THE THESES OF THE DOCTORAL DISSERTATION

University of Sopron Faculty of Wood Engineering and Creative Industries József Cziráki Wood Science and Technologies Doctoral School

Leader: Prof. Dr. Németh Róbert

THESIS SUMMARY

Doktoral Program: Management in the Wood Industry
Discipline: materials science and technologies

The Interrelation of Efficiency and Competitiveness in Wood and Furniture Industry Enterprises

Created by: Kornfeld Zsuzsanna

Supervisors: Dr. Bednárik Éva, Dr. Horváth Péter György

2025

1. JUSTIFICATION OF THE TOPIC AND RESEARCH OBJECTIVES

The economic performance and future prospects of a company are closely linked to its chosen strategy, willingness to adapt, delivered performance, service quality, and value creation, all of which are primarily supported by well-organized logistics and operational processes. One of the key elements of long-term success is the ability to respond flexibly and rapidly to emerging changes. Transparent, systems-oriented enterprises have a greater capacity to achieve this goal, which can be realized primarily through effective logistics processes.

In today's highly competitive and time-sensitive markets, corporate survival and future prospects are influenced by pricing, constant fluctuations, customer demands and purchasing habits, as well as market oversupply. Consequently, it is increasingly difficult to ensure sustainable operations or to achieve even temporary competitive advantages. The primary opportunities for enterprises lie in **improving efficiency** and **reducing costs**, in which innovation, artificial intelligence, and continuous renewal are the most decisive factors. Whether a company possesses a competitive advantage in its sector and market depends largely on the quality of its business system, strategy, production and procurement efficiency, quality assurance, and flexibility, all of which contribute to creating high added value for both customers and the enterprise itself.

The central theme of this dissertation is the examination of efficiency and competitiveness in wood and furniture industry enterprises, a topic of particular relevance in an era defined by globalization, rapid technological advancement, and continuously shifting consumer expectations. A distinctive feature of the Hungarian wood industry is its relatively low level of

innovation and digitalization, which was already forecast by primary competitiveness and digitalization studies in 2022. Combined with the constant pressures of the market, most enterprises in the sector tend to focus on stabilizing their operations rather than pursuing development. Meanwhile, at the international level, digitalization, sustainability, and value creation have increasingly come to the forefront, providing companies with significant advantages.

The objective of this research is therefore to develop a framework that evaluates the interconnections between efficiency and competitiveness from a new perspective and, through the application of the Quality Function Deployment (QFD) methodology, enables the measurable weighting of strategic factors.

2. DESCRIPTION OF THE DISSERTATION

The dissertation is structured around five hypotheses. The first hypothesis posits that, in the absence of a unified theoretical and methodological framework, the concept of competitiveness is "fragmented," which poses challenges when assessing and evaluating wood industry enterprises.

The second hypothesis assumes that the competitiveness of domestic wood industry companies is not determined solely by productivity, but rather by a set of complex efficiency indicators, such as process, resource, and energy efficiency.

The third hypothesis suggests that companies prioritize operational stabilization in their strategies, while innovation and digitalization considerations tend to be marginalized.

The fourth hypothesis addresses the notion that changes in consumer preferences do not directly stimulate technological renewal in the wood industry.

Finally, the fifth hypothesis posits that the integration of innovation and artificial intelligence plays a key role in ensuring long-term sustainable competitiveness.

3. RESEARCH METHODS

The research is based on a mixed-methods approach. A comprehensive review of the literature on efficiency and competitiveness highlighted the difficulties associated with measurement and comparison.

As part of the study, a case study was conducted at a domestic wood industry company, focusing on the integration of a Manufacturing Execution System (MES) and its impacts. The information obtained through this integration provided additional advantages in terms of reinforcing a process-oriented perspective and enhancing efficiency (e.g., multi-route planning, component families, standard times). The case study demonstrated that such technological solutions can measurably increase the transparency of manufacturing processes, improve efficiency, and, consequently, enhance productivity.

The results of the primary questionnaire surveys and secondary research revealed how responses to market changes can be linked to corporate knowledge and competencies to promote optimization, development, and efficiency. The surveys highlighted that the vast majority of companies primarily focus on cost reduction and operational stabilization, while innovation, digitalization, and internationalization remain secondary priorities. One of the most significant methodologies applied in this research was the Quality Function Deployment (QFD)

model, which enabled the weighting of competitiveness factors and their visualization on a radar chart.

4. OVERVIEW OF THE RESERACH BACKGROUND

The competitiveness of the wood and furniture industry is of paramount importance today, as globalization, rapid technological development, and sustainability considerations shape the market environment. The situation of Hungarian wood industry companies is unique: while international trends are dominated by innovation, digitalization, and high value-added activities, most domestic firms focus primarily on operational stabilization and cost reduction. This strategy is closely linked to capital shortages, technological lag, and slower adaptation to evolving consumer demands. At the same time, sustainability, energy efficiency, and the integration of artificial intelligence have become unavoidable challenges for the Hungarian wood sector. Scientific investigation of this topic is therefore justified, as it contributes to uncovering the complex factors of competitiveness and provides practical guidance for companies seeking to align with international trends.

5. ETABLISHED HYPOTHESES

The research aims to explore the competitive characteristics of Hungarian wood industry companies in light of changing market conditions and technological advancement. The formulation of the hypotheses was based on a comprehensive literature review and preliminary findings from primary research. The analysis incorporated questionnaire surveys, case studies, international comparative data, MES system integration, and

efficiency optimization in wood industry companies, enabling a thorough evaluation of various competitiveness factors.

The following hypotheses were established for this research:

Hypothesis 1: Due to the lack of a unified conceptual and methodological framework for competitiveness, the separate examination of individual factors is insufficient for an objective assessment of the overall competitiveness of wood industry companies.

Hypothesis 2: The competitiveness of Hungarian wood industry companies is primarily determined by complex corporate efficiency indicators—such as process, resource, energy, cost efficiency, and data-driven flexibility—rather than the productivity-focused value importance generally observed by Pupos et al. (2020).

Hypothesis 3: The majority of Hungarian wood industry companies implement operational stabilization measures (e.g., cost reduction, liquidity maintenance), while the significance of digitalization and innovation performance indicators shows an increasing trend.

Hypothesis 4: The pace of change in consumer preferences does not significantly influence technological renewal or the willingness to innovate in Hungarian wood industry companies.

Hypothesis 5: Innovation and artificial intelligence ensure the sustainable competitiveness of Hungarian wood industry companies and support the adaptation of value creation.

6. RESERACH RESULTS

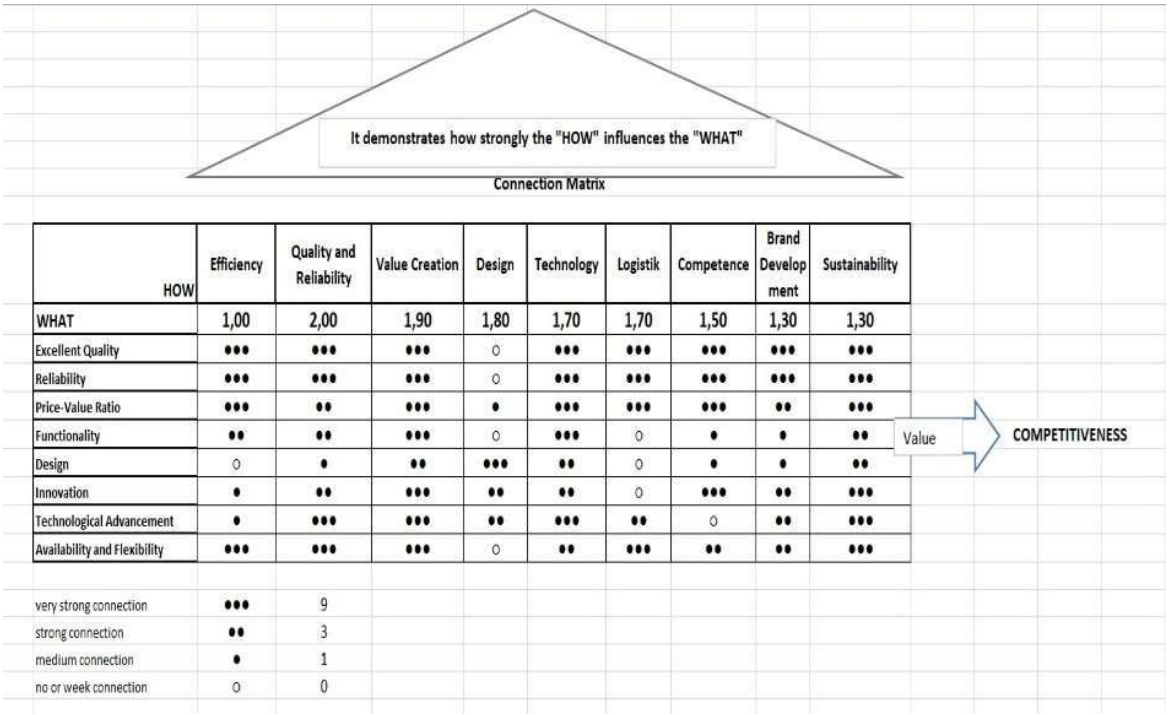
The hypotheses were tested based on empirical evidence, literature review, and practical examples, with the main findings of the research presented below.

Hypothesis 1 posits that the concept and measurement methodology of competitiveness lack a unified, widely accepted theoretical and methodological framework, which significantly complicates the objective comparison of wood industry companies. Industry-specific factors, such as the constraints arising from the use of raw, natural materials, assign different meanings to general categories like efficiency, innovation, or productivity. In the wood industry, sustainable forest management and the responsible use of natural resources constitute a foundational condition that carries different weight compared to other sectors. Furthermore, intra-industry specializations - such as furniture manufacturing, construction timber production, or integrated multinational operations - cannot be assessed using uniform indicators. The complexity of the supply chain, along with the differing value creation logic of manufacturing, trading, and mixed-profile companies, further justifies their separate analysis. Multinational corporations, such as IKEA, leverage complex competitive advantages through integrated operations that are not directly comparable to the performance of smaller, specialized companies. Traditional financial indicators, such as revenue or company size, are insufficient on their own for a comprehensive assessment of competitiveness, as they overlook factors like knowledge base, innovation capacity, or inimitability. This issue is further compounded by corporate secrecy and the lack of transparency, which reduce data reliability and comparability. A valid analysis therefore requires a multidimensional model

capable of simultaneously handling quantitative and qualitative factors. One-sided approaches lead to distorted results because they fail to capture the complex and sector-specific nature of competitiveness. In today's market, competitiveness reflects not only the degree of growth but, more importantly, the company's adaptation and survival strategies. Accordingly, the first hypothesis asserts that the competitiveness of wood industry companies can only be objectively evaluated using an integrated, weighted model that considers sector-specific characteristics.

The weighting model was developed using the QFD methodology (Table 1), incorporating both primary customer research data and international comparative data. The model results indicated that product quality, innovation, and reliability are the most decisive factors in determining the competitiveness of wood industry companies, with customers regarding them as fundamental expectations alongside price–value considerations. Based on the weighting, delivery accuracy and sustainability aspects also emerged as significant determinants. In contrast, traditional financial indicators, such as revenue or company size, received low importance ratings in both customer decisions and competitiveness parameters. These results confirm that, due to the specific characteristics of the wood industry, an objective assessment of company competitiveness cannot be made without accounting for customer expectations and industry-specific factors.

Consequently, the hypothesis was confirmed: the integrated, weighting-based model (Table 2) is capable of measuring company competitiveness in a more comprehensive and reliable manner.



HOW	Efficiency	Quality and Reliability	Value Creation	Design	Technology	Logistik	Competence	Brand Development	Sustainability
WHAT	1,00	2,00	1,90	1,80	1,70	1,70	1,50	1,30	1,30
Excellent Quality	●●●	●●●	●●●	○	●●●	●●●	●●●	●●●	●●●
Reliability	●●●	●●●	●●●	○	●●●	●●●	●●●	●●●	●●●
Price-Value Ratio	●●●	●●	●●●	●	●●●	●●●	●●●	●●	●●●
Functionality	●●	●●	●●●	○	●●●	○	●	●	●●
Design	○	●	●●	●●●	●●	○	●	●	●●
Innovation	●	●●	●●●	●●	●●	○	●●●	●●	●●●
Technological Advancement	●	●●●	●●●	●●	●●●	●●	○	●●	●●●
Availability and Flexibility	●●●	●●●	●●●	○	●●	●●●	●●	●●	●●●

very strong connection	●●●	9
strong connection	●●	3
medium connection	●	1
no or week connection	○	0

1. Table: Relationship matrix

EFFICIENCY	1,0
Quality and Reliability	**2,0**
Value Creation, Addes Value	**1,9**
Innovation and Design	**1,8**
Technology	**1,7**
Logistic	**1,7**
Diversification and Inimitability	**1,6**
Market Flexibility and Adaptivity	**1,6**
Human Capital and Corporate Competence	**1,5**
Internationalization and Export Orientation	**1,5**
Supply Chain Stability	**1,4**
Brand Building	**1,3**
Sustainability	**1,3**

2. Table: Table Weighting of the Competitiveness Measurement Model

Hypothesis 2 posits that the competitiveness of Hungarian wood industry companies is determined primarily by complex efficiency indicators rather than mere productivity. Due to rapid market changes, increasing productivity alone does not ensure sustainable operations, as it may lead to overproduction, inventory accumulation, or quality compromises. In contrast, efficient resource management, optimized processes, and data-driven flexibility enhance both sustainability and competitive

advantage. For companies, reducing waste and enabling agile decision-making are more important than merely increasing volume. European directives and studies (e.g., EIB, EU energy efficiency programs) also reinforce that efficiency, rather than mass production, is the main driver of competitiveness. International comparisons highlight that while China relies on volume and price competition, Europe emphasizes sustainability, innovation, and customer value creation. In the wood industry, responsible forest management and resource protection are especially critical, forming the foundation for long-term success.

Hypothesis 3 suggests that most Hungarian wood industry companies focus primarily on operational stabilization, while the importance of innovation and digitalization continues to grow. Research demonstrates that innovative companies gain measurable economic benefits, making innovation a prerequisite for competitiveness. However, in the Hungarian wood industry, particularly among SMEs, practical implementation of digitalization and innovation lags behind potential opportunities. In an uncertain market environment, companies prioritize cost reduction, liquidity preservation, and investment postponement, which relegates development initiatives to the background. OECD and EU reports identify structural barriers—such as financial constraints, skills shortages, and limited resources—as factors slowing innovation. Export-oriented companies are compelled to focus more on development, but overall, retrenchment remains dominant in the sector. International comparisons show that Hungary's innovation performance is moderate and below the EU average.

Hypothesis 4 asserts that rapid changes in consumer preferences do not significantly influence the technological renewal

or innovation willingness of Hungarian wood industry companies. Firms primarily pursue operational stabilization, while investment decisions are determined by internal resources, company size, financial capacity, and export market requirements. Due to long investment cycles and the slow replaceability of machinery, demand changes affect product portfolios and design solutions more than technological innovation. Surveys conducted by FABUNIO and EFFIX-Marketing indicate that purchasing decisions are dominated by quality and price, with technological innovation playing a negligible role. This conclusion is further supported by the 2025 primary customer survey results. The EIB Survey also confirms that consumer demand does not directly stimulate investment willingness. These findings align with the observation that technological push and institutional support have a stronger effect on innovation than demand-pull factors. In premium segments and more sophisticated markets (e.g., Scandinavia, Germany), consumer preferences exert a stronger influence, whereas in Hungary, this effect is relatively limited.

Hypothesis 5 proposes that innovation and artificial intelligence (AI) ensure the sustainable competitiveness and value creation capacity of Hungarian wood industry companies. Research indicates that, alongside operational stabilization and relative independence from consumer preferences, Industry 4.0 technologies, AI, and innovation form the foundation for long-term growth. Evidence comes from international examples (Austrian and German studies) as well as domestic experiences (FA-BUNIO, WOODIGITAL program, FALCO Plc. developments, and fault-detection research at the University of Sopron). The literature also confirms that AI and innovation can reduce costs, increase productivity, and reinforce sustainability.

Primary research revealed that while smaller firms are constrained by liquidity limitations, larger companies already show improvements in material efficiency and defect reduction. MES integration demonstrated that AI-based process modeling leads to increased efficiency. Collectively, these findings confirm that innovation and AI represent not short-term market pressures but long-term strategic factors.

7. RESULTS AND SCIENTIFIC CONTRIBUTIONS OF THE DISSERTATION

The dissertation yielded multiple scientific results, and the hypotheses were validated as follows:

H1 – Confirmed: Both the literature review and empirical investigations confirmed the fragmented understanding of competitiveness.

H2 – Confirmed: Complex efficiency indicators are more determinant of competitiveness than productivity alone.

H3 – Confirmed: Companies primarily follow stabilization strategies, while innovation and digitalization remain underemphasized.

H4 – Confirmed: Consumer demands do not directly stimulate technological renewal in the Hungarian wood industry, whereas in Europe their impact is more pronounced and measurable indirectly.

H5 – Confirmed: Innovation and artificial intelligence (AI) are key factors in ensuring the sustainable competitiveness of Hungarian wood industry companies.

A **weighted factor-based competitiveness model** was developed, tailored to the characteristics of the wood and furniture industry. Utilizing the **QFD methodology**, the model provides a novel approach for **measuring competitiveness** and allows comparative evaluation of strategic factors. The case study demonstrated that **MES system integration** directly improves efficiency, while primary research revealed that Hungarian companies' competitiveness lags behind these internationally significant trends. Consequently, a **new strategic framework emerged** that contributes both **scientifically and practically**. The results are applicable in corporate strategic planning, performance measurement, and the design of industry development programs. The QFD model and radar chart support companies in **objectively assessing** their strengths and weaknesses, **guiding deliberate development** strategies.

Overall, the dissertation advances the scientific understanding of the wood and furniture industry while providing a framework that supports strategic decision-making at both corporate and industry levels. The findings also confirm that, despite the **dominance of stabilization strategies** in the Hungarian wood sector, **strengthening innovation and digitalization** is essential for companies seeking long-term competitiveness in international markets.

8. FURTHER RESEARCH RECOMMENDATIONS

Future research could explore the convergence opportunities for Hungarian wood industry companies, specifically how the latest digital technologies and data-driven solutions can be integrated into operations with minimal risk and maximal efficiency. Deloitte risk analyses and the Fraunhofer Institute's concepts for industrial digitalization and sustainability can serve as valuable references for identifying technological priorities and adaptation strategies.

A key research direction involves identifying the factors and experiential gaps that hinder digital preparedness among Hungarian wood industry companies, as well as recognizing support mechanisms that can facilitate the sector's digital and innovation transition.

Publications Related to the Research Topic

1. **PERFORMANCE/EFFICIENCY-ORIENTED APPROACH IN THE INTEREST OF ECONOMIC GROWTH -** Kornfeld Zsuzsanna

III. RING – FENNTARTHATÓ NYERSANYAG-GAZDÁLKODÁS - III. SUSTAINABLE RAW MATERIALS KONFERENCIAKÖTET - PROCEEDINGS Sopron, Magyarország: Soproni Egyetem Kiadó (2019) 310 p. pp. 195 – 202. Paper: ISBN 978-963-334-353-1, 8 p.

2. **A BESZERZÉS JELENTŐSÉGE EGY VÁLLALAT SIKERESSÉGÉBEN** – Kornfeld Zsuzsanna

MAGYAR ASZTALOS WOODO: HAVONTA MEGJELENŐ FA- ÉS ASZTALOSIPARI FOLYÓIRAT 2020. Június
https://faipar.hu/cikkek/gazdasag/9465/a-beszerzes-jelentosege-egy-vallalat-sikeressegeben (2020)

3. **A BESZERZÉS ÉRTELMEZÉSE A FAIPARI VÁLLALATOK KÖRÉBEN** – Kornfeld Zsuzsanna

PROCEEDINGS OF THE MISKOLC IPW- IV. Sustainable raw materials international project week
Miskolc-Egyetemváros, Magyarország: Institute of Raw Material Preparation and Process Engineering, University of Miskolc (2020) p. B103, 12 p.

4. **AZ ÖKOMARKETING LEHETŐSÉGEI, KÖRNYEZETVÉDELMI ELVÁRÁSAI ÉS AKADÁLYAI, AZAZ A FELMERÜLŐ KONTRA PROBLÉMÁK** – Kornfeld Zsuzsanna

PROCEEDINGS OF THE MISKOLC IPW- IV. Sustainable raw materials international project week
Miskolc-Egyetemváros, Magyarország: Institute of Raw Material Preparation and Process Engineering, University of Miskolc (2020) p. B101 Paper: ISBN 978-963-358-222-0, 8 p.

5. **ECO-TENDENCIES REGARDING PELLETS** – Kornfeld Zsuzsanna

PROCEEDINGS OF THE MISKOLC IPW- IV. Sustainable raw materials international project week
Miskolc-Egyetemváros, Magyarország: Institute of Raw Material Preparation and Process Engineering, University of Miskolc (2020) p. A115 Paper: ISBN 978-963-358-222-0, 10 p.

6. **A VEVŐKISZOLGÁLÁS SZÍNVONALA A VÁLLALATI SIKERESSÉG FÜGGVÉNYÉBEN** – Kornfeld Zsuzsanna

MAGYAR MINŐSÉG 30: 5 pp. 51 – 59., 9 p. (2021)

7. **A FAIPARI VÁLLALATOK BESZERZÉSI TERÜLETÉNEK FELMÉRÉSE A DIGITALIZÁCIÓ ÉS AZ IPAR 4.0 SZEMSZÖGÉBŐL** – Kornfeld Zsuzsanna, Dr. Bednárik Éva

MAGYAR MINŐSÉG 30: 6 pp. 18 – 28. Paper: HU ISSN 1789-5510, 10 p. (2021)

8. **COMPETITIVE ADVANTAGE IN TE LIGHT OF CORPORATE SUCCESS** – Kornfeld Zsuzsanna, Dr. Bednárik Éva, Dr. Horváth Péter György

MINŐSÉG ÉS MEGBÍZHATÓSÁG 2022: 3 pp. 288 – 295., 8 p. (2022)

Magyar megjelent változata:

A VERSENYELŐNY A VÁLLALATI SIKERESSÉG MEGVILÁGÍTÁSÁBAN – Kornfeld Zsuzsanna, Dr. Bednárik Éva, Dr. Hortváth Péter György

MINŐSÉG ÉS MEGBÍZHATÓSÁG 2022: 4 pp. 340 – 347., 8 p. (2022)

9. **ASPECTS OF SUCCESS ORIENTED THINKING IN CORPORATE ENVIRONMENT** – Kornfeld Zsuzsanna, Dr. Bednárik Éva, Dr. Horváth Péter György

MINŐSÉG ÉS MEGBÍZHATÓSÁG 2022/4 Minőség és Megbízhatóság - EOQ MNB Közlemények pp. 340 – 347. Paper: 2022/4, 8 p. (2022)

Magyar megjelent változata

A SIKERORIENTÁLTSÁG MEGVILÁGÍTÁSA A VÁLLALATOK RÉSZÉRŐL – Kornfeld Zsuzsanna, Dr. Bednárik Éva, Dr. Horváth Péter György

MINŐSÉG ÉS MEGBÍZHATÓSÁG 2023/1 pp. 63 – 68. oldal (2023)

10. **EFFICIENCY AND COMPETITIVENESS** – Kornfeld Zsuzsanna, Dr. Bednárik Éva, Dr. Horváth Péter György

INTERNATIONAL JOURNAL OF ENGINEERING, MANAGEMENT AND HUMANITIES (IJEMH) Volume 5, Issue 2, Mar.-Apr., 2024 pp. 202-206

11. **COMPTETIVENESS IN THE WOOD INDUSTRY: A QFD-BASED MODEL FOR**
ALIGNING CUSTOMER EXPECTATIONS WITH STRATEGIC CAPABILITIES – Kornfeld Zsuzsanna, Dr. Bednárik Éva, Dr. Horváth Péter György

Drewno – Folyamatban