12 Sustainable servitisation in the automotive sector

An exploratory study

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Introduction

The 2030 Agenda for Sustainable Development, signed on 25 September 2015 by the governments of the 193 member states of the United Nations (UN) and approved by the UN General Assembly, has called on institutions, governments, companies and society to make massive efforts to achieve 17 Sustainable Development Goals (SDGs), comprising 169 environmental, economic, social, and institutional targets.

The resulting challenges have led the scientific and professional communities to reflect on the implementation of new business models that can ensure simultaneously environmental, economic, and social benefits (Raith and Siebold, 2018). Perhaps not by chance, interdisciplinary scientific debates concerning sustainable business models have been increasing considerably in recent years (Nosratabadi et al., 2019).

Among others, a topic that has attracted noticeable attention is that of sustainable mobility (Holden et al., 2019). The issue holds many interrelated challenges. From an environmental perspective, it requires the reduction of the carbon emissions of vehicles to achieve zero impact, which drives the development of new electric, hydrogen, and hybrid engines (Shin et al., 2019. To create these new high-tech solutions, a significant challenge emerges on the economic sustainability front, as high research, development and production costs have to be incurred and covered, mainly by manufacturers (Tanç et al., 2019). Last but not least, from a social perspective, the experimentation with inclusive mobility models, supported in particular by the expansion of sharing economy, is leading to renewed ways of using and conceiving vehicles, such as car-pooling and car-sharing, as well as implementing alternative urban mobility solutions, such as scooters and bike sharing (Nosratabadi et al., 2019). In this regard, it is worth mentioning the concept of Mobility-as-a-Service (MaaS), understood as the development of digital platforms aimed at providing citizens with several complementary mobility services within a single digital environment (Smith and Hensher, 2020).

DOI: 10.4324/9781003379409-15

Through this manuscript, our aim is to enter the debate on sustainable mobility. To be more specific, in the following sections we will focus on servitisation, intended as the attention paid by manufacturing companies to enlarging their offering through services (Gaiardelli et al., 2016; Pistoni and Songini, 2018). Furthermore, we will present and discuss how servitisation can support environmental, economic, and social sustainability. The focus of this chapter, intended as a pilot and exploratory study which is part of a larger research project involving several Italian universities and research centres, is the automotive and heavy and commercial vehicles industries, which are intrinsically linked to the concept of sustainable mobility, and can be considered reference sectors for understanding the relationship between sustainability and servitisation, as both paradigms have long been common elements of these businesses.

In the following, we present and discuss the theoretical background of servitisation and its relation to environmental, economic and social sustainability. Then, we introduce the methodology and describe the sample involved for the purpose of this study. Next, we present the main findings on the relationship between servitisation and environmental, economic and social sustainability in the automotive sector. Finally, we discuss the results, highlighting the limitations of this work, and presenting our conclusive considerations.

Theoretical background

Servitisation

Servitisation, conceived as the integration of services and products into the offerings of companies aiming to create added value for customers (Raddats et al., 2019), is considered one of the major recent trends in the manufacturing industry (Zheng et al., 2021).

The factors that have contributed to the expansion of servitisation in manufacturing are manifold. A first ally is, without a doubt, digitisation (Frank et al., 2019; Tao and Qi, 2017). Indeed, the acceleration in technological advances and the consequent digital transition make it possible to design and implement advanced systems of services to be offered to customers (Rapaccini et al., 2020). In other words, digitisation can be seen as "an enabler and a driver of servitisation" (Martín-Peña et al., 2018: 96). Several studies have found that the interplay between digitisation and servitisation positively impacts the profitability of manufacturing companies (e.g., Abou-Foul et al., 2021; Kharlamov and Parry, 2021; Kohtamäki et al., 2020).

Consistently with the previous consideration, the increased profitability lies as a second factor contributing to the expansion of servitisation in the modern industry (Wang et al., 2018). Despite the debate among scholars and practitioners on the impact of servitisation on profitability is still open, due to many contradictory findings (Ambroise et al., 2018), the scientific evidence seems to be

more consistent regarding the positive impact of servitisation on the operational (Atif et al., 2021) and innovation performance (e.g., Shen et al., 2021; Weigel and Hadwich, 2018).

Finally, servitisation enables manufacturing companies to have higher levels of customer proximity (Kastalli and Van Looy, 2013), thus achieving greater interactions with customers than non-servitised companies (Tan et al., 2019). This becomes even more important for competitiveness, as service interactions trigger co-creation processes between producers, customers (e.g., Huikkola et al., 2016; Sjödin et al., 2016) and other partners of the service ecosystem (Gaiardelli and Songini, 2018).

Servitisation and sustainability

Servitisation seems to be an extra arrow in the fight for sustainability (Kanatlı and Karaer, 2022).

From an environmental point of view, several recent studies have found that servitisation affects the thinking of manufacturing companies, leading them to reflect on how to create added value for their customers, also in environmental terms (Chávez et al., 2019). In this regard, the recent history of servitisation of manufacturing is full of examples of companies that have developed green product-service solutions, properly designed to respond to the growing concern of society about the issues of natural resource depletion and environmental degradation and to create awareness of green issues in that part of the population not yet concerned on the environment. This is the case of green maintenance services, where activities are carried out using reconditioned spare parts and making use of energy from renewable sources, or just eliminating the use of paper as much as possible thanks to digitalised processes. Such a gradual transformation towards a greener servitisation has also stimulated the implementation of circular economy business models (Abdelkafi et al., 2022; Doni et al., 2019). This applies in many industries, such as mining (e.g., Vargas et al., 2022), agricultural machinery (e.g., Kolling et al., 2022), and electrical and electronic equipment production (e.g., Kim et al., 2022). Among others, sustainable mobility has been emerging as a new business model characterising the automotive industry that entails significant changes in consumption models. The latters are increasingly shifting from a logic based on customer ownership of vehicles to solutions geared towards the satisfaction of needs through the use of a product and/or one or more related services (the so-called product-service system). In this respect, sustainable mobility represents an advanced stage in the evolution towards result-oriented servitisation, whose implementation may create remarkable positive effects on the environment, as it leads to less use of raw materials, components and energy for the production of smaller volumes of vehicles. In addition, the shared use of the same vehicles by many users means greater

efficiency in the utilisation of the product during its life cycle. Further positive effects on the environment result from decreased traffic and thus lower air pollutant emissions, reduced noise pollution, and improved road safety, which translates into more livable and people-friendly cities.

From an economic point of view, although the scientific and professional communities agree that servitisation has a positive impact on manufacturing companies' profitability, there is a risk of being faced with the so-called servitisation paradox (Li et al., 2015). The latter consists of two facets (Brax et al., 2021): (i) the financial paradox emerges when companies are unable to cover the investments made to build their service offerings (Gebauer et al., 2005); (ii) the organisational paradox happens when servitisation generates organisational rigidity due to a failure to change in terms of capabilities and mindset in the transition from a product-oriented to a service-oriented organisation (Brax, 2005). Therefore, the recognition of the servitisation paradox should invite us to reflect on servitisation as a holistic strategy that requires profound organisational changes (Martín et al., 2020), not automatically implying economic sustainability. In this respect, with regard to sustainable mobility, the biggest challenge is to figure out how and when the massive investments required in technology and infrastructure both by car manufacturers and institutions can start generating economic returns. In addition, the evolution toward sustainable mobility entails significant changes in revenue models and pricing policies, which pose challenges for both product-service providers and customers.

Finally, with reference to the social dimension, scientific evidence of the impact of servitisation on social performance is limited and dispersed (Moro et al., 2022). Some studies have indeed found that servitisation has a positive impact on social sustainability (e.g., Graça, 2021; Zighan et al., 2021) while others have only indicated its potential influence (e.g., Martín et al., 2020; Zhang et al., 2021). However, a clear gap in the literature on this issue emerges, despite the development of new business and consumption models, such as MaaS, that can have positive effects from this perspective. Indeed, they enable greater accessibility to products/services by customers, greater flexibility and customisation in meeting their needs, and a better quality of life for customers and the community.

Methodology

The exploratory nature of this work led us to choose a qualitative methodology, based on in-depth interviews involving managers and entrepreneurs of the automotive industry, belonging to firms operating at different positions of the service network. Given the pilot nature of this study, we decided to involve a

limited number of people to better manage the complexities and any unforeseen contingencies that may arise.

Specifically, the sample was composed of three experts in the automotive industry: the Managing Director of Alpha and President of the Italian branch of one of the most relevant European Association of automotive makers; the Service Design & User Experience Director of Beta; and the Owner and Managing Director of Gamma. Respectively, the involved people represent the point of view of an industrial and commercial vehicle manufacturer, an automotive trade association, an innovative mobility service provider, and a dealer. As a consequence, this composition of the research sample allowed us to achieve a high level of heterogeneity of views, experiences, and opinions on the same issue. Furthermore, the experts' long experience in this field and the senior positions held in their respective companies allowed us to draw highly strategic and generalised considerations.

The interviews were conducted during a roundtable where all three experts were involved; it was recorded and then transcribed. Then, we applied a coding process (Williams and Moser, 2019) which resulted in three codes in line with our research objective: Environmental sustainability, Economic sustainability, and Social sustainability. In the following section, we report the main results of our analysis.

Results

Environmental sustainability

As evidenced by the Alpha's and Beta's top managers, the automotive sector's main challenge in terms of environmental sustainability concerns the production of less polluting vehicles, intending to achieve zero emissions. In this sense, vehicle manufacturers have long since begun the research and development process leading them to produce vehicles with low environmental impact.

> Beta is a new mobility company we are building within the Delta group, which has already been engaged in fleet electrification for several years. Today, the main challenge is creating solutions with little environmental impact. Delta has already embarked on a very long journey of electrification, which began with the Zeta car and continues with other increasingly electrified solutions.
>
> (Beta's Service Design & User Experience Director)

> Another of the promises is hydrogen, so we are working hard on that. However, this solution requires a proper infrastructure to put electric or hydrogen

> vehicles on the road. Also, it is important to understand how this energy is generated. The risk is that we move the problem upstream, thus having vehicles with zero or almost zero impact but producing energy from fossil fuels or coal. So, we have to be committed but very pragmatic.
>
> (Alpha's Managing Director)

Two main relevant challenges emerge from the previous consideration. The first concerns the need to implement infrastructures, also investing in renewable energy sources, to support the mobility of electric or hydrogen vehicles. In this respect, investments by central governments seem to play a crucial role. The second lies in technological innovation. Indeed, even though the search for environmentally friendly vehicles began a time ago, with electric and hydrogen solutions, the game seems to have only just started, as the solutions currently developed, in particular in heavy truck vehicles sector, do not yet seem to be sufficient to satisfy transportation and logistic companies' needs:

> All of truck manufacturers are at the forefront of this transition to electric, with all the difficulties involved. However, today's technology allows us to have these kinds of vehicles more for urban use. Long-distance transport with an electric vehicle is not possible yet, and long distances are still the predominant part of the sector.
>
> (Alpha's Managing Director)

In this context, a service-oriented business can effectively contribute to addressing critical issues that automotive companies have to face. For instance, new services can be offered to help drivers to use and manage a technology they are unfamiliar with and whose potential they may not fully exploit:

> We must be good at assisting customers and helping them raise a new generation of drivers, desperately needed, trained in ecological and sustainable driving.
>
> (Gamma's Managing Director)

Furthermore, the implementation of solutions and tools for measuring environmental impact can be proposed to increase users' awareness of the pollution produced by their vehicles and activities.

> We are developing solutions to reduce the environmental impact, involving different types of users and bringing out through tangible measurements, such as data, the reduction of CO_2 and noise pollution of vehicles on the road today.
>
> (Beta's Service Design & User Experience Director)

Finally, services can help create competencies and tools to support eco-driving and, more broadly, eco-mobility. However, as pointed out by Alpha's top management, the big enemy to beat in the fight for environmental sustainability remains obsolete vehicle fleets as the number of old vehicles on the road is still too high.

> Frankly, we must look to the future, but we must also hit the big target… and the big target today is the fleet, which is old and thus has an impact both from an ecological point of view in terms of emissions and, let me say, from an economic and safety point of view.
>
> (Alpha's Managing Director)

> And it would be a cost-free initiative [...]. There would be a number of reasons why these vehicles could serenely retire. There is, perhaps, not the will to do so.
>
> (Gamma's Managing Director)

Economic sustainability

The high commitment to environmental sustainability of automotive players translates into a high economic interest. However, as highlighted by the experts, matching environmental with economic sustainability still remains an open issue to solve.

> The big problem remains matching environmental with economic sustainability, which is a really big problem, actually. The only thing that can act as a buffer is government aids.
>
> (Gamma's Managing Director)

Here, public economic support plays a crucial role, especially in the business-to-business, as the market cannot totally afford the high costs of product-service providers, due, on one hand to high costs of electric and hydrogen-powered vehicles, and on the other hand on the available technology that seems to be more suitable for urban mobility rather than to meet the needs of the freight transport.

> The ecological transition in the freight mobility sector happens, and there is no second thought. The problem is to reconcile the light vehicle and the last-mile mobility requirements with the technical features of vehicles; on the heavy vehicle we still have to find the right balance between the hardware costs and the customer's ability to pay these costs.
>
> (Gamma's Managing Director)

However, what central governments make available to large manufacturers does not seem to be sufficient to cover the huge costs incurred in producing environmentally friendly vehicles.

> Today, without government subsidies, an electric heavy truck vehicle is not economically sustainable. We, as a country, are called upon to support this transition. The solutions of public support, to date, are totally insufficient.
>
> (Alpha's Managing Director)

Consequently, it becomes essential to think, design and develop alternative and sustainable business models to enable resilient organisations and create suitable sources of capital to support the investments in research and development of low-impact vehicles.

> As manufacturers and distribution networks, we will be called upon to change our skin. It is clear that these new types of vehicles will not have the "classic" sources of profit that we are used to.
>
> (Alpha's Managing Director)

> The subject of electrification requires manufacturers to invest a lot. If we then go on to the subject of mobility, this is even more complex because, to date, no business model is adaptable and, above all, scalable to meet all mobility needs. When it comes to car sharing, there are different business models. We are exploring others, but they are very costly.
>
> (Beta's Service Design & User Experience Director)

Hence, two main observations arise. First, new business models enabling manufacturing companies to be resilient and economically sustainable go through use-oriented servitisation strategies, such as car-sharing. Second, citizens and users play a critical role in supporting these new business models. Therefore they cannot shy away from the challenge, even if this requires to rethink and change their (often bad) habits.

> … We are looking for other strands that are more economically sustainable. This implies people change their habits. If we are resilient, these changes will become a habit. Without this, we will go nowhere. So, an economically sustainable service-based business model is a key to achieving a long life and giving all the experiments we are doing a chance.
>
> (Beta's Service Design & User Experience Director)

Social sustainability

The issue of our habits as citizens, customers and users of mobility services becomes particularly relevant with regard to social perspective. In this context,

digitalisation plays a key role. By enabling simple, user-friendly and affordable access to services, it stimulates the demand for mobility services thus facilitating the transition of the vehicle idea from a mere physical product to be purchased to a platform for the provision of service solutions. Consistently, it fosters the shift of customers from consumers to users.

> Environmental sustainability is undoubtedly done by bringing less and less polluting solutions to the market. […] we can create platforms to personalise individual needs, including public and private transport. They can be increasingly easy to access, increasingly digitised, and they are very user-friendly and affordable. However sustainability comes through the ability to make people change their habits. That is the biggest challenge.
>
> (Beta's Service Design & User Experience Director)

Finally, two other considerations arise. First, the needs of the new generations in terms of mobility, such as integrated and usership-based mobility, are far different from those of previous generations, posing the challenge of creating new solutions that meet the new forms of demand. Second, servitisation offers numerous solutions for satisfying both integrated and usership-based mobility, thus meeting the needs and demands of the new generation while promoting social sustainability.

> […] indeed, approaching integrated mobility is totally different from what we have experienced till now. It is really about redesigning completely one's rules of life.
>
> (Gamma's Managing Director)

> Considering also the social issues of the new generations, which increasingly focus on usership and less on ownership, Beta was born two years ago with the aim of providing asset-based mobility services based on the electrified vehicles of the Delta group.
>
> (Beta's Service Design & User Experience Director)

Final conclusion and limitations

The fight for environmental, economic and social sustainability in the automotive sector presents many challenges and hides many pitfalls. In light of the results obtained in this study, servitisation seems to be a valuable ally of automotive manufacturing companies. From an environmental point of view, on the one hand, one of the main challenge is to achieve zero emissions, which necessarily means investing in research and development for producing vehicles with little or no environmental impact, on the other it is also necessary to modernise the current fleets, replacing them with new vehicles that perform better in terms of emissions and safety. In this sense, our results suggest that servitisation might,

both directly and indirectly, impact environmental sustainability. The direct impact concerns the reduction of the adoption of raw materials, components and energy, less pollution and more livable cities, as a consequence of the diffusion of mobility as a service. The indirect impact implies the need to change the *modus operandi* of product-service providers and customers, by training drivers and raising people's awareness about environmental issues, in line with what has already emerged in other sectors.

However, continued investments in research and development are needed, thus requiring product-service providers to maintain a high profitable business. As the results show, this cannot be achieved without substantial central government supports. At the same time, service solutions can help by providing direct economic support, thus fostering automotive companies' resilience and at the same time stimulating citizens and consumers, to question their driving and mobility habits as well as rethinking their *modus vivendi*. In this perspective, servitisation acts as a lever for promoting social sustainability.

The evidence of this research must be read in the light of its limitations. In particular, we recognise that the exploratory nature of our study led to the choice of starting with a sample which, although heterogeneous in terms of representation of the industry, is composed of a limited number of people. Nevertheless, the quantity and quality of the emerging themes demonstrated the importance of deepening the role of servitisation in environmental, economic, and social sustainability in the automotive sector.

Servitisation cannot and should not be considered the panacea for such a complex phenomenon as sustainable development. Rather, it represents a valuable ally for environmental, economic, and social sustainability that becomes particularly valuable when there is an orchestration of the efforts of the different actors involved.

References

Abdelkafi, N., Pero, M., Masi, A., & Capurso, I. (2022). Revisiting the servitization-sustainability link: A case study in the professional printing supply chain. *Cleaner Logistics and Supply Chain*, 4, 100061.

Abou-Foul, M., Ruiz-Alba, J. L., & Soares, A. (2021). The impact of digitalization and servitization on the financial performance of a firm: An empirical analysis. *Production Planning & Control*, 32(12), 975–989.

Atif, S., Ahmed, S., Wasim, M., Zeb, B., Pervez, Z., & Quinn, L. (2021). Towards a conceptual development of Industry 4.0, servitisation, and circular economy: A systematic literature review. *Sustainability*, 13(11), 6501.

Ambroise, L., Prim-Allaz, I., & Teyssier, C. (2018). Financial performance of servitized manufacturing firms: A configuration issue between servitization strategies and customer-oriented organizational design. *Industrial Marketing Management*, 71, 54–68.

Brax, S. (2005). A manufacturer becoming service provider–challenges and a paradox. *Managing Service Quality: An International Journal*, 15(2), 142–155.

Brax, S. A., Calabrese, A., Ghiron, N. L., Tiburzi, L., & Grönroos, C. (2021). Explaining the servitization paradox: A configurational theory and a performance measurement framework. *International Journal of Operations & Production Management*, 41(5), 517–546.

Chávez, C. A. G., Romero, D., Rossi, M., Luglietti, R., & Johansson, B. (2019). Circular lean product-service systems design: A literature review, framework proposal and case studies. *Procedia CIRP*, 83, 419–424.

Doni, F., Corvino, A., & Martini, S. B. (2019). Servitization and sustainability actions. Evidence from European manufacturing companies. *Journal of Environmental Management*, 234, 367–378.

Frank, A. G., Mendes, G. H., Ayala, N. F., & Ghezzi, A. (2019). Servitization and Industry 4.0 convergence in the digital transformation of product firms: A business model innovation perspective. *Technological Forecasting and Social Change*, 141, 341–351.

Gaiardelli, P., & Songini, L. (2018). Modelli di business, servizi e performance nel settore del veicolo pesante (*Business models, services and performance in the heavy vehicle industry*). EGEA, Milan.

Gaiardelli, P., Songini, L., Morgantini, M., & Bonesio, P. (2016). Successful product-service strategies and managerial practices: A case study research of the Italian heavy truck assistance networks. *Procedia CIRP*, 47, 102–107.

Gebauer, H., Fleisch, E., & Friedli, T. (2005). Overcoming the service paradox in manufacturing companies. *European Management Journal*, 23(1), 14–26.

Graça, S. S. (2021). A global PSS framework for sustainable B2B partnership. *Sustainability*, 13(6), 3066.

Holden, E., Gilpin, G., & Banister, D. (2019). Sustainable mobility at thirty. *Sustainability*, 11(7), 1965.

Huikkola, T., Kohtamäki, M., & Rabetino, R. (2016). Resource Realignment in Servitization: A study of successful service providers explores how manufacturers modify their resource bases in transitioning to service-oriented offerings. *Research-Technology Management*, 59(4), 30–39.

Kanatlı, M. A., & Karaer, Ö. (2022). Servitization as an alternative business model and its implications on product durability, profitability & environmental impact. *European Journal of Operational Research*, 301(2), 546–560.

Kastalli, I. V., & Van Looy, B. (2013). Servitization: Disentangling the impact of service business model innovation on manufacturing firm performance. *Journal of Operations Management*, 31(4), 169–180.

Kharlamov, A. A., & Parry, G. (2021). The impact of servitization and digitization on productivity and profitability of the firm: A systematic approach. *Production Planning & Control*, 32(3), 185–197.

Kim, C. H., Kuah, A. T., & Thirumaran, K. (2022). Morphology for circular economy business models in the electrical and electronic equipment sector of Singapore and South Korea: Findings, implications, and future agenda. *Sustainable Production and Consumption*, 30, 829–850.

Kohtamäki, M., Parida, V., Patel, P. C., & Gebauer, H. (2020). The relationship between digitalization and servitization: The role of servitization in capturing the financial potential of digitalization. *Technological Forecasting and Social Change*, 151, 119804.

Kolling, C., de Medeiros, J. F., Ribeiro, J. L. D., & Morea, D. (2022). A conceptual model to support sustainable product-service system implementation in the Brazilian agricultural machinery industry. *Journal of Cleaner Production*, 355, 131733.

Li, J. H., Lin, L., Chen, D. P., & Ma, L. Y. (2015). An empirical study of servitization paradox in China. *The Journal of High Technology Management Research*, 26(1), 66–76.

Martín, M. G., Álvarez, A. P., Ordieres-Meré, J., Villalba-Díez, J., & Morales-Alonso, G. (2020). New business models from prescriptive maintenance strategies aligned with sustainable development goals. *Sustainability*, 13(1), 1–26.

Martín-Peña, L. M., Díaz-Garrido, E., & Sánchez-López, J. M. (2018). The digitalization and servitization of manufacturing: A review on digital business models. *Strategic Change*, 27(2), 91–99.

Moro, S. R., Cauchick-Miguel, P. A., & de Sousa Mendes, G. H. (2022). Adding sustainable value in product-service systems business models design: A conceptual review towards a framework proposal. *Sustainable Production and Consumption*, 32, 492–504.

Nosratabadi, S., Mosavi, A., Shamshirband, S., Zavadskas, E. K., Rakotonirainy, A., & Chau, K. W. (2019). Sustainable business models: A review. *Sustainability*, 11(6), 1663.

Pistoni, A., & Songini, L. (2018). *Servitization strategy and managerial control*, Emerald Group Publishing Limited, Howard House, Wagon Lane, Bingley.

Raddats, C., Kowalkowski, C., Benedettini, O., Burton, J., & Gebauer, H. (2019). Servitization: A contemporary thematic review of four major research streams. *Industrial Marketing Management*, 83, 207–223.

Raith, M. G., & Siebold, N. (2018). Building business models around sustainable development goals. *Journal of Business Models*, 6(2), 71–77.

Rapaccini, M., Saccani, N., Kowalkowski, C., Paiola, M., & Adrodegari, F. (2020). Navigating disruptive crises through service-led growth: The impact of COVID-19 on Italian manufacturing firms. *Industrial Marketing Management*, 88, 225–237.

Shen, L., Sun, C., & Ali, M. (2021). Role of servitization, digitalization, and innovation performance in manufacturing enterprises. *Sustainability*, 13(17), 9878.

Shin, J., Hwang, W. S., & Choi, H. (2019). Can hydrogen fuel vehicles be a sustainable alternative on vehicle market?: Comparison of electric and hydrogen fuel cell vehicles. *Technological Forecasting and Social Change*, 143, 239–248.

Sjödin, D. R., Parida, V., & Wincent, J. (2016). Value co-creation process of integrated product-services: Effect of role ambiguities and relational coping strategies. *Industrial Marketing Management*, 56, 108–119.

Smith, G., & Hensher, D. A. (2020). Towards a framework for Mobility-as-a-Service policies. *Transport Policy*, 89, 54–65.

Tan, K. H., Ji, G., Chung, L., Wang, C. H., Chiu, A., & Tseng, M. L. (2019). Riding the wave of belt and road initiative in servitization: Lessons from China. *International Journal of Production Economics*, 211, 15–21.

Tanç, B., Arat, H. T., Baltacıoğlu, E., & Aydın, K. (2019). Overview of the next quarter century vision of hydrogen fuel cell electric vehicles. *International Journal of Hydrogen Energy*, 44(20), 10120–10128.

Tao, F., & Qi, Q. (2017). New IT driven service-oriented smart manufacturing: Framework and characteristics. *IEEE Transactions on Systems, Man, and Cybernetics: Systems*, 49(1), 81–91.

Vargas, J. P., Muñoz Lagos, A. P., Feriz Torres, J. G., Kinney, I. S., Pérez Cortés, S., & Hurtado, J. P. (2022). Achieving circularity through novel product-service systems in the mining industry: An opportunity for circularity. *Sustainability*, 14(6), 3614.

Wang, W., Lai, K. H., & Shou, Y. (2018). The impact of servitization on firm performance: A meta-analysis. *International Journal of Operations & Production Management*, 38(7), 1562–1588.

Weigel, S., & Hadwich, K. (2018). Success factors of service networks in the context of servitization – Development and verification of an impact model. *Industrial Marketing Management*, 74, 254–275.

Williams, M., & Moser, T. (2019). The art of coding and thematic exploration in qualitative research. *International Management Review*, 15(1), 45–55.

Zhang, J., Qi, L., Wang, C., & Lyu, X. (2021). The impact of servitization on the environmental and social performance in manufacturing firms. *Journal of Manufacturing Technology Management*, 33(3), 425–447. https://doi.org/10.1108/JMTM-11-2020-0451

Zheng, T., Ardolino, M., Bacchetti, A., & Perona, M. (2021). The applications of Industry 4.0 technologies in manufacturing context: A systematic literature review. *International Journal of Production Research*, 59(6), 1922–1954.

Zighan, S., Alkalha, Z., Bamford, D., Reid, I., & Zu'bi, M. F. (2021). Servitisation through structural adaptation. *Journal of Service Theory and Practice*, 31(3), 468–490. https://doi.org/10.1108/JSTP-06-2020-0144