Job Specifications during the Era of Disruption and Industry 4.0

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*Abstract***:** *This research synthesizes study findings about job specifications in the era of disruption and industry 4.0. Industrial revolution 4.0 era, based on digital technology, artificial intelligence, robotics, and automation, changes the type of jobs in the workforce to keep accelerating and unpredictable. The journals studied are from 2015 to 2019. This research focuses on the problem of job specifications in the era of disruption and industry 4.0 era in Taiwan. Revolution industry 4.0 brought more significant changes to all aspects, including education. The assessment and comparison of education management in Taiwan has led to the industry 4.0. Besides analyzing the types of jobs and competencies that graduates must have in accordance with industry 4.0 demands, this research also discusses job specifications that will still exist and new competencies that must be developed in order to face industry 4.0 in Taiwan. Vocational education as an education that creates job-ready graduates, must be ready to face industry 4.0. Therefore, this research discusses the ways in how to anticipate this problem. The research method used in this research uses literature review by analyzing journals related to job specifications and industry 4.0 competence. Based on several studies that have been carried out, the types of jobs that will still survive and the types of new jobs that will exist to face industry 4.0 can be classified, as preparation for the development of vocational education.*

Keywords **:** *Industry 4.0, job specifications, competence.*

I. INTRODUCTION

This is revolution industry 4.0 is centered that use of mass production technology that is flexible [1]. Humans will coordinate with machines that operate independently [2]. Revolution industry 4.0 era is used to control the production process by using time synchronization as well as unification and adjustment of production [3]. Revolution industry 4.0 is carried out three interrelated factors between one factor and the other, namely; 1) digitization and interaction of economics with simple techniques towards economic networks with complex techniques; 2) digitization of products and services; and 3) new market models [4]. Artificial intelligence is a characteristic of revolution industry 4.0 era.

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One of the forms in applying that is robots used to replace human labor, lack of production costs are cheaper, more effective and efficient. Revolution industry 4.0 is a phase by technological revolution that changes mindset and way of human activity works scale, scope, complexity, and transformation previous phase. Each country has different characteristics; therefore, each country must be able to respond as a changes an integrated and comprehensive manner. The response should involve every global political stakeholder, ranging from the public sector, private sector, academic, to civil society lack of revolution industry 4.0 era challenges can be managed into opportunities.

In many countries, including Taiwan, revolution industry is a term used for Industry because the term "fourth industrial revolution" is more interesting and more familiar than Industry 4.0 [2]. We are beginning of fourth industrial revolution built a much more digital revolution and mobile internet everywhere, smaller and more powerful sensors that are becoming effectively and efficiently by technology [6]. Global research trends and Taiwan's research performance are mostly related of revolution industry 4.0 era. Five fields of research related are 3D printing, Internet of Things (IoT), Big Data, Artificial Intelligence (AI), and Cloud Computing [7].

In many way to face revolution industry and disruption phenomenon to prevent various impacts on people's lives, like jobless or unemployment. The Employment and Social Outlook Trend in 2018 showed number of unemployed people globally by 2019 is expected to reach 204.000.000 people and increased to 206.700.000 unemployment. Almost, this condition experienced by western countries. Indonesia is also predicted unemployment rate in February 2018 is 5.33% or 7.01 million of the total 131.55 million workforces [8].

The problem of unemployment and competitiveness of human resources is a real challenge for Indonesia. The challenges facing Indonesia are also compounded by the demands of companies and industries. The job market requires multi-skills graduates coming in units and created by education systems, both secondary education and higher education [9]. Revolution industry 4.0 brough more challenges like encourage innovation and the creation of vocational education. The government needs to review the relevance of vocational education and employment to respond to changes, challenges, and opportunities of industry 4.0 while continuing to pay attention to humanities. The challenges of vocational education are increasingly complex with industry 4.0. Therefore, to answer these challenges, it is necessary to analyze the relevant competencies to be developed in facing Industry 4.0.

The analysis is carried out by obtaining data among academics (teachers, lecturers) and practitioners (industry) regarding expertise relevant to Industry 4.0 and to start planning regarding what types of expertise are needed in the future in facing Industry 4.0.

II. METHOD

Literature review is identified by browsing the Web of Sciene database, followed by Scopus by entering the keywords "revolution industry 4.0 job specifications" and " revolution industry 4.0 job competency," resulting in 20 articles from the last 5 years, ranging from 2015 until 2019. The 20 articles that were obtained were then read, analyzed and coded using a spreadsheet program.

Coding Scheme

The coding scheme is adapted from a structured/systemic approach on literature review. The approach uses four main categories in analyzing articles, namely:

a. Basic data: author, year of publication, journal, place of study
b. Research method: research methodology, method, theme, data collection, analytical method, research results
c. Content analysis: revolution industry 4.0, vocational education, revolution industry 4.0 job specifications and competency, content areas and designed paths (i.e., how researchers analyze and classify the types of jobs designed to face industry 4.0).
d. Discussion: issues discussed, future instructions, personal comments.

III. RESULT AND DISCUSSION

Industry 4.0 created a term has attracted a lot of attention from various groups, ranging from academics, practitioners, government officials, and politicians around the world. Revolution industry 4.0 is the current trend towards automation and data exchange in manufacturing technology. Includes cyber physical systems, Internet of Things, and cloud computing [10]. Revolution industry 4.0 created and referred to as a "smart factory." In a modular, structured smart factory, physical system monitors cyber-physical processes, makes virtual copies of the physical world, and makes decentralized decisions. Internet of things refers to cyber physical systems that communicate and cooperate each other and humans in real time through internet services, both internal and cross-organizational services are offered and used by participants throughout the value chain [11].

The fourth wave of revolution is in the middle of life, marked by a wave of sophisticated technology and the emergence of various digital industries through the transformation of the 9 pillars of sophisticated technology [12] [13]. The challenges of knowledge and competence that are closely related to the era of disruption and industry 4.0 require a new strategy to prepare Human Resources (HR) that can compete and meet various needs that continue to develop [14] [15]. Revolution industry 4.0 will direct a substantial reduction in various low skills based on the standards applied in workforce and increasing high skills activity, including planning, controlling, and tasks related to Information and Technology (IT) [16] [12] [17]. This is also strengthened by

various 4.0 technologies used in the industry to increase the productivity and effectiveness of the production process [18].

In addition, Industry 4.0 will show how industries and work environments are very dependent on Cyber Physical System (CPS) and its implementation on smart factories [13]. Various aspects, including the most important competency expertise, will also be heavily affected by Industry 4.0 [19] accompanied by the phenomenon of the disruption era that keeps going very fast. Workers in the future will be highly demanded to have a high level of skill and competence in the use of various advancements in CPS-based technology that are clearly very different from the current state of the industry [20] [21] [22].

Various expertise competencies that exist in vocational secondary education must begin to think of new strategies in fierce competition between robots and humans, such as human-machine cooperation that will be widely used by smart factories [23] [24]. So it is necessary to pay attention to various competencies prepared by vocational schools to create graduates who can compete. It is also important to pay attention to the relevance of expertise competencies with conditions of dynamic and rapid industrial revolution industry by various challenges and shifts that occur in this disruption phenomenon. In the picture below, framework and digitization in facing Industry 4.0 can be seen, namely technology digitization is a framework in all aspects to face Industry 4.0 [25].
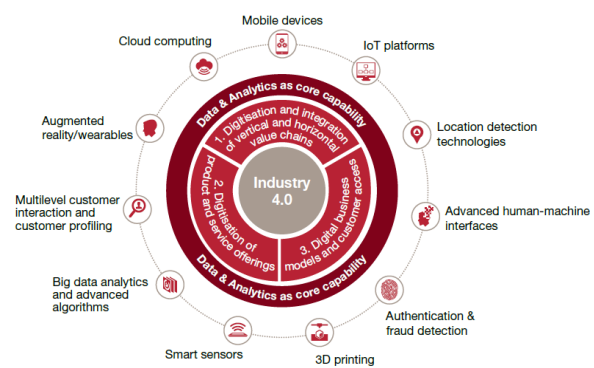

Figure 1. Industry 4.0 framework and contribution of digital technologies.

A. Job Specifications in Taiwan

The era of industry 4.0 makes a profound change and impact, both for the industry and for the workers. This change demands innovation in the industry [26]. This happens because in the era of Industry 4.0, convenience is a priority for consumers in determining which industries will be used for various needs. One important component in the era of Industry 4.0 is the factory or industry in the future that will shift and divert not only equipment, sensors, workers, and others that are linked through automatic information switching, but it will also replace the intellectual intelligence of workers in predicting, processing and managing systems in factories or industries.

This is called a smart factory that is able to replace the jobs of workers with the CPS system to achieve large profits and low costs [27].

As a result, industries will be required to improve and increase its capacity to be

able to compete. This phenomenon occurs in various fields including Human Resources (HR) or workers [28].

In this era of Industry 4.0, some tasks that workers must have are skills such as being widely knowledgeable in information and technology, able to make decisions, solve problems, execute tasks properly, sharpen social abilities in the work environment, be optimistic, and be experts in their fields for at least 2 years [29]. Based on the description of the tasks carried out in the industrial era above, it can be concluded that workers must be able to develop their skills to be able to fulfill industry needed in revolution industry era. The placement of PMI (Indonesian Migrant Workers) in several countries carried out by the National Board of Placement and Protection of Indonesian Workers (BNP2TKI) in the last 3 years with placement in 25 countries can be seen in table 1 below:

Table 1. Placement of PMI by Country, Period of 2019 (September).

NO	COUNTRY	YEAR		
		2017	2018	2019
1	MALAYSIA	6.945	6.389	7.120
	TAIWAN	4.453	6.4111	6.962
2	HONGKONG	6.687	6.086	4.598
3	SINGAPORE	1.162	1.355	1.599
4	SOUTH KOREA	386	762	1.049
5	SAUDI ARABIA	648	839	512
6	BRUNEI DARUSSALAM	391	515	444
7	ITALY	71	79	512
8	PAPUA NEW GUINEA	27	13	59
9	UNITED ARAB EMIRATES	187	72	59
10	KUWAIT	68	73	34
11	MALDIVES	10	72	31
12	OMAN	79	52	27
13	JAPAN	46	24	25
14	POLAND	4	1	22
15	SOLOMON ISLANDS	8	27	13
16	RUSSIA	8	3	12
17	ZAMBIA	15	20	11
18	QATAR	99	42	10
19	GABON	7	13	10
20	BAHRAIN	15	12	9
21	TURKEY	15	18	7
22	MACAO SAR	2	1	7
23	SRI LANKA	5	12	2
24	JORDAN	2	1	1
25	OTHERS	111	116	31
	TOTAL	21.451	23.008	22.796

Source: http://www.bnp2tki.go.id

From table 1 above, it can be seen that the placement of the highest PMI is in Malaysia (first rank), Taiwan (second rank), and Hong Kong (third rank). This shows that these countries have high attractiveness for PMI in 2017-2019. Out of all the considerations in why workers are interested in being able to work in certain countries, one of which is the amount of opportunities or job vacancies as illustrated in Figure 1 below:

Figure 1. 10 Countries with the most job vacancies.
Source: http://www.bnp2tki.go.id

In Figure 1 above, it can be seen that Taiwan has the most job opportunities with 65,119 jobs for foreign workers. This is a consideration and an appeal for job seekers to be able to take these opportunities. Other support can be seen from the number of SIPs issued by the country concerned. In connection with this SIP, it functions as a permit granted by the Government to PPTKIS to recruit prospective migrant workers from certain regions, for certain positions, and to be employed in certain prospective users for a certain period of time. Taiwan has other attractions for foreign workers such as PMI who work or want to work in Taiwan. Among them are high salaries and health insurance for foreign workers which is in full attention of the country of Taiwan which was delivered directly by John Chen, Chair of the Taipei Economic and Trade Office (TETO) [30].

Some of the industrial fields that are mostly filled by foreign workers include fisheries, manufacturing, construction, social work. The more complete information of the amount of foreign workers in Taiwan in the sectors of those fields mentioned above can be seen in table 2 below:

Table 2. Number of Foreign Workers in Taiwan.

Industry	Total	Indonesia	Philippines	Thailand	Vietnam
Fisheries	10.713	6.860	1.706	20	2.127
Manufacturing	366.127	52.448	103.223	54.837	155.618
Construction	6.451	1.333	68	3.155	1.895
Social Work	711.001	271.583	155.560	60.423	223.443
Total	1.094.292	332.224	328.489	138.415	383.083

Source: Processed from *Workforce Development Agency,* MOC 2019

Some of the industries that have the most opportunities for PMI to work include fisheries, manufacturing, construction and social work. Judging from the information in table 2 above, it can be concluded that PMI fills the most in social work industries in 2019 with 271,583 people.
Therefore, there are things that need to be improved and prepared by prospective workers to be able to fill the industry sector well.

Some types of work in the social work industry include nursing, household assistants, nurses in institutions, and

nurses for families [31]. The preparation to start working in the field of social work industry is by preparing several things, such as: first, skills in getting information, operating media, and technology [32]. In other terms, technology literacy is a must. What is meant by information, media and technology skills include media literacy, visual literacy, multicultural literacy, global awareness, and technological literacy. Second, skills in learning and innovation which include creativity and curiosity, problem solving and risk taking. Third, skilled in life and learning such as having leadership and being responsible, having ethical and moral values, productivity and accountability, flexibility and adaptation, social and cross-cultural, initiative and self-directed. Fourth, having the ability to communicate effectively such as being able to work in teams and collaborate, having personal and social responsibilities, communication must be interactive and have a national and global orientation [28].

B. Industry 4.0

Industry 4.0 becomes a challenge for all nations in preparing qualified human resources [33]. Digitalization and intelligence of the manufacturing process is a necessity for industry today. The manufacturing industry is now changing from mass production to specialized production [34]. Rapid advances in manufacturing technology and applications will help to increasing productivity [35]. Revolution industry 4.0 era term is defined as a new level of organization and control over entire product life cycle value chain; it is directed at customer needs that becomes increasingly individual. Revolution industry is a realistic concept that includes the Internet of Things, Industrial Internet, Smart Manufacturing, and Cloud Manufacturing [36]. Industry 4.0 deals with tight human integration in the manufacturing process with the aim of having continuous improvements and focus on value-added activities and avoids waste [37].

Revolution industry needed is to convert regular machines into independent machine learning and independent learning to improving overall performance and maintenance management with the interactions around it [38]. Industry 4.0 aims to build an open and smart manufacturing platform for industrial-network information applications. Monitoring real-time data, tracking product status and position, and holding instructions for controlling the production process are the main requirements of Industry 4.0 [39]. At the moment, the lack of powerful tools is still a major obstacle in exploiting the full potential of Industry 4.0. In particular, formal methods and system methods are very important to generate Industry 4.0, which presents unique challenges [40]. To answer these challenges, researchers will conduct an analysis about the types of competencies that are in accordance with Industry 4.0 and what types of competencies do not yet exist to answer the challenges of the Industry 4.0 itself.

C. Industry 4.0 and Future Jobs

In the fourth industrial revolution era, disruptive technology comes very quickly and is feared to threaten the existence of long-standing companies and their workforce. History records that industrial revolution has claimed many lives with the downfall of giant corporations [41]. Entrepreneurs are demanded to be skilled in utilizing

technological sophistication such as Internet of Things (IoT) and robotics. Industry 4.0 in its implementation will not cut employment for humans. However, there is a shift in future work needs [42]. In this case, humans must be able to adjust to the needs of these competencies [43].

There are a number of jobs that actually require a lot of manpower, but the demand is still lacking. The results of the analysis of Human Resources with the ability to match industry demands are also not too many. The fields that require a lot of manpower in the future are those related to information and technology [44]. Some jobs now do not require physical presence and perfection of appearance; they are enough only with digital technology. There will be more of this type of work in the future.

Human Resources must adjust to the needs of work in the future, it requires awareness in the community to understand what is needed by Industry 4.0 [37]. Employment is more inclusive, giving everyone the opportunity to create skills or reskilling, or upskilling, or improving quality [45]. Vocational education as a creator of human resources who are ready to work, needs to continue to increase its quality in vocational education and skills training for high school and university graduates in supporting their development in terms of effective resources [46] to be ready to work and ready to enter Industry 4.0.

IV. CONCLUSION

Industry 4.0 provides change in educational innovation. Industry 4.0 prepares graduates for more complex jobs, where smart robots will replace people in certain activities. Rapid advances in manufacturing technology will help to increasing productivity. Vocational education as an education that creates job-ready graduates must be able to be ready to face Industry 4.0. Based on several studies that have been carried out, the types of jobs that will still survive and the types of new jobs that will exist to face industry 4.0 can be classified, as preparation for the development of vocational education.

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REFERENCES

1. H. Kagermann, W. Wahlster, and J. Helbig,

"Recommendations for implementing the strategic," 2013.

2. T. K. Sung, "Technological Forecasting & Social Change Industry 4 . 0 : A Korea perspective," Technol. Forecast. Soc. Chang., vol. 132, no. October 2017, pp. 40–45, 2018.

3. D. Kohler and J. D. Weisz, Industry 4.0: the challenges of the transforming manufacturing. Germany: BPIFrance, 2016.

4. F. Zezulka, P. Marcon, I. Vesely, and O. Sajdl, "Industry 4.0 – An Introduction in the phenomenon," IFAC-PapersOnLine, vol. 49, no. 25, pp. 8–12, 2016.

5. R. R. Tjandrawinata, "Raymond R. Tjandrawinata - 2017 - Industri 4.0 Revolusi Industri 4.0 Revolusi Industri Abad Ini Dan Pengaruhnya Pada Bidang Kesehatan Dan Bioteknologi," vol. 29, no. 1, pp. 31–39, 2016.

6. K. Schwab, "Shaping the Fourth Industrial Revolution," 2016. [Online]. Available: https://www.project-syndicate.org/commentary/fourth-industrial-revolution-human-development-by-klaus-schwab-2016-01?barrier=accesspaylog.

7. D. J. A. Informatika and K. K. dan Informatika, "Big Data, Kecerdasan Buatan, Blockchain, dan Teknologi Finansial di Indonesia," pp. 1–66, 2018.

8. B. P. Statistik, "Statistik Indonesia 2018," 2018. [Online]. Available: https://www.bps.go.id/publication/2018/07/03/5a963c1ea9b0fed6497d0845/statistik-indonesia-2018.

9. World Bank, "Bank Dunia," p. 1, 2015.

10. H. Kagermann and R. Anderl, Industrie 4.0 in a Global Context. Acatech, 2013.

11. B. Hermann, M., Pentek, T., & Otto, "Design Principles for Industrie 4.0 Scenarios," Present. 49th Hawaiian Int. Conf. Syst. Sci., 2016.

12. L. Bonekamp and M. Sure, "Consequences of Industry 4 . 0 on Human Labour and Work Organisation," no. 1, pp. 33–40, 2015.

13. K. Zhou, T. Liu, and L. Zhou, "Industry 4.0: Towards future industrial opportunities and challenges," 2015 12th Int. Conf. Fuzzy Syst. Knowl. Discov. FSKD 2015, pp. 2147–2152, 2016.

14. G. Erdoğan, "Land selection criteria for lights out factory districts during the industry 4.0 process," J. Urban Manag., no. January, pp. 1–9, 2019.

15. F. Hecklau, M. Galeitzke, S. Flachs, and H. Kohl, "Holistic Approach for Human Resource Management in Industry 4.0," Procedia CIRP, vol. 54, pp. 1–6, 2016.

16. B. Y. Jeong, "Characteristics of occupational accidents in the manufacturing industry of South Korea," vol. 20, pp. 301–306, 1997.

17. The Boston Consulting Group (BCG), "Industry 4.0: The Future of Productivity and Growth in Manufacturing Industries," Bost. Consult. Gr., p. 20, 2015.

18. L. S. Dalenogare, G. B. Benitez, N. F. Ayala, and A. G. Frank, "The expected contribution of Industry 4.0 technologies for industrial performance," Int. J. Prod. Econ., vol. 204, no. August, pp. 383–394, 2018.

19. B. Motyl, G. Baronio, S. Uberti, D. Speranza, and S. Filippi, "How will change the future engineers ' skills in the Industry 4 . 0 framework ? A questionnaire survey," Procedia Manuf., vol. 11, no. June, pp. 1501–1509, 2017.

20. E. Kaasinen et al., "Empowering and engaging industrial workers with Operator 4 . 0," Comput. Ind. Eng., 2019.

21. C. Schröder, "The Challenges of Industry 4.0 for Small and Medium-sized Enterprises a good society – social democracy # 2017 plus," the Friedrich-Ebert-Stiftung, p. 28, 2016.

22. R. Y. Zhong, X. Xu, E. Klotz, and S. T. Newman, "Intelligent Manufacturing in the Context of Industry 4 . 0 : A Review," Engineering, vol. 3, no. 5, pp. 616–630, 2017.

23. F. Ansari, S. Erol, and W. Sihn, "Rethinking Human-Machine Learning in Industry 4.0: How Does the Paradigm Shift Treat the Role of Human Learning?," Procedia Manuf., vol. 23, no. 2017, pp. 117–122, 2018.

24. A. Szalavetz, "Industry 4.0 and capability development in manufacturing subsidiaries," Technol. Forecast. Soc. Change, no. May, pp. 0–1, 2018.

25. G. Reinhard, V. Jesper, and S. Stefan, "Industry 4.0: Building the digital enterprise," 2016 Glob. Ind. 4.0 Surv., pp. 1–39, 2016.

26. K. D, "Revolusi industri, 75% jenis pekerjaan akan hilang," 2017. [Online]. Available: https://ekbis.sindonews.com/read/1183599/34/revolusi-industri-75-jenis-pekerjaan-akan-hilang-1488169341.

27. J. Qin, Y. Liu, and R. Grosvenor, "A Categorical Framework of Manufacturing for Industry 4.0 and beyond," Procedia CIRP, vol. 52, pp. 173–178, 2016.

28. W. Bauer, M. Hämmerle, S. Schlund, and C. Vocke, "Transforming to a Hyper-connected Society and Economy – Towards an 'Industry 4.0,'" Procedia Manuf., vol. 3, no. Ahfe, pp. 417–424, 2015.

29. A. Ana, D. Meirawan, V. Dwiyanti, and S. Saripudin, "Character of industrial 4.0 skilled workers," Int. J. Eng. Technol., vol. 7, no. 4, pp. 166–170, 2018.

30. R. A. Hasan, "HUT Nasional ke-107, Taiwan Berharap Hubungan dengan Indonesia Semakin Baik," 2018. [Online]. Available: https://www.liputan6.com/global/read/3663951/hut-nasional-ke-107-taiwan-berharap-hubungan-dengan-indonesia-semakin-baik.

31. W. D. Agency and M. of Labor, "45th WorldSkills Competition National Team paraded on National Day," 2019. [Online]. Available: https://www.wda.gov.tw/en/News_Content.aspx?n=8E8FA34452E8DBC2&sms=AE3C87216823B14C&s=2CFDAFF5DC6B8FD2.

32. S. McKee, "The Future of Jobs And Education that Works "How should the Education System Respond? Series of talks by Labtech," in Dr, 2018.

33. M. Kiss, G. Breda, and L. Muha, "ScienceDirect ScienceDirect ScienceDirect ScienceDirect Information Information security security aspects aspects of of Industry Costing models for capacity optimization in Industry 4 . 0 : Trade-off between used capacity and operational efficiency," Procedia Manuf., vol. 32, pp. 848–855, 2019.

34. S. Ezell, "Why Manufacturing Digitalization Matters and How Countries Are Supporting It," Inf. Technol. Innov. Found., no. April, pp. 1–66, 2018.

35. C. Martin and H. Leurent, "Technology and innovation for the future of production: Accelerating value creation," World Econ. Forum, no. March, pp. 1–38, 2017.

36. J. K. Gerrikagoitia, G. Unamuno, E. Urkia, and A. Serna, "Digital Manufacturing Platforms in the Industry 4.0 from Private and Public Perspectives," Appl. Sci., vol. 9, no. 14, p. 2934, 2019.

37. A. Benešová and J. Tupa, "Requirements for Education and Qualification of People in Industry 4.0," Procedia Manuf., vol. 11, no. June, pp. 2195–2202, 2017.

38. J. Lee, H. A. Kao, and S. Yang, "Service innovation and smart analytics for Industry 4.0 and big data environment," Procedia CIRP, vol. 16, pp. 3–8, 2014.

39. F. Almada-Lobo, "The Industry 4.0 revolution and the future of Manufacturing Execution Systems (MES)," J. Innov. Manag., vol. 3, no. 4, pp. 16–21, 2016.

40. L. Da Xu, E. L. Xu, and L. Li, "Industry 4.0: state of the art and future trends," Int. J. Prod. Res., vol. 56, no. 8, pp. 2941–2962, Apr. 2018.

41. S. Coşkun, Y. Kayıkcı, and E. Gençay, "Adapting Engineering Education to Industry 4.0 Vision," Technologies, vol. 7, no. 1, p. 10, 2019.

42. A. C. Pereira and F. Romero, "A review of the meanings and the implications of the Industry 4.0 concept," Procedia Manuf., vol. 13, pp. 1206–1214, 2017.

43. E. Ras, F. Wild, C. Stahl, and A. Baudet, "Bridging the skills gap of workers in industry 4.0 by human performance augmentation tools - Challenges and roadmap," ACM Int. Conf. Proceeding Ser., vol. Part F1285, pp. 428–432, 2017.

44. F. Hecklau, M. Galeitzke, S. Flachs, and H. Kohl, "Holistic Approach for Human Resource Management in Industry 4.0," Procedia CIRP, vol. 54, pp. 1–6, 2016.

45. W. E. Forum, B. C. Group, and Burning Glass Technologies, Towards a Reskilling Revolution Industry-Led Action for the Future of Work, no. January. 2019.

46. Abiddin, N. Z., & Ismail, A., Exploring service and support needs in postgraduate education towards the higher education quality. Asian Social Science, 10(17), 52-56. doi:10.5539/ass.v10n17p52, 2014.

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