Innovative ideas: Thailand 4.0 and the fourth industrial revolution

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Abstract

Thailand 4.0 is a new ‘buzzword’ for many things just now being defined. It also appears to mean many things to many people, but the majority of Thai citizens surveyed fail to grasp just what it is. In the simplest of terms, it seems to be a Thai government policy in which technology and innovation are proposed tools for boosting the quality of life. Thailand 4.0 is also targeted at 10 key economic sectors and their supporting research from US$1 billion in funding for 12,290 new PhDs. This research therefore investigated the legacy of proceeding Thailand 1.0, 2.0, and 3.0, the use of the S-curve to describe their implementations, educational objectives to support Thailand 4.0, the digital/e-commerce agenda, agribusiness and ‘smart farmers’, how to learn from unicorns, and what is meant by ‘next generation automotive’ under Thailand 4.0.

Keywords: agribusiness, automotive sector, digital, e-commerce, Fourth Industrial Revolution (4IR), Industry 4.0, next generation automotive, S-curve, unicorns

Introduction

*Thailand 4.0 and the Fourth Industrial Revolution (4IR)*

In an early 2017 survey conducted on a sample size of 1,033 Thais by Dhurakij Pundit University, it was disclosed that 59.66% knew nothing of what is being touted by the current Thai government as Thailand 4.0 (“Most Thais not understand ‘Thailand 4.0’, 2017). So, the question is, “What is Thailand 4.0”?

The simple answer is the Thailand 4.0 agenda is an economic model based on creativity, innovation, new technology and high-quality services (Bussi & Khatiwada, 2017), which is used to boost the quality of life. Thailand 4.0 is however the next step in the evolution of Thailand’s development, with Thailand 1.0 (*agriculture*) having been farmer mechanization and increased yields for agriculture, Thailand 2.0 (*light industry*) used cheap labour to turn raw materials into finished goods for production and manufacturing such as textiles and garments, Thailand 3.0 (*advanced industry*) was the assembly and production of products such as computer disk drives,
electrical components, compressors, and automobiles for export (Figure 1) (Rojniruttikul & Rodchom, 2014), while Thailand 4.0 *(fourth industrial revolution-4IR)* will be focused on turning Thailand’s labor force into ‘knowledge workers’ across 10 key economic sectors *(Thailand Investment Review, 2017; Thailand’s 20-Year National Strategy and Thailand 4.0 Policy, 2016; Figure 2).*

![Figure 1. Innovation S-curves from Thailand 1.0 through Thailand 3.0](image)

*Figure 1. Innovation S-curves from Thailand 1.0 through Thailand 3.0*

*Source: Jones and Paitoon (2017)*

The process to achieve this according to Thailand’s Prime Minister Prayut Chan-o-cha is to explore the usage of science, technology and innovation to boost the country's economy, focusing on industrial and agricultural sectors, medical technology and public health, together with the global trend for a robotics industry (Wipatayotin, 2017). Further challenges however will be overcoming “a middle- income trap”, “an inequality trap”, and “an imbalanced trap” (Thai Embassy- Washington, D.C., 2017).
Also, according to the Thai Embassy website in Washington, D.C., Thailand 4.0 will over come these traps through the use of “New Growth Engines” by:

1) Building economic prosperity through innovation, knowledge, technology, and creativity. This creates a “competitive growth engine” to unlock individuals from the middle-income trap.

2) Building social security through equitable distribution of income, opportunity, and wealth, operating under a principle of “moving forward together without leaving anyone behind” to unlock Thai citizens from the inequality trap.

3) Creating sustainability through environmentally friendly development (Green Growth Engine), to unlock Thai citizens from an imbalance trap.

The model follows the directions of the 20 years’ national strategic plan by building strength from within and connecting the country to the global community under the principle of Sufficiency Philosophy (The Chaipattana Foundation, 2017), which is consistent with the United Nations’ Sustainable Development Goals (also referred to as Global Goals) (UNDP, 2017).

**Thailand’s Digital World**

In the steps to embrace a sustainable, value-based economy, building digital communities, creating digital innovative start-up networks, and establishing digital parks (or clusters) for small and medium-sized enterprises (SMEs) (Koanantakool, 2016; Sangwanna & Pupat, 2014), has become a Thai government priority (Tortermvasana, 2016). This is easy to understand knowing there are 2.7 million Thai SMEs which account for 98% of all business units in
Thailand, which also account for 37% of GDP (Thai GDP in 2014 was US$374 billion), 25% of exports, and which provided for over 11 million jobs in 2015 (Thailand Investment Review, 2015 October; Limsmaraphumph, 2016). Information and communication technology (ICT) therefore, is one of key drivers of national development, and to support this, over 6,000 computer science graduate students are presently enrolled in Thai institutions. These individuals will be critical in the transition to a knowledge-based economy required under Thailand 4.0 implementation.

Furthermore, Tan (2016) has indicated that a 20% investment in ICT contributes 1% to gross domestic production (GDP), a 2.1% increase in competitiveness, a 2.2% increase in innovation, and a 2.3% in productivity. The effective use of ICT can also improve life quality, reduce educational gaps, and raise efficiency in industrial production and government service provisioning (Thailand Science Technology and Innovation Profile, 2014).

However, shortages of industry-ready skilled workers present one of the biggest challenges for the five core member countries of the Association of Southeast Asian Nations, ASEAN-5, as they strive to realize their economic visions (Tan & Tang, 2016). Disruptive technologies also threaten to render jobs obsolete in many industries, including those in information and communications technology (ICT).

To offset these problems and professionally staff the environments and educational institutions necessary for sustainable growth, and as part of the Thailand 4.0 initiative to support 10 key economic sectors (Figure 2), the Thai government has also announced plans to budget US$ 1 billion for 12,290 doctoral researchers to serve the country's industrial development and serve human resource development needs over the next 20 years ("Govt designs 20-year plan", 2016). To put this goal in perspective, only 1,295 individuals enrolled in science and technology PhD programs in 2013 (Figure 3), as compared to 2,138 doctoral candidates in Thai university social sciences and humanities programs (Thailand Science Technology and Innovation Profile, 2014).
The Thailand 4.0 PhD sponsorship campaign is part of the Royal Golden Jubilee (RGJ) PhD Programme, which since 1996 has been under the auspices of the Thailand Research Fund (TRF). In 2014, Thailand had 9.5 doctoral researchers per 10,000 people, which the present government wishes to increase to 80 researchers per 10,000 people by 2036 (“Govt designs 20-year plan”, 2016). Also, according to a 50-nation digital economy study from Huawei Technologies, Thailand only has one IT worker per capita, as compared to the study average of 3.18 workers (Tan, 2016). It seems both Thai academic and ICT professional human resource development needs serious improvement to meet the goals set forth in Thailand 4.0.

In Thailand, the National Economic and Social Development Plan (NESDP) serves as the roadmap for economic development with the 12th Plan (2017 – 2021) aiming to transform, upgrade, and increase the R&D focus of key domestic industries, including automotive, agriculture, food manufacturing, tourism, and hospitality (Kumpa, 2016; Tan & Tang, 2016). The information and communications technology (ICT) and the education sectors will be instrumental in providing the physical and digital infrastructure, as well as the human capital needed to support the transformation. This is consistent with Numprasertchai and Igel (2005)
which concluded that ICT communication, collaboration, and storage technologies, are essential tools for collaboration within Thai university research environments.

Unfortunately, although ICT expenditure accounted for 7% of Thai GDP in 2015, of the projected annual requirement of 6,000 - 7,000 Thai ICT professionals, only 10% of the ICT graduates are considered employable according to interviews conducted with Association of Thai ICT Industry members (Tan & Tang, 2016). This is a major reason that the Thai government has singled out human capital development as a key focus of the 12th NESDP 2017-2022, and implemented other plans such as the STEM Masterplan 2015 (ATPAC, 2015; World Bank, 2016).

Learning from Unicorns

As businesses have to take a long hard look in the mirror to consider how to best exploit digital transformation, they may want to look to the ‘unicorns’ in technology disruption for guidance. Unicorns in this case are not mythical, one-horned horses, but instead recent start-ups that already have an implied valuation in excess of $US1billion (Carter, 2015). These are the companies such as Space X, Uber, and Snapchat, that have completely built their business models around constant technological disruption (Figure 4). Their level of investment and commitment to IT many seem unattainable or even mythical to the ‘horses’ in the traditional business world, but a horse can learn from the unicorn.

![Figure 4. The digital unicorn](image)

Source: G. P. Bullhound (2016)

Under Thailand 4.0 the Thai government is proposing ways to learn from the
unicorns (“Learning from Unicorns”, 2017), by implementing critical factors such as personalized marketing with customer insights, delivering customer-driven innovation products, and staying abreast of changes and the latest trends in consumer behaviour. A unicorn enterprise is a pioneering business that truly represents the evolving global digital economy. These are businesses whose meteoric successes aren’t predicated on advertising, but instead on customer centric, product or service developments (Farnhill, 2016). According to G. P. Bullhound (2016), Europe has a total of 47 ‘start-up’ unicorns worth more than US$1 billion each. These businesses have disrupted their sectors with their transformational customer centric approaches. They commit time, energy, and cash to optimizing their service performance as opposed to just broadcasting what they do. The strongest sectors are e-Commerce, Software, and Marketplace, representing 64% of the total number of European unicorns. Augmented Reality/Virtual Reality is an emerging sector, producing two of 2016’s new unicorns. The Software sector increased its share from 20% in 2015 to 26% in 2016. It is now Europe’s dominant specialism.

In Bangkok, Thailand in March 2017 a conference, "Thailand's Startups: Learning from Unicorns" (Sattaburuth, 2017) was held in which a Thai government official outlined three key measures necessary for the development of startups. They are presented in Table 1.

Table 1

Jump-starting Thai start-ups

<table>
<thead>
<tr>
<th>Jump-starting the Start-Ups</th>
<th>Objectives/Measures</th>
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<tbody>
<tr>
<td>Provide financial support for startups.</td>
<td>Create ‘angel funds’ which are investment funds provided by an angel investment network of affluent investors to help with funding support and carry the startup entrepreneurs through their difficult early stages. Investors in business startups and entrepreneurs will be granted tax exemptions during the first six years of their businesses. Create a hub for startup investment in accordance with the government’s Thailand 4.0 policy, which seeks to steer the country toward a digital economy through innovation and the increased use of technology.</td>
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| **Boost the capabilities of startups.** | The Thai government will work with universities and other learning centers to help support small startups.  
The Thai government will also encourage universities to set up venture capital agencies and innovation-driven entrepreneurship centers for startups in the private sector.  
New learning environments are to be created which promotes analytical-thinking skills of students and workers, and creating environments conducive to supporting startups.  
Focus on building strength from within by grooming human resources to be well-equipped to meet the challenges of the 21st century. |
| Connect startups to communities, regions, and the global community. | The Thai government will connect startups with regional and global communities by introducing special visas, therefore facilitating the travel of startup entrepreneurs, and inviting foreign startup experts to impart their knowledge and transfer technology to local entrepreneurs.  
New ecosystems must be created for businesses and investments, along with new kinds of collaboration and innovation if more startups are to get off the ground successfully. |

Traditionally, it has been venture capital groups that back these early stage companies, which profit when their companies go public. Today, there are more and more non-traditional investors participating, which include pension funds, mutual funds, hedge funds, sovereign wealth funds, as well as private equity in unicorns. This, in part, explains the success of a high number of unicorns worldwide, but is Thailand ready for its own unicorn and where will the skilled labor come from to support it?

*Industry 4.0 (Industrial Internet of Things-IIOT)*

As mentioned previously, many new terms are used in any discussion of what the Thai government has labelled Thailand 4.0. Two of the terms tightly linked to Thailand 4.0 is Industry 4.0 and IIOT (“Tokyo government”, 2017; Clark, 2017). So, what is Industry 4.0 or IIOT?

Industry 4.0 and IIOT are the outgrowths and continuation of Britain’s first industrial revolution, which today is now preparing itself to adopt and adapt to the fourth industrial revolution (4IR), - driven by digital data, connectivity, and cyber systems (McGregor, 2017). This 4IR, or ‘Industry 4.0/IIOT” has the potential to create impressive, new, and sometimes unimaginable business opportunities for those who are innovative and agile and adopt ‘smart manufacturing’.
Using digital technologies such as artificial intelligence, sensor technologies and automation, makes companies more agile and better equipped to respond to or even act ahead of the quick pace of changing consumer demands, supplier conditions and technology availability. And in today’s world, agile makes competitive.

Countries with deeper talent pools and higher productivity however are capturing a growing share of Industry 4.0’s manufacturing investment. In the United Kingdom over the past three years, government investment in 4IR solutions has exceeded £200 million in transformative digital technologies such as (Oracle, 2017):

- Additive manufacturing.
- Robotics and autonomous systems.
- Modelling and simulation.
- Augmented and virtual reality.
- Data analytics.
- Artificial intelligence.

Under the ‘smart cities’ Industry 4.0 initiative, the Tokyo Metropolitan Government (TMG) is stepping up its efforts to attract what it describes as 4IR companies to the city, while simultaneously establishing English speaking regulatory and support offices. Segments included in this initiative include companies in the areas of Internet of Things (IoT), big data and artificial intelligence (AI), and foreign financial corporations (“Tokyo government”, 2017).

To help with the measurement of Industry 4.0, the German national academy of science and engineering has contributed to the development of the Industrie 4.0 Maturity Index that will enable companies to assess their current Industrie 4.0 capabilities and map out a structured digital roadmap that includes steps and capabilities needed to realize its value potential. The Index also will provide a unique multidimensional assessment that covers production and logistics, research and development, service, and sales and marketing. The Readiness Model is the foundation for a self-assessment and comparison. The Online Self-Check developed for this purpose gives companies the ability to check their own Industry 4.0 readiness (Industrie 4.0, 2017).
Since Thailand’s manufacturing sector accounts for over 30% of Thailand's US$395 billion (13.6 trillion baht) GDP and employs 6.2 million people in it (Bussi & Khatiwada, 2017), the stakes are huge in Thailand’s ability and willingness to adopt these rapid changes.

**Thailand’s Agribusiness Sector (Smart Farmers)**

Since Thailand 1.0, there has always been a government focus on agricultural production, which in 2015 contributed 23% to Thailand’s gross domestic product (GDP) and US$25.5 billion in exports, which consisted of rice (17.1%), sugar (8.6%), chicken (7.8%), tuna (7.5%), and shrimp (6.3%) (Thailand Investment Review, 2016 July).

As *Kitchen to the World* and under Thailand 4.0, the focus is being shifted to increase the farmer’s ‘life quality’ however (Wipatayotin, 2017). Also, under the Thailand 4.0 model, emphasis will be given to upgrading small and medium sized enterprises (SMEs) and ushering in an era of *smart farmers* who can make the most of advances in technology to prosper (Sattaburuth, 2017). Additionally, according to Thailand’s Prime Minister Prayut Chan-o-cha, Thailand 4.0 is a great opportunity for labourers and farmers to develop and improve their career paths to obtain higher incomes and a better quality of life.

To achieve these high goals, Prime Minister Prayut in a speech at a March 2017 Kasetsart University conference entitled ‘Mobilising Thailand 4.0: Agriculture, Food and Biotechnology’,
stated that the Ministry of Agriculture and Cooperatives is the key to helping farmers learn how to adapt by changing traditional ways of farming to technology-led cultivation through more than 2,000 learning centers countrywide and that farmers should have proper plantations in line with soil quality and geographic locations suggested by the "Agri-Map" developed by the ministry (Agri-Map, 2017; Wipatayotin, 2017).

Furthermore, the Ministry of Agriculture and Cooperatives has been working to promote a change of farming patterns by upgrading farmers to "smart farmers", who can use technology for their plantations and sell products on the market for better prices. General Prayut said Thailand 4.0 will not leave anyone behind as "all walks of life go together", but people must learn and adapt to live with technology and make use of it. Labourers must not be replaced by robots, but they should develop labour skills with the ability to speak foreign languages. They all need to adapt and develop to be "smart people".

The Thai government recognizes the importance of food innovation with the Finance Ministry proposing establishing a US$ 283.8 million fund to support the Food Innopolis Project at the Thailand Science Park (TSP) (Figure 6). This project aims to position Thailand as a global food innovation hub and with Ministry of Science and Technology coordination, plans to use the Food Innopolis Project as a hub for 3,000 researchers, 10,000 students in Food Science and Technology programs, 9,000 food factories, 150 food research laboratories, 20 pilot plants, and 70 universities (Thailand Investment Review, 2016 July).

![Figure 6. Food Innopolis Project at the Thailand Science Park (TSP)](image-url)
It is interesting to note that these goals seem to mirror earlier words from Thailand’s richest man, billionaire Dhanin Chearavanont and CEO of Charoen Pokphand Group (CP Group) on CNBC Managing Asia in December 2012 (CNBC, 2012), in which he stated “CP’s success is due to the use of technology” (American in particular), as well as helping locals gain access to modern methods of farming (8:00), modern farming management (16:20), and through the use of technology, farmers work less and improve their income and by extension, ‘life quality’. Wise words from a wise man.

Next Generation Automotive (NGA)

Within Thailand’s maturing automotive industry (Thailand 3.0), there are approximately 2,400 companies employing over half a million ‘technology’ workers (Figure 7), which in 2013 accounted for approximately 12% of the Thai GDP (ASEAN UP, 2016).

![Structure of Thai Automotive Industry](image_path)

**Figure 7. Thailand’s automotive Tier 1 – 3 manufacturers and suppliers**

In recent years (Figure 8), however the road has been bumpy, with production numbers significantly lower than the peak years of 2012 (2,462,000 vehicles) and 2013 (2,458,000 vehicles) (Yongpisanphob, 2016), having dropped to 1,944,417 vehicles in 2016 (MarkLines, 2016). To turn this significant decline around, various schemes have been proposed, including green automotive production including hybrid and electric vehicle technologies (Board of
Investment, 2014). Under the label ‘eco-car’, Thailand set out a bold plan, which in 2017 is having difficulties at meeting the plan’s targets for each of the manufactures participating in the scheme (Maikaew, 2017).

Prime Minister Gen Prayut Chan-o-cha therefore met with top executives of Japanese auto makers in March 2016 and outlined new plans that would pave way for the manufacturing of high-technology electric and hydrogen-driven vehicles (“Thailand pushes for next-generation automotive”, 2016), as well as low-emission vehicles powered ethanol and biodiesel. which under Thailand 4.0 is now referred to as Next Generation Automotive.

![Figure 8. Thai Automobile Production and Sales 2000-2015](image-url)

Although the eco-cars program has stalled due to the requirements for large investments (Maikaew, 2017) and weak domestic demand (Yongpisangphob, 2016), the good news is that in March 2017, Thailand’s Federation of Thai Industries (FTI) reported that domestic car sales rose by 19.9% year-on-year in February 2017 to 68,435 units, and on a monthly basis, the figure increased 19.5% from 57,254 units in January (Maikaew, 2017). For the world’s 12th largest automotive producer, this is great news! The passenger car segment also rose by 59.8% year-on-year to 26,702 units, with sales of pickup trucks and big trucks also rising by 15% and 12.3% to 30,348 and 2,300 units respectively. For the first two months of 2017, domestic car sales amounted to 125,689 units, up by 15.4% from the same period in 2016.
E-commerce and SMEs

Retailers are quickly embracing the ideas contained in Thailand 4.0, with one of the best examples being China’s Alibaba Lazada Group subsidiary, which in March 2017 celebrated their 5th anniversary in Thailand, while also becoming the ASEAN (Association of Southeast Asian Nations) e-commerce market leader in Indonesia, Malaysia, the Philippines, Thailand, and Vietnam (Borderless Business, 2017).

Alibaba has also signed a letter of intent with the Thai government to help Thailand reach the Thailand 4.0 economic model sooner. Part of the agreement entails providing digital marketing training to 30,000 local small and medium-sized enterprises (SMEs) to raise their online capabilities (Leesa-nguansuk, 2017), which is expected to grow from 67 billion baht (US$1.9 billion) in 2016 to 87 billion baht (US$2.5 billion) in 2017. Main reasons for this explosion in e-commerce is Thailand proliferation of mobile devices and smartphones, as well as nationwide high-speed wireless connectivity. Thailand’s e-commerce market is expected to account for 5% of total retail sales over the next five years, up from less than 1% of retail sales currently. As a comparison statistic, South Korean e-commerce accounts for 14% of retail sales which totalled US $36.76 billion in 2015.

The ‘S-Curve’ Industries

As stated previously, the Thailand 4.0 development plan is focused on 10 targeted industries, 5 of which are classified as existing industries (First S-Curve), with another 5 industries classified as new industries (New S-Curve) (Thailand Investment Review, 2017; Tantivorawong, 2015). This transformative shift is depicted in Figure 9 (Maesincee, 2016).
Figure 9. Thailand’s 4.0 industry transformative shift

First S-Curve Industries (Table 2)

1. Next Generation Automotive
2. Smart Electronics
3. Affluent, Medical and Wellness Tourism
4. Agricultural and Biotechnology
5. Food for the Future (food innovation)

New S-Curve Industries (Sibunruang, 2015)
Table 2. Thailand 4.0 future industry development targets

<table>
<thead>
<tr>
<th>Thailand 4.0 new S-curve industries</th>
<th>Components</th>
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<tbody>
<tr>
<td>Robotics</td>
<td>Robots for the automotive, plastics, medical, &amp; electronic industries. Robots for underwater support (Remotely Operated Underwater Vehicles-ROVs)</td>
</tr>
<tr>
<td>Aviation &amp; Logistics</td>
<td>Transport services – Modern logistics service centers – Aviation maintenance, repair, &amp; overhaul (MRO) – Manufacture of aviation parts (OEM) – High Value Business with time sensitive products – Aviation Training Centers</td>
</tr>
<tr>
<td>Medical Hub</td>
<td>Telemedicine – Consulting, diagnosis, &amp; testament – Remote health monitoring device manufacturing – Biologics &amp; Biosimilars</td>
</tr>
<tr>
<td>Biofuels &amp; Bio chemicals</td>
<td>2nd generation biofuels – Development of the biochemical industry midstream sector – bioplastics - Bio Economy</td>
</tr>
</tbody>
</table>

What is an S-curve?

Much of the Thailand 4.0 information being provided by government officials refers to something called a S-curve. So, what is the S-curve?

The S-Curve is a measure of the speed of adoption of an innovation, which was first discussed in 1903 by Jean-Gabriel De Tarde, who first plotted the S-shaped diffusion curve (Kumar & Phrommathed, 2006). The S-curve represents (Figure 9) an area just over the first half of a bell curve, in which growth turns to maturity and then declines (Nunes & Breene, 2011). For businesses, an S-curve is often times used to describe the evolution of technologies.
**Figure 10. S-shaped diffusion curve**

*Thailand 4.0’s Objectives*

According to the Thai Embassy web site in Washington, D.C., the four stated objectives of Thailand 4.0 are as follows:

1. **Economic Prosperity**: to create a value-based economy that is driven by innovation, technology and creativity. *The model aims to increase Research and Development (“R&D”) expenditure to 4% of GDP*, increase economic growth rate to full capacity rate of 5-6% within 5 years, and increase national income per capita from 5,470 USD in 2014 to 15,000 USD by 2032.

2. **Social Well-being**: to create a society that moves forward without leaving anyone behind (inclusive society) through realization of the full potential of all members of society. The goals are to reduce social disparity from 0.465 in 2013 to 0.36 in 2032, *completely transform to social welfare system within 20 years* and develop at least *20,000 households into “Smart Farmers” within 5 years.*

3. **Raising Human Values**: to transform Thais into “Competent human beings in the 21st Century” and “Thais 4.0 in the first world. Measures under Thailand 4.0 will raise Thailand HDI from 0.722 to 0.8 or the top 50 countries within 10 years, *ensure that at least 5 Thai universities are ranked amongst the world’s top 100 higher education institution within 20 years.*
4. **Environmental Protection**: to become a livable society that possesses an economic system capable of adjusting to climate change and low carbon society. The targets are to develop at least 10 cities into the world’s most livable cities, and reduce terrorism risk.

**Conclusion**

Thailand 4.0 is noble and inspired. It however has a very tall mountain to climb to realize its lofty goals. Fundamentals across all supporting aspects for the program leave many questions that need to be explored and answered. Key pillars of the program such as skilled-worker education open a Pandora’s Box of unanswered questions. Innovation and creativity require individuals capable of critical thinking skills. Communications skills are required as well, but by definition, this requires the ability and willingness to ask questions. Lack of foreign language and culture skills are consistent problems across all sectors and at all levels.

From the research, it was determined that Thailand 4.0 is a ‘catch-all’ for many new and transformational ideas. Added to the lack of understanding concerning what Thailand 4.0 is, are new terms (to many in Thailand) such as angel funds, Industry 4.0, unicorns, next generation automotive, and smart farmers. Some of the definitions thus far are either unstated, unclear, or open to interpretation.

Also, the answer to the concerns as to who is going to pay for all these ideas seems to be ambiguous as well. The Thai government has supposedly budgeted US$ billion for the 12,290 new PhD researchers, but where is the funding coming from for the smart farmers’ 2,000 countrywide learning centers?

Furthermore, according to a recent International Labour Organisation (ILO) report on transformative changes across Asean countries, it was stated that three in five jobs in the region will face "a high risk of automation" (Bussi & Khatiwada, 2017). Also, the kingdom's birth-rate has fallen dramatically from seven children per woman in the 1970s to just 1.5 children today. It's also the third-most-rapidly aging society in the world, making it one of the countries facing the daunting challenge of a shrinking labour pool coupled with a greying population.

For decades, investment in research and development (R&D) has been modest at just 0.2-0.3% of GDP. Vietnam, by comparison, has set a target of 2% R&D spending by 2020 (Bussi & Khatiwada, 2017). Typically, only the biggest players in Thai industry have taken on
the financial risk to invest in R&D to accelerate innovation. Thailand's scarcity of advanced researchers remains a challenge but steps appear to be underway to relieve this pressure (“Govt designs 20-year plan”, 2016).

There does however seem to be a focus that funding is expected to come from the private sector, such as the unicorn start-ups (Table 1). Foreign direct investment (FDI) in Thailand is also an obvious key for helping finance Thailand 4.0 as well, but statistics from the Bank of Thailand (BOT) and Thailand’s Board of Investment leave researchers scratching their heads trying to interrupt whose statistics to believe (Fernquest, 2016). However, if one takes the side of the BOT and believe FDI has significantly declined, the reasons given by the BOT are rising wages and lagging technology.

It seems at the end of the day, no matter how much money is thrown at Thailand 4.0 (Industry 4.0 / Fourth Industrial Revolution), without skilled workers, researchers, engineers, technicians, and teachers to implement the unicorns, educate the smart farmers, or SME digital entrepreneurs, the whole plan falls apart. Is the house therefore being built on a foundation of shifting sand, or solidly laid stone? Only time will tell.
References


APPENDIX 1: Five Agendas for Thailand 4.0

Agenda 1: Prepare Thais 4.0 for Thailand becoming a first world nation

The most important element in the development of Thailand 4.0 is Thai people. The model aims to transform Thais into more competent human beings in the 21st century and develop Thais 4.0 as first world citizens through the following measures:

1. Reform education system to prepare Thais for Thailand becoming a first world nation: by transforming learning ecosystem to purposeful learning, generative learning, mindful learning, and result-based learning. These shifts will lead to changes in goals and administration of the education system, teachers’ skills and teaching paradigm, curriculum and teaching/learning methods.

2. Setup skills development program: the transformation to industry 4.0 will replace routine jobs with robotics and automation. Therefore, it is necessary to develop new skills that better support Non-Routine/Non-Repetitive/Task specific/Project-based jobs. The government will set up a system to integrate education, training, and occupation development for Thais to adjust to changes and allow them to set their future paths. Measures under this sub-agenda include alternatives for education, training and occupation development, development of educational and training systems, and development of skills to meet the demands of the industrial sector.

3. Measures to support Refill and Reform strategy to improve the status of Thais 1.0-2.0: Development of Thais 4.0 is based upon unlocking individual limitation. Thais 1.0 and 2.0 are those who caught up in the cycle of poverty and lack opportunities. Thais 3.0 or Thais who earn moderate income but still lack security. Under Thailand 4.0, the government will help to develop Thais 4.0 who have potentials and high-level of preparedness through provision of financial supports, building and promoting social opportunities, and developing area-base mechanism.

Agenda 2: Development of Technology Cluster and Future Industries

In order to transform Thailand’s comparative advantage into competitive advantage through knowledge, technology, and innovation, a long term goal to develop 10 Future Industries (First S-Curve and New S-Curve) has been set by the government.

The First S-Curves: Building upon 5 old industries that already have solid foundation but still require further innovative improvement and research and development to add value and keep up with competition in the global field (Next Generation Automotive, Smart Electronics, Affluent, Medical and Wellness Tourism, Agricultural and Biotechnology, Food for the Future)
The New S-Curves: developing the 5 new industries to enhance their capabilities to support future competitiveness (Robotics, Aviation and Logistics, Biofuels & Biochemical, Digital, Medical Hub)

⇒ In order to attract high-valued investments in the 10 future industries, the government has amended the Investment Promotion Act B.E. 2520 and endorsed the draft National Competitiveness Enhancement for Targeted Industries Act to give more benefits from investors, such as corporate tax exemption up to 13 years for business using advanced technology and innovation, or conducting R&D activities; import duty exemption for machine and raw materials; etc.

⇒ Thailand 4.0 is an engine to propel new economic growth through transformation of “comparative advantage” into “competitive advantage”. This approach will fulfill the country with knowledge, creativity, innovation, science, technology, research and innovation, and build upon comparative advantage with “5 Groups of Technology and Targeted Industries” which comprises of:

1. Food, Agriculture and Bio-Tech: building a stable economy base on biodiversity and environmentally friendly biotechnology and moving Thailand toward becoming the center of premium agricultural products and food, and an exporter of technology in agriculture, seeds, vaccine.

2. Health, Wellness and Biomedical: building medical infrastructure and move Thailand forward to be “Medical Hub” of ASEAN within 2025.

3. Smart Devices and Robotics – Mechatronics: moving Thailand forward to advance as a leader in automatic system, industrial robotics, and service robotics in ASEAN.

4. Digital, Internet of Things (IoT), Artificial Intelligence and Embedded Technology: using digital tools and IoT as platforms to enhance productivity, quality and innovation in various economic activities within agriculture, industrial, service and education sectors.

5. Creativity, Culture and High-Value Services: undertaking actions that synergize basic cultural assets, innovation and technology in order to increase commercial value and ultimately enable Thailand to move forward in becoming one of ASEAN’s “Creative hubs” within the next ten years.

⇒ The “5 technology and targeted industries” will be transformed into “integrated research” in order to provide possible solutions to challenges that may arise at the national and global levels, as well as identify business opportunities for the private. At the initial stage, the government will pursue the following five agendas:

1. Integrated research on Food and Agriculture
2. Integrated research on Energy
3. Integrated research on Aging Societies
4. Integrated research on Smart Cities
5. Integrated research on Creative Economy

Tools to propel the 5 technology clusters and targeted industries

1. Demand for knowledgeable and highly-skilled manpower in the industries: such as agricultural engineers, biomedical engineers, robotic technicians and fashion designers.

2. Reform of Thai research system: The following reforms will be undertaken to allow development in the 5 key technological and industrial groups to take place:

♦Change the research ecosystem: by restructuring the function of funding institutions in order to enable a clear direction in the function and duties of all funding agencies by focusing on improving country’s business and research related to area-based and community development, and restructuring research organizations to be independent from political influence.

♦University 4.0: universities will be transformed to embrace know-how and ideas of University 4.0 by adapting their administrative paradigm and the investment in human resources and giving more priority to serve the objectives of society. Universities will serve as bases for developing technology and innovation reform, and building cooperation with leading international universities in each specific research field.

♦Measures to propel national research: by creating a network alliance to propel basic and applied research to national and international level, putting a research fund for innovation development in place to continue transnational research, allowing tax exemptions on the import of materials for research.

Agenda 3: Incubate Entrepreneurs and Develop Networks of Innovation-Driven Enterprise

The 5 technology cluster, as well as newly-emerging industries will support entrepreneurs and networks of innovation – driven enterprises through the following developments:

1. A shift from traditional farmers to” Smart Farmer” who focus on management and technology and have the ability to convert themselves into a modern agricultural business model. Development of ecosystem for smart farmers will include educational and training, study and career support funds, database and agricultural information system development.

2. A transformation of traditional SMEs into “Smart SMEs” Thailand 4.0 aims to increase the revenue and contribution of SMEs from 37% of total GDP to 50% of national GDP within 10 years. The Government plans to develop SMEs through financial support for SMEs that have potential but lack of financial liquid, develop knowledge and management skills, enhance digital transformation, create Big Data and develop open innovation for SMEs.

3. A switch from traditional services to “High Value Services” Thailand is internationally recognized in 6 service businesses; (1) Wellness & medical services: spa and beauty services, elderly care, medical services (2) Digital content services: movie industry, advertising, animation, gaming, and software (3) Hospitality services: tourism service, hotel management, reception services, event organizations (4) Education services (5) Professional services: designers, accountants, lawyers, consultants, doctors, dentists, IT developers and (6) Logistics services: logistics, distribution centers, IT logistics, postal services. Several measures are set
enhance competitiveness of these 6 services cluster, for example, investment promotions, establishment of Service Innopolis, build global collaborative and market networks.

4. Startup development promotion Thailand 4.0 has set the policy to support startups development at all stages with the policy to push Thailand towards becoming “Center of Connectivity and Destination for Startup Investment in ASEAN” by encouraging competition for business ideas, providing clear and strong incentives to angel and venture investors, undertaking policies to support incubation and growth of startups and establishing stock exchanges for startups to sell the equity of successful startups to interested investors.

Moreover, 3 measures have been set in order to build ecosystems for incubating startups. Such measures include (1) financial support and risk management measures, (2) Capacity-Building Measures for Thai startups, and (3) Building connectivity with the regional and global community.

**Agenda 4: Strengthening the Internal Economy through the Mechanisms of 18 Provincial Clusters and 76 Provinces**

Thailand 4.0 will strengthen the internal economy by ensuring that the benefits of economic growth spreads to all region, promoting regional employment and regional investment, and ensuring equal distribution of economic benefits in order to promote competition and reduce social inequality;

1. Strengthening the Economic Structure and Internal Market System by (1) creating database on trade and connectivity at both the physical and digital dimensions that can accommodate production and trade, so that farmers, community enterprises and SMEs can have better access to reap benefits at the local, provincial and national level and, (2) setting up “Modern trade rules under Thailand 4.0” that are appropriate and fair regulatory regime in order to assist SMEs, as well as social enterprises, to gain access to free market.

2. Strategies and Guidelines for 18 Provincial Clusters The Government has set a strategic economic position of the 18 provincial clusters as follows:

Upper Northern Region 1: Creative Cluster and Agricultural and Food Innopolis

Upper Northern Region 2: Gateway to GMS and ASEAN+3 and Green Tourism Destination

Lower Northern Region 1: Indo-China Trade and Service Center and Gateway to Myanmar

Lower Northern Region 2: Rice Business Center and Heritage Tourism Destination

Upper Northeastern Region 1: GMS Trading Center and Gateway to Eastern ASEAN & China

Upper Northeastern Region 2: Agricultural and Livestock Center and Northeastern Green Tourism Destination

Middle Northeastern Region: Northeastern Agricultural Food Innopolis and Logistics Hub

Lower Northeastern Region 1: Khmer Civilization and Sport Creative Cluster and Agricultural Trading Center
Lower Northeastern Region 2: World Jasmine Rice Production Center and Gateway to Eastern ASEAN

Upper Central Region 1: Cultural Heritage Tourism Hub and Food Innopolis

Upper Central Region 2: Organic Food Production Base

Middle Central Region: Green Industry Hub, Green Tourism, and Gateway to ASEAN & Global

Lower Central Region 1: Western Creative Tourism and Trade Destination

Lower Central Region 2: Seafood and Agricultural Trade Center and Global Tourism Destination

Eastern Region: Organic Fruits & Clean Industry, and Medical Tourism Destination

Southern Region (Gulf of Thailand): Southern Agricultural Trading Center (Rubber, Oil Palm, Fruits)

Southern Region (Andaman Coast): World Class Tourism, and Creative Cluster – City of Gastronomy

Southern Border Region: Agricultural and Food Innopolis (Rubber, Fishery, Halal Food)

3. Establishment of an Innovation Hub at a regional Level by expanding opportunity and prosperity to the regional level through Innovation Hubs as follows:

⇒ Innovation Hub for Agriculture and Food: aims at the development of “Advanced Bio-Based Economy”, shifting from basic food industry basic petrochemical industry and bio-fuels to neutraceuticals industry, bio-based medicine, specialty chemicals and bio-based plastics with high value in the future.

⇒ Innovation Hub for Aging Society: aim to turn crisis to opportunity by developing an “Elderly Industry” using medical technology as the foundation, and will be supplemented by robotic, digital and other technologies.

⇒ Development of a Smart City: aim to develop five smart cities within ten years using digital technology as the foundation and will be supplemented by other technologies.

⇒ Innovation Hub for Smart Energy: will focus on energy technology as the foundation, and will be supplemented by other technologies such as digital and biotechnology.

⇒ Creative Hub for Creative Economy: will focus on creating value added from a combination of arts, culture, food, design and creativity. The service industry will serve as the foundation, to be supplemented by other technologies such as digital, in order to utilize biodiversity and culture diversity of each location.

4. “Province 4.0” Strategic Plan The “Province 4.0” strategic plan is a social contract for the civil state at the local level (between the governor, commercial officers, industrial officers, chambers of commerce, federations of industry, Young FTI, local BizClub, community leaders, etc). This plan will set out the short term, medium term and long term strategic plans
that connect with the 20 years national strategy. Target groups under this plan are 1) Transformation from enterprise 1.0 – 2.0 to enterprise 3.0 by improvement in productivity and standards, access to funding sources, creation of business networks, 2) Transformation from enterprise 3.0 to enterprise 4.0 by development of innovation and business models, conducting businesses on digital platforms, creation of commercial networks, and 3) Promotion of Local Startups within provinces through financial measures and risk management, building potential and capacity and the development of regional and global connectivity.

**Agenda 5: Integrating with ASEAN and Connecting Thailand to the Global Community**

Against the backdrop of the global geopolitics and geoeconomics of the 21st century, Thailand cannot rely solely on its geographical advantage in Southeast Asia but must position itself on key strategies to become a trading nation and one of Asia’s business centers by achieving four interrelated goals.

1. **Positioning Thailand as a Trading Nation and one of Asia’s Business Centers**

   The key strategies to position Thailand as a trading nation and one of Asia’s business centers consists of four interrelated elements:

   1. Encouraging multinational corporations to establish international headquarters (IHQ) and international trading centers (ITC) in Thailand, especially in the service sector, financial management, purchasing and procurement, raw materials and components.

   2. Developing the Eastern Economic Corridor (EEC) which covers three eastern provinces; Chachoengsao, Chonburi and Rayong that will connect with ASEAN-China-India through world-class infrastructure, including roads, ports, airports, high-speed trains, and freight.


   4. Establishing Special Border Economic Zones in 10 provinces: Tak, Sakaeo, Trat, Mukdahan, Songkla, Nong Khai, Chiang Rai, Kanchanaburi, Nakhon Phanom and Narathiwat. This policy will improve economic opportunities and competitiveness, attract investment both domestic and international while simultaneously regulate the border economic areas to resolve issues such as illegal migrant workers and the trafficking of agricultural products from neighboring countries.

2. **Economic Integration in CLMVT Context**

   The ASEAN economy is estimated to double in value from currently 2.6 trillion USD by 2030. To become a regional hub, Thailand must begin to shift its focus from “Border” to “Bridge” and from “Nation to Nation” to “City to City” through the concept of “Extending Nation”. This means borders between Thailand and neighboring countries should be gradually perceived as bridges linking economies, trade and investment together. At
the same time, Thailand should view the four neighboring countries (Cambodia, Laos, Myanmar and Vietnam) as internal markets, with four major cities, i.e., Vientiane, Yangon, Phnom Penh and Ho Chi Minh, and 13 secondary cities, i.e., Mandalay, Myawaddy, Myeik, Dawei, Haiphong, Hanoi, Can Tho, Siem Reap, Sihanoukville, Koh Kong, Luang Prabang, Savannakhet, Champasak, Cebu, Davao and Selangor.

3. International Business Models in the 21st Century

Thailand will adopt a ‘Service Sector Policy and Strategy based on Mode of Supply’ to enhance the competitiveness of Thai service providers on the global stage. These 4 modes include 1) cross-border supply 2) consumption abroad, 3) commercial presence, and 4) presence of natural person. Each mode of supply have distinct ‘Service Ecosystems’, requiring different conditions, rules, regulations and standards, as well as different degrees of service differentiation.
APPENDIX 2: Thailand 4.0 infographic – by Ministry of Commerce