



Is the Fourth Industrial Revolution a Panacea? Risks toward the Fourth Industrial Revolution: Evidence in the Thai Economy

Patipan Sae-Lim^a, Kittisak Jermsittiparsert^b, ^aGraduate School of Management and Innovation, King Mongkut's University of Technology Thonburi, Bangkok, Thailand, ^bSocial Research Institute, Chulalongkorn University, Bangkok, Thailand,

The Thai economy has recently become attentive to the fourth industrial revolution as a solution for stimulated growth. Furthermore, there are numerous studies investigating its positive effect; with limited negative publications; however in this article it is intentionally pointed out that highly innovative and advanced technology is not a panacea. The aims of this study were to present the opposite side of the impact of advanced technology and to identify, assess and propose responding strategies regarding the fourth industrial revolution within a risk management framework (RMF). From an analysis of various documents as well as interviews with experts, it was found that apart from the contributions of advanced technologies, there are also societal and economic risks to be considered. The major concerns with regards to the adoption of the fourth industrial revolution in the Thai economy would be the potential high rate of unemployment as a result of disruptive technology and social inequality, closely followed by cybersecurity risks. Moreover, the closure of businesses and lack of human interaction within society would have medium severity. In relation to policy considerations, to mitigate unemployment risk, individuals should build skills in consideration of future need and the government should consider enhancing social protection with a concrete guaranteed social minimum expectation and social insurance during a period of unemployment. Next, to response to existing inequality in Thai society, government policy should reflect investment in human capital closely followed with creating a fiscal policy that reduces tax avoidance techniques used by many wealthy



people to lessen their profits. Such tax revenue could be redistributed to the low-income people, particularly with an emphasis on education. Other risk mitigations are further explored in this paper.

Key words: *4.0 industrial revolution, economic growth, Thai economy, risk responses, digitalisation.*

Introduction

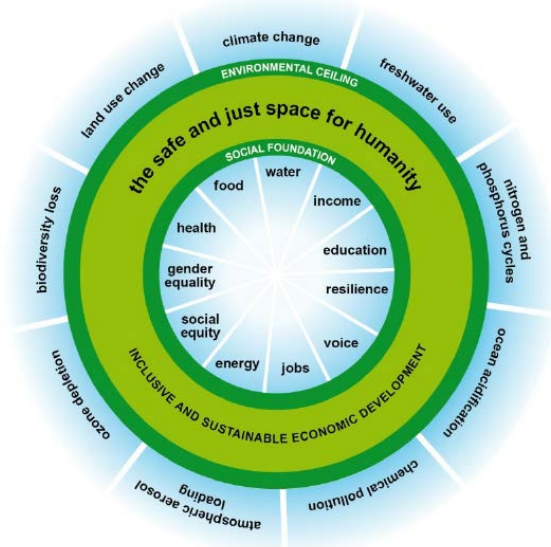
Several economic growth theories, including classical, neoclassical as well as endogenous growth theory, have all proven that the adoption of technology is the function of a nation's development. The law of diminishing return could be resolved by the employment of advanced technology (Jeffrey, 2013; Oyewale & Osadola 2018). Therefore, theoretically, technology could explicitly prove beneficial for global and local growth. Accordingly, the fourth (4.0) industrial revolution unsurprisingly would have a key role, especially for the Association of Southeast Asian Nations (ASEAN) countries for driving economic growth.

In Thailand, the Board of Investment (BOI) is projecting that technology will alter the current classical economy so that it becomes a digital economy, which is expected to play a significant role in every sector and is estimated will to contribute to 25% of the country's gross domestic product (GDP) by 2027 (Thailand Board of Investment, 2017). Moreover, Sichel (1999) studied the correlation between the sales of computers and the GDP's growth rate. It was found that there were some similarities. As described, the advancement of technology is the causality of growth; adversely, it is still questionable for global and local well-being (Haseeb et al., 2019).

Historically, several economic growth theories have explained a nation's growth from the acceleration of the GDP while development economists have argued that the GDP is not deemed enough to explain this growth. Raworth (2017) whose research has focused on the social and ecological challenges of the 21st century proposed "Doughnut Economics" (refer to Figure 1), which opposed the goal from the GDP and began with the principle question: What enables human beings to thrive? Raworth concluded that the world should change global focus to social priorities ensuring that everyone needs to have a good life-social foundation rather than a focus on GDP at the expense of the planet. Furthermore, the world should alter the economic policy from economic growth measurement to an ecological ceiling that circulates a regenerative and distributive economy. Therefore, even though the fourth industrial revolution would generate more global and local economic growth, it is unsure

what the escalating risks factors could be for humanity, ways of work and social well-being, and so on.

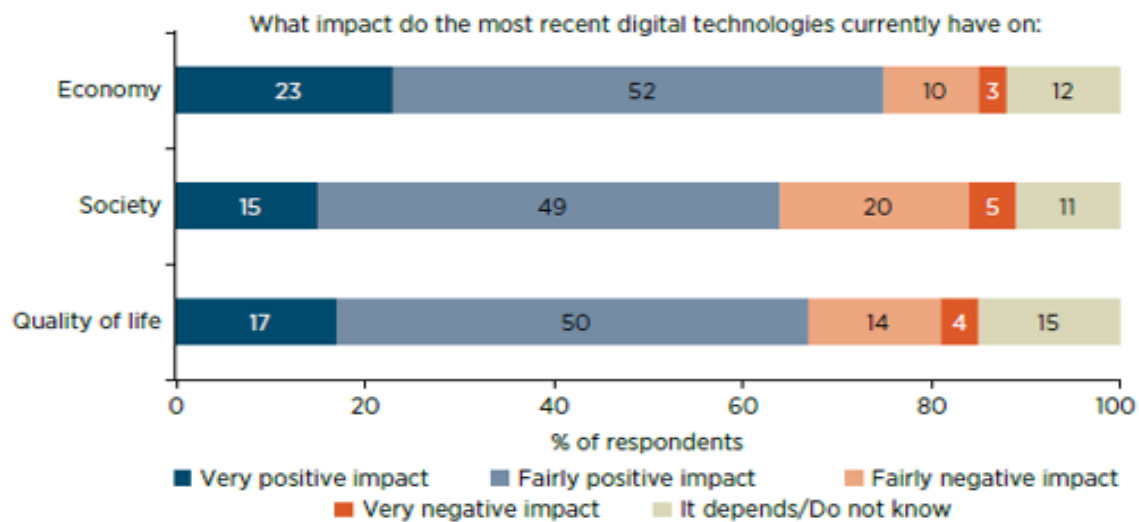
Figure 1. Doughnut Economics



Source: Raworth (2017)

Most people's perspectives with regards to the concept of advances in technology seem to be positive (refer to Figure 2 below) even though there were some studies that found the negative effect of advance technologies in relation to globalization and environmental degradation (Szopiński, & Nowacki, 2014; Orji, et al 2018; Sriyakul, & Jermittiparsert, 2019), research of associated risk is neglected. Therefore, this article chose another angle that aimed to adopt an enterprise risk management (ERM) framework for identifying, assessing, and mitigating global and local risks with regards to the fourth industrial revolution (Sabatino, 2016). The contribution from the findings would generate awareness for policymakers to not only be keen on the positive sides of the advancement of technology, but also pay attention to its risk. Moreover, apart from risk awareness, an adaptive system with regards to such global risks is also a major concern. Even though humans are living with limited resources, knowing and understanding the risks with regards to the growth of the economy is vital.

Figure 2. The impact of digital technologies to people's perspectives.



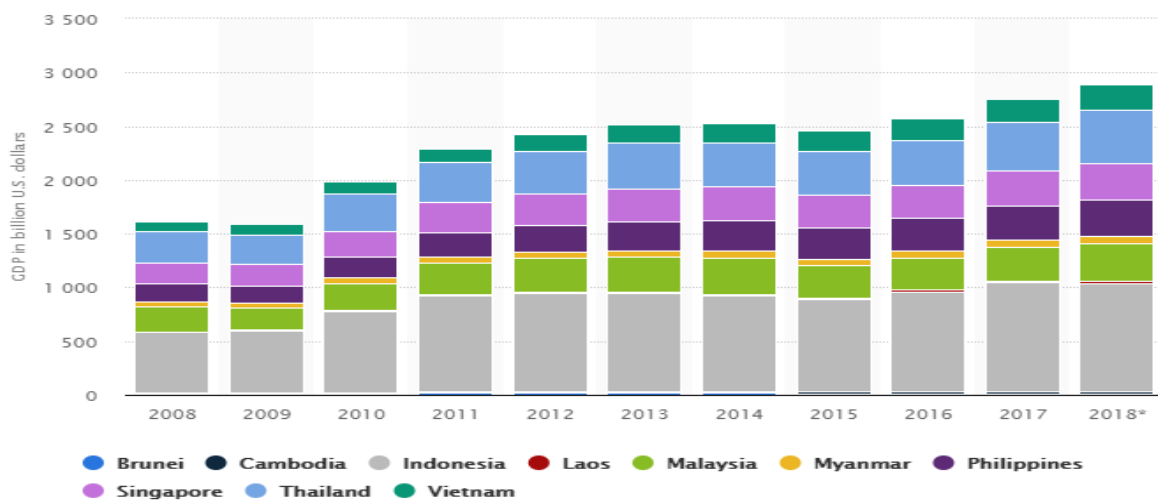
Source: The World Bank (2019)

What is the fourth industrial revolution in the Thai economy?

Most economists in developing countries see the opportunities from the fourth industrial revolution (Thailand Investment Review, 2017) due to the prior adoption of such revolution by developed countries such as the USA, UK, China, South Korea etc. (Ciszewska-Mlinaric, 2009). The first industrial revolution initially focused on the agricultural sector while the second industrial revolution promoted domestic products. In Thailand 3.0, a production hub for exports (Thailand Investment Review, 2017), the industrial sector focused on more complex industries to attract foreign investment making. Even when compared to other ASEAN countries, the GDP in the Thai economy is higher than others, as growth has moderated to between 3-5% annually (refer to Figure 3 below).

Although the third industrial revolution somehow adopted technology, beneath Thailand 3.0, there has been a confrontation with imbalanced development, wider income gap, and growing disparities that have resulted in the Thai government's to prompt promotion of the Thai economy with regards to the fourth industrial revolution.

Figure 3. Gross domestic product (GDP) of the ASEAN countries in 2008-2018 (in billion USD)



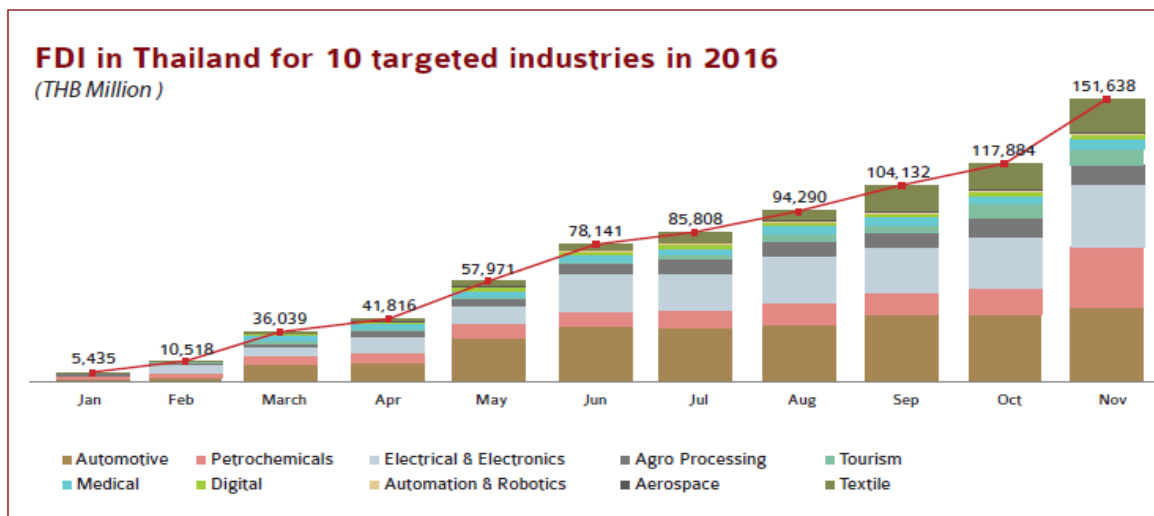
Source: Statista (2019)

As such, the Thai government has driven the fourth industrial revolution with the concept of “doing less getting more” within an innovative economy. The concept of the fourth industrial revolution emphasizes promoting advanced technology by changing from a production based to service based economy in 10 target industries (five existing industrial sectors and five next generation industrial sectors). Next generation industries account for automation and robotics; aerospace; bioenergy and biochemicals; digital; and medical and healthcare, which the government hopes will accelerate Thailand’s future growth.

In terms of economics, opportunities with regards to the fourth industrial revolution in the Thai economy have obviously been generated through foreign direct investment (FDI.) (refer to Figure 4 below). FDI itself is a determinant of industrial expansion as well as the growth in developing countries (Jermsittiparsert & Sriyakul, 2019). Systemically, advanced technology and innovation in Thailand 4.0 has brought with it a new economic model that has disrupted a plethora of industries (Stevens & Strauss, 2018). Pre-digital incumbents (the first and second industrial revolutions) were focused on a supply-side economy that contained huge marginal costs in operation while the fourth industrial revolution has shifted the economic system to “demand-side economies of scale” that have created powerful tech giants, that are leveraging

network effects and reducing marginal costs on the supply side to near zero (Dechprom & Jermittiparsert, 2018).

Figure 4. FDI in Thailand in 2016



Source: Thailand Investment Review (2017)

As mentioned, everything has two points of view that need to be taken into consideration. Apart from the positive impact from digitalisation in the fourth industrial revolution, this article examines another aspect of its impact that focused on the global and local risks with regards to the fourth industrial revolution which policymakers seem to neglect.

Paradigm shift of risk management

Risk management initially became a buzzword at the same time as the globalised world became a phenomenon. Risk is a multifaceted term defined by many seminal authors, however even though there are several definitions of risk, its cause is derived from the effect of globalisation that examines the approaches of the level of dependency. Most risk definitions account for uncertain negative events while modern risk management theories interpret risk trading with opportunities (Benjamin, 2017).

More recently, risk management has been shifting its paradigm toward enterprise risk management (ERM). Traditional risk management (TRM) initially focused on risk processes such as: identify, assess, mitigate and monitor whereas ERM included the impact of governance, risk culture and internal environment into the risk management system

(Committee of Sponsoring Organizations of the Treadway Commission, 2004). TRM's disadvantage is due to the gradual process of undertaking risk as a project rather than that at the corporate level. Moreover, TRM lacks consolidation of the tone at the top. ERM would then rectify such aspects and become the latest paradigm of conducting risk management in firms.

When the organisational board of directors decides to implement ERM, it should firstly consider an appropriate framework as a point of reference. According to an empirical survey, Thai listed companies accounted for 80% of adopting the COSO ERM framework (Sae-Lim & Pathranarakul, 2018; Sae-Lim, 2019) as a reference framework since they would like to leverage the prior process using the COSO internal control framework that the COSO ERM framework consolidates internal control within (Saardchom, 2013). Additionally, with its most renewed framework, COSO has attempted to improve the framework from the COSO ERM 2004 to COSO ERM 2017 because the business environment has become increasingly complex and technologically driven; moreover, global and risk professionals are seeking more up-to-date resources describing the ERM concepts.

To explain this concept more simply, the COSO ERM 2017 has shifted its paradigm with regards to increased processes. Previously, the COSO ERM 2004 determined the risk management processes by establishing a suitable internal environment, identification, assessing, strategic managing, and monitoring potential risks. The new framework structure has five components and twenty principles that are aligned to the business life cycle making risk conversion more intuitive for firms (refer to Figure 5). Moreover, this framework links risk with setting strategies and day-to-day activities with helping businesses to use ERM principles that support the creation, realisation, and preservation of value. Ultimately, the processes of engaging in risk management are very much the same, but the new version of ERM has added the principle of risk management to be a more top-down view.

Figure 5. COSO ERM 2017 framework



Source: Committee of Sponsoring Organizations of the Treadway Commission (2017)

The results of risk analysis with regards to the fourth industrial revolution in the Thai economy

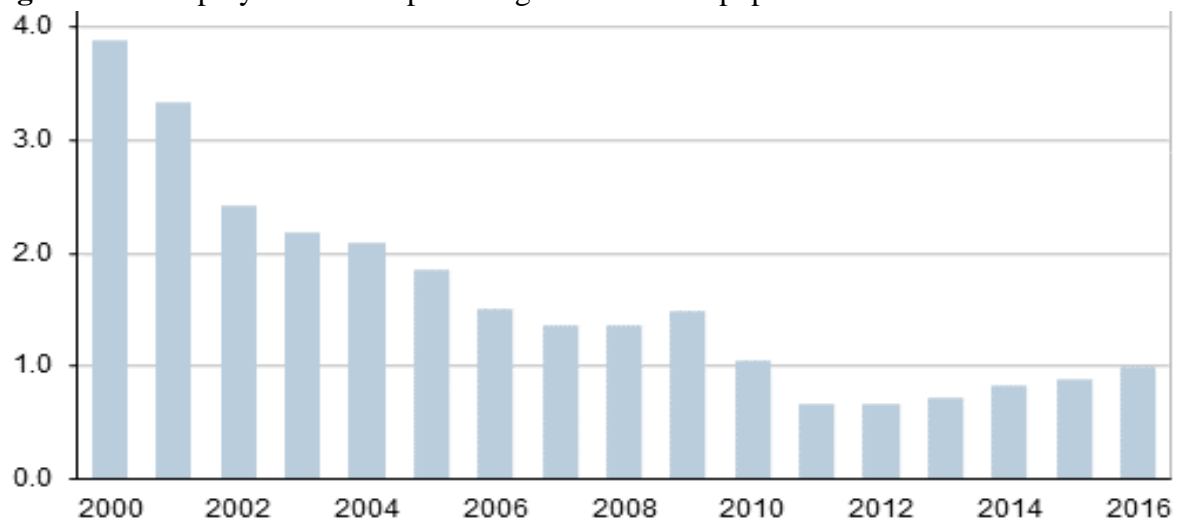
In reference to the above-mentioned concept of ERM, the author mostly gathered, triangulated and concluded qualitative information from reliable documents, which were white papers from non-profit organisations including the World Economic Forum (World Economic Forum, 2019), World Bank, Committee of Sponsoring Organisations of the Treadway Commission (COSO), and other research including interviewing the experts. After identifying the key risks, and making an assessment, some risk mitigation examples from related experts were employed.

Risk Identification

1) High rate of unemployment: Advance technology is not a panacea. Even though the fourth industrial revolution drives growth from the classical and endogenous growth theories, technology itself disrupts a staff's ways of working, while creating convenience and greater accuracy than capable using only human competencies. For the Thai economy, there is some evidence of disruptive technology from the financial sector with regards to mobile banking that performs better than human tellers within the aspects of fast manipulation, convenience, high security and various related functions. It is important that to reduce banking operation costs in the Thai economy, banks will retrench a number of front-line staff and will no longer recruit new staff when old staff resign because of the performance of mobile banking.

Statistically, the Bank of Thailand (BOT) (refer to Figure 6) recorded unemployment in the percentage of the active population. This displayed that even though such rate had dramatically declined by 2000, it showed an upward trend from 2012 and is experiencing an increase to more than 1.0 and is driven by the adoption of advanced technology.

Figure 6. Unemployment in the percentage of the active population in 2000-2016

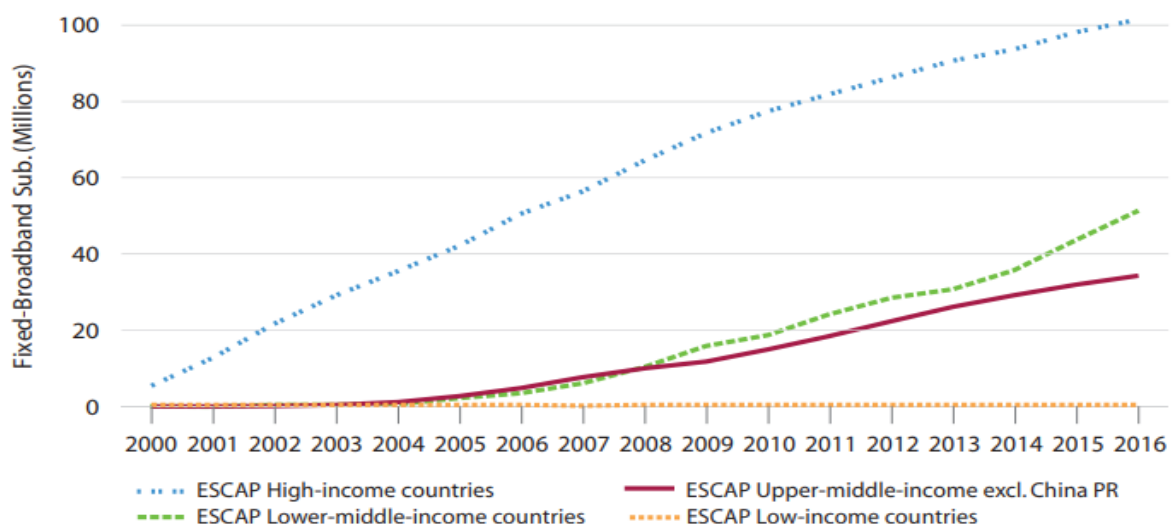


In the Thai economy, the technology diffusion rate is not quite as high as compared to China and Singapore; where, the effect of technology has disrupted people's jobs due to the speed of adoption. Lessons can be learnt from this as technology has reduced millions of jobs world-wide: 100,000 bankers lost their jobs (Banking's 'Uber moment'), the Bank of America cut up to 8,000 jobs, Deutsche Bank shut 188 German branches, cutting off 3,000 staff (UX Design Agency, 2018).

2) Inequality: Advance technology has effectively improved productivity, stimulated growth, created accurate manipulation, and ease of information sharing while it has also been

the cause of driving inequality (United Nations ESCAP, 2017). Technology reaps benefits for high-income countries while low-income countries seem to lack the opportunity to access technology (refer to Figure 7). As frontier technologies go mainstream, high-income countries could reduce operating costs, have high-speed productivity, and therefore increase their revenue via technological advances while such phenomena will not happen in lower-income countries where there is a lack of opportunity for technology access.

Figure 7. Total fixed-broadband subscriptions by income group in 2000-2016, excluding China

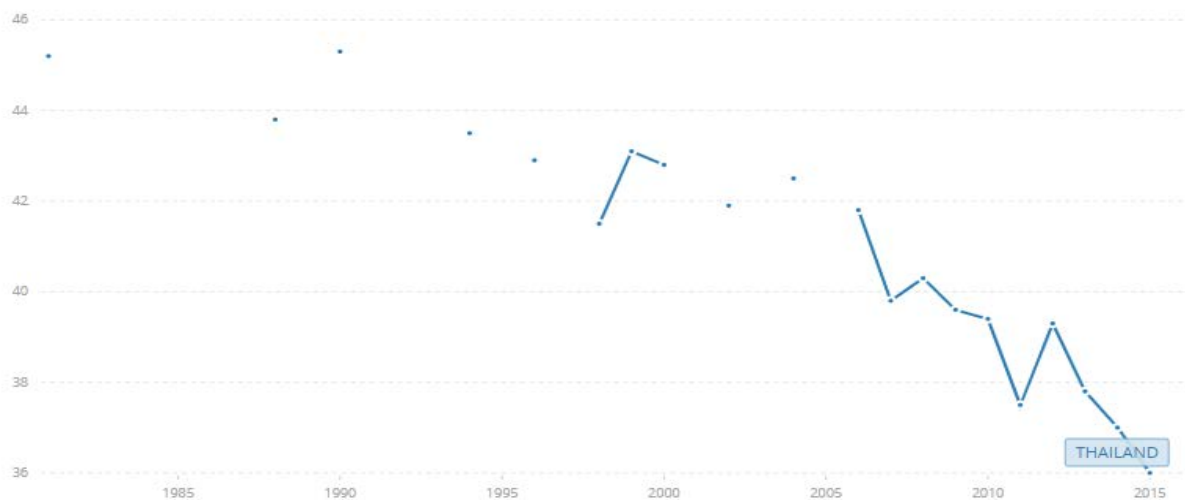


Source: ESCAP (2017)

Apart from the level of accessibility, sophisticated technological aspects like artificial intelligence (AI), big data, internet of things (IOT), cloud computing, and so on need a high level of user knowledge that seems too difficult for under-developed or developing countries where the literacy rate is quite low. From a survey by a Swiss bank, Thailand has overtaken Russia and India as the nation with the highest level of inequality (Bangkokpost, 2018). However, on the positive side, the GINI index (refer to Figure 8), a statistical measure of the degree of variation or inequality represented in a set of values used especially in analysing

income inequality, shows that the Thai economy seemed to be on a downward trend displaying a low risk of inequality. This could however widen during the next decade due to advanced technology. Even Jermittiparsert, & Haseeb (2019) found that inequality has a correlate effect on green energy consumption, in terms of its pitfall, this risk should be a concern.

Figure 8. GINI index in Thailand



Source: World Bank (2019)

3) Security risks: Loss of privacy to companies and governments is also likely to occur (World Economic Forum, 2019) due to a trade-off between convenience and security. Even though AI will make the business environment become more sophisticated, AI will still create the potential of cyberattacks (Gohwong, 2017). The Thailand Computer Emergency Response team (Thailand Computer Emergency Response Team, 2016) conducted a cybersecurity survey and divided such risks into eight types: abusive content, malicious code,



information gathering, information security, intrusion attempts, intrusions, availability, and fraud. This survey was conducted using an empirical analysis with regards to companies in Thailand. It was found that the most risks in the aspects of its impact accounted for availability, malicious code and intrusion. For private organisations, advanced technologies in mobile banking have reduced operational costs, but this has also introduced more concern about fraud.

Security risks from advanced technologies have affected both customers and organisations. For the former, without trust, innovation is impossible and sophisticated technologies will be meaningless if there is a low level of perceived trust by consumers. For the latter, leaders in organisations will face the dilemma about the leverage of the technologies that are driving customers' expectations to be a high level while people will grow skeptical of how organisations are using such technologies. Therefore, the challenge after the adoption of new technology is cybersecurity (Vlahinić, & Jakovac, 2014).

4) Business shutdown: The fourth industrial revolution has been destroying the market mechanism such that monopolies will soon no longer exist. To illustrate, working in a higher education institution (HEI) as a lecturer generated very high job stability in the past, yet today, with highly advanced technologies, distance learning is a trusted and utilised online learning channel and consequently some universities in Thailand and around the world will likely close due to the accessibility of other learning tools and declining population. The physical traditional classroom is losing its monopoly as a place of learning. Nguyen (2015) compared the effectiveness of such traditional learning and online learning. The results displayed that there were no differences between the two ways of learning. Moreover, this study showed that there was robust evidence to suggest online learning is generally at least as effective as the traditional format. This will not only affect HEI, but also other business sectors that will be besieged by advanced technologies that need a high level of adaptability.

In the Thai economy, there is some evidence which supports the risk of businesses shutting down as risk response, this includes transforming as well as mergers. For example, the most recent Post Today-, the Thai Language business newspaper, decided to transform the printed version of newspaper to a "digital only version" in March, 2019. A second example is the large scale merger between TMB Bank (TMB) and Thanachart Bank (TBANK) which has been caused by digitalisation.

5) Lack of humanity and society: Humanity and society are mostly ignored as key factors in consideration of the impact of the fourth industrial revolution, but the individual level is vital for both a macro and micro analysis. The fourth individual revolution is altering humanity's



norms, how people live, work and communicate. As described throughout this article, the fourth industrial revolution is not only altering what we do, but also who we are (Schwab, 2016). Advanced technology and innovation connect people more easily but have changed the nature of relationships, creating a human augmented formation that questions the concept of human existence. Within this consideration, the family relationship is paramount as it is the foundation of society, but with advanced smartphones and devices, this relationship is being destroyed by innovations that engage the attention of children and youth rather than them spending valuable time with their parents and family members.

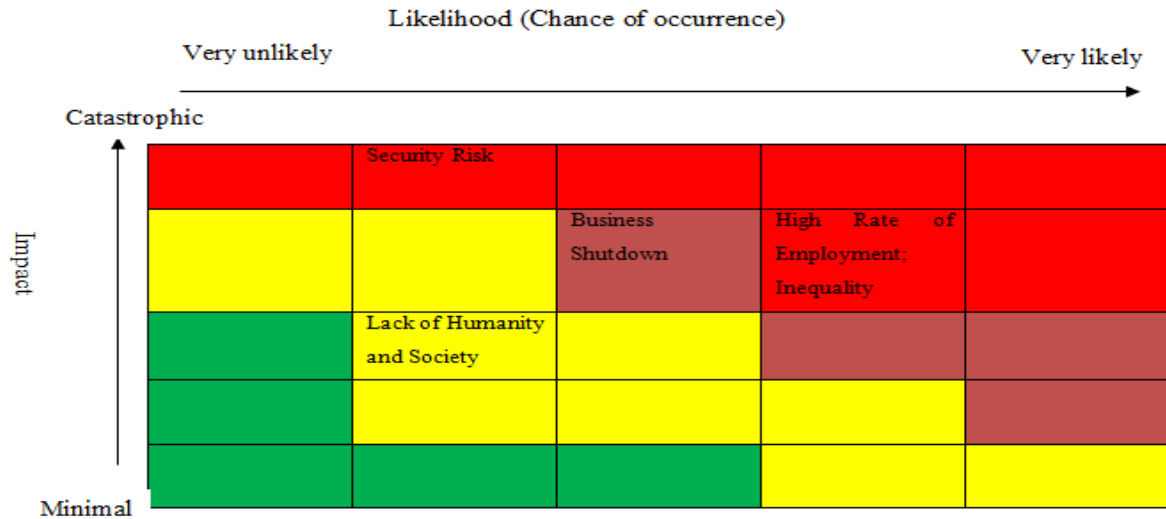
In addition, technology will continue to change societal values. Humanity in the next few decades will measure its value through the lens of high level of technology. There is growing concern that perceptions regarding empathy, honour and respect, and co-habitation skills will all become meaningless.

Risk Assessment

The two determined dimensions of risk assessment have originated from the probability of its occurrence and the impact of risk (Fraser and Simkins, 2010: 31). The results of assessing risk came from 20 experts (ten academics and ten from risk management industries). They were all asked to rate the probability of the occurrence of risk with a 1-5 scale (1= very unlikely; 5 = very likely), and for the question on the impact, the experts could select one of five choices: “minimal”, “minor”, “moderate”, “severe”, or “catastrophic”; the five alternatives were transformed into a 1–5 scale (1 =minimal; 5 = catastrophic). Figure 9 below displays the below-risk matrix, which represents the risk assessment results. With regard to the interviewees:

- 1) Fifteen of the interviewees indicated that sophisticated innovation and technology will change the ways of work and make some positions redundant. They voted it as a highest severity based on likelihood and impact.
- 2) Half of the interviewees were concerned about the income-trap or that the income gap would widen due to the asymmetry of accessing advanced technology from lower income earners in Thailand.
- 3) Nine of the interviewees agreed that security risks were located in the second quadrant (low likelihood but high impact). Based on its impact, it is perceived as of the most concern but has a low level of occurrence compared to others.
- 4) Most interviewees expressed that lack of humanity and society are likely to occur but compared to other risks, it should have low concern.

Figure 9. Risk matrix.

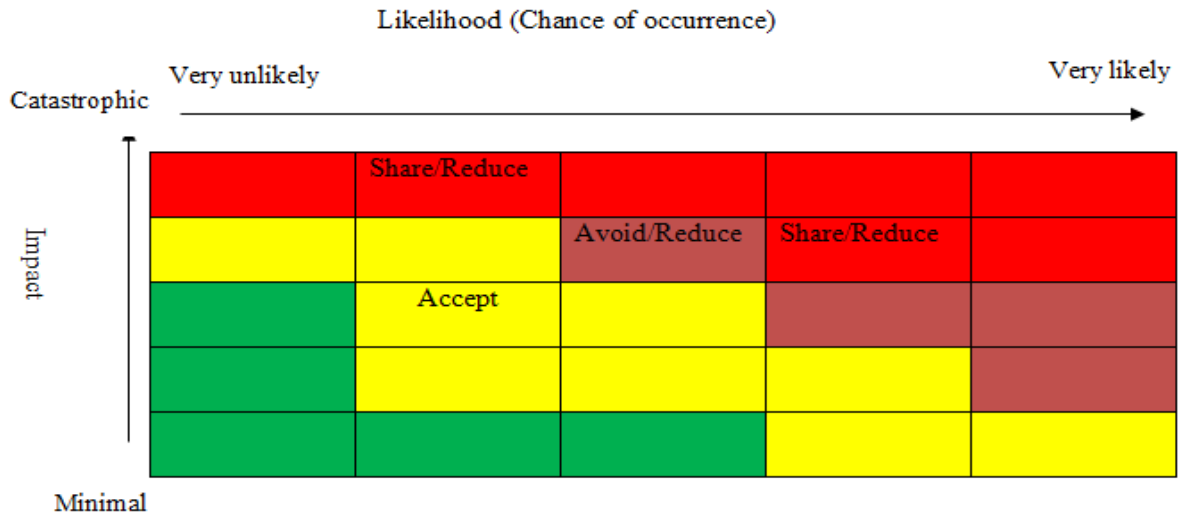


Based on the overall assessment risk, the high rate of employment and inequality were the major concerns for high impact and likelihood (4*4). On the contrary, the lack of humanity and society were the least concerns due to the abstractness of its impact and low chance of occurrence. Based on the severity level or risk impact, security risks accounted for catastrophes (Scale 5).

Risk response strategies

The COSO ERM 2017 proposed five methods of risk response strategies: accept, avoid, reduce, share and pursue (COSO, 2017). Based on Figure 9, the matching between the zoning of the risks with regards to the fourth industrial revolution and risk response strategies were as follows:

Figure 10. Risk response strategies.



1) Response to the high rate of unemployment: According to the World Bank (2019), the major concern for digitally disruptive technology is for people with a middle income while those with a lower income would not now be concerned due to the lack of lower income staff according to the convergence of an aging society. First and foremost, at the individual level, he/she would need to adapt to working on a project basis rather than that of a routine job due to the substitution of digitilisation. For the required skills, the demand for advanced cognitive skills, socio-behavioural skills, as well as skill combinations associated with greater adaptability is rising (World Bank, 2019). The high rate of unemployment is not only a household concern, but a national concern. Therefore, the Thai government should respond to the impact of unemployment by enhancing social protection with a concrete guaranteed social minimum and develop social insurance during the period of unemployment. Surprisingly, for the Thai economy, the concern of unemployment is mainly with regard to higher education graduates. The Thai government initially started to respond to such risk by providing a service called “Job Ready Centre” for undergraduates to match jobseekers and firms. The Office of the National Economic and Social Development Board (NESDB) of Thailand (2019) revealed that in the first 10 months of the fiscal year 2018, “166,160 people were employed by these services, which was higher than the 150,000 year target”.

2) Responding to inequality: As mentioned, the GINI index in Thailand has experienced a downward trend, yet it will go higher due to digitilisation in the fourth industrial revolution. Hence, it could be perceived that Thailand may face inequality in the next few decades. Furthermore, the GINI index is calculated from an aggregated view; thus, if we analyse the inequality in-depth, the income inequality is much higher than what past surveys had suggested in which “the top 10% income share went from 52.62% of the national income in



2001 to 51.49% in 2016, and the bottom 50% share increased from 11.30% to 13.90%” (Jemmana, 2018). To respond to the inequality, investing in human capital, especially in children’s education is a good remediation. For the Thai government policymakers to reduce the income gap, a redistributive policy is required (Doerrenberg and Peichl, 2012). To be more precise, the Thai government needs to create a fiscal policy that has the aim of tax avoidance reduction that lessens profit for the wealthy people, reallocating these funds for redistribution to low-income earners, particularly through education. Moreover, governments could enhance a tax system to raise revenue without resorting to tax rate increases. Apart from a redistributive policy and enhancing human capital education, this could display the relationship between the reduction of inequality and governance (Vora-Sittha, 2012). Voice and accountability, political stability, the absence of violence, as well as rule of law are all direct effects for rectifying Thai inequality and poverty.

3) Responding to the security risk: According to the analysis, security risk accounts for a high impact, but low likelihood in this study. The best reduced risk strategy is to reduce its impact (COSO, 2017). Initially, the Electronic Transactions Development Agency (Public Organisation) (ETDA) in Thailand adopted the National Institute of Standards and Technology (NIST)’s framework, which is designed to identify, protect, detect, respond and recover in order to reduce the impact of a security risk and was announced as a regulatory base to public organisations. With regards to such a framework, ThaiCert (2016) concluded that in Thailand, the vulnerability was about how to respond to technological incidents. Training is then a key for responding to a security risk. Apart from training, as can be ascertained from the views of the experts in the interviews conducted, it is proposed that cyber risk governance is a required principle. Cyber risk governance maturity in the Thai circumstance is quite low. Accordingly, the author poses that in order to achieve their business goal as well as respond to the security risk, organisations should employ the Governance, Risk and Compliance (GRC) framework. Good governance would set a positive direction from the top tier in terms of procedure and policy while risk management would determine the areas exposed to a potential cyber risk. Thus, from a detection compliance process originates the tactical action to mitigate such cyber risk.

Conclusions and Implications

The objective of this study was to create awareness of the adoption of advanced innovative technologies with regards to the fourth industrial revolution within an enterprise risk management (ERM) framework. While ERM is the compulsory requirement for firms and businesses, this study displayed its benefit at the national level.



The author intentionally conducted this study to questions whether the benefits of greater digital adoption would be sufficient to counteract the negative aspects of globalization given that a group of industrial sectors are prepared to change in the context of the the fourth industrial revolution in Thailand (Chinachoti, 2018). Inequality, crime, unemployment and identity are all globalisation concerns (Stiglitz, 2003), and why potential negative implications and risks that policymakers should take into consideration needed to be investigated.

Toader et al. (2018) used panel data analysis for the causality of the relationship between the indicators of ICT infrastructure and the gross domestic product GDP in the EU countries. The results indicated the positive effects of the indicators. Even in the Thai economy, there are few empirical studies comparing advanced technologies and economy; as such, inherent risks from the fourth industrial revolution still exist. According to the qualitative analysis, the severity risks with regards to the fourth industrial revolution are a “high rate of unemployment and inequality” closely followed by security risk. Business shutdown and lack of humanity and society are neutral concerns.

After identifying and assessing the risks, the risk response strategies were presented. To respond to the high rate of unemployment, individuals should identify and develop future needed skills including cognitive, social behaviour and adaptability skills while the government should be involved to set a guaranteed social minimum as well as social insurance. Moreover, to reduce the impact of potential unemployment, the Thai government has begun to initiate a “job fair venue” for new graduates. In terms of reducing the severity of inequality, the government’s policy, in particular investing in human capital since childhood, improving the tax avoidance system from higher incomes, generating a new fiscal policy, as well as better governance systems are all potential solutions. Ultimately security risk impact should be reduced by focusing on incident training, and employing the NIST and GRC frameworks.

The direct contribution of this article would be to persuade policymakers to investigate the negatives as well as the positives of leveraging advanced technology and learn from the pitfalls of globalisation. Risk management means turning potential negative factors/outcomes into opportunity. Future research in this field could involve the collection of secondary evidence and an empirical study of the numerical relationship between the measurable indicators of the effect of the fourth industrial revolution and growth. This next starting point could be employed as a quantitative framework in the future as a result of the findings of this paper.



REFERENCES

- Bangkokpost. 2018. Report: Thailand most unequal country in 2018. Retrieved from www.bangkokpost.com/business/news/1588786/report-thailand-most-unequal-country-in-2018.
- Benjamin, S. 2017. *Enterprise Risk and Opportunity Management: Concepts and Step-by-Step Examples for Pioneering Scientific and Technical Organizations*. New York: John Wiley & Sons.
- Chinachoti, P. 2018. "The Readiness of Human Resource Management for Industrial Business Sector with regards to Industrial 4.0 in Thailand." *Asian Administration and Management Review* 1 (2): 123-131.
- Ciszewska-Mlinaric, M. (2009). The Conditions of Organization Adaptive Capabilities. Case of Polish Public Hospitals. *Contemporary Economics*, 3(4), 143.
- Committee of Sponsoring Organizations of the Treadway Commission. 2004. *Enterprise Risk Management: Integrated Framework: Executive Summary & Framework*. New Jersey: COSO.
- Committee of Sponsoring Organizations of the Treadway Commission. 2017. *Enterprise Risk Management Integrate with Strategy and Performance*. New Jersey: COSO.
- Dechprom, S. & Jermstittiparsert, K. 2018. "Foreign Aid, Foreign Direct Investment and Social Progress: A Cross Countries Analysis." *Opcion* 34 (86): 2086-2097.
- Doerrenberg, P. & Peichl, A. 2012. *The Impact of Redistributive Policies on Inequality in OECD Countries*. (Discussion Paper No.6505).
- Fraser, J. & Simkins, B. (eds.). 2010. *Enterprise Risk Management: Today's Leading Research and Best Practices for Tomorrow's Executives*. New Jersey: John Wiley & Sons.
- Gohwong, S. 2017. "The Cyber-attacks in Vietnam during 2010-2016." *Asian Political Science Review* 1 (1): 51-55.
- Haseeb, M., Hussain, H. I., Ślusarczyk, B., & Jermstittiparsert, K. (2019). Industry 4.0: A solution with regards to technology challenges of sustainable business performance. *Social Sciences*, 8(5), 154



- Jeffrey, M. 2013. *Introductory Econometrics a Modern Approach*. 5th ed. New York: John Wiley & Sons.
- Jenmana, T. 2018. *Income Inequality, Political Instability, and the Thai Democratic Struggle*. (The Paris School of Economics Masters in Analysis and Policy in Economics Working Paper).
- Jermstittiparsert, K. & Haseeb, M. 2019. "Impact of Income Inequality, Unemployment and Globalization on Green Energy: Evidence from Thailand." *Ekoloji* 28 (107) (In press).
- Jermstittiparsert, K. & Sriyakul, T. 2019. "The Impact of Business Environment and the Macroeconomic Variables on the Foreign Direct Investment in ASEAN countries: Does Political Stability Matters." *Ekoloji* 28 (107) (In press).
- Nguyen, T. 2015. "The Effectiveness of Online Learning: Beyond No Significant Difference and Future Horizons." *MERLOT Journal of Online Learning and Teaching* 11 (2): 309-319.
- Orji, A., Ogbuabor, J. E., Okon, A. N., & Anthony-Orji, O. I. (2018). *Electronic Banking Innovations and Selected Banks Performance in Nigeria*. *The Economics and Finance Letters*, 5(2), 46-57.
- Oyewale, P. O., & Osadola, O. S. (2018). *Military Regimes and Nigeria's Economic Development, 1966-1999*. *Journal of Social Economics Research*, 5(1), 29-38.
- Raworth, K. 2017. *Doughnut Economics: Seven Ways to Think Like a 21st Century Economist*. London: Clay Ltd, St Ives plc.
- Saardchom, N. 2013. "Enterprise Risk Management under Sustainability Platform." *Journal of Business and Economics* 4 (1): 49-259.
- Sabatino, M. (2016). *Competitiveness and Resilience of the productive districts in Sicily. The behavior of the Sicilian production areas during the economic crisis*. *Contemporary Economics*, 10(3), 233-248.
- Sae-Lim, P. & Pathranarakul, P. 2018. "Risk Management and Organizational Adaptability-Strategic Framework for Corporate Crisis Recovery: The Study of Oil and Gas Industry." *PSAKU International Journal of Interdisciplinary Research* 7 (2): 112-130.



- Sae-Lim, P. 2019. "Enterprise Risk Management (ERM) as a Strategic tool: The Empirical Study in Thai Listed Companies." *Journal of Public and Private Management* 26 (In press).
- Schwab, K. 2016. *The Forth Industrial Revolution*. Cologny: World Economic Forum.
- Sichel, D. 1999. "Computers and Aggregate Economic Growth." *Business Economics* 34 (2): 18-24.
- Sriyakul, T. & Jernsittiparsert, K. 2019. "The Role of Economic, Social and Political Dimensions of Globalization in Influencing Environmental Degradation: Evidence from ASEAN Countries." *Ekoloji* 28 (107) (In press).
- Statista. 2019. Gross domestic product (GDP) of the ASEAN countries from 2008 to 2018 (in billion U.S. dollars). Retrieved from www.statista.com/statistics/796245/gdp-of-the-asean-countries/.
- Stevens, A. & Strauss, L. 2018. *Chasing Digital: A Playbook from New Economy*. New York: John Wiley & Sons, Inc.
- Stiglitz, J. 2003. *Globalization and Its Discontents*. London: Norton Paperback.
- Szopiński, T., & Nowacki, R. (2014). Plane ticket price dispersion in the online selling system in Poland. *Contemporary Economics*, 8(2), 207-218.
- Thailand Board of Investment. 2017. "Thailand 4.0 Mean Opportunities in Thailand." *Thailand Investment Review* 27 (1): 1-12.
- Thailand Computer Emergency Response Team. 2016. *Cybersecurity Survey*. Bangkok: ThaiCert.
- The World Bank. 2019. *The Changing Nature of Work*. Washington, DC: World Bank Group.
- Toader, E., Firtescu, B., Roman, A., & Anton, S. 2018. "Impact of Information and Communication Technology Infrastructure on Economic Growth: An Empirical Assessment for the EU Countries." *Sustainability* 3750 (10): 1-22.



United Nations ESCAP. 2017. Technology and Inequalities. Retrieved from www.unescap.org/sites/default/files/06Chapter4.pdf.

UX Design Agency. 2018. Banks Will Cut Millions of Jobs in The Next Decade Because of Technology. Retrieved from www.uxdesignagency.com/blog/Banks_will_cut_millions_of_jobs_in_the_next_decade.

Vlahinić, N., & Jakovac, P. (2014). Revisiting the energy consumption-growth nexus for Croatia: New evidence from a multivariate framework analysis. *Contemporary economics*, 8(4), 435-452.

Vora-Sittha, P. 2012. "Governance and Poverty Reduction in Thailand." *Modern Economy* 3 (1): 487-497.

World Economic Forum. 2019. *The Global Risks Report 2019*. 14th ed. Geneva: World Economic Forum.