

# Industry 4.0 and Innovation

Adrián Nagy<sup>1</sup>, Szabolcs Tóth<sup>1</sup>, István Bognár<sup>1</sup>, Forest David<sup>1</sup>

<sup>1</sup>Faculty of Economics, University of Debrecen, Hungary.

E-mail: nagy.adrian@econ.unideb.hu

**Abstract:** Explosive changes in technology are having a significant impact on all industries. Robotics, artificial intelligence, cyber physics systems, cloud computing, IoT and blockchain technology, 5G, nanotechnology, 3D printing are all defining elements of Industry 4.0. The integrated use of these methods enables the perception and display of the external environment, which significantly enables improvements in each industry. In the future, we expect a fusion of physical, digital, and biological technologies, which will provide new opportunities for innovative solutions. The authors of the present study present a future study to predict innovative solutions to key global challenges.

**KEYWORDS:** INDUSTRY 4.0, INNOVATION, DEVELOPMENT, STRATEGY

## 1. Introduction

Today business leaders and the public alike are concerned with disruptive technologies also commonly referred to as the Circular Economy and Industry 4.0 (Suarex-Eiroa et al, 2019). These two paradigms have created an abundance of research opportunities for academics and consultants and caused many gray hairs to grow on business leaders worldwide. There is often great confusion on just how impactful Industry 4.0 will become and with the almost hysteria threat of being quickly unable to compete, often managers and strategist make ill informed choices with respect to their firm direction. So what exactly is Industry 4.0? Rubmann et al (2015) described what the key pillars as defined by the Boston Consulting Group (BCG) as: big data and analytics, autonomous robots and vehicles, additive manufacturing, simulation, augmented and virtual reality, horizontal/vertical system integration, the Internet of Things, cloud, fog, and edge technologies, and blockchain and cyber-security. As the astute reader will notice, many of the key pillars identified by BCG are nothing new. Vertical integration has been practiced for decades, the Internet was quite mature even in the late 1990s, using data and analytics to make decisions has been a part of firms for decades and firms have taken great care with cyber security since the 1990s. When of strategic importance, firms likely need to make significant changes quickly. However, when Industry 4.0 is more of a tactical consideration, firms are advised not to confuse their strategic strategy for a few new tactical considerations related to Industry 4.0. This level of thinking should keep firms well positioned and competitive in their market despite Industry 4.0 challenges. The purpose of this article is to provide some guidelines and suggest four propositions on what constitutes a firm's ability to provide solutions to the global economy with respect to Industry 4.0 tactics. We achieve this aim by combining Industry 4.0 thinking with strategic management theory and purpose both are needed for a firm to be better adapt at solving global problems through Industry 4.0 thinking and practices.

## 2. Literature Review

Industrial revolutions increase significantly advance human life. (Tuegeh et al., 2021) There have been four major industrial revolutions throughout the history of human life. The industrial revolution 1.0 began with the invention of the steam engine in the late 18th century. Industry 2.0 was marked by the invention of electricity and mass production in the late 19th century which became the main power of production machines, enabling increased effectiveness and efficiency. Industry 3.0 is marked by the invention of computers and industrial automation in the late 20th century, machines replaced by electronic devices that are programmed automatically. The industry is entering the era of digitalization. The discovery of the internet in generation 3.0 opened the gates to the generation of industry 4.0, with the use of the Internet of Things (IoT) and Cyber-Physical System (CPS)

(Schwab, 2016). Digitalization and innovation go hand in hand. Over the past decades wealth of research (Bassanini et al, 2000, Kovács et al., 2022) shows that the competitiveness of the European economy depends on a knowledge-based economy and support for research and development (R&D). While the first point is closely linked to the development of human capital and quality improvement, R&D activities imply the integration and development of information and communication technologies (ICT), (Banhidi et al, 2020, 2021). One of the flagship initiatives of the EU 2020 strategy is the Digital Agenda for Europe. In order to achieve its objectives quickly and on time, the proposed governance framework is based on the enhanced Digital Economy and Society Index (DESI), which has been tracking the digital progress of Member States since 2014. In September 2021, the European Commission proposed the Roadmap to the Digital Decade, a blueprint for the digital transformation of the European economy and society (EC, 2022).

Industry 4.0 connects a myriad of equipment through wired and wireless networks with the Internet serving as the glue that connects and holds everything together (Wan et al. 2016). For example, a traditional assembly line would entail a machine and manual workers ensuring produces moved efficiently through the process and likely someone checking for defects to ensure quality control. With Industry 4.0 various workstations of the assembly line can now work with each other in real time, slowing down or speeding up various processes along the line (Ng et al. 2017). This example would match closely with the autonomous robots described by the BCG. Banks have employed techniques such as discriminate analysis for decades to determine which interest rate to offer a potential customer or if to offer them at all. One large insurance company in the US was advertising in the early 2000s that they will give you the best rate and let you know of a better rate even if it is not with them. For the unknowing customer, this seems too good to be true but, the insurance firm even 20 years ago was employing the use of Industry 4.0 big data knowing a customer is likely not profitable at a lower rate based on their risk profile, they pass this customer on to a rival and receive the good marketing public relations of "taking care of the customer." They were simply sending a rival a losing proposition according to their own data and research. As society moves forward clear data acquisition measures and tools will increasingly be needed (Cohen et al. 2019) to compete effectively. Hermann, Pentek and Otto (2016) even describe Industry 4.0 as tools to increase operational effectiveness of new business models or services.

The most vulnerable impact of industry 4.0 is in developing countries like Indonesia. Indonesia is a country with abundant natural gifts, requires quality human resources to process and manage them to provide optimal benefits for the national economy (Tumiwa & Nagy, 2021).

This situation can motivate entrepreneurs to be more creative, especially by developing their potential internal resources into valuable internal strengths. In addition to being creative, entrepreneurs must also be able to take advantage of opportunities and even turn threats into opportunities (J. Tumiwa & Paruntu, 2017; J. R. Tumiwa et al., 2020; J. R. Tumiwa & Nagy, 2021). In

the future there is little doubt that firms who are not savvy with respect to Industry 4.0 will likely struggle mightily against firm's who are more adapt. But is there another element in play that must be considered for meeting and solving global challenges?

### 3. Strategy vs Tactics

Examining the strategy tactics relationship is key for researchers, consultants and managers alike in positioning their firms. Bittner et al (2020) in their article said the market environment has changed significantly in recent years, developing strategic plan and recognize the opportunities and threats have outstandingly importance. More than ever with a rapidly changing external environment there is need for a clear distinction between the two. Industry 4.0 thoughts and perspectives sometimes lead managers or researchers astray and unfortunately cause strategy to be pushed aside among the premise the world changes too fast for strategy. Thoughts such as "I can't predict tomorrow much less 5 years into the future" can dominate business thinking. However, the more dynamic the industry is, the more dynamic Industry 4.0 issues are, the more the need for a clear strategic strategy not the less need. Let's first start by defining strategy as major activities that are unique to the firm, that would not make sense when applied to a firm outside that respective industry. For example, McDonald's strategic strategy could be selling inexpensive fast food, at an attractive price, with consistency around the world. This same strategy would not possibly apply to Boeing and another burger restaurant that attempted to compete on the same dimensions as McDonald's would likely struggle at best or meet a bloody fate at worst. However, McDonald's tactics of how they manage their inventory system with respect to data analytics could also possibly be applied to Boeing with respect to their inventory system. With this information, we will define tactics as middle range activities that help to support and facilitate the strategy. Firms that confuse strategy and tactics or focus mainly on tactics are likely to underperform. As one can see here, having a clear strategic strategy is really not impacted by a dynamic environment, Boeing and McDonald's are likely to be around for another 100 years. Strategy is more static in nature and tactics are more dynamic. For virtually all firms Industry 4.0 considerations are tactical in nature. So what is key for firm's with established strategies? We propose having excellent Industry 4.0 capabilities, but we would be remised by not mentioning that strategy must come first.

### 4. Propositions

Based on the literature review of what factors constitute Industry 4.0 and the differences in strategy and tactics. We have developed a series of propositions that will aid in predicting solutions to global challenges. We feel our propositions are in need of testing empirically in later studies to better determine the balance and relationship between strategy and what we propose as the tactical nature of Industry 4.0 supplementing and executing the strategy to a world class level.

*Proposition 1: Firms with a clear strategic strategy will outperform rival firms especially with respect to addressing solutions for new global challenges.*

*Proposition 2: Firms who have an excellent basket of tactics as outlined by BCG with respect to Industry 4.0 but who also do not have a clear strategy will underperform and provide fewer solutions to global challenges than their counter parts with clearer strategic strategy but lesser developed Industry 4.0 tactics.*

*Proposition 3: Firms who have both a clear strategic strategy and keep abreast on the latest rapidly changing Industry 4.0 challenges and tools will be the most adapt to provide solutions for the new global challenges.*

*Proposition 4: The majority of the waste in an organization is not from having inadequate Industry 4.0 systems, rather from having an ineffective strategy.*

### 5. Discussion

With its origins dating back thousands of years in military history, both strategy and tactics are frequently discussed in the literature. But is the difference between the two? And why is having a clear distinction more important than ever? This paper provides a synopsis of the differences in strategy and tactics and proposes that strategy is more important than ever for firms that hope to have an impact on providing solutions to global problems. But what is the role of Industry 4.0 in providing solutions to global problems?

There is great debate in the literature on which technologies should be categorized as I4.0 technologies. The list can include 100s of various technologies, always changing almost by the day it seems as new technologies emerge. In the introduction of this paper, we identified nine such pillars that the BCG considers as I4.0. For the purposes of this paper, we limited our discussion to the nine pillars previously discussed but readers should take liberty to make their one judgements on an entire litany of possible I4.0 factors. Depending on the industry or even the business itself different I4.0 factors will be of greater or lesser significance in providing solutions to global problems.

The public, academics, and businesses are capitulated by the rapidly changing globally economy and at times can become overwhelmed by what direction the firm should take. We propose through our series of three propositions that firm's even in this climate of great change and innovation to not forget having a clear strategy is paramount but the most successful firms will have a strategy supported by world class Industry 4.0 thinking and tactics.

### 6. Conclusion

This paper addressed concept of Industry 4.0 and provided evidence the concept is not as new as many people believe. We only mention the newness of Industry 4.0 not to downplay its significance in providing business solutions but rather to remove some of the fussy thing and fear that firm's no long need a strategy. In addition, this paper provided four proposed propositions designed for future research that will determine strategy's impact on providing global solutions vs simply being well acquainted with Industry 4.0 technologies and tactics. One of the main contributions to this paper is the author's opinions that strategy must come first even in a dynamic world. The authors are not underestimating the role of Industry 4.0, (we actually find Industry 4.0 concepts vital to success) but ask the reader to take a step back and not forget strategy's likely importance as there is little use in getting somewhere as efficiently as possible or through using the latest technology and techniques if you wind up in the wrong location.

### 7. References

- Bánhidi, Z.; Dobos, I.; Nemeslaki, A. 2020: What the overall Digital Economy and Society Index reveals: A statistical analysis of the DESI EU28 dimensions. Reg. Stat. 2020, 10, 42–62.
- Banhidi, Z.; Dobos, I.; Nemeslaki, A. 2021: Comparative Analysis of the Development of the Digital Economy in Russia and EU Measured with DEA and Using Dimensions of DESI. Vestn. St. Petersburg Univ.-Ekon. 2019, 35, 588–605.
- Bassanini, A.; Scarpetta, S.; Visco, I. 2000. Knowledge, technology and economic growth: Recent evidence from OECD countries. OECD Econ. Dep. Work. Pap., 259, 39.

- Bittner, B – Nagy A - Kovacs, T. - Madai, H. 2020: Methodology of the external environmental analysis as a part of strategy planning, *Annals of the university of Oradea economic science* 29 : 1 pp. 461-466. , 6 p.
- Cohen, Y., H. Naseraldin, A. Chaudhuri, and F. Pilati. 2019. "Assembly Systems in Industry 4.0 era: a Road map to Under- stand Assembly 4.0." *The International Journal of Advanced Manufacturing Technology* 105 (9): 4037–4054.
- European Commission. State of the Union: Commission proposes a Path to the Digital Decade to Deliver the EU's Digital Transformation by 2030; European Commission: Brussels, Belgium, 2021
- Hermann, M., T. Pentek, and B. Otto. 2016. Design Principles for Industrie 4.0 Scenarios. Paper presented at the 2016 49th Hawaii international conference on system sciences (HICSS) (pp. 3928-3937). IEEE, Koloa, HI, USA.
- Kovács, Tünde Z., Beáta Bittner, László Huzsvai, and András Nábrádi. 2022. "Convergence and the Matthew Effect in the European Union Based on the DESI Index" *Mathematics* 10, no. 4: 613. <https://doi.org/10.3390/math10040613>
- Kőmíves, P. M., Pilishegyi, P., Novák, N., Nagy, A. S., & Körösparti, P. 2019. The Role of the Higher Education in the Development of the Agriculture. *International Journal of Information and Education Technology*, 9(9), 607-612. <https://doi.org/10.18178/ijiet.2019.9.9.1275>
- Ng,K.K.H.,C.K.M.Lee,S.Z.Zhang,K.Wu,andW.Ho. 2017. "A Multiple Colonies Artificial bee Colony Algorithm for a Capacitated Vehicle Routing Problem and re-Routing Strategies Under Time-Dependent Traffic Congestion." *Comput- ers & Industrial Engineering* 109: 151–168.
- Rüßmann, Michael, Markus Lorenz, Philipp Gerbert, Manuela Waldner, Jan Justus, Pascal Engel, and Michael Harnisch. 2015. "Industry 4.0 - The Future of Productivity and Growth in Manufacturing Industries." doi:10.1007/s12599-014-0334-4.
- Schwab, K. 2016. *The Fourth Industrial Revolution*. Crown Business.
- Suárez-Eiroa, Brais, Emilio Fernández, Gonzalo Méndez-Martínez, and David Soto -Oñate. 2019. "Operational Principles of Circular Economy for Sustainable Development: Linking Theory and Practice." *Journal of Cleaner Production* 214 (March): 952–961.
- Tuegeh, O. D. M., Harangi-Rákos, M., & Nagy, A. Sz. 2021. Industry 4.0 and human resource in Indonesia: a systematic literature review. *Economic Annals-XXI*, 190(5-6(2)), 171-180. doi: <https://doi.org/10.21003/ea.V190-16>
- Tumiwa, J., & Paruntu, C. P. (2017). The Analysis of Human Capital Building and Financial Assistance on Small Medium Enterprises Development in Manado and Tomohon. *Journal of ASEAN Studies on Maritime Issues*, 3(5), 1–12.
- Tumiwa, J. R., Tuegeh, O. D. M., & Nagy, A. 2020. Factor Influencing MSMEs Performance Measurement - A Literature Review TUMIWA. *The Annals of the University of Oradea, Economic Sciences*, Tom 29(1), 151–162.
- Tumiwa, J. R., & Nagy, A. 2021. Micro, Small, and Medium Enterprises in Emerging Economies and Economic Transition: A comparative study between Indonesia and Hungary. *International Journal of Entrepreneurship and Small Business*, 43(1), 22-38. <https://doi.org/10.1504/IJESB.2021.115312>