Potential and prospect analysis of labor market in education in the fields of renewable energy engineering, industrial automation and robotics, and automotive engineering

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Abstract. The large number of graduate graduates who work not in accordance with the competence and rapid industrial revolution that occurred, demanding the implementation of higher education that is competent and relevant to the course of national development now and for the future. This paper will present the results of research on the prospects and employment potential of graduates of vocational education in the fields of renewable energy (RE), industrial automation and robotics (IAR) and automotive engineering (AE) in the industrial era 4.0 and driving technology. The aim of this research is to obtain a picture of the feasibility of developing the organization of vocational education in RE, IAR and AE study programs at the Faculty of Technology and Vocational Education (FPTK) Bandung Indonesia Education University. The research method used in this research is descriptive qualitative method. Data collection is done by studying and discussing; student interests and teacher conditions in 10 vocational high schools in the Bandung and Cimahi regions; the views of academics, appraisers of professional certification bodies and study of government policy program documentation in the development of study programs (RE, IAR and AE). From the results of the analysis and focus group discussions it was concluded that the three RE, IAR and AE study programs in the West Java region in particular and generally nationally feasible to be built in FPTK, its existence has a strategic position, prospects and potential for a wide open user market for graduates of third education these fields (RE, IAR and RE) work in the industrial, business and educational institutions.

1. Introduction
Over the past few years, periods of significant technological change can bring significant socio-economic benefits and enhance environmental prospects, but can also pose severe challenges to the educational, economic, human welfare and environmental processes. Such conditions have occurred in developing countries [1].
Likewise, in Indonesia, along with the ongoing industrial revolution 4.0 and the emergence of disruptive technology, significantly affected the country's economic governance and business behavior, production systems and consumer societies. On the other hand, the readiness and presence of human resource competencies in adjusting to environmental changes that occur is still a major problem. This indicator is marked by the problem of the still large open unemployment rate that occurs mainly in high school and higher education graduates.
1.1. Industries 4.0 and technology disruptive

Industry 4.0 is an industrial modernization that results from the implementation of sophisticated technologies at production stage that could generate upgraded standards, services, flexibility and quality for the clients and the firms to satisfy the requirements of latest business and service paradigms [2]. Industry 4.0 will provide future jobs through creating new business modes [2]. Advanced robots are able to perform monotonous actions with much greater efficiency and with much less errors. Human however, has unique abilities of a person not just to reproduce and transform knowledge, but also to create new knowledge [3].

Today’s workers are not necessarily lack skills but the new workplace requires skills that they don’t have although it is agreed that the smart manufacturing would not only abolish jobs but also to create new opportunities [4,5]. This new opportunity however most probably will demand for workers which are high skilled, innovative and dynamic [6], with preference of the employees with high IT competence that have good understanding of practical, engineering and programming skills [4,5].

In this research the term ‘disruptive technologies’ refers to large-scale technology/market changes occurring through technological advances such as automation, advanced robotics and virtualisation. Industry 4.0 gave rise to Disruptive technology or innovative technology, whose existence integratedly influenced the demand for technical and soft skills in many jobs, with some skills declining and others in higher demand. Impacts on companies will also tend to vary according to company size, stage of development, and their ability and capacity to innovate. The effect will also differ depending on the purpose the disruptive technology has been utilized [7].

1.2. The impact of industry 4.0 in Indonesia education

In such conditions, the government through the Ministry of Industry has developed a Making Indonesia 4.0 program and has made a road map policy is implemented to achieve Indonesia's goal of becoming the world's 10th largest economy in 2030. Since its launch by the Indonesian President exactly four year ago, the Ministry of Industry has taken various steps to accelerate the application of Making Indonesia 4.0 as a game changer for national economic growth.

One stage of its application is to improve the quality of Human Resources in Indonesia. The plan is for Indonesia to change and design an educational curriculum that is more emphasizing the STEAM system (Science, Technology, Engineering, the Arts, and Mathematics).

The Ministry of Education and Culture through the Directorate of Vocational High School Development conducts a Simulation and Communication Revitalization Program and will establish 100 Vocational Schools in the field of renewable energy engineering expertise and established the Center for Excellence in Electricity [8], Automation and Renewable Energy.

Furthermore, the Ministry of Research and Higher Education suggests that all tertiary institutions in Indonesia make adjustments to the curriculum in the face of the 4.0 industrial revolution and 'disruptive innovation'. In adjusting curriculum in tertiary institutions, the types of study programs and competencies in mastering communication technology, production, distribution and transportation (delivery) are integrated.

Based on the results of preliminary research, it is known that the Renewable Energy (RE), Industrial Automation and Robotics (IAR) and Automotive Engineering (AE) fields are identified as one of the competencies and expertise relevant to responding to the needs of Indonesia's current and future digital economic development.

In line with this condition the faculty of technology and vocational education at Bandung education university plans to build a new study program. For this purpose, it is necessary to know the level of utility and quality in commodities that make individuals have the potential and prospects to choose them, and the fact that individuals make commodity choices shows that they have “utility”. Other problems that are often discussed with classical theory types are balance structures, supply-demand interdependence [9] and sufficiency for real world markets [10].

In practice, the needs of the workforce in the user community (stakeholders) in accordance with the competence of study programs built in tertiary institutions are very fundamental.
2. Research methods
The purpose of this research is to identify the possible needs and support of the labor market for graduates of undergraduate education (S1) from new study programs to be built at the Faculty of Technology and Vocational Education at UPI, Bandung. In an effort to do this, related questions that must be answered are:

- Will the industrial community, business world and related vocational education institutions support the existence of new study programs (renewable energy engineering education, industrial automation and robotics, automotive engineering) which will be built by the faculty of technology and vocational education (FPTK) UPI Bandung-West Java?
- Are the industry and the business world willing to employ graduates of the Study Program from the FPTK?
- Are vocational high school students in the Bandung - Cimahi area of West Java interested? Support aspects are expected to come from the industrial community, the business world, vocational colleges, teachers and students of vocational secondary education institutions.

The research was conducted involving students, vocational high school teachers, from Bandung - Cimahi West Java, stratified random sampling interviews from 247 students and 35 teachers and management leaders of the Vocational School, Researchers, Practitioners from Industry, Observers and researchers and the Industrial Automation Assessors Team. This research was conducted during August and November 2019. In general, the sources of research data can be presented in the following table 1.

| Item | Institution / Company | Number of People | The Number of Students | Information |
|------|-----------------------|------------------|------------------------|-------------|
| 1.   | SMK Bandung -Cimahi    | 35               | 234                    | 10 SMK (Department Electronics, Mechatronics, Electrical and Installation Engineering, Audio Video, Software Engineering, Computer Networking Engineering, R and Automotive Machinery) |
| 2.   | industry              | 3                | -                      | PT LEN       |
|      |                       |                  |                        | PT SCHNEIDER |
|      |                       |                  |                        | PT Tri Patra Multi Energy |
| 3    | Academics and researchers professional certification institution | 2                | -                      | Manufacturing polytechnic |
| 4    | P4TK BMTI             | 2                | -                      | In the fields of: Renewable Energy and industrial automation and robotics |
| 5    | Consultants           | 1                |                        | Ricky Elson, LENTERA BUMI NUSANTARA (LBN), Ciheras -Tasikmalaya, West Java |

In general, the steps of this research can be represented through the following Research Flow Diagrams:
3. Results and discussion

Table 2. Result and discussion prospect and potency labor market of study program in education of industrial automation and robotic, renewable energy and automotive engineering.

| Item | Results of Discussion | Information |
|------|-----------------------|-------------|
| 1    | renewable energy engineering, industrial automation and robotics engineering, automation engineering; is one of the main and strategic fields in industry 4.0 and Technology Disruption | Resources:  
- Mc Kinsey Global Institute Analysis  
- Global Forum of Economy  
- Summary of Focus Group Discussion: Researchers, industrial practitioners, academics and consultancies |
| 2    | Prospects and job market potential graduates of Renewable Energy Engineering education, Industrial automation Engineering and Pharmacy, Automotive engineering; for the level of vocational high school and undergraduate education (S1) in the business, industry and educational and training institutions widely open. | Conclusion of the results of the discussion, study of policy documents with stakeholders (KEMENDIKBUD, KEMENDIKTI, Ministry of Industry, Industry, Educational and training institutions, Academics, Researchers and the business world) |
| 3    | Teachers' needs for these three study programs are high, apart from that the other aspect is that most of the teachers in all SMKs in the Bandung - Cimahi West Java region will retire. | 40% of the teaching staff remain retired, and almost 50% of the teaching staff who are available are contract teachers (non-permanent) |
| 4    | the interest and interest of prospective students continuing on to college is huge. | prospective SMK students |
4. Conclusion
From the results of this activity, it was concluded and illustrated as prospects and potential needs for Vocational Schools and Productive Educators for three Study Programs (IAR, RE and AE) in the West Java region based on the needs and uses of the nation that were open wide by positives. This is supported by the limited productive teachers in the fields of IAR, RE and AE, and the support of vocational students who will continue to Higher Education. On the other hand, the opening of the world of work in industry and business. Other support is from the government which plans to build simultaneous and national IAR and AE vocational education programs in 100 SMKs and the development of productive teacher training and education in 184 SMKs in 2022.

References

[1] Massa I 2015 Technological change in developing countries: Trade-offs between economic, social, and environmental sustainability United Nations University-Maastricht Economic and Social Research Institute on Innovation and Technology (MERIT)
[2] Khan A and Turowski K A 2016 A survey of current challenges in manufacturing industry and preparation for industry 4.0 Proceedings of the First International Scientific Conference “Intelligent Information Technologies for Industry”(IITI’16) 15-26 Springer, Cham
[3] Kolesnichenko E A, Radyukova Y Y and Pakhomov N N 2019 The Role and Importance of Knowledge Economy as a Platform for Formation of Industry 4.0 Industry 4.0: Industrial Revolution of the 21st Century (Springer) 73-82
[4] Industriall Global Union 2017 The Challenge of Industry 4.0 and The Demand for New Answers. Internal Working Paper, 2nd Draft 38
[5] Bonekamp L and Sure M 2015 Consequences of Industry 4.0 on human labour and work organisation Journal of Business and Media Psychology 6(1) 33-40
[6] Shamim S, Cang S, Yu H and Li Y 2016 Management approaches for Industry 4.0: A human resource management perspective Paper presented at the Evolutionary Computation (CEC), IEEE
[7] Seet P S, Jones J T, Spoehr J and Hordacre A L 2018 The Fourth Industrial Revolution: the implications of technological disruption for Australian VET (Adelaide: NCVER)
[8] Kemdikbud 2017 100 SMK Energi Terbarukan Siap Dibangun [Online] Retrieved from: http://psmk.kemdikbud.go.id/konten/2248/100-smk-energi-terbarukan-siap-dibangun
[9] Kirman A 1989 The intrinsic limits of modern economic theory: the emperor has no clothes The Economic Journal 126–139
[10] Goodwin N, Nelson J A, Ackerman F and Weisskopf T 2009 Microeconomics in context (New York)