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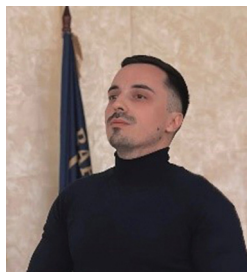

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# FAMILY BUSINESSES AND GREEN TRANSFORMATION: THE ROLE OF LOGISTICS AND ARTIFICIAL INTELLIGENCE

*Abstract: The European Union's Green Agenda for the Western Balkans encourages structural changes aimed at sustainable development, recognising family-owned small and medium-sized enterprises (SMEs) as key actors in the transition. Within this process, logistics emerges as one of the most important areas where efficiency, environmental responsibility and digital innovation can be integrated through artificial intelligence. This paper explores the role of artificial intelligence in supporting the green transformation of family businesses by enhancing logistics models and resource management. The focus is on connecting digital technologies with sustainable practices, as well as on the role of intellectual capital in their implementation. Based on examples from the information technology and agribusiness sectors, with a particular emphasis on logistics functions in family enterprises, the study analyses the key challenges and opportunities that artificial intelligence brings in the context of green transformation. Special attention is given to the development of a conceptual model that encompasses green logistics practices, intelligent risk management, and data-driven strategic decision-making. The aim of the paper is to contribute to a better understanding of the potential of digital solutions in facilitating the sustainable transition of the family business sector, in line with the European Union's policy objectives.*

*Key words: Family SMEs, green transformation, artificial intelligence, logistics, intellectual capital, sustainable development, Western Balkans.*

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## Introduction

The green transition today is not merely an environmental necessity, but a fundamental transformation of modern societies and economies. It entails a comprehensive re-evaluation of production and consumption patterns, the use of natural resources, approaches to innovation, and the role of markets and institutions in shaping sustainable development. Within this context, the concept of a green economy is gaining increasing prominence, referring to the alignment of economic growth with environmental preservation and social justice. According to Nešković (2024, 30), "the transformation towards a green economy does not merely imply adaptation aimed at reducing the negative impacts of the linear economic model. On the contrary, it represents a systemic change that builds long-term resilience, creates business and economic opportunities, and, most importantly, enables social inclusion and numerous environmental benefits." In line with this, the European Green Deal has been positioned as the key development strategy of the European Union, with the objective of making Europe the first climate-neutral continent by 2050. EU institutions have outlined a trajectory towards net-zero greenhouse gas emissions, with an intermediate goal of reducing emissions by at least 55% by 2030 compared to 1990 levels (European Commission, 2019, 4). The document emphasises that the transition must be socially fair and inclusive, with broad participation from citizens, industry, and institutions.

In the effort to achieve climate neutrality and protect the environment, the European Union is redefining its relations with neighbouring regions, particularly the Western Balkans. In 2020, the European Commission adopted the Guidelines for the Implementation of the Green Agenda for the Western Balkans, which provide a strategic framework for supporting the implementation of the Economic and Investment Plan for the region. The document highlights key regional characteristics, such as high vulnerability to climate change, strong reliance on coal-based energy, and untapped potential for sustainable mobility, digital transition, and the development of a circular economy (European Commission, 2020, 3–4). It also underlines the importance of the social dimension of sustainability and digital transformation, as well as the need to enhance cooperation among Western Balkan countries.

The EU's approach encompasses a broad range of financial instruments aimed at supporting sustainable transformation. A central initiative is the InvestEU programme, which consolidates thirteen existing mechanisms into a unified framework to support projects in four priority areas: sustainable infrastructure, research and digitalisation, small and medium-sized enterprises, and social investment and skills. At least 30 percent of the investments are dedicated to climate-related objectives (Fetting, 2020, 7–8). This framework encourages the integration of sustainable practices into national budgets, a redefinition of tax incentives, and the establishment of a green investment taxonomy based on six goals, including climate change mitigation, circular economy development, pollution prevention, and biodiversity conservation.

Family-owned enterprises play a particularly important role in the green transition, as they constitute the backbone of the Western Balkan economies. Their rootedness in local communities, intergenerational legacy, and long-term orientation are strengths that can support the successful implementation of sustainable business models. However, challenges such as limited access to capital, insufficient integration of modern technologies, and often weak institutional frameworks necessitate additional incentives to ensure these enterprises are adequately prepared to respond to the demands of both green and digital transformation. Among the aspects that contribute to the resilience

and sustainability of local communities, green and functionally integrated spaces are gaining increasing importance. Their role in improving quality of life confirms the need for a multidimensional approach to the planning and management of spaces that serve environmental, social, and economic purposes. "Users highly value the ecological, economic, and social functions of urban green spaces, particularly those related to stress reduction, improved microclimates, pollution mitigation, and enhanced social cohesion. These factors not only support improvements in physical and mental health but also significantly enhance the urban quality of life by shaping positive user experiences and fostering social interaction" (Dmitrović et al., 2025, 23). This underscores the importance of locally embedded solutions and multisectoral approaches in the planning and management of spaces and resources aligned with the objectives of sustainable development.

Logistics and digital technologies are becoming key factors in achieving the goals of the green transition. Efficient resource management, optimisation of goods flows and the introduction of energy-efficient storage systems contribute to waste reduction, more rational use of materials and greater transparency across supply chains. The application of circular principles through logistics activities such as packaging recycling, extension of product life cycles and integration of renewable energy sources into warehouses demonstrates the potential of logistics to support the objectives of the circular economy and enhance the sustainability of business practices (Rashid, 2019). The improvement of integrated risk management is further supported by the implementation of advanced technologies, as "technologies such as artificial intelligence, blockchain and predictive analytics enable dynamic risk identification and faster decisions, while the S-curve model provides a framework for understanding phases of digital transformation" (Vapa Tankosić, Lekić N., Bejatović, Lekić S., 2025b, 1524).

The role of emerging technologies in advancing the circular economy is further confirmed by analyses that highlight their capacity to enhance resource efficiency, optimise supply chains, support innovative business models and enable advanced management of product life cycles. Particularly important is the synergy between blockchain technology and artificial intelligence. However, certain challenges need to be addressed, including the lack of regulatory alignment, centralised data structures, and insufficient technological capacity among employees, especially in small enterprises and less developed regions (Sánchez-García, Martínez-Falcó, Marco-Lajara, Manresa-Marhuend, 2024, 1). These technologies offer substantial economic and environmental benefits, but their successful integration into business models requires a comprehensive approach that includes innovation, appropriate regulatory frameworks, and the development of digital competencies among employees. Circular logistics, therefore, should not be seen merely as an operational tool but rather as a strategic path toward sustainable development.

Building on the previous discussion, this paper aims to explore the role of family businesses in advancing the EU Green Agenda, with particular emphasis on decarbonisation, digitalisation and sustainable logistics. The analysis focuses on the framework of European green policies, the specific guidelines for the Western Balkans, and the potential of the family business sector to engage in transformative change through digital and logistical solutions. Special attention is given to the synergistic interaction of innovation, regulatory measures and market dynamics in fostering sustainable development.

## Family Businesses and Sustainable Development

Family businesses form the backbone of economic systems worldwide, regardless of the level of national economic development. Their importance lies not only in their significant contribution to gross domestic product and employment but also in their role as stabilisers during times of crisis, owing to their long-term orientation, strong embeddedness in local communities, and pronounced intergenerational responsibility. In today's business environment, shaped by the imperatives of the green transition and sustainable development, family businesses are increasingly recognising the need to align traditional values with innovative practices, efficient resource management, and adherence to social and environmental principles.

The green transition does not merely entail technical compliance with environmental standards, but rather a profound transformation of development paradigms. It requires the redefinition of business models, proactive risk management, investment in circular processes, and transparent reporting on non-financial performance. Within this context, family businesses face a dual challenge: preserving continuity and identity while also meeting the growing demands of markets, regulatory bodies, and stakeholders. Sustainability should not be viewed as an external obligation but as an component of long-term strategic planning and organisational culture.

Studies indicate that family firms possess specific resources that can significantly contribute to sustainability, particularly strong family capital, which includes mutual trust, a shared vision, emotional attachment to the business, and a willingness to make sacrifices for long-term survival (Jamil, Stephens, Md Fadzil, 2025). However, despite these favourable predispositions, sustainability is often not implemented systematically. There is a lack of formal mechanisms for monitoring goals, clearly defined performance indicators, and institutionalised processes for impact assessment. A qualitative analysis conducted on a sample of family-owned businesses revealed that, although there is an awareness of the importance of sustainability, it is most commonly viewed as a moral obligation rather than as a strategic component of growth and differentiation. It is therefore recommended that a strategic entrepreneurial orientation be adopted, combining proactiveness, innovativeness, and strategic planning as the foundation for sustainable business operations.

Three key groups of resources and capabilities that contribute to the sustainability of family businesses have been identified: (1) intangible resources, such as internal family support, human capital and social capital; (2) tangible resources, including financial capital, equipment and human resources; and (3) social capabilities, which encompass organisational culture, internal leadership structures and relationships with key stakeholders (Jamil et al., 2025, 39). Achieving a balance between these elements through the development of market, production and leadership strategies enhances the resilience of family businesses and their ability to respond to the complex challenges of transition.

Empirical findings from the domestic context support these claims. In the dairy farming sector, research conducted on organic family farms in the Republic of Serbia shows that human capital significantly influences business performance. It is highlighted that "human capital in terms of learning and education, experience and expertise, innovation and creativity, and sources of knowledge has a positive relationship with the business performance and that human capital in organic milk production of the Republic of Serbia does not represent a limiting factor in the future development of this system" (Ignjatijević et al., 2022b, 140). Similarly, in the viticulture and winemaking sector, a

positive correlation between environmentally responsible behaviour and business success has been confirmed. As stated, "wine producers are ready to adopt the new technological environmental solution to increase quantitative and qualitative business results," while managers' attitudes towards the environment indirectly influence service and financial performance (Ignjatijević et al., 2022a, 16). Agroecological support instruments also play an important role in enhancing sustainable practices, especially when tailored to the specific characteristics and needs of family producers. Research focused on financial measures supporting organic production emphasises that organic farming, as part of an agroecological approach, can generate significant economic benefits for agricultural producers. As noted, "through further development of the organic market and the implementation of development measures and incentives in line with European standards, financed partly from national budgetary funds, organic production can ensure long-term income stability for producers, high rates of productivity and processing, as well as improved placement and market promotion of organic agricultural products" (Vapa-Tankosić, Lekić S., 2018, 674). This further confirms that systemic support for family farms is a prerequisite for strengthening their position in the value chain and for the successful integration of sustainable practices into business operations. Additional evidence of the importance of sustainable production practices, particularly in the domain of food safety, is provided by a study analysing the presence of pesticide residues in honey from conventional and organic production. The authors emphasise that "understanding the potential risks and advocating for sustainable and transparent agricultural practices can contribute to a safer and more resilient food supply" (Puvača et al., 2024, 564). The findings of this study point to the need for further development of agroecological standards and highlight the role of family producers in strengthening the resilience of the food system through the application of sustainable and responsible practices

The theoretical framework of family entrepreneurship has in recent years been enriched by concepts that further highlight the role of family firms in responding to global challenges. Randerson (2024) emphasises that family entrepreneurship is a specific form that develops at the intersection of family, entrepreneurship and family business, and that this combination enables a deeper understanding of how social and environmental responsibility can become an integral part of everyday business operations. This approach creates opportunities for defining new business models that incorporate not only economic efficiency, but also environmental awareness, shared values and social inclusion.

An international comparative study by Fernandez (2023), covering more than 28,000 family and non-family firms across 49 countries, shows that family businesses often demonstrate a higher readiness to adopt digital and technological innovations compared to their competitors, yet tend to be more cautious when it comes to radical product and market innovations. The study also reveals that family involvement in ownership and operational structures has a dual impact – on the one hand, it accelerates the early development of the business, while on the other, it can hinder the transition from the start-up phase to a stable growth stage if clear rules for succession and professionalisation are not in place.

Although family businesses are increasingly engaging in the transition towards more sustainable business models, their long-term development remains constrained by various challenges. In addition to internal factors such as resources, leadership and strategy, external conditions often determine the capacity of these firms to systematically implement sustainable practices. Uneven institutional support, regulatory uncertainty

and underdeveloped incentive programmes further complicate the adaptation process. As highlighted in recent analyses, "the legal enactment of family business matters is nowadays of the utmost importance to provide a fundamental pillar that family entrepreneurs may rely on, as well as to ensure easier access to scientific researchers for the purpose of conducting research in the given field" (Novotná, Lušňáková, Hanová, 2022, 9).

Despite the challenges, family businesses hold the potential to become drivers of sustainable transformation. However, achieving this requires the adoption of a long-term perspective, diversification of capital sources, professionalisation of management, and the development of strategies that transcend sectoral and market boundaries. As noted in the literature, "considerable public funding and supports are being directed towards business start-up initiatives. However, there needs to be a (re)evaluation of the support that are needed to achieve sustainability, especially in resource constrained enterprise settings like family businesses" (Jamil et al., 2025, 40). In this regard, empowering family firms calls for a synergy between public policies, educational institutions, sectoral networks and the entrepreneurial families themselves.

The sustainability of family businesses cannot be viewed solely through the lens of economic performance. It is necessary to develop an integrated approach that encompasses environmental, social and organisational dimensions, while respecting the specificities of the family context. Only through such a multidimensional perspective can family businesses achieve long-term competitive advantage and make a meaningful contribution to sustainable development.

## Logistics as a Driver of Sustainable Transformation

Logistics is evolving beyond its traditional role of cost optimisation and is increasingly recognised as a key enabler of sustainable transformation. Its strategic importance lies in the ability to integrate efficiency, resilience, and environmental responsibility across supply chains. Rather than focusing solely on operational goals, modern logistics systems are oriented towards alignment with the principles of the circular economy and climate neutrality. This involves the use of multi-criteria optimisation models, digital tools, and advanced analytical approaches that support the balance between economic and environmental objectives.

Within the scope of contemporary approaches to sustainable logistics, green supply chain management (GSCM) is gaining prominence as a crucial factor in improving corporate sustainability performance. A review of trends in the scientific literature over the past decade confirms that GSCM has a positive impact on the environmental, social, and economic dimensions of sustainable business. Increasing attention is being directed towards circular and closed-loop supply chains, digital logistics, and the Industry 4.0 paradigm. A comprehensive analysis of recent studies identifies four thematic clusters of particular importance: optimisation models for sustainability, the relationship between sustainable supply chains and triple bottom line (TBL) performance, life cycle assessments of resource-intensive supply chains, and the key factors influencing the effectiveness of GSCM implementation. The findings indicate that green logistics is no longer merely an operational function but a strategic component of business transformation, increasingly involving multi-criteria models and assessments of social and environmental impacts (Kamra, Mani, Sharma, Joshi, 2024, 23).

Research confirms that green logistics practices contribute not only to the reduction of environmental footprint but also to the improvement of overall logistics performance.

Within this framework, green logistics management (GLM) and green innovation play a significant role in enhancing logistics efficiency, thereby strengthening firms' capacity to meet the demands of sustainable development. Empirical studies show that companies which integrate environmental standards and innovative approaches into their logistics systems achieve higher levels of operational efficiency and contribute to reducing variability in the implementation of sustainable solutions (Garg, Vemaraju, 2025, 183).

Measuring the effectiveness of sustainable logistics practices requires the use of clearly defined indicators that encompass environmental, social, and economic dimensions of business performance. Key performance indicators (KPIs) within sustainable supply chains include areas such as energy efficiency, materials management, water consumption and discharge, waste volume and treatment, greenhouse gas emissions, land use, and compliance with environmental regulations. From a social perspective, KPIs cover aspects such as human rights, anti-corruption efforts, occupational health and safety, employee training, customer satisfaction, and social compliance. Economic indicators include profitability, market competitiveness, income distribution, and investment in sustainable initiatives, including local sourcing and research and development (Tundys, Fernando, 2019, 38–39). These indicators enable the systematic monitoring of logistics and supply chain performance in the context of sustainable development goals and form the basis for strategic decision-making.

In the context of the transition towards sustainable business models, logistics is acquiring a new strategic dimension. Beyond functional efficiency, modern logistics systems aim to align with the objectives of the circular economy and climate neutrality. The use of multi-criteria optimisation models, digital tools and advanced analytical approaches has become essential to achieving this balance. For instance, the analysis of supply chains for energy storage systems (ESS) shows that the integration of artificial intelligence, machine learning and deep learning models contributes to cost optimisation, reduced environmental impact and enhanced operational resilience (Bamufleh, Wang, Rammohan, Yang, 2025, 21). Although this example relates to the energy sector, the methodological approaches and digital solutions employed have strong potential for application in family businesses undergoing digital and green transformation.

Green logistics practices contribute not only to environmental protection but also to strengthening a company's competitive position. In the field of sustainable banking, systematic risk management incorporating Environmental, Social and Governance (ESG) criteria confirms the importance of integrating sustainability into operational and logistics processes. Although focused on the financial sector, these approaches have broader relevance for organisational resilience and market stability. As the authors point out, "ESG strategies not only contribute to environmental sustainability but also reinforce financial stability and competitive advantage" (Vapa Tankosić, Ignjatović, Kranjac, Lekić S., Prodanović, 2025a, 1368). Applying similar principles in logistics involves the implementation of green procurement, energy-efficient transport, $CO_2$ emissions reduction and effective waste management throughout all stages of the value chain. Moreover, the flexibility and agility of logistics systems have become critical for their adaptability in the face of increasingly frequent climate and geopolitical disruptions.

By integrating sustainability principles with digital technologies, traditional supply chains are being transformed into agile, transparent, and automated systems. These systems enable more accurate planning, more efficient resource management, and waste. In the agricultural sector, the integration of technologies such as smart sensors, IoT systems, artificial intelligence, and digital monitoring platforms has proven essential for enhancing logistics processes and ensuring sustainable supply chains,

particularly among small and medium-sized family farms. Digital transformation within the framework of Agriculture 4.0 leads to a redistribution of activities and resources, accompanied by a pronounced need for the development of new knowledge and skills. As the authors note, "the transition to digital agriculture implies changes in the practices and ways of doing business of actors in the entire chain of agricultural production" (Vapa Tankosić, Mirjanić, Prodanović, Lekić S., Carić, 2024, 1040). This confirms that logistics, when strategically directed and digitally supported, is not merely a support function for production and distribution, but also a mechanism for implementing broader development policies and sustainability goals.

An important component of sustainable logistics is urban logistics, which focuses on optimising last-mile deliveries while simultaneously reducing pollution and noise in urban areas. The introduction of electric vehicles, micromobility solutions, and consolidated logistics centres in city zones contributes to greater efficiency and improved acceptance by local communities. A particular challenge is posed by rural and peripheral areas, where sustainable logistics can play a crucial role in strengthening regional connectivity, preventing depopulation, and supporting local agricultural production. However, achieving a balance between economic efficiency and environmental sustainability remains a challenge in last-mile logistics. Research indicates that high levels of transport effectiveness, measured by the Transportation Overall Vehicle Effectiveness (TOVE) indicator, do not necessarily coincide with low $CO_2$ emissions. A comparative analysis of TOVE and emissions shows that maximising operational performance often overlooks environmental considerations, highlighting the need for the development of new, integrated indicators that align economic and environmental goals (Ferraro Cantini, Leoni, De Carlo, 2023, 1).

The sustainability of logistics does not rely solely on technology, but also on organisational culture, employee competencies, and a company's ability to develop management models that foster accountability and continuous improvement. Investment in education and interdisciplinary skills is essential, as is strengthening cooperation with academic and research institutions to support the implementation of innovative solutions. Logistics must be viewed as a strategic, rather than merely operational, component of business activities. When aligned with ESG principles and supported by digital tools, it becomes a driver of resilience, innovation, and long-term value. In family businesses in particular, the enhancement of logistics practices contributes to greater market flexibility and competitive sustainability. Modern sustainable logistics increasingly relies on digital solutions that enable accurate planning, predictive analytics, and process automation. This creates opportunities for the broader application of artificial intelligence as a key factor in the development of integrated, efficient, and environmentally responsible logistics systems.

## The role of Artificial Intelligence in the Transformation of Family Businesses

Artificial intelligence (AI) is one of the key technologies transforming modern business models, including family enterprises. Its application includes resource optimisation, enhanced decision-making, more efficient knowledge management, predictive analytics and the automation of operational activities. In the context of increasing market uncertainty, growing digital demands and the rising importance of sustainability, family businesses face the challenge of maintaining competitiveness. Artificial intelligence can play a crucial role in strengthening their flexibility, resilience and strategic agility.

One of the main advantages of applying artificial intelligence lies in its ability

to optimise the use of existing resources. Machine learning earning algorithms enable the analysis of large datasets in real time, contributing to the more rational use of raw materials, energy, human labour and time. For family firms, which often operate with limited capacity, this potential is particularly important. The adoption of AI solutions reduces subjectivity in decision-making and lowers the risk of decisions being based solely on experience and intuition, which is characteristic of traditional family-run management models.

Inventory management, logistics, production planning and procurement are just some of the areas where artificial intelligence is already demonstrating potential for process improvement. The automation and predictability enabled by AI bring greater stability to business operations, increase responsiveness to changes in supply chains, market dynamics and consumer demands. By integrating various data sources, both internal and external, AI supports more complex analyses, allowing for higher quality strategic decision making and longer-term planning.

A particularly important aspect of applying artificial intelligence lies in knowledge management. The digital processing, structuring and distribution of knowledge facilitate the development of organisational memory, improve access to useful information and contribute to the strengthening of innovation capacity. In family firms, knowledge is often concentrated within a single founder or generation, creating a risk of loss. AI supports the institutionalisation of knowledge and enables its transfer between generations, which is essential for ensuring continuity and strategic resilience. This role of artificial intelligence in knowledge management is especially evident when considered within the broader context of intellectual capital development and management, as confirmed by empirical analyses of small and medium-sized enterprises in the ICT sector.

Considering that knowledge is one of the fundamental elements of intellectual capital, it is clear that the application of artificial intelligence has the potential to further strengthen its components. This connection becomes particularly evident in knowledge-intensive sectors, such as information and communication technologies. For this reason, the following section explores the results of empirical research that highlight the importance of the synergy between artificial intelligence and intellectual capital in the context of improving business performance.

Empirical research points to a strong connection between artificial intelligence and the components of intellectual capital, particularly contributing to the enhancement of business performance in small and medium-sized enterprises within the information and communication technology sector. Studies conducted in the Republic of Serbia confirm that all three components of intellectual capital (human, structural, and relational) significantly influence business success, with human and structural capital playing a particularly prominent role. It has been established that “companies in the ICT sector adequately manage intellectual capital because all the values of the intellectual capital constructs are in the rank of values reported in the findings of more developed countries” (Lekić N. et al., 2022, 16), indicating a high level of intangible asset management. Similar findings from the international context confirm that the integration of various AI technologies – such as self-learning algorithms, machine translation, and automated communication tools – can improve organisational processes, increase the business value of transformation initiatives, and strengthen competitive advantages. It is emphasised that the successful implementation of AI requires the reconfiguration of existing processes whilst simultaneously recognizing the intangible benefits arising from digital transformation (Domini, Dewi, Cesna, 2023, 24).

Continuous advancement of knowledge, creativity, and innovation is recognised

as a fundamental basis for long-term competitiveness: "the permanent development of knowledge, creativity and innovation is the starting point for the growth and success of these companies and a key enabler of competitiveness, particularly evident in the conditions of global and international business" (Lekić N, Vapa Tankosić, Mandić, Lekić S., 2023a, 88–89). In addition to technological and organisational aspects, contemporary research increasingly highlights that successful digital transformation also depends on the development of employee competencies. A human-centred approach to transformation enables the alignment of individual capabilities with organisational goals, thereby encouraging active employee engagement in innovation and adaptation to change. It has been emphasised that employee competencies are "crucial in enabling an organisation's transformation toward digitalisation" (Blanka, Krumay, Rueckel, 2022, 1). The modern business environment therefore demands new approaches to the development of intellectual capital, with a specific focus on human capital. The importance of highly competent employees who are committed to innovation and teamwork is increasingly recognised, as they "form the base of intellectual capital" (Lekić N., Vapa Tankosić, Mandić, Vapa, Lekić, S., 2023b, 44–45).

The further development of intellectual capital requires a systematic approach, particularly in the area of structural capital, which is directly linked to other components. Research confirms that various elements of structural capital, such as systems and processes, knowledge management, and organisational culture, significantly influence innovation capacity, especially in the field of process innovation, thereby positively affecting firm performance (Beltramino, Garcia-Perez-de-Lema, Valdez, 2020, 934). In this regard, "clearly defined strategies and procedures of managing intellectual capital are performances that contribute to higher level of structural capital which should be promoted further" (Lekić N., Vapa Tankosić, Rajaković Mijailović, Lekić S., 2020, 52), confirming the need for institutionalising knowledge and procedures as a foundation for sustainable competitive advantage.

The implementation of artificial intelligence, however, does not occur without obstacles. Family businesses often exhibit resistance to change, which is associated with entrenched decision-making patterns, informal structures, and concerns regarding the erosion of family values. A lack of technical expertise, limited resources, and underdeveloped digital infrastructure further hinder the adoption of advanced technologies. Decision-making is frequently centralised, without a strategic perspective on technological trends. It has been observed that these businesses generally adopt a reactive and incremental approach to digital transformation, with managers displaying overconfidence in their competitive position despite possessing low levels of digital competence. This combination reduces their ability to adapt in a timely and strategic manner (Bouncken, Schmitt, 2022, 1).

In this regard, partnerships with academic and research institutions, innovation clusters, and external experts can play an important role by providing access to knowledge, training, and advisory support. Such collaboration can significantly reduce resistance to change, improve digital competencies, and facilitate the effective integration of AI tools into existing business models.

Despite the challenges, the potential of artificial intelligence in family businesses is manifold. With their long-term orientation and strong local roots, family firms are well-positioned to integrate AI in alignment with their values, creating sustainable business models based on knowledge, responsibility, and strategic agility. This gives rise to several key research questions, including the role of AI in succession planning, the emotional intelligence of machines in preserving family culture, its contribution to

decision-making and conflict management, as well as the ethical challenges related to transparency and fairness in algorithmic decisions. These questions provide a foundation for deeper exploration of AI's transformative potential in family firms (Sawang, Kivits, 2023, 804).

In addition to enhancing operational aspects of business, AI supports the development of a culture of learning, innovation, and adaptability. In the process of green and digital transformation, particularly in light of increasing climate and market pressures, AI enables precise impact mapping, informed decision-making, and process optimisation aligned with ESG principles. Due to their long-term vision and deep-rooted presence in local communities, family firms are uniquely suited to implement AI in a manner that upholds their values, fostering sustainable business practices grounded in knowledge, accountability, and strategic flexibility.

## Conceptual Framework and Discussion

Based on the previously presented theoretical insights and sectoral observations, a conceptual model has been formulated linking three key elements in the transformation of family businesses: human capital and family-based governance structures, the functional role of logistics in sustainable transformation, and the adoption of artificial intelligence technologies. The aim of this model is to illustrate how the interaction of these components contributes to strengthening organisational resilience and achieving sustainable competitiveness in family-owned firms.

The proposed model is grounded in the fact that family businesses possess specific forms of human and social capital that serve as a basis for long-term development, yet they are often limited in terms of technological and process capacities. In this context, AI solutions and logistics digitalisation act as enhancers of adaptive capability. In this regard:i logistička digitalizacija, koji deluju kao pojačivači adaptacionih sposobnosti. U tom smislu:

- AI contributes to improved forecasting and risk management, as well as optimisation of internal processes;
- Logistics functions as an integrative activity that connects procurement, production and distribution in line with the goals of energy efficiency and the circular economy;
- The family-based structure, supported by the adequate development of competencies and leadership, can enable flexibility and prompt decision-making during times of crisis

The model is supported by insights from the information technology, agribusiness and digital logistics sectors, where it has been observed that, despite differences in technological maturity and access to resources, the following recurring patterns are evident: a lack of qualified personnel, high digitalisation costs, and institutional limitations in accessing knowledge. At the same time, important development opportunities have been identified, such as the application of predictive analytics in agribusiness, the advancement of circular logistics flows, and the synergy between human and digital capital in the ICT sector. As noted by Lekić N. and Vukosavljević (2021, 301), "human capital has a key value and role in the development of ICT enterprises, compared to all other forms of capital," confirming its strategic importance in the digital environment.

The results of empirical research show that "information technology agility predominantly determines business agility, confirming the hypothesis that leadership, positive business outlook, readiness to respond quickly to competitors' actions, and

the success rate of new product launches have the strongest direct impact on business agility" (Lekić N., Vapa-Tankosić, Mirjanić, Lekić S., 2023c, 181–182). These findings further confirm the strategic importance of digital competencies and support the model's proposition regarding the synergy between human and digital capital in the ICT sector.

The model is further reinforced by contemporary insights from international literature, which confirm the interdependence of technological, organisational, and competency factors in the process of sustainable digital transformation. Modelling and optimisation of supply chains in the energy storage sector involves structural changes that enable resilience and flexibility in the context of the transition (Bamufleh et al., 2025). Successful digital transformation, as stated, requires the simultaneous development of employee competencies and alignment with the strategic goals of the company (Blanka et al., 2022). The importance of structural capital and innovative processes for the performance of small and medium-sized industrial enterprises has been confirmed in the work of Beltramino et al. (2020), while it is also highlighted that business transformation initiatives based on artificial intelligence can contribute to the growth of company performance (Domini et al., 2023). In the field of logistics, the development of circular models and the redefinition of performance in line with sustainability principles are key factors of transformation (Rashid, 2019; Ferraro et al., 2023; Sánchez-García et al., 2024). Performance measurement, in this context, must be integrated with the goals of a sustainable supply chain to enable strategic control and continuous improvement (Tundys, Fernando, 2019). In family businesses, artificial intelligence is recognised as a potential driver of the transformation of traditional business models (Sawang, Kivits, 2023), while a strategic entrepreneurial orientation is seen as crucial for sustainability in conditions of limited resources (Jamil et al., 2025). These insights confirm the core assumption of the model that resilience and competitiveness in the digital environment depend on the coordination of human, organisational, and technological factors.

The purpose of the model is not to offer a universal solution, but to highlight the structural relationships that condition the success of the digital transformation of family businesses. At the core of this transformation is the organisation's ability to integrate technological innovations into existing values, structures, and resources, while retaining recognisable elements of family identity. In this context, resilience and competitiveness emerge as the result of the coordinated action of human capital, logistical capabilities, and AI technologies.

## Conclusion

Family businesses have a unique structure based on intergenerational trust, long-term orientation, and strong value foundations, making them well-suited to implement sustainable business practices. However, practice shows that the concept of sustainability in family businesses is often perceived declaratively, while concrete strategies and operational measures remain underdeveloped. Limitations in the professionalisation of management, reliance on traditional management models, and a lack of systemic knowledge regarding ESG principles indicate the need to strengthen education, strategic vision, and institutional support, particularly in transitioning countries.

In this context, logistics emerges as a functional area with significant potential for sustainable transformation. If properly directed, logistics processes can significantly contribute to reducing environmental impact, more rational use of resources, and cost reduction. The application of circular economy principles, such as reuse, recycling, and optimisation of material flows, forms the foundation for creating more resilient

and sustainable supply chains. At the same time, digitalisation of logistics enables greater efficiency, transparency, and the possibility of predictive decision-making, thus supporting the overall business agility of enterprises.

Artificial Intelligence further expands the scope of transformation, particularly in the areas of planning, risk management, and innovation. Introducing AI solutions into the business models of family firms not only enables process automation but also enhances data analysis, enables quicker reactions to market changes, and strengthens decision-making. However, the efficient implementation of artificial intelligence requires not only technological infrastructure but also the development of digital competencies and a change in organisational culture, which can present a challenge for firms with a more traditional structure.

The proposed conceptual model provides an integrated framework for understanding how human capital, logistics, and digital technologies, alongside family governance specifics, collectively contribute to sustainable competitiveness. This model does not claim universal application, but aims to identify the key interdependencies that determine the success of transformation in a contemporary business environment. Findings from domestic and international sources confirm that the resilience and competitiveness of family firms do not rely solely on individual resources, but on their coordination, strategic alignment, and the ability to integrate innovations without compromising family identity.

The purpose of the model is not to offer a universal solution, but to highlight the structural relationships that condition the success of the digital transformation of family businesses. At the heart of this transformation is the organisation's ability to integrate technological innovations into existing values, structures, and resources, while retaining recognisable elements of family identity. Resilience and competitiveness, in this context, emerge as the result of the coordinated action of human capital, logistical capabilities, and AI technologies.

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