Industry 4.0 toward Sustainability[1]

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Abstract

This paper presents the global trends that influence global industries including industries in Thailand. In Europe, the concept of Factories of the Future has been adopted by European Commission to bring industries back home since 2008. Many countries in several regions both in Europe and outside Europe are in the same influent and develop their own similar initiative to modernize their industries to be more competitive. The most successful industrial development is in Germany where they introduced the concept of Industry 4.0. They have started the scheme of Industry 4.0 several years ago and have since become successful in increasing their competitiveness. They have applied automation and robotics together with ICT, the so called Cyber-Physical systems; it changes their way of manufacturing and doing businesses. However the context of Factories of the Future goes beyond modernizing manufacturing infrastructures. It involves other areas such as human well-being, green production and new materials development. This paper provides strong reasons why Thai Industries have to develop themselves to the new level toward Industry 4.0 to be more competitive globally, and move Thailand as a whole up to become one of the higher-income nation. The Federation of Thai Industries has put up several efforts to move Thai industries toward Industry 4.0 by creating several strategies. They will be elaborated here.

Keywords: industry 4.0, sustainability

Introduction

There have been many studies of global trends from several public and private organizations; several of these trends would affect all of us globally. The most recognized so-called Megatrends are demographics, globalization, climate changes, dynamic technology and innovation for example ICT, global knowledge society, mass customization, sharing global responsibility and global economic crisis, etc. As for Thailand, we are also facing the same Megatrends but on top there are other domestic issues such as middle income trap, aging society, low population growth, very low unemployment, slow GDP growth, etc. (Credit Suisse, 2015)

Thailand had developed from agriculture based nation to light industry and then heavy industry nation several decades ago. But for the last decade Thai industries

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have not moved forward as much but only rely on old existing technologies without new innovation. Especially the global competitive index showed that Thailand's indexes are behind in applying science, technology and innovation to the country development. According to Global Innovation Index by INSEAD Business School, Cornell University and World Intellectual Property Organization, Thailand's innovation index ranking was at the world's 57th in 2012 and the world's 55th in 2015, while Vietnam's innovation index ranking was at the world's 76th in 2012 and the world's 52th in 2015. Vietnam is also one of the world's leader in innovation efficiency with Innovation Efficiency Ratio ranking at the world's 9th in 2015 while Thailand's innovation efficiency ratio ranking was at the world's 43th in 2015. (Cornell University, INSEAD & WIPO, 2015)

Now under the existing Government of General Prayut Chan-o-cha, there have been several new public policies introduced such as Digital Economy, Science-Technology-Innovation Driven Economy and Thailand 4.0 policies, etc. Under the scheme of Public and Private Partnership these policies are intended to move Thailand out off middle-income trap toward high value based economy, higher income nation and to increasing Thailand global competitiveness and sustainable. The context of Industry 4.0 is very much in line with these new policies.

The Industry 4.0

In 2008, the Public-Private Partnership (PPP) initiative for Factories of the Future (FoF) was launched under the European Economic Recovery Plan or Digitizing Industry under European Commission. The FoF is the multi-annual roadmap for the years 2014-2020 had set a vision and outlines routes towards high added value manufacturing technologies for the factories of the future, which will be clean, efficient, environmental friendly and socially sustainable.

The Industry 4.0 is the 4th industrial revolution as the name was given to honor and recognized the changes of how German industries revolutionize manufacturing since the last industry revolution happened several decades ago. Many published papers stated how German had succeeded in developing Industry 4.0. On the last or the 3rd industrial revolution was the one that electronics and integrated circuits were introduced into industries and changed the mechanical programming/sequencing of manufacturing processes to be more precise by using electronic control in the form of Programmable Logic Control (PLC), etc. The objective of the Industry 4.0 initiative is to help EU manufacturers across all sectors, in particular SMEs, to adapt to global competitive pressures by increasing the technological base through the development and integration of several enabling technologies. Industry 4.0 is a collective term for technologies and concepts of value chain organization that brings together the technological concepts of cyber-physical systems, the Internet of Things and the Internet of Services.

Not only countries in European Union are applying the Industry 4.0 initiative, several countries around the world have also realized that it is logical to move to this direction as well. China has announced "China Manufacturing 2025" initiative to strengthen their manufacturing prowess. Japan began the "Industry Revitalization Plan" in 2013 to revamp manufacturing industry with equipment and R&D investments. South Korea devised "Manufacturing Innovation 3.0" strategy to help SMEs establish smart and optimized production processes. Taiwan has also announced "Productivity 4.0 (Pro 4.0)" initiative, they plan to spend NT$45 billion over the next 9 years (2 phases) to help and improve hidden champions in 7 key industry sectors. As for USA, they planned to invest US$2.2 billion for "Advanced Manufacturing Partnership" program starting 2013 to encourage the return of domestic manufacturing from oversea and regain their leading position in the manufacturing industry.

Several global consultant firms have devoted their resources to study, analyze, and make use of this revolution to advise companies on how to do the transition to Industry 4.0. This transition requires comprehensive digitization of the horizontal and the vertical value chain, as shown in Figure 1. The horizontal integration, shown on the left of Figure 1, is an integration through value chain networks (suppliers to factory to customers). The vertical integration, shown on the right of Figure 1, is an end-to-end digital integration of engineering, planning and production across the entire chain.

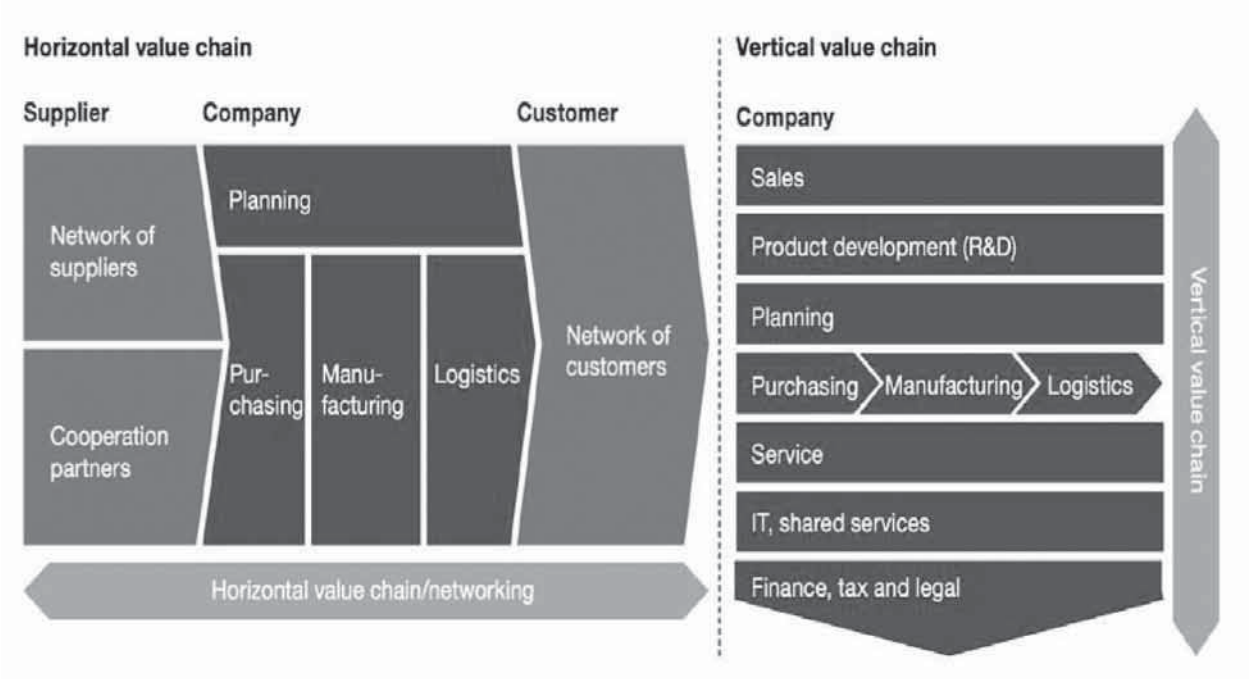

Figure 1: Industry 4.0 requires comprehensive digitization of the horizontal and vertical value chains

Toward Sustainability

There are four essential components in the case of sustainability of Industry 4.0. First is the usage of ICT in manufacturing such as Digital Engineering, Digital Workflow, Logistics and Supply Chain management (using MRP or ERP, RFID, MES, big data and data analytics, IoT, etc.). It can be described by using three terms. The term Smart Factories is the first term, being use to represent the factories that tightly integrates ICT in automation for better control and optimization of manufacturing processes (PLC and SCADA including big data and data analytics). The outcome is less waste, less energy usage, on-time delivery or faster shipment to market and better quality. The second term is Virtual Factories is to use ICT tools such as MRP, ERP and MES, etc. to manage value chains, logistic and supply chains, in order to manage assets and on-time delivery, or faster time to market, or to response to mass customization. The third is Digital Factories, which is to use ICT and software tools (CAD, CAE and CAM) to design, test and see the products before they are produced (the so-called simulation processes).

The second component is High Performance manufacturing. It can enhance manufacturing processes through the use of automated modular and robotics production lines with higher degree of integration. Robots of the future will not rely on computer programming but will be able to learn from human supervisor how to operate certain tasks. Artificial intelligence software/system and better man-machine interface are required. 3D printing

(additive manufacturing) will be widely used not only to make prototypes but it will be able to produce small batches of highly innovative products. More sensors, along with Big Data and Data Analytics, will be used to monitor the performances of manufacturing processes in real time. Any deviation can be corrected to achieve near zero defect manufacturing reducing waste. And all information and adjustment can be sent to responsible persons via IoT for additional instructions.

Of course with new manufacturing processes, the third component is to find new materials or raw materials that enable such improvements. On top of that, recycle or renewable materials such as bio-plasticrecycle materials and also special materials like Graphene, etc. are a must to help environment due to limited resources.

The fourth priority is the Sustainable Manufacturing or Green Production, in which energy, the environmental and people well-being, are the main boundary conditions. Sustainability can only be achieved if these boundary conditions are met.

In order to be able to achieve Industry 4.0, there are several enabling technologies that should be mentioned here are ICT and Digital Engineering technology, Advanced manufacturing technology (automations), Precision engineering technology, Nanotechnology, Biotechnology, Microelectronics, Advanced materials technology, Laser technology, 3D Printing, Robotics, Sustainable environmental and energy technology, Sensor technologies, etc. These technologies will be used to create new materials, measuring systems, new production processes, new products and on top is to be able to manage logistics cost, and lean management system.

At WEF 2015 summit in Davos (Brodtmann, 2015), the forum on "The New Global Context", was meant to raise awareness of the opportunities of Industry 4.0 for everyone, not only in Europe but worldwide. Digitization of manufacturing processes will fundamentally change the existing business models. Instead of mass produced goods for the common, the products can be uniquely customized, locally manufactured, and delivered to each individual customer with unprecedented efficiency. Industry 4.0 offers more than economic opportunities. It also presents opportunities for sustainable society. It is important the people are not afraid of new technologies but see the possibilities to think of how to make use of them. If we do the Industry 4.0 right, not only the industries will benefit but society as a whole will also benefit.

Vision and Mission of The Federation of Thai Industries

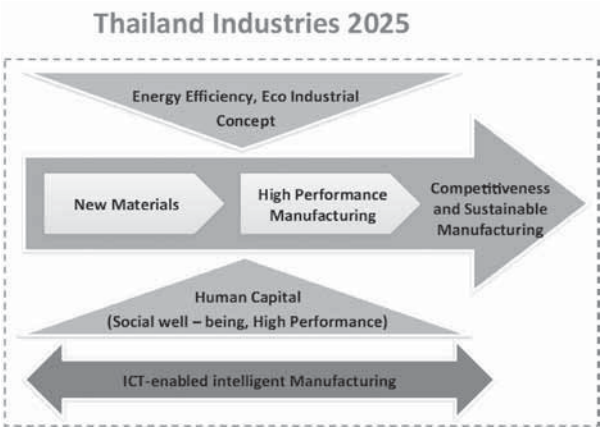

Figure 2: Vision of The federation of Thai Industries

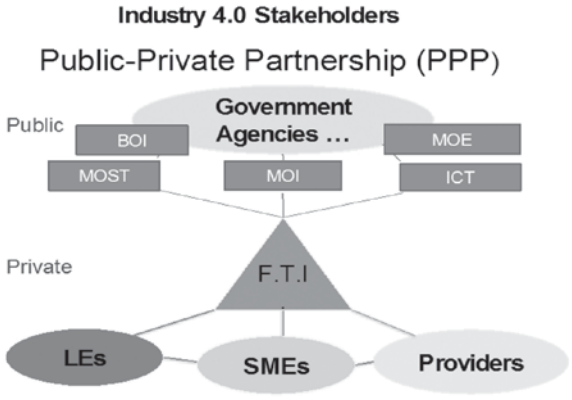

Figure 3: Industry 4.0 stakeholders

The Federation of Thai Industries (FTI) who represents the whole industries in Thailand has also realized the important of this revolution. Our Vision is

"Thai Industries 2025", shown in Figure 2. The ecosystem or the stakeholders of Industries 4.0 are shown in Figure 3. The ultimate goal is to help SMEs and Thai industries to revolutionize the existing manufacturing operations by applying Industry 4.0 concept towards sustainability by year 2025. FTI has come up with three new strategies to lead the industries and to collaborate and participate with government agencies in the development of Thai industries. They consist of three parts. First, the Proliferation of Innovation to expand the coverage of innovation from products innovation to processes and business model innovations since most of Industry 4.0 revolutions are either processes or business model innovations. Second is to improve the way FTI works with government agencies, it is called Innovative Public and Private Partnership. The innovative way is the smart ways of introducing problems and requesting assistance from policy-making and funding agencies to help private sectors especially to SMEs. Third strategy is to be able to directly help SMEs by transforming FTI into an Innovative Market Place to intelligently match the need of SMEs to Innovation Service Providers and government funding agencies.

Conclusions

There is no real industrial development in Thailand for a period of time. This had led us to be in the bottom of Value-added Smile Curve, which means doing more or less assembly work with small value added or without creating innovation of our own. The Industrial 4.0 is the new role model for Thai industries to follow and catch up. There is no doubt about it. The only problem is how to jump-start the development fast enough and large enough to catch up with the global changes in order to have a meaningful impact and be more competitive, since many key manufacturing players in many countries have already started doing so for a period of time. The most important factors are how Thai industries and government agencies could work together as Public and Private Partnership to move forward this agenda. So that all parties could achieve their goals of higher income nation and be competitive and sustainable in global market place together.

The industry 4.0 is not only the industry revolution. Itself is the New Economic Revolution.

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