

Interdisciplinarity as a Key Competence on Industry 4.0 Labor Market

Paweł Poszytek*

Foundation for the Development of the Education System

pawel.poszytek@frse.org.pl

Abstract¹

The discussions on the concept of competences 4.0 in the context of 4th industrial revolution, or industry 4.0, have been being growing recently, and extensive analyses and researches have been being carried out by experts within various scientific disciplines such as management, economy, psychology, education, human resource, informatics and systemics. Due to the relevance of industry 4.0 concept in relation to current socio-economic challenges worldwide, the growing interest on the part of researchers and the proliferation of the above-mentioned terms in literature has formed a complicated network of patterns and relations constituting a scientific landscape of the discussions in questions. Accordingly, the aim of this article is to explain the contextual terminology of these discussions, namely: industry 4.0 and competences 4.0, and to discuss the nature of interdisciplinarity as one of the key factors defining future skills in the context of the new labor market needs.

Keywords: *interdisciplinarity, industry 4.0, competences of the future, 4th industrial revolution, labor market.*

1. Introduction

Different terminology has been coined to describe new, fully digitalized era of economy which we are entering due to unprecedentedly fast technological developments. Industry 4.0, known also as the fourth industrial revolution, or I4.0 in short, is a German concept that describes and defines this new fully-automated realm of current and future world of work and production. It is one of the elements of the High-Tech Strategy 2020 action plan announced in 2011 by the German Government during Hannover Fairs. The aim of this strategy was a more competitive, efficient, flexible, and digitalized production and economy (Prifti, Knigge, Kienegger, & Krcmar, 2017; Smit, Kreutzer, Moeller, & Carlberg, 2016). The very term “fourth industrial revolution” was introduced on a wider scale by Klaus Martin Schwab, an executive chairman of the World

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Economic Forum in 2016 to describe the same phenomenon (Schwab, 2015). A detailed definition of the fourth industrial revolution concept in reference to all previous industrial revolutions is provided by Andreja Rojko (2017) and Shu Ing Tay et al. (Tay, Lee, Hamid, Ahmad, 2018). Rojko also presents the concept of industry 4.0 in the broader context of similar governmental initiatives worldwide. Similar initiative, called industrial internet, was introduced in the USA by General Electric in 2012. France has its own *industrie du futur* characterized by additive manufacturing, internet of things and augmented reality (see: descriptions below) and in 2015 China introduced the concept of “Made in China 2025” inspired by German Industry 4.0. However, the most comprehensive overview of the concept is provided by Kazimierz Górka, Agnieszka Thier, & Marcin Łuszczuk (2020). The authors depict all four industrial revolutions in reference to their main features, dates and duration, implementation of new technologies, as well as major economic and social consequences. Additionally, the fourth industrial revolution can be presented in the broader socio-economic context of the so-called three megatrends, namely: demographic change, globalization, and technological progress (Poszytek & Jeżowski, 2019). In most cases the concept of industry 4.0 is defined by the following features (Dobrowolska & Knop, 2020; Górka, Their, & Łuszczuk, 2020; Jeschke, Brecher, Song, & Rawat, 2017; Sanders, Elangeswaran, & Wulfsberg, 2016; Schwab, 2015; Tay, Lee, Hamid, & Ahmad, 2018):

- Smart factory: intelligent factory that is based on internet of things and cyber-physical systems
- Internet of things (IoT): advanced connectivity of systems, services and physical objects enabling object-to-object communication and data sharing;
- Cyber-physical systems: systems that integrate humans with machines;
- Big data: huge amount of data obtained from devices connected to the internet;
- Cloud computing: system logic that provides a huge space for data storage;
- Autonomous robots: robots which interact with each other and collaborate with humans;

- Simulation; modelling real or virtual processes by using real-time data to represent the real world in a simulation model;
- Augmented reality: reality enhanced by virtual elements;
- Additive manufacturing/3D printing: implementation of new manufacturing skills for the purpose of integrating information technologies;
- Blockchain: decentralized and dispersed database.

2. Industry 4.0 and the Need for New Competences

Consequently, industry 4.0 calls for new competences, the so-called competences 4.0. However, before going into details on the definition of competences 4.0, it is worth resuming how the definition of the very competences evolved. The process of shaping the modern definition of competences started in the last two decades of the 20th century. At that time, competences were perceived, first of all, from the technical point of view as something that determines whether an individual can do something or not (Lamri, 2021). However, Michel Parlier's point of view on competences marked the departure from technical perception of competences towards the definition in which competences are understood as knowledge and soft skills (Parlier, 1994). Accordingly, the terms of hard skills and soft skills became an integral part of the discussions on competences. Hard skills meant technical competences or simply the things that an individual can do, whereas soft skills meant social, emotional, and relational competences or simply human competences (Lamri, 2021). Consequently, Guy Le Boterf (2000) proposed three-dimensional perception of a competence as (1) the ability to act, using internal and external resources in a proper time and with suitable proportions; (2) eagerness to act; (3) the opportunity to act when an individual undertakes some action depending on external conditions. Such an approach meant putting the notion of competences in a broader external or functional context (Le Boterf, 2000). Currently, Jérémy Lamri (2021) proposes four main categories of competences: (1) technical competences – acquired through learning and experience; (2) behavioral and motivational competences, such as extraversion, openness, agreeableness and emotional stability – they determine how an individual reacts in various situations; (3) cognitive competences – creativity,

critical thinking, communication and co-operation; (4) social competences – they determine how an individual perceives society and his or her relation with this society. This approach reverberates in current discussions on competences of the future, and finally, on competences 4.0 where interdisciplinarity has its focal position. Coming back to the notion of competences 4.0, most common models of these competences refer to three main areas, namely: digital, cognitive, and social one (Bakhshi, Downing, Osborne, & Schneider, 2017; Fitsilis, Tsoutsas, & Gerogiannis, 2018; Hecklau, Galeitzke, Flachs, & Kohl, 2016; Leinweber, 2013; McKinsey Global Institute, 2018; Śledziwska, & Włoch, 2020; Włoch, & Śledziwska, 2019). Although some of them slightly differ in terminology and the way they are categorized, the most prevailing matrix, or framework, of competences 4.0 can be presented as follows:

- Digital and technical competences;
- Social competences: cooperation with others, communication abilities, managing others, leadership, entrepreneurship, interdisciplinarity;
- Cognitive competences: adaptability, critical thinking, creativity, solving complex problems.

Although in most cases interdisciplinarity is categorized as an element of social competence, its nature and various characteristic features go much further beyond the social aspect of the phenomenon. Traditionally, interdisciplinarity is defined as collaboration between scientific disciplines (Toš, 2021) but for the further discussions in this article it would be more appropriate to simply state that it is an effective use of knowledge, skills, and practices from two or more subject areas. In the context of industry 4.0 which in general terms can be characterized as a cooperative ecosystem of humans and machines, one must consider the idea of interdisciplinarity on a few different levels. Firstly, interdisciplinarity is an ability to combine digital and the so-called soft skills represented mainly by social competences in the above model. The best engineers are those who not only write algorithms but can also communicate and manage people in a very effective way. Secondly, the link between interdisciplinarity and cognitive competences is obvious if interdisciplinarity is understood as an ability to produce new knowledge and practical solutions to complex problems (Toš, 2021). Accordingly, interdisciplinarity encompasses practically all elements included in the above competences 4.0 model and must be treated here as an overarching, transversal competence, or skill. Therefore, higher education institutions perceive interdisciplinarity as a crucial competency that students need to acquire and develop in order to function

effectively on a labor market. For example, higher education systems response takes the form of new curricula which “stimulate interdisciplinary cooperation is a complex interaction between content, methods and organization” (Sabbe, & Wemel, 2019). Additionally, a common mode of project work employed by students also calls for interdisciplinary approach (Parker, 2010). Thus, “the ability to work and to communicate in an interdisciplinary context does not arise all by itself but may be promoted during the academic education” (Godemann, 2006). And finally, Loina Prifti et al. (2017), who carried out a bibliometric analysis on how often competences 4.0 appear in the specialist literature in the context of the fourth industrial revolution, claim that interdisciplinarity is one of the most common competences required by industry 4.0. This leads, in turn, our discussion towards the issue of the so-called “big interdisciplinarity” which is defined as knowledge, practices, and behaviors that intersect with differences of status, culture, disciplines, and adeptness (Bock von Wülfingen, 2021). Such an approach can constitute a full response to the complexities of industry 4.0 realm described above.

3. Conclusions

Interdisciplinarity is a multifaceted phenomenon which deserves separate studies on its multitudinal representations in reference to competences 4.0. Although treated as a separate skill, or competence, its nature can be observed in all other elements constituting the model of competences 4.0. And since current research (McKinsey Global Institute, 2018) shows a sudden shift from traditionally understood competences towards 4.0 ones as a requirement of the labor market, then interdisciplinarity becomes a crucial and fundamental element of the new competence model.

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5. References

- Bakhshi, H., Downing, J. M., Osborne, M. A., & Schneider, P. (2017). *The Future of Skills. Employment in 2030*. London: Pearson–Nesta.
- Bock von Wülflingen, B. (2021). ‘Big Interdisciplinarity’: Unsettling and Resettling Excellence in Community and Identity in Contemporary Technosciences. In K. Kastenhofer, & S. Molyneux-Hodgson (Eds.), *Community and Identity in Contemporary Technosciences* (pp. 263–282). Cham: Springer. doi: [10.1007/978-3-030-61728-8_13](https://doi.org/10.1007/978-3-030-61728-8_13)
- Dobrowolska, M., & Knop, L. (2020). Fit to Work in the Business Models of the Industry 4.0 Age. *Sustainability*, 12, 4854. doi: [10.3390/su12124854](https://doi.org/10.3390/su12124854).
- Fitsilis, P., Tsoutsas, P., & Gerogiannis, V. (2018). Industry 4.0: Required Personnel Competences. *International Scientific Journal ‘Industry 4.0’*, 3(3), 130–131.
- Godemann, J. (2006). Promotion of Interdisciplinary Competence as a Challenge for Higher Education. *Journal of Social Science Education*, 5(2), 51–61. doi: [10.4119/UNIBI/jsse-v5-i4-1029](https://doi.org/10.4119/UNIBI/jsse-v5-i4-1029)
- Górka, K., Thier, A., & Łuszczuk, M. (2020). Consequences of the Fourth Industrial Revolution in Social and Economic Development in the 21st Century. In P. Buła, & B. Nogalski (Eds.), *The Future of Management Industry 4.0 and Digitalization* (pp. 60–71). Kraków: Jagiellonian University Press.
- Hecklau, F., Galeitzke, M., Flachs, S., & Kohl, H. (2016). Holistic Approach for Human Resource Management in Industry 4.0. *Procedia CIRP*, 54, 1–6.
- Jeschke, S., Brecher, C., Song, H., & Rawat, D. B. (Eds.). (2017). *Industrial Internet of Things, Springer Series in Wireless Technology*. Cham: Springer.
- McKinsey Global Institute. (2018). *Skill Shift. Automation and the Future of the Workforce*. Retrieved 9 6, 2021, from <https://www.mckinsey.com/featured-insights/future-of-work/skill-shift-automation-and-the-future-of-the-workforce>
- Lamri, J. (2021). *Kompetencje XXI wieku*. Warszawa: Wolters Kluwer.
- Le Boterf, G. (2000). *Construire les competences individuelles et collectives*. Paris: Editions d’organisation.
- Leinweber, S. (2013). Etappe 3: Kompetenzmanagement. In M. T. Meifert (Ed.), *Strategische Personalentwicklung – Ein Programm in acht Etappen* (3rd ed., pp. 145–178). Wiesbaden: Springer Fachmedien Wiesbaden.
- Parker, J. E. (2010). Competencies for Interdisciplinarity in Higher Education. *International Journal of Sustainability in Higher Education*, 11(4), 325–338.
- Parlier, M. (1994). La competence au service d’objectifs de gestion. In: F. Minet, M. Parlier, & S. De Witte (Eds.), *La competence. Mythe, construction ou realite?* (pp. 91–108). Paris: L’Harmattan.
- Poszytek, P., & Jeżowski, M. (2019, July 7). *From Steam Engine to Blockchain – How Technological Progress Has Been Influencing the Competences We Need* [Plenary speech]. The 23rd World Multi-Conference on Systemics, Cybernetics and Informatics, Orlando, USA. Retrieved 9 6, 2021, from https://www.researchgate.net/publication/350459239_From_steam_engine_to_blockchain_-_How_technological_progress_has_been_influencing_the_competences_we_need
- Prifti, L., Knigge, M., Kienegger, H., & Krcmar, H. (2017, February 12–15). A Competency Model for ‘Industrie 4.0’ Employees. In J. M. Leimeister, & W. Brenner (Eds.), *Tagungsband. 13. Internationale Tagung Wirtschaftsinformatik* (pp. 46–60). Institut für Wirtschaftsinformatik, St.Gallen, Switzerland. Retrieved 9 6, 2021, from https://www.wi2017.ch/images/tagungsband_wi_2017.pdf
- Rojko, A. (2017). Industry 4.0 Concept: Background and Overview. *International Journal of Interactive Mobile Technology*, 11(5), 79–80.
- Sabbe, E., & Wemel, D. (2019, June 16–19). Educating for Interdisciplinary Competences: A VIVES-Framework. In *Proceedings of the European Distance and E-Learning Network 2019 Annual Conference* (pp. 343–349). European Distance and E-Learning Network, Bruges, Belgium. doi: [10.38069/edenconf-2019-ac-0037](https://doi.org/10.38069/edenconf-2019-ac-0037)

- Sanders, A., Elangeswaran, C., & Wulfsberg, J. (2016). Industry 4.0 Implies Lean Manufacturing: Research Activities in Industry 4.0 Function as Enablers for Lean Manufacturing. *International Journal of Industrial Engineering and Management*, 9, 811–833.
- Schwab, K. (2015, December 12). The Fourth Industrial Revolution. What It Means and How to Respond. *Foreign Affairs*. Retrieved 9 6, 2021, from <https://www.foreignaffairs.com/articles/2015-12-12/fourth-industrial-revolution>
- Smit, J., Kreuzer, S., Moeller, C., & Carlberg, M. (2016). *Industry 4.0*. Brussels: European Parliament Policy Department A: Economic and Scientific Policy. Retrieved 9 6, 2021, from [https://www.europarl.europa.eu/RegData/etudes/STUD/2016/570007/IPOL_STU\(2016\)570007_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/STUD/2016/570007/IPOL_STU(2016)570007_EN.pdf)
- Śledziwska, K., & Włoch, R. (2020). *Gospodarka cyfrowa. Jak nowe technologie zmieniają świat*. Warszawa: Wydawnictwa Uniwersytetu Warszawskiego.
- Tay, S. I., Lee, T. C., Hamid, N. Z. A., & Ahmad, A. N. A. (2018). An Overview of Industry 4.0: Definition, Components, and Government Initiatives. *Journal of Advanced Research in Dynamical and Control Systems*, 14, 1379–1382.
- Toš, I. (2021). Interdisciplinarity and Transdisciplinarity – Problems and Guidelines. *Collegium Antropologicum*, 45 (1), 67–73.
- Włoch, R., & Śledziwska, K. (2019). *Kompetencje przyszłości. Jak je kształtować w elastycznym ekosystemie edukacyjnym?* Retrieved 9 6, 2021, from https://www.delab.uw.edu.pl/wp-content/uploads/2019/09/Kompetencje_przyszlosci_Raport_DELabUW.pdf