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Supportment for organization and management competences of ASEAN community and European Union toward Industry 4.0

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ABSTRACT

The paper focuses on supporting environment for Organization and Management Competences of the European Union and ASEAN Community, by which Industry 4.0 is the challenge. The paper used available, trusted sources of data to compare and investigate Organization and Management Competences supporting dimensions of European Union and ASEAN Community countries, i.e., Strategy, Leadership, Governance, Supply Chain Network, Culture, People and Process Digitalization. Result presentation discusses several observations on the issue of interest. Countries that are the most and least opportune to O&M competences are identified and discussed. Also, selected economy of interest, i.e., Austria, Italy, Slovakia, and Thailand, were further investigated and discussed in detail.

1. Introduction

Today, technology has become advanced and has driven the industrial productivity as never before. Since the industrial evolution in 1970s, industry is today moving toward the 4th revolution. Known as the Industry 4.0, the industry is becoming smart, connected and integrated along the supply chain (Lasi et al., 2014; Lee et al., 2015; Rüßmann et al., 2015). The Industry 4.0 is from the betterment of Cyber-Physical System (CPS) that can integrate the physical system with the information systems via connected digitalization platform, e.g., Internet services and Industrial Internet of Things (IIoT). This allows the companies to monitor, control, adjust, predict and act to response anything of interest (Gilchrist, 2016; Jazdi, 2014).

Whilst the scope of Industry 4.0 is extended from the Smart Factory or Smart Manufacturing to Smart Logistics, this includes digitalization of manufacturing, connected devices, collaborative supply chain, integrated decision making, advanced sensors and data analytics (Kang et al., 2016; Lee, 2015; Lu et al., 2016; Blecker et al., 2012; Uckelmann, 2008; Wang et al., 2016). Such technologies are now available and accessible, yet the implementation is challenging (Ganzarain and Errasti, 2016). Another big obstruction is the Organization and Management (O&M) of the companies as well as their environment if they are fitted to the Industry 4.0 requirements (Brettel et al., 2014; Matt et al., 2018). Fig. 1 illustrates the Industry 4.0 holistic concept, used in this paper.

It is, therefore, the aims of the paper to investigate if the environment of the selected economies are supportive to the O&M Competences and are aligned with the advancement of the industry. Countries in European Union and ASEAN Community are of interest of this paper.

2. The European Union and ASEAN community in brief

This research paper is a part of the Project "Industry 4.0 for SMEs" from the European Union's Horizon 2020 research and innovation program under the Marie Skłodowska-Curie grant agreement. The beneficiaries are the European and South East Asian countries where the concept of Industry 4.0 will be applied. The research focuses on Smart Manufacturing, Smart Logistics and Organization and Management. The following provides information of the EU and AC in brief.

The European Union (EU), established in 1993, is a collaboration of 28 European countries, aiming at creating a single standardized market, allowing free flow of goods, service, money and people (Hitiris, 2003; El-Agraa, 2011). The EU in 2018 holds an expected GDP of 16,241 US billion, contributing 22% of global GDP with the population of 6.6% of the world. In general, the EU are undoubtfully powerful

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in economics. However, there are still big gap between the collaborated countries. The EU economies varies in size from the largest of 3,466.6 US billion of Germany, to the smallest of 11.0 US billion of Malta. GDP per capita also varies from the highest of 103,198.8 US of Luxemburg to the lowest of 7,368.5 US of Bulgaria (Martin et al., 2018).

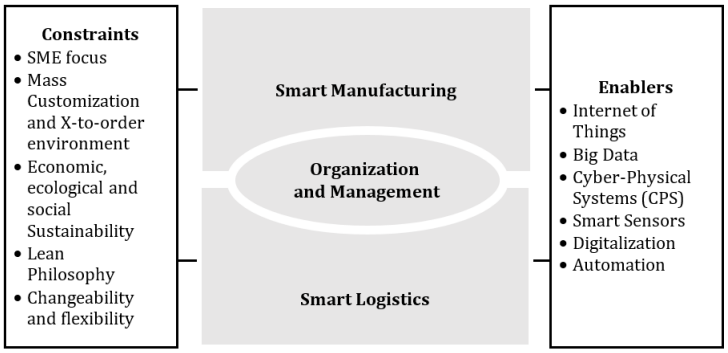


Fig. 1: Industry 4.0 holistic concept

ASEAN Community (AC), recently established in 2015, is a cooperative initiative of 10 South-East Asian countries, aiming at creating the economies into a single market and a single production base. This will allow free flow of goods, services, investment, capital and skilled labor, by which will strengthen ASEAN economies to compete to the world (ASEAN, 2008; Plummer and Yue, 2009). AC GDP is at 2,553.4 US billion in 2018, contributing 3.4% of global GDP with the population of 8.4% of the world. In general, AC members are mostly underdeveloped and developing countries, except the small but mighty Singapore and Brunei. The GDP varies from 932.4 US billion of Indonesia to 13.8 US billion of Lao PDR. GDP capita varies from 9,360 US of Malaysia to the low 1,299.6 US of Cambodia (Martin et al., 2018). It shall be noted here that Brunei and Singapore are excluded from Fig. 1 as being considered outliers. GDP per capita of Singapore and Brunei are at 52,960.7 US and 26,424.4 US, respectively. They far out league other AC countries. At first, it can be seen that EU and AC economies are incomparable (Fig. 2). However, taking Manufacturing contribution to GDP in consideration, AC are more industrial intense however lower-tech in comparison than EU (Fig. 3). The average GDP manufacturing ratio of EU is at 14.2%. The figures vary from the highest of 21.5% of Slovakia to 4.1% of Cyprus. Medium hi-tech and hi-tech industry ratio also varies from the highest of 61.4% of Germany to the lowest of 20.9% of Greece. The average of such industry in EU is at 40.96% (Martin et al., 2018). Manufacturing ratio to GDP of AC varies from 28.7% of Thailand to 17.6% of Cambodia with the average of AC at 21.9%. Medium hi-tech and hi-tech industry ratio also varies from the highest top 3 of 42.6% of Malaysia, 40.7% of Thailand and 40.4% of Vietnam to the lowest of 0.3% of Cambodia. The average of such industry in AC is at 34.17%. Again, Singapore is considered outlier the medium hi-tech and hi-tech industry ratio of Singapore is at 80.4% (Martin et al., 2018).

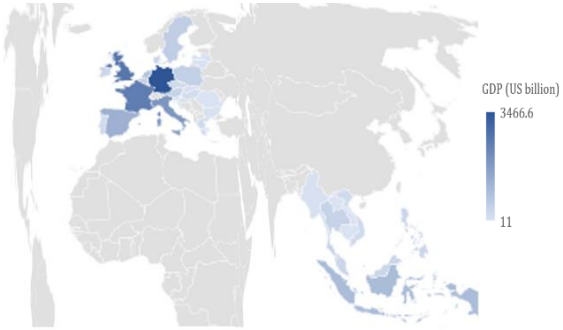


Fig. 2: GDP of EU and AC Countries (Martin et al., 2018)

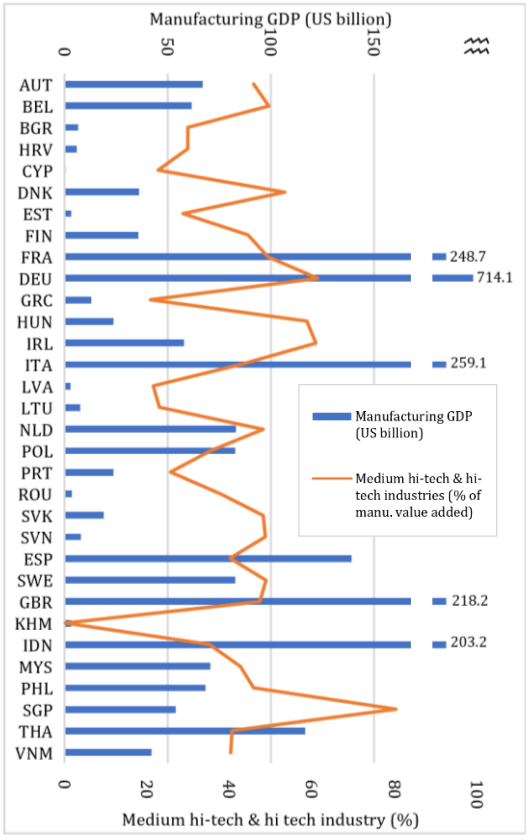


Fig. 3: Manufacturing and ratio of medium hi-tech and hi-tech industries of EU and AC countries (Martin et al., 2018)

Therefore, the paper will investigate and try to normalize several economic dimensions in order to reflectively compare these economies.

3. Organization and management scopes

If Industry 4.0 concepts are to be adopted to the company in any level, it needs appropriate organizing and managing to deliver the preferred output (Agarwal, 1982; Garvin, 1998). This includes organizing and managing firm, people, culture and their supply chain from the strategic to operational levels, from leadership to governance, and from current stage to Industry 4.0 transformation. There are 7 main dimensions to address Industry 4.0 O&M Competences of the organization (Matt et al., 2018):

1. Strategy: Vision, strategy, roadmap, business models.
2. Leadership: Management competence, central coordination of Industry 4.0.
3. Governance: Data security management, protection of intellectual property, labor regulations for Industry 4.0.
4. Supply Chain Network: Digital competence of customer and supplier, digitalization of processes along the supply chain.
5. Culture: Knowledge-sharing, open innovation, awareness of Industry 4.0.
6. People: ICT competencies of people, willingness and openness of employees.
7. Process Digitalization: ICT tools for digitalization, mobile devices, real-time communication.

4. Methodology

Whilst O&M competences are based on each firm readiness, it is also interesting to see if the environment is suitable and supportive to these competences. For example, the competencies of people cannot be high, if the higher education is not well controlled or the digital skills are not available. The digitalized supply chain cannot be satisfied if the technology is not accessible. Therefore, the paper will focus on the supporting factors to these 7 O&M competence dimensions. It will therefore be reflective the level of competences of the firms.

It shall be noted that the paper is interested in the ecosystem to facilitate these O&M competences. Thus, instead of focusing in the firm (micro) level, the paper focuses on the macro level. In addition, the paper focuses directly to the O&M context. Therefore, the study is not in a specific aspect (Santiteerakul et al., 2018) or in general dialogue as previously published (Baller et al., 2016; Martin et al., 2018; Schwab, 2017).

Using trusted sources of data, selected indicators are used to reflect the O&M competences of these economies.

5. Source of data

Sources of data used in this paper are as follow: Readiness for the Future of Production Report 2018 (FOP2018), reported by World Economic Forum (Martin et al., 2018), investigated 100 economies in terms of the future of production, in both drivers of production and structure of production components. The Structure components comprise of Complexity and Scale, the Driver component comprises of Technology and innovation, Human capital, Global trade and investment, Institutional framework, Sustainable resources and Demand environment. Together, there are 59 indicators to reflect the readiness for the future of production.

The Global Information Technology Report 2016 (GITR2016), reported by World Economic Forum (Baller et al., 2016), investigated 139 economies using the Networked Readiness Index (NRI) to reflect the role of information and communication technologies in driving innovation toward the digital economy. The investigation is based on 10 pillars of interest, i.e., Political and regulatory environment, Business and innovation environment, Infrastructure, Affordability, Skills, Individual usage, Business usage, Government usage, Economic impacts and Social impacts. Together, there are 53 indicators.

The Global Competitiveness Report 2017–2018 (GCR2017-2018), reported by World Economic Forum (Schwab, 2017), investigate 137 economies using set of institutions, policies and factors that determine the level of productivity. There are 12 pillars of interest, i.e., Institutions, Infrastructure, Macroeconomic environment, Health and primary education, Higher education and training, goods market efficiency, labor market efficiency, Financial market development, Technological readiness, Market size, Business sophistication and Innovation. Together, there are 114 indicators.

It shall be noted here that some indicators are common between reports. Hence the latest available data shall be used in the paper.

The author selects indicators that are indicative if those O&M competences are supportive. The relationship of indicators and the O&M competences are illustrated in Fig. 4.

6. Result presentation and discussion

As of several available indicators, the paper aggregates the supporting indicators by normalizing related indicators to 0-1 scale, by which 1 denotes the most preferable. Fig. 5 illustrates the aggregated O&M competence support score versus Manufacturing GDP of EU and AC. It shall be noted here that Germany is considered outlier and neglected for the case. Germany manufacturing GDP is as high as 714.1 US billion.

It can be seen that O&M Competence Support Score of EU and AC are relatively marginal. The overall trend lines of EU and AC indicate that the EU supportment to O&M are slightly stronger than AC (Fig. 5).

From Fig. 5, it is also suggestive that which country's environment supports O&M competences in the right direction and hence provide a better-than-average indication. The best supportive countries of EU in this case are Denmark, Estonia,

Finland, Netherland and Poland. The indicators indicate that they provide accessibility and availability of latest technologies.

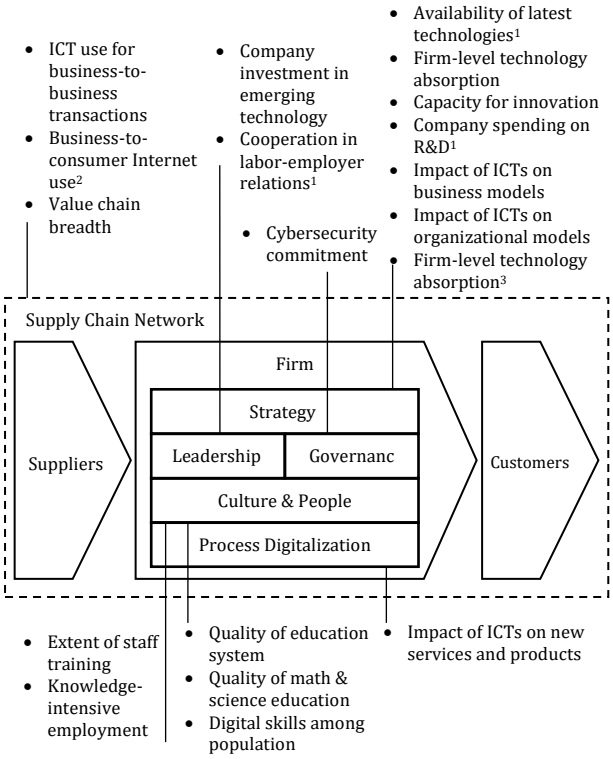


Fig. 4: O&M competence dimensions and supportive indicators (Schwab, 2017; Baller et al., 2016; Martin et al., 2018)

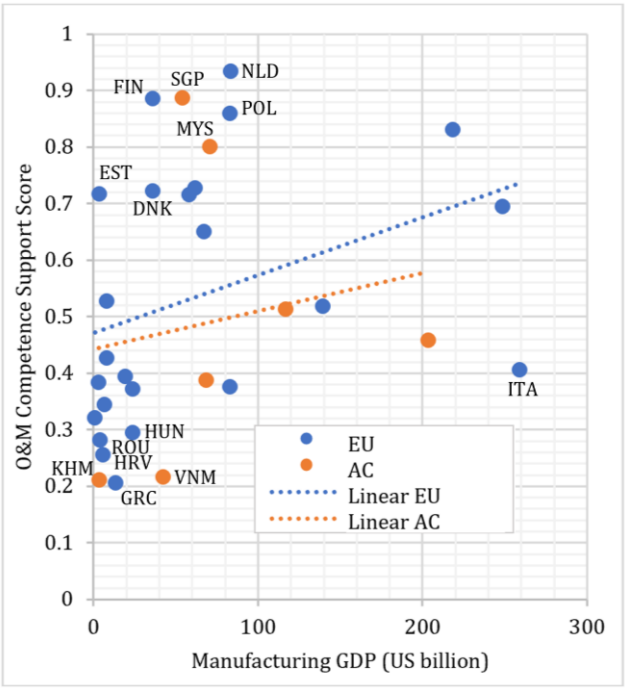


Fig. 5: Aggregated O&M competence support score versus manufacturing GDP of EU and AC

The countries have high quality of education and hence high ratio of digital skills among population. It also results in higher impact of ICTs on new services and products. It is also the case for Malaysia and Singapore in AC where O&M competence support score are better than the average. The companies in Malaysia and Singapore tends to spend on R&D and invest in emerging technology heavily and, as a result, the impacts of ICT are evident in term of business and organization models. The supply chain is well connected throughout the digitalized platform. Moreover, the people are well skilled, educated and culturized to cope with the emerging Industry 4.0 environment. Cooperation in labor-employer relations are strong. In addition, the cybersecurity commitment of these countries is among the best in the world.

On the other hands, environment in Hungary, Croatia, Greece, Romania and, surprisingly, Italy are the least supportive in terms of O&M competences of the industry in EU. The capacity of innovation, firm-level technology absorption and investment in emerging technology are low. ICT impacts on new organizational model are low. ICT use for supply chain are also less than what is preferable. For AC, Cambodia and Vietnam are among the least satisfied with low capacity for innovation, low firm-level technology absorption. ICT yields low impact on new service and product. Human resource development system need improvement. Their cybersecurity commitments are among the world's lowest ranks.

7. Selected economies discussions

Selected economies of interest are Austria, Slovakia and Italy of EU and Thailand of AC. The radar charts in Figs. 6a and 6b illustrate their O&M competence supports to the average of EU and AC.

Austria is among the above-average performers in EU. The country is outstanding in supply chain network and value chain breath. Other O&M competence supporting dimensions are also progressive, e.g., strategy, leadership and people (Schartinger et al., 2006).

Slovakia yields relatively low score. However, compared to its economy size, the country is considered moderate. Their ICT and internet use in supply chain are comparably good. Yet, the quality of the education system and process digitalization capability seems to be the obstacle of the improvement (Müller et al., 2005).

Italy is by far the least supporting to O&M competences. Strategy, leadership, culture and people dimensions are among the lowest if aligned with the country economy size (Federico, 2014). ICTs have shown low impact to the supply chain and process digitalization.

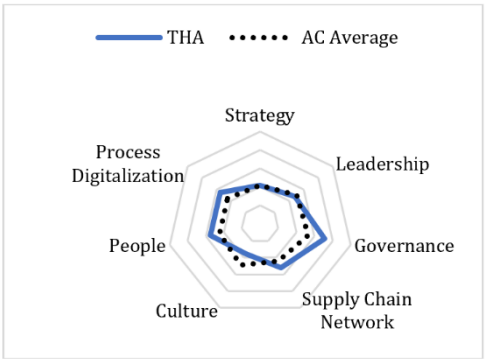
Thailand, in quest of Industry 4.0 (Jangkrajarng et al., 2018; Limcharoen et al., 2017; Tippayawong et al., 2015; Ramingwong et al., 2015) is advanced in governance, people and process digitalization. However, culture of work and skilled employee are what hold back to their O&M competences.

8. Summary

The paper investigates macro indicators supporting Organization and Management

competences in European Union and ASEAN community. Of interest are what is supportive to Strategy, Leadership, Governance, Supply Chain Network, Culture, People and Process Digitalization of the firms in the countries. Based on available source of data, many observations are made. Countries that are the most and least opportune to O&M competences are identified and therefore discussed. Further discussions were made to Austria, Slovakia, Italy and Thailand as selected case study economies of interest. The paper yields interesting facts and hopefully be useful for any measurements, may they cause.

(a) Austria, Slovakia and Italy and EU Average



(b) Thailand and AC Average

Fig. 6: O&M competence supports of selected economies

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Compliance with ethical standards

Conflict of interest

The authors declare that they have no conflict of interest.

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