

Editorial for the Special issue on “Managing Industry 4.0 technologies and their impact on the sustainable performance of territories”

A proliferation of technological advances often described under the umbrella term of Industry 4.0, are increasingly changing the way firms operate as they improve their productivity and performance (Wagner and Walton, 2016). Despite a substantial body of literature have examined Industry 4.0 at the firm level, its effect on regions and territories is largely remaining unexplored (Rüßmann et al., 2015). A wealth of advanced technologies and systems such as artificial intelligence, smart systems, smart cities, predictive analytics, blockchain, autonomous vehicles, Big Data, Internet of Things increasingly change not only the companies that adopt them, but also the context within which this adoption take place (Schwab, 2016).

The ways new technologies affect the context in which they are being adopted has largely been omitted in the academic literature. Although servicescape is well established in the marketing literature (Nilsson and Ballantyne, 2014), the regional and territorial effects of technological networks are yet under-researched. Past studies have documented the technology productivity paradox (Brynjolfsson, 1993) to describe that productivity and performance in industries and territories did not follow the investments in and expectations from new technologies (Hajli, Sims, and Ibragimov, 2015). Also, following research in sustainability management, the social dimension, including the impact on the employability of local populations (e.g., Low et al., 2019), remains understudied in the field of Industry 4.0 compared to the economic and environmental dimensions (Bag et al., 2018) and such gap needs to be addressed in theory and practice. Some studies tend to identify opportunities related to Industry 4.0. technologies like Big Data and show there could be advantages for sustainable supply chain management that directly or indirectly impact the sustainable performance of territories such as product and market strategies, customization of deliveries, cost reductions, new business models, collaboration with entire supply chain ecosystems (Kache and Seuring, 2017). These improvements however do not go without challenges for companies like ethical dilemma, change management, IT infrastructures, investments, talent management, cybersecurity and governance systems (Kache and Seuring, 2017). Opportunities and challenges of sustainability and Industry 4.0 technologies for territories remain unexplored and further research is needed to identify them.

This special issue, therefore, attempts to address some of these research gaps that exist in the literature. In this Special Issue we have selected a range of strong publications that provides some interesting insights around the Industry 4.0 technologies and their impact on the sustainable performance of territories.

The first paper entitled: ‘**Applying the Industry 4.0 Technologies in the COVID–19 Sustainable Chains**’ by Ferreira, Carina; Scavarda, Annibal; Reis, Augusto conducted a literature review to examine how interactions between the real and the virtual world affect sustainable supply chain processes. The authors identify the opportunities and the challenges focused on the emerging Industry 4.0 theme and specifically suggest exploring the concept of

society 5.0 or the “super-smart society”. The study puts the above concepts in the context of COVID–19 pandemic and analyzes how it affects the relationship among the man, the machine, and the labor in the fourth industrial revolution.

The second paper is entitled “**Current Sustainability Scenario of Industry 4.0 Enabling Technologies in Indian Manufacturing Industries**” by Bhaveshkumar Pasi, Subhash Mahajan and Santosh Rane examined the sustainability of Industry 4.0 enabling technologies in the Indian manufacturing industry. The authors followed a mixed methodology with a survey followed up by interviews with experts. The study shows that the adoption of Industry 4.0 technologies create fear of job loss among the employees in Indian manufacturing industries. Specifically, the study finds that higher sustainability leads to new job creation, yet it peaks at a certain level, thus the unemployment fear increases from this point and on. Further, sustainability is directly proportional to workers’ qualifications since higher sustainability level requires highly skilled and qualified workers. In relation to the skills Industry 4.0 requires, this creates a further skills gap at the regional level.

The third paper entitled “**Assessing the key Enablers for Industry 4.0 adoption using MICMAC Analysis: A case study**” by Kaliyan, Mathiyazhagan; Krishnan, Srijit; Gupta, Sumit; Kumar, Vikas; Garza-Reyes, and Jose Arturo, assessed the key enablers for Industry 4.0 adoption using MICMAC Analysis. The authors developed a 7-level framework and applied it in the automotive industry. Enablers span from sustainability factors (i.e., Ability to satisfy the expectation of the society, Ability to address environmental challenges) to technology leverages (i.e., Future viability of Industry 4.0; Digital and Integrated Process Capabilities) and competitive factors (Competitive Global Advantage; Firm’s Innovativeness). The study demonstrates the multi-level impact of Industry 4.0 on firm, region, and industry level.

The fourth paper entitled “**Engineering companies and their readiness for Industry 4.0**” by Váně, Jan; Kalvas, František; Basl, Josef used a unique data set in the engineering-oriented Pilsen region of Czech Republic to explore the state of readiness of companies for the implementation of Industry 4.0 in the following dimensions: (a) level of use of I4.0 technologies; (b) digital strategy of company; (c) criteria for investment decisions; (d) I4.0 challenges; and (e) impact of I4.0 on the company’s workforce. The study finds that, contrary to proclaimed diffusion, in medium-sized and large engineering companies in the Pilsen region, I4.0 areas have not yet received much attention. The study uncovers that customer satisfaction, digital strategies, and cost are the main determinants of Industry 4.0 in the Pilsen region.

To conclude, these initial studies on I4.0. and its impact on the sustainability of territories highlight a wide variety of impacts. Since the papers presented in this special issue investigate the topic in different socio-economic contexts (India, Czech Republic), further research in this field need to take into account these contexts. Also, the selected papers underline the regional sustainability impact of I4.0., mainly on the social dimension such as “fear of job loss” or “skill gap”. Further research avenues could focus on further investigating the relation between the regional/socioeconomic context of supply chains; solutions to adress the skill gap could analyse the role that institutions play based on the Institutional Theory (DiMaggio and Powell, 1983) or the role of different supply chain stakeholders across the supply chain based on the Stakeholder Theory (Freeman, 1984). Overall, research on the topic of I.4.0 and sustainability offers a wide range of research topics and research fields that still need to be explored in order to guide businesses and policy-makers in making decisions that truly support a sustainable regional development.

References

- Bag, S., Telukdarie, A., Pretorius, J.H.C., Gupta, Shivam, (2018), “Industry 4.0 and supply chain sustainability: framework and future research directions”, *Benchmarking: An International Journal*, <https://doi.org/10.1108/BIJ-03-2018-0056>
- Brynjolfsson, E., (1993), “The productivity paradox of information technology”, *Communications of the ACM*, Vol. 36, No. 12, pp. 66-77.
- DiMaggio, P.J., Powell, W.W., (1983), “The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields”, *American Sociological Review*, Vol 48, No. 2, pp. 147–160.
- Freeman, R. E. 1984. *Strategic Management: A Stakeholder Approach*. Boston: Pitman.
- Hajli, M., Sims, J.M. and Ibragimov, V., (2015), “Information technology (IT) productivity paradox in the 21st century”, *International Journal of Productivity and Performance Management*, Vol. 64, No. 4, pp. 457-478.
- Kache, F., Seuring, S., (2017), “Challenges and opportunities of digital information at the intersection of Big Data Analytics and supply chain management”, *International Journal of Operations & Production Management*, Vol. 37, No. 1, pp.10-36.
- Low, S.P., Gao, S. and Ng, E.W.L. (2019), “Future-ready project and facility management graduates in Singapore for industry 4.0: Transforming mindsets and competencies”, *Engineering, Construction and Architectural Management*, Vol. 28, No. 1, pp. 270-290.
- Nilsson, E. and Ballantyne, D., (2014), “Reexamining the place of servicescape in marketing: a service-dominant logic perspective”, *Journal of Services Marketing*, Vol. 28, No. 5, pp. 374-379.
- Rüßmann, M., Lorenz, M., Gerbert, P. Waldner, M., Justus, J., Engel, P., and Harnisch, M., (2015), “Industry 4.0: The future of productivity and growth in manufacturing industries”, *Boston Consulting Group*, Vol. 9, No. 1, pp. 54-89.
- Schwab, K., (2016). “*The Fourth Industrial Revolution*”, Geneva, Switzerland: World Economic Forum.
- Wagner, S.M., and Walton, R.O., (2016), “Additive manufacturing’s impact and future in the aviation industry”, *Production Planning and Control*, Vol. 27, No. 13, pp. 1124-1130.

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List of Papers on the Editors

Bhaveskumar Pasi, Subhash Mahajan and Santosh Rane, (2021), 'Current Sustainability Scenario of Industry 4.0 Enabling Technologies in Indian Manufacturing Industries', *International Journal of Productivity and Performance Management*.

Ferreira, Carina; Scavarda, Annibal; Reis, Augusto, (2021), 'Applying the Industry 4.0 Technologies in the COVID–19 Sustainable Chains', *International Journal of Productivity and Performance Management*.

Kaliyan, Mathiyazhagan; Krishnan, Srijit; Gupta, Sumit; Kumar, Vikas; Garza-Reyes, Jose Arturo, (2021), 'Assessing the key Enablers for Industry 4.0 adoption using MICMAC Analysis: A case study', *International Journal of Productivity and Performance Management*.

Váně, Jan; Kalvas, František; Basl, Josef, (2021), 'Engineering companies and their readiness for Industry 4.0', *International Journal of Productivity and Performance Management*.