

SKRIPSI

**STUDI MATA KULIAH PRAKTIKUM DEPARTEMEN PENDIDIKAN
TEKNIK ELEKTRO UPI DALAM MENGHADAPI KEBUTUHAN INDUSTRI**

4.0

Diajukan untuk Memenuhi Sebagian Syarat untuk Memperoleh Gelar Sarjana
Pendidikan Teknik Elektro



Disusun Oleh:

Zulfikar Pamungkas

E.0451.1500923

**PROGRAM STUDI PENDIDIKAN TEKNIK ELEKTRO
DEPARTEMEN PENDIDIKAN TEKNIK ELEKTRO
FAKULTAS PENDIDIKAN TEKNOLOGI DAN KEJURUAN
UNIVERSITAS PENDIDIKAN INDONESIA**

2020

**STUDI MATA KULIAH PRAKTIKUM DEPARTEMEN PENDIDIKAN
TEKNIK ELEKTRO UPI DALAM MENGHADAPI KEBUTUHAN INDUSTRI**

4.0

Oleh

Zulfikar Pamungkas

Sebuah skripsi yang diajukan untuk memenuhi salah satu syarat memperoleh gelar
Sarjana pada Fakultas Pendidikan Teknologi dan Kejuruan

© Zulfikar Pamungkas 2020

Universitas Pendidikan Indonesia

Desember 2020

Hak Cipta dilindungi undang-undang

Skripsi ini tidak boleh diperbanyak seluruhnya atau sebagian,

Dengan dicetak ulang, difotocopy, atau cara lainnya tanpa izin penulis

Zulfikar Pamungkas, 2021

*STUDI MATA KULIAH PRAKTIKUM DEPARTEMEN PENDIDIKAN TEKNIK ELEKTRO UPI DALAM
MENGHADAPI KEBUTUHAN INDUSTRI 4.0*

Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

LEMBAR PENGESAHAN

Zulfikar Pamungkas

E.0451.1500923

**STUDI MATA KULIAH PRAKTIKUM DEPARTEMEN PENDIDIKAN
TEKNIK ELEKTRO UPI DALAM MENGHADAPI KEBUTUHAN INDUSTRI**

4.0

Disetujui dan disahkan oleh:

Pembimbing I



Dr. H. Bambang Trisno, M.SIE

NIP. 19610309 198610 1 001

Pembimbing II



Drs. Yoyo Somantri, ST. M.Pd.

NIP. 19570805 198503 1 003

Mengetahui,

Ketua Departemen Pendidikan Teknik Elektro FPTK UPI



Dr. Yadi Mulyadi, M.T.

NIP. 19630727 199302 1 001

**STUDI MATA KULIAH PRAKTIKUM DEPARTEMEN PENDIDIKAN
TEKNIK ELEKTRO UPI DALAM MENGHADAPI KEBUTUHAN INDUSTRI**

4.0

Oleh:

Zulfikar Pamungkas

E.0451.1500923

ABSTRAK

Adanya Industri 4.0 saat ini, berdampak pada dunia teknologi sistem produksi industri dan penyelenggaraan Pendidikan di berbagai jenjang. Demikian halnya di DPTE FPTK UPI sebagai LPTK yang berorientasi menghasilkan lulusan S1 dibidang vokasi berupaya melakukan penyesuaian sarana dan prasarana pendidikan. Pada penelitian ini akan dikaji salah satu diantaranya adalah mengkaji materi praktikum Otomasi industri yang berada pada program studi Elektronika Industri (ELIND). Adapun tujuan dari penelitian ini adalah mengidentifikasi indikator-indikator kompetensi materi praktikum Otomasi industri yang perlu dikembangkan sesuai dengan standar kebutuhan industri 4.0. yang dibakukan oleh lingkungan CSE (*Control System Engineer*) pada Automation Competency Model (ACM). Metode pengumpulan dan analisis data untuk penelitian ini digunakan dengan melakukan studi dokumentasi, wawancara dengan pihak terkait, studi literatur. Dari hasil penelitian diperoleh gambaran bahwa indikator dan kompetensi pada materi praktikum otomasi industri pada konsentrasi Elektronika Industri perlu mengembangkan materi sarana dan prasarana untuk studi pengantar *Smart Factory*.

Kata Kunci : Kompetensi, Revolusi Industri 4.0, Praktikum Otomasi Industri

**STUDI MATA KULIAH PRAKTIKUM DEPARTEMEN PENDIDIKAN
TEKNIK ELEKTRO UPI DALAM MENGHADAPI KEBUTUHAN INDUSTRI**

4.0

Oleh:

Zulfikar Pamungkas

E.0451.1500923

ABSTRAK

The existence of Industry 4.0, has an impact on the world of industrial production system technology and the implementation of Education at various levels. Similarly, in DPTE FPTK UPI as an LPTK oriented to produce undergraduate graduates in the field of vocational to make adjustments to educational facilities and infrastructure. In this research will be studied one of them is reviewing the material of industrial automation practicum in the study program Industrial Electronics (ELIND). The purpose of this research is to identify indicators of practical material competencies of industrial automation that need to be developed in accordance with needs of industry 4.0 which is standardized by the CSE (Control System Engineer) environment in the Automation Competency Model (ACM). Data collection and analysis methods for this research are used by conducting documentation studies, interviews with related parties, literature studies. From the results of the research obtained an overview that indicators and competencies in industrial automation practicum materials at the concentration of Industrial Electronics need to develop material facilities and infrastructure for the study of introduction to Smart Factory.

Kata Kunci : Kompetensi, Revolusi Industri 4.0, Praktikum Otomasi Industri

Zulfikar Pamungkas, 2021

*STUDI MATA KULIAH PRAKTIKUM DEPARTEMEN PENDIDIKAN TEKNIK ELEKTRO UPI DALAM
MENGHADAPI KEBUTUHAN INDUSTRI 4.0*

Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

DAFTAR ISI

LEMBAR PENGESAHAN	3
LEMBAR PERNYATAAN	Error! Bookmark not defined.
KATA PENGANTAR.....	Error! Bookmark not defined.
ABSTRAK	4
DAFTAR TABEL	9
DAFTAR LAMPIRAN.....	10
Bab 1 Pendahuluan	Error! Bookmark not defined.
1.1 Latar Belakang Penelitian	Error! Bookmark not defined.
1.2 Rumusan Masalah	Error! Bookmark not defined.
1.3 Batasan Masalah.....	4
1.4 Tujuan Penelitian.....	Error! Bookmark not defined.
1.5 Manfaat Penelitian.....	5
1.6 Sistematika Penulisan.....	5
BAB 2 Kajian Pustaka	Error! Bookmark not defined.
2.1 Kompetensi.....	Error! Bookmark not defined.
2.2 Revolusi Industri 4.0	Error! Bookmark not defined.
2.3 Model Kerangka Industri 4.0.....	Error! Bookmark not defined.
2.4 Teknologi Industri 4.0	Error! Bookmark not defined.
2.5 Pendidikan 4.0	Error! Bookmark not defined.
BAB 3 Metode Penelitian	Error! Bookmark not defined.
3.1 Prosedur Penelitian.....	Error! Bookmark not defined.
3.2 Objek Penelitian	Error! Bookmark not defined.
3.3 Data Penelitian	Error! Bookmark not defined.

3.4	Pengujian Keabsahan Data.....	16
BAB 4 Temuan dan Pembahasan		18
4.1	Temuan Penelitian	18
4.2	Pembahasan Penelitian	18
4.2.1	Identifikasi Kebutuhan <i>Control System Engineer</i> di Industri 4.0 dan Indikator Capaian Pembelajaran Praktikum di Elektronika Industri DPTE UPI	18
BAB 5 Simpulan, Implikasi dan Rekomendasi		28
5.1	Simpulan.....	28
5.2	Implikasi	28
5.3	Rekomendasi	28
Daftar Pustaka.....		30
LAMPIRAN.....		39

DAFTAR GAMBAR

Gambar 2.1 Linimasa Revolusi Industri	Error! Bookmark not defined.
Gambar 2.2 Struktur Fraunhofer industrie 4.0 Layer Model (Neugebauer, 2016).	Error! Bookmark not defined.
Gambar 3.1 Diagram alir proses penelitian.....	Error! Bookmark not defined.
Gambar 3.2 Triangulasi Data	17

DAFTAR TABEL

Tabel 1.1 Tingkat Pengangguran Terbuka (TPT) Menurut Tingkat Pendidikan Tertinggi yang Ditamatkan (persen), Agustus 2015-2019... **Error! Bookmark not defined.**

Tabel 2.1. Teknologi yang mendukung Industri 4.0**Error! Bookmark not defined.**

Tabel 4.1 Indikator Capaian Pembelajaran Mata Kuliah Praktikum pada Konsentrasi Elektronika Inudstri DPTE UPI 2020 18

Tabel 4.2 Mapping Indikator Capaian Pembelajaran Mata Kuliah Praktikum Elektronika Industri DPTE UPI dengan Kompetensi Control System Engineer di Era Industri 4.0 25

DAFTAR LAMPIRAN

Lampiran 1 Kisi – kisi Instrumen Data	40
Lampiran 2 Deskripsi Rencana Pembelajaran Mata Kuliah Praktikum Sensor dan Mikriprosesor	41
Lampiran 3 Deskripsi Rencana Pembelajaran Mata Kuliah Praktikum Otomasi Industri	57
Lampiran 4 Deskripsi Rencana Pembelajaran Mata Kuliah Praktikum Elektronika Analog	71

Daftar Pustaka

- Alcácer, V., & Cruz-Machado, V. (2019). Scanning the Industri 4.0: A Literature Review on Technologies for Manufacturing System. *Engineering Science and Technology, an International Journal*. Vol. 22 (3), pp. 899-919.
- Abele, Eberhard, et al. (2015). Learning Factories for Research, Education, and Training. *Procedia CIRP*. Vol. 32, pp. 1-6.
- Andulkar, Mayur, et al. (2018). A Multi-Case Study on Industri 4.0 for SME's in Brandenburg, Germany. *Proceedings of the 51st Hawaii International Conference on System Sciences*, pp. 4544-4553.
- Anjarichert, Lana Plumanns, et al. (2016). Learning 4.0: Virtual Immersive *Engineering Education*. *Digital Universities International Best Practices and Application*. Vol. 2, pp. 51-66.
- Arikunto, S. (2013). *Prosedur Penelitian: Suatu Pendekatan Praktik*. Jakarta: Rineka Cipta.
- Badan Pusat Statistik (2019). *Keadaan Ketenagakerjaan Agustus 2019*. Badan Pusat Statistik Jawa Barat
- Baena, Felipe, et al. (2017). Learning Factory: The Path to Industri 4.0. *Procedia Manufacturing*. Vol. 9, pp. 73-80.
- Bahrin, Mohd Aiman Kamarul, Mohd Fauzi Othman, NH Nor Azli, and Muhamad Farihin Talib. "Industri 4.0: A review on industrial automation and robotic." *Jurnal Teknologi* 78, no. 6-13, pp.137-143, 2016.

- Bal, H. Ç., & Erkan, Ç. (2019). Industri 4.0 and Competitiveness. *Procedia Computer Science*, 158, 625–631.
- Baygin, Mehmet, et all. (2016). An Effect Analysis of Industri 4.0 to Higher Education. 15th International Conference on Information Technology Based Higher Education and Training (ITHET). pp. 1-4.
- Benešová, Andrea, & Jiří Tupa. (2017). Requirements for Education and Qualification of People in Industri 4.0. *Procedia Manufacturing*. Vol. 11, pp. 2195 – 2202.
- Bender, Beate, et all. (2015). Learning Factory 2.0 – Integrated View of Product Development and Production. *Procedia CIRP*. Vol. 32, pp. 98-103.
- Bonnaud, Serge, et all. (2019). Industri 4.0 Cognitive Manufacturing. IBM Global Market.
- Brettel, Malte, et all. (2014). How Virtualization, Decentralization and Network Building Change the Manufacturing Landscape: An Industri 4.0 Perspective. *International Journal of Mechanical, Aerospace, Industrial, Mechatronic and Manufacturing Engineering*. Vol. 8(1), pp.37- 44.
- Catal, Cagatay, & Bedir Tekinerdogan. (2019). Aligning Education for the Life Sciences Domain to Support Digitalization and Industri 4.0. *Procedia Computer Science*. Vol. 158, pp. 99-106.
- Chryssolouris, George, et all. (2013). Manufacturing Systems: Skills & Competencies for the Future. *Procedia CIRP*. Vol. 7, pp. 17-24.

- Chua, C. K., & Leong, K. F. 3D Printing and *Additive Manufacturing: Principles and Applications* (with Companion Media Pack) of Rapid Prototyping Fourth Edition. World Scientific Publishing Company, 2014.
- Dogaru, L. (2020). The Main Goals of the Fourth Industrial Revolution. Renewable Energy Perspectives. *Procedia Manufacturing*, 46, 397–401.
- Elbetsawi, Mo, et all. (2018). SEPT Learning Factory for Industri 4.0. Education and Applied Research. *Procedia Manufacturing*. Vol. 23. Pp. 249-254.
- Ellahi, Rizwan Matloob, et all. (2019). Redesigning Curriculum in Line with Industri 4.0. *Procedia Computer Science*. Vol. 151, pp. 699–708.
- Faller, Clemens, and Dorothee Feldmüller. (2015). Industri 4.0 Learning Factory for Regional SMEs. *Procedia CIRP*. Vol. 32, pp, 88-91.
- Georgakopoulos, Dimitrios, et all. (2016). *Internet of Things and Edge Cloud Computing Roadmap for Manufacturing*. *IEEE Cloud Computing*. Vol. 3(4), pp. 64 –71.
- Gilchrist, Alasdair. (2016). *Industri 4.0: The Industrial Internet of Things*. Berkeley: Apress.
- Gräßler, Iris, et all. (2016). Creation of A Learning Factory for Cyber Physical Production Systems. *Procedia CIRP*. Vol 54, pp.107-112.
- Günther, O. P., Kletti, W., & Kubach, U. *RFID in Manufacturing*. Springer Science & Business Media, 2008.

Hofmann, Erik, & Marco Rüsç.(2017). Industri 4.0 and the Current Status As Well As FutureProspects on Logistics.Computers in Industri. Vol. 89, pp. 23–34.

Hooley, Tristram, et al. (2013).The 'Blueprint' Framework for Career Management Skills: ACritical Exploration.British Journal of Guidance & Counselling.Vol. 41(2).

Jeschke, S., Brecher, C., Meisen, T., Özdemir, D., & Eschert, T. Industrial *Internet of Things* and cyber manufacturing systems. In *Industrial Internet of Things* (pp. 3-19). Springer, Cham, 2017.

Kanuru, S. L., & M, P. (2020). Lifelong Learning in higher education using Learning Analytics. *Procedia Computer Science*, 172(2019), 848–852.

Kemeny, Zsolt, et all. (2016).Complementary Research and Education Opportunities – AComparison of Learning Factory Facilities and Methodologies at TU Wien and MTA Sztaki.Procedia CIRP. Vol. 54, pp. 47-52.

Kolberg, Dennis, & Detlef Zühlke.(2015). Lean Automation Enabled by Industri 4.0 Technologies.IFAC-Papers OnLine.Vol. 48(3), pp. 1870–1875 .

Kozák, Štefan, et all. (2018). Research and Education for Industri 4.0: Present Development. 2018 Cybernetics & Informatics (K&I).

Lasi, Heiner,et all. (2014). Industri 4.0.Business Information Sysems.*Engineering*. Vol. 6(4), pp. 239–242.

Lee Jay, et all. (2014). Service Innovation and Smart Analytics for Industri 4.0.andBig Data Environment. Procedia CIRP.Vol. 6, pp. 3-8.

- Lee Jay, et all. (2015). A *Cyber-physical systems* architecture for Industri 4.0-based manufacturing systems A *Cyber-physical systems* architecture for Industri.Manufacturing Letters. Vol. 3, pp. 18–23.
- Leyh, Christian, et all. (2017). Industri 4.0 and Lean Production – A Matching Relationship? An Analysis of Selected Industri 4.0 Models. 2017 Federal Conference on Computer Science and Informatics Systems (FedCSIS) Prague. Vol. 11, pp. 989-993.
- Lin, Feilong, et all. (2016). Autonomous Channel Switching: Towards Efficient Spectrum Sharing for Industrial Wireless Sensor Networks. *IEEE Internet of Things Journal*. Vol. 3(2), pp. 231–243.
- Lu, Yang. (2017). Industri 4.0: A Survey on Technologies, Applications and Open Research Issues. *Journal of Industrial Information Integration*. Vol. 6, pp. 1–10.
- Lozano, Carolina Villarreal, & Kavin Kathiresh Vijayan. (2020).Literature review on *Cyber Physical Systems* Design. *Procedia Manufacturing*. Vol. 45,pp. 295–300.
- Merkel, Lukas, et all. (2017).Teaching Smart Production: An Insight into the Learning Factory for Cyber-Physical Production Systems (LVP).*Procedia Manufacturing*. Vol. 9, pp. 269-274.
- Mosconi, F. (2015). The new European industrial policy: Global competitiveness and the manufacturing renaissance. London, England: Routledge.

- Motyl, Barbara, et all. (2017). How will Change the Future *Engineer's* Skills in the Industri 4.0 Framework? A questionnaire Survey. *Procedia Manufacturing*. Vol. 11, pp. 1501–1509.
- Mulyasa, E. (2004). *Kurikulum Berbasis Kompetensi (Konsep, Karakteristik, Dan Implementasi)*. Bandung: PT. Remaja Rosdakarya.
- Nelles, Jochen, et all. (2016). Human-Centered Design of Assistance Systems for Production Planning and Control. 2016 IEEE International Conference on Industrial Technology (ICIT), pp. 2099-2104.
- Neugebauer, Reimund, et all. (2016). Industrie 4.0. - From the Perspective of Applied Research. *CIRP Conference on Manufacturing Systems*. Vol. 57, pp. 2-7.
- Oses, Noelia, et all. (2016) Uncertainty Reduction in Measuring and Verification of Energy Savings by Statistical Learning in Manufacturing Environments. *International Journal for Interactive Design and Manufacturing (IJIDeM)*. Vol. 10(3), pp. 1–9.
- Pendit, P.L. (2007). *Perpustakaan Digital Perspektif Perpustakaan Perguruan Tinggi Indonesia*. Jakarta: Sagung Seto.
- Pérez, Federico, et all. (2015). A CPPS Architecture Approach for Industri 4.0. 2015 IEEE 20th Conference on Emerging Technologies & Factory Automation (ETFAs). pp. 1-4.
- Peruzzini, Margherita, et all. (2017). Benchmarking of Tools for User Experience Analysis in Industri 4.0. *Procedia Manufacturing*. Vol. 11, pp. 806–813,

- Posada, Jorge, et al. (2015). Visual Computing as A Key Enabling Technology for Industrie 4.0 and Industrial Internet. *IEEE Computer Graphics and Application*. Vol. 35(2), pp. 26–40.
- Ramirez-Mendoza, Ricardo A., et. all. (2018). Engineering Education 4.0. *IEEE Global Engineering Education Conference (EDUCON)*. Vol. xx, pp.1273 - 1282.
- Richert, Anja, et al. (2016). Educating *Engineers* for Industri 4.0: Virtual Worlds and Human-Robot-Teams: Empirical Studies Towards A New Educational Age. *IEEE Global Engineering Education Conference (EDUCON)*. pp. 142-149.
- Rostkowska, M. Simulation of production lines in the education of *engineers*: how to choose the right software?. *Management and Production Engineering Review*, 5(4), pp. 53-65, 2014.
- Rüßmann, Michael, Markus Lorenz, Philipp Gerbert, Manuela Waldner, Jan Justus, Pascal Engel, and Michael Harnisch. "Industri 4.0: The future of productivity and growth in manufacturing industries." Boston Consulting Group 9, 2015.
- Sakuneka, Tumelo, et all. (2019). Industry 4.0. Competencies for A Control System Engineer. *IEEE Technology & Engineering Management Conference*.
- Sanders, Adam et all. (2016). Industri 4.0 Implies Lean Manufacturing: Research Activities in Industri 4.0 Function As Enablers for Lean Manufacturing. *Journal Ind. Eng. Manage*. Vol. 9(3),pp. 811–833.
- Schmalstieg, D., & Hollerer, T. *Augmented reality: principles and practice*. Addison-Wesley Professional, 2016.

- Schmidt, Rainer, et al. (2015). Industri 4.0 - Potentials for Creating Smart Products: Empirical Research Results. *Business Information Systems*. Vol. 208, pp. 16–27.
- Schuster, Katharina, et al. (2016). Preparing for Industri 4.0—Collaborative Virtual Learning Environments in *Engineering Education*. The International Conference on E-Learning in the Workplace 2015 (ICELW). pp. 1-6.
- Shafiq, Syed Imran, et al. (2016). Virtual *Engineering Factory: Creating Experience Base for Industri 4.0*. *Cybernetics and Systems*. Vol. 47(1-2), pp. 32–47.
- Stock, T, & G. Seliger. (2016). Opportunities of Sustainable Manufacturing in Industri 4.0. *Procedia CIRP*. Vol. 40, pp. 536 – 541.
- Sultana, Ronald G. (2012). Learning Career Management Skills in Europe: A Critical Review. *Journal of Education and Work*. 2012. Vol. 25(2), pp. 225-248.
- Thiede, Sebastian, et al. (2016). Implementing Cyber-Physical Production Systems in Learning Factories. *Procedia CIRP*. Vol. 54, pp. 17-24.
- Tvengea, Nina, & Kristian Martinsen. (2018). Integration of Digital Learning in Industri 4.0. *Procedia Manufacturing*. Vol. 23, pp. 261-266.
- Usman, H. & Nuryadin, E.R. (2012). Model Pendidikan Karakter Kewirausahaan Di Sekolah Menengah Kejuruan. *Jurnal Pendidikan Teknologi dan Kejuruan*. Vol. 21. pp. 140-147.
- Wagner, Ulf et al. (2012). The State-of-the-Art and Prospects of Learning Factories. *Procedia CIRP*. Vol. 3, pp. 109- 114.

Wan, Jiafu, Caifeng Zou, Keliang Zhou, Rongshuang Lu, and Di Li. "IoT sensing framework with inter-*Cloud Computing* capability in vehicular networking." *Electronic Commerce Research* 14, no. 3, 389-416, 2014.

Yamin, M. (2007). *Kiat Membelajarkan Siswa*. Jakarta: Gaung Persada Pres Jakarta.

Zabiński, T., Maoczka, T., Kluska, J., Madera, M., & Sęp, J. (2019). Condition monitoring in Industry 4.0 production systems - The idea of computational intelligence methods application. *Procedia CIRP*, 79, 63–67. <https://doi.org/10.1016/j.procir.2019.02.012>

Zarte, Maximilian, & Agnes Pechmann. (2017). Concept for Introducing the Vision of Industri 4.0 in A Simulation Game for Non-IT Students. *IEEE 15th International Conference on Industrial Informatics (INDIN)*. pp. 512-517.

Zhong, Ray Y., Xun Xu, Eberhard Klotz, and Stephen T. Newman. "Intelligent manufacturing in the context of industri 4.0: a review." *Engineering* 3, no. 5, pp 616-630, 2017.