ACTA FACULTATIS XYLOLOGIAE ZVOLEN, 66(2): 155−171, 2024
Zvolen, Technická univerzita vo Zvolene
DOI: 10.17423/afx.2024.66.2.13

AGILITY ASSESSMENT IN THE WOODWORKING COMPANY

Katarína Marcineková – Andrea Janáková Sujová – Martin Halász

ABSTRACT

Agility has become a strategic priority for organizations striving to succeed in dynamic and unpredictable environments. This study is aimed at evaluating the agility of a Slovak woodworking company based on the application of a proposed assessment framework by authors to find out the agility level, the main gaps in its agility practices, and how these gaps can be addressed to improve agility. The custom-designed agility maturity model, structured interviews, questionnaires, and diagnostic tests are used in the research to examine 35 key agility elements and seven dimensions, including organization, processes, change culture, human resources, customer engagement, and innovation. The findings reveal significant gaps in process management, technology integration, and customer orientation, where agile practices are partially recognized but still need to be fully implemented. Actionable recommendations are proposed to enhance operational flexibility, foster innovation, and improve customer-centricity. This study demonstrates the critical role of agility in maintaining competitiveness and provides a roadmap for its systematic enhancement in small and medium-sized enterprises.

Keywords: agile maturity model; agility evaluation; woodworking company; enterprise agility; change management.

INTRODUCTION

Agility and agile principles were first introduced in the Agile Manifesto, focusing on uncovering better software development (Beck *et al.*, 2001). Business agility is defined as an organization's ability to swiftly and effectively adapt its business and processes to unpredictable internal and external changes, enhancing flexibility and responsiveness (Oosterhout *et al.*, 2006). It enables businesses not only to manage but also capitalize on opportunities arising from dynamic environments. Couto (2015) emphasized the importance of quick responsiveness in agile businesses, highlighting both reactivity and proactivity and stated that agility is among the top 10 organizational concerns. Nowadays, it is crucial for businesses to adapt to changing circumstances and shape them, as they face increasing levels of uncertainty (Girod, *et al.*, 2023). Agility is the ability of a system to respond to change, and it is essential to adopt a holistic perspective, as a firm comprises processes that vary in complexity. Less complex processes are more accessible to modify and, therefore, more agile (Arteta and Giachetti, 2004).

The principles of agility revolve around fostering adaptability, speed, and responsiveness across all levels of an organization. According to Tseng and Lin (2011), agility is rooted in four key drivers: responsiveness, competency, flexibility (adaptability),

and quickness (speed). Responsiveness entails identifying and reacting swiftly to external changes, while competency ensures that organizations possess the necessary skills, resources, and processes to deliver effective solutions. Flexibility allows businesses to restructure processes and resources to align with evolving demands, and quickness focuses on minimizing the time required to implement changes (Tamtam and Tourabi, 2019). Christopher (2000) highlights the importance of focusing on customer needs in agile practices. Additionally, agility emphasizes continuous improvement and iterative approaches, enabling firms to test, learn, and adapt without significant delays (Beck *et al.*, 2001). These principles underscore the need for in-depth analysis to evaluate the level of business agility.

Agility is widely applied in business, economy, management, and business finance. Agility played a significant role in enhancing flexibility and responsiveness in supply chain management (Rathod *et al.*, 2019), lean processes (Narasimhan *et al.*, 2006), and business process management (BPM) (Fertalj and Matejas, 2015). Agile principles have been applied in manufacturing and supply chain management to improve adaptability and competitiveness by promoting flexibility and rapid response to market changes (Berthot, 2023). Agile supply chain practices enhance responsiveness to disruptions, optimizing inventory and delivery times (Shpak *et al.*,2023; Alzoubi *et al*., 2022). Agile BPM emphasizes continuous improvement, flexibility, and rapid iteration, allowing businesses to adapt processes swiftly to new information or environmental changes. This synergy between BPM and agility ensures that organizations remain resilient, competitive, and capable of sustaining long-term growth in dynamic environments (Badakhshan *et al*., 2019).

Agile methodologies are more flexible and responsive to change than traditional methodologies. Key components include Adaptive Planning (Wang *et al*., 2010), Iterative Processes (Larson, 2019), Collaboration and Communication (Papadopoulos, 2015), Flexibility and Responsiveness (Imgrund and Janiesch, 2019), and a focus on Value and Innovation (Diego *et al*., 2020). In business management, finding the golden mean between traditional and agile methodologies (Perides *et al*., 2021; Milenković *et al*., 2019). This integration allows organizations to benefit from structured planning and risk management while leveraging the flexibility and iterative nature of agile methodologies.

Agility is vital for enterprises as it enhances their ability to respond to market fluctuations, seize emerging opportunities, and mitigate uncertain risks. Agility enables firms to sense and respond quickly to market changes and positively affects profitability, speed to market, and customer satisfaction (DeGroote and Marx, 2013). It fosters innovation by creating an environment where processes and strategies can be adjusted to meet evolving demands. Firms with strong agility capabilities are better at leveraging innovation for competitive advantage (Ashrafi *et al.*, 2019). Furthermore, agility drives operational efficiency by streamlining workflows, reducing redundancies, and enabling quicker decision-making (Kock and Gemünden, 2016).

Agility in resource integration allows companies to be more responsive to customer needs, thereby improving customer satisfaction and loyalty (Findsrud, 2020). Agile practices prioritize customer collaboration, ensuring that development aligns with user needs, which helps deliver market-driven products (Chakravarty and Singh, 2024).

Nowadays, business agility is considered a key success factor in the dynamic business sphere. Agility assessment is the starting point in the journey toward gaining a competitive advantage and ensuring a company's success. Following this initial step, overall agility can be analyzed, leading to developing an action plan and implementing necessary changes

(Mahapatra and Shenoy, 2021). Assessing agility can reveal inefficient processes, leading to reduced time to market (Kumar and Dhas, 2023), faster decision-making (Leroux and Wright, 2010), and increased overall operational efficiency. Identifying key agile categories, such as agility factors and dimensions, provides a coherent view of an organization's current state (Walter, 2020).

Various assessment methods have been developed to better understand and measure agility within organizations (Looks *et al*., 2021; Gren *et al*., 2015; Ganguly *et al.*, 2009). Looks *et al.* (2021) developed a questionnaire measuring team agility, encompassing six dimensions: communication, openness to change, iterativity, self-organization, focus on products, and continuous improvement. Their approach involved professional reviews and a case study for validation. Rdiouat *et al.* (2021) proposed a three-level structure for each perspective, consisting of a mission, critical success factors, and criteria for agility assessment. Chacko and Suresh (2021) employed a multi-grade fuzzy approach, classifying attributes using Importance Performance Analysis (IPA). Their model assists startups in assessing their agility index, focusing on identifying weaknesses and implementing improvements. Shafiabady *et al.* (2023) developed an AI model that facilitates proactive adjustments to enhance agility and identifies both obstacles and benefits associated with improving agility to predict the future level of organizational agility. Yu and Heng (2006) developed an index system for measuring agility, identifying three levels of agility: low, medium, and high. When combined with methods like the Analytical Hierarchy Process (AHP) and Bayesian Belief Networks (BBN), managers can make informed decisions supported by comprehensive data analysis.

One notable example is the method developed by Gergin *et al.* (2022), which utilizes a comprehensive questionnaire composed of 51 questions. These questions are grouped into eight categories that define agility: Technology & Innovation; Collaboration & Involvement; Responsiveness & Reactivity; Connectivity & Integration; Adaptability & Quick Changeover; Efficiency; Continuous Improvement & Versatility; and Time. This structured approach allows for a detailed evaluation of an organization's agility across multiple dimensions, providing valuable insights for balancing traditional and agile methodologies.
Agility Maturity Models (AMMs) are designed to evaluate an organization's current agility level, identify areas for improvement, and provide a structured pathway for enhancing agility across various dimensions, making them a critical tool in agility assessment (Wendler, R., 2014). Schmitt *et al.* (2019) analyzed 14 Agile Maturity Models (AMMs), defined criteria for their comparison, and highlighted the pros and cons of each model. In conclusion, they recommended the AMM model by Patel and Ramachandran as it meets most of the defined criteria and is based on the Capability Maturity Model Integration (CMMI). In the study by Carvalho *et al.* (2019), a model based on CMMI was developed to create a unique approach for determining organizational agility through specific maturity levels. In this model, the traditional first level is subdivided into individual levels to provide a more precise characterization of the initial phases of agility implementation. A scoring method was employed, with the Zeroth level corresponding to 0%, the first level ranging from 1% to 20%, the second level from 21% to 40%, the third level from 41% to 60%, the fourth level from 61% to 80%, and the fifth level from 81% to 100%.

After agility assessments, key areas for resource optimization can be identified, leading to better allocation and utilization (Vasanthan and Suresh, 2021).

After the resource analysis, it could be stated that many approaches to agility evaluation are excessively complex and theoretical, and it is difficult to apply them to the market environment. Many publications focus on organizational agility assessment, but most tend to concentrate on theoretical model creation, which can be challenging to apply in

practical conditions. While having a comprehensive theoretical background is essential, there remains a gap in the future development of agility assessment.

Even though agility enhancement is essential for every market competitor, there is a lack of comprehensive studies focusing on the Slovak woodworking industry. This gap in the literature presents a significant opportunity to explore how companies in this sector adapt to changes and manage agility. The woodworking industry, characterized by its reliance on traditional practices and modern technological advancements, faces unique challenges requiring agile responses. Therefore, exploring how companies in this sector adapt to changes and manage agility is essential. In comparing recent research publications and the focus of our study, we identified a gap in the understanding of agile methods by large corporations versus small enterprises. Most papers concentrate on large corporations or technological giants (Edison *et al*., 2022; Moe and Mikalsen, 2020; Alqudah and Razali, 2016), but the real competition primarily consists of many small and medium-sized enterprises (SMEs). More than 99.7% of companies in the Slovak woodworking industry are classified as SMEs.

To address the gaps mentioned above, our study focuses on a set of key research questions aimed at deepening our understanding of agility within a specific Slovak woodworking enterprise:

- How does the selected woodworking enterprise perceive its current level of agility, and what challenges does it face in enhancing its agility?
- Which specific agility factors and dimensions are most critical to the selected enterprise?
- How effective are the current change management practices within the selected enterprise in addressing market challenges?

These questions will guide the research methodology, focusing on structured interviews and questionnaires to gather in-depth insights into the agility practices of the Slovak woodworking enterprise. This approach helps identify the company's strengths in agility and areas for potential improvement, allowing us to recommend adjustments that balance traditional and agile methodologies. The study aims to comprehensively assess the overall agility and provide actionable recommendations for enhancing agility and achieving a competitive edge in the analyzed company.

MATERIALS AND METHODS

This study evaluated the approach to agility in a woodworking company by employing a multi-faceted data collection process, including structured interviews, an analysis of agility practices via a questionnaire, and a diagnostic test of agility evaluated in the study. These methods were chosen to comprehensively assess the company's agility across multiple dimensions, ensuring a holistic understanding of its practices and challenges. The methodology aligns with the proposed assessment framework, which combines established theoretical models of agility with practical evaluation tools. This approach addresses the research questions, focusing on identifying the company's agility level, key factors influencing it, and strategies for improvement. The chosen company, a small-sized enterprise with up to 50 employees, has been producing construction and carpentry products for 25 years. Its size and long-term operations make it a suitable case study to validate the proposed methodology, as it provides a clear context for examining the interplay between traditional practices and agility requirements. Data sources included direct insights from the

owners and information from the company's annual reports, ensuring the relevance and accuracy of the analysis.

Assessment framework

The Agility Maturity Model (AMM) used in this study was developed by integrating insights from established frameworks and models discussed in the literature. Heng (2006) provided foundational ideas with an index system for measuring agility. This approach inspired the inclusion of structured levels in our model to evaluate agility comprehensively. Building on Heng's concept, Schmitt *et al.* (2019) reviewed 14 Agile Maturity Models (AMMs) and emphasized the value of frameworks that balance theoretical rigor with practical applicability. Their recommendation of the AMM model by Patel and Ramachandran, based on Capability Maturity Model Integration (CMMI), reinforced the importance of incorporating detailed maturity levels to capture nuanced agility stages. We adopted this principle by structuring our model into five levels, ensuring precision and flexibility in assessing organizational adaptability. Carvalho *et al.* (2019) contributed additional inspiration with a modified CMMI-based model, introducing finer subdivisions within early maturity levels to provide a granular understanding of initial agility adoption. This directly influenced our decision to break down the "Agility Awakening" stage into lower and middle ranges, enabling a more detailed evaluation of early-stage agility.

By synthesizing these inspirations, our **custom-designed Agility Maturity Model** bridges theoretical foundations with practical needs, ensuring its relevance for small enterprises like the woodworking company examined in this study. The dimensions assessed include:

1. *Organization*: focuses on the company's ability to create flexible structures, leadership and decision-making that support agility.
2. *Strategy:* evaluates how strategic planning, goals and strategy encourages agile practices.
3. *Processes and systems*: analyses the efficiency and adaptability of core operational processes.
4. *Customer engagement and responsiveness*: Measures the company's ability to respond to changing customer needs and preferences.
5. *Products and services*: assesses the company's commitment to innovation and ongoing improvement in products and services.
6. *Culture of change*: evaluates how the company is ready and open to changes, its ability and willingness to take risks.
7. *Employee Development and Collaboration*: focuses on the ability of employees to collaborate and develop skills that contribute to organizational agility.

Each dimension is broken down into five maturity levels, ranging from Zeroth to Fourth Level, providing a detailed framework for assessing the company's agility

0. ***Agility Ignorance (0%)***: No agile principles are applied, and processes are unsystematic.
1. ***Agility Awakening – low agility (1% to 25%)***: Awareness of agile principles begins, but decision-making is slow, and structures are rigid.
2. ***Agility Understanding – middle agility (26% to 50%)***: Basic agile practices are implemented with some adaptability, but not fully integrated across the company.
3. ***Agility Integration – high agility (51% to 84%)***: Agile principles are integrated throughout the organization, enabling fast decision-making and effective adaptation to change.

4. ***Agility Excellence (85% to 100%)***: The company continuously optimizes agile practices using data and proactively anticipates market trends.

Methods of data collection

Structured interviews are a systematic method for collecting consistent and detailed data, often used to explore organizational dynamics (Kallio *et al.,* 2016). In this study, interviews with the company's owners focused on their agility challenges and strategies. Inspired by Srivastava *et al.* (2023), who explored digital agility in higher education, this method was adapted to the business context, aligning questions with the research objectives to gather insights into key agility dimensions. The aim was to understand how the company handled challenges arising from the COVID-19 crisis and subsequent economic disruptions. The interview comprised 14 questions organized into three main areas:

- Obstacles and Challenges: identify key barriers faced during the crisis.
- Realized Solutions: explore measures implemented to overcome these challenges.
- Reached results: the impact of the solutions on core business processes and financial results.

Agility assessment questionnaire was designed to evaluate the company's attitude, perception, and application of agility across its operations. It was completed by the company's two owners and all five managers, totaling seven respondents, ensuring comprehensive input from key decision-makers and operational leaders. The questionnaire consisted of two sections: General Company Information (questions A - E) and the Agile Practices Survey (questions 1 - 15), which focused on assessing the adoption of agile methodologies, identifying practices implemented in various departments, and evaluating the company's overall commitment to agility. This method draws inspiration from Looks et al. (2021), who developed a standardized questionnaire for measuring team-level agility, and Bottani (2009), who used case studies in two manufacturing companies to reveal the perception of agility drivers, attributes, enablers, and their corresponding degree of implementation. These sources guided the structure and content of the questionnaire, ensuring a detailed and relevant evaluation aligned with theoretical frameworks.

Diagnostic test aimed to evaluate specific elements of agility within the company by examining 35 items across seven dimensions. Each question offered two possible responses, reflecting either agile or non-agile characteristics. The choices were designed so that both options appeared equally valid. This approach was inspired by Salama and Said (2023), who developed a detailed questionnaire to assess agility in modular and offsite construction firms. Their tool covered 48 attributes across four categories, allowing participants to identify agile and non-agile practices. Drawing on this methodology, the diagnostic test was designed to provide a comprehensive analysis of the company's agility level, ensuring alignment with established theoretical frameworks.

Data analysis and evaluation

Structured interview**:** analysis of the responses to assess how the company adapted to the COVID-19 crisis and subsequent economic challenges and proved the ability to be agile. The methods of content analysis and Term Frequency-Inverse Document Frequency (TF-IDF) analysis were applied. The analysis aimed to identify the most significant terms and themes within the text, with a focus on key areas such as the impact of the crisis, the company's response measures, and the challenges faced. In our analysis, the selection by excluding common words (pronouns, adverbs, and so on) was refined. The remaining keywords were grouped and analyzed, reflecting the company's strategies and actions in

response to the challenges posed by the pandemic. By eliminating common stopwords and non-informative terms, the analysis was able to highlight the most relevant words that reflect the core issues addressed by the company during this period.

Agility Assessment Questionnaire was used analyze responses to determine how the company views its agility through their classification into "agile" and "non-agile" categories by comparing responses to predefined agile practices. The scale-based answers to questions enable assessing the agility level in each dimension using the scoring method and summarizing the company's perspective on agility. These insights complement the company's self-perception of agility.

***Diagnostic test*:** a scoring method based on relative frequencies of agile versus non-agile answers. Calculating the company's overall agility level, categorizing it into one of four levels: low, medium, high, or excellence within the agility maturity model.

Cross-analysis and verification were used to compare the qualitative insights from the structured interview with the results from the agility assessment questionnaire to identify any discrepancies between the company's perception of agility and its actual practices during the crisis. Cross-checking the findings from the perception analysis and qualitative interviews with the objective results from the diagnostic test was made to ensure consistency and accuracy in the company's agility assessment.

Final evaluation and agility level determination were performed by combining the results from all three questionnaires to determine the company's final agility level and identify areas where the company excels and where improvements are needed, based on both qualitative and quantitative data.

RESULTS AND DISCUSSION

Analysis of the structured interview

The Term Frequency-Inverse Document Frequency (TF-IDF) analysis was conducted on the responses provided by the company regarding their experiences during the coronavirus crisis. The analysis aimed to identify the most significant terms and themes within the text. The analysis revealed that the terms "coronavirus," "crisis," "company," "measures," and "business" were among the most significant, indicating a strong focus on the company's operational challenges and strategic responses during the pandemic. The inclusion of "3D printing" as a unified term underscores the importance of innovation and adaptability in the company's strategy. The frequent mention of "employees," "safety," and "health" reflects the prioritization of workforce well-being during the crisis. Overall, the results suggest that the company successfully navigated the challenges of the pandemic by implementing significant operational measures, emphasizing employee safety, and leveraging new technologies to maintain business continuity.

A content analysis of responses to questions 1 through 14 was conducted. The results were grouped into three main areas:

- ***Obstacles and Challenges***: during the COVID-19 pandemic and the period of high inflation, the company faced significant challenges, including *supply chain disruptions* that affected operations, *rising operating costs* due to inflation, and pressure to raise prices while maintaining competitiveness. The need to *protect employee health* and *business continuity* added complexity, as the company worked to ensure both safety and operational flow. Additionally, inflationary pressures further strained financial stability, with sharp increases in input material, energy, and service costs.

- ***Realized Solutions:*** the company implemented *operational adjustments* by reorganizing work processes with a two-shift system and enhanced sanitation to protect employees while ensuring production continuity. Through *budget optimization*, the company improved efficiency, renegotiated supplier contracts, and adjusted pricing to balance competitiveness with rising costs. To ensure financial resilience, the company *bolstered reserves, revised investment* plans, and maintained clear communication with employees. Lastly, *digital transformation* efforts enhanced digital channels and adopted new technologies to engage customers and partners amid restricted in-person interactions.
- ***Reached Results***: achieved Revenue Growth, increasing from €1.57 million in 2019 to €1.98 million in 2022. Profitability also improved, with profits rising from €29,500 to €32,800, driven by strategic cost management and pricing. The company's Gross Margin saw a boost, with ROS reaching 38.5%, reflecting enhanced efficiency. While Debt Management led to a slight dip in ROE, the debt ratio was reduced to 51.5%, ensuring financial stability. Non-financial positive outcomes include enhanced flexibility, improved team collaboration, optimized processes, and a stronger focus on sustainability. Overall, the company's adaptability contributed to the company's resilience and competitive position in the market..

Analysis of the Agility Assessment Questionnaire

Attitude and self-perception of agility

The enterprise under study perceives agility as important to keep up with competitors and retain customers. It perceives several barriers to being agile, such as complex bureaucracy that slows down decision-making, lack of quality staff and competition. The level of agility achieved is rated as high by the enterprise, which means that it is usually able to adapt in a timely manner.

Self-assessment of the agility level

Organization - agility level 1: the company primarily uses traditional management structures and decision-making, showing low to medium organizational agility, where agile practices are recognized but not fully implemented.

Strategy - agility level 2: the firm shows medium agility, adapting to market changes while maintaining a structured, gradual approach. Agile strategies are present but not fully integrated across all processes.

Change Culture - agility level 3: the company shows high agility with a positive attitude towards change, supporting continuous improvement and experimentation, though full agility across all dimensions hasn't been achieved yet.

Processes and Technology - agility level 0: the company exhibits the lowest agility, with limited flexibility and slow adoption of technologies like automation and data-driven decision-making, as traditional processes remain dominant.

Products and Services - agility level 2: the company shows a balance between traditional product development cycles and responsiveness to market needs, suggesting some agility in how it handles innovations and customer requirements. Medium agility, as there is recognition of agile principles, but they are not fully integrated across all product development phases.

Customer Orientation - agility level 2: the firm places significant emphasis on customer feedback and adapts its processes based on customer needs, which aligns with agile methodologies. Medium to high agility, depending on how systematically customer insights are incorporated into decision-making.

Human Resources and Teamwork - agility level 4: there is a strong focus on teamwork, autonomy, and continuous learning, which are key agile principles. The company promotes a collaborative environment with decision-making autonomy at team levels. Agility Excellence, indicating a well-integrated agile approach to human resource management.

Overall Agility Assessment: Considering the varying levels across dimensions, the company's overall agility can be classified as medium (***Level 2 – Agile Understanding***). The company has adopted several agile practices and principles but is still in the process of fully integrating them across all departments and processes. The next steps towards higher agility would involve more systemic adoption of agile methodologies in their organizational structure, decision-making, and processes.

Analysis of the Diagnostic Test

Each question in the diagnostic test has either an agile or a non-agile (traditional) answer. We assigned a score of 1 for agile answers and 0 for non-agile ones. After calculating the total score for each area, we computed the relative frequency (RF) by dividing the number of agile answers by the total number of questions for each dimension. This RF gives us a percentage of agile practices implemented in each dimension and the agility level can be detected. The results are shown in Table 1.

Tab. 1 Agility assessment by diagnostic test.

Agility Dimension	Total questions	Agile answers	RF	Agility level
Organization	6	5	83.33%	3 - high
Strategy	8	2	25.00%	1 - low
Culture Change	4	3	75.00%	3 - high
Processes / Technologies	5	0	0.00%	0 - none
Products + Services	4	2	50.00%	2 - medium
Customers	4	1	25.00%	1 - low
Human Resources	6	6	100.00%	4 - excellent
Overall Agility	37	19	51.35%	**3 - high**

The results in Table 1 show that the biggest space to building agility is in the dimensions of process/technology, strategy and customer orientation, especially in meeting the changed requirements for the company's products and services.

Cross – analysis

Organization: the previous self-assessment indicated low agility, reflecting the company's view of itself as still developing. However, the diagnostic test results reveal agility integration, highlighting a gap between self-perception and actual practices. This suggests a modest initial self-assessment.

Strategy: a low agility score in the diagnostic test contrasts with the self-assessed medium level, indicating that the company's strategic agility may be more traditional than initially perceived.

Culture Change: a high agility score is consistent in both evaluations regarding embracing change and innovation.

Processes / Technologies: both assessments confirmed a zero score, which indicates no agility in processes and technology adoption.

Products + Services: a medium agility score aligns with both evaluations of balancing traditional and agile practices.

Customers: a low agility score in diagnostic tests contrasts with a medium-to-high self-assessment, revealing that agility in customer-facing processes may be more limited than previously thought.

Human Resources: the company's highly agile human resource practices are confirmed by an excellent agility score consistent in both assessments.

As for overall agility, the company perceives it at a high level, which was confirmed in diagnostic test. However, a self-assessment through questionnaire showed a lower, medium level as the integration of agile principles across all dimensions is not completed.

The comparison of the agility level self-assessed and tested is depicted in Fig. 1.

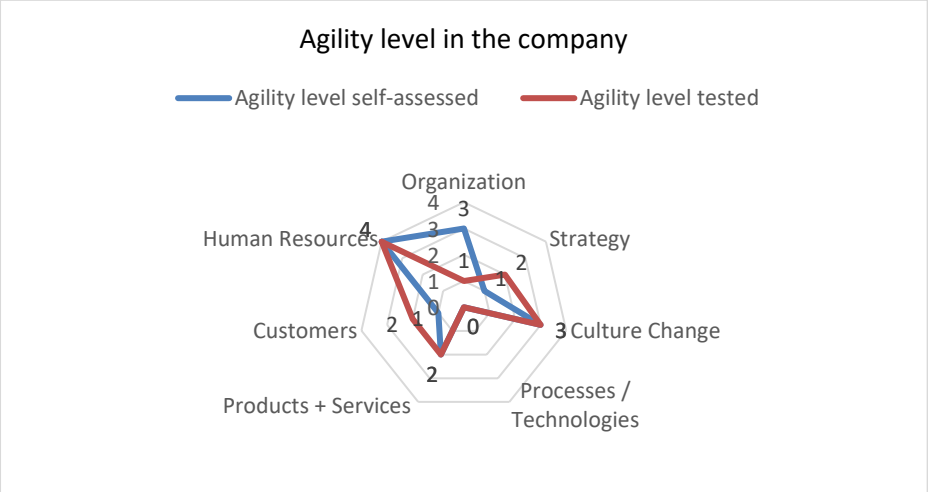

Fig. 1 Comparison of agility assessments in the company.

Identification of agility weak areas and recommendations

One area where an agile approach is absent in the surveyed enterprise is in processes and technology, which includes elements such as process management, automation, flexibility, the time required for changes and optimization, and the integration of information systems. Additionally, significant gaps were found in the strategy dimension, encompassing managing continuity and change simultaneously, building relationships with external stakeholders, resource mobility, engagement, responsiveness to environmental changes through goals and strategies, and the scope of planning. Weaknesses also appeared in the customer focus dimension, including elements such as monitoring feedback, tracking customer needs and requirements, measuring customer satisfaction, and prioritizing customer value orientation.

To enhance agility and achieve a competitive edge, the enterprise should consider the following actionable recommendations:

Continuous process improvement: Adopt lean and six sigma practices to eliminate waste and inefficiencies. Implement Kaizen to encourage small, incremental improvements involving all employees. *Specific Impact:*

- Shortened production cycles and lower operational costs through streamlined workflows.
- Improved employee productivity and morale, as workers actively contribute to continuous improvement.
- Faster adaptability to process disruptions or inefficiencies, reducing downtime by 20-30%.

Continuous improvement processes (CIP) significantly enhance efficiency and reduce operational costs. Schuh et al. (2019) demonstrated that CIP shortens production cycles and

reduces operational costs by using predictive models to optimize workflows, while empowering employees to innovate increases productivity. Wongsomboon et al. (2023) showed a 14% reduction in production cycle times and cost savings through waste elimination and production line balancing. Furthermore, Beraldin et al. (2020) emphasized that involving employees in continuous improvement initiatives improves product quality, cost efficiency, and responsiveness, while enhancing morale and organizational outcomes.

Technology Integration: Invest in digital tools like cloud computing, big data analytics, and AI-driven decision-making. Utilize agile project management tools for adaptive and efficient execution. *Specific Impact:*

- Real-time data processing leads to faster (up to 50%) decision-making.
- Increased production accuracy and reduced errors due to AI-driven insights and automation.
- Scalable operations allow the company to handle a 15-20% increase in customer demand without additional overhead costs.

The integration of advanced technologies enhances real-time responses to market dynamics and operational efficiency. Schuh et al. (2019) highlighted how predictive analytics optimizes workflows, providing actionable insights for decision-making and streamlining processes. Azizi (2015) demonstrated that technological upgrades, such as SPC, enhance productivity by reducing errors and machine downtime. Digital tools like agile project management software ensure adaptive planning and execution, while automation improves scalability and responsiveness to customer needs.

Strategic Agility: Develop flexible strategic plans to respond to future scenarios and diversify supply chains to minimize dependency on single sources. *Specific Impact:*

- Enhanced resilience to supply chain disruptions, potentially reducing material shortages by 40-50%.
- Greater strategic alignment with market trends, leading to sustained market presence during volatile periods.
- Improved profitability through better resource allocation and minimized operational risks.

Strategic agility enhances resilience by enabling businesses to adapt to changes rapidly and effectively. Wongsomboon *et al.* (2023) illustrated the benefits of strategic flexibility in reducing inefficiencies and minimizing disruptions in production cycles. Schuh *et al.* (2019) emphasized how prescriptive analytics can align strategic plans with dynamic market demands, ensuring agile and informed decision-making. Diversifying supply chains and reducing reliance on single sources further mitigate risks and enhance continuity during crises.

Customer-Centric Innovation: Engage customers in the innovation process via feedback loops, beta testing, and pilot programs. Use agile methodologies to rapidly develop and test products. *Specific Impact:*

- A 25-30% improvement in customer satisfaction due to more tailored products/services.
- Faster time-to-market for new offerings (by up to 40%), ensuring a competitive advantage.
- Increased revenue streams from co-created products, with higher customer retention rates.

A focus on customer-centric innovation strengthens product-market alignment and customer satisfaction. Beraldin *et al.* (2020) highlighted that engaging customer in continuous improvement processes enhances quality and responsiveness, directly benefiting organizational outcomes. Schuh *et al.* (2019) reinforced the value of feedback-driven

innovation, which ensures products and services remain relevant to evolving customer needs. Agile methodologies, such as rapid prototyping, allow for quick testing and refinement, reducing time-to-market and improving competitiveness.

Agility Metrics and Assessment: Regularly assess agility to identify gaps and track progress. Use key performance indicators (KPIs) such as time-to-market, customer satisfaction, and innovation rates. *Specific Impact:*

- Improved alignment of processes with strategic objectives, increasing overall efficiency by 15-20%.
- Measurable improvements in agility-related outcomes, enabling data-driven decision-making.
- Enhanced competitiveness by maintaining a consistent focus on operational and strategic agility.

Regular evaluation of agility provides actionable insights for organizational improvement. Schuh *et al.* (2019) demonstrated how prescriptive analytics can track key performance indicators (KPIs), such as time-to-market and customer satisfaction, ensuring alignment with strategic goals. Beraldin *et al.* (2020) emphasized that monitoring progress fosters a culture of continuous improvement, enhancing both organizational responsiveness and employee morale. Metrics-driven assessments also support resource optimization and long-term growth by identifying and addressing agility gaps.

Discussion

The methods and tools we employed to assess agility, such as the structured questionnaire divided into general company information and agile practices, align closely with approaches documented in prior studies. For example, Looks *et al.* (2021) developed a standardized questionnaire to measure team-level agility, focusing on dimensions like communication, iteration, and adaptability. Our approach also incorporates similarly structured questionnaires, emphasizing agile and non-agile traits, ensuring consistency with established tools in the field. Additionally, the diagnostic framework we applied shares similarities with Wendler's (2014) Organizational Agility Maturity Model, which systematically evaluates agility across multiple dimensions to identify improvement areas.

Our findings highlight a strong link between agile practices applied to Human Resources and the firm’s ability to adapt to unexpected changes, such as COVID-19, corroborating the outcomes of similar research. Agile HR strategies focusing on remote work, employee well-being, and flexible management practices played a crucial role in enabling organizations to navigate the unpredictable challenges of the pandemic (Plater *et al.*, 2022). Tseng and Lin (2011), for instance, identified key drivers of agility: responsiveness, competency, flexibility, and quickness and demonstrated their importance in enhancing organizational adaptability.

The alignment of our approach with these studies underscores its validity and applicability. By comparing our methods and findings, it becomes evident that our study not only confirms existing knowledge but also offers unique insights into agility assessment in the woodworking industry. This comparison highlights the robustness and transferability of our methodology.

CONCLUSION

The study confirmed that using an agile approach helped the surveyed company achieve financial stability and survival during the pandemic crisis. By implementing flexible

work models, workforce agility has increased, ensuring continuity during the pandemic and future adaptability. Leadership and culture play key roles, with swift decision-making, transparent communication, and high morale. At the same time, stable financial performance and operational continuity suggest agility metrics and assessment, indicating mechanisms to evaluate agility.

Our aim was to evaluate the agility level achieved in the chosen woodworking company. The diagnostic test offered an objective perspective of the company's agility compared to the self-assessment methods, which included the structured interview and agility assessment questionnaire. While the Organization has progressed to agility integration, the Strategy has revealed a lower agility score than previously perceived. Culture Change retains high agility, but Processes/Technologies confirm minimal agility. Products and Services align with medium agility, though Customers score lower than expected. Human Resources remains consistently excellent in agility. Overall, the results point to both progress and areas for improvement.

The company's financial results (2019–2022) showed revenue growth of €0.41 million and a €3,300 profit increase, driven by agility improvements in organizational structure and human resources. A 38.5% ROS and improved gross margin reflect strong performance. However, lower agility in Strategy and customer focus suggests room for further growth to stay competitive and financially stable. The detected non-agile dimension of processes and technology requires the most attention and implementation of agile principles. Adaptive, continually improved processes, digitization, and intelligent technologies are the path to increased agility.

Overall, the company has successfully addressed many areas of agility enhancement, contributing to its resilience and ability to navigate the challenges posed by the COVID-19 pandemic and subsequent economic disruptions. By implementing the suggested recommendations, the woodworking enterprise can enhance its agility, better navigate market complexities, and gain a competitive advantage in its respective industries.

REFERENCES

Alqudah, M., Razali, R., 2016. A Review of Scaling Agile Methods in Large Software Development. International Journal on Advanced Science, Engineering and Information Technology 6, 828-837. https://doi.org/10.18517/IJASEIT.6.6.1374

Alzoubi, H., Elrehail, H., Hanaysha, J., Al-Gasaymeh, A., Al-Adaileh, R., 2022. The Role of Supply Chain Integration and Agile Practices in Improving Lead Time During the COVID-19 Crisis. Int. J. Serv. Sci. Manag. Eng. Technol., 13, 1-11. https://doi.org/10.4018/IJSSMET.290348

Arteta, B., & Giachetti, R., 2004. A measure of agility as the complexity of the enterprise system. Robotics and Computer-integrated Manufacturing, 20, 495-503. https://doi.org/10.1016/J.RCIM.2004.05.008

Ashrafi, A., Ravasan, A., Trkman, P., Afshari, S., 2019. The role of business analytics capabilities in bolstering firms' agility and performance. Int. J. Inf. Manag., 47, 1-15. https://doi.org/10.1016/J.IJINFOMGT.2018.12.005

Azizi, A., 2015. Evaluation Improvement of Production Productivity Performance using Statistical Process Control, Overall Equipment Efficiency, and Autonomous Maintenance. Procedia Manufacturing, 2, 186-190. https://doi.org/10.1016/J.PROMFG.2015.07.032

Badakhshan, P., Conboy, K., Grisold, T., Brocke, J., 2019. Agile business process management: A systematic literature review and an integrated framework. Bus. Process. Manag. J., 26, 1505-1523. https://doi.org/10.1108/bpmj-12-2018-0347

Beck, K., Beedle, M., van Bennekum, A., Cockburn, A., Cunningham, W., Fowler, M., Grenning, J., Highsmith, J., Hunt, A., Jeffries, R., Kern, J., Marick, B., Martin, R., C., Mellor, S.,

Schwaber, K., Sutherland, J., Thomas, D., 2001. The Agile Manifesto. Agile Alliance. http://agilemanifesto.org/

Beraldin, A., Danese, P., Romano, P., 2020. Employee involvement for continuous improvement and production repetitiveness: a contingency perspective for achieving organisational outcomes. Production Planning & Control, 33, 323 - 339. https://doi.org/10.1080/09537287.2020.1823024

Berthot, B., 2023. Agile Supply Chain Management Theories, Empirical Data, and Future Directions. InSITE, 15 p. https://doi.org/10.28945/5153

Bottani, E., 2009. On the assessment of enterprise agility: issues from two case studies. International Journal of Logistics Research and Applications, 12, 213 - 230. https://doi.org/10.1080/13675560802395160

Carvalho, A., Sampaio, P., Rebentisch, E., 2019. On Agile Metrics for Operations Management: Measuring and Aligning Agility with Operational Excellence. 2019 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM), 1601-1605. https://doi.org/10.1109/IEEM44572.2019.8978806

Chacko, E., Suresh, M., 2021. Assessment of Start-Up Agility Using Multi-grade Fuzzy and Importance Performance Analysis. In: Kumaresan, G., Shanmugam, N.S., Dhinakaran, V. (eds) Advances in Materials Research. ICAMR 2019. Springer Proceedings in Materials, vol 5. Springer, Singapore, 685-694. https://doi.org/10.1007/978-981-15-8319-3_68

Chakravarty, K., Singh, J. A., 2024. dissection of agile software development in changing scenario and the sustainable path ahead. Int J Syst Assur Eng Manag 15, 2606–2622. https://doi.org/10.1007/s13198-024-02283-1

Christopher, M., 2000. The agile supply chain: Competing in volatile markets. Industrial Marketing Management, 29(1), 37-44. https://doi.org/10.1016/S0019-8501(99)00110-8

Couto, E., Lopes, M., Sousa, R., 2015. Can IS/IT Governance Contribute for Business Agility?. , 1099-1106. https://doi.org/10.1016/J.PROCS.2015.08.565

DeGroote, S., Marx, T., 2013. The impact of IT on supply chain agility and firm performance: An empirical investigation. *Int. J. Inf. Manag.*, 33, 909-916. https://doi.org/10.1016/j.ijinfomgt.2013.09.001

Diego, S. S., Ghezzi, A., Barbosa de Aguiar, R., Marcelo, N. C., Schwengber, C., 2020. Lean startup, agile methodologies and customer development for business model innovation: A systematic review and research agenda. [Business Model Innovation] International Journal of Entrepreneurial Behaviour & Research 26(4), 595-628. https://doi.org/10.1108/IJEBR-07-2019-0425

Edison, H., Wang, X., Conboy, K., 2022. Comparing Methods for Large-Scale Agile Software Development: A Systematic Literature Review. IEEE Transactions on Software Engineering 48, 2709-2731. https://doi.org/10.1109/TSE.2021.3069039

Fertalj, K., Matejas, M., 2015. Using Agility in Building Business Process Management Solutions. International Journal of Industrial and Systems Engineering 9, 3826-3832.

Ganguly, A., Nilchiani, R., Farr, J., 2009. Evaluating agility in corporate enterprises. International Journal of Production Economics 118, 410-423. https://doi.org/10.1016/J.IJPE.2008.12.009

Gergin, Z., Çolak, E., Kayalar, M., Yavaşoğlu, C., 2022. A New Organizational Agility Assessment Approach Applied in the Logistics Industry. Journal of Business Research – Turk 14(2), 1129-1147. https://doi.org/10.20491/isarder.2022.1431

Girod, S. J. G., Birkinshaw, J., Prange, C., 2023. Business agility: Key themes and future directions. *California Management Review, 65*(5), 5-21. https://doi.org/10.1177/00081256231186641

Gren, L., Torkar, R., Feldt, R., 2015. The prospects of a quantitative measurement of agility: A validation study on an agile maturity model. Journal of Systems and Software 107, 38-49. https://doi.org/10.1016/j.jss.2015.05.008

Imgrund, F., Janiesch, C., 2019. Understanding the Need for New Perspectives on BPM in the Digital Age: An Empirical Analysis. Di Francescomarino, C., Dijkman, R., Zdun, U. (eds) Business Process Management Workshops. BPM 2019. Lecture Notes in Business Information Processing, vol 362. Springer, Cham. https://doi.org/10.1007/978-3-030-37453-2_24

Kallio, H., Pietilä, A., Johnson, M., Kangasniemi, M., 2016. Systematic methodological review: developing a framework for a qualitative semi-structured interview guide. Journal of advanced nursing, 72 12, 2954-2965. https://doi.org/10.1111/jan.13031

Kock, A., Gemünden, H., 2016. Antecedents to decision-making quality and agility in innovation portfolio management. Journal of Product Innovation Management, 33, 670-686. https://doi.org/10.1111/JPIM.12336

Kumar, A. K. R., Dhas, J. E. R., 2023. Improving supplier performance and strategic sourcing decisions by integrating jobshop scheduling, inventory management and agile new product development. Journal of Global Operations and Strategic Sourcing 16(2), 456-491. https://doi.org/10.1108/JGOSS-06-2022-0047

Larson, D., 2019. A Review and Future Direction of Business Analytics Project Delivery. In: Anandarajan, M., Harrison, T. (eds) Aligning Business Strategies and Analytics. Advances in Analytics and Data Science, vol 1. Springer, Cham. https://doi.org/10.1007/978-3-319-93299-6_7

Leroux, K., Wright, N., 2010. Does Performance Measurement Improve Strategic Decision Making? Findings From a National Survey of Nonprofit Social Service Agencies. Nonprofit and Voluntary Sector Quarterly - NONPROFIT VOLUNT SECT Q. 39. 571-587. 10.1177/0899764009359942

Looks, H., Fangmann, J., Thomaschewski, J., Cuaresma, M., Schön, E., 2021. Towards a Standardized Questionnaire for Measuring Agility at Team Level. , 71-85. https://doi.org/10.1007/978-3-030-78098-2_5

Looks, H., Fangmann, J., Thomaschewski, J., Cuaresma, M., Schön, E., 2021. Towards a Standardized Questionnaire for Measuring Agility at Team Level. In: Gregory, P., Lassenius, C., Wang, X., Kruchten, P. (eds) Agile Processes in Software Engineering and Extreme Programming. XP 2021. Lecture Notes in Business Information Processing, vol 419. Springer, Cham., 71-85. https://doi.org/10.1007/978-3-030-78098-2_5

Mahapatra, M. S., Shenoy, D., 2021. Lean maintenance index: A measure of leanness in maintenance organizations. Journal of Quality in Maintenance Engineering 28(4), 791-809. https://doi.org/10.1108/jqme-08-2020-0083

Milenković, M., Lalic, B., Pavlovic, K., Beric, I., Šobajić, V., 2019. Comparison of traditional and agile approach to manage product development projects. In: Proceedings of the 5th IPMA SENET Project Management Conference. https://doi.org/10.2991/senet-19.2019.8

Moe, N., Mikalsen, M., 2020. Large-Scale Agile Transformation: A Case Study of Transforming Business, Development and Operations. Agile Processes in Software Engineering and Extreme Programming 383, 115 - 131. https://doi.org/10.1007/978-3-030-49392-9_8

Narasimhan, R., Swink, M., Kim, S., 2006. Disentangling leanness and agility: An empirical investigation. Journal of Operations Management 24, 440-457. https://doi.org/10.1016/J.JOM.2005.11.011

Oosterhout, M., Waarts, E., Hillegersberg, J., 2006. Change factors requiring agility and implications for IT. European Journal of Information Systems, 15, 132-145. https://doi.org/10.1057/palgrave.ejis.3000601

Papadopoulos, G., 2015. Moving from traditional to agile software development methodologies also on large, distributed projects. Procedia - Social and Behavioral Sciences 175, 455-463. https://doi.org/10.1016/J.SBSPRO.2015.01.1223

Perides, M. P. N., Barrote, E. B., Sbragia, R., 2021. The competencies of project managers working with agile and traditional approaches: a comparative study. Revista De Gestão E Projetos 12(1), 11–38. https://doi.org/10.5585/gep.v12i1.17534

Plater, Q., Frazier, M., Talbert, P., Davis, V., Talbert, P., 2022. Human Resources Strategies & Lessons Learned During the COVID-19 Pandemic: A Literature Review. Management Dynamics in the Knowledge Economy, 10, 330 - 342. https://doi.org/10.2478/mdke-2022-0021

Rathod, G., Puranik, V., Hiremath, V., 2019. Developing agility system in supply chains. International Journal of Business and Systems Research 13(2), 15. https://doi.org/10.1504/IJBSR.2019.10018715

Rdiouat, Y., Bahsani, S., Lakhdissi, M., Semma, A., 2021. Measuring and improving information systems agility through the balanced scorecard approach. International Journal of Computer Science Issues (IJCSI) 12(5), 58. https://doi.org/10.48550/arXiv.2109.07281

Schmitt, A., Theobald, S., Diebold, P., 2019. Comparison of Agile Maturity Models. In: Franch, X., Männistö, T., Martínez-Fernández, S. (eds) Product-Focused Software Process Improvement. PROFES 2019. Lecture Notes in Computer Science, vol 11915. Springer, Cham., 661-671. https://doi.org/10.1007/978-3-030-35333-9_52

Schuh, G., Prote, J., Busam, T., Lorenz, R., Netland, T., 2019. Using Prescriptive Analytics to Support the Continuous Improvement Process. In: IFIP International Conference on Advances in Production Management Systems, book series, 46-53. https://doi.org/10.1007/978-3-030-30000-5_6

Shafiabady, N., Hadjinicolaou, N., Din, F., Bhandari, B., Wu, R., Vakilian, J., 2023. Using Artificial Intelligence (AI) to predict organizational agility. PLOS ONE 18(5), e0283066. https://doi.org/10.1371/journal.pone.0283066

Shpak, Y., Ilnytskyi, V., Andrukhiv, I., 2023. Comparative characteristics of lean- and agile-methodology of supply chain management under uncertainty. Scientific opinion: Economics and Management 3(83), 64-71. https://doi.org/10.32782/2521-666x/2023-83-9

Srivastava, A., Yadav, M., Yadav, R., Singh, B., Dewasiri, N., 2023. Exploring Digital Agility and Digital Transformation Leadership. Journal of Global Information Management. https://doi.org/10.4018/jgim.332861

Tamtam, F., Tourabi, A., 2019. Agile capabilities in Moroccan companies: Criteria and practices. 2019 4th World Conference on Complex Systems (WCCS), 1-6. https://doi.org/10.1109/ICoCS.2019.8930721

Tseng, Y., Lin, C., 2011. Enhancing enterprise agility by deploying agile drivers, capabilities and providers. Inf. Sci., 181, 3693-3708. https://doi.org/10.1016/j.ins.2011.04.034

Vasanthan, P., Suresh, M., 2021. Assessment of organizational agility in response to disruptive innovation: a case of an engineering services firm. International Journal of Organizational Analysis 30(6), 1465-1475. https://doi.org/10.1108/IJOA-09-2020-2431

Walter, A., 2020. Organizational agility: ill-defined and somewhat confusing? A systematic literature review and conceptualization. Management Review Quarterly 71, 343-391. https://doi.org/10.1007/s11301-020-00186-6

Wang, L., Keshavarzmanesh, S., Feng, H. Y., 2010. A function block based approach for increasing adaptability of assembly planning and control. International Journal of Production Research 49(16), 4903–4924. https://doi.org/10.1080/00207543.2010.501827

Wendler, R., 2014. Development of the organizational agility maturity model. 2014 Federated Conference on Computer Science and Information Systems, 1197-1206. https://doi.org/10.15439/2014F79

Wongsomboon, C., Maneerat, N., Thudthong, J., Sukasem, S., Luangpol, A., 2023. Cycle Time Reduction for Productivity Improvement in an Engine Assembly Industry. 2023 9th International Conference on Engineering, Applied Sciences, and Technology (ICEAST), 89-92. https://doi.org/10.1109/ICEAST58324.2023.10157291

Yu, L., Heng, Z., 2006. Measuring Agility of Enterprise Using Analytic Hierarchy Process and Bayesian Belief Networks. 2006 International Conference on Management Science and Engineering, 551-556. https://doi.org/10.1109/ICMSE.2006.313954

ACKNOWLEDGMENT

The authors are grateful for the support of the Slovak VEGA Agency, the paper is a partial result of the grant scientific project VEGA 1/0333/22 and IPA ESG no. 4/2024.

AUTHORS' ADDRESSES

Ing. Katarína Marcineková, PhD. et Ph.D.
doc. Ing. Andrea Janáková Sujová, PhD.
Ing. Martin Halász
Technical University in Zvolen, Faculty of Wood Sciences and Technology
T. G. Masaryka 24, 960 01 Zvolen, Slovakia
xmarcinekovak@is.tuzvo.sk
andrea.sujova@tuzvo.sk
xhalasz@tuzvo.sk