AN OUTLOOK ON TECHNOLOGICAL READINESS OF ASEAN PLUS THREE

Sakgasit Ramingwong[1, 3], Lachana Ramingwong[1] and Sakgasem Ramingwong[2, 3]
[1]Department of Computer Engineering
[2]Department of Industrial Engineering
[3]Excellence Center in Logistics and Supply Chain Management
Chiang Mai University, Chiang Mai, THAILAND

Introduction

ASEAN Plus Three (APT) is a cooperation between Southeast Asia and East Asia nations which consists of 13 countries, i.e., Brunei Darussalam, Cambodia, China, Indonesia, Japan, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, South Korea, Thailand, and Vietnam. Main focus of this forum is to strengthen development of energy, transportation, and information and communication technology. Its rapid economic growth is expected to play important roles in the world economy in the next decades (HV et al., 2014).

Technological readiness is a critical factor which facilitate sustainable growth, especially during the current waves of economic disruption. It is important for both investors and facilitators to analyse and assess overall potential of this element in order to efficiently prepare and strategize their business initiatives. Many technological readiness indexes are reported annually by international institutes. This paper attempts to study relevant facets of this aspect and summarize them accordingly. Four major indexes are chosen in this study based on their organizational creditability and citations. These includes the Global Information Technology Report (GITR) by the World Economic Forum, ICT Development Index (IDI) by the International Telecommunication Union, Internet Usage Statistics (IUS) by Miniwatts Marketing Group, Global Salary Survey (GSS) by Robert Walters, and Global Cities Report (GCR) by A.T.Kearney. It is also important to note that this study only attempt to identify trends of these countries as an overview of regional body, not as an absolute comparison.

The second section of this paper reviews various perspectives of technological readiness described by the aforementioned indexes. Then, general outlook towards technological readiness of ASEAN Plus Three is discussed in the third section. Overall rankings on each nation are proposed in the fourth section. Finally, the fifth section conclude this paper.

Technological Indexes

The latest version of four international technological indexes are represented in this paper. All of these international indexes can be freely accessed online for non-commercial purposes.

Global Information Technology Report (GITR)

Global Information Technology Report is created and distributed by the World Economic Forum (World Economic Forum, 2016). The latest update of this data is from 2016. This index has been previously recognized as Networked Readiness Index during 2004-2014. It classifies ten pillars of ICT readiness. This involve (1) political and regulatory environment, (2) business and innovation environment, (3) infrastructure and digital content, (4) affordability, (5) skills, (6) individual usage, (7) business usage, (8) government usage, (9) economic impacts, and (10) social impacts. In their latest report, 139 countries were surveyed. All of APT countries excepted Brunei Darussalam were included in the latest report. On the other hand, Lao PDR and Myanmar were just included only since 2014. It is remarked that the analysis in the subsequent section on all other APT countries are based on the 2016 data while the data of Brunei Darussalam is inevitably from the 2014 report.

Due to the fact that this index has the most completed perspective, it is used as the main structure of this paper. Table 1 illustrates the GITR score of APT countries during 2012 to 2016. The numbers in the brackets depict their annual ranking. It can be seen that there are no significant changes in the readiness scores and rankings of most APT countries. Singapore is ranked 1st in the world in this index. South Korea, Japan and Malaysia are also ranked in the top quartile of the list. Brunei

Darussalam, although with missing latest data, is still likely to be on the top of the second quartile. China still retains the fifth seat of APT countries. Thailand makes the biggest jump in APT cluster, that is, from 77th rank in 2012 to 62nd in 2016. Moreover, Indonesia, the Philippines and Vietnam are attempting to climb up to the middle of the second quartile. Cambodia, Lao PDR and Myanmar are still lagging in the last quartile.

Country	**GITR Score (Rank)**				
	2012	**2013**	**2014**	**2015**	**2016**
Brunei Darussalam	4.0 (54)	4.1 (57)	4.3 (45)	N/A	N/A
Cambodia	3.3 (108)	3.3 (106)	3.4 (108)	3.3 (110)	3.4 (109)
China	4.1 (51)	4.0 (58)	4.0 (62)	4.2 (62)	4.2 (59)
Indonesia	3.8 (80)	3.8 (76)	4.0 (64)	3.9 (79)	4.0 (73)
Japan	5.2 (18)	5.2 (21)	5.4 (16)	5.6 (10)	5.6 (10)
Lao PDR	N/A	N/A	3.3 (109)	3.6 (97)	3.4 (104)
Malaysia	4.8 (29)	4.8 (30)	4.8 (30)	4.9 (32)	4.9 (31)
Myanmar	N/A	N/A	2.4 (146)	2.5 (139)	2.7 (133)
The Philippines	3.6 (86)	3.7 (86)	3.9 (78)	4.0 (76)	4.0 (77)
Singapore	5.9 (2)	6.0 (2)	6.0 (2)	6.0 (1)	6.0 (1)
South Korea	5.5 (12)	5.5 (11)	5.5 (10)	5.5 (12)	5.6 (13)
Thailand	3.8 (77)	3.9 (74)	4.0 (67)	4.0 (67)	4.2 (62)
Vietnam	3.7 (83)	3.7 (84)	3.8 (84)	3.9 (85)	3.9 (79)
Surveyed Countries	**142**	**144**	**148**	**143**	**139**

Table 1: Global Information Technology Report of APT countries during 2012-2016
(World Economic Forum, 2012; World Economic Forum, 2013; World Economic Forum, 2014; World Economic Forum, 2015; World Economic Forum, 2016)

ICT Development Index (IDI)

The International Telecommunication Union is an agency supervised by the United Nations with a focus on information and communication technology aspects. Their latest ICT Development Index was published in 2017, involving 176 countries (International Telecommunication Union, 2017). This index highlights three major areas. The first area, ICT accessibility, comprises phone users, Internet bandwidth and percentage of household with Internet access. The second area, ICT users, designates ratio of Internet users and subscribers. The final area is the educational level of the population. All APT countries were included in the index.

As can be seen from Table 2, the rankings of APT nations during 2016 and 2017 are similar. South Koea, Japan and Singapore are in the top quartile. Brunei Darussalam, Malaysia, Thailand and China are ranked in the second quartile. Yet, although the rest of the APT cluster are located in the third quartile, there were noticeable increases in their raw scores. This suggests a promising sign of development in the regional overview.

Internet Usage Statistics (IUS)

A report on Internet Usage Statistics was annually published by Miniwatts Marketing Group. In the latest report, internet penetration rate of 242 countries were highlighted (Miniwatts Marketing Group, 2018). The report indicates that the average internet penetration rate of the world is 54.4% while Asia is slightly lower at 48.1% average. Number of Facebook users is also included but not used in this paper.

Table 3 displays the internet penetration rate of APT countries. It can be seen that almost all of APT countries have higher internet penetration rate than the average of Asia. In addition, more detailed data suggest that although the number of internet users are still low in several countries, their growth rate is exceptionally high. For example, Myanmar's internet penetration rate has been rapidly rising from

only 2.1% in 2014 to 33.4% in 2017. Likewise, this rate has been increasing from 14.3% in 2014 to 35.0% in 2017 in Lao PDR.

Country	IDI Score (Rank)	
	2016	2017
Brunei Darussalam	6.56 (54)	6.75 (53)
Cambodia	3.04 (128)	3.28 (128)
China	5.17 (83)	5.60 (80)
Indonesia	3.85 (114)	4.33 (111)
Japan	8.32 (11)	8.43 (10)
Lao PDR	2.43 (144)	2.91 (139)
Malaysia	6.22 (62)	6.38 (63)
Myanmar	2.59 (140)	3.00 (135)
The Philippines	4.52 (100)	4.67 (101)
Singapore	7.85 (20)	8.05 (18)
South Korea	8.78 (1)	8.85 (2)
Thailand	5.31 (79)	5.67 (78)
Vietnam	4.18 (108)	4.43 (108)
Surveyed Countries	**176**	**176**

Table 2: ICT Development Index 2017 of APT countries
(International Telecommunication Union, 2017)

Country	Population (Estimated)	Internet Penetration (Rank)
Brunei Darussalam	434,076	94.6% (19)
Cambodia	16,245,729	49.3% (153)
China	1,415,045,928	54.6% (134)
Indonesia	266,794,980	53.7% (139)
Japan	127,185,332	93.3% (24)
Lao PDR	6,961,210	35.0% (178)
Malaysia	32,042,458	78.3% (75)
Myanmar	53,855,735	33.4% (185)
The Philippines	106,512,074	62.9% (121)
Singapore	5,791,901	83.6% (60)
South Korea	51,164,435	92.6% (29)
Thailand	69,183,173	82.4% (63)
Vietnam	96,491,146	66.3% (110)
Surveyed Countries	**242**	**242**

Table 3: Internet Usage Statistics 2017 of APT countries (Miniwatts Marketing Group, 2018)

Global Salary Survey (GSS)

Robert Walters is an international recruitment consultancy. Their 2017 survey in salary involve 9 countries from APT region (Robert Walters, 2017). Although incomplete, it can be used as a guideline for the region. Table 4 lists approximate maximum annual salaries of positions equivalent to software developers in US Dollars in APT nations. It can be seen that the salary diversity is high amongst the region. Brunei Darussalam, is expectedly to be on par with Japan and Singapore. On the other hand, salary for software developer in Cambodia, Myanmar and Lao PDR are highly likely to be lower than all listed nations.

Country	Salary (USD)
Brunei Darussalam	N/A
Cambodia	N/A
China	22,000-58,000
Indonesia	15,000-34,000
Japan	54,000-90,000
Lao PDR	N/A
Malaysia	20,000-44,000
Myanmar	N/A
The Philippines	20,000-49,000
Singapore	51,000-110,000
South Korea	45,000-67,000
Thailand	27,000-49,000
Vietnam	20,000-30,000

Table 4 Global Salary Survey 2017 of APT countries (Robert Walters, 2017)

Global Cities Report (GCR)

Unlike other indexes, the Global Cities Report by A.T.Kearney focuses on major cities instead of the entire nations. The 2018 report includes 135 cities (A.T.Kearney, 2018). This involves cities from China, Indonesia, Japan, South Korea, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam. The Global Cities Report has been in published for almost a decade. It observes major cities from 2 perspectives, i.e. current performance and future potential. The current performance of a city is determined by business activities, human activities, information exchange, cultural experience, and political engagement. On the other hand, the future potential illustrates personal well-being, economics, innovation, and governance. Since the report focuses on cities and is not directly related to technological readiness and the detailed scores are not revealed by this index, it is used only as a supplementary evidence. Furthermore, Brunei Darussalam, Cambodia and Lao PDR were not surveyed. Table 5 displays both current performance and future potential during 2016-2018 of major cities in APT nations. Only the top two cities are displayed here.

Country	City	Current Performance Rank (2016/2017/2018)	Future Potential Rank (2016/2017/2018)
China	Beijing	9 / 9 / 9	42 / 45 / 47
	Shanghai	20 / 19 / 19	63 / 61 / 64
Indonesia	Jakarta	56 / 56 / 59	110 / 109 / 114
	Surabaya	104 / 104 / 105	109 / 110 / 120
Japan	Osaka	52 / 51 / 50	33 / 41 / 39
	Tokyo	4 / 4 / 4	19 / 23 / 14
South Korea	Seoul	11 / 12 / 12	32 / 38 / 45
Malaysia	Kuala Lumpur	49 / 49 / 49	54 / 53 / 61
Myanmar	Yangon	118 / 120 / 127	115 / 108 / 112
The Philippines	Manila	59 / 66 / 64	74 / 75 / 85
Singapore	Singapore	8 / 6 / 7	17 / 11 / 5
Thailand	Bangkok	41 / 41 / 43	89 / 83 / 82
Vietnam	Ho Chi Minh	76 / 76 / 80	97 / 74 / 83
Surveyed Cities		**125 / 128 / 135**	**125 / 128 / 135**

Table 5: Global Cities Report 2018 of APT cities (A.T.Kearney, 2018)

Technological Readiness

Technological readiness can be defined by various items. This paper moderates and classifies all key information from the four reports into 4 main dimensions, i.e., regulatory, infrastructure, ecosystem and people.

1st Dimension: Regulatory

Regulatory involves the readiness in politics, regulations, taxes and supports from the government. In the Global Information Technology Report, information for this dimension is drawn from the first and second pillars which involves availability of ICT laws, effectiveness and efficiency of enforcement, intellectual property protections, software piracy and tax rate.

Data from related index suggest that there are laws and regulations for ICT and related issues in APT region (World Economic Forum 2014; World Economic Forum 2016). However, they might not be sufficient in some countries. According to GITR index, Singapore and Malaysia have the most appropriate set of laws and regulations and they are both ranked amongst the top ten world ranking. South Korea and Japan also have adequate regulatory. On the other hand, enforcement of the law can be an issue for most APT countries. Singapore, Japan, Malaysia and Brunei Darussalam have the most effective law enforcement system in the region. China, Lao PDR, Vietnam and Indonesia are reported to have moderately effective enforcement. However, there seems to be challenges in the effectiveness of law enforcement in the Philippines, Thailand, South Korea, Myanmar and Cambodia. This is similar to the intellectual property protections.

Software piracy rate is reported to be generally moderate to high throughout the region. Nations with the lowest problem of software piracy are Japan, Singapore and South Korea. Japan is actually the second best in the world on actions against piracy. It is important to note that there are missing data from several countries such as Cambodia, Lao PDR and Myanmar.

In contrast, despite of having reliable regulatory system, Japan and Malaysia's tax rate may be less appealing when compared to other APT nations. China, the Philippines and Vietnam are also reported to have comparatively higher tax rate. Cambodia, Lao PDR, Thailand and Indonesia provide more attractive tax structure that the aforementioned countries. Yet, although not significantly different from the previous group, Singapore and Brunei Darussalam are reported to be the most preferable destination in the region in term of taxation.

2nd Dimension: Infrastructure

Infrastructure is another critical factor which influence success on investment. Information discussed in this section are retrieved from the third pillars in the Global Information Technology Report and the Internet Usage Statistics.

It is unfortunate that more than half of the APT members seem to have lower electricity capability than the rest of the world. Only South Korea, Brunei Darussalam, Singapore and Japan are ranked amongst the world leaders. In contrast, the reliability of electricity in Vietnam, Indonesia, the Philippines, Myanmar and Cambodia seem to have a large room for improvement.

Overall international internet bandwidth per population in Singapore and Brunei are peerless. Thailand, Japan and South Korea are reported to offer above average of services. On the other hand, the international bandwidth in Vietnam, Cambodia, Indonesia, China and Lao PDR are lagging behind. Nevertheless, it needs to be noted that this index considers the entire population of a country therefore it is not surprising to see lower scores in larger countries.

The 2017 internet penetration rate exceeds 90% in Brunei Darussalam, Japan and South Korea. Singapore and Thailand also have satisfying penetration rate at more than 80%. On the other hand, more than 50% of the population do not have access to the Internet in Cambodia, Lao PDR, and Myanmar. Yet, the Global Cities Report suggests that in certain cities of these countries, it may be possible to find high quality infrastructure.

3rd Dimension: Ecosystem

Overall environment and ICT ecosystem discussed in this section is based on information from the eighth, ninth and tenth pillar in the Global Information Technology Report, the ICT Development Index and the Global Salary Survey. It discusses the support from the government, availability of knowledge-based job positions, salaries, usage of technologies and accessibility to technologies.

According to the Global Information Technology Report, there are excellent reception towards ICT business from the government in Singapore, Malaysia, Japan, South Korea and Brunei Darussalam. China, Indonesia and Vietnam also gain increasing support from the government. In contrast, the government of Thailand, Cambodia and Myanmar provide the least support on ICT industry in the region.

As for job positions, Singapore is currently one of the world leaders in knowledge-intensive jobs. Brunei Darussalam, Malaysia, Japan, the Philippines and South Korea are also reported to be in the top half of the world. On the other hand, the percentages of knowledge-based workforces in Cambodia, Indonesia, Vietnam and Thailand are still rather low. There is no report on this index from China, Lao PDR and Myanmar.

Salaries in more developed APT countries are significantly higher than the rest of the region. Singapore and Japan's high wage may not be attractive to the investors. However, most of other APT nations share similar salary structure while Vietnam and Indonesia's talents can be hired with the lowest budgets. Other countries which are not included in the Global Salary Survey, i.e. Lao PDR, Myanmar and Cambodia are expected to have the same, if not lower, rate of salary as well.

Singapore, Malaysia and South Korea are reported to be familiarized with the use of technology in the highest level. Japan, Brunei Darussalam and China score slightly lower than the three previous nations. In contrast, in Cambodia and Myanmar, ICT has been used in a substantial lower rate than other APT nations.

South Korea is ranked second in the world for overall development of technology-related issues based on ICT Development Index 2017. Japan and Singapore also offer high quality ecosystems for investors. Nevertheless, several APT countries, i.e. the Philippines, Vietnam, Indonesia, Cambodia, Myanmar and Lao PDR, are still in an early stage of ICT ecosystem development.

4th Dimension: People

People is the last dimension in this paper. It includes information from the fifth and seventh pillars of the Global Information Technology Report on the aspects of education system, adult literacy rate and capacity of innovation. Population from the Internet Usage Statistics is also discussed.

Singapore and Malaysia are reported to provide the highest overall quality of education systems in the region. Japan, the Philippines, Brunei Darussalam and Indonesia are also providing a competitive level of education. Thailand, Vietnam, Cambodia and Myanmar, on the other hand, need more improvement on their systems.

Regarding the populations, it is clear that China has the highest potential in this region with more than one billion residents. Indonesia, Japan, and the Philippines all host more than 100 million populations. In contrast, Lao PDR, Singapore and Brunei Darussalam

Adult literacy rate in APT nations are interestingly at the same level. Apart from Cambodia and Lao PDR which have almost 80% literacy rate, all other countries have exceeded 90% adult literacy. Although information from Japan and South Korea are not presented in the study, it is expectable that the literacy rate in both countries are on par with the majority.

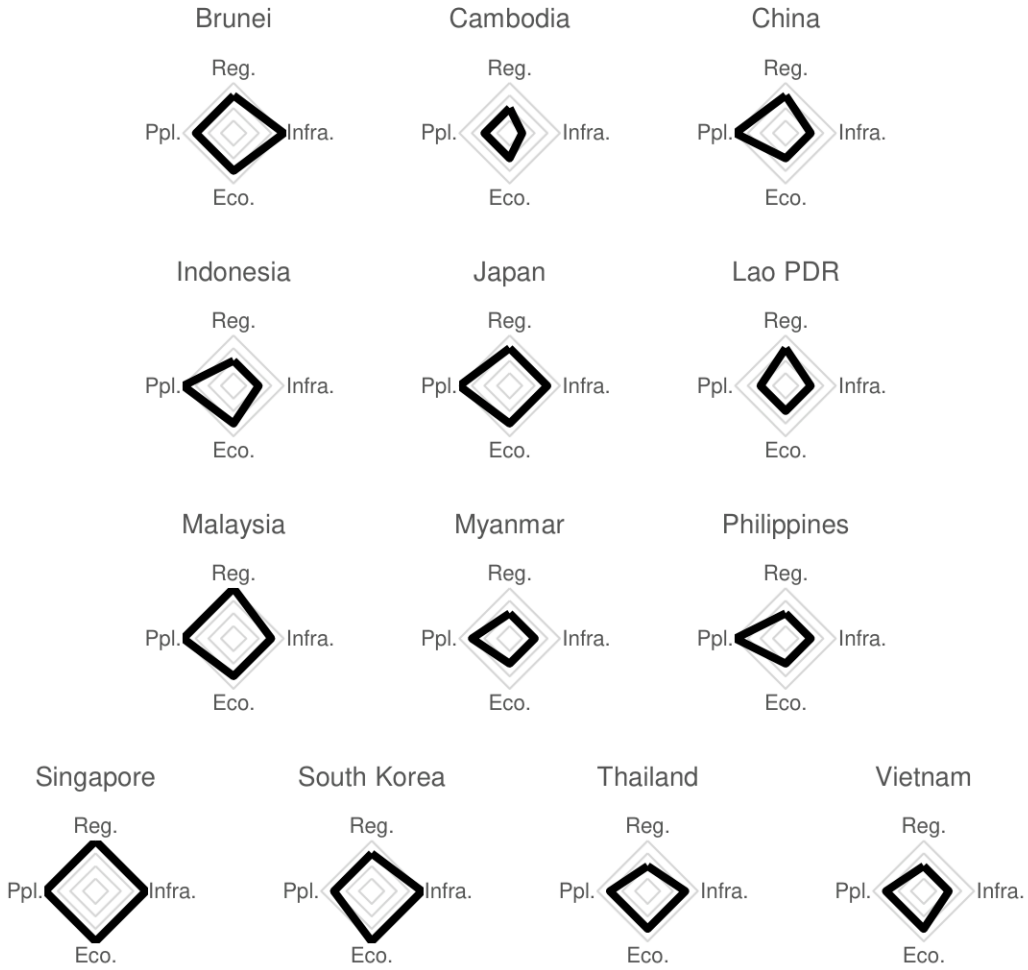
Malaysia is at the top of the region for the capacity of innovation, following by Japan, Singapore and South Korea, respectively. Indonesia and the Philippines leads the second tier of innovation. China, Thailand and Brunei Darussalam appear to be the upcoming contender. The rest of APT region is under development on this aspect.

Outlook on Nations

All four dimensions on technological readiness are summarized in Figure 1. Based on the criteria, it is obvious that Singapore is the current leader in technological readiness due to several aforementioned issues. Brunei Darussalam, Japan, Malaysia and South Korea are also the top tier of the region. Then, China, Indonesia, the Philippines, Thailand and Vietnam are developing their

competitiveness as an upcoming tier. On the other hand, Cambodia, Lao PDR and Myanmar, is a future tier which are still full of potential. They may require more time to develop their capacities to meet the average of the region.

Yet, it is obvious that, due to incompleteness of data as well as other business limitation, investors must realize that these information is relative. It does not necessarily mean that the top tier countries will always be the most preferable destination for all. For example, higher wage can be a sole reason to hold an investment. On the other hand, investing in a less ready country may yield higher and several facets of long-term benefits.



Note: Reg.=Regulatory; Infra.=Infrastructure; Eco.=Ecosystem; Ppl=People

Figure 1: Outlook on APT Nations

Conclusion

This paper surveys latest reports and suggests a technological readiness outlook of ASEAN Plus Three countries. The outlook consists of 4 main dimensions, i.e. regulatory, infrastructure, ecosystem and people. Advantages and disadvantages of each nation based on the dimensions are explained and discussed. As a result, three tiers of APT nations are summarized. Firstly, the top tier countries which have already established their readiness includes Singapore, Japan, South Korea, Brunei Darussalam and Malaysia. The second tier which still has challenges in certain aspects are China, Indonesia, the Philippines, Thailand and Vietnam. Finally, Cambodia, Lao PDR and Myanmar are found to be lagging at present. However, due to the rapid growth of technology, they may require a short period of time to move up their tier in the future.

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