



A Survey of Industry 4.0 and Future Prospects About Automated Production Systems in Cambodia

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Abstract—Nowadays, the industry 4.0 revolution is the trend towards automation and data exchange in manufacturing technologies and processes to create a smart and high profitable factory which built production facilities and logistics systems without or few human interventions. The Asean Factori 4.0 projects under the funding of the Erasmus+ programme is provided for a great survey of Cambodia industries in order to develop involved universities programs of Automation system. With this project of surveyed industries contributes to the university recognizing where to begin for requirement of industry 4.0, such as automated production, applied technologies, and programing skills. In prediction of short future, industry in Cambodia will be extended key segments of Industry 4.0 technologies for 5G, data centers, intelligent artificial (AI), industrial Automation (IA), additive manufacturing, industrial internet of things (IIoT) and smart factories, intelligent management, cyber-security, and machine learning as similar as other developing Asian countries.

Keywords—Industry 4.0, automation, programable logic control (PLC), Cambodia

I. INTRODUCTION

Automated production systems are critical enablers for Industry 4.0 technologies which have been revolutionized from Industry 1.0 for a long period of time. Industry was revolutionized by utilizing waterpower, steam, fuel engine, electricity, and the integration of computer and electronic controllers including the Internet of Things (IoT), cloud computing, machine learning (ML), deep learning (DL) approaches, cyber-security, and networking to leverage the applications of industrial 4.0 [1], [2]. The industry 4.0 revolution is the trend towards automation and data exchange in manufacturing technologies and processes to create a smart and high profitable factory which built production facilities and logistics systems without or few human interventions [3], [4]. In developing Asian countries, a professional human resources with sufficient knowledge in the fields of Automation are important role to facilitate these modern manufacture and production. In **Cambodia**, industries have not reached the technologies. Also, both academies and industries are not still matched with the state of technologies, knowledges, skills, and novelty solutions for automation of industry 4.0 concepts [7]. To improve this vision, the first and most important task is to prepare for the future engineers [5]. To contribute to this purpose, the Asean Factori 4.0

project is formed. This project is funded by the framework of the ERASMUS+ Key Action 2 CBHE (Capacity Building in High Education) program of European Commission.

Based on supported Asean Factori 4.0 projects, a Survey of PLC and Future Prospects about Automated Production systems in **Cambodia** was established and contributed to skill matching enhancement of both industrial and educational sectors. In developing the industry 4.0 in **Cambodia**, we aim to survey knowledges for students and staff in several contributing fields of smart sensors, IoT, cyber-physical systems, cloud systems, and networking which are required to support automated production system from industries requirement [6][8].

In this research, we conduct a qualitative study and analysis to aid us in designing a needful program of PLC and Future Prospects about Automated Production Systems in **Cambodia** well-being application and improve on the various fields where most of them are lacking.

II. ASEAN INVESTMENT IN INDUSTRIAL 4.0 REVIEW

ASEAN remained an attractive investment destination; the region's share of global **foreign direct investment (FDI)** rose from 11.9 percent in 2019 to 13.7 percent in 2020 although impact of the COVID-19 pandemic. The pandemic affected most Member States, with seven seeing a drop in investment. Brunei Darussalam and the **CLMV (Cambodia, the Lao People's Democratic Republic, Myanmar and Viet Nam)** countries were relatively resilient, with either an increase in investment or a small change in inflows. Most industries other than those in infrastructure and digital economy sectors saw FDI fall. FDI in manufacturing contracted by 55 percent, from \$49 billion in 2019 to \$22 billion in 2020 [10], [12].

Relocation of production to ASEAN is not new; however, now **multinational enterprises (MNEs)** are not relocating just for cost reasons. Influencing the decision are a mix of additional factors, including geopolitical and supply chain resilience considerations. MNEs' diversification of production from China to ASEAN countries was originally driven by rising costs in China. The trade tensions between the United States and China accelerated the process, including for Chinese companies. The disruption of supply chains during the pandemic is a further motivation. Home-country policy measures that encourage diversification of supply chains are also encouraging firms to move operations or restore away from China to neighboring countries [11], [13].

Foreign investors in ASEAN are playing an important catalytic role in the industry 4.0 transformation process as users, technology providers, manufacturers, trainers, influencers of **small and medium-size enterprises (SMEs)**, and ecosystem enhancers [18]. The presence of many MNEs operating in key segments of Industry 4.0 technologies in ASEAN (e.g., 5G, data centers, IA, AI, additive manufacturing, the **industrial internet of things (IIoT)** and smart factories) is a testament to the growing significance of the region for FDI in Industry 4.0 activities. Subsidiaries of MNEs are often better equipped to adopt Industry 4.0 technologies than are local companies because of their relatively stronger financial and technological capacities, and the influence of their parent companies' adoption of technology [15].

The investment needs for 5G infrastructure in ASEAN are significant, estimated at about \$14 billion in annual capital expenditure between 2020 and 2025 to upgrade telecommunication facilities, networks and equipment to 5G requirements. The region is projected to be one of the world's fastest-growing data center markets in the next few years, exceeding the growth in North America and the rest of Asia-Pacific. More than 40 per cent of data centers in ASEAN are foreign owned or involve joint ventures. Many major MNEs that provide data centers and cloud services are present in ASEAN. These digital enablers permit efficient deployment of Industry 4.0 technologies and make possible greater digitalization of supply chains. They will accelerate digitalization and Industry 4.0 transformation in ASEAN [16], [21].

ASEAN Member States are actively promoting the adoption of Industry 4.0 technologies to improve manufacturing efficiency and productivity. Industry 4.0 transformation can further boost the region's manufacturing potential, upgrade industrial development, enhance ASEAN's attractiveness for international production and support upgrading in **global value chains (GVCs)**. At the regional level, Member States actively cooperate on digitalization and Industry 4.0 transformation, which has led to the adoption of agreements and declarations on Industry 4.0, as well as on cybersecurity, e-commerce and a smart cities network [14].

III. CAMBODIA PROSPECTION IN INDUSTRIAL 4.0 REVIEW

Cambodia adopted Digital Economy and Social Policy Framework (2021-2030). The policy sets out a long-term vision for building a vibrant digital economy and society by laying the foundations for promoting digital adoption and transformation in all sectors of society, and among states, citizens, and business, to accelerate new economic growth and improve social welfare in alignment with the "new normal" trajectory [17].

Cambodia aims to achieve upper-middle-income status by 2030 and high-income status by 2050. Therefore, The Government is prioritizing the adoption of new technologies in manufacturing and encouraging investment in industries that are undergoing rapid technological innovation. It aims to ensure that the country can adapt and transform in line with technological change while minimizing the social and economic costs of transitioning. **Cambodia's** Industrial Development Policy (2015–2025) encourages private sector participation in technological innovation. It covers reforming the education system to enhance the role of **science,**

technology, engineering and math (STEM) education and promoting entrepreneurship and soft skills training [20].

While **Cambodia** has taken these steps towards technological innovation and transformation, it faces challenges in moving to Industry 4.0 (UNDP, 2020). They include a shortage of STEM professionals; underdeveloped cybersecurity, data protection and data privacy regulations; limited internet services; a lack of data infrastructure; and a shortage of workers with digital skills. Tapping the potential of new technologies to upgrade and diversify the economy could assist in the transformation. So, Government has identified priority sectors for investment, which include industries that link with regional production, strategic industries such as ICT and industries with high value-added products (e.g., the machine, electronic and automotive assembly industries) (e.g., **Cambodia** announced and designated **special economic zones (SEZs)** 46 locations, which 20 locations are in operation and 11 locations are in construction). Moreover, The Government signed an agreement in 2019 with Huawei (China) to build 5G network and Viettel (Viet Nam) has tested 5G deployment in **Cambodia** in 2019 in order to increase ability of internet services. With 5G network in **Cambodia**, four data centers were developed which 25 percent of the four data centers is owned by foreigner company (e.g., Southeast Asia Telecommunication SeaTel Singapore) [20] [21].

Cambodia is just beginning to map out their digitalization path, but this country has adopted specific policy measures aimed at attracting FDI in Industry 4.0 with 2 steps as following.

First step, Government adopted a Law on E-commerce on 2019, Sub-decree 134 on the determination of type, formality and procedures for issuing approvals or license to intermediaries and electronic commerce services providers and exceptions on 2020 and E-Commerce Strategy on 2020. The **Cambodia** Digital Economy and Social Policy Framework (2021–2035) was also adopted in 2021 [20].

Second step, **Cambodia** passed Sub-Decree No. 124 ANKr.BK, in to incentivize the development of SMEs in priority sectors through income tax holidays and deductible expenditures. These sectors include agricultural or agro-agricultural products; food manufacturing and processing; manufacturing of finished products, spare parts or assembling parts to supply other manufacturers; R&D associated with IT or the supply of IT-based services and enterprises located in SME Cluster Zones and enterprises developing cluster zones. An SME cluster zone (e.g., the \$30 million World bridge i4.0 SME cluster zone) is being developed to bridge the gap between manufacturing FDI and local SMEs to create and locate complete value chains inside an industrial ecosystem containing supporting facilities, services and ICT platforms [19]. **Cambodia's** development plans also promote SME linkages with large firms (OECD/ERIA, 2018). It provides various types of investment incentives, which include an income tax holiday for a maximum of nine years, a special depreciation allowance of 40 per cent on the value of new or used tangible properties, and duty-free import of equipment and construction materials for production [21].

IV. METHODOLOGY

The objective of the study was to quantify the importance of a set of generic competences to the respondent's future and the level to which they feel the competence is being

developed, make comparisons and draw conclusions from the responses obtained.

The general process followed was to produce an initial set of questions, create a set of pilot questionnaires, carry out a small pilot study, make appropriate modifications and then launch the full survey. This section describes this process in more detail and explains the rationale to the approach at each stage.

The first step of survey question is about information of company and industry. These questions look for industry name, activity of service of industry, and employee properties in industry such as number, salary, experience, and position. The second step of survey question is about skill requirement and competencies of industry which define for important skill, main challenges of industrial automation, knowledge degree, technology of automation, popular programming language, and how to recruit an engineer. The third step of survey question is about useful soft skill for industry such as personal traits, ability, performance, and communication. The last step of survey question is about training and Internship.

The Tuning Methodology approach of using a 5-point Likert scale for the importance and level of development of each competence was retained. Respondents were asked to rate how important this is to them on a 5-point scale where 1 represents “ Not even important, 2 “ Not important ”, 3 “ Neutral ”, 4 “ Important ”, 5 “Very important”. They were then asked to indicate how soft skill is being developed in their industries, also on only 1 to 4 scale with exactly meaning for none till high.

A number of questionnaire delivery mechanisms were proposed. An online website was created for direct electronic entry. Electronic versions of the questionnaire were created for sending to potential respondents by email.

In the final form each questionnaire starts with an introductory page containing a brief overview of the objective of the study and the questionnaire and who the supporting body is. It then makes a statement about confidentiality and data protection and gave a name and contact details for more information. Finally there is a general instruction on how to complete the questionnaire.

V. RESULT AND DISCUSSION

The survey questions were responds from 30 various and potential industries in city and provinces of **Cambodia**. One of important results for industrial 4.0 which is currently main service and activity of each industry. Unexpected result of main service and activity of industries in **Cambodia** are as following: PLC & HIM & driver trademark, Electrical power transmission, Automation designer & simulation software, Renewable Energy solution, Energy carriers & power saving solution, Fieldbus systems, Pump, moto drive & generator, Instrumentation measurement & control & Vibration measurement, Actuator or Sensor or pneumatic manufacturer, Data infrastructure, Heating, ventilation, air-conditioning equipment, Embedded systems, Maintenance service, Process automation, Drink & food packaging, Transport & delivery activity, Product trading, Agriculture product processing, Consumer Goods Manufacturing, Water cleaning and distribution, Automotive, Special machinery designer for manufacturing, Industrial internet of things, Small Electrical housing manufacturer. These Technologies of automations

are important to understand where **Cambodia** industries are currently existing.

Most of industries in **Cambodia** really need the Automated Production Systems to support their production and manufacture with low expense and high quality, because those industries rated 4 and 5 scores approximately 96 percent based on survey result. Moreover, each industry consists of staff between 10 to 100, except that Electric of **Cambodia** and Minebear **Cambodia** consist of staff 3000 and 6000, respectively. Most of staffs are technical staffs and engineers with salary rank 200\$ to 500\$ and 500\$ to 1000\$, respectively. With technical staff and engineer, the background that industries expect to recruit is 85 percent of Bachelor, and then 30 percent of vocational diploma as seen in Fig. 2, which is a useful result for developing Automated industry program in **Cambodia**.

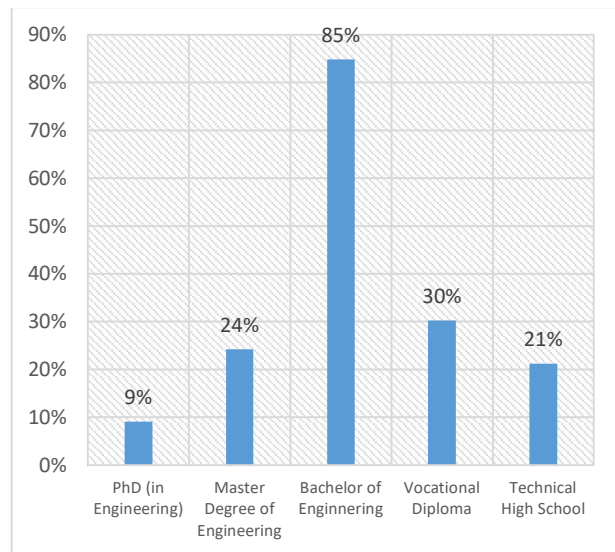


Fig. 2. Estimate state of staff background that industries expect to recruit in coming years based on survey result

From Fig. 3 to Fig. 6, Those collected data from survey result was convert into percentage by derive all total data from 1 to 5 score rating and then divide by total 165 highest score from all surveyed industries. As seen in Fig. 3 the Most importance skill interests for industries in **Cambodia** when recruiting staff is technical skill 75 percent related to Automated production. After the technical skill, Analytical thinking and Soft-Social Communication skills are still a main concern with the score rating 72 percent. The rest skills are leadership, Management, decision, and cognitive skills with score rating between 67 to 70 percents which are possible skills to consideration, because score rating was much more over 50 percent.

For Fig. 4, A majority of the top two challenges for industrial automation in **Cambodia** currently and 5 years later are energy saving efficiency and SCADA system in digital factory with score rating 73 percent. After that, internet of thing in industry and customization of production were rated score 72 percent and 70 percent, respectively. The rest challenges are between 60 to 69 percent which are still consideration because the score rating was much more over 50 percent.

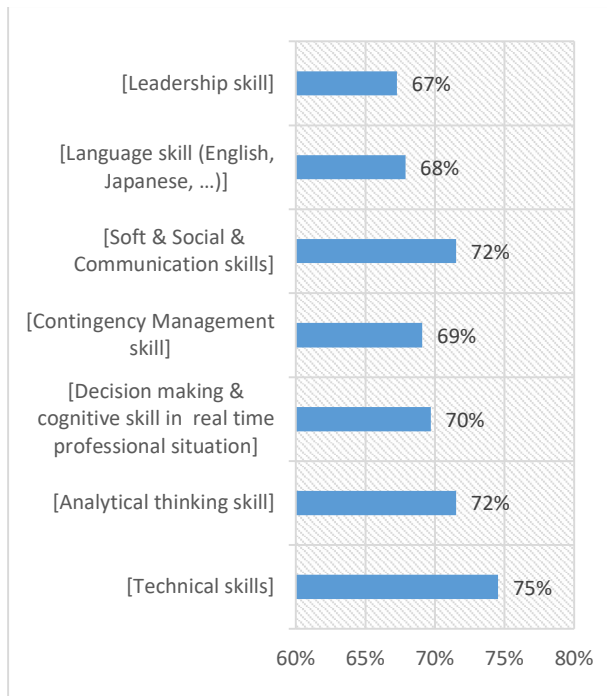


Fig. 3. The importance of following skills interests when recruiting staff based on survey result.

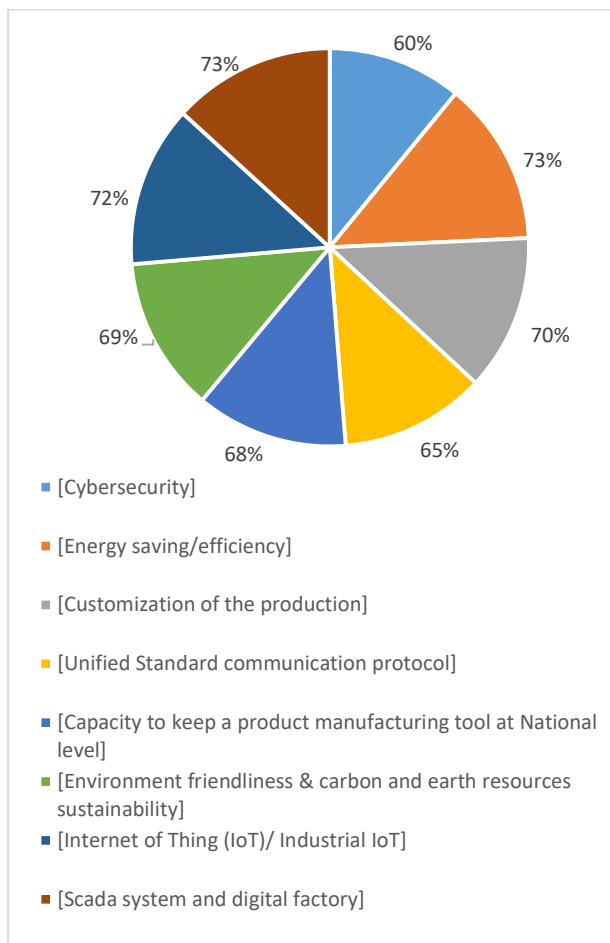


Fig. 4. Main challenges for industrial automation in Cambodia currently and 5 years later

When most of students graduated, the essential thing to do is job applying to industries, factory, company. As long as most of graduated students receive a good job matching to their skills, A successful program of automated production is appearing. To achieve this objective, Fig. 5 was shown survey results which highest potential technical skills interest for industry is process control with score rating 75 percent. Other interesting technical skills for industry are hardware-software of industrial technology, handle several PLD devices, and industrial internet of thing with score rating 72 percent, 71 percent, and 70 percent, respectively. The remaining technical skills are SCADA programming, handle one plc device, and industrial device with score rating between 68 to 69 percent.

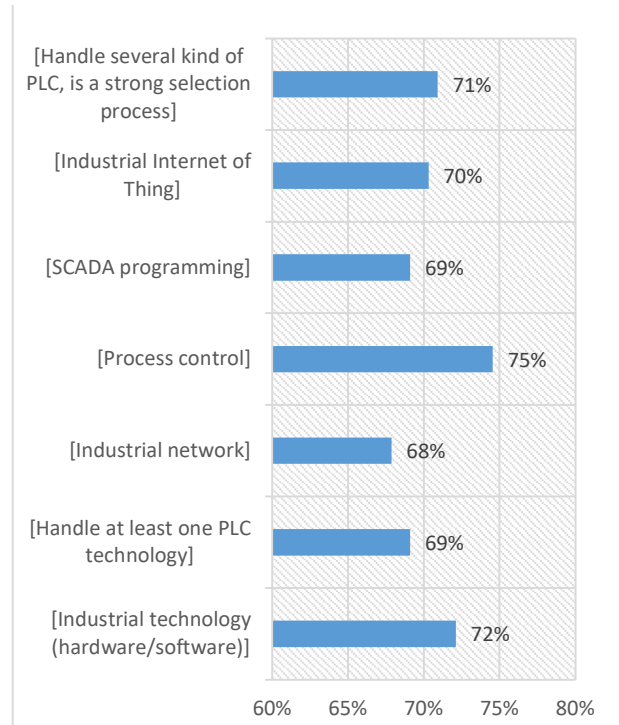


Fig. 5. Technical skills interest for job applicant based on surveyed result

Moreover, technical skills related to programming language are significant for automated industry in Cambodia, because multi various programming languages consist of advantage and disadvantage to control automated hardware which they are commonly used and not used by industry. Therefore, Fig. 6 was shown survey results which the most popular programming languages to control automation are Ladder, Structure Text (ST), SFC, DFB, Instruction List (IL) with score rating 69 percent. After that C language was rated score with 62 percent. Other remaining programming languages are Java, MATLAB, and Python with score rating between 52 percent to 56 percent.

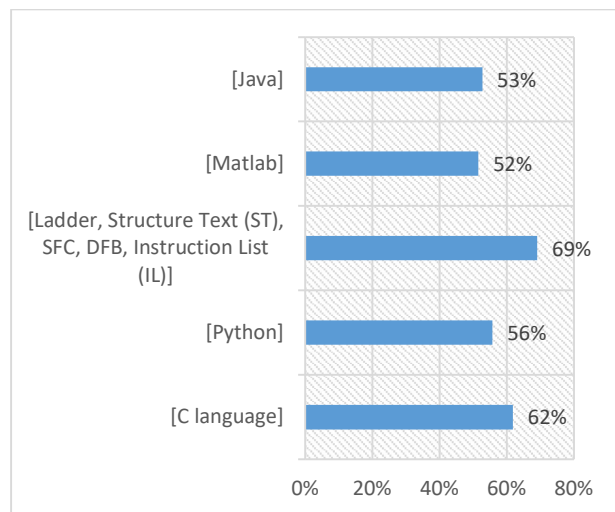


Fig. 6. Technical skills interest for Programming Language based on survey result

As all surveyed results, we are able to use these data for developing an automation program which able to maintain good quality to students in related skills, knowledge and requirement of 4.0 industrial revolution in **Cambodia**.

VI. CONCLUSION

The discussions and analysis of the questionnaire and result have given us the picture of the present situation of industry in **Cambodia**. There are different practices concerning recognition of industry and recognition of obtained competencies in different countries and even in different universities. For industry in **Cambodia**, bachelor of Engineering, technical skills, SCADA system and digital factory, Energy saving and efficiency are the best option of starting point to develop Automated Production Systems in **Cambodia**. Others options are still consideration because they are in score rating above 50 percent. In short future, industry in **Cambodia** will be extended key segments of Industry 4.0 technologies for 5G, data centers, IA, additive manufacturing, industrial internet of things (IIoT) and smart factories, intelligent management, cyber-security, and machine learning as following as other developing Asian countries [8].

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