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ASEAN in the Global Arena — Science, Technology and Innovation in ASEAN

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Abstract: The Association of Southeast Asian Nations or ASEAN with ten member nations, namely Malaysia, Indonesia, Philippines, Singapore, Thailand, Brunei, Vietnam, Laos, Myanmar and Cambodia is one of the most important trading blocs globally with the emphasizing of various economic co-operations between their members.

The Vision 2020 that was issued by ASEAN Heads of government in 1997 with the aim to narrow down the development gaps, one of them is science, technology and innovation area in ASEAN. ASEAN members had worked together to improve research and development in science and technology, transfer of technology within members nations and closer integration in science and technology projects. While the ASEAN members are progressing in this area, there are some members who are catching up. This paper discusses about the challenges in science and technology area those faced by ASEAN. Recommendations and conclusion are provided at the end of the discussion.

Key words: ASEAN, science, technology, innovation

1. Introduction

The Association of Southeast Asian Nations (ASEAN) was established on 8 August 1967 in Bangkok by the five original member countries. These five member countries are Malaysia, Singapore, Thailand, Indonesia and Philippines. In 1999, the ASEAN members countries had expanded to total 10 members, with newly joined Brunei, Vietnam, Laos, Myanmar and Cambodia[1]. The aims of ASEAN are to accelerate the economic growth, social progress and cultural development in the region and to promote science, technology and innovation cooperation and collaboration among member states.

Science, technology and innovations enhance human capital to increase productivity. Knowledge in science helps to develop technology and lead the country to achieve advanced country level. Table 1 shows the human resource capital indicators in 2011 for advanced countries and developing countries.

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[1] http://www.state.gov, 2015.

Table 1 Human Resource Capital Indicators (2011)

Country	No. of Professionals 2011	Population 2011	Human resource capital/ 1,000 people
Denmark	57,170	5,515,575	10.4
Finland	54,526	5,255,068	10.3
Sweden	78,480	9,074,055	8.6
Norway	38,882	4,676,305	7.9
Singapore	**37,013 (2010)**	**4,701,069**	**7.9**
Japan	877,928	126,804,433	6.9
South Korea	335,228	48,636,068	6.9
Russia	839,183	139,390,205	6.0
Malaysia	**57,405**	**28,274,729**	**2.0**
Thailand	**80,344 (2009)**	**67,089,500**	**1.2**
Indonesia	**51,544**	**242,968,342**	**0.2**

Sources: UNESCO: A global perspective on Science, Technology & Innovation (STI), 2011

Table 1 shows that the advanced countries, such as Denmark had 10.4 professionals per 1,000 people, Finland had 10.3 professionals (per 1,000 people), Sweden had 8.6 professionals (per 1,000 people), Norway and Singapore had 7.9 professionals (per 1,000 people), and Japan and South Korea had 6.9 professionals (per 1,000 people). Denmark is one of the countries has the advanced level of technology in manufacturing ship. Maersk line from Denmark is known for its quality and durability of the ships. Volvo car and Electrolux washing machine possess a portion of automotive and electrical appliances market in the world. Orkla from Norway is a conglomerate operates in branded consumer goods and aluminium solutions and had operation in more than 40 countries[2]. Singapore is well known for its water treatment and waste water recycling technology, medical and biological technology in the world.

Comparing the top five countries with highest number of professional per 1,000 people, ASEAN members' countries, namely, Malaysia had 2.0 professionals, Thailand had 1.2 professionals and Indonesia had 0.2 professionals (per 1,000 people), this shows that ASEAN members are far behind in science and technology development, except Singapore. This table also shows that countries with more than 5.0 professionals (per 1,000 people) are eligible to become advanced countries. If ASEAN members would like to be in the advanced countries list, they need to develop science, technology and innovation (STI). STI plays an important role to enhance human capital, which then leads to become advanced country.

The first section outlines the ASEAN efforts to stimulate science and technology (S&T) since 1970s and involvements of ASEAN members in S&T. The second section reviews the achievements of ASEAN members in STI performance, economic growth rate, governance score and income group. The third section discussed the challenges faced by ASEAN members in S&T, such as technological gaps, government effectiveness and political stability. Lastly, recommendations and conclusions were provided at the end of the paper.

2. ASEAN Efforts to Stimulate S&T

In ASEAN, STI policies are integrated at the intergovernmental level, which is these policies are formed and implemented among the member's governments. In 1997, the Heads of ASEAN governments had issued 'Vision

[2] http://en.wikipedia.org/wiki/Orkla_ASA, 2015.

2020' with the aim to achieve advanced country by 2020. This year is 2015, 18 years had passed since 1997, and there are only 5 years more to be year 2020. Three questions need to be looked in depth and more attention need to be paid. These three questions are:

- What had ASEAN done for STI?
- Where is ASEAN stand now for STI?
- What ASEAN need to do more from now to develop STI?

Smits and Kuhlmann (2002) had categorized the focus of STI policies by ASEAN in 70's, 80's, 90s' and 2000. In 70's, the STI focused in stimulating the research & development (R&D) in the ASEAN members. In 80's, the STI focused on technology transfer projects and collaborations. In 90's, technological based S&T focus was expanded into application of S&T in management processes and systems. In 2000, the STI focus was extended from management applications to encourage creation, invention and innovation.

The ASEAN was established in 1967. Since ASEAN had formed, through the sharing information among the members, application of science and technologies in agricultural sector had been developed to produce food to ensure enough supply for own country and the extra food had been supplied to members nations. In 1969, His Majesty the King of Thailand had started R&D in agricultural sector to produce more food for the country. With the Royal project started in 1969 to solve problems of deforestation, poverty and opium production, His Majesty the King of Thailand had encouraged implementation of S&T to increase agricultural productivity. His Majesty the King of Thailand had aware of the importance of S&T to move up the economy, slowly from agricultural sector, expanded to manufacturing and production sector. On 10th January 1969, His Majesty the King of Thailand visited Faculty of Agricultural, Chiang Mai University to have a deep understanding the implementation of Royal project and how to improve their people living standard by developing S&T in agriculture.

Since 1970, ASEAN members had worked in committees to improve S&T. In 1970, Ad-hoc Committee Meeting on S&T was formed. In 1971, it had been upgraded to Permanent Committee Meeting on S&T. In 1978, Committee on S&T was formed to provide resources among members country, cooperate for S&T projects, to enhance technology transfer among members and to coordinate and monitor STI projects and programmes.

The ASEAN members had formed some policies and implemented strategic plans to boost up S&T in the countries.

The 10th Malaysia Plan 2011-2015 aims at increasing R&D activities and to position Malaysia as a technology provider in advanced industries. This plan continues from the 9th Malaysia Plan 2006-2010 which emphasized on developing the S&T in the general sectors. In 2000, the 7th Malaysia Plan1996-2000 had targeted to produce 1,000 researchers per 1 million people. Up till 2011, Malaysia had achieved 1,643 researchers per 1 million people (World Bank, 2012).

Comparing with Singapore has 6,494 researchers per 1 million people in 2011 (World Bank, 2012), there is still some figure for Malaysia to catch up. In 2015, Research, Innovation and Enterprise (RIE) had allocated SD 16.1 billion in research, innovative and entrepreneurial economy (www.sgc.org.sg/, 2015). Singapore actively involves in S&T and had invested large amount of money for S&T related activities, brought in new technologies and developed with the research teams in Singapore.

Brunei introduced "Wawasan 2035" with the aim to coordinated and integrated national strategy to emphasize on STI development. With the 10th National Development Plan 2011-2015, Brunei government had allocated BD16.6 million for S&T development in the country.

Indonesia emphasized the R&D activities with Strategic Policy for National S&T Development 2000–2004.

With National Mid-Term Development Plan 2010–2014, more budget was allocated to S&T development.

Philippines implemented the Medium-Term Plan 2004–2010 targeted at proper functioning of the Philippine National Innovation System. This effort was upgraded to strengthen the country's competitiveness in S&T through the Medium-Term Plan 2011–2015.

Thailand started the 8th National Economic and Social Development Plan 1997–2001 to focus on S&T development. With 9th National Economic and Social Development Plan 2002–2006, Thailand focused on strengthening S&T in industrial production. Recently, Thailand had increased the effort to improve the national innovation system through National S&T strategic plan 2004–2013.

Laos encouraged the R&D activities with the 6th National Socio-Economic Development Plan 2006–2010. The 7th National Socio-Economic Development Plan 2011–2015 focused on training up the skilled work force.

Vietnam introduced Socio-Economic Development Plan 2006–2010 to promote R&D. This plan was continued in 2011 as Socio-Economic Development Plan 2011–2015 to train up the labour and upgrade the skill level of workforce.

These countries share the same vision, that is, to achieve advance country level by year 2020. To achieve this, ASEAN members need to enhance their competitive advantages. How to enhance their competitive advantages? The answer is to create capabilities. How to create capabilities? That is by creating new technologies. How? Through R&D. The following section explains further the R&D in the ASEAN members.

3. Achievements of ASEAN Members

ASEAN members had achieved some results in S&T, economic growth, governance score and income level. Singapore is leading in these four mentioned aspects (S&T, economic growth, governance score and income level) among ASEAN members. Table 2 shows the R&D expenditure (2014) for the ASEAN members.

Table 2 R&D Expenditure (2014)

Countries	Index(/1.00)
Brunei	0.1
Cambodia	0.1
Indonesia	0.2
Laos	**0.4**
Malaysia	**0.8**
Myanmar	0.1
Philippines	**0.8**
Singapore	**0.9**
Thailand	**0.5**
Vietnam	0.2

Source: Rodriguez & Soeparwata (2015)

This table shows that in 2014, Singapore ranked as the first place for its R&D expenditure (with index 0.9 out of 1.00) among the ASEAN members. Malaysia and Philippines are at the second place with index 0.8. Thailand is at the third place with index 0.5, follows by Laos (index 0.4). From the above figures, it shows that ASEAN members had put their efforts in nurturing R&D culture to achieve development in STI, especially Singapore, Malaysia and Philippines.

ASEAN members R&D expenditure is closely related with their STI performance. Table 3 shows the ASEAN members STI performance from 1999 to 2009.

Table 3 ASEAN Members STI Performance (1999–2009)

Countries	Mean	Performance
Brunei	0.2	Trailing
Cambodia	0.2	Trailing
Indonesia	**0.3**	**Catching up**
Laos	0.2	Trailing
Malaysia	**0.5**	**Follower**
Myanmar	0.2	Trailing
Philippines	**0.3**	**Catching up**
Singapore	**0.6**	**Leader**
Thailand	**0.3**	**Catching up**
Vietnam	0.2	Trailing

Source: Rodriguez & Soeparwata (2015).

Table 3 shows that Singapore with the mean (0.6) as the leader among ASEAN members, follows by Malaysia (mean 0.5) as the follower. Thailand, Indonesia and Philippines at the third place with mean (0.3). The other countries, such as Brunei, Vietnam, Laos, Myanmar and Cambodia are trailing in STI. STI performance influences economic growth. ASEAN members had put efforts in their STI and this directly had influenced their technology levels in manufacturing and production sectors and had some impacts on their economic growth. Table 4 shows the ASEAN members economic growth rate from 1999–2009.

Table 4 ASEAN Members Economic Growth Rate (1999-2009)

Countries	Mean	Growth
Brunei	**0.53**	**Significant progress**
Cambodia	0.03	Slight progress
Indonesia	0.06	Slight progress
Laos	0.01	Slight progress
Malaysia	**0.71**	**Significant progress**
Myanmar	0.01	Slight progress
Philippines	0.27	Slight progress
Singapore	**0.31**	**Significant progress**
Thailand	**0.29**	**Significant progress**
Vietnam	0.14	Slight progress

Source: Rodriguez & Soeparwata (2015).

Table 4 shows that Singapore, Malaysia, Thailand and Brunei had achieved significant progress in economy from 1999 to 2009 (11 years). The other member countries, such as, Indonesia, Philippines, Laos, Myanmar, Cambodia, Vietnam had slight progress in economic growth.

Government stability, accountability and regulatory quality are closely related with their involvements in S&T. Table 5 shows the governance score for 2009 which measured government from six aspects, thus, voice and accountability, political stability, government effectiveness, regulatory quality, rule of law and control of corruption. The score ranges from -2.5 to +2.5.

Table 5 Governance Score for 2009 (from -2.5 to +2.5)

Countries	Accout.	Politic.	Effect.	Quality	Rule	Control	Score
Brunei	**-0.79**	**1.35**	**0.87**	**1.11**	**0.79**	**0.96**	**0.72**
Cambodia	-0.88	-0.63	-0.74	-0.37	-1.05	-1.18	-0.81
Indonesia	-0.05	-0.64	-0.21	-0.28	-0.56	-0.71	-0.41
Laos	-1.71	0.0	-1.03	-1.05	-0.94	-1.14	-0.98
Malaysia	-0.53	0.07	-0.99	0.33	0.55	0.02	**0.24**
Myanmar	-2.17	-1.72	-1.85	-2.31	-1.52	-1.75	-1.89
Philippines	-0.12	-1.42	-0.14	0.02	-0.53	-0.71	-0.48
Singapore	**-0.4**	**1.15**	**2.19**	**1.84**	**1.61**	**2.26**	**1.44**
Thailand	-0.4	-1.11	0.15	0.37	-0.13	-0.23	-0.23
Vietnam	-1.52	0.19	-0.26	-0.56	-0.43	-0.52	-0.52

Source: Kaufmann, Kraay & Mastruzzi (2011).

**Accout.: voice & accountability; Politic: political stability; Effect: government effectiveness; Quality: regulatory quality; Rule: rule of law; Control: control of corruption.

Table 5 shows that Singapore and Brunei have high governance score, follows by Malaysia. Looking into voice and accountability aspect, all the ASEAN members have negative figures, means that these governments do not show accountable actions responded to the voices articulated by their citizens. For political stability, Brunei, Singapore, Malaysia, Vietnam and Laos show positive figures; means that political is stabile in these countries. There are only three countries gained positive figures for government effectiveness, namely, Singapore, Brunei and Thailand, means that these governments work effectively and efficiently. For regulatory quality, five ASEAN members show positive figure (Brunei, Singapore, Malaysia, Philippines and Thailand), explains that the regulations implemented fulfilled the quality demand generally. Singapore has the highest score (1.61) for rule of law, follows by Brunei (0.79) and Malaysia (0.55). This illustrates that Singapore has very strict laws and orders. For control of corruption, Singapore also gained the highest score (2.26), Brunei at the second place (0.96) and Malaysia ranked at the third place (0.02). These governments have harsh punishments to punish criminals to lower the level of corruptions.

Governance quality affects Foreign Direct Investment (FDI) flows to the country. Most of FDI tend to invest in political stable countries with efficient and transparent governments. Table 6 shows the FDI inflows in ASEAN from 2002 to 2011 (10 years) in millions USD).

Table 6 FDI Inflows in ASEAN (2002–2011) (in millions USD)

Year	Camb.	Laos	Vietn.	Indon.	Mal.	Phipl.	Thail.	Singp.
2002	145	5	1,400	146	3,203	1,542	3,355	6,157
2003	84	19	1,450	-597	2,473	491	5,222	17,051
2004	131	17	1,610	1,896	4,624	688	5,859	24,390
2005	381	28	1,954	8,336	4,065	1,854	8,067	18,090
2006	483	187	2,400	4,914	6,060	2,921	9,501	36,700
2007	867	324	6,700	6,928	8,595	2,916	11,359	46,972
2008	815	228	9,579	9,318	7,172	1,544	8,455	12,200
2009	539	190	7,600	4,877	1,453	1,963	4,854	24,939
2010	783	279	8,000	**13,771**	9,060	1,298	9,147	**53,623**
2011	902	301	7,430	**19,241**	**12,198**	**1,816**	7,779	**55,923**

Source: United Nation Conference on Trade and Development, UNCTAD (2013)

**Camb.: Cambodia; Laos: Laos; Vietn.: Vietnam; Indon.: Indonesia; Mal.: Malaysia; Phipl.: Philippines; Thail.: Thailand; Singp.: Singapore.

Table 6 shows that in 2010 and 2011, FDI inflows in ASEAN had increase drastically in Indonesia, Malaysia, Philippines and Singapore. Singapore received the most FDI among the ASEAN members. Since 2004, FDI to Cambodia, Laos and Vietnam had increased annually except in 2008, which was influenced by the global financial crisis. Recently, Cambodia, Laos and Vietnam had been one of the most attractive investment destinations for foreign investors around the world. In 2014, Samsung had built up the third manufacturing factory in Vietnam. Samsung also spent 1% of the annual income for R&D activities centered in Ho Chi Minh City.

Thailand is the world's second largest pick-up truck market after the U.S., and it is ASEAN's largest automotive market and assembler. In 2014, 39% of the FDI inflows to Thailand were in metal, machinery and transportation industry. Auto assembly and auto parts manufacturing projects covered 96% of this industry[3]. Thailand was chosen as an investment destination by Toyota in 2003 to establish up a local R&D centre in Thailand (Duangjai, 2013). In 2005, Toyota invested Thailand as the R&D center in Asia Pacific and set up Toyota Technical Center Asia Pacific in Bangkok (Natsuda & Thoburn, 2011).

Table 7 shows the income level of ASEAN members. For low income level, the gross national income per capita is USD995 or less. For lower middle income, the gross national income per capita is from USD996 to USD 3,945. High middle income has gross national income per capita from range of USD 3,946 to USD 12,195. For high income level, the gross national income per capita is USD 12, 196 and above. This table shows that Singapore and Brunei have high income level compared with the other ASEAN members.

Table 7 Income Group of ASEAN (2009)

Countries	Income group
Brunei	**High income: non-OECD**
Cambodia	Low income
Indonesia	Lower middle income
Laos	Low income
Malaysia	Upper middle income
Myanmar	Low income
Philippines	Lower middle income
Singapore	**High income: non-OECD**
Thailand	Lower middle income
Vietnam	Lower middle income

Source: World Bank (2011).

By looking into Table 5 and Table 7, it shows that high-income economies (Singapore and Brunei) have high governance scores. This shows that the open, excellent, effective, efficient, transparent government and attractive systems and rules contributed to the technological development in the countries, which then contributes to their economic growth.

Malaysia has upper middle income level, ranked at the third place. Indonesia, Philippines, Thailand and Vietnam are lower middle income countries. Laos, Cambodia and Myanmar have low income level compared with the ASEAN members.

[3] http://www.business-in-asia.com, 2015.

4. Challenges of ASEAN Members in S&T

ASEAN faces challenges in narrow down the technological gaps, enhance education and maintain political stability in the countries. Education is the important tool to develop people and nation. With educated people who have sufficient science knowledge will contribute to development of technologies, which then enhance the competitive advantages and capabilities of the country. The real examples of contribution of education to countries development are China and South Korea. In 1978, during Deng Xiao Ping official visit to Japan, he also dropped by a factory that manufactured digital watch in Japan. He observed by himself the technology in Japan produced digital watches in few minutes and realized that China was far left behind. After his returned to China, under the economic reform policy, he had allocated Renminbi 10 billion budget to develop the education system in the country to provide educational opportunities to the people (Zhang, Chong & AP, 1999). After 37 years reformed in China, today China manages to produce air planes, bullet train, rockets, jet fighters, battleships, battle tanks, smart phones and also leads in 3D bio-printing of tissues and organs technologies, quantum communirecommenation technologies, 5G wireless technologies, submarine technologies, architectural technologies and so on.

The other example is South Korea. After the Korean War ended in 1953, South Korea faced scarcity of resources[4]. The South Korea leaders had aware that to improve South Korea economy, the people need to have education. The South Korea government had implemented an effective and efficient educational system since 1960 to increase enrolment rate in schools, develop high standards for national curriculum and textbooks, improve teaching quality and emphasize on S&T learning and development (Lee, 2014). In 2014, South Korea government spent $7,652 per student, as compared to the Organization for Economic Cooperation and Development (OECD) average of $8,868. This represents 7.6% of South Korea's GDP spent on education, as compared to the OECD average of 6.1%. South Korea is the third-highest percent of GDP spent on education among OECD countries, after Iceland and Denmark[5].

Today, South Korea educational system had been recognized worldwide for its rigorous system[6]. South Korea had achieved advanced country level with high Gross Domestic Product (GDP) per capita and known for its leadings conglomerates, such as Samsung, LG, Hyundai, Kia, SK Hynix and Posco.

These succeed examples provide the evidence that education is important for the development of S&T, which then contributes to the economic growth of the country.

Table 8 shows the Programme for International Student Assessment (PISA) test results 2012. This PISA tests the skills and knowledge of 15 years old students for mathematics, science and reading with 65 countries participations.

Table 8 shows that Shanghai, China ranked at first place for mathematics, science and reading for PISA 2012. Singapore, a member in the ASEAN ranked at second place for mathematics, third place for science and reading. Comparing with the other ASEAN members, their scores in PISA were behind. Vietnam gained no. 8 for science, better than Germany at no. 12. But, for mathematics and reading, Vietnam was just slightly after Germany. Vietnam was at no. 17 (after German at no. 16) for mathematics and at no. 20 (after German at no. 19) for reading.

[4] http://en.wikipedia.org/wiki/Korean_War, 2015.
[5] http://www.ncee.org, 2015.
[6] http://en.wikipedia.org/wiki/Education_in_South_Korea, 2015.

Table 8 Programme for International Student Assessment (PISA) 2012

Mathematics	Science	Reading
1. Shanghai, China	**1. Shanghai, China**	**1. Shanghai, China**
2. Singapore	2. Hong Kong, China	2. Hong Kong, China
3. Hong Kong, China	**3. Singapore**	**3. Singapore**
16. Germany	8. Vietnam	19. Germany
17. Vietnam	12. Germany	20. Vietnam
50. Thailand	48. Thailand	47. Thailand
51. Malaysia	53. Malaysia	59. Malaysia
64. Indonesia	64. Indonesia	60. Indonesia
65. Peru	65. Peru	65. Peru

Source: PISA (2013).

Thailand ranked at no. 50 for mathematics, no. 48 for science and no. 47 for reading. Thailand showed better PISA results than Malaysia. In Thailand, the world leading automotive manufacturers, such as Toyota, Honda, BMW, Mercedez Benz, Volvo, General Motors, Ford, Peugeot manufacture and assemble cars in Thailand along with their group of subcontractors and suppliers. Thailand has become the main production base for auto parts in South East Asia. This shows that Thailand has these automotive technologies and catching up in this industry, doing better than Malaysia and the other ASEAN countries.

Indonesia ranked at no. 64 for mathematics, science and at no. 60 for reading. Peru ranked at the last place for PISA test 2012. This table shows that ASEAN members have very different level in their education, especially for mathematics, science and reading subjects. More efforts from the ASEAN members are needed to narrow down this gap.

5. Recommendations

Science, technology and innovation (STI) are related to economic growth. Heads of ASEAN aim at Vision 2020. To achieve it, ASEAN needs to deeper integration among members, such as transfer technology, joint-venture projects, and collaboration in R&D. More efforts are needed to move up the value chain, increase its reliance on productivity and enhancing innovations. For example, ASEAN governments can provide incentives to manufacturers who involve in R&D activities for their productions, awards to be given to scientists who contributed in their studies and innovations, loans and funds provided to organizations for technological trainings for their employees.

Since 2000, Malaysia' Institutes of Higher Learning (IHL) had encouraged science to arts students to achieve ratio 60:40, means that among 100 students, 60 students study science and 40 students study arts. After 15 years, Malaysia had achieved 42: 58[7], that is among 100 students, 42 study science and 58 study arts. This shows that more efforts are needed to encourage students to study science rather than arts to achieve the target science to arts 60:40 ratio.

Additionally, Malaysia, Indonesia, Thailand, Philippines and the other ASEAN members need to focus on bring in FDI. Besides the FDI inflows to generate the economics, these countries can develop the modern skills that FDI brings with. For example, ASEAN countries research team can join and work together with the experts

[7] http://www.science2action.my, 2015.

brought in by FDI when set up the R&D centers in ASEAN countries as Samsung did in Ho Chi Minh city, Vietnam and Toyota set up Asia Pacific R&D centers in Bangkok, Thailand to develop products, for technology transfer or invent new products or new technologies.

Singapore is suggested to target on capital, skill and technology-intensive activities to raise the technological capability level, such as in medical, biological and, environmental engineering, water treatment technologies and so on. Singapore as one of the most attractive country for new technology development center had succeed to bring in investments from U.S., German, UK., Japan and China to build their manufacturing plants in Singapore. Among these multinational corporations (MNCs) are IBM, Microsoft, E.Excel, Siemen, GlaxoSmithKline, Panasonic, Sony, Haier and so on. Singapore High Technology Association (SHTA) was set up to develop high technologies and make Singapore the most attractive operation and expansion technologies center in the world.

Firms are encouraged to nurture life-long learning among staff to equip themselves with updated skills and knowledge. At higher levels, public and private sectors need to have greater emphasis on high-level, specialized trainings and closer interaction between education and production collaboration. For example, universities can have more internship projects, collaborative ventures with MNCs for S&T training and development programmes.

At national levels, the national policies to be implemented and combined with periodical monitoring, evaluation, review and bench-marking to have the best practice. Implementation without monitoring and review can cause overlook of problems embedded in management and administration, which then leads to inefficiency and ineffectiveness.

6. Conclusion

As conclusion, education plays an important role to stimulate STI development in the country. At low levels, the ASEAN governments need to improve the quantity and quality of primary schooling and basic technical educations. In Malaysia, the education systems were reviewed and revised to improve the implementation and quality of the systems. Since 1982, Malaysian government implemented primary school new curriculum which emphasized on establishing reading, listening and writing skills of primary school children to prepare a strong foundation for them for secondary and tertiary educations.

Organizations, firms, companies and factories are encouraged to provide on the job trainings, especially for S&T development trainings for their employees. Additionally, management needs to encourage life-long learning cultures in the organizations to inspire continuous development of the staff.

To conclude, ASEAN members had involve in S&T since 1960s and they had achieved some achievements. Singapore is far ahead, and the other ASEAN members are far behind. This is a challenge for ASEAN to narrow down the gap. For Singapore, the other ASEAN members expect more collaboration in S&T, joint-projects and technology transfers from Singapore to the other members. For the ASEAN members who left behind in term of S&T development, more efforts are needed to push up the results.

Union is strength. ASEAN members need to unite together to achieve success in STI, economics and social and cultural development. With cooperation, sincerity and sharing, ASEAN can perform new miracles and create wonderful future.

References

Kaufmann D., Kraay A. and Mastruzzi M. (2011). “Access governance indicators”, *World Bank*, November 4, 2015, available online at: http://info.worldbank.org/governance/wgi/sc_country.asp.

Lee H. W. (2014). "Proactive educational reforms in South Korea: Schools for improvement and multicultural education", *Revue Internationale d'éducation de Sèvres*, November 1, 2015, available online at: https://ries.revues.org/3897.

Lee M. and Lee S. (2016). "Evaluating internal technologies capabilities in energy companies", *Energies*, Vol. 9, No. 145, pp. 1–23.

Kabue L. W. and Kilika J. M. (2016). "Firm resources, core competencies and sustainable competitive advantage: An integrative theoretical framework", *Journal of Management and Strategy*, Vol. 7, No. 1, pp. 98–108.

Nakamichi K., Hanaoka S. and Kawahara Y. (2016). "Estimation of cost and CO_2 emissions with a sustainable cross-border supply chain in the automobile industry: A case study of Thailand", *Transportation Research Part D: Transport & Environment*, Vol. 43, pp. 158–168.

Natsuda K. and Thoburn J. (2011). "Industrial policy and the development of the automotive industry in Thailand", Ritsumeikan Center for Asia Pacific Studies (RCAPS) Working Paper No. 11-5, pp. 1–45.

Programme for International Student Assessment (PISA). Organization for Economic Co-operation and Development (OECD). (2013). November 12, 2015, available online at: http://www.oecd.org/pisa.

Rodriguez V. and Soeparwata A. (2015). "The governance of science, technology, and innovation in ASEAN and its member states", *Journal of the Knowledge Economy*, Vol. 6, No. 2, pp. 228–249.

Smits R. and Kuhlmann S. (2002). "Strengthening interfaces in innovation systems: Rationale, concepts and (new) instruments", in: European Commission (Ed.): *Science and Technology Policies in Europe: New Challenges and New Responses — Proceedings of the STRATA Consolidating Workshop*, Brussels, 22–23 April 2002.

UNESCO (2011). "A global perspective on Science, Technology & Innovation (STI)", November 2, 2014, available online at: http://www.uis.unesco.org/scienceTechnology.

United Nation Conference on Trade and Development (UNCTAD) (2013). "Trade and development report", accessed on 10th November, 2015, available online at: http://unctad.org.

World Bank (2013). "ASEAN integration monitoring report", accessed on 3rd November, 2015, available online at: http://data.worldbank.org.

Zhang H. Q., Chong K. and Ap J. (1999). "An analysis of tourism policy development in modern China", *Tourism Management*, Vol. 20, No. 4, pp. 471–485.