

## THE ROLE OF TECHNOLOGY INNOVATION TO SUPPORT THE COMPETITIVENESS IN MANUFACTURING INDUSTRIES IN THE ERA OF INDUSTRIAL REVOLUTION 4.0 (A LITERATURE STUDY)

Handy Aribowo<sup>1</sup>, Erni Halim<sup>2</sup>

STIE IBMT Surabaya  
Jl. Raya Kupang Baru No. 8, Surabaya  
INDONESIA

Emails: <sup>1</sup>[handy@ibmt.ac.id](mailto:handy@ibmt.ac.id), <sup>2</sup>[erni@ibmt.ac.id](mailto:erni@ibmt.ac.id)

### ABSTRACT

*The existence of Industrial Revolution 4.0 is a specific challenge for manufacturing industry; therefore, the government of Republic Indonesia gives responses by launching Making Indonesia 4.0 which is used as the foundation for economic growth in Indonesia in the future. The method that is used in the research include literature reviews in the objective of drawing conclusion from the research which says that Industrial Revolution 4.0 gives a certain challenge especially in the industrial manufacture sectors in Indonesia. The government through the Ministry of Industries has chosen 5 (five) sectors of manufacturing fields that it would focus mainly on the development to become the sample or the starting point in the implementation of Industrial Revolution 4.0. The policy on innovation in national scope particularly in order to support the performance of manufacturing industries must be integrated well among several closely related research institutions among research institution, universities, industries, companies, and people in the society, and the absorption of technology innovation from other foreign countries that requires certain investment for research human resource and the development of competent human resources.*

**Keywords** : Industrial Revolution 4.0, Making Indonesia Indonesia 4.0 and Innovation.

### INTRODUCTION

Industrial manufacture in Indonesia is one of the engine drive to boost Indonesia's economy sector because industrial manufacture can create and provide employment through absorption of a big number of people. Companies in Indonesia, especially in manufacturing companies need to improve the power of competitiveness through science and technologies in the purpose and objectives to increase the productivity in industrial sectors to become more productive in order to win the competitions from other countries in the world. The development and growth of the economy of Indonesia in the future depends so much on the improvement and development of manufacturing industries. For that reasons, the development of manufacturing industries has to be done not only on the basis of natural resources, but more to be directed to the industries on the basis of human resources, and that includes the improvement in the mastery of technology, researches, and development, innovations and creativity.

Nowdays in the world, Industrial Revolution 4.0 is happening and that can be marked or seen by the existence of cyber physical system, where digital technology, wireless technology, and big data are massively integrated by internet network in the activities or production in manufacturing using engines or machines that are internet integrated (internet of things). Industrial Revolution 4.0 is the continuation or the improvement of industrial revolution 1.0; 2.0; 3.0.

**Table 1. The Development of Industrial Revolution**

Name	Year	Characteristics
Industrial Revolution 1.0	Start in year 1784	The use of steam machine, water, wind powered machines in Industries
Industrial Revolution 2.0	Start in year 1870	The use of electrical energy / Fuel powered energy to produce mass products
Industrial Revolution 3.0	Start in year 1969	The use of information technology and electronic technology that are applied to automatic machines production system
Industrial Revolution 4.0	2011 – now	The use of integrated internet power network (internet of things)

Source : Various Source, processed

Other than that, Industrial revolution 4.0 is also marke by the existence of technology disruptive. Technology disruptive can be defined by the Indonesian Big Dictionary (Kamus Besar bahasa Indonesia as something that can be uprooted, or we can define them as the happening that a technological change has targeted the human life gap. In Indonesian Law or Undang-undang Republic Indonesia number 18 year 2002 in the first article (pasal 1) it is mentioned that technology is ways or methods and process or products that are produced from the implementation and usage as the results of various sciences that provide value to fulfill the needs, the continuation, and the improvement of human lives. The emergence of new technology has caused a temendous change in all subjects and sciences, in economy and industries. Until now, in all aspects of jobs and work all over the world, a transitional process from traditional ways of working and doing has switched to automation ways. According to Schwab (2017), technology disruptive era is the combination or mix among physical domain, digital, and biological domain. Therefore the development and improvement of technology in certain area can encourage the changes in jobs, or the jobs even dissappeared, and new jobs in the old area appeared.

The Pricewater-house coopers (Pwc) consultant, 3 (three) years ago, to be exact on February 2015 released a report about the changes in working world or employment world in the future in the duration of 5 to 10 years ahead, based on the surveys given to 10.000 (ten thousand people in Asia, Europe, United Kingdom, and USA. The result of the survey and its research was briefly described as the following table:

**Table 2. Factors that Make the Ways People Work Change**

No.	Factors that Make the Ways People Work Change	Percentage
1.	Technology Breakthrough	53%
2.	The shortage of human resources and climate change	39%
3.	Swift in global economic power	36%
4.	Domography swifting	33%
5.	Urbanisation	26%

6.	Other factors	4%
7.	Cannot answer respondents	13%

Source : Pwc, February 2015

With the ability of a country to absorb the technology development, it can be said that it can increase the economic growth potential through an innovation and through the increase of productivity. The development of Indonesia's future economy depends mostly on the development and improvement of national industries which are based not only on the natural resources richness, but more directed towards the industries that are based on Human Resources, that includes the technology mastery, research, and development, innovation, and creativity. All business people should not treat technology as a treat but business people should take advantage and benefits of the development of technology. In business sector, especially in product with national scale or export products, if the use of the latest technology can be made use of to its fullest, there will be efficiencies and the decrease in cost. Therefore, from the price and quality factors of export scale, the competitiveness in the end will increase market share of export products. For the employees or workers, the development of technology can be used as the opportunity to increase their income and the standard of living of the workers or employees. The research has the objectives of finding how far the development from the industrial revolution 4.0 happens in the world, as well as to see what kind of strategies must be done by companies in Indonesia in relation with the competition in Industry 4.0

## LITERATURE REVIEW

### **Manufacturing Industry**

According to the Law number 5 year 1984 (Undang-Undang No. 5, tahun 1984) about the Industries, industry is all the economy activities that process raw material, material or parts, half-processed goods, and/or ready to use goods to become goods with higher value in their usage and benefits. That also includes all the design and trials dan industry engineering. As for the understanding of industrial manufacturing according to Wignjosobroto (1992) is the industry which processes the raw material to be made and shaped into many various shapes, model products, in the form of half-made product or finished products.

According to Hastina (2007), industries is often defined in manufacturing industry sector or which also means the processing activities which can provide one of the business fields in calculation of national income according to production approach. Apart from that, Central Bureau of Statistics or Badan Pusat Statistik (BPS) defines manufacturing industries as a business activity which does activities to change a basic goods mechanically, chemically, or manually (by hand) so that it becomes finished goods or semi-finished goods or to change the less-valued goods to become higher value goods, and they are closer to the end users.

### **Innovation**

According to the Law number 18, year 2002 (Undang-Undang No. 18, tahun 2002), the meaning of innovation is the research activities, development, and or engineering which is intended to develop the practical value and the new scientific contexts or new ways to apply new science or new ways to apply existing science and technology into products or processes of production.

As according to Burtonshaw-Gunn, innovation in Aribowo (2018) is the use of new technology and new market knowledge in order to offer new product or product to meet the customer's wishes.

### **Industrial Revolution 4.0**

According to Kagermann & friends (2013) Industry 4.0 is the integration from Cyber Physical System (CPS) and Internet of Things and Services (IoT and IoS) into the industrial process which cover manufacturing and logistics as well as other process. Industry 4.0 is an approach to

control the production process by synchronizing the time by uniting and adjusting production (Kohler & Weisz, 2016)

Hermann & friends (2015) add that Industry 4.0 is the term to refer to a set of technology and value chain organizations in the form of smart factory, Cyber Physical System (CPS) and Internet of Things and Services (IoT and IoS). Industry 4.0 next presents to replace Industry 3.0 which is marked by cyber physics and manufacturing collaboration (Hermann et al in Irianto, 2017). One of the unique characteristics of industry 4.0 is the application of artificial intelligence (Tjandrawinata, 2016)

## **RESEARCH METHODS**

The methods used in the research is the literature review/study. According to Jesson et al (2011) the literature study is the writing product that explores a published topic or research result, without any description of a scientific methodology. According to Zed in Aribowo and Wirapraja (2018), the literature review limits its activities to library materials only without the need for field research.

As for the data collected in the research came from national and international journals that discussed the Competitiveness of the Manufacturing Industry in the Industrial Revolution Era 4.0 selected subjectively by researchers. Also in the research it is supported by data and information that is available in the public such as supporting books, newspaper, magazines, research publication report, and the empirical study from the competent institutions. After collecting data from several books, scientific journals, internet websites on Manufacturing Industrial Competitiveness in Industrial Revolution Era 4.0

## **DISCUSSION**

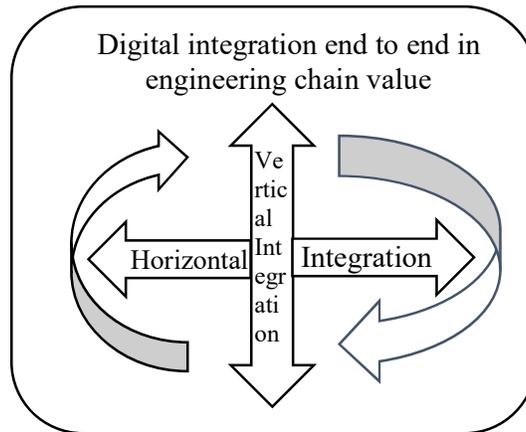
One of the current government challenge in is the limited government spending and the weakening of household consumption is to be done by encouraging the growth of manufacturing industries. Several various efforts continues to be done by government in its effort to support the growth of manufacturing industries such as continuously put the effort to attract domestic investment, and also to look after the domestic investment climate.

World Economic Forum (WEF) in Davos Swiss views the industrial revolution as a new chapter of life that will change all the lines of human life through the development of technology. Also in Industrial Revolution 0.4 there are eight (8) key issues which are 1) disruption or interruption in work; 2) innovation and production power; 3) inequality; 4) smart/intelligent management; 5) security and conflict; 6) business disruption; 7) technology integration; 8) ethnic issues & identity. According to Irianto (2017), the challenges of Industry 4.0 are; (1) industry readiness; 2) trusted workforce; (3) easy socio-cultural setting; (4) diversification and job creation and industry opportunities 4.0 which are (1) ecosystem innovation; (2) competitive industrial base; (3) investment on technology; and (4) the integration of small & medium business enterprises (UKM).

According to Schawab (2017), he said that Industrial Revolution 4.0 with the support of the rapid technology advancement can bring the condition of transitional technological revolution to change the way of life, the way people work, and the way organization communicates and contacts with each other fundamentally. As according to Sniderman, Mahto, and Cotteleer (2016), they have the opinion that the value from the concept of Industry 4.0 can be increased or improved by making roles clarifications, the roles and functions by technology which facilitate by manipulating of physical objects.

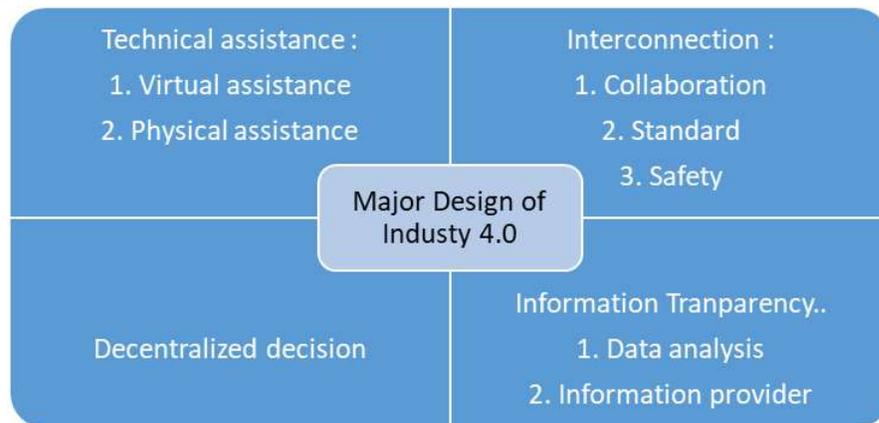
Kagermann et al. (2013) gives recommendation of the framework model of Industry 4.0, where the model that is recommended is the realization from 3 aspects integrations which are: First aspects is the horizontal integration which means that Cyber Physical Systems is integrated into the business strategy and the collaboration of companies' network now covers partners, supplier,

customers or clients, and other parties. Second aspects is the vertical integration, which includes how technology is implemented and applied, the Cyber Physical Systems (CPS) is implemented or applied in the system of manufacturing /production in the company so that they become flexible and modular. Third aspects cover the technology implementation of Cyber-Physical Systems (CPS) into the chain of value engineering from end to end.



**Figure 1. The aspect of integration In Industry 4.0**  
Source : Kagermann et.al (2013)

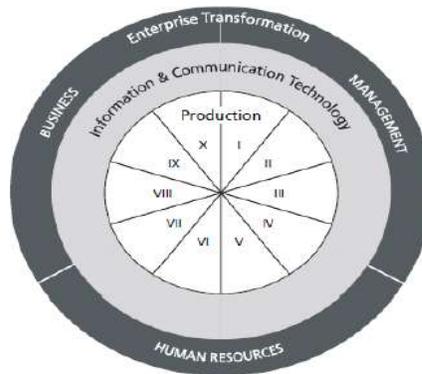
Hermann et al (2016) adds that there are 4 major design of Industry 4.0. First, interconnection, Second, information transparency, Third, assistance. And Fourth, decentralized decision



**Figure 2. Major Design of Industry 4.0**  
Source : Hermann.et.al (2016)

A research and technology organization called Fraunhofer in Europe recommends different model which is called Fraunhofer Industrie 4.0 layer model (Neugebauer et. Al 2016) which is the result of document extraction from previous researches and the result of interviews to the experts. Fraunhofer Industrie 4.0 layer model consists of 3 main layers or levels, which are : Core Layer relates to productions, where the layer is divided into ten core technologies which

are : engineering, manufacturing, technologies and organization, machines, smart capabilities, robotics and human-robot collaboration, production planning control, logistics, work organization, workplace design and assistance, and resource and energy efficiency. As for the next Layer or Level is the aspects of information technology and communication which enable the realization of Industrial Concept 4.0, and the most outer layer relates to company's transformation as the result of the implementation of Industry 4.0 which covers business, management, and human resources.



**Figure 3. Structure From Fraunhofer Industrie 4.0 Layer Model**

Source : Neugebauer.et.al (2016)

As the commitment in building manufacturing industries in Indonesia which has the global competitiveness by the implementation of industri 4.0. therefore, the Indonesia's through President Joko Widodo on the 4th of April launched Making Indonesia 4.0 as the road map and Indonesia's strategy in entering the digital era. Making Indonesia 4.0 as the road map is expected to become the Indonesia's economic growth foundation in the future. As the conceptor of Making Indonesia 4.0, the ministry of industries has set 5 (five) manufacturing sectors which are mainly focused on the development and become the model or example in the implementation of industrial revolution 4.0 which are food and beverage industry, textile and apparel industries, otomotive, electronics, as well as chemicals.

The ministry of industries has prepared four strategic steps in implementing the industrial revolution 4.0 era, among others are: 1) to encourage the workforce in Indonesia to continue to learn and to improve their skills in understanding and mastering the use of internet technology of things or to integrate their internet skills with the production line in industry, 2) digital technology utilization to spur productivity and competitiveness for small medium industries (IKM) so that they are able to penetrate the export market through e-smart IKM program. 3) to ask national industries to use digital technology such as Big Data, Autonomous Robots, Cybersercurity, Cloud, and Augmented Reality. 4) technology innovation through the development of start up by facilitating the business incubation premises.

Other than that, the Ministry of Industry has also set 10 (ten) national priorities to Making Indonesia 4.0 which are: 1) improvement of material flow flow, 2) redesigning the industrial zone, 3) accomodating Sustainability standard, 4) empowerment of micro small medium enterprises (UMKM), 5) building national digital infrastucture, 6) to attract foreign investors, 7) quality improvement of Human Resources, 8) the formation of innovation ecosystem, 9) applying technological investment incentives, and 10) harmonization of regulation and policies.

Innovation is the key in encouraging the economic growth of a country. Other than that, innovation is also the spearhead of the competitiveness creation of a country. The innovative nation will generate result in better competitiveness and better performance on an ongoing basis. (Manurung, 2010). How about the development of innovation in Indonesia? According to the report from Cornell University, INSEAD, and WIPO about Global Innovation Index 2017, it showed that the rank of Indonesia is positioned in 87 rank among 127 countries. The position of Indonesia di South East Asia is still below Singapore (rank 7), Malaysia (rank 37), and Vietnam (rank 47), Thailand (rank 51), and Philippines (rank 73).

**Table 3. Global Innovation Index Ranking in the ASEAN Region (GII) 2017**

<b>Country</b>	<b>World Rank</b>	<b>Asean Rank</b>
Singapore	7	1
Malaysia	37	2
Vietnam	47	3
Thailand	51	4
Philippines	73	5
Indonesia	87	6
Cambodia	101	7

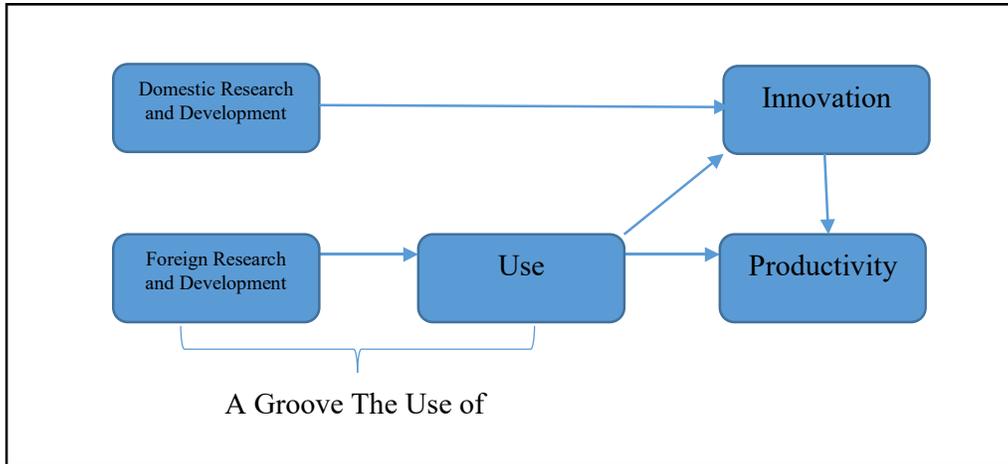
Source : Cornell University, INSEAD, and WIPO

As for the ranking of each indicator that becomes the assessment of Global Innovation Index (GII) 2017 from 127 countries among others : institution (87), human capital and research (92), infrastructure (81), market sophistication (64), business sophistication (96), technology and knowledge output (70), as well as creativity output (77). Based on the report from Global Innovation Index (GII) 2017, it can be seen that innovation in Indonesia indeed needs improvements in all assessment indicators, especially human capital and research which rank very far below, whereas, in addition to the output of knowledge and technology and the output of creativity, human capital and research is also the key element in the progress of innovation in a country. If the manufacturing company is able to innovate, it will occur efficiency on the performance of the company that ultimately can improve the competitiveness of manufacturing companies.

As for the impact of Industry 4.0 for the man power in Indonesia (Kemnaker/Ministry of Man Power 2018) which says that technology /robot replaces muscle/man power, technology replaces dangerous jobs/tasks, and technology breaks distances. But all disruption due to the presence of the industrial revolution 4.0 should not be a burden on industry and labor in Indonesia. Every change, especially the existence of industry 4.0, will certainly create new opportunities for industry and labor in Indonesia. For this reason, the government must prepare human resources who have an independent spirit with mental self driving, self power, creativity and innovation to be able to, explore new professions and be responsive in facing every change (Ministry of Manpower / Ministry of Man Power, 2018).

As for the implementation of innovation in order to support business sustainability according to Aribowo and Wirapraja (2018) among others by strengthening the research and development by continuing to develop digital skills and trying to apply the latest technology prototype and then utilizing technological progress as a means to innovate such as mobile application, internet of things, artificial intelligence and others. According to Manurung (2010) that in the national innovation policy, it must be able to integrate and to synergize among research institution, universities, industries, companies, and society towards national comprehensive innovation order and in the end, it will be able to give more value to the society or community and nation.

A report from International Monetary Fund (IMF) on March 9, 2018 which is published by *Bisnis Indonesia* (Indonesia's Business) on April 10, 2018, it is explained that the dissemination and absorption of a knowledge and technology that comes from developed countries towards developing countries is able to increase innovation activities and to increase productivity in the recent years so it becomes the key factor in sustaining the economic growth of a country so that the global economy will also increase.



**Figure 4. the technology innovation dissemination**  
Source : IMF in *Bisnis Indonesia*, April 10, 2018

A technology innovation can create new skills and is able to develop new thinking pattern. However, it is important to note that the absorption of technology innovation which comes from foreign or developed countries need an investment for research and development staff as well as the competent workforce.

## CONCLUSION

The conclusion that can be drawn on the research are as following:

1. In respond to the industrial revolution 4.0, the government through the Ministry of Industry has set five (5) manufacturing sectors that are prioritised in their development and become the model or example in the implementation of Industrial Revolution 4.0 era. The government has prepared 4 step-strategy and 10 national priorities in the implementation of Industrial Revolution 4.0.
2. The existence of Industrial Revolution 4.0, the government has to prepare Human Resource who has the independent spirit with self-driving mentality, self power, creativity, and innovation in order to be able to explore new profession as well as to be able to be responsive in facing every change.
3. The steps that must be done by the companies or organization in facing the Industrial Revolution 4.0 are by strengthening research & development (R&D), by continuously developing digital skills as well as trying and implementing prototype of the latest technology, dan then make use of technology advancement as a means to innovate.

4. In supporting the innovating policy nationally and in supporting the manufacturing industries, integration , it is required to have integration and synergy among research foundation, research institution, , universities, industries, and society.
5. In supporting the absorbtion of technology innovation which come from foreign countries investment is needed for research and development staffs and the human resources which are competent too.

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