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**Zarządzanie łańcuchem wartości w branży motoryzacyjnej  
w warunkach globalnej konkurencyjności**

*Value Chain Management in the Automotive Industry under Conditions of  
Global Competitiveness*

Rozprawa doktorska napisana pod opieką naukową  
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The doctoral dissertation is devoted to a multifaceted analysis of value chain management in the automotive sector, which, over the past two decades, has become one of the most dynamically transforming areas of the contemporary economy. The intensification of global competitiveness, the rapid development of digital technologies, the growing importance of artificial intelligence, and the increasing demands of sustainable development have rendered traditional models of organisational functioning insufficient. In this context, the automotive industry constitutes a particularly distinctive case, as it combines exceptionally high product architecture complexity with an extensive, multi-tier supply network and the strong influence of technological, environmental, and regulatory megatrends. Simultaneously, the sector has become a space of intensified processes of globalisation, offshoring and nearshoring, as well as dynamic competition for digital competences and organisational adaptability.

Against this backdrop, the principal cognitive and application-oriented objective of this dissertation is to identify and model the key interdependencies occurring within the value chains of automotive enterprises operating under conditions of global competitiveness. Achieving this objective requires both a theoretical perspective - encompassing the evolution of the value chain concept and contemporary theories of global value chains - and a comprehensive empirical analysis enabling verification of the adopted hypotheses and the central research thesis, according to which, under global competitive pressure, the competitive advantage of an automotive enterprise is determined by the strategic implementation of artificial intelligence throughout the entire value chain. AI is not merely a process-optimisation tool; it constitutes a critical transformative force within the areas of sustainable development and human capital management, thereby fundamentally reconfiguring the model of value creation.

The theoretical part of the dissertation presents a systematic reconstruction of the evolution of the value chain concept, beginning with Michael Porter's classical framework, through alternative value configurations, up to modern approaches addressing global value chains, governance structures, business ecosystems, and the architecture of intelligent products. Particular emphasis is placed on the shift from a linear conceptualisation of sequential activities to a contemporary interpretation of the value chain as a complex network of interconnections in which relationships between actors, flows of information and data, and coordination mechanisms play equally significant roles. The analysis also encompasses contemporary models of global value chain governance, including the governance theories developed by Gereffi, Humphrey, and Sturgeon, which explain the diverse forms of coordination within value chains and the power relations between lead firms and suppliers. Another important theoretical

stream elaborated in the dissertation concerns the role of information technologies and artificial intelligence in transforming business models in the automotive sector.

The study also presents a critical review of the current state of research in the field of value chain management, with particular emphasis on the existing research gap. The literature analysis revealed a lack of holistic studies integrating, within a single framework, the strategic aspects of value chain functioning in the automotive sector with the role of artificial intelligence, as well as organisational, structural, and regulatory factors. Existing publications often focus on selected value chain links - such as logistics, production, or supplier relations - while overlooking interdisciplinary interdependencies between these areas. This dissertation seeks to address this gap by offering a comprehensive model for analysing the value chain, grounded in advanced statistical techniques, which enables the identification of causal relationships.

In the empirical part, a study was conducted on a sample of enterprises representing the automotive industry in Poland, differentiated in terms of size, digital maturity, scope of activity, and organisational structure. The research process employed tools enabling advanced quantitative analyses, including reliability testing of measurement instruments, confirmatory factor analysis, between-group tests, and structural equation modelling (SEM).

The dissertation formulates the following set of hypotheses:

Hypotheses concerning differences in the assessment of value chain characteristics

**1. By enterprise size**

- H<sub>01</sub>: There are no statistically significant differences in the assessment of value chain characteristics between enterprises of different sizes.
- H<sub>11</sub>: There are statistically significant differences in the assessment of at least one value chain characteristic depending on enterprise size.

**2. By respondent job position**

- H<sub>02</sub>: There are no statistically significant differences in the assessment of value chain characteristics between employees holding different positions.
- H<sub>12</sub>: There are statistically significant differences in the assessment of at least one value chain characteristic depending on the respondent's job position.

### 3. **By length of service**

- H<sub>03</sub>: There are no statistically significant differences in the assessment of value chain characteristics between respondents with varying lengths of service.
- H<sub>13</sub>: There are statistically significant differences in the assessment of at least one value chain characteristic depending on length of service.

### **By scope of professional responsibility**

- H<sub>04</sub>: There are no statistically significant differences in the assessment of value chain characteristics between individuals with different scopes of professional responsibility.
- H<sub>14</sub>: There are statistically significant differences in the assessment of at least one value chain characteristic depending on professional responsibility.

### 5. **By level of IT advancement**

- H<sub>05</sub>: There are no statistically significant differences in the assessment of value chain characteristics between enterprises with different levels of IT advancement.
- H<sub>15</sub>: There are statistically significant differences in the assessment of at least one value chain characteristic depending on the level of IT advancement in the enterprise.

Statistical analysis confirmed that the perception of value chain functioning varies significantly depending on variables such as enterprise size, job position, length of service, scope of responsibility, and technological maturity. In particular, it was demonstrated that enterprises with higher levels of IT advancement and those that more extensively integrate AI-based technologies exhibit more favourable assessments of operational effectiveness, communication efficiency, interdepartmental collaboration quality, and adaptive capability in a turbulent environment. These findings support the adopted thesis that AI constitutes not merely a modernisation tool, but a fundamental driving force behind strategic transformation in value chain management.

The author's contribution to the field lies in the development and empirical validation of a structural equation model (SEM) enabling precise identification of the relationships among key analytical constructs. The model demonstrated that the level of technological maturity and the degree of AI integration significantly influence the effectiveness of value chain management, manifested in improved risk management, higher innovativeness, more effective

implementation of sustainability objectives, and greater organisational coherence. The model also confirmed that technological transformation substantially affects the quality of human resource management, which constitutes a crucial component of competitive advantage in a sector increasingly based on knowledge, competencies, and employee adaptability.

The dissertation presents conclusions and outlines the theoretical and practical implications of the findings. From a theoretical perspective, the work systematises the existing scholarly output by proposing an integrated approach to value chain analysis that combines classical strategic concepts with a global perspective and contemporary theories of technology and digital ecosystems. From a practical perspective, the dissertation provides automotive enterprises with recommendations regarding the strategic utilisation of artificial intelligence systems, process optimisation, development of inter-organisational collaboration, and enhancement of employee competencies in ways that strengthen organisational resilience and innovativeness.

This dissertation constitutes a significant contribution to the disciplines of management and quality sciences by offering an empirically validated model and an in-depth analysis of the role of artificial intelligence in transforming the value chain. The study demonstrates that, under conditions of global competition, the competitive advantage of automotive enterprises no longer stems solely from effective process management, but from the ability to integrate technologies, manage knowledge, build relationships within global networks, and adapt to the requirements of sustainable development. The applied research approach - encompassing both a rich theoretical foundation and advanced empirical analysis - grants the findings considerable explanatory and predictive power, while the dissertation itself represents a valuable contribution to the development of research on value chain management in the context of digital transformation.