The impact of robotics in the growth and economic development

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Abstract

We are currently living in the age of the fourth industrial revolution and the world is evolving rapidly as it undergoes along with the revolution where robotic process automation will redefine economic activity and lead our way of living into a new era. The technology today around the world are not only changing, but they are upgrading and emerging with one another. And this automation revolution irrevocably has impacts on the individual, social and economic sectors and the lives of future generations. The purpose of this study is to find out robotics' impact on the worldwide economy. We represent how intensely robotics enhances the economy of countries throughout the world, especially in some top robotics major countries. We analysed a huge number of previous findings regarding the relevant topic and came up with some specific reasons concerning why robotics is the ultimate booster in the economical factor. Although this is a new field in lots of countries, so there is still a significant amount of challenges that must be faced and overcome. We point out some major challenges of robotics major countries and the way they are struggling and finding solutions to those challenges so that the rest of the world can learn from that, come out of the fear of automation and adopt the technology. Some key opportunities have also been discussed, and there is a little direction of the future of robotics in the economy so that the next generation may have some ideas of the future industrial sector of this field.

Introduction

We are currently living in the era of the fourth industrial revolution. There is no substitute for robotics to bring the revolutions of automation in the industrial sector. The use of robotics in our daily life is increasing day by day throughout the world.

The demand for robots has been accelerating since 2010 due to the ongoing trend toward automation and continued innovative technical improvements in industrial robots. The market study is experiencing a significant transformation, with the unexpected growth of robots in manufacturing industries and initiating to adopt the roles of personal assistants, surgical assistants, delivery vehicles, autonomous vehicles, exoskeletons, customer service, cleaning systems, defence weapons, agricultural systems, construction service, and unmanned aerial vehicles, among many other uses. From healthcare and homecare to military use and emergency response, robots are fast becoming a very crucial component in our lives and the lives of future generations.

At the very beginning of the 1900s, several child stories very narrowly introduce the idea of robots. Officially, the term "robot" first used in a play in 1921 (Hemal & Menon, 2018). In this modern era, a significant advancement of robots has been initiated, such as unmanned aerial vehicles, self-driving cars, space robots, software robots, entertainment robots etc. and they are being

successful profoundly. They are not only making our lives easier but also having a great impact on the growth of the world economy. The evolution of robots in the 20th and 21st centuries has advanced so radically by including machines that can assemble other machines and sometimes can be confused with human beings.

So, as we can see, started from just e child's book to have an impact on the world's economy greatly, robotics has come to a very long way very successfully. And it has been found that the rise of the robots won't stop, instead, more evolutions are coming.

Literature review

Robotics continues to evolve as a large and influential market. Spectacular technological advances in the field of robotics and Artificial Intelligence are being reported every day. The market of Collaborative Robots, Service Robots is expanding rapidly.

A collaborative robot, or cobot, is a type of robot designed to work alongside humans and/or physically interact with humans in a shared workspace. Collaborative robots are experiencing rapid growth in the robotics market industry. The growth rate mainly lies in the major areas such as Autonomous mobile robotics (AMR), Machine tending, Pick and place robots, Quality inspection cobots etc. As an example, in 2017, installations of logistics robots increased by 162% over 2016 levels. It is expected that in 2018, sales of these systems will increase by 66% over 2017 levels to reach a total market value of USD 3.9 Billion. Much of this growth, approximately 90% of logistics automation systems sold in 2017 were mobile robots for achievement (IFR, 2019).

A professional service robot is defined as a semi or fully autonomous robot for assisting human beings for automation of commercial tasks, also household chores but excluding manufacturing operations. Innovations in machine learning, artificial intelligence, adaptive computing and vision systems are causing the robotics market to nearly triple in value. According to the International Federation of Robotics World Robotics 2018 Service Robots report, the combined market value for 2019 through 2021 for professional service robots is estimated to be worth USD 37 Billion (IFR, 2018).

Overview of some Service Robots which are experiencing exponential growth

The agricultural robot market size is predicted to rise at an intense 21.1 billion USD between 2017 and 2025, from USD 4.1 billion in 2017 to USD 25.2 billion in 2025. The compound annual growth rate (CAGR) is expected to increase at 25.34% between the period. The technology has developed greatly in the past few years and due to its high demand for the Toughest Agriculture Challenges, the technology is expected to grow at a fast rate in the coming years (Markets and Markets, 2017).

The production of global construction robot market was 1296 units in 2016, growing at a steady compound annual growth rate (CAGR) of 8.7%, it is projected to reach 2134 units in 2022. On the other hand, the revenue of global construction robots was USD 180 million in 2016 which will rise to USD 321 million in 2022, with a CGAR of 10.1% over the period (Reuters Plus, 2018).

The worldwide market for customer service or public relations robots reached $53.77 million in 2016. In 2018, the market grew 53% over 2017, with an estimated 7,000 units sold. It is expected that between 2019 and 2021, with a compound annual growth rate (CAGR) of 37%, approximately 40,500 units will be sold. It is also predicted that by the end of 2022, the market value will reach USD 87.97 million (Tractica, 2017).

In 2017, defence robots accounted for roughly 11% of all service robots, at a value of $902 million. Alone the military robot market is projected to grow to USD 30.83 Billion by 2022, while it was USD 16.79 Billion in 2017, at a CAGR of 12.92% (Markets and Markets, 2017).

Demolition robots are one of the first service robots that were the most feasible robots to maintain applications in labour-intensive industries. Currently, demolition robots are mostly occupied with construction robots, a value of 90% of the total market. In 2016, the global construction robot production was 1296 units and the revenue was USD 180 million. It is expected that the

production will be 2134 units and the revenue will be USD 321 million by 2022, with a global compound annual growth rate (CAGR) of 8.7% and 10.1% respectively between 2016 and 2022 (Wise Guy Reports, 2017).

The market for exoskeleton robots is expected to explode in value to USD 2,810.5 Million by 2023 from USD 104.3 Million in 2016 and the compound annual growth rate (CAGR) will be of 45.2% between 2017 and 2023 (Markets and Markets, 2017).

In 2018, there were approximately 7,210 field robot units sold. It is estimated that 32,700 units will be sold between 2019 and 2021, representing a 22% compound annual growth rate (CAGR). The growth of this sector is massively dependent upon the financial prosperity of farmers (RIA, 2019).

The humanoid robot market is the most striking technology in the recent era and the growth rate and demand are gigantic. It's projected that the market for humanoid robots will be valued at USD 3.962.5 million by 2023 from USD 320.3 million in 2017, growing at an astounding 52.1% compound annual growth rate (CAGR) between 2017 and 2023 (Report Buyers, 2017).

Industrial cleaning robots are expected to experience significant growth. An estimated 3,000 units will be sold between 2019 and 2021 where the bulk of them will be floor cleaning systems. The unit shipment of global industrial cleaning robot will be likely at a CAGR of more than 74% during 2016−2022 (Research and Markets, 2017).

The global market for inspection robots is expected to grow at a compound annual growth rate (CAGR) of 21% with the projected market size of USD 3.72 billion by 2021 (Technavio, 2017).

With a 162% increase over 2016, logistics robots experienced robust growth in 2017 where 69,000 units were installed. It's predicted that the growth in robots for logistics forecast will be at a value of USD 31 billion by 2020. It's also estimated that 485,000 units will be sold in total, rising at a rate of 18% compound annual growth rate (CAGR) between 2019 and 2021 (Green, 2016).

Medical robot sales were accounting for 2.7% increment of all professional service robot sales in 2017, sales increased 73% over 2016. The medical robot market is projected to reach USD 22.10 billion by 2027 from an estimated USD 6.46 billion in 2018, at a CAGR of 14.6%. Between 2019 and 2021, roughly 22,100 units are estimated to be sold. Due to the drop in the price of sensors and software, Grand View Research projected the medical robotic systems market will be growing at an estimated compound annual growth rate (CAGR) of 12.6% from 2014 to 2020 and will be worth USD 18 billion by 2020. According to Visiongain, revenues and volumes are forecast to extend in the surgical (which was accounted for 60% of medical robots in 2016), rehabilitation, non-invasive radiosurgery, and hospital/pharmacy submarkets. North America will be accounted for the largest share of the medical robotics market, followed by Europe and the Asia-Pacific (Markets and Markets, 2019).

There are other sectors too where the robot shipment boomed, such as food and consumer goods sectors, manufacturing industries, retail sector etc. In the food and consumer goods sectors, shipments of robots surged 60% in 2018 compared to the year before. In manufacturing industries, automation is becoming increasingly prevalent, viable and beneficial because of the competitiveness among business industries leading the best business productivity in the least labour cost and cheaper machines (Business News, 2019). Employment figures show that the US added the highest figure of 327,000 manufacturing jobs between July 2017 and July 2018 since 1995. The sector also improved by the boost of overall economic activity and a cut in federal tax in the same period. Data from the Bureau of Economic Analysis also announced that US manufacturers are producing at near-record levels. Sales were strong across the board and it is expected that more than 1.7 million new industrial robots will be installed by 2020 (Perryer, 2019).

Research methodology

The research process is the heart of any research methodology and the application of scientific methods to discover solutions of the complex task. Following is the research methodology that has been followed throughout the whole research process,

Step 1: Came to know the various tracks of The International Conference on Globalization, Entrepreneurship and Emerging Economies (ICGEEE).

Step 2: Analysed the tracks and select the most enthusiastic topic in the 4IR era.

Step 3: Brainstormed about the topic and structured the research title.

Step 4: Examined the research title and research directions.

Step 5: Brainstormed about what will be considered as key elements of the research.

Step 6: Studied and analysed relevant works of literature.

Step 7: Analysed the change of overview of preceding and existing situation regarding the research topic.

Step 8: Discussed the current perspective based on the topic and finally concluded.

Findings

According to Junji Tsuda, President of the International Federation of Robotics, the mark of 400,000 robot installations per year has been passed for the first time in 2018 [1]. The robotics market was valued at USD 31.78 billion in 2018 and is expected to register a Compound annual growth rate (CAGR) of 25% over the forecast period of 2019-2024 [2]. The new World Robotics report released by the International Federation of Robotics (IFR) in 2019, shows a new record of the annual global sales value of robots of 16.5 billion USD in 2018 [1]. 422,000 units were shipped globally in 2018 which is an increase of 6% compared to the robot shipments in 2017 (IFR, 2019).

Top Five Major Industrial Robotics Markets

According to International Federation of Robotics (IFR), five major industrial robot markets, China, Japan, Republic of Korea, the United States and Germany represented 74% of global robot installations in 2018 (IFR, 2019).

Economic Advancement

China owns the gigantic deployment of the country's dominating electronic and automotive manufacturing sector which makes them domineer in the regional adoption rate of robotics. China held its number one position of being the world´s largest industrial robot market with a share of 36% of total installations in 2018, about 154,000 units were installed which was 1% less compared to 2017 but more than the number of robots installed in Europe and the Americas together. The value of installations rose 21% higher than in 2017 reaching 5.4 billion USD. Also, Chinese manufacturers gain domestic market share (IFR, 2019).

Japan is the world´s predominant and number one industrial robot manufacturer. In Japan, the average annual growth rate was 17% since 2013 which was already remarkable for a market with a highly automated industrial production. But in 2008, Japan reached its highest value ever for the country in robot selling. Robot sales increased by 21% to about 55,000 units and delivered 52% of the global supply in 2018. The most productive manufacturing sectors in Japan are automotive and electronics which are massively reliant on automation for production processes (IFR, 2019).

To enhance the U.S. industries in both domestic and global markets and to compete with the rest of the world with the production rate of the country, all manufacturing industries of U.S. has been playing a strong role in the current trend of automating production since 2010. Resulting, in 2018, robot installations in the United States increased to a new peak for the eighth year in a row, reaching approximately 40,300 units. This is 22% higher than in 2017. Regarding annual installations, the country has taken the third position from the Republic of Korea (IFR, 2019). According to data seen by an international news organization, Reuters, robot shipments reached 28,478, nearly 16% more than in 2017. In 2018, robot shipments to food and consumer goods companies deluged 60% compared to 2017 while shipments to semiconductor and electronics plants were up over 50% and shipments to metal producers rose 13% (Aeppel, 2019).

According to a research study by Transparency Market Research, robots will drive the global robotics market to $147.26 billion USD with North American firms accounting for a large percentage

of that revenue because of improving efficiency and automating business processes using robots that have been overwhelmingly a popular choice. The report predicts a 17.4% revenue increase in the compound annual growth rate (CAGR) from 2017 to 2025 (Transparency Market Research, 2018).

The U.S. has experienced a productive year in 2018; while in Asia robot sales were down, in America it was up 6%. The robot sales were up 15% from 2017, while both Canada and Mexico were down 15% and 13%, respectively (Tobe, 2019).

The Republic of Korea so depends on the electronics industry that the Korean machinery industry has declined its import and export business except for the machine tool industry. In the last year, the Korean electronics industry had a tough year. As a result, the annual robot installations in the Republic of Korea in 2018 declined by 5% and about 38,000 units have been sold. Still, installations have increased by 12% on average per year since 2013 (IFR, 2019). The Korean robotics market is expected to grow to as much as CHF 4 billion by 2019 (Switzerland Global Enterprise, 2018).

To achieve the goal of maximizing the efficiency of the machining process, high-speed multitasking machining systems are being used. The Korean automobile, electronics, and machinery markets hold the largest portion of the entire machine tool market, which accounts for about 50% in 2019. It is growing faster than the growth rate of the entire machine tools market. It is expected to grow at a compound annual growth rate (CAGR) of 9.46% in 2019, and its size is expected to reach about CHF 16 billion. Japan, Germany and Switzerland are competing in the Korean market, regarding high-end products such as precision machining equipment and grinding machines, where sales of Korean domestic products amount to 31% (Switzerland Global Enterprise, 2018).

Germany is the number one largest robot market in Europe and the fifth-largest in the world. Machine vision sales maintained a record level of 2.6 billion euros in 2017 [7]. In 2018, the number of robots sold rose to a new all-time record of 26% to almost 27,000 units [1] and according to VDMA, the German robotics and automation sector's growth was 4%, reaching a total turnover of 15 billion euros for the very first time in 2018. Currently, the VDMA predicts that sales in 2019 will increase by 2 to 5% to sales of somewhere in the 15.3 to the 15.7-billion-euro range. Installations are mainly driven by the automotive industry (VDMA, 2019).

Global Robotics Markets

Asia is the world's largest industrial robotics market that grew by 1% in total in 2018. In 2018, robot installations in China and the Republic of Korea declined, while Japan increased considerably. Europe, the second-largest market in robot installations, installations increased by 14% and reached a new peak for the sixth year in a row. In America, the growth rate reached 22% more than 2017 which also marks a new record level for the eighth year in a row (IFR, 2019).

By region, Europe has the highest level of robot density worldwide, with 106 industrial robots per 10,000 employees installed in the manufacturing industry, while Germany is in 3rd position, Sweden is in 5th, Denmark is in 6th, Belgium is in 9th and Italy stands in 10th position, all make the top 10. The UK ranks 22nd worldwide with a density of 85 units, which is equivalent to the global average. China overtook the UK in 2017 and is currently ranked 21st with 97 units (IFR, 2018). While in 2017, robot sales in the United Kingdom had risen by 31%, installations of industrial robots fell by 3% to 2,306 units in 2018. Although the European Union´s recent sales numbers are still positive, up 12%, according to the preliminary results of the World Robotics Report 2019 (IFR, 2019).

In 2018, Singapore was the 6th largest receiver of U.S.-made products such as replacement parts and end-of-arm tooling, which totalled USD 21 million in exports of industrial robots and industrial robot parts (Export, 2019).

Bangladesh is a developing country and a land of great opportunities. Although there are very few robotics industries has been established in our country recently, but it is believed that there are a lot of possibilities to develop a robotics foundation in Bangladesh in near future. The most pleasant

point is that the young generations of Bangladesh have already proved their creativity by making impacts in global robotics competitions.

India is the world's fourth-largest vehicle producer by OICA´s production statistics. It had just about 2,100 industrial robots installed in its automotive industry (IFR, 2018).

Discussions

There are varieties of opinions regarding the disruption of technologies and the impact of the disruption, especially on human labour. Some argue that a large number of jobs could be impacted by disrupted technologies while others claim that intelligent technologies will lead to new job creation. For example, it is suggested that 47% of all jobs in the United States could be eliminated or significantly changed by computerization and intelligent digital technologies compared to 57% in OECD countries, 69% in India, 72% in Thailand, 77% in China, and 85% in Ethiopia. According to a report from Oxford Economics, around 1.7 million manufacturing jobs have already been lost to robots since 2000. These include 260,000 jobs in the US, 400,000 jobs in Europe, and 550,000 jobs in China. According to the report, the global stock of industrialized robots has more than doubled since 2010 and If this rate of robotization stands, the global manufacturing workforce will shrink by 8.5% by 2030 (Ahmed, 2017).

Oxford Economics also found that each new robot installation replaces an average of 1.6 manufacturing employees. Because of the advancement of AI, machine learning, and engineering, the use of robots in service industries will also increase rapidly in the coming five years. This will impact sectors such as logistics, healthcare, retail, hospitality, and transportation. According to analysis firm Oxford Economics, up to 20 million manufacturing jobs around the world could be replaced by robots by 2030 due to the rise of artificial intelligence (AI), machine learning, and robotics (Rayome, 2019).

So, what is the strategy of robotics being the economic booster while decreasing such a huge amount of jobs?

Because the number of advantages is a lot higher than the number of disadvantages. By increasing automation will also boost jobs and economic growth.

Demand for Labor: Rise of new opportunities creates new jobs that may not have existed a decade or more ago. Robot automation reduces demand for labours to perform routine tasks, but it also increases employment in other job sectors such as software engineering, training, robot installing, maintenance etc. These jobs offer higher level payment than the manual occupations. So, it leads to direct and indirect influence on employment numbers, therefore, it improves competitiveness and trend rate of economic growth of a country. On the other hand, installing robots as a substitution of labours increases productivity and lower the unit of costs of supplying products in the least amount of time.

Job Creation: Because of the robotics industry, an estimated 500,000 to 750,000 new jobs were created between 2008 and 2011. As a result of this growth, productivity level in manufacturing companies was increased. While several employees have earlier been displaced by the robotic solution, the increased efficiency also led to increased productivity. This improved output has historically led to lower prices and increased demand for more circulating products. As more people work together to deliver products to consumers, entirely new market segments resulted. As these automated systems continue to provide value in the manufacturing industry so naturally the demand for more, newer, and better systems continue to rise. And this increases the demand for qualified people in the robotics industry. At the same time, these manufacturing companies require people to do varieties of works such as, manage, maintain, and program the new material handling robots, conveyor systems, as well as other automated solutions. The robotics industry is generating around 170,000 jobs worldwide on its own, according to some estimates. Tens of thousands more are accounted for by the operators and technicians who use and deploy these robots, and those figures do not include jobs created indirectly due to increased productivity (Colzani, 2018).

***Improved Efficiency and Work-Speed*:** In the workplace, the use of robots implies that manufacturing will always be fast and effective. Robots do not need to take breaks, sleep, go on vacation, take sick leave, don't get bored in repeating tasks, unlike human employees. This effectiveness implies higher production and higher profits, efficiently.

The company productivity has risen, as a result, businesses achieve more profits. Also, company loss has been reduced because flawed products are sheared down to almost none.

Cost-Effectiveness: Labor wages are increasing day by day. So, it is cost-effective to install a robot rather than paying a high salary to multiple numbers of employees. It is easier and cheaper to install a robotic system rather than paying employees who are not efficient in his job. Apart from the affordability and user experience, size and shape also play an essential role in driving the robotics industry. So, declining sensor prices and increasing adoption have further aided lower costs.

Make our work easier and safe: From simple farming tools to current-day assembly-line robots in factories, technology has played a vital role in making work more efficient for thousands of years. Robots are becoming present in more and more feasible and beneficial in business. They work right alongside human workers or completely replace them where the task is dangerous or repetitive. For example, Tesla Motors has fully robotic and automated assembly lines for its electric cars and batteries. Amazon uses a variety of robots in its warehouses to stock inventory, retrieve and package items.

*P**roductivity Growth:*** Growth results from one or a mixture of three things: increases in the quality of labour, increases in capital and total factor productivity (TFP), also known as multi-factor productivity. Higher living standards come through higher wages, lower pricing of goods and services, and an overall greater variety of products and services. Labour productivity growth, as measured as output per hour leads these things to occur.

Gross Domestic Product Growth: With increased productivity comes an increase in the gross domestic product (GDP) automatically. Graetz and Michaels researched on the effects of robots in the economy on 17 countries including the United States and analyzed a variety of data for a 15-year period ending in 2007 and found that, across the 17 countries, the increasing use of industrial robots over the time period raised the annual growth of GDP by 0.37%, on average (Graetz & Michaels, 2015). According to the estimation by Oxford Economics, USD 5 trillion additional global GDP would be created if robot installations rose 30% worldwide (Oxford Economics, 2019).

Conclusion

Robotics has a significant role in the global economy, social and daily life. Robots are the most technological advancement that makes living easy and industry work more safe, convenient and beneficial. It is one of the leading drivers of competitiveness and flexibility in large scale manufacturing industries, therefore, in the growth of the economy. Robotics has a great impact in successfully running the wheel of development of many European, American, Asian and rest of the continents' manufacturing industries.

Although Robotics already built its foundation strongly in the industrial sector by underpinning an enormous amount of employment, there are some challenges that still need to overcome. Especially in the small manufacturing industries, robotics has become a threat of replacing human workforce, therefore, replacing jobs. But the opportunities are already outweighing the threats and new demands are being discovered continuously.

The field of robotics research is going to be competitive and designing patents for global industries according to their nature of applications will be very competing. The demand for robotics technology is extending in a wide range of applications and human activities, such as manufacturing, consumer industries, medical, transportation, service, space, defence etc. Robotics is a new technology domain, which is why, to represent the human role in automation, more and more scientists, practitioners, scholars should enter into the field. Because in the future, we are expecting to

experience a huge technical transformation and it is not very far that the world will be run by both human and robots together.

Limitations and direction for future research

Robotics is still in its initial phase, so, with the invention of a new system also brings lots of challenges with it.

Challenges:

Some major challenges that the top robot market countries are still fighting to overcome,

The biggest challenge for Chinese robotics manufacturers is the lack of knowledge and skilled workers. Foreign companies mainly perform better in manufacturing core components because of precision machining. As a result, foreign companies account for 75 % of the total sales within the Chinese market (Renéry, 2019). Another challenge will be to replace the current working-age population. It is estimated that by 2030 the working-age population will drop from 1 billion to 960 million and even worse to 800 million by 2050. It also means automation will have to fill the loss of approximately 200 million workers decreasing in the workforce (Renéry, 2019).

As the humanoid robotics sector is in its inception phase so there lie robotics standards and regulations in Japan. The long term investment is a high-risk factor as a single lapse sometimes could cause a great loss. Since humanoid robots are used in an individual's service so trust is the most crucial factor in this field; one single mistake could lead someone's life in danger.

Dr Byron Clayton, chief executive officer of the USA Advanced Robotics for Manufacturing (ARM) Institute, addressed "workforce development" as the biggest challenge in the world of engineering. He stated the lack of understanding and knowledge of codes and standards of graduates who are not prepared for the workforce is the common and concerned issue because this creates fear of abolishing robots in the future because of efficient workers (ASME, 2019).

As South Korea is the leader in robotics industries so their strategies, policies and investments may not necessarily be in beneficial use in the short-term processes. No country can be certain that the way it is going will hold its market dominance permanently.

Although Germany is very strict on maintaining privacy and security of data, especially regarding surveillance, there was a breach in February 2017 by a banned robotic doll called "My Friend Cayla" (Vijay, 2015). Through its microphone data of a child with whom the doll used to interact were collected and sent to an American company. This is a very big struggle not only for Germany but also to many countries who are still trying to maintain privacy and security with phone calls and e-mails.

Opportunities

As the challenges are rising continuously so do the opportunities are making their ways. Though the opportunities are much fewer in developing countries, they are fighting to blend in this 4IR era.

Here are some opportunities in the major robot industrial countries,

The Chinese robotics industry has a bright future due to the "Made in China 2025" strategy. Also, the rise of Chinese labour costs, the shortage of skilled workers and the ageing population are other key factors of Chinese industrial robotics revolution. To fulfil the purpose of modernizing the Chinese economy, currently, the number stands at 68 per 10,000 workers. Also, the Guangdong province is investing $150 billion into industrial robots and new automation centres. It offers many opportunities for Chinese companies as well as foreign companies to develop the market and set themselves as leaders (Renéry, 2019).

Another key opportunity is the GBA or Greater Bay Area, an international innovation and technology hub which is a great platform of robotics competition. Economists predict that the GBA will end up generating a record amount of foreign capital invasions of up to USD 125 billion dollars into China's stock market in 2019 (Renéry, 2019).

Japan has plenty of opportunities in robotics industries. Because of the growth of demand in human assisting robots, relevant work as software development, maintenance, hardware installations etc. is increasing rapidly. User consumer characteristics have been developed; insurance companies are becoming more vigilant.

The Population Division of the UN Department of Economic and Social Affairs released an estimation for Japan that showed the population of the country will go below 100 million shortly after the mid-21st century. By the end of the century, Japan stands to lose 34% of its current population (UN, 2001). So, it is expected that the automation will be the major driving factor of the economy of the country. Also, Europe faces the same population ageing as Japan which makes them rely on each other regarding the fact of reducing labour cost and increasing of manufacturing productivity.

According to robotics industry insiders, robots can bring jobs back to the USA, and have an impact on improving factory productivity as well as helping manufacturers acquaint to changing consumer preferences. Ulrich Spiesshofer, CEO of robot maker ABB, is enthusiastic about the potential for bringing manufacturing back to the U.S. from low-cost countries. He thinks automation technology can help U.S. factories get production costs to Chinese levels. The reason for saving jobs in America while the Chinese adopt the same technology is relative wage rates. The average U.S. factory worker makes about $16 per hour whilst the rate in China is more like $2 to $4 per hour (Root, 2019).

According to the president of South Korea, Moon Jae-in, the government has set a goal of turning the nation's robotics industry into a 15 trillion won ($13.3 billion) industry, the fourth-largest player in the world by 2023 by fostering 20 major robotics companies. The 20 companies refer to firms that generating 100 billion won each in sales. The Ministry of Trade, Industry and Energy declared to fund the distribution of 7,560 manufacturing robots to replace human workforces in the areas of textiles, foods and beverages that have been losing workers repeatedly due to adverse work environments and work ferocity. At the beginning of 2020, the government plans to inject 300 billion won of research and development funds in the service robots due to its inception level of development in Korea. The funds will help foster robots to provide help to the growing need in areas of caring, clothing and logistics (Ji-hye, 2019).

Germany is investing for more than €350 million ($391.9 million) to jumpstart fourth industrial revolution, which would apply robotics, artificial intelligence, and the Internet of Things to advanced manufacturing (Prakash, 2017).

On the other hand, German robotics industries are really concern about robotics rules, laws and regulations. Such as, in 2016 the German transport minister proposed three rules for autonomous systems which are called "Three Laws of Robotics or Asimov's Laws" by the science fiction author Isaac Asimov and the main theme of those rules is robot ethics which is not to harm and must to obey human beings (Asimov, 1942).

Unlike other robotic major countries, Germany isn't worried about technological unemployment due to the upcoming wave of the robotics revolution. German businesses have taken different approaches so that there won't be any aggregate effect on German employment, instead, robot exposure is found to increase the chances of workers staying with their original employer.

German robotics laws are cracking the books while the rest of the world is still discussing possibilities.

Future of Robot Industries

It is predicted that in the future, along with the developments of the Internet of Things(IoT) and cloud computing, the number of smart factories will be increased, resulting in vast market growth in industrial robotics, in particular, demand for collaborative robots that work with humans in the industrial field is expected to increase to a great extent.

IFR estimates shipments in 2019 will diminish from the record level in 2018 but expect average growth of 12% per year from 2020 to 2022. According to Junji Tsuda, President of the International Federation of Robotics, the IFR´s longer-term outlook shows that the ongoing automation trend and continued technical improvements will result with an estimate of about 584,000 units in 2022 (IFR, 2019).

Asia is expected to record the highest growth rate over the forecast period, owing to the significant installation of industrial robots throughout the region.

According to the authors of Oxford economics, the inconvenient effects of robotics have thus far been small compared to those just over the horizon. Over the past two decades, the robot uses in the whole worldwide has been increased by three-fold to a total of 2.25 million. As the trend is stirring so the global stock of robots will multiply even faster in the next 20 years. By 2030, the stock will reach as many as 20 million where China alone will have 20% of the global total up from .1% in 2000. The report found that China currently has the most robots installed, representing one out of three worldwide. By 2030, China will have as many as 14 million manufacturing robots in use, consolidating its position as the world's largest manufacturing hub, the report predicted (Oxford Economics, 2019).

Historically, technology has created more jobs than it has destroyed, so automation will also create jobs. AI alone is expected to have an economic impact of $15.7 trillion by 2030 (World Economic Forum, 2019). As industry costs are falling so industrial robot sales are skyrocketing. And this trend is expected to continue where the cost of robots will be falling by 65% between 2015 and 2025. As the cost of labour generally rising so this makes it more difficult to keep low-skilled jobs. Research has found that roughly 48% of hours primarily relied on the use of manual or physical labour in North American and European manufacturing jobs. It's estimated that only 35% of the time will be spent on such routine work by 2030 (World Economic Forum, 2019).

According to a recent report from a multinational professional services network, PricewaterhouseCoopers (PwC), the impact on Organization for Economic Co-operation and Development jobs or OECD jobs will start to be felt in the mid-2020s. As an example, it's projected that 10-15% of jobs in manufacturing, transportation and storage, and wholesale and retail trade sectors will have a high potential for automation by 2025. By 2035, the range of jobs with high automation potential will be closer to 35-50% for those three sectors (World Economic Forum, 2019).

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