scheduled production plans.

Additionally, Covid-19 has restricted the capabilities of human resources, raw materials, and consumables, forcing many manufacturing businesses to close or suspend their operations. Manufacturing companies, like other industries, were forced to cut down on costs to remain operational amid a constrained flow of income, hence why many workers were laid off and others subjected to work-from-home policies (Ardolino et al. 2022b). When this happened, some manufacturing companies in the U.S. were forced to shut down because the prevailing Covid-19 circumstances rendered it almost impossible for them to continue with their normal operations.

Post-COVID U.S. Manufacturing

Manufacturing industries have added jobs at a staggering rate as one of the world's worst pandemics has ended, attempting to restore pre-pandemic conditions to the workplace. Unfortunately, many of these companies are unable to rehire quickly enough to keep up with the dire need for workers considering the increased demand by consumers. It is important to appreciate that when Covid-19 woes were dialed down a notch, many people started making huge purchases with the savings they managed to accumulate when the pandemic was in full swing (Helper & Soltas 2022a). It appears as if this came as a surprise for many manufacturing companies which had not anticipated this kind of behavioral shift by consumers in such a short period.

Manufacturing companies in the U.S. have also been unable to restore their inventories fully to pre-pandemic levels, resulting in low inventory-to-sales ratios. Ordinarily, when manufacturing companies have little inventory to sell, they register very few sales, therefore, subjecting them to losses (Helper & Soltas, 2022b). Because manufacturers did not anticipate that demand patterns would change significantly overnight, it is evident from the preceding that U.S. manufacturing was chaotic following Covid-19. U.S. Manufacturers embraced the new way of life because people were living on a tight budget and the situation was extremely unpredictable. However, almost immediately after the COVID-19 wave, staggering demand patterns started to appear. It should come as no surprise that their supply chains would struggle to keep up with the sudden shift**.**

U.S. Manufacturing Towards the Growth of the Global Economy

U.S. manufacturing delivers more economic activity than other sectors, especially now driven by digitalization and the incorporation of cyber and physical systems. Thanks to technological advancements being incorporated into manufacturing, more accurate forecasts of product demand patterns and production can be made. In addition, modern manufacturing with the aid of technological advances enhances a better understanding of plant performance across multiple dimensions to enable manufacturers to understand how to best streamline production processes (Gold 2016). That said, it is important to acknowledge that U.S. manufacturing supports the growth of the global economy by promoting increased research and development, fostering middle-class job growth, revitalizing supply chain operations, promoting lower cost per unit, etc. U.S. manufacturing has a global impact on countless other industries, raising living standards worldwide. Local economies worldwide are supported when this occurs, putting money in people's pockets and food on their tables (AirBoss 2022).

U.S. Manufacturing Vs Manufacturing in Other Nations

U.S. manufacturing compares competitively with manufacturing in other nations, which is mostly attributable to its strengthening economy, workforce quality, favorable tax policies, conducive regulatory environment, and top-notch infrastructure. China is ranked as the top country in the world with the most impressive manufacturing output, which skyrockets the country’s economy. Poland is considered the country with the highest percentage of workers who are assimilated into the manufacturing sector, followed by Germany, Italy, Turkey, then South Korea. U.S. manufacturing represents 12% of the nation’s output and 18% of the world’s capacity. Together with Japan and China, these three nations produce 48% of the world's manufacturing output due to the advanced technology they invest in their manufacturing sectors to achieve this incredible output (West & Lansang 2018a).

The U.K.’s manufacturing sector also does well, which has been attributed to the most recent drop of the British pound against the U.S. dollar and the euro, facilitating an increased demand for U.K. goods overseas. In addition, the manufacturing sector in the U.K. also thrives because of its vital role in the country’s export economy and the tax incentives offered by the British government to facilitate stellar manufacturing research and growth. Switzerland has

an impressive manufacturing sector as well. This is due to the country's favorable government policies and political stability, which make it possible for the manufacturing sector to operate without any obstacles. On the other hand, Brazil has a weak manufacturing sector owing to the corruption that has plagued the country, which creates fear in investors and renders them skeptical about injecting financial resources into the country's manufacturing sector. Indonesia also has a weak manufacturing sector because of its anemic labor productivity, whereby meagerly renumerated workers are not incentivized to perform well, consequently making manufacturing firms complacent (West & Lansang 2018b).

Results

Technological advancements have made the United States manufacturing sector more competitive than that of most other nations, which is evident. Certainly, the staggering sales from satisfied clients bring tremendous profitability with such elevated levels of competition. Technological advancements in the U.S. manufacturing sector have also been pivotal in enabling large-scale production of manufactured goods to happen from a unique location because of the use of relevant machines which allow for the mass production of goods. In addition, technological advancements in the U.S. manufacturing sector have also been instrumental improving communications between manufacturers and consumers of goods because people can now communicate remotely without due regard to geographical limitations.

On the other hand, it is also worth mentioning that these technological advancements have adverse effects on workers because they replace human labor with machines in the confidence that the latter would outperform the former by a great margin. Moreover, automation and innovative technologies subject workers to meager remuneration as a form of laying off workers to push them to resign because more regard is given to technology over human resources with the advent of robust technological advancements. What is more, workers' discrimination is also feasible through automation and innovative technologies because these technological advancements categorize workers according to their biometrics, such as race, age, gender, etc., resulting in algorithmic discrimination.

COVID-19 had a significant impact on manufacturing in the United States by altering demand and delivery patterns, lowering sales and profits, and causing raw material prices to fluctuate. Sales fell dramatically because many people were working with limited funds and only purchasing manufactured goods that they needed rather than wanted. Most notably, the impending unpredictability of the economy prompted many people to give up expensive goods to avoid having their mode of survival disrupted by things they could live without. By extension, demand patterns were also immensely affected depending on the nature of manufactured goods in contemplation, whereby healthcare equipment was in high demand while luxury goods dropped in demand. Healthcare equipment such as masks and ventilators were in high demand because people needed to shield themselves from the lethal virus. Due to the prevalent lockdown measures in all states of the United States, delivery patterns decreased, making it difficult for goods to be delivered on time as consumers had anticipated. Supply chains became distorted as a result, harming both consumers and manufacturers.

U.S. manufacturing contributes towards the growth of the global economy through a domino effect, whereby cumulative efforts in the U.S. alone were felt globally. It is also worth illuminating that the U.S. enhances these cumulative efforts by providing jobs locally for people in the lower and middle classes, offering favorable tax policies to manufacturers, having a high-quality workforce integrated into the manufacturing sector, having top-notch infrastructure, etc. With 12% of the nation's output and 18% of global capacity, the manufacturing sector in the United States ought to be the most productive sector. The U.S. manufacturing industry also influences countless global economies, enabling people to attain economic affluence that is attributed to the consistent flow of income derived from dealing in manufactured goods. Because of this, the manufacturing sector in the United States helps a lot of people who are assimilated into supply chains gain more money and the means to feed themselves.

Discussion

U.S. manufacturing has remained a pacesetter for many countries globally by, most fundamentally, sustaining their economies owing to how intensely the nation has invested in ensuring the success of its manufacturing sector. By investing in a high-quality workforce, the U.S. manufacturing sector has remained consistent in producing high manufacturing output. Notably, the high-quality workforce is attributable to rigorous training mechanisms to which workers are subjected to ensure that product quality and output are not compromised. The U.S. government also provides manufacturers with favorable tax policies to ensure that the manufacturing sector remains stable even during economic crises because of the level of national output garnered from the sector. The U.S. also has a lot of high-

quality infrastructure, which makes sure manufactured goods get from the plant stations to consumers without any problems. This keeps perishable and fragile goods from getting damaged. Additionally, the U.S. has a favorable regulatory environment that does not compromise the manufacturing sector even when there are disagreements in parliament regarding manufacturing issues. This level of political stability has continued to play a crucial role in ensuring the continued existence of manufacturing operations in the U.S. for the subsequent benefit of the nation and the world as well (West & Lansang 2018c).

The U.S. manufacturing sector has the reputation of a sector graced by rapid productivity improvements over the years, whereby its spectacular performance is mostly attributable to the subsector of computers and electronics. Despite everything, it has been noted with tremendous regret that there is a significant decline in U.S. manufacturing employment, whereby machines and other sophisticated technological advances replace human labor. Expectedly, this has had devastating effects on workers because it implies that they would be subjected to a personal financial crisis owing to affected remunerations, which, by extension, affects their households as well. It is important to note that when such ripple effects are felt across a large population, many people's incomes would be affected, which would have an impact on the U.S. economy (Baily & Bosworth 2014a).

The U.S. manufacturing sector, although performs exemplarily well, has proven to have its limitations, especially with the recent full-swing wave of Covid-19 which endangered progress that had already been made. Covid-19 disoriented the U.S. manufacturing sector by promoting unprecedented delivery delays, distorting demand patterns, hiking prices of raw materials and finished goods, etc., all of which had a paralyzing effect on supply chains nationally. Given the intensity with which the U.S. manufacturing sector was affected by the devastating global pandemic, it could be argued that the sector is not as strong as it should be. Post-COVID-19 was equally dramatic in the U.S. manufacturing sector, whereby staggering demand patterns that were resuscitated once again had a crippling effect on the supply chains. This is because manufacturers were already accustomed to stocking little inventory after supply exceeded demand. As a result, when COVID-19 appeared to slow down, manufacturers claimed to have been caught off guard by the dramatic buying behavior of consumers (Helper & Soltas 2022c).

The future of U.S. manufacturing appears promising, depending on the angle with which this is analyzed. For the manufacturing workforce, the future could be argued to appear bleak because new technological advancements are likely to keep replacing human labor (Baily & Bosworth 2014b). This prediction is likely to remain viable unless the U.S. government rises to the occasion to cushion its citizens from unemployment. When analyzing the future of U.S. manufacturing from the perspective of manufacturing output, it could be argued that the future is promising because with increased technological advances would come more manufacturing output in terms of quality and quantity, owing to the potential of machines to vitalize product quality and quantity.

Conclusion

U.S. manufacturing performs exemplarily well compared to other sectors in the U.S. and provides more revenue for the U.S. government. U.S. manufacturing also does well on the international plane by emerging second in terms of manufacturing output after China. U.S. manufacturers now have a competitive advantage in competitive business environments thanks to technological advancements that have enabled them to achieve greater success. It was unfortunate to witness the extent to which the Covid-19 global pandemic frustrated the U.S. manufacturing sector by having a crippling effect on supply chains. In this respect, it is imperative that the U.S. government invests more in the manufacturing sector to make it more ready to deal with future unanticipated catastrophes that threaten this invaluable sector. On the same note, it is important that the government invests in ensuring that employment in the manufacturing sector is revitalized to continue benefitting ordinary citizens whose sole reliance is on the income they derive from the manufacturing sector. When this happens, it is inevitable that the future of the U.S. manufacturing sector would become promising across all domains, be it through employment or with regard to the economy.

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Biographies

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