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DIGITAL TRANSFORMATION AND BUSINESS PROCESS INNOVATION IN SLOVENIAN AUTOMOTIVE INDUSTRY: AN IN-DEPTH QUALITATIVE STUDY

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Abstract

This paper aims to delve into the process of transforming business models and value chains within the automotive industry, with a specific focus on the significance of digital transformation (DT) and its role in addresing transition challenges based on changed consumer preferences, electrification and supply chain complexities. By examining empirical insights derived from in-depth interviews conducted with Slovenian companies operating in automotive industry, this study contributes to the existing literature by establishing connections and shared concepts across various research domains. It sheds light on key empirical findings within a country boasting a long tradition in automotive industry, while providing informed recommendations. The main findings underscore the considerable variations between companies in terms of their current technological progress and the technologies they employ in their operational processes. These differences are influenced by factors such as their position within the supply chain, company size and the leadership's attitude toward embracing digital solutions.

Keywords: automotive, digitalisation, Slovenia

1. INTRODUCTION

The automotive industry, in terms of its economic significance one of the most important industries not only in European Union but also globally, is facing major technological breakthroughs that cannot be avoided. Disruptive effects resulting from digital transformation (DT), electrification, diverse mobility and connectivity are driving the 2030 automotive revolution (Gao, Kaas, Mohr & Wee, 2016; Koerte, 2021; Llopis-Albert, Rubio & Valero, 2021). Recent survey on automotive top management executives report that the industry needs to reinvent their organizations' business models by applying digital technologies along the value chain if it wants to

succeed or even survive in the next decades (Newman, Schumacher, Kajitani & Lakshminarayanan, 2020).

In the last two decades, the phenomenon of DT has become a game changer in many industries (Bharadwaj, El Sawy, Pavlou, and Venkatraman, 2013; Ghezzi, Cortimiglia, & Frank, 2015; Lopez-Vega & Moodysson, 2023) and revolutionised the way of doing business by providing opportunities to integrate products and services across functional, organisational, and geographic boundaries (Sebastian, Moloney, Ross, Fonstad, Beath, & Mocker, 2017; Vaska, Massaro, Bagarotto, & Dal Mas, 2021). Digital platforms, through which companies interact with their customers and collaborate on value creation (Presch, Mas, Piccolo, Sinik, & Cobianchi, 2020), have changed the dynamics of value networks (Jain & Kulkarni, 2022) and have significantly transformed society (Lopez-Vega & Moodysson, 2023; Ng & Wakenshaw, 2017).

To adapt to a new business reality, the new digital ecosystem demands agents to use digital innovations (technologies and platforms) for data gathering, integration, and utilisation. Platform economy represents a viable model for identifying fast-changing consumer preferences and capturing economies of scale and scope on the supply and demand side in order to prosper in the future (Meyer, Brouthers & Jean, 2023; Petrakaki, Hilberg & Waring, 2018). Dynamic firm-level capabilities that are urgently needed in order to cope with competitors could be developed by incorporating external innovations in start-ups and accelerators (Enkel & Sagmeister, 2020; Bagnoli, Massaro, Ruzza & Toniolo, 2020). Digitalization is therefore seen as an entrepreneurial process (Argun & Kilic, 2023; Autio, Nambisan, Thomas & Wright, 2018) where firms in pursuit of DT upgrade formerly successful but obsolete business models (BM) by implementing business model innovation (BMI) (Acciarini, Borelli, Capo, Cappa & Sarrocco, 2021; Kiel, Arnold & Voigt., 2017). Contarty to traditional business models, data streams are considered to have a central role in supporting DT strategies in digital adopters (Pigni, Piccoli & Watson, 2016; Vaska et al., 2020). An automotive company (OEM), for example, is experiencing a profound shift from being a traditional car manufacturer to mobility provider and developer of digitally connected (car) products (Mocker & Fonstad, 2017). For this reason, adopting digital technologies are usually inherently link to strategic changes in business models (Van Veldhoven & Vanthienen, 2022) and the main ingredient in developing new BMs (Hess, Matt, Benlian & Wiesböck, 2016; Yang, Fu & Zhang, 2021).

The purpose of this paper is to delve into the course of business model transformation and value chain reconfiguration within the automotive industry, while emphasising the importance of DT and its role in solving supply chain puzzles that arose not only during Covid-19 (Chervenkova & Ivanov, 2023), but also as a result of twin transitions based on changed consumer preferences and electrification. Our research question tackles the issue of how new, general purpose and complementary technologies contributed to business model innovations in automotive industry in general, identify push and pull factors and the implications on human resources. As firms along the value chain in automotive industry are very different, it is an interesting issue whether the technological advancements have similar effects on their business models. Incumbent automotive companies along the supply chain are forced to introduce new business models at higher pace to win a competitive battle with start-up business models in the mobility sector (Kim, Paek & Lee, 2022; Remane, Hanelt, Nickerson & Kolbe, 2016). In general, DT in an organization enables better customization and higher customer satisfaction with lower manufacturing costs. Consequently, it has a positive impact on firm performance (measured by profitability, customer retention, return on investment (ROI), and sales growth) and improves innovation activities (Nwankpa & Roumani, 2016; Rigby, Saenz & Guarraia, 2022).

Our paper contributes to the literature by identifying links and shared ideas across a variety of academic contributions, presenting important empirical findings from automotive companies operating in Slovenia, a small country with a long history in the automotive industry, and making well-informed recommendations for its maintained progress. Identifying essential enablers and disablers and their impact on the transformational process applies to other manufacturing industries as well.

This paper comprises of four chapters. First, it presents an in-depth literature overview of the DT, its drivers and the role of dynamic competences. The second section introduces research design and characteristics of the automotive industry. In third section we explain main findings and the results. The paper concludes with discussion based on theoretical and empirical implications of our survey. The limitations of our research represent the avenue for future studies.

2. THEORETICAL BACKGROUND: OBJECTIVES, DRIVERS AND SUCCESS FACTORS OF DT

Digital disruption of organizations and entire industries in last decade represent the urgent need to take responsive and long-lasting transformational activities (Berghaus & Back, 2017; Neugebauer & Zanko, 2021). Supportive and agile organizational culture based on entrepreneurial mindset with tolerance of failure and risk affinity, innovativeness and willingness to learn, represents an environment that flourish joint business and IT initiatives (Jones, Hutcheson & Camba, 2021; Mueller & Renken, 2017). Although agility is often presented as the most important underlaying factor, empirical evidence shows there is no "one size fits all" approach to DT and the specificity of organisational design determines the appropriate approach (Berghaus & Back, 2017).

2.1. The impact of DT on business models and value chain configurations

The digitization process provides new tools and notions of the digital world that are revolutionising the way businesses are conducted (Bresciani, Ferraris, & Del Giudice, 2018; Neugebauer & Zanko, 2021). Scholars have recognised three basic categories of digital technologies: digital artefacts, digital platforms, and digital infrastructures (Bogers, Garud, Thomas, Tuertscher & Yoo, 2022; Nambisan, 2017). Numerous digitised products demonstrate innovative capabilities and functionalities by combining digital components into physical objects (referred to as digital artefacts), acting as both a product and a digital platform (incorporating a connected ecosystem). Data analytics, cloud computing, and 3D printing have emerged as strong technologies for enabling the invention process and rapid scaling (Ahi, Sinkovics, Shildibekov, Sinkovics & Mehandjiev, 2022; Huang, Henfridsson, Liu, and Newell, 2017).

Traditional Original Equipment Manufacturers (OEMs) use a traditional business model that relies around selling vehicles with accessories and offering well-paid aftersales services (Ball, Cordier-Deltour, & Magrath, 2018). However, various facts such as component shortages caused by the crisis, electrification, long waiting times, expensive shipments, material improvements, and new complementary technologies have prompted market participants to reconsider their customer value proposition and underlying operating model (Ball et al., 2018). Toyota's keiretsu practise, which entails various parts sourcing and a monitoring system to handle shortages quickly, facilitates constant evaluation and adaptability to uncertainties (Legget, 2022). To address the concerns of electrification and autonomy, OEMs and the entire supplier network are strengthening cooperation and risk-sharing throughout the vast global supply chain in order to continue work efficiently (Opsahl, 2021). Faster production and higher quality standards provide tremendous pressure on Tier 1 suppliers to adapt to a new business environment by heavily integrating automation and robotics into their manufacturing processes. This helps them to adhere to greater quality and speed criteria. This enables businesses to meet increased production speed and quality standards while reducing fixed costs and improving programme and operational efficiencies (Behrendt, Gomey, Retting, & Soubien, 2022). Tier 2 suppliers, in addition to Tier 1 suppliers, are primarily focused on shifting from manual labour to automation and robotization in processes where these developments have not yet been adopted. They also concentrate on improving integrated automated or robotized processes in regions where such transformations have already occurred (Gelowitz & Stark, 2019). Despite its flaws, the new keiretsu-style organisational strategy

provides a valuable foundation for businesses looking to strengthen their supplier connections for long-term benefits (Aoki & Lennerfors, 2013).

Traditional automotive companies are also disrupted by new, agile start-up companies applying advances in digital technology for developing new types of business models to offer sharing services as a key value proposition (Remane et al., 2016). Incumbent automotive manufacturers often reacted by acquiring companies with heterogeneous but complementary knowledge of digital technology (digital competences) in order to integrate and commercialize it (Hildebrandt, Hanelt, Firk & Kolbe, 2015).

The key objectives of DT are diverse. First of all, it allows organisations to respond rapidly when needed (Berghaus & Back, 2017; Llopis-Albert et al., 2021). Second, developing digitally enhanced products supported by innovative, potentially disruptive business models assists organisations in remaining competitive (Mocker & Fonstad, 2017; Berghaus & Back, 2017; Bachmann & Jodlbauer, 2023). Third, upgrading digital channels and digitalizing production processes are critical fundamentals for companies to keep up with changing customer behaviours and expectations, which leads to improved digital products, improved and maintained customer satisfaction, and dialogue (Berghaus & Back, 2017; Bilgeri, Wortmann, & Fleisch, 2017; Isaksson & Hylving, 2017; Mocker & Fonstad, 2017; Bachmann & Jodlbauer, 2023).

2.2. The importance of dynamic competences

Academic research publications shed light on the importance of integrating internal and external information in the context of DT, which is frequently accomplished through mergers and acquisitions (Hildebrandt et al., 2015). Other research has emphasised the need of leveraging customer information to develop new digital value and provide a smooth end-user experience (Piccinini, Hanelt, Gregory, & Kolbe, 2015). Collaboration with start-ups has also been emphasised as a way to adopt more agile project techniques and embrace a change-oriented attitude in order to overcome reluctance to change among core personnel in established organisations (Bilgeri et al., 2017; Piccinini et al., 2015). Building collaborations, addressing gaps, and improving information flow among different stakeholders and business units were identified as major concerns for establishing innovative business models in the automobile industry specifically (Piccinini et al., 2015). Internal price disputes and a lack of expertise to discover and build possible digital partnerships have been recognised as negative motivations for collaboration within large manufacturing businesses' business units (Bilgeri et al., 2017).

Achieving successful internally focused DT depends not only on identifying and implementing innovative digital technologies but also on supporting employees in the process of upgrading their competences and leveraging these technologies to drive innovation in their work (Mueller & Renken, 2017). It is essential to attract, recruit and retain individuals with digital expertise and abilities to integrate new digital technologies in exisiting business processes (Piccinini et al., 2015; Cetindamar, Abedin & Shirahada, 2021). Organisations can enhance their market intelligence capabilities to sense changes in the business environment, identify opportunities and threats based on prevailing trends, and respond accordingly (Leischnig, Wölfl, Ivens & Hein, 2017).

The effective deployment of technologies delies on the speed at which employees embrace their roles as digital transformers (Tabrizi, Lam, Girard & Irvin, 2019). Apart from fostering an organizational culture that supports transformation, effective communication with employees and group formation are vital for successful transformation (Mueller & Renken, 2017). Employees involved in the processes affected by DT need to actively engage with the changes for the transformation to realize its full potential (Mueller & Renken, 2017; Petrikina, Krieger, Schirmer, Stoeckler, Saxe & Baldauf, 2017). Furthermore, employee participation in change processes

diminishes their resistance, enhances goal achievement and fosters organizational commitment (Petrikina et al., 2017).

2.3. Drivers of DT

Firms embark on digital transformation journey due to various external and internal drivers (Gašperlin, Pucihar & Kljajić Borštnar, 2021; Črešnar, Dabić, Stojčić & Nedelko, 2023). These drivers emerge from the need to keep pace with digital shifts occurring within the industry in which they operate. Changing customer behaviors and expectations, along with digital changes within the industry and its landscape represent triggers for transformation (Haffke, Kalgovas & Benlian, 2017; Schmidt, Drews & Schirmer, 2017; Berghaus & Back, 2017).

Firms now encounter new competitive challenges as they face an expanding range of competitors, including non-industry entrants (Berghaus & Back, 2017; Piccinini et al., 2015). Furthermore, firms experience pressure to undergo digitalization due to competitors demonstration of digital advancements, the emergence of new market entrants with disruptive digital business models, and overall technological progress (Haffke et al., 2017). In situations where the pressure intensifies and rapidly accumulates, firms may find it necessary to establish a Chief Digital Officer (CDO) role to drive the process of DT and express the firm's digital ambitions (Haffke et al., 2017; Culasso, Gavurova, Crocco & Giacosa, 2023). Regulatory changes also oftern force the firms to reconsider their business practices and stimulate the transformational process (Berghaus & Back, 2017).

3. RESEARCH METHODOLOGY

3.1. Qualitative research design

In this study, a qualitative methodology was employed to gather and analyse pertaining to the transformation of business models and value chains in the automotive industry. The choice of utilizing in-depth semi-structured interviews was driven by the objectiveof attaining a comprehensive understanding of the subject matter through first-hand experiences and elucidating the underlying reasons and mechanisms behind the phenomenon. This approach proves particularly valuable when investigating a topic that lacks substantial prior evidence (Cho, Grenier & Williams, 2022), as is the case with DT. Thus, qualitative research is deemed ideal for gaining a deeper insights itno the unique characteristics and impacts of DT phenomena.

3.2. Research setting

Our qualitative research was conducted in Slovenia, a small export-oriented country, that provides an ideal context for analyzing DT. In terms of integrating digital technology in business activities, Slovenia ranks ninth among 27 EU countries, with a score of 39.8 compared to the EU average of 36.1 (European Commission, 2022). The automotive sector holds significant importance in EU economy, contributing approximately 7% to the EU's total GDP. It employs 12.7 million people accross the EU and represents the largest investor in research and development, accounting for a third of all R&D investments in Europe. The industry is undergoing a green transformation, with battery-powered vehicles already comprising 23% of all vehicles sold in 2022. Globally, EU automotive producers hold a market share of 20%. The automotive industry is at the forefront of automation and robotization of production processes and the implementation of smart factory solutions, thereby driving the digital transformation of the entire European industry (SRIP ACS, 2023)

Automotive industry plays a crucial role in Slovenia's economy, employing 7.43% of all manufacturing sector employees (specifically in sector C29 according to NACE classification), and

10% of all employess in business sector when considering the more than 400 companies within the automotive cluster (SRIP ACS, 2023). The adoption of new technologies aligned with industry 4.0 is higher in automotive industry compared to other industries (see figure 1) and the value added per worker exceeded 60,000 EUR in 2022 (Statistical Office of the Republic of Slovenia, 2021). Over 90% of automotive industry production in Slovenia is exported , accounting for approximately 20% of the country's total exports. The key market for the Slovenian automotive industry is Germany, which receives 40% of the export, followed by France, Italy, Austria, Great Britain and the United States. Slovenian companies supply products to at least 25 vehicle brands and around 70 system suppliers in the automotive industry.

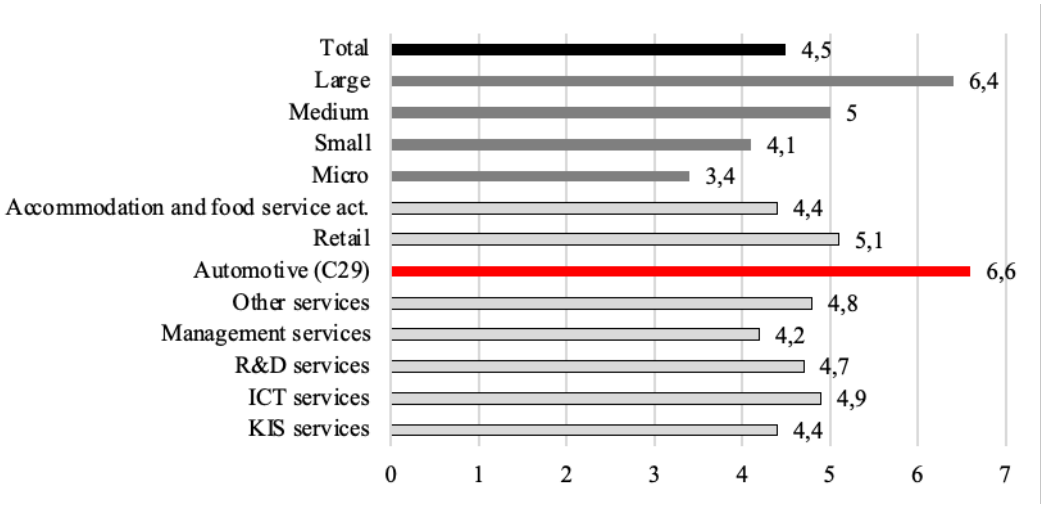

Figure 1 Average number of new Industry 4.0 technologies employed by Slovenian businesses by industry and company size (2020)

Source: Statistical Office of the Republic of Slovenia (2021).

3.3. Data collection and data analysis

Between 23 August and 9 September 2022, data was gathered through 15 in-depth interviews conducted with 24 selected executives representing predominantly global companies that have their headquarters or subsidiary in Slovenia (see table 1). The interviews revolved around 15 key questions concerning DT in the industry, including the primary motives, challenges and barriers encountered in implementing digital transformation within their respective companies. Additionaly, the interviews explored the impact on business and strategy, as well as perspectives on human resources and policy. The interview format encouraged open discussions, allowing for the emergence of additional questions based on the responses provided by the interviewees. The data collection provess involved purposively selecting experts from various companies accross the supply chain, encompassing Original Equipment Manufacturers (OEM), Tier 1, and Tier 2 suppliers. Besides companies listed in the NACE categorization of C29 (Manufacture of motor vehicles, trailers, and semi-trailers) and C30 (Manufacture of other transport equipment), the selection critera were expanded to include companies that play a significant role within the automotive value chain. This comprehensive approach ensured a diverse range of perspectives. The insights and feedback gathered during the interview session are presented in the subsequent chapter.

Table 1 List of companies in the sample

Company (C)	Value chain position	Size[1] (1-Small, 2-Medium, 3-Large)	Ownership	Interviewee's position(s)	Gender (M/F)
C1	OEM	3	MNE subsidiary	HR Director President of management board Project manager	M M M
C2	OEM	3	MNE subsidiary	Executive Sales and Marketing Director	M
C3	Tier 1	2	MNE subsidiary	Plant Director IT Head HR Manager Head of planning	M M F M
C4	Tier 1	3	Domestic corporation	CEO Director of R&D and sales	M M
C5	Tier 1	3	MNE subsidiary	VP Mechatronics	M
C6	Tier 1	3	MNE subsidiary	Director (commercial sales)	M
C7	Tier 2	3	Domestic corporation	Executive Manager (Production and IT)	M
C8	Tier 2	1	Family owned	Managing Director Sales director	M M
C9	Tier 2	2	Family owned	CEO	M
C10	Tier 2	1	Family owned	Managing Director	F
C11	Tier 2	1	Family owned	Managing Director Deputy Director	M F
C12	Tier 2	1	MNE subsidiary	Operation & Quality Manager IT head	M M
C13	Tier 1	3	MNE subsidiary	Global Business Unit Controller	F
C14	Supportive services	1	MNE subsidiary	Managing Director	F
C15	Supportive services	3	MNE subsidiary	Marketing & Quality Manager	F

Source: Own work.

4. FINDINGS

4.1. DT, new technologies and business process innovation

Automotive companies are increasingly realizing the significance of DT and actively pursuing suitable solutions to optimize their business models. The demand for enhanced software, machinery, robotics and skilled personnel is on the rise. However, the level of technological advancement varies across companies and is influenced by factors such as their position in the supply chain, company size, and the company's leadership's stance on digital solutions. The specific areas and functions of digitalization also depend on the company's position in the supply chain and the unique characteristics of their manufacturing processes. Despite implementing digitalized solution, companies often fail to fully harness their potential benefits. Nonetheless, if fully utilized, there are areas that can be improved to enhance user-friendliness, speed, and reliability of process.

The need for digitized solutions becomes increasingly significant for companies higher up in the supply chain, such as Tier 1 or OEM. This implementation requires highly skilled and knowledgeable employees. Tier 2 or Tier 3 suppliers increasingly utilize specific technologies (e.g., robotics) to enhance their process efficiency, rather than digitized marketing communications or

[1] Small companies < 50 employees, medium companies: > 50 and < 250 employees, big companies > 250 employees

sales techniques. When selecting a digital solution to support their operations, the company's management considers the firm's size as a crucial factor. Smaller companies benefit from simplified communication and operational procedures, which can be easily monitored using software or manual methods. However, as the company grows, more advanced software becomes necessary.

The technologies that automotive businesses use for their operations also differ. There are two types of technologies that are frequently mentioned: general purpose technologies (GPT) and complementary technologies. Table 2 summarises their usage and impact on the automotive industry.

Table 2 Frequently mentioned technologies

GPT	
Artificial intelligence (AI)	• **Use**: Coded driving protocols, smart object discrimination, predicitive modeling and obstacle avoidance algorithms, • **Impacts**: Improved vehicle safety, performance and efficiency
Robotization	• **Use**: Collaborative robots ("cobots") working independently • **Impacts**: Higher quality and precision
Cloud computing	• **Use**: Usage of remote computers • **Impacts**: Maximized uptime, improved cost-efficiency and first-time quality, increased reliability, optimized machine productivity, better scalability and management of large amount of data, lower data leakage concerns.
Additive manufacturing (3D printing)	• **Use**: Rapid prototyping, producing one-of-a-kind parts • **Impacts**: Great power and achievements of effect, better cost control, better time management and better precision
Complementary technologies	
Enterprise resource planning (ERP)	• **Use**: Managing plant scheduling, order processing, inventory management, and customer service • **Impacts**: higher productivity, reduced costs, and improved performance
Manufacturing execution system (MES)	• **Use**: Tracking and monitoring products and raw materials, gaining insight into manufacturing operations • **Impacts**: higher productivity, reduced costs, and improved performance
Supervisory control and data acquisition (SCADA)	• **Use**: Data collection that facilitates remote management through monitoring devices • **Impacts**: higher productivity, reduced costs, and improved performance
Virtual modeling Digital twin	• **Use**: Simulation of the manufacturing process of vehicles • **Impacts:** better time management and reduced time from invention to the market.

Source: Own work.

4.2. Motives for DT

The reasons for DT are essentially similar among the organisations interviewed, with some differences dependent on their supply chain position.

There were two types of motives noticed: reactive and proactive. Because the industry has such high product quality standards, and because large OEMs put pressure on companies to meet these standards, reactive motives are certainly present. Furthermore, due to rigorous inventory and traceability standards, traceability is a considerable burden in the sector. Manufacturers of automotive parts and accessories must have business systems in place to track and document any changes made to a product over its lifecycle.

Customer pressures (in the B2B market) are, on the other hand, particularly severe for companies higher up the supply chain and thus a crucial role in the DT process. Company 9 supports that by stating, "Customers demand feedback immediately, and I do not think we could manage this amount of data without digital solutions. And I cannot imagine that, even if we were to reinforce the teams, it seems that there would be so many errors and our feedback to customers would be questionable." In this setting, Tier 1 companies face enormous pressure from OEMs, whereas Tier 2 companies are mostly motivated by proactive motives but must nonetheless match

the expectations of Tier 1 customers. Finally, we have seen that multinational organisations are predominantly pursuing the DT road in order to comply to the overarching digital strategy.

Tier 2 firms are generally motivated by proactive motives, which are influenced by factors such as their size, family ownership, and the significance of staying abreast with market developments and regulations. OEMs and Tier 1 companies, on the other hand, understand the importance of DT in optimising business processes, enhancing operational efficiency, and increasing value added.

Companies with highly automated manufacturing processes are compelled to adopt digital solutions exclusively for automation purposes. Additionally, several companies from the survey have incorporated digital solutions due to the nature of their products. Among the proactive reasons identified, the most commonly mentioned is the realization that without DT, they would be unable to gain a competitive advantage in the future. This holds particularly true for Tier 1 and Tier 2 companies operating in a fiercely competitive environment where differentiation is crucial. Other proactive motivations expressed in the interviews included leadership's interest in DT, potential cost savings, the need to address Covid-19-related challenges, and the desire to enhance effectiveness with end customers.

4.3. Impact on business processes

Numerous companies interviewed have reported that digitalization has had a considerable effect on business performance, especially in terms of cost-effectiveness. They maintain that the implementation of digital solutions can increase value by guaranteeing the production of high-quality products, thereby leading to a larger market share. As interviewee 3 from Company 2 states "The digital transformation is surely enabling what is most important for all of us, after all, which is more value added than in the past." Furthermore, Slovenian automotive businesses reap the rewards of DT by becoming more flexible and efficient through the availability of transparent and accessible data. In terms of productivity, company 2 reports, "Our company managed to increase productivity levels by 20 percent by implementing digitalized solutions." This improvement can be attributed to the user-friendly nature of digital technologies, which makes processes easier and more efficient. As Interviewee 2 from Company 1 succinctly puts it, "DT must save time, people and, after all, money," reflecting the prevailing sentiment among the majority of companies in our sample. Moreover, digital solutions play a crucial role in reducing the number of improperly produced parts substantially. Company 9 states, "The number of complaints has substantially lowered due to the implementation of digital solutions." This reduction is particularly significant as the industry becomes more stringent regarding acceptable errors (measured by the PPM[2] metric). Overall, digital technologies enhance safety for end users, provide a competitive advantage, and improve market position.

However, some companies have expressed concerns about the potential drawbacks of excessive data in the event of a system collapse. They also acknowledged that storing data in the cloud increases vulnerability to cyber-attacks and data breach. Moreover, the abundance of data can introduce process complexity if systems are not interconnected, necessitating a greater need for appropriate know-how and appropriate expertise to navigate the complexity introduced by digitalization.

4.4. Human resources aspect

"The biggest problem is the human factor." (Interviewee 1, C6) Challenges in Slovenian automotive companies stem from employees lacking an understanding of DT and the new skills they can acquire with new technology. Companies observe that some employees are hesitant to adapt, and

[2] Parts per million

they might not recognize the advantages of this transition, as it may not have an impact on their job roles. Some are also fearful that new technology (especially robots) might replace their work position. However, the interviewed companies claim that none of the positions were replaced by their use. We found out that this fear is mainly shared by older employees.

Moreover, ongoing employee education is essential for the success of many companies. To accomplish this, company representatives prioritize mandatory courses to discuss new technologies, machines, and procedures. As interviewee 3 from Company 3 pointed out, "Every time something new is introduced, there is a parallel developing system in place. So, there are no gaps, and the employees are well qualified." In addition to mandatory seminars, employees have the option of attending supplementary seminars to gain additional skills. However, if these non-mandatory seminars are organized outside working hours, some employees might be unwilling to participate. Additionaly, some companies lack sufficient digital training seminars, while others are limitet by financial constraints when it comes to carrying them out. Some companies have discovered a way to overcome their employees' lack of appropriate expertise in the adoption of digital solutions. They started acquiring startups that specialize in software solutions that could be integrated into the processes, as company 15 stated: "We are solving that by buying startups, because our IT department is usually used to the old system." This strategy guarantees the necessary understanding to stay abreast of industry trends and to remain competitive.

Another challenge they highlighted are difficulties in finding new employees with the knowledge and skill set. Or even the willingness to obtain it. "In Slovenia, we have this problem that people are too generally educated." (Interviewee 3, C2) Most companies criticize the Slovenian educational system for lacking a vision. According to interviewee 2 from company 4, "High schools do not sufficiently focus on specialized skills. We know five to ten years what the key occupations for the automotive industry will be, but to get these specialists through the school system, the whole curriculum would have to change." They urge the Slovenian government to develop a national strategy that focuses on specific fields and provides education that is aligned with future economic demands. As Company 7 states, "We expect from the state to empower people that they will know how to work." To overcome these challenges, the government should prioritise specialised schools, expand internship opportunities, invite more corporate guest lecturers, and provide practical examples to ensure relevant and up-to-date educational programs.

5. THE LIMITATIONS OF THE STUDY AND CONCLUSION

The automotive industry is in the midst of a change that combines lean production, green mobility, and new digital technologies. DT is vital to the industry's current development, and its importance is likely to expand further due to the dynamic mobility market. In this industry, digital solutions must be implemented in production processes. The faster and more effective digital solutions are implemented, the easier it is to establish a competitive edge and increase market share.

This research adds to the body of knowledge on digital transformation and business process innovation in the Slovenian automotive industry. Semi-structured in-depth interviews with representatives from Slovenia's automotive industry provided insights on the impact of technology on business models, innovation, and the overall value chain. Practical examples and insights were shared, and the key characteristics, motivations, and challenges of DT in the industry were discussed. The study also compared and highlighted similarities and differences in how various industries responded to digitalization, offering valuable empirical data.

It is important to acknowledge the limitations of this study. The research focused on firms within the automotive supply chain registered in Slovenia, limiting the generalizability of the findings. Due to the small number of OEMs, Tier 1 and Tier 2 automotive industry representatives in Slovenia, the saturation applied with 15 company-level interviews. With a larger sample that includes companies from different countries, a more comprehensive understanding can be

obtained, considering variations in the business environment that either support or hinder DT. Furthermore, this study is based solely on qualitative research, which has some limitations. However, a qualitative approach is beneficial in a field with limited market knowledge, which is unquestionably the case with our research.

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