Industrial Revolution 4.0:
A New Challenge to Brunei Darussalam's Unemployment Issue

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ABSTRACT

Brunei Darussalam has been facing unemployment issue in the past few years. With the upcoming fourth industrial revolution (IR4.0) where there will be extensive use of machineries, robotics, and sensors, a shift in the job market is anticipated. This study aims to investigate the potential challenges on unemployment that Brunei Darussalam will face if it does not move in the necessary direction to embrace IR4.0. In addition to that, this study will analyze the current education system that Brunei implements and the e-readiness of its society to further make conclusion and recommendation on improvements Brunei should focus into as a preparation towards the digitalization era. Literature review is chosen as the most appropriate methodological approach to identify and evaluate the key points of this chosen topic. Multiple systematic literature reviews and research papers revolving around the relevant keywords were used extensively to construct the basic understanding of this paper's topic. Secondary data from previous research papers and national reports from 2014 to 2019 were used for to gain insights of Brunei Darussalam's education system, digital literacy, and e-readiness among the society. In conclusion, this study has shown that unemployment rate in Brunei Darussalam is believed to have not been amplified by the Fourth Industrial Revolution (IR4.0), given that the current employees are retrained and younger generations are equipped with digital literacy-based knowledge and soft skills.

KEYWORDS

Brunei Unemployment, Educational System Digital Literacy, Industry Revolution 4.0, Job Replacement

INTRODUCTION

Brunei Darussalam has been facing unemployment issue in the past few years. Unemployment among youths are seen to ever be increasing annually, due to a mismatch between the employees' expectation and the skills that they have, among a plethora of factors that was addressed (Musa & Idris, 2020). With the upcoming fourth industrial revolution (IR4.0) which is the automation of everything, thus

extensive use of machineries, robotics and sensors, a shift in the job market is anticipated. This paradigm shift will cause more employees losing jobs (i.e. increase of unemployment) and only a specific pool of human capitals able to retain their jobs because they have the necessary skills to stay relevant in the era of digitalization (de Pablos, 2002, 2003).

With the current unemployment issue in Brunei Darussalam, a significant portion of academia has raise the question of how developing countries would stay relevant in the near future and would the IR4.0 cause a further amplification of unemployment among its labor force. Brunei Darussalam's long-term national development plan, "Wawasan 2035" aspires to keep the nation to stay relevant in the future, where the three outcomes and goals are for the people to be highly educated, skilled and accomplished, has high quality of life and for the nation to have a dynamic and sustainable economy.

Thus this study aims to investigate the potential challenges on unemployment that Brunei Darussalam will face shall it doesn't move in the necessary direction to embrace IR4.0. In addition to that, this study will make analysis on the current education system that Brunei implements and the e-readiness of its society to further make conclusion and recommendation on improvements Brunei should focus into as a preparation towards the digitalization era.

LITERATURE REVIEW

Industrial Revolution 4.0

Industry 4.0 is a term introduced in the early 2011 as German's "High-Tech Strategy" initiative in improving their manufacturing industry's competitiveness in 2020 on the global scale. Industrial Revolution 4.0 (IR4.0) emerges due to the global demand of shift in revolutionizing the basic nature of previous automation of manufacturing industries (industrial 3.0) towards greater efficiency by digitalization, automation and Internet of Things in manufacturing processes (Islam et al., 2018). Developing and emerging countries such as China, that depended on manufacturing industries have moved towards investing more in the technologies that would catalyst their production development level for industry 4.0 (Bahrin et al., 2016; Berawi, 2018). Experts say, currently Germany; the leading developed country in manufacturing industry; has reached almost total transformation of its manufacturing industry towards industry 4.0, with less than a decade of transformation remaining (Islam et al., 2018).

The main driver of emergence of IR4.0 is the vast advancement of global technologies that compliments the shift of industrial modernization towards IR4.0. These said technologies includes innovations in cloud computing, development of smart interconnected products (i.e. internet of things), development of smart logistics (i.e. internet of services) and also the trend in using natural resources efficiently (i.e. internet of energy) (Lom et al., 2016).

IR4.0 differs from the previous revolutions in a way that it merges all technologies and integrate the real physical world with the virtual world by means of cyber-physical systems thus erasing the distinction between physical, digital and biological realm (Schwab, 2017; Zhou et al., 2015). Depending on the countries, Industry 4.0 are also known as "smart industry", "Industrial Internet of Things" or "Industrie 4.0" among other names (Barcik, 2018). Calitz *et al* (2017) is convinced that all business firms and societies around the world would inevitably pursue industry 4.0.

On a micro scale, it was forecasted by experts that IR4.0 promises increase in productivity by 30% to all businesses that embraces it. This positive impact is due to the fact that with the aid of digital technologies, automation and digitalization of manufacturing processes would significantly reduce the cost of operations by producing based only on the required demands, improves the efficiency of communication by the ability of being hyper-interconnected within the business organisation (i.e. interactions of human to human (H2H), human to machines (H2M) and machines to machines (M2M)) and in-turn minimizing any losses by means of risk predictions using simulations by AI and Big Data (Lee et al., 2014; Manda & Dhaou, 2019). Moreover, with the ability of communicating more

efficiently, prompt management decisions can be made instantly, thus eliminating the possibility of missing on any major business opportunities. The benefits that came along with IR4.0 would intensify economic growth in the long run on a macro scale.

Changing Demands of Employment and Education in IR4.0

With the automation and digitalization in Industry 4.0, it can be seen that IR4.0 would cause a significant shift in the job market. Advancement of technologies in IR4.0 would create new business models that would result in a change in job patterns and emergence of new employment opportunities (Rajnai & Kocsis, 2017). According to (Anshari, 2020), routine jobs that requires machine-to-machine (M2M) or fully machine interaction will be fully automated in IR4.0 because these work are routine and non-complex in nature.

However, certain skills that encompasses around "problem solving, non-routine tasks and creation of digital outputs" will not be replaced by machineries (Anshari, 2019; Djumalieva & Sleeman, 2018) as it requires high intellectual and creative thinking that no forms of technologies are able to surpass. This level of intellectuality and creativity that only humans are equipped with is essential to make innovations in forms of research and developments in the future. Sustainability in IR4.0 era is highly dependent on the innovativeness, creativity, technical skills and complex development system (Anshari, 2020) in creating new products, creative business models and novel production techniques (Manda & Dhaou, 2019).

The Figure 1 shows the job matrix that explains the cluster of jobs that will and will not be replaced in the implementation of IR4.0 formulated by Anshari (2019).

There are four phases that is incorporated with establishment of IR4.0 Figure 2 shows the demands of skills and competencies needed for each phases that differs consequently from one to another.

As being observed above, the society needs to have knowledge in ICT (for technical competencies) and also being equipped with soft skills (for personal competencies and social competencies) essentially when embracing the four phases of IR4.0's establishment. Thus, the educational institutions from primary to tertiary levels should put emphasis in developing these skills as a preparation for IR4.0.

In facing IR4.0, lack of the aforementioned necessary skilled labor would hinder the development of industry 4.0 within the country. Educational institutions on all levels should shift their focus on producing a new genre of workforce that are innovative, creative mindset, respectably good digital

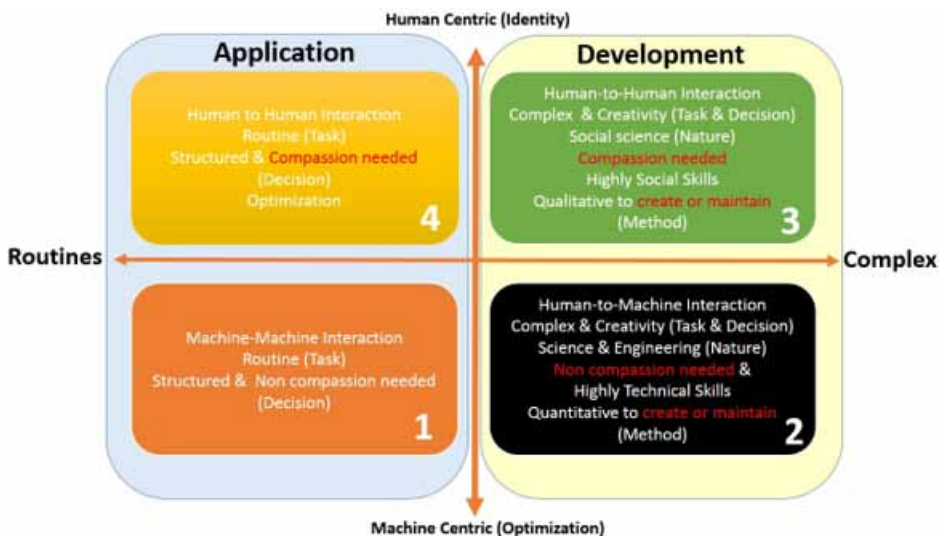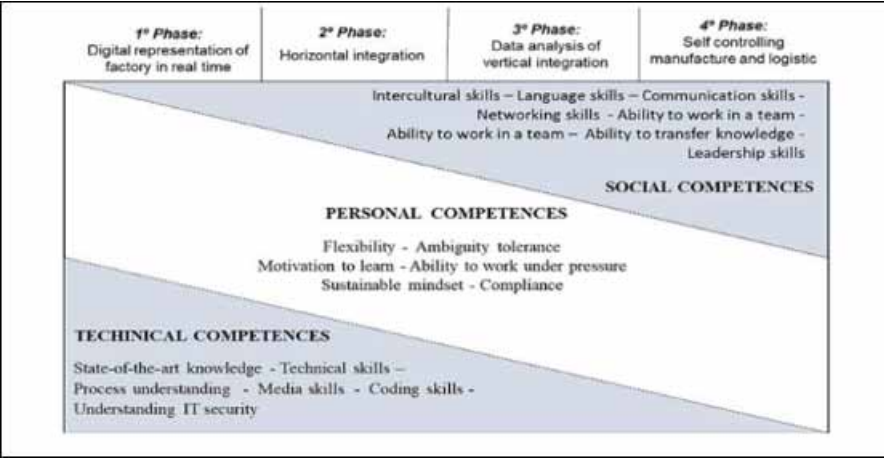**Figure 1. Job Matrix of Industry 4.0 (Anshari, 2020)**

Figure 2. Key competencies required for IR4.0 (Liboni et al, 2019)

literacy i.e. obtained extensive understanding in Information Communication Technology (ICT) and Computing, and equipped with soft skills to cater to the demand of highly skilled labors in IR4.0 (Manda & Backhouse, 2017). Academic curriculum must be redesigned to emphasize on the instigation of soft skills i.e. leadership skills, social skills, intercultural skills, as well as making a broad and better structured knowledge that captures the basic knowledge of the new industrial revolution as these are believed to be necessary in the advancement of industry 4.0 (Baygin et al., 2016; Motyl et al., 2017).

Smart Society: E-Readiness and Digital Literacy

E-readiness is a term that encircles around the acceptance of individuals or societies towards digital technologies. Individuals or societies that are e-ready, are said to have the necessary e-skills and e-literacy to operate majority of digital technology offered in industry 4.0 era (i.e. e-Wallets, FinTech). E-readiness among society means that they embrace any new technological advancements which thus creates a new society called "smart society" (Manda & Backhouse, 2016). Smart society is also known as "digital citizen", which in general means society that are able to use technology competently and ethically (Spires et al., 2018). Transformation towards smart society essentially needs e-readiness, digital literacy and network readiness (i.e. good internet infrastructure) within the members of society to be able to fully participate in the social and economic activities within the smart society (Manda & Backhouse, 2016).

To be e-literate and equipped with e-skills, arguably the society needs to firstly be digital literate (Spires et al., 2018). By definition, digital literacy is the "ability to understand and use information in multiple formats from a wide range of sources when it is presented via computers" (Gilster & Glister, 1997). Moreover, according to Spires *et al* (2018), "digital literacy involves any number of digital reading and writing techniques across multiple media forms, including: words, text, visual displays, motion graphics, audio, video and multimodal forms" regardless on any forms of digital devices such as smart phones, computers, laptops, smart televisions, to name a few.

Moreover, the second most important after digital literacy is the society's digitization which is the Internet accessibility or penetration within the society (Levy & Wong, 2014). To achieve good internet penetration, the society needs to be provided with good internet infrastructure. This is because Internet of Things (IoT) demanded a medium to enable the society to interact with front-end systems of applications such as e-Wallets efficiently, preferably using a state-of-the-art communication medium that offers low latency, high reliability and longevity which will potentially be offered by 5G cellular network (Varghese & Tandur, 2014).

METHODOLOGY

To achieve this paper's objective as mentioned in the introduction section, a literature review is chosen as the most appropriate methodological approach to identify and evaluate the key points of this chosen topic. Search engines such as Google, Google Scholars, Emerald Insights, ResearchGate and Elsevier was comprehensively used to search the keywords that comprises on 'Industry Revolution 4.0', 'Smart Society AND E-readiness', 'Digital Literacy AND Education 4.0' and 'Industry 4.0 AND employment demand'. Moreover, multiple systematic literature reviews and research papers revolving around the aforementioned keywords were used extensively to construct the basic understanding of this paper's topic. Articles and research papers in Malay languages and English were used in this paper. Secondary data from previous research papers and national reports (i.e. Brunei Annual Consensus Reports and UN Reports on Brunei Darussalam) from recent years (ranging from 2014 to 2019) were used for to gain insights of Brunei Darussalam's digital literacy and education system.

ANALYSIS AND DISCUSSION

Potential Job Replacement in Brunei Darussalam

Referring to Figure 1, Anshari (2020) has denoted that jobs belonging in Cluster (1), will definitely be obsolete and replaced by automations and machineries in IR4.0 as these jobs do not need any decision makings, and its nature of being structured and routine. The table below shows the Cluster (1) jobs in Brunei Darussalam, and the number of employees under the said occupation over the course of two years.

Based on the Table 1 and Table 2, the number of unemployed in Brunei is 19,223 in 2018, which has increased by 0.12% compared to 2017. Moreover, the number of employees in cluster (1) jobs in 2018 has decreased by 1.84% compared to 2017. The number of people that would become

Table 1. No. of employees for Cluster 1 Jobs in Brunei Darussalam (Department of Economic Planning and Development, 2018)

Cluster (1) Job in Brunei Darussalam	2017	2018
Clerical Support Workers	19,045	21,555
Service and Sales Workers	39,897	48,241
Craft and Related Trades Workers	12,451	16,563
Plant and Machine Operation and Assemblers	5,714	8,408
Elementary Occupation	31,647	11,990
Total Employees in Cluster (1) Jobs	**108,754**	**106,757**

Table 2. Educational Attainment of the Unemployed in Brunei Darussalam (Department of Economic Planning and Development, 2018)

Educational Attainment of the Unemployed	2017	2018
Primary and below	1,009	1,168
Secondary	11,129	10,315
Technical and Vocational	3,150	3,787
Tertiary	3,911	3,953
Total Unemployed	**19,199**	**19,223**

unemployed impacted by IR4.0 would totaled up to 125,980. This figure shows that a significant portion of the labor force would become unemployed and remained obsolete due to their lacking of skills that are needed in IR4.0. These unemployed labor force should be educated and retrained by instilling necessary skills that would be in demand during IR4.0 so that they can be utilized and do not remained unemployed in the future. If this issue is left unattended, it would cause greater national issues to Brunei Darussalam. Thus, the next section will discuss on the current Brunei Darussalam's education system which will be needed to ensure the Bruneian's labor force stayed relevant in the upcoming years.

Brunei Darussalam's Current Education Standings

Brunei Darussalam's vision by the end of the Wawasan 2035 national plan is to be ranked as one of the top 10 in the world for United Nation's Human Development Index (UNHDI). Human Development Index (HDI) is a measure of the country's level of human development in the aspect of the people's life expectancy, education quality and income per capita in terms of statistic composite index (Sagar & Najam, 1998). Brunei was ranked at 43 out of 189 countries and territories in 2018, at 0.845, above the average of 0.741 for countries in the East Asia and the Pacific (United Nations Development Programme, 2019). The Table 3 shows Brunei Darussalam's HDI value throughout the year 2017 to 2018.

Based on the Table 3, we can observe that the average number of years that Bruneians aged of 25 years and older receive in a life-time has been 14.4 years in 2018 and expected years of schooling for children at the entry age is 9.1 years. This shows that Bruneians have been given more access to learning and gaining knowledge which consequently means that the literacy among the Bruneians are comparatively very good. Moreover, Brunei Darussalam having HDI of 0.845 means that Brunei have comparatively higher life quality, more access to knowledge and high standard of living among its society.

As being denoted in Figure 1, throughout the four phases of IR4.0, the society essentially needs to be instilled with ICT knowledge from the primary level to the tertiary educational level, thus a relevant education model should be deployed to carry out this purpose. The table below shows the number of higher education (tertiary level) students graduating with Computing and Information Communication Technologies with includes Doctor of Philosophy (PhD), Master's Degree, Bachelor's Degree, Higher National Diploma, Advanced Diploma, National Diploma, Diploma and HNTec certifications throughout the year 2016 to 2018.

Based on Table 4, we can observe that there has been a significant increase by 18%, from 2017 to 2018 of students graduating from tertiary level with ICT and Computing courses. With this figure, it can be concluded that there has been an increase in number of Bruneians that has ICT and Computing backgrounds on a tertiary level, showing that this is a positive movement that would be very beneficial as the driving force towards the nation's technological development and preparedness for IR4.0. This positive movement shall be maintained in the upcoming years, to ensure that there is enough labor force that specializes in the technology-based knowledge.

Moreover, on the primary and secondary level, SPN21 – Brunei's 21st Century's National Education System – emphasizes on the development of digital literacy as an essential learning skill amongst the primary to tertiary education level illustrated on its curriculum model. Observing on

Table 3. Brunei Darussalam's HDI (United Nations Development Programme, 2019)

	Life expectancy at birth	Expected years of schooling	Mean years of schooling	GNI per capita (2011 PPP$)	HDI Value
2017	75.6	14.4	9.1	77,188	**0.843**
2018	75.7	14.4	9.1	76,389	**0.845**

Table 4. ICT and Computing Education Level Attained in 2017 and 2018 (Department of Planning, Development and Research, 2018, 2019)

ICT and Computing Education Level Attained	2017	2018
PhD	3	2
Master's Degree	5	15
Bachelor's Degree	59	207
HND & Adv. Diploma	97	230
Higher National Certificate	4	2
ND, Diploma, HNTec	130	89
Skill Certificates (SC2 and SC3)	73	0
Certificates	41	0
Total	**460**	**545**

the direction of educational system implemented from primary to tertiary level, we can observe that Brunei Darussalam is moving towards the digital era and would remain relevant in the IR4.0. Based on the report "The National Education System for the 21st Century – SPN21" by Ministry of Education Brunei Darussalam, digital literacy is needed to help the learners to be able to:

apply ICT skills for creativity and communication in learning; retrieve, analyze, process, present and exchange information; communicate information electronically through the local and global network; and improve ability in informational skills, instrumental skills and strategic skills which make up the digital literacy concept.

Figure 3. SPN21 Curriculum Model (Department of Planning, Development and Research, 2013)

e-Readiness in Brunei Darussalam

In terms of Network Readiness Index (i.e. a measure of country's capacity in utilizing ICT or simply put, how a country's society accepts digitalization in their lives) Brunei Darussalam is ranked at 45th out of 148 countries based on The Global Information Technology Report 2014. Moreover, a direct comparison in terms of network readiness and internet penetration (thus internet infrastructure in general) between Brunei Darussalam and the current leading Industry 4.0 country, Germany, can be observed in the Table 5.

Based on the Table 5, we can observe that Brunei Darussalam still has a long way to go in terms of its internet infrastructure. LTE/WiMAX coverage for Germany is 96.2%, which is 5.6% more than Brunei Darussalam. Moreover, households that have access to internet for Brunei Darussalam is significantly low at 75.0%, about 20.8% less than of Germany's. Furthermore, individuals that regularly accessing the internet is significantly higher for Germany at 89.6%, more than 10% from Brunei Darussalam's. When making a close comparison with Germany, Brunei is significantly far from the bench-mark to embrace the Internet of Things that IR4.0 offers. Thus, Brunei Darussalam should put emphasis on developing innovative ideas to increase its internet penetration by investing more on its internet infrastructure throughout the Sultanate.

The study conducted by Anshari *et al* in 2017 on the smartphone habits among 355 students in Brunei Darussalam, in which it is believed to represent the youth generation of Brunei Darussalam as a whole. Based on the study it can observe that all 355 respondents posses smartphones, ranging from 1 to 6. Moreover, significant portion of the youths (77%) accesses internet from smartphones. These figures shows that youths do have the necessary tools to access internet and that evidently, has the necessary digital literacy skills to make up a "smart society" of Brunei Darussalam in few years ahead.

Strategies for Shortage Skills Workers

To explain the shortage skills of workers by referring to Figure 1 as a strategy. Cluster 2 are job landscapes that require human to machine interaction and while these jobs are considered complex (as they require high technical skills), these jobs are considered important even though they are still lacking in Brunei Darussalam. Human to machine interaction job landscapes are usually associated to those in the Science and Engineering realms but in practice (and depending on the eco-system of the country), it can be simply jobs stemming from the agriculture sector like agriculture. An agriculture or are agriculture related are still small in numbers. Despite of its importance and the continuous efforts of the Government to ensure they are reeking the interests of young people, this sector is still quite unpopular and hence, unattractive to the youth. A study conducted by Siti Fatimahwati and Siti Rozaidah (2020:93) on *Addressing Issues of Unemployment in Brunei: The Mismatch between Employers Expectations and Employees Aspirations*, there is a culture of risk aversion detected among the Bruneian youth towards employability. Through results from the focus groups, most of the young

Table 5. Direct comparison between Brunei Darussalam and Germany in terms of network readiness and internet penetration (Report et al., 2014 and ITU, 2017)

	Brunei Darussalam	Germany
Network Readiness (out of 148) as of 2014	45th	12th
Mobile-cellular subscription per 100 inhabitant	120.7	125.5
LTE/WiMAX coverage (% of population)	89.6%	96.2%
Households with internet access (% of population)	75.0%	90.8%
Percentage of individuals using internet (% of population)	75.0%	89.6%

people prefer to get jobs with stable monthly incomes rather than venture in Entrepreneurship, and more than half of them voiced out their insecurities of doing business full-time (Fatimahwati et al., 2020).

Furthermore, the job skill that are considered to be lacking in Brunei under Cluster 2 is an automation or robotics engineers. The automation or robotics engineer's role is to manage maintenance on the automation processes, to set up the equipment, to provide training on how to use the robots and demonstrate basic knowledge of data collection and research protocols. The robotics coordinator in this context, refers to the robot that is used to conduct surgeries (Advanced Urology, 2020).

By using a Root Cause Analysis, specifically the 5 WHY's in order to identify why the issue pertaining the lacking of Robotics Coordinator are lacking in Brunei; Why? – Lacking of people with the expertise of using Robotics in surgical operations. Why? – Still considered as a niche occupation, as there are still many surgeries that can be done by a doctor. Why? – No budget to buy the machineries and pay for long term maintenance. Why? – The education system do not provide a course of Robotics Coordinator in higher education level (such as Universities) thus there are lacking of experts. Why? – No robot coordinator in Brunei.

Thus the 5 Why's shows how the many factors such as the lacking of experts, the lacking of available equipment and by having no budget to supply for this item. This lead to why the automation engineers in Brunei seems to still be lacking in Brunei especially in the use of IR4.0 in medical industry.

This is where solutions are developed. This is also where the solutions from Planning are implemented and operates the business continuity policy, controls, processes and procedures (Avalution, 2010). The first step in "do" is for companies to perform a business impact analysis as well as risk assessment, this is vital to explain the outcome of their current policies implemented in the organization and to find ways to solve this issue without risking the organization's day to day operation. When going back to the prime example of lacking of Robotics coordinator in Brunei, the government or organization can develop solutions such as sending an individual for training or for an individual upskilling course. In order to market this occupation to the public, the government or organization can advertise how vital this job is such as giving talks to youth or students. By opening an opportunity to do scholarship can also help to entice youths to be interested in this occupation.

The result of the implementation is studied in term of its effectiveness and decide whether it answers the new aim of the organization (Mind Tools, 2020). This process will also monitor and review performance against established management system objectives and to report the result to be reviewed. In addition, this process will also help the organization to better recognize any risks that would impact the organization and to prepare any impact that will succumbed to the organization (Avalution, 2010).

After sending employees or individuals under scholarship to study the role of Robotics Coordinator, these individuals will then come back to the organization with equipped knowledge that are relevant to the issue in which the company will be able to gain new or additional knowledge from the individual on automation engineers could then help the organization to have more certified individuals that have the knowledge as a robotics or automation engineers. These certified individuals will then be able to share the knowledge gained and to help promote the job qualities to others in the hopes that this will be able to increase the number of interested individuals that will want to learn this expertise and help increase the number of engineers in Brunei.

Then, the solutions are standardized. According to Avalution (2010), this process maintains and improves the program by taking preventice and corrective actions based on the result of the review from the management and after a full appraisal is done. This step could also be regarded as a post-mortem review process in which all results from the first three (3) steps are being considered and initiate the plan based on corrective measures (Mind Tools, 2020).

When the process is standardized, the organization or the government would need to always look out for potential improvements that needed to take place and make this process continuous and to ensure that problems aren't repetitive thus it is important and will help if the organization can lead to standardized prevention. When implemented to the Brunei's Government Issue on having a lacking of

automations engineers, the organizations or government officials can ensure that advertising the job will be able to help to reduce the issue on lacking experts on these jobs. Thus, the process of ensuring those job is well received and to also ensure continuous demand can be sustained for the profession.

CONCLUSION

In conclusion, this study has shown that unemployment rate in Brunei Darussalam is believed to not be amplified by the Fourth Industrial Revolution (IR4.0), given that the current employees are retrained and younger generations are equipped with digital literacy based knowledge and soft skills. Brunei Darussalam has moved towards embracing digital technologies by equipping the younger generations with digital literacy based knowledge (ICT and Computing) on the primary to tertiary level. Its Human Development Index is at 0.845 showing that local citizens have good access towards education, quality life and income. Moreover, the youth generation is seen to readily embrace and accept the use of smartphones and internet usage, which is a positive behavior towards the creation of "smart society" in the near future. Brunei's network readiness should be emphasized for the nation's development, because it is the main necessity to successfully implement the digitization of things in IR4.0. However, Brunei Darussalam unemployment issue on its own is a big topic that needs further studies on the nation's economic standing, financial resources, and political landscape to concisely come up with a proper framework which can suppress the employability of the citizens. Industrial Revolution 4.0 itself is a topic that is very infant in academia to conclude its effect on employability on a macro-scale. Hence, further studies should be performed while considering other factors that would be influenced by IR4.0.

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