The Frontier of Global Lean Smart Manufacturing:
The Disturbance and Turning Points of Industry 4.0

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1. Introduction

Since 1990, manufacturing has gradually moved to China; however, the trend shifted and reshoring has occurred as early as in 2010.(Liu and Chen, 2014) When Germany sounded the trumpet of industry 4.0, the manufacturers around the world have strived to maintain existing competiveness by creating its own ICT innovation and strategy.

Nevertheless, the latest surveys in Germany show that Industry 4.0 proposed by German government has yet come into real practice, most national platforms as well as solution platforms have stalled or even terminated. Standardization of the connection interface has ceased to function with no Small and Medium Enterprise seems to care.(Mitsuyama H. & Nakazawa T., 2017. The Collapse and Beyond: Fantasies of Industry 4.0, *Hitotsubashi Business Review*, 2017 Winter, 108-121.) Our study also shows that the successful cyber system of leading enterprises on internet provides little help in value creation when applying to manufacturers physical system, sometimes even compresses competiveness which is by its original differentiation.

2. The Disturbance of Industry 4.0

The counter-attack of the German Meister, along with the frustration found in physical system among the nations, help gave birth of Lean Smart Manufacturing that includes the essence of TPS. This process also explains the confusion of the existence of industry 4.0.

The first confusion is the missing of the goal: have no idea what they are fighting for. The difficulties of the factory production plan to reach the goal lies not in ICT level; but rather in lack of basic production technology, production process supporting capability, and organizational capability. Without a clear goal, it is hard to begin the development of the solution platform. Adopting IoT became a waste of resource and expense.

The other confusion is the lack of scientific proof. The cause and effect theory cannot fully detail the true value of Smart manufacturing. Neither marketing AI nor big data can be applied to manufacturer physical system to create effect. Exactly what data is needed and how to obtain those data again bring them back to the need of finding the

cause.

This speech reflects the observation of the field trip at Japanese enterprises like Daikin、Shimano、Fanuc、Komatsu、ALPS, in their Japan factories as well as in their EU, US & Korea subsidies. We took a closer look and examined the world's first class manufacturer physical system and its industry 4.0 smart factory, digging out the keys and turning point for practical application.

3. The Frontier of Global Lean Smart Manufacturing

A factory manager in EU described those who tried to adopt AI that is already popular in many marketing campaign to real site factory data collection and analysis could either know too little about production line or being too optimistic about AI because few ever created value, if any. He showed one smart processing line which is based on existing production process and know-how that includes manual measurement, automatic comparison, processing setting and execution. The working hour variation used to be big, simply because the high standard of precision was only made possible by individual technician operator. Now they changed to measure the small variance of the metal raw material and apply the variance to processing setting in order to increase the man-machine efficiency. Data shows the new production line still needs as many technician operators; however, the averaged output has increased by 10%. More importantly, such data has also increased the product quality traceability in terms of processing as well as the possibility of issue tracking of the metal raw material.

The above-mentioned production line illustrates how the data was collected (by sensor), how the data is processed and logic analyzed (by software) and how the data help creates a pure, value-added solution, echoing what the author advocates as 3S formula (Figure 1).

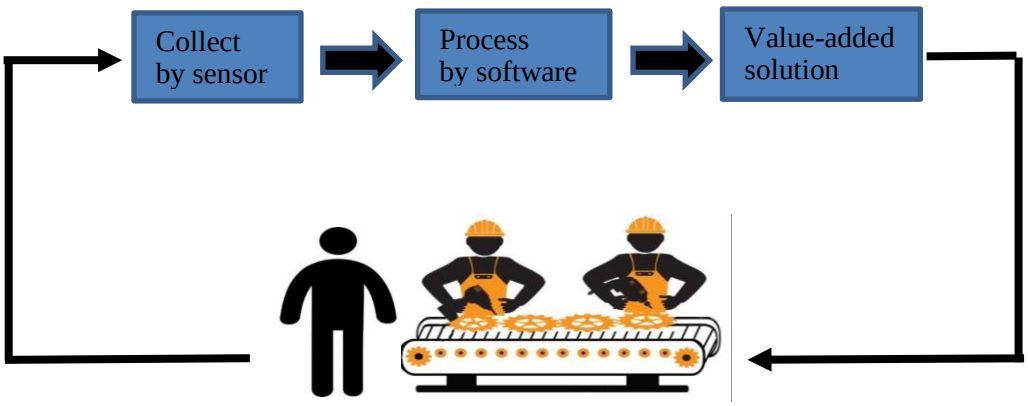

Figure 1 Architecture of Smart Manufacturing

I began to study Daikin back in 2003. In the recent 15 years, the numbers of Daikin employee have increased from 8,000 to almost 70,000. Daikin has gain the largest market share by 2010. In 2018 (2017 April to 2018 March), it reports a total revenue of 2.5 billion Japanese Yen. The rise of Daikin actually came from two things: it grows from China domestic demand to fulfill global market competition while fully learns from Toyota lean revolution.

Daikin believes there is no first class world factory without having first class Japanese factory. It believes mid-to-long-term forecast is for reference only. It believes the key to survival is to adjust in-house lead time to quickly fulfill real-time market trend. The result is a testimony to its revolution happened between 2003 and 2015. Its production lead time has decreased from 68 hours to 4.94 hours in twelve years (one thirteens) while help shortened supply chain WIP to be less than one fourths. (Table 1)

Table 1 Daikin Lean Revolution Result

Year	2003	2008	2013	2015
Lead Time (hours)	68	9.5	5.9	4.94
Supply Chain WIP (day)	64	20	16	15

Source: survey done at January of each year

The result sees the reshoring of domestic air conditioning from China to Japan shortly after 2012. Lean revolution has also become a role model for oversea factory. IE process standardization, production technology standardization and multiple task labors are all part of the foundation of its success

In the year of 2000s, the cost of raw material has begun to soar. Daikin, however, has kept improving its profit by enforcing lean development and service. Even with the highest retail price, Daikin has more profit than all the competitors from all over the world by providing enjoyable service and by instilling confidence to its customers with clean and health air.

In 2014, Google announced Smart Home, merging NEST, a start-up home automation producer of programmable, self-learning, sensor-driven, Wi-Fi-enabled thermostats and security systems. Daikin felt a strong threatening and asked itself: is this the begin of Daikin becoming an outsourcing air conditioning vendor if Google AIoT cloud home platform has its way?

In 2016, Daikin consolidated cross-department consensus and transformed air-conditioning into solution business that focuses on co-creating customer value. Foreseeing AIoT would eventually takes control the existing central management in each business building, Daikin designed its own AIoT smart service boxes to cut into

market. The Retrofit System that includes customer experience was offered in spring, 2016, exclaiming 13~15% less electricity expense by replacing compressor and control board to continue enjoying comfortable, energy saving and long-term guarantee. It was a huge success in Europe and mid-East since the beginning of 2018.

Daikin has invested over ten billions in 2016 and opened it Technology Innovation Center. Besides keep maintaining its advantage in air-conditioning technology, it aims to train and cultivate AI talent and established Daikin Global Platform. By aligning with other office equipment companies, it intends to embrace AWS, open AC data and continue to create service that can rightfully keep its customers happy for many years to come.

4. Implication for Manufacturing Transformation

In our new book ”Facing the future of Smart Manufacturer”, we promote the concept of Lean Smart Manufacturing solution platform that emphasizes the importance of creating value for customer. Not only does this echo the global reshoring, but it also helps break the current dilemma for manufacturing industry.

Leading by GAFA, many internet platform enterprises, such as the unmanned warehouse from Google Robotics, do put up eye-popping numbers in big data and AI application on the market side; however, they barely inspired smart manufacturing. With internet platform enterprises reaching their hands in channel and branding, it has slowly killed the differentiation in manufacturing and helped bring down the product pricing, as well as the industry salaries.

The same threat that dawn on Daikin in 2014 also challenges the many leading enterprise in US, Japan, Korea and Taiwan. The crisis awareness led Daikin to transforming into solution business has lifted the bar higher for other platform vendors to cut into the existing market share. How manufacturing enterprises can compete with the internet cross-platform enterprises and how they can maintain its existing advantage in differentiation remains an interesting topic for discussion.

5. Taiwanese Manufacturer’s Challenge

For Taiwan manufacturing enterprises, we have three suggestions.(Liu et al., 2018) First, they need to continue the advantage in manufacturing network and to provide solutions with effectiveness. Taiwan mother factory, such as Foxconn, Tongtai Machine & Tool Co., and Giant Manufacturing Co. can continue increasing its lean manufacturing and optimizing its cross-network, cross-countries manufacturing network. Second, the companies such as TSMC, Advantech Co., Hiwin, they need to raise higher the bar so their competitors cannot easily copy their product and service platform. Third, they should develop a solution business, especially through the lean

customized capability to solve customer distress and achieve high profits.

The first and second are long-term advantages Taiwan has developed over the years; however, Taiwan is also facing keen competition from China and other third countries. This has made our third suggestion even more important and crucial. Revolution and transformation are complicated and it takes time and effort, but it is the most assured development that is profitable while maintaining the competiveness in the long run.

The global lead manufacturing tells us, that this is only the beginning of IoT era in real site factory. The execution of lead manufacturing solution platform is yet to be explored and developed. Our new publication aims to introduce the direction and the first step in manufacturing, development and customization for lean smart business solution transformation. We hope to light the flame to create global smart manufacturing opportunity.