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TRANSITION OF LPP DISTRIBUTION CENTERS TOWARDS INDUSTRY 5.0. SWOT + MAM ANALYSIS

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Contemporary distribution centers face the challenge of evolving toward operational models aligned with Industry 5.0 principles. To analyze LPP's transformation potential, this study uses SWOT + MAM methodology, which sequentially employs SWOT analysis, Mind Mapping, and Morphological analysis to assess organizational readiness and generate strategic solutions. This article also describes a new, previously almost entirely overlooked proposal to combine the SWOT and MAM methodologies in a single work. The analysis of LPP's current infrastructure reveals significant automation capabilities through cross-belt sorters processing 5,000 packages per hour and the proprietary Control Tower platform enabling real-time supply chain transparency. The company possesses strong foundations in sustainable development, as evidenced by BREEAM Excellent certifications, and experience in green initiatives. Morphological analysis identifies two equivalent transformation pathways: a high-autonomy warehouse system integrating AutoStore technology with renewable energy sources and dedicated cybersecurity infrastructure, and a partially autonomous model featuring AI-enhanced security combined with drone-based logistics and RFID identification systems. Both solutions received identical 22-point evaluations across criteria including novelty, feasibility, rationality, originality, usefulness. These results indicate that the Industry 5.0 transition at LPP focuses primarily on sustainability as its main transformation driver, with organizational resilience in second place, while human-centricity aspects require further development. The SWOT + MAM methodology proves effective in the comprehensive strategic assessment of transition towards Industry 5.0 and in establishing practical frameworks for this process.

Keywords: Industry 5.0, distribution centers, SWOT + MAM methodology, LPP

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1. INTRODUCTION

The contemporary industrial revolution, evolving from automation-driven Industry 4.0 toward the human-centric paradigm of Industry 5.0, presents enterprises with the challenge of integrating digital technologies with human needs. Industry 5.0 transcends the Industry 4.0 concept, instead focusing on three fundamental pillars: human-centricity, sustainability, and resilience (Górny, 2024, p. 45; Pasman, Behie, 2024, p. 202). In terms of warehouse management, this represents a shift from simple automation systems to intelligent ecosystems, where technologies such as the Internet of Things (IoT), artificial intelligence (AI), and cyber-physical systems (CPS) not only serve process optimization but primarily support employee well-being (Adel, Alani, 2024, p. 1740).

A key element of Industry 5.0 transition is achieving synergy between workers and technology. For example, CPS systems are designed to support natural human decision-making processes rather than replace them (Majernik et al., 2022, p. 17). Research indicates that such approaches can increase operational efficiency while simultaneously reducing worker stress and improving engagement. Particular attention is devoted to sustainable development solutions, such as intelligent energy management systems or resource utilization optimization, which not only reduce environmental impact but also create healthier and more comfortable working environments (Murtaza et al., 2024, p. 102935).

Contemporary warehouse management research in the Industry 5.0 context emphasizes the necessity of designing human-oriented systems that harmoniously combine automation with worker well-being (Saharan, Sharma, 2022). A key aspect is creating friendly workspaces, encompassing ergonomic workstations, relaxation zones, and solutions fostering work-life balance. Studies demonstrate that implementing such solutions can reduce sick leave and increase employee satisfaction (Górny, 2024, pp. 50-51).

Modern warehouses evolve toward intelligent warehouse management systems (WMS), where technology serves to support, not replace, humans. Industry 5.0 promotes a collaboration model, where robots and automation systems are designed with the intention of increasing human work comfort (Narkhede et al., 2024, p. 2). Collaborative robots (cobots) play a special role, adapting to the natural pace of human work and supporting tasks requiring precision or physical strength (Pasman, Behie, 2024, p. 206).

A new aspect of Industry 5.0 transition involves concentrating on employee personal development through training programs utilizing VR/AR technologies and e-learning platforms. According to Saharan & Sharma, this can increase new skill acquisition efficiency while simultaneously reducing the stress of adapting to new technologies (Saharan, Sharma, 2022).

The research context presented in this article is the case of LPP enterprise. LPP, as a leading European fast fashion player (Reserved, House, Cropp, Mohito, Sinsay brands), manages a global distribution network encompassing 40 markets and over 1700 physical stores. The company's logistics activities, coordinated by internal operator LPP Logistics, are based on an integrated system of distribution centers (DC) and fulfillment centers (FC) with a total area of 500,000 m² (LPP, 2024).

While extensive research exists on Industry 4.0 implementation in logistics, limited studies examine the human-centric transition toward Industry 5.0 in distribution centers. The present study addresses this gap by proposing a structured methodology for evaluating and planning such transitions.

The main objective of this article is to develop and validate a strategic framework for the human-centric transition of distribution centers toward Industry 5.0 principles, using the SWOT + MAM methodology to provide comprehensive assessment tools for strategic decision-making in warehouse modernization.

According to the authors, sequential application of methods in line with SWOT + MAM methodology facilitates a holistic assessment of technological and organizational conditions, providing tools for strategic decision-making regarding warehouse transition toward Industry 5.0.

2. METHODOLOGY

This study employs the SWOT + MAM methodology, a sequential application of three complementary analytical methods: SWOT analysis, mind mapping, and morphological analysis (fig. 1). The methodology enables systematic evaluation of transition readiness while generating strategic solutions.

Fig. 1. Sequence of methods in the SWOT + MAM methodology

SWOT analysis identifies internal capabilities (Strengths, Weaknesses) and external factors (Opportunities, Threats) (Gurtel, Tat, 2017, pp. 995-996) affecting the implementation of Industry 5.0. Data collection involved analyzing the available sources in terms of LPP's operations and Industry 5.0 technologies applicable in warehouse management. The primary sources for understanding the operations of the enterprise being studied were information available on its website (lpp.com), which includes mostly press releases. The authors were aware that the possibility of bias (especially connected to strengths) creating a positive but false image should be taken into account during the analysis. It is a serious limitation of the study. Therefore, the strengths were chosen which reflect documented technological assets and organizational capabilities, specifically focusing on measurable metrics. Regarding weaknesses, the reliability of the findings was ensured by a deductive approach, in which weaknesses related to Industry 5.0 were cross-referenced and empirically validated against the specific solutions observed in the enterprise in question.

In terms of external factors, articles published in scientific journals devoted to various aspects important for implementing the Industry 5.0 concept dominated. Using virtual databases, the materials given priority in the analysis were those focusing directly on elements of the 4th Industrial Revolution (e.g., general barriers), including its characteristics and paradigms. Data on specific issues (e.g., predictions regarding the development of the energy grid in the study area) were then used. The analysis involved a rigorous evaluation of source credibility based on comparisons with other data, their scientific and research value, and their relevance to the topic in question. Therefore, materials published after 2022 predominate. Efforts were also made to consider the context and appropriateness of using specific information or values for the company and area under examination.

Mind mapping transforms SWOT results into conceptual nodes, identifying relationships between factors and generating additional elements. This visual representation helps identify the key problem dimensions for morphological analysis.

Morphological analysis (Zwicky Method) systematically explores different technological and organizational combinations for implementing Industry 5.0. Using SWOT and mind mapping results, the method creates a morphological matrix enabling various solution variants to be evaluated on a 5-point scale (1 = lowest, 5 = highest) across the following criteria: novelty, feasibility, rationality, originality, and usefulness. In general, the Zwicky Method is an analytical-intuitive method that allows multi-element solutions to be developed in an orderly manner by breaking the problem down into a finite number of sub-problems (Trocki, Wyrozębski, 2014, pp. 30-31; Zwicky, 1971).

The study focused on LPP SA, a company in the apparel industry, specifically on warehouses as part of the supply chain. The analysis encompassed the implementation of innovative solutions for its warehouse, transshipment within the Industry 5.0 framework. Technologies already in use in practice were presented in terms of the proposed solutions. This should be considered one of the fundamental methodological limitations, as this meant the solution presented is based on existing technologies, avoiding highly innovative proposals, which is one of the hallmarks of morphological analysis. This also represents an advantage from the perspective of its practical implementation. Other barriers may include the rapid obsolescence of certain datasets used in the analysis, a heavy reliance on bibliographic and review data, and the highly theoretical nature of the proposed solution, which stems from the absence of company representatives in the study.

From a methodological perspective, this article proposes an innovative combination of methods typically used separately when searching for solutions. Primarily used for situational diagnosis, SWOT analysis combined with mind mapping provides a strong foundation for subsequent morphological analysis, which focuses on developing innovative solutions. The proposed method is firmly rooted in existing realities. At the same time, the work is empirical in nature, discussing a specific example of the method's application in an existing enterprise based on real-world data. According to the authors, the resulting proposals can be implemented in practice. In a broader sense, the work can provide inspiration and guidance for planning the creation and management of warehouses or other facilities within the Industry 5.0 concept.

3. RESEARCH RESULTS

3.1. SWOT analysis results

SWOT analysis identified four key elements in each category (fig. 2) that affect Industry 5.0 implementation.

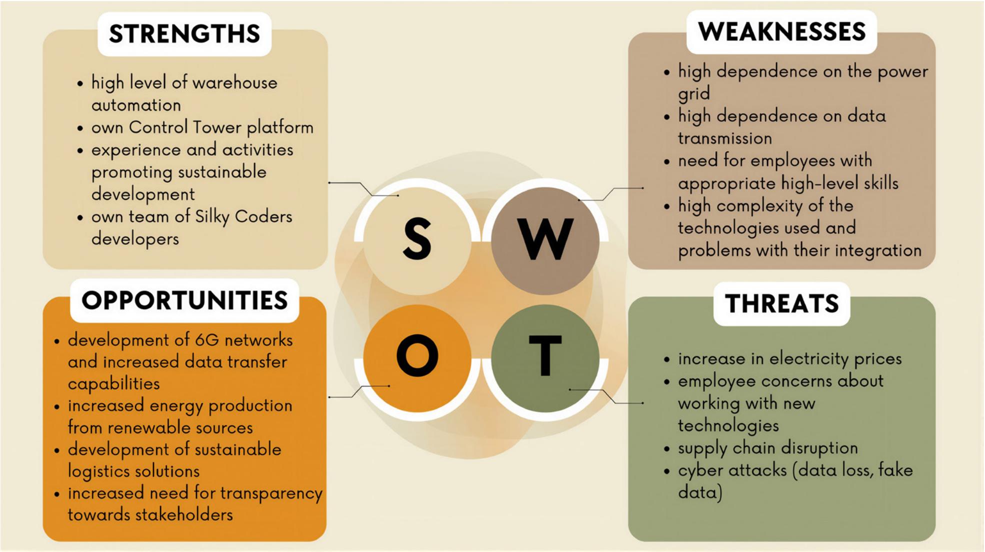

Fig. 2. SWOT analysis results matrix

In the first phase, factors referred to as strengths (S) were examined, i.e., resources currently possessed by the company that could have a beneficial impact on the further implementation of the Industry 5.0 concept. These included:
- high automation level – advanced distribution centers feature automated conveyor lines and cross-belt sorters with 5,000 packages/hour capacity (LPP, 2025);
- Control Tower platform – proprietary platform ensuring supply chain transparency and real-time decision-making capabilities (LPP, 2023);
- sustainability experience – BREEAM Excellent certifications and green initiatives demonstrate Industry 5.0 readiness (LPP, 2023; Nowoczesny Przemysł, 2023);
- internal development team (Silky Coders) – guarantees control and continuous development of IT solutions (LPP, 2023).

The next four factors concerned weaknesses (W). These are understood as existing aspects of the functioning of the surveyed company that may hinder the implementation of Industry 5.0 solutions. They are as follows:
- energy network dependency – high vulnerability to power supply disruptions and cost fluctuations (Almusharraf, 2025, pp. 13-14);
- data transmission dependency – critical reliance on IoT communication and data integration systems (Xu et al., 2024, p. 1590);
- high competency requirements – need for workers with advanced IT and collaborative skills (Galabova, Trifonova, Hristov, 2024, p. 8);
- technology complexity – integration challenges between diverse external and internal systems (Amirkhizi et al., 2024, p. 1).

Factors referred to as opportunities (O) relate to elements of the environment that may have a positive impact on the area under study. In the case of the present analysis, these are the following elements supporting the development of solutions that are part of or drive implementation of the Industry 5.0 concept:
- 6G network development – enhanced data transmission capabilities for Industrial IoT systems (Hazra et al., 2024);
- renewable energy growth – 5% projected increase in national renewable energy share until 2030 (Firlej, Stanuch, 2023, pp. 40-41);
- sustainability awareness – growing understanding of sustainable development role in warehousing (Bartolini, Bottani, Grosse, 2019, p. 242);
- stakeholder transparency demands – increasing expectations for real-time reporting and communication (Mahesh, 2024).

The last four factors are defined as threats (T). These are elements in the environment of the entity being studied that may negatively impact the proposed solutions or hinder their development and implementation:
- rising energy costs – projected 12% annual increase until 2030 (Firlej, Stanuch, 2023, pp. 40-41);

- technology adoption concerns – employee resistance and skills gap challenges (Galabova, Trifonova, Hristov, 2024, pp. 6-7);
- supply chain disruptions – increased vulnerability to global crises (Leończuk et al., 2020, p. 442, 448);
- cyber attacks – growing sophistication of data security threats (Książkiewicz, 2016, p. 59).

3.2. Mind mapping results

The next stage of the study was to create a mind map (fig. 3) based on the SWOT factors. This allowed conclusions to be formulated regarding the effects and conclusions resulting from the previously conducted analysis.

The graphical representation allowed for further analysis to identify the links between factors and their effects, leading to the formulation of the following four components: 1) zero-emission warehouse creation; 2) operational cost management; 3) cybersecurity self-reliance; and 4) human potential optimization. These components bring together various issues affecting different areas, integrating internal capabilities or constraints (strengths and weaknesses) with external conditions (opportunities and threats) (fig. 4).

Leveraging the growing renewable energy technologies and LPP's experience enables the creation of zero-emission warehouses. The integration of "green" technologies and renewable energy allows emissions to be gradually reduced, along with a transition to environmentally neutral operations. Rising energy prices and warehouse dependence on stable energy supplies pose challenges. Implementing proprietary renewable energy sources increases cost control, while the use of energy-efficient technologies improves profitability.

Having its own programming team, Silky Coders, allows for the creation of customized, proprietary cybersecurity solutions, enabling a rapid response to threats and strengthening organizational resilience.

Implementing Industry 5.0 raises concerns and demands higher employee competencies. LPP is planning its communication, training and recruitment to take developmental potential into account. Systematic investments in developing competences and employee well-being support effective innovation implementation.

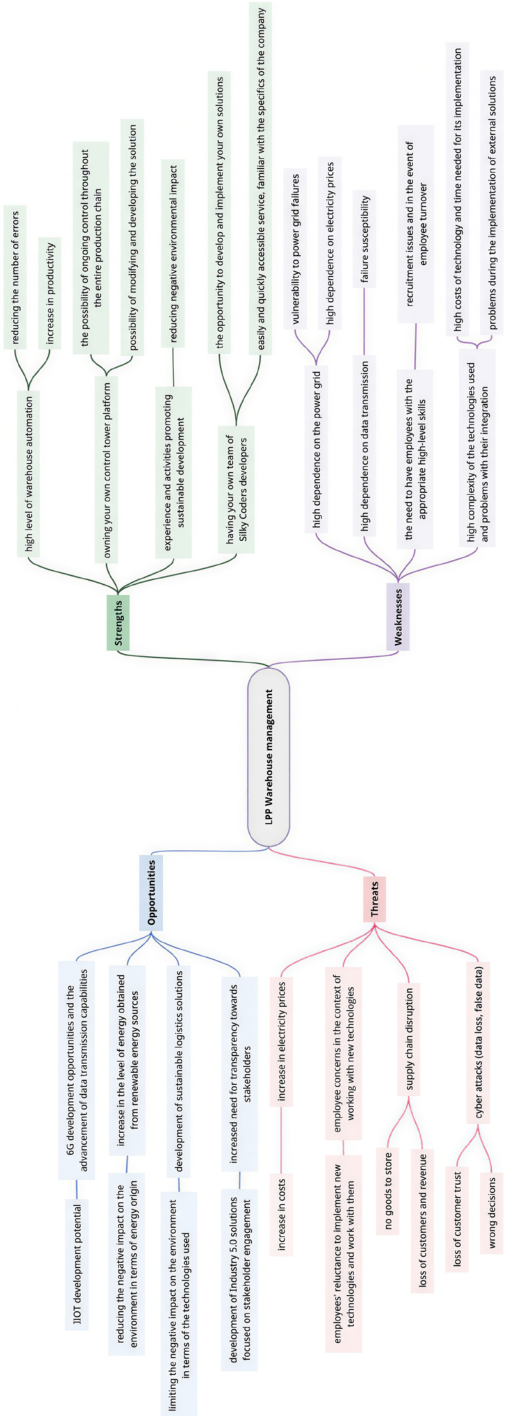

Fig. 3. Mind mapping based on SWOT research

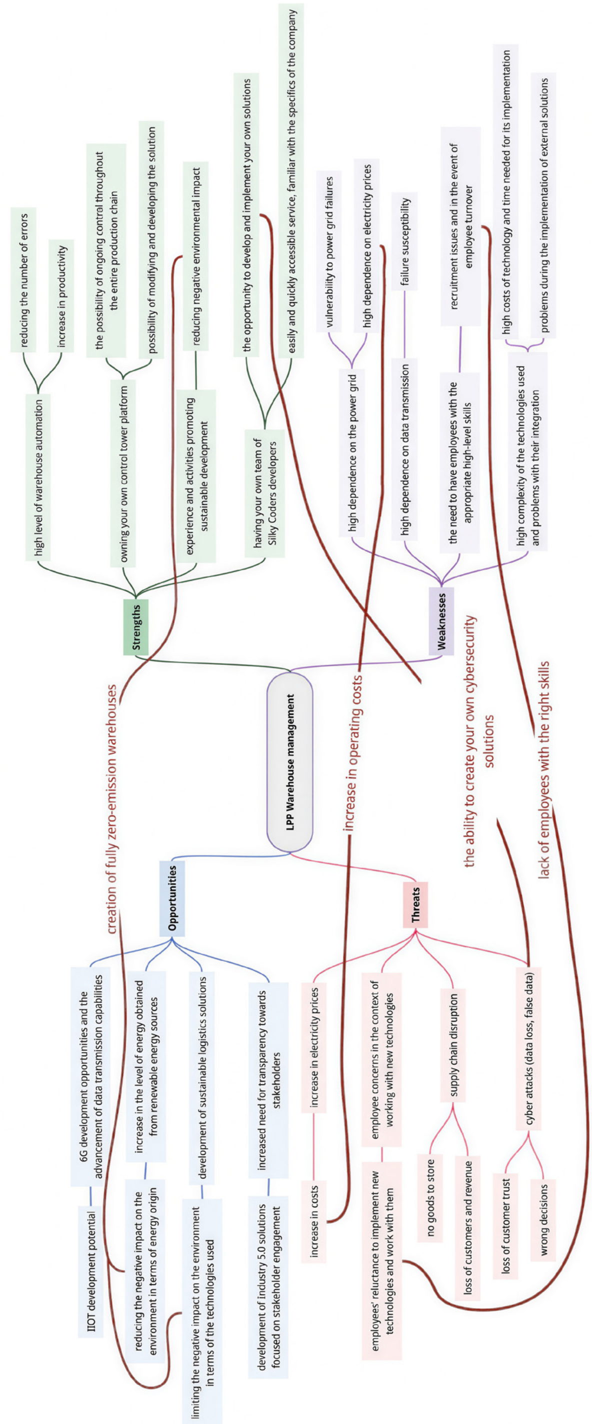

Fig. 4. The most important relationships between selected SWOT factors

3.3. Morphological analysis results

The morphological analysis aimed to select the optimal set of solutions forming an innovative system supporting the implementation of the Industry 5.0 concept in the LPP warehouse management. The study incorporated findings from SWOT and mind mapping analyses and identified additional factors and technologies. A "weak" morphological analysis using the Moles matrix was applied, avoiding the need to examine all (3600) connections (Ujwary-Gil et. al., 2006, pp. 24-30). Solutions were evaluated on a 1-5 scale.

Five dimensions derived from key insights of SWOT and mind mapping analyses were chosen. Presented in table 1, these indicate strategic areas for the transition towards Industry 5.0. Dimension A describes the level and maturity of automation, enabling optimal human-machine collaboration on the principle that automation supports rather than replaces workers, expanding on the concept of autonomous warehouses (Pulijz, Gorbachev, Hein, 2018, p. 2). Dimension B concerns cybersecurity, threat response, and the use of the Silky Coders programming team, which strengthens system resilience. Newly described concepts include solutions based on artificial intelligence (AI) and machine learning (ML), blockchain, cloud security, and threat intelligence (Mustapha, Alhassan, Ashi, 2024, p. 102, 104, 105-107). Dimension C combines zero emissions and rising energy cost issues, fulfilling the sustainability pillar. Dimensions D and E cover internal transport and goods identification, supporting operational efficiency and the implementation of innovations such as cobots and RFID, which are significant for LPP's fast fashion business. For D, in addition to the technologies mentioned in the previous sources, solutions such as industrial AGVs (Ellithy et al., 2024, pp. 23-24), UAVs (Wawrla, Maghazei, Netland, 2019, p. 4), humanoid robots (Rossowiecki, 2024) or AutoStore matrix (Rhenus Group) were proposed. In E, the various proposals included optical identification by an operator or an ML system, the use of automatic identification using barcodes, two-dimensional QR codes and an RFID system (Pawelczyk, 2018, p. 226, 237).

Table 1. Morphological table

Dimension	1	2	3	4	5	6
A. Level and maturity of automation	coordinated automation	partial operational autonomy	high autonomy	complete autonomy		
B. Ensuring cybersecurity	solutions based on machine learning (ML) and AI	use of blockchain technology	use of Cloud Security solutions	use of Threat Intelligence (TI) solutions	establishment of a Cybersecurity Center based on our own team of programmers	

Dimension	1	2	3	4	5	6
C. Method of supplying the warehouse	national power grid	own wind energy	own solar energy	own energy from various renewable energy sources	own energy from various renewable energy sources + national power grid	own geothermal energy
D. Method of internal transport	classic battery-powered trucks (operated by people)	AGV	belt conveyors	drones	humanoid robots	autostore-type mesh
E. Method of identifying cargo/goods	optical identification by the operator	automatic optical identification based on ML	automatic optical identification barcodes	RFID sensors	automatic optical identification QR codes	

Next, a preliminary matrix was created (tab. 2) to examine the connection between dimensions defined as the level and maturity of automation and cybersecurity assurance.

Table 2. Preliminary matrix

B / A	solutions based on machine learning (ML) and AI	use of blockchain technology	use of Cloud Security solutions	use of Threat Intelligence (TI) solutions	establishment of a Cybersecurity Center based on our own team of programmers
coordinated automation	coordinated automation with cybersecurity solutions based on machine learning (ML) and artificial intelligence (AI)	coordinated automation with cybersecurity solutions using blockchain technology	coordinated automation with cybersecurity solutions using Cloud Security solutions	coordinated automation with cybersecurity solutions using Threat Intelligence (TI) solutions	coordinated automation with our own Cybersecurity Center based on our own team of developers

A \ B	solutions based on machine learning (ML) and AI	use of blockchain technology	use of Cloud Security solutions	use of Threat Intelligence (TI) solutions	establishment of a Cybersecurity Center based on our own team of programmers
partial operational autonomy	partial operational autonomy with cybersecurity solutions based on machine learning (ML) and artificial intelligence (AI)	partial autonomy of operation with cybersecurity solutions using blockchain technology	partial autonomy of operation with cybersecurity solutions using Cloud Security solutions	partial autonomy of operation with cybersecurity solutions using Threat Intelligence (TI) solutions	partial operational autonomy with its own Cybersecurity Center based on its own team of programmers
high autonomy	high autonomy with cybersecurity solutions based on machine learning (ML) and artificial intelligence (AI)	high autonomy with cybersecurity solutions using blockchain technology	high autonomy with cybersecurity solutions using Cloud Security solutions	high autonomy with cybersecurity solutions using Threat Intelligence (TI) solutions	high autonomy with its own Cybersecurity Center based on its own team of programmers
complete autonomy	full autonomy with cybersecurity solutions based on machine learning (ML) and artificial intelligence (AI)	full autonomy with cybersecurity solutions using blockchain technology	full autonomy with cybersecurity solutions using Cloud Security solutions	full autonomy with cybersecurity solutions using Threat Intelligence (TI) solutions	full autonomy with its own Cybersecurity Center based on its own team of programmers

Combinations are formed at the intersection of rows and columns, and these undergo selection for further analysis, thereby creating a new analytical structure. The selection process may involve subjective elements, depending on the researcher's individual preferences and analytical abilities. This selection can be systematically conducted using evaluation criteria such as innovation, feasibility, logic, effectiveness, uniqueness, and practical value. Each criterion can be assessed using a five-point Likert scale. Combinations with the highest scores or within specified point ranges are selected and compiled into subsequent analytical structures. The process is organized to arrange selected combinations from the basic matrix in rows, then incorporate the next problem area as columns. With six problem areas, there are four intermediate structures (excluding the morphological table and final structure).

Due to the presentation limitations of this research, only the final matrix is presented (tab. 3). Some names used earlier have been shortened according to the abbreviations given in the previous tables.

Table 3. Final matrix

E / ABCD	optical identification by the operator	automatic optical identification based on ML	automatic optical identification barcodes	RFID sensors	automatic optical identification QR codes
high autonomy with its own Cybersecurity Center based on its own team of programmers, powered by energy from renewable energy sources, using an AutoStore network	high autonomy with its own Cybersecurity Center based on its own team of programmers, powered by energy from renewable energy sources, using an AutoStore network and optical identification of goods by the operator	high autonomy with its own Cybersecurity Center based on its own team of programmers, powered by energy from enewable energy sources, using an AutoStore network and automatic optical identification of goods based on ML	high autonomy with its own Cybersecurity Center based on its own team of programmers, powered by energy from renewable energy sources, using an AutoStore network and automatic optical identification of goods using barcodes	high autonomy with its own Cybersecurity Center based on its own team of programmers, powered by energy from renewable energy sources, using an AutoStore network and goods identification using RFID sensors	high autonomy with its own Cybersecurity Center based on its own team of programmers, powered by energy from renewable energy sources, using an AutoStore network and automatic optical identification of goods using QR codes
partial operational autonomy with cybersecurity solutions using Cloud Security solutions based on the national power grid and own energy from renewable energy sources using AGV trucks	partial operational autonomy with cybersecurity solutions using Cloud Security solutions based on the national power grid and own energy from renewable energy sources, using AGV trucks and optical identification of goods by the operator	partial operational autonomy with cybersecurity solutions using Cloud Security solutions based on the national power grid and own energy from renewable energy sources, using AGV trucks and automatic optical identification of goods based on ML	partial operational autonomy with cybersecurity solutions using Cloud Security solutions based on the national power grid and own energy from renewable energy sources, using AGV trucks and automatic optical identification of goods using barcodes	partial operational autonomy with cybersecurity solutions using Cloud Security solutions based on the national power grid and own energy from renewable energy sources, using AGV trucks and goods identification using RFID sensors	partial operational autonomy with cybersecurity solutions using Cloud Security solutions based on the national power grid and own energy from renewable energy sources, using AGV trucks and goods identification using RFID sensors

E / ABCD	optical identification by the operator	automatic optical identification based on ML	automatic optical identification barcodes	RFID sensors	automatic optical identification QR codes
partial operational autonomy with cybersecurity solutions based on ML and AI based on the national power grid and own energy from renewable energy sources using drones	partial operational autonomy with cybersecurity solutions based on ML and AI based on the national power grid and own energy from renewable energy sources using drones and optical identification of goods by the operator	partial operational autonomy with cybersecurity solutions based on ML and AI based on the national energy grid and own energy from renewable energy sources using drones and automatic optical identification of goods based on ML	partial operational autonomy with cybersecurity solutions based on ML and AI based on the national power grid and own energy from renewable energy sources using drones and automatic optical identification of goods using barcodes	partial operational autonomy with cybersecurity solutions based on ML and AI based on the national power grid and own energy from renewable energy sources using drones and identification of goods using RFID sensors	partial operational autonomy with cybersecurity solutions based on ML and AI based on the national power grid and own energy from renewable energy sources using drones and automatic optical identification of goods using QR codes

Table 3 presents a reduced number of attributes for each dimension, from which the following ideas were selected:

- solution 1: High Autonomy Warehouse with Integrated Cybersecurity Center;
- solution 2: Partial Autonomy with AI-Enhanced Cybersecurity.

Table 4 shows attributes connected to each chosen solution.

Table 4. Comparative summary of selected solutions derived from the morphological analysis

Dimension	Solution 1: High Autonomy Warehouse with Integrated Cybersecurity Center	Solution 2: Partial Autonomy with AI-Enhanced Cybersecurity
A. Level and maturity of automation	high autonomy	partial operational autonomy
B. Ensuring cybersecurity	establishment of a Cybersecurity Center based on our own team of programmers	solutions based on machine learning (ML) and AI
C. Method of supplying the warehouse	own energy from various renewable energy sources	own energy from various renewable energy sources + national power grid

Dimension	Solution 1: High Autonomy Warehouse with Integrated Cybersecurity Center	Solution 2: Partial Autonomy with AI-Enhanced Cybersecurity
D. Method of internal transport	AutoStore-type mesh	drones
E. Method of identifying cargo/goods	automatic optical identification QR codes	RFID sensors

The first proposed solution envisions the development of a high-autonomy warehouse system for LPP, characterized by the integration of a dedicated in-house Cybersecurity Center powered by a multifunctional team of software engineers. This center will oversee the continuous enhancement and adaptive response mechanisms against emerging cyber threats. The energy infrastructure will leverage diversified renewable energy sources (RES), including rooftop photovoltaic installations, strategically deployed wind turbines, and where geologically feasible, supplementary renewable technologies, ensuring resilience and sustainability. Warehouse operations will be supported by AutoStore technology, offering a compact and autonomous storage grid that is optimized for efficiency, despite the spatial reconfiguration demands. Roof surfaces will be utilized extensively for expanded photovoltaic deployment to offset energy consumption. Advanced optical identification using QR code systems facilitates high-throughput, versatile product identification that transcends linguistic barriers and maintains robustness against physical label degradation. This will shift the role of human workers from operators to supervisors and planners. The need to work in conditions of immediate danger will disappear, and ergonomics will improve thanks to the use of convenient and highly autonomous technologies. Furthermore, the mental and cognitive burden on workers will be reduced thanks to the system necessary to identify the precise position of items in the warehouse space.

This enhancement fosters operational transparency, providing real-time informational access to stakeholders regarding inventory status and product availability, aligning with Industry 5.0's human-centric and sustainable paradigms.

Table 5 presents selected aspects of solution 1 in terms of the main pillars of Industry 5.0.

Table 5. Solution 1 and pillars of Industry 5.0

Solution 1: High Autonomy Warehouse with Integrated Cybersecurity Center	
Human-centricity	– transferring the role of a human to a controller and supervisor from an operator – reducing the risk of accidents related to operational activities – providing data (including inventory and product availability) to stakeholders in real time

Solution 1: High Autonomy Warehouse with Integrated Cybersecurity Center	
Resilience	– high cyber resilience thanks to its own Cybersecurity Center – energy resilience thanks to its reliance on its own renewable energy sources and high independence from the external grid
Sustainability	– extensive use of renewable energy sources – optimization of operations through the use of AutoStore and QR for lower electricity consumption

The second proposed solution advocates for a partially autonomous warehouse configuration for LPP, emphasizing advanced cybersecurity measures based on machine learning (ML) and artificial intelligence (AI). This cybersecurity infrastructure enables proactive threat detection and mitigation, ensuring system resilience. The energy supply is supported by a hybrid system combining the national power grid with diverse renewable energy sources, balancing reliability with sustainability. Internal transport within the warehouse will be revolutionized by using autonomous drones, thereby necessitating adaptive recalibration of existing storage and dispatch protocols. This aerial approach optimizes the use of space by reducing ground vehicle dependency, consequently increasing storage density and operational fluidity. For safety reasons and due to the reduced need for human activity in storage space, employee roles will be limited primarily to supervision, planning, and control, possibly involving remote control of certain operations, and responding to unforeseen situations. This will further reduce the risk of serious health damage and simultaneously improve work ergonomics, as it eliminates the need to operate directly in the warehouse space. Furthermore, the technology itself, also based on automatic identification, will reduce the mental and cognitive burden on employees. Product identification leverages RFID sensor technology, well-established yet innovatively integrated here for compatibility with drone logistics. Automated data capture through RFID enhances inventory accuracy, minimizes human error, and substantially boosts transparency by enabling real-time tracking accessible to clients. Implementing this solution will increase operational efficiency and streamline existing warehouse infrastructure performance in line with the Industry 5.0 vision.

Table 6 presents selected aspects of solution 2 in the context of the main pillars of Industry 5.0.

Table 6. Solution 2 and pillars of Industry 5.0

Solution 2: Partial Autonomy with AI-Enhanced Cybersecurity	
Human-centricity	– relieving employees of simple, undemanding, and often dangerous tasks (e.g., transporting goods, routing) – opportunity to focus on supervision and more creative activities – simplifying work through constant monitoring of warehouse operations and conditions – ensuring access to up-to-date information on warehouse inventory and facility operations for stakeholders and customers
Resilience	– high resistance to attacks and human error, thanks to the use of AI and ML solutions – reduced dependence on the grid thanks to the energy mix
Sustainability	– increased use of renewable energy – optimization of storage operations to reduce energy consumption

The selection of the above solutions is the result of a 5-point-based analysis according to following criteria.: novelty, feasibility, rationality, originality, and usefulness

Solution 1: High Autonomy with Integrated Cybersecurity Center

- Novelty (4) – The integration of high-autonomy AutoStore technology with a dedicated in-house cybersecurity center is an innovative approach to warehouse management. While individual components exist, their systematic integration with renewable energy infrastructure and comprehensive optical identification creates a novel ecosystem for implementing Industry 5.0.
- Feasibility (4) – The solution builds upon established technologies (AutoStore, QR systems, renewable energy) while requiring significant but manageable infrastructure adaptation. LPP's existing technological capabilities and financial resources foster implementation, though coordination complexity presents moderate challenges.
- Rationality (5) – The comprehensive approach addresses multiple Industry 5.0 pillars simultaneously: human-centricity through enhanced transparency, sustainability via renewable energy integration, and resilience through robust cybersecurity measures. The synergistic combination of technologies maximizes operational efficiency while minimizing the environmental impact.
- Originality (4) – When individual technologies are established, their holistic integration within a fashion industry distribution context, particularly the combination of autonomous storage, renewable energy systems, and dedicated cybersecurity infrastructure, represents a distinctive approach to warehouse modernization.

- Usefulness (5) – The solution directly addresses LPP's operational challenges by enhancing storage efficiency, reducing energy costs, improving security posture, and enabling real-time supply chain visibility. The framework supports scalability and adaptation to changing market demands, while maintaining operational continuity.

Solution 2: Partial Autonomy with AI-Enhanced Cybersecurity

- Novelty (4) – The integration of AI-enhanced cybersecurity with drone-based internal logistics represents a forward-thinking approach to warehouse automation. The combination of machine learning-based threat detection, hybrid energy systems, and aerial product transport creates an innovative framework for implementing Industry 5.0.
- Feasibility (5) – Building upon existing infrastructure while simultaneously incorporating proven technologies (RFID, drones, AI/ML) ensures high implementation feasibility. The partial autonomy approach allows gradual transition, reducing implementation risks while also leveraging LPP's current technological foundation and expertise.
- Rationality (5) – The solution demonstrates high internal coherence by integrating complementary technologies that enhance each other's effectiveness. AI-driven cybersecurity protects drone operations, while RFID enables precise aerial logistics, and hybrid energy systems ensure operational stability and sustainability.
- Originality (3) – Individual components (drones, RFID, AI cybersecurity) are increasingly common in warehouse environments. However, their specific integration within the fashion industry context, particularly the coordination of AI-enhanced security with drone logistics, represents a less common, albeit not unprecedented approach.
- Usefulness (5) – The solution offers significant practical benefits by optimizing space utilization through aerial transport, enhancing security through predictive threat detection, and improving operational efficiency while maintaining compatibility with existing systems. The approach enables sustainable growth while supporting Industry 5.0's human-centric objectives through improved working conditions and real-time information access.

Both solutions scored equally, suggesting multiple viable pathways for the Industry 5.0 transition, each emphasizing different aspects of human-technology collaboration.

4. CONCLUSIONS

This study aimed to develop strategic frameworks for transforming LPP's distribution centers toward Industry 5.0 using SWOT + MAM methodology. The analysis results show that this transition does not proceed uniformly across the three main pillars of Industry 5.0, but rather focuses on specific business priorities of the company.

SWOT analysis revealed that LPP possesses strong technological foundations for transition, particularly in the areas of automation and sustainable development. The company operates advanced internal transport systems with 5,000 packages per hour throughput and maintains a Control Tower platform ensuring supply chain transparency. BREEAM Excellent certifications and experience in green initiatives are additional assets. Simultaneously, identified weaknesses such as energy network dependency and high competency requirements indicate areas requiring special attention.

Regarding sustainability, research results clearly demonstrate this as currently the strongest transition driver for LPP. Mind mapping identified "Zero-emission warehouse creation" as a key strategic component, as reflected in both proposed solutions. The first option assumes the utilization of diversified renewable energy sources, including rooftop photovoltaic installations and wind turbines. The second focuses on hybrid energy systems combining national grid with renewable sources. This approach stems from practical needs – the projected 12% annual energy cost increases until 2030 make renewable energy investments not only environmentally but primarily economically justified.

Organizational resilience occupies second place in the priority hierarchy. Utilizing the internal programming team Silky Coders enables dedicated cybersecurity solutions to be created, boosting independence and increasing response speed to threats. Both proposed solutions contain advanced protection systems – from integrated cybersecurity centers to AI-enhanced security utilizing machine learning for predictive threat detection. This element gains particular significance in view of the growing sophistication of cyberattacks and enhanced vulnerability of global supply chains to disruptions.

Human-centricity was less reflected in particular technical solutions within the study, which may result from LPP's current operational priorities. While mind mapping identified the "Human potential optimization" component, in morphological analysis, human-machine collaboration aspects were treated more generally. Both final scenarios include human-centric elements but focus mainly on improving working conditions through better process transparency and reducing human error rather than direct collaboration with collaborative robots. It should be recognized that the improvements in quality, comfort, and employee safety are closely linked to, and partly a consequence of, the implemented technologies. However, this was taken into account when selecting the solution options. Furthermore, both proposed solutions also increase operational transparency for stakeholders, including customers, who can continuously monitor their orders.

The results and the method presented here can guide management in implementing innovations in the logistics sector, and more broadly, in manufacturing. The proposals presented in this article can be considered and implemented by other companies after appropriately adapting them to their business profiles and operations. Further analyses will refine and validate the method, which could ultimately serve as an important tool in the decision-making regarding the design of warehouse facilities and their equipment, taking into account existing conditions.

The SWOT + MAM methodology proved to be an effective tool for assessing the readiness for holistic transition. The sequential progression from situational analysis through relationship mapping to generating solutions provided a systematic approach to strategic planning. Of particular value was morphological analysis, which enabled systematic exploration of various technological-organizational combinations. Applying this methodology allowed the identification of realistic transition paths adapted to fast fashion industry specifics.

It should be emphasized that the solution generation method used is not the only one. In the context of selecting solutions that collectively constitute a system within Industry 5.0, other multi-criteria analysis tools are also widely used, including the Analytical Hierarchy Process (AHP), Analytical Network Process (ANP), Technique for Order Preference by Similiarity to Ideal Solution (TOPSIS), Simple Additive Weighting (SAW), and others (Avramova, Peneva, Ivanov, 2025, pp. 1-3; Troisi, Visvizi, Grimaldi, 2024, pp. 2-13). While SWOT analysis combined with mind mapping may be considered the most appropriate approach when determining the current situation of the entity being studied and its surrounding environment, it is necessary to consider whether morphological analysis may be replaced with another method, and under what conditions this would be beneficial and under what conditions would it reduce the value of the results. This topic may be the subject of further research.

Morphological analysis generated two solutions with identical summary evaluation of 22 points. The high-autonomy warehouse with integrated cybersecurity center received higher scores for rationality (5) and originality (4), but lower ones for feasibility (4). The partially autonomous configuration with AI-enhanced cybersecurity achieved maximum feasibility (5) and rationality (5) scores, although the scores were lower for originality (3). This balance indicates that both implementation paths have their advantages and may be taken into consideration depending on time priorities and available resources.

Given that both solutions scored equally, LPP may choose to implement either one, depending on its current strategic priorities. The partially autonomous solution may be preferred in the short term, due to its higher feasibility and gradual approach to changes. The high-autonomy solution offers greater originality and may be considered to be more innovative in the longer term. The methodology developed in this study provides solid analytical foundations for planning the transition, regardless of which implementation path is ultimately selected.

Research results also shed light on broader the Industry 5.0 implementation context in logistics environments. Organizations under pressure from direct operational challenges – rising energy costs, cybersecurity threats, supply chain disruptions – tend towards prioritizing sustainability and resilience as first transition steps.

This approach, while departing from theoretical assumptions of equal development across all three pillars, may prove more realistic in business practice.

The study focuses on a single organization from the fast fashion sector, limiting the possibilities of generalizing from these conclusions. Future research should verify the SWOT + MAM methodology's applicability across different industry contexts and examine whether the sustainability-first approach observed at LPP represents a broader trend in logistics transition. It would be particularly valuable to conduct multi-year studies tracking the actual implementation progress of the proposed solutions. The analysis of this work's data shows that some of the information originates from the official media reports of the enterprise being studied, which causes LPP to be analyzed in an excessively positive way (primarily the "Strengths" section of the SWOT analysis). Obtaining official data on weaknesses was also a problem. The process of identifying LPP's weaknesses used a deductive approach based on the barriers to the implementation of Industry 5.0 technologies recognized in the literature. This allowed a purely subjective assessment to be avoided. There is great importance in practical application on ensuring reliable data that does not lead to the creation of an idealized vision of the enterprise.

A limitation of this study is the lack of quantitative validation of the effectiveness of the proposed solutions; however, this is beyond the scope of this article. The study constitutes a qualitative strategic design phase in which solutions were identified and conceptually assessed using the SWOT + MAM methodology.

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TRANSFORMACJA CENTRÓW DYSTRYBUCYJNYCH LPP W KIERUNKU PRZEMYSŁU 5.0. ANALIZA SWOT + MAM

Streszczenie

Współczesne centra dystrybucyjne stoją przed wyzwaniem ewolucji w kierunku modeli operacyjnych zgodnych z zasadami Industry 5.0. Badanie analizuje potencjał transformacji LPP SA przy użyciu, niestosowanej dotychczas, metodologii SWOT + MAM, która sekwencyjnie wykorzystuje analizę SWOT, mapowanie myśli oraz analizę morfologiczną w celu oceny gotowości organizacyjnej i generowania rozwiązań strategicznych. Analiza obecnej infrastruktury LPP ujawnia znaczące możliwości automatyzacji poprzez sortery krzyżowe przetwarzające 5000 paczek na godzinę oraz autorską platformę Control Tower umożliwiającą transparentność łańcucha dostaw w czasie rzeczywistym. Firma ma silne fundamenty w obszarze zrównoważonego rozwoju dzięki certyfikatom BREEAM Excellent oraz doświadczeniu w inicjatywach ekologicznych. Analiza morfologiczna zidentyfikowała dwie równoważne ścieżki transformacji: system magazynu o wysokiej autonomii integrujący technologię AutoStore z odnawialnymi źródłami energii i dedykowaną infrastrukturą cyberbezpieczeństwa oraz model częściowo autonomiczny z zabezpieczeniami wspomaganymi sztuczną inteligencją połączony z logistyką opartą na dronach i systemami identyfikacji RFID. Oba rozwiązania otrzymały identyczne oceny 22 punktów według kryteriów nowości, wykonalności, racjonalności, oryginalności, użyteczności. Wyniki wskazują, że transformacja Industry 5.0 w LPP koncentruje się głównie na zrównoważonym rozwoju jako podstawowym kierowaniu zmian, z odpornością organizacyjną na drugim miejscu, podczas gdy aspekty orientacji na człowieka wymagają dalszego rozwoju. Metodologia SWOT + MAM okazuje się skuteczna w kompleksowej ocenie strategicznej transformacji w kierunku Przemysłu 5.0 oraz wyznaczeniu praktycznych ram dla tego procesu.

Słowa kluczowe: Przemysł 5.0, centra dystrybucyjne, metodologia SWOT + MAM, LPP