

# INDUSTRY 4.0 IMPLEMENTATION IN EMERGING COUNTRIES: CHALLENGES, OPPORTUNITIES AND STRATEGIES

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## ABSTRACT

*The digitalization of the manufacturing industry is becoming an absolute reality as we are on the verge of experiencing the 4<sup>th</sup> industrial revolution. Industry 4.0 has both prolonged the possibilities of digital transformation and increased its importance to the manufacturing industries not only in developed countries but also in emerging countries around the world by the integration of digital and physical technological factors such as big data analytics, artificial intelligence, the Internet of Things (IoT), additive manufacturing, robotics, cloud computing, machine learning and so on. The aim is to drive more flexible, responsive, and interconnected enterprises (Santos et al., 2017). This evolving digitized platform is going to connect people, products, plants, ICT, businesses and supply chain networks together to create proactive intelligent manufacturing systems that will bring optimum ramifications. This paper focuses on the relevance and impact of this manufacturing revolution of limitless opportunities to the welfare of emerging economies such as Thailand, China, Vietnam, Bangladesh and so forth. It is apparent that the fourth industrial revolution will bring tremendous benefits such as agility and automation in factories, profit optimization and so on to the emerging economies. However, it will also require the respective Governments to make an astounding amount of initial investment to develop the essential infrastructure to embrace such prospects (“Economies around the world,” 2017). Whenever opportunities are mentioned, there are certain challenges as well and this industrial revolution is no different in this aspect for emerging economies. Industry 4.0 represents a combination of infinite hope and ambiguity for the emerging nations because the overall implication of such technological revolution is yet to be figured out from a wider perspective. Therefore, in this paper, we first discuss potential opportunities such as the accomplishment of optimum productivity, increased efficiency and ideal facilitation of energy and resource management and we also attempt to recognize the pivotal challenges such as the rapid shift from emerging countries being a source of cheap labor to being able to integrate advanced technology in the production. Overall macroeconomic effect in the short-run and long-run in emerging economies include loss of jobs and a shortage of required skill set to tackle such advancement. Furthermore, this paper concludes with some concrete suggestions for how emerging countries can overcome the challenges while embracing limitless growth opportunities through the implementation of Industry 4.0.*

Keywords: Industry 4.0; Implementation; Emerging country.

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## 1. Introduction

Manufacturing processes have changed drastically over the years from the first industrial revolution which used steam power, to the second which used electricity and assembly lines for mass production to the third revolution which used computers for automation of processes (Marr, 2018). Now we stand to face the fourth big industrial revolution – Industry 4.0 – driven by connectivity, advanced automation, interactive machines technology, and collaborative advanced manufacturing networks; controlled by computers combining them into a physical – digital environment (Marr, 2018). Marr (2018) states that this change includes the entire value chain from raw materials to end use to recovery. The industry 4.0 technologies will bring in a lot of advancement in our interactions not only with the machines but also with each other. This enhanced digitization and automation will surely change the way an economy functions. In the present scenario, emerging countries such as the BRICS nations mainly serve as production houses for the developed countries mainly due to availability of factors such as cheap labour and other resources for production. The factories built in emerging countries bring business to these economies which increase production and decrease unemployment which helps the economy to grow as a whole. The implementation of new improved technology in Industry 4.0 will optimize manufacturing processes, but it will also face numerous challenges for emerging economies. For example, the lack of infrastructure, finances, education and skill sets, loss of employment, unfavorable rules and regulations etc. This paper will address some of these issues and suggest how the implementation of industry 4.0 will affect emerging countries. Moreover, how they should strategize to take advantage of the opportunities presented and be stable enough to survive through the short term economic and social storms.

## 2. Technologies Facilitating Industry 4.0 in Emerging Countries & Benefits

Advanced technology is thoroughly revolutionizing the manufacturing industry and , in the near future, machinery and equipment will be able to improve manufacturing procedures through digitization as well as self-optimization (Santos et al., 2017). There are several technological

factors that are predominantly transforming Industry 4.0 at its core. Each component is similar in nature and when integrated and connected together, creates a capability that has never been possible before (Sniderman, Mahto & Cotteleer, 2016). For instance, Big Data Analytics, which is the analysis of a “large collections of data sets containing abundant information” to generate valuable results (Yin, 2015). Another component is cloud computing which according to the National Institute of Standards and Technology is “a network access to shared pool of configurable computing resources” (Storey & Song, 2017). Big data analytics with the integration of cloud computing helps early detection of defects and production failures, cloud-based manufacturing can also be described as a networked manufacturing model with reconfigurable cyber-physical production lines enhancing efficiency (Santos et al., 2017). The evolution of Industry 4.0 will change the way organizations and solutions within organizations work together to interpret data more meaningfully to make smarter decisions for factory management by processing data with tools such as analytics and algorithms (Rüßmann et al., 2015).

There is another simple factor of a magnificent concept, the industrial internet of things (IoT), which is fundamentally the virtual and instantaneous connection of all devices to the internet and to each other (Rüßmann et al., 2015). Today, only some of a manufacturer’s sensors and machines are networked and are typically organized in a vertical automation pyramid where sensors and devices with limited intelligence automate manufacturing-process. However, with the implementation of Industrial Internet of Things, more devices including even unfinished products will be developed with embedded computing using standard technologies (Rüßmann et al., 2015). This will decentralize analytics and decision making, enabling real-time responses both within the enterprise and to third-party partners. Also, the interconnection of devices will enable “smart factories” to take shape as equipment will automatically use data to manufacture, report at surprising rates (Rüßmann et al., 2015).

Correspondingly, Artificial Intelligence and machine learning will also pave the way for Industry 4.0. Although the boundless information archived and delivered by sensors and IoT-driven systems is too massive for humans to reasonably analyze, AI and machine learning algorithms can contextualize the archived and stored data, identify anomalies, make changes and provide creative recommendations (Santos et al., 2017). AI and machine learning processes will be particularly

effective for industry 4.0 as the contextualized data will be used to make intelligent decisions and allow the decision-makers to easily understand the effects before they implement something new (Santos et al., 2017). Consequently, if all these factors are effectively brought together and put into work, companies can accomplish 'interoperability' by establishing the swift connection among AI, humans, cyber-systems, and factories, finally leading smart factories in emerging nations towards the error-free transmission (Santos et al., 2017). During the year 2016, Thailand launched 4.0 strategy, with the goal of developing advanced and high value-added industries in order to reach high-income status ("Economies around the world", 2017). The strategy embraces the development of technology clusters and start-ups based around Industry 4.0 such as AI, robotics, IoT and machine learning, and joins with the Eastern Economic Corridor strategy to create growth hubs ("Economies around the world", 2017).

Lastly, manufacturers in many industries have been using robots to tackle some complex projects, however, robots are now evolving for an even greater usefulness and are becoming more autonomous, flexible, and cooperative with technological advancements (Rüßmann et al., 2015). Eventually, they will become self-sufficient and will interact with one another to work safely side by side with humans and learn from us. For instance, China has undertaken "Made in China-2025" plan for economic and technological revolution in the next decade, embracing the Industry 4.0 concept (Li, 2018). They are investing millions of dollars in robotics, cyber-systems, 3D printing and AI to produce artificially intelligent robots and equipment to replace their aging labor as well as to install smart factories successfully (Li, 2018). These unconventional robots are basically interconnected so that they can work together and automatically adjust their actions to accomplish tasks effectively in any situation.

There are various benefits for emerging economies in embracing Industry 4.0 for overall industrial improvement. All these transforming factors of 4IR drive a proactive system where employees and systems can anticipate and act before issues or challenges arise, rather than simply reacting to issues after they occur (Santos et al., 2017). Middle-income emerging economies such as Mexico, South Africa, Cambodia, Vietnam and Bangladesh in different continents require automation in manufacturing plants, innovation in process and product design, better designed workplaces, production cost reduction as well as profit optimization to compete with the developed economies

to retain their economic growth in the upcoming years (Larson, Oshiro & Camargo, 2012). Emerging countries can surely become manufacturing leaders in the world economy even though they are currently lagging behind in terms of technological advancement provided that they can capitalize on the following benefits of 4IR.

**Agility and automation:** Industry 4.0 came about not just as an approach to use new technologies, but to fundamentally change the equation for manufacturing. This manufacturing revolution will allow much greater agility in a factory without sacrificing quality, cost, or speed (Santos et al., 2017). Cloud-based AI optimizes performance and computer systems equipped with machine-based learning algorithms enable robotic systems to learn and operate with greater automation (Li, 2018). With the increased flexibility, agility and automation in manufacturing plants as well as with the usage of AI, China has already been producing shorter lead-time products with mass customization and improved quality while flooring the way to other emerging countries to be more dynamic and expedient producers (Li, 2018).

**Rapid innovation:** Since Industry 4.0 production lines are made to accommodate a high mix of customized products in low volumes, they are ideally suited to new product introduction and experimentation in design (Rüßmann et al., 2015). The extreme perceptibility from IIoT (Industrial Internet of Things-The network of intelligent computers) helps develop intelligent products and equipment and it also enables deeper understanding of what works better for both innovative product and process design for manufacturing plants (Sniderman, Mahto & Cotteleer, 2016). Intelligent products with the ability of information handling, creative designing and decision making will replace conventional products that need more human interaction, instructions and production time, in emerging economies and will help produce more innovative and customized products to efficiently compete in the international arena (Meyer, Främling, & Holmström, 2009).

**Improved communication and better workplace:** Under industry 4.0, high volumes of detailed data are collected, stored, processed and shared providing valuable information about every step of the planning and production stages. This helps improve the working processes and communication by integrating digital systems such as sensors, embedded computers, smartphones and machines, which allows the exchange of data both between themselves and outside of the

factory work (Santos et al., 2017). Besides, better information flow facilitates scheduling and prevents breakdowns. Furthermore, under Industry 4.0, staff are valued and supported by the addition of technology to their functional operations by installing ergonomic workstations ensuring optimal output (Santos et al., 2017). One of the BRICS countries, Brazil, has already had tremendous success through the 3M Brazil Ergonomics project which was a risk reduction program in the workplace to design ergonomic tools to work with (Larson, Oshiro & Camargo, 2012). This actually helps reduce work stress, improve productivity and overall quality of lives of the workers (Larson, Oshiro & Camargo, 2012).

**Cost reduction and profit optimization:** It is true that Industry 4.0 will require a staggering amount of initial investments to be made by emerging countries, however, it comes with much more benefits in comparison to the initial investment. Once the intelligence is built and embedded into products and processes, the costs will plunge. This new manufacturing revolution will also provide better quality with lower costs, higher fusion of customized and higher-margin products (Sniderman, Mahto & Cotteleer, 2016). Therefore, fewer defects and quality problems will lead to less material waste, lower personnel and operating costs, hence, optimizing profit by ensuring the best output in the long run. This is why there are more emerging economies preparing to embrace Industry 4.0. For instance, Indonesia just launched its 4IR-oriented plan in 2018, Indonesia 4.0, government expects it will help boost annual GDP growth by one to two percentage points. The strategy focuses on five priority sectors based on these benefits of industrial revolution, namely food and drinks, automotive, textile, electronics and chemicals (“Economies around the world,” 2017).

### **3. Opportunities for Emerging Countries In Implementing Industry 4.0**

As mentioned above, adapting to industry 4.0 has several benefits for emerging countries but these benefits can only be gained if the opportunities put forth are reaped and the economies are able to sustain the challenges that might occur during the transition. Since the first industrial revolution, subsequent revolutions have resulted in radical changes in manufacturing, and the processes have become increasingly complicated, automatic and sustainable (Marr, 2018). The fourth industrial revolution will further enhance the automation implemented in the third industrial revolution by

computers by making them smarter, more interactive and easier to use (Marr, 2018). This change in the manufacturing industry is expected to bring several opportunities for emerging economies.

The first opportunity that Industry 4.0 would offer to manufacturers in emerging economies is to optimize their operations through high-level automation and configuration of machines. High-level automation will enable improved productivity and efficiency, and thus, facilitate better energy and resource management. For instance, at current emerging economies such as BRICS nations have most of the necessary resources such as, raw material, low-cost labor, abundance of natural resources, and proper infrastructure (Acton, 2018). Combining the Industry 4.0 technologies with these readily available resources will facilitate better utilization of resources thus boosting the country's' competitive advantage (Acton, 2018).

Increased efficiency and productivity will, in the long run, result in a higher economic growth and thus, improve the GDP. Increased competitive advantage will help the economies to retain the manufacturing units and side-step the risk of production units being withdrawn and shifted to other developed economies. Secondly, the collection of big data that can identify maintenance, performance or other issues would offer optimization of complicated supply chains to accommodate new information easily and proactively adjust further processes (Rüßmann et al., 2015). This will automatically reduce functioning delays which arise due to problems such as machines breakdown, climatic changes, and communication gap (Marr, 2018). This also facilitates further optimization of industrial processes.

Finally, in a long run, the increased competition in automation industry would make hi-tech machinery economical due to increased competition. For example, robots, which were once unaffordable, can now be purchased by retailers like Amazon for doing groundwork. It not only reduces operational costs but also enhances productivity (Wingfield, 2017). While most of the emerging countries are considered to be low-cost manufacturing markets or cheap labor markets, adopting advanced technology might further boost the economies to lower their operating costs and earn higher profits (Acton, 2018).

All the opportunities above can be taken advantage of, if economies proactively accept the change in business processes, adopt advanced technologies and diversify their growth into different industries, at an early stage. For instance, Nigeria has the potential to be the fastest growing large African economy and could move up the GDP rankings from 22nd place to 14th by 2050 (PWC, 2017). However, Nigeria will only realize this growth if it can diversify its economy away from oil and strengthen its institutions and infrastructure (PWC, 2017). This would also facilitate improving the global rankings of emerging economies.

Emerging economies like Singapore, India and Vietnam, which are still undergoing changes introduced by IR 2.0 or 3.0, can leapfrog the value chain by importing the industry 4.0 technologies or gain higher investments from developed countries to boost technological infrastructure (UNIDO, 2016). Combining these opportunities with low costs of production factors, fast growing populations, and boosting domestic demand will give them the competitive advantage over developed countries.

Emerging countries can also opt for partnering with developed countries for increase in trade activities or to improve overall infrastructure of the country. For instance, Japan is now actively engaging in India's infrastructure projects to develop an improved Industrial Corridor and the connectivity in the country (All Listicles, 2018). Further, owing to India's strong IT talent pool, some of the largest US-based companies are investing in India to take advantage of this talent (All Listicles, 2018). This can potentially increase the employment opportunities in these countries.

Revolutionizing the manufacturing processes and demonstrating the ability to be a leader in manufacturing can attract FDI for development in infrastructure and education. This can also be done by adopting investor-friendly regulations and giving tax-credits. These countries will also need to be economically stable to ride out the short term economic and social storms that will inevitably occur in these emerging economies as they move towards maturity (PWC, 2017). In the present scenario, this can be done only if these economies stay ahead of the competition and take proactive measures. Emerging economies such as India, Malaysia and Africa, can leapfrog the value chain by importing the Industry 4.0 technologies (UNIDO, 2016). Further, combining them with low costs of production factors and the size of workforce will give them the necessary



competitive advantage over developed countries. However, this would have to be complemented by investment in higher education and improvement in macroeconomic fundamentals (PWC, 2017).

#### **4. Challenges Emerging Countries Have to Face in Industry 4.0**

As mentioned above Industry 4.0 will bring several benefits and opportunities to emerging countries. However, the implementation of this manufacturing advancement comes with challenges to overcome in order to make it successful.

##### **4.1 Financial constraints**

In order to implement Industry 4.0, high initial financial investments are required (Ślusarczyk, 2018). New technologies such as autonomous robots are not yet available in emerging countries and are relatively expensive. This means that the companies that would want to adopt them would need to import them from developed countries. Given the fact that the currency power in emerging countries is lower than that of a developed one, they would have to invest an even higher amount of money to adopt such technology.

##### **4.2 Lack of infrastructure**

Electricity and Informational technology (IT) infrastructure are both imperative in order to make the implementation of Industry 4.0 successful (Luthra & Mangla, 2018). In terms of electricity, the lack of stable electricity supply is a challenge for an emerging country such as South Africa to overcome (Deloitte, 2018). This is due to the fact that a lack of stability in infrastructure would disrupt the manufacturing operations from running smoothly. In addition to that, the current IT infrastructure is unable to cope with fast-paced changes in a new Industry 4.0 environment as they are unable to communicate with each other (Deloitte, 2018).

##### **4.3 Cyber-Security**

The fact that Industry 4.0 will lead companies to have a flow of data exchange will make it possible for a third party to intercept those insights and use it for their own benefit (Schroder, 2016). This, therefore, creates a concern about the security of the information used by a company. According

to the senior vice president of Toyota South Africa, the increased open collaboration facilitated by advanced IT solutions has heightened cyber risk (Deloitte, 2018). This challenge will push organizations that want to implement Industry 4.0 to invest more into the security of their data. Companies will also have to be aware of the fast-paced evolving of technologies and be prepared for the likewise changing of cyber threats. If they are not ready for it, in the worst cases, a hacker could even control the physical machinery due to the fact that with Industry 4.0, everything is controlled via a web portal from a distance (Khan et al, 2017).

#### **4.4 Education and skill set**

In most BRICS nations, the skills that job seekers have and the ones that the recruiting companies expect them to have are not aligning. This gap in skill will widen up in the situation where Industry 4.0 is to be implemented (Aulbur et al, 2016). Therefore, skill development will be a significant challenge to focus on for emerging countries as well as companies who want to implement Industry 4.0. In terms of skill set, companies will have to invest into training their employees to make them able to cope with the new technologies. For instance, a current blue-collar worker will have to be able to operate a robot and thus, be trained to do so. Additionally, the fact that the technology is going to be rapidly and frequently changing, it is likely that the employees resist newer changes (Aulbur et al, 2016).

#### **4.5 Macroeconomic effect**

Implementing Industry 4.0 will have a tremendous effect on the emerging countries' economies. Several tasks will be automated, and thus, will not need a person to be in charge of them (Schröder, 2016). This will incur a large number of jobs being replaced by machines and thus, human labor will become irrelevant to some extent. . In addition to this, countries which usually manufacture in emerging countries, such as China, will not need to maintain their operations in these countries once they have invested in the right technologies (Acton, 2018). Therefore, bringing back their operations to their home countries will enlarge the number of job losses of jobs in emerging countries and will also have a negative effect on their economy such as a lower Foreign Direct Investment (FDI).

#### **4.6 Legal issues**

The sharing of data across several systems through the adoption of cloud computing gives a rise to several legal issues. For instance, given the fact that an organization has a manufacturing plant in Philippines while using a data facility in Singapore, they would have to adhere to both jurisdictions (Gill, 2018). In addition to that, the factor of liability is an issue when it comes to Industry 4.0. Naturally, when a faulty product is created, one of the parties that was involved in the production process has to be responsible. It will be challenging for companies to address the responsibility of faulty products legally as most tasks will be automated (Schröder, 2016). This will be especially difficult for emerging countries such as Brazil or China due to the fact that their formal institutions lack of legal recourse (Worldwide Governance Indicators, 2018) .

### **5. Policy Implication**

The future of the manufacturing industry will lead to an increase in demand for skilled-labor, sustainable products, and it will be more cost effective for companies to move their production near the consumers (Souza, 2017). Therefore, emerging countries will need to focus on preparing for the Industry 4.0 wave in order to capture the opportunity of improving their manufacturing plants and ultimately, move up in ranking in the world's economy.

It is important to classify the focus based on 4 distinct groups: global investment, infrastructure, human capital, technology infrastructure and cyber security, and institutional framework. As financial constraints is an issue preventing emerging countries from investing in technological improvement and development, those countries can look for partnership opportunities with the successful countries in the 4.0 or those whose focus is in technology innovation. Acton (2018) indicates the tight relationship between Africa and China, and how it is helpful for Africa in catching up with the industry 4.0. China has been investing heavily in African infrastructure to boost the technology development in this continent (“Industry 4.0: Opportunities and Challenges for the Developing World”, 2018). According to Acton (2018), there are now countless Chinese plants in Africa, which now “creates ample opportunity for skills and knowledge transfer” within the continent. Likewise, there is an increasing number of foreign investments flowing into

emerging countries with the focus on “knowledge-intensive activities, including R&D and technology sourcing” (Nepelski & Prato, 2012).

Additionally, the emerging countries should be able to identify the suitable technology that can boost their manufacturing development the most. For instance, Africa is considered to be far behind in the fourth revolution in the manufacturing industry due to the infrastructure deficiency and lack of financial resources to invest in new technology (Oxford Business Group, 2018). Looking into the mobile communication industry in Africa, despite the lack of fixed-line communication, some countries figure out a way to develop their mobile communications and related technology. Instead of investing in the fixed-line communication and infrastructure, some African countries have shifted their focus to mobile communication and related technology service, such as, mobile banking, which eventually benefits those countries in the communication and technology infrastructure (Oxford Business Group, 2018). This lesson in the mobile communication sector can be applied in the manufacturing industry. To illustrate, the 3D printing technology can be adopted to improve and optimize the production process without having the countries to experience intensive investment in fixed infrastructure (Oxford Business Group, 2018). This technology will enable them to minimize their import of high-cost capital materials from developed countries as they can now replicate the products with the 3D printing (Oxford Business Group, 2018).

Technology infrastructure will play an important role in embracing and fostering the Industry 4.0 in emerging countries. Yan Lida, the head of enterprise division of Huawei suggests that in order to immerse in Industry 4.0, the information and communication technology will need to be improved (BBC, 2015). As mentioned in the analysis of challenges, electricity deficiency may still remain and be one of the greatest obstacles. This issue, however, will require a long term strategy as it not only involves in the industry 4.0 but also in other areas, for example, improving quality of life. Meanwhile, there are some key areas in improving technology infrastructure emerging countries can take into consideration. Firstly, as there is electricity deficiency, it is critical to place the data closer to the production infrastructure with computing support (McGinn, 2017). McGinn (2017) states that in this fast changing 4.0 world, the loss of power or data connection can cost the companies or emerging countries their competitive advantages. The placement of power network

and data centers should be put as close as possible to the production houses (McGinn, 2017). Besides, the manufactures should be able to simplify the deployment process so as to reduce cost and time incurred when dealing with the work. Less time and error will be involved in a standardized process. This will help avoid being loaded up with too many data given limited capacity of electricity and internet (McGinn, 2017). Moreover, the world in general, will witness a trend towards renewable energy and sustainable use of other resources in order to be self-sufficient and have the facilities to adopt the strong technology movement in Industry 4.0 (Souza, 2017). These areas of technology should be the key focus when investing in improving the infrastructure in emerging countries.

The growth in technology infrastructure and data connection also mean that corporations and countries should pay more attention to the cyber security issue. According to Waslo, Lewis, Hajj, and Carton (2017), there is no easy way for countries to address cyber security issues. Instead, emerging countries should get themselves ready for such threats with proper response plan to such unavoidable incidents. These countries need to take a "secure, vigilant, and resilient approach" to respond to the issue. They need to make a proper assessment and measurement about how safe their supply chain and information technology system are (security) with continuous monitoring (vigilance). After all, a proper plan needs to be prepared beforehand to ensure business continuity in such circumstances (Waslo, Lewis, Hajj, & Carton, 2017). Emerging countries with limited knowledge in this area need to put their focus in building this defense system to prove their ability to counter such drastic changes in industry 4.0 and ensure corporations within the countries follow the same approach.

In regard to human capital, as mentioned in the challenges, there is a short-term risk that the advancement in the automobile production and the use of robots will replace a large number of blue-collar jobs. However, in the long-run, the need for highly-skilled labor to support the technology advancement will be needed (Souza, 2017). Countries going through the transition of Industry 4.0 will need to improve their education and training systems to provide the current and future labor force with appropriate knowledge and skills that enable them to foster the manufacturing advancement. Those skills and knowledge may include data programming, maintaining and interacting with automated systems (Oxford Business Group, 2018). These

changes take time to occur and would involve the Government in order to transform the education system as a whole. According to The report: Thailand 2018 (2018), Thailand is among the emerging countries that are making strong progress in preparing for Industry 4.0. The Thailand 4.0 strategy was launched by the Government in 2016 showed their goal to gain high-income status through the development of high value-added industries and innovation in production (Oxford Business Group, 2018). In order to succeed with this strategy, there is a strong movement in the education system in Thailand to include AI and cybersecurity in the curriculum (Oxford Business Group, 2018). The government can provide funding to universities and researches focusing in these areas.

The legal system of emerging countries will also be challenged with the evolvement of Industry 4.0. Issues such as who owns the newly generated data or innovation and who is responsible for faulty products will create difficulties to companies and the Government to address. This is due to the fact that the different stakeholders, for example, the company and its suppliers, in the supply chain will become more connected. The line to separate their ownership and responsibility may be blurred (Sniderman, Mahto, & Cotteleer, 2016). The Government in these countries should be planning to make the institutional framework more adaptive and be able to scope with these changes.

The Government and its role to frame institution will also be highlighted in the context of FDI. Ginsburg (2018) mentions the Government in emerging markets usually concentrate on the factors that could traditionally attract FDI. One of the most important factors is low-cost labor (Ginsburg, R, 2018). However, as the world is moving into Industry 4.0, the Government in these emerging countries need to do a reassessment of their competitive advantages rather than relying on inexpensive labor. In this case, only when the emerging countries can implement cost efficiency with the use of technology and provide fast innovation in products and manufacturing process may retain and attract FDI. According to Ginsburg (2018), the foreign investors who are focusing on innovation and technology development may require friendly regulations in regard to innovation. Thus, being able to develop an institutional framework that encourage domestic innovation as well as foreign investment in technological areas will be critical for the emerging countries in the Industry 4.0 era.

## 6. Conclusion

There are several factors that drive organizations to implement Industry 4.0. The evolution of technology through big data analytics, industrial internet of thing, AI and learning algorithms and robotics bring strong benefits to organizations who decide to implement industry 4.0. Emerging countries can find multiple opportunities such as optimizing their manufacturing operations. Also, the collection and usage of big data can improve the overall performance of their businesses and ultimately, help them increase their profit margin.

However, there are some challenges those emerging countries will be facing if they decide to implement Industry 4.0. They will have financial constraints due to the fact that they would need to acquire the technology from overseas. Bringing these new technologies to emerging countries will widen up the gap in skills between what employers want and what employees have. Additionally, the implementation of Industry 4.0 will cause a high number of job losses as well as lower foreign direct investment. the lack of stable electricity and information technology infrastructure is also big challenge. Besides, there are cyber-security issues that will arise due to the high flow of data exchange. The adoption of cloud will create legal issues as the data used might come from different countries. Also, when a faulty product is created, it will be challenging for emerging countries to address who is responsible for it.

In response to these challenges, emerging countries will need to improve their education and training systems to adapt with the manufacturing advancement. They will also need to invest in improving their infrastructure to become self-sufficient. Additionally, tackling the issue of having financial constraints would need emerging countries to find partnerships with countries that have been successful in Industry 4.0. Another way to tackle this issue is to invest into the most suitable technology to advance their manufacturing operations and thus, be more independent from developed countries and reduce their costs. Finally, The government should work towards making the institutional framework responsive to the changes that Industry 4.0 will bring on a legal aspect and to encourage domestic innovation as well as foreign direct investments.

Industry 4.0 will serve as an incentive for businesses to come up with new business models which will bring new employment opportunities (Schroder, 2016). However, it will also incur in a massive loss of jobs as several tasks will be automated and the possibility of developed countries' companies bringing back their manufacturing operations to their home country. Overall, the implementation of Industry 4.0 brings several benefits and opportunities to emerging countries. However, they have to be aware and take the appropriate actions to address the challenges they will face.

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