
Editorial

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Biographical notes: Margherita Russo is a Full Professor of Economic Policy at the University of Modena and Reggio Emilia, Italy. She has published widely on innovation dynamics and innovation policies, effects of innovation on the organisation of labour and skill requirements, structure and change of local production systems, with a focus on ceramic tile districts, the mechanical industry in Italy and the automotive industry in Europe and North America (emergence of competence networks; local development policy; competition of local production systems, environmental and social sustainable local development, innovation and local development, agents and artefacts in the EVs production) and socio-economic impact of natural disasters.

Francesco Garibaldo is a non-academic researcher in industrial sociology. He was the Director of IRES-CGIL and the Institute for Labour (IPL) of Emilia-Romagna Region. He is author of many books and papers: Garibaldo, F; Bardi, A. (Eds.): *Company Strategies and Organizational Evolution in the Automotive Sector: A Worldwide Perspective*, Peter Lang, 2005, Garibaldo, F., *Urban Mobility as a Product of Systemic Change and the Greening of the Automotive Industry*. In Calabrese, G. (Ed.): *The Greening of the Automotive Industry*, Gerpisa 2012. Garibaldo, F. – *The Evolving Features of the Automotive Industry*, in Stocchetti, A.; Trombini, G.; Zirpoli, F. (Eds.) *Automotive in Transition. Challenges for Strategy and Policy*; Edizioni Ca' Foscari, 2013. Caria, S.; Garibaldo, F; Rinaldini, M. - *Shadowing Industry 4.0: an Empirical Study of Digitalisation in a German/Italian Automotive Firm – in the International Journal of Automotive Technology and Management*, 2023.

Giuseppe Giulio Calabrese is a senior researcher at the CNR-Ircres (Research Institute on Sustainable Economic Growth of the National Research Council, former CNR-Ceris) of Turin, Italy which he joined in 1988. He taught as a Visiting Professor in Managerial Economics at the University of Turin and Polytechnic of Turin. He is the Editor-in-Chief of the International Journal of Automotive Technology and Management and member of the International Steering Committee of Gerpisa. His main areas of research are focused on industrial organisation, SMEs, technological innovation, industrial policy, balance sheets analysis and automotive industry.

The concept of Industry 4.0 (I4.0) originated in Germany in 2013 and, since its inception, has gained widespread acceptance around the world, even though I4.0 still has the characteristics of a vision rather than a concrete reality: the processes of pervasive diffusion of digital technologies in the manufacturing sector and the transformation of traditional factories into fully networked smart factories have not yet been fully realised. At the same time, many technological transformations have already been implemented in many realities, changing the organisation of production and work processes and the way we look at the future of employment and production. These issues are debated in several papers published by this journal. The occasion of a special issue is due to the contributions presented at the international conference ‘Industry 4.0, ten years later’, held on May 2023 in Modena, the core of the motor valley in Italy, at the Department of Economics Marco Biagi (University of Modena and Reggio Emilia). During the conference, the debate on I4.0 explored what we have learned so far and, in particular, how our understanding of I4.0 impacts on workers and organisations. The conference presented interdisciplinary discussions and debates to formulate new empirical questions and explore new theoretical perspectives and methodological approaches. Researchers and academics presented theoretical and empirical papers, with contributions covering different sectors and individual firms, different stages of the production chain, and different regions and countries in the Global North and the Global South. The discussions engaged trade unions and policymakers at regional and national levels in an attempt to promote a dialogue on automotive issues between stakeholders, industry experts and the scientific community.

The special issue of *IJATM* hosts a selection of four papers focusing on the automotive sector from different perspectives. In particular, they address the topic of I4.0 with original empirical analyses, using first-hand data and secondary sources, with methods embracing network analysis and spatial analysis. In three papers in the special issue, the focus on I4.0 in the automotive industry is proposed, with different angles, on individual countries: Poland, Portugal, and the United Kingdom. A fourth essay deals with the analysis of subnetworks in the automotive industry worldwide, showing an overall framework of the Global value chain in the current twin transition phase.

A focus on regional analysis is presented by the paper Krzysztof Gwosdz, Marcin Baron, Marcin Budka, Mariusz Hetmańczyk, Agnieszka Sobala-Gwosdz and Robert Szczepanek, ‘Territorial coupling in Industry 4.0: assessing the impact of geographical proximity to automotive industry on the digital entrepreneurs in Poland’. The question of the benefits of spatial proximity - debated in the literature on regional development - is analysed in this essay concerning the potential development of digital entrepreneurs to consolidate production in regions with a higher concentration of automotive companies. A geostatistical analysis (to compute the Local Indicator of

Spatial Association using Moran's I statistics) is carried out by the authors to examine the spatial distribution of automotive and digital entrepreneurs. Knowledge about digital entrepreneurs (a highly heterogeneous group) was extracted from a variety of dispersed sources (patent databases, leading industry journals related to automation, robotics and information technologies, websites of technology parks, special economic zones, clusters and industry associations), thus creating a unique database of such enterprises in Poland. The identification of I4.0 technology suppliers is based on the type of predominant activity. A questionnaire survey was directed at the providers of I4.0 technologies, yielding responses from 150 companies, to explore also the network connections between Board members across the various companies. Together with analysis of secondary sources, the authors identify the mechanism behind territorial coupling, explaining the dynamics of co-location in terms of both anchoring to customers and spin-off from the automotive industry, with digital entrepreneurs that are 'likely to be an enriching element of local economic diversification rather than a significant driving force for the local economy'. The results show that the strength of the territorial link varies between different types of digital entrepreneurs, depending on the specificity of the solutions offered, with a focus on the differences between metropolitan areas and medium-sized industrial cities having a strong industrial base.

In the scarcity of studies on the automotive industry in Portugal, which is the sixth largest vehicle-producing country in Europe, the essay by Marta Candeias and António B. Moniz, 'Public policies for Industry 4.0: some lessons from the Portuguese case' offers a description of the industry context and focuses on the impact that the industrial policies undertaken by the Portuguese government in the last decade on the digital transition of the automotive sector. At the macro level, the analysis comments on the array of policy documents to provide a framework for the policy design and its implementation in Portugal. At the meso level, the tendency of effects of I4.0 on productivity, employment, and I4.0 systems' investment in the automotive sector in Portugal between 2017 and 2023 is quantitatively assessed (using secondary statistical analysis). At the micro level, the paper presents the results of semi-structured interviews with experts and managers (technology providers, end users, academics and social actors) to gather evidence on expert knowledge, opinions, and perceptions around the effects of the I4.0 strategy and public incentives in place, on the digital transformation of manufacturing of automotive companies and government agencies. The specific research questions addressed in this paper concern how the I4.0 has been set-up and who was involved; what have been the effects of these technologies on workers and organisations, and if the current policy initiatives are effective in promoting and supporting I4.0. The results show the effectiveness of I4.0 in enhancing predictability, consistency, and adherence to delivery times, thus increasing efficiency, productivity, and waste reduction, with a not generalised negative impact on the number of employees. Strengths and weaknesses of the policy design are discussed with regard to investments and skills and training, highlighting also that workers' representatives were not involved, except for training purposes.

Upcoming changes in the automotive industry and the emergence of new capabilities related to vehicle electrification and connectivity are discussed in the paper by Carlo Bozzola, Guendalina Anzolin and Eoin O'Sullivan, 'The changing landscape in EV 'value chain ecosystem': a framework to assess present and future capabilities'. The analysis refers to the automotive sectors of the UK and Italy. The UK is considered for its Net Zero strategy and the need to adapt to new trends in electrification and connectivity.

Italy is included for its automotive sector, which exhibits traits similar to those in the UK, such as its focus on powertrain and premium market. The data used include academic papers, industry association reports and consultancies. The methodology combines secondary data analysis and interviews. Building on the analytical framework proposed by Andreoni, the paper includes a dynamic element that focuses on how capabilities move within the value chain. The analysis covers the last ten years, focusing on future transformations in the coming decades, including projections on the changing capabilities in the automotive industry's value chain. The results show a reallocation of software-related capabilities and the emergence of new skills in the industry.

The relationships between the most important automotive firms and their Tier 1s are considered in the paper by Elisa Flori, Giuseppe Caruso, Francesco Pattarin and Giovanni Solinas' analysis 'The global structure of the automotive industry: a network-based view'. The data are taken from Bloomberg database, and the paper presents an original analysis of the networks of relationships (average annual sales during fiscal years 2018-2020) between the ten prominent carmakers – General Motors, Ford, Stellantis, Volkswagen, Renault, Toyota, Hyundai, Kia, BYD, and Great Wall – and their suppliers and Tier 1 industrial customers, as well as the suppliers of that subset of companies, with OEMs and other customers. While in other studies, network analysis refers only to individual countries or individual firms, the particular contribution of this paper comes from its extension of the analysis on a global scale to identify OEM partners' degree of geographical and industrial diversification. The data are processed using network analysis models. In particular, the paper contributes to assessing the weight of the main trade networks of automotive OEMs and their importance in the various geographical contexts in which the headquarters of the multinationals are located. The analysis highlights different patterns of the macro-regional scope of these networks. This snapshot also traces the importance of overlap between these networks, which sees a marked difference between Chinese OEMs and the other OEMs. Such a snapshot is valuable for reflecting on the impact of the twofold transformation that the automotive industry is undergoing, the digital transformation, with its effects on the organisation of production and the management of information flows that are related to the ecological transition and decarbonisation. Both of these transformations will impact the future location processes of automotive production and the structure of GVCs.