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INVESTMENTS IN R&D AS A COMPONENT OF MODERN BUSINESS COMPETITIVENESS

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Purpose: This paper explores the impact of investments in research and development (R&D) on the competitiveness of modern enterprises.
Design/methodology/approach: In article was use literature of subject in the theoretical part and the example of Northwood, a company from Gryfice, Poland in practical part.
Findings: It highlights how R&D initiatives contribute to creating competitive advantages by improving product quality, operational efficiency, and brand reputation. By implementing a comprehensive R&D strategy, Northwood achieved substantial gains in competitiveness within the wood production industry.
Practical implications: Using the case study of Northwood, a company from Gryfice, Poland, the study illustrates the practical applications of R&D in enhancing market position through sustainable practices, innovation, and technological advancements.
Originality/value: This paper examines the broader economic significance of R&D investments in driving national and international competitiveness, with an emphasis on their strategic value in business growth and resilience.
Keywords: Research and Development, Competitiveness, Innovation, Sustainable Business, Competitive Advantage**.**
Category of the paper: Case study.

1. Introduction

Modern businesses are compelled to engage in continuous competition to maintain their market position. Competitiveness against market rivals serves as a pathway to achieving a competitive advantage for an organization. On the contemporary market, competitive advantage can be achieved not only through the quality and usability of products and services offered but also through the image and reputation they hold among consumers. At the same time, innovative initiatives undertaken by companies play a crucial role in this regard. One key element of innovation initiatives is investment in research and development (R&D).

R&D investments are a critical factor for both modern economies and organizations. Their significance is essential from both macroeconomic and microeconomic perspectives. On the one hand, new investments contribute significantly to achieving high rates of economic growth and development at the national level, thereby enhancing international market competitiveness. On the other hand, for companies, R&D is also a factor that ensures a strong market position. Consequently, small and large economic entities, as well as the academic and government sectors, engage in research and development to foster technological, economic, and social progress.

The aim of this study is answer the question: whether and to what extent investments in the R&D department of a company can be a tool for building and improving the competitiveness of the company? This article, based on a literature review, also presents a case study of Northwood, a company from Gryfice in the West Pomeranian Voivodeship, which implemented pioneering R&D methods in its operations to establish its reputation within the regional and national wood production market, as well as internationally. Based on materials provided by the company, the article describes current R&D activities and their outcomes.

2. Competitiveness and Investments in Research and Development in the Enterprise

Competitiveness in the simplest terms refers to a company's ability to contend with other market entities and to achieve an advantage over them. A competitive advantage enables an organization to secure a superior position relative to competitors. This advantage is the result of actions and strategies through which a company, by offering products and services that are better than those of competitors, aligns with the needs and expectations of customers. However, competitive advantage does not have a clear-cut definition in the literature (Żabiński, 2000; Moroz, 2008).

Similarly, the concept of corporate competitiveness lacks a singular definition in theory. One definition, suggested by A. Kędzierska (2005), views corporate competitiveness as the ability to operate effectively within a free-market economy (Szymanik, 2016). This definition emphasizes that greater competitiveness correlates with a stronger position within an industry, and less vulnerability to external stimuli and economic downturns (2005).

E. Szymanik (2016) notes that definitions of corporate competitiveness can be considered narrowly or broadly. Narrow definitions focus on competition through new technologies, emphasizing modern products and services that differentiate a company from its market rivals. Hampden-Turner and Trompenaars (2000) suggest that "competitiveness is simultaneous rivalry and cooperation, leading to the understanding of essential technologies, customer needs, and requirements". Meanwhile, Hamel and Prahalad (1999) see competitiveness as a company's

ability to develop core skills more cost-effectively and swiftly than competitors, resulting in superior products.

Regardless of how competitiveness is defined, it is essential to identify the factors that shape it. Defining these factors is complex due to the lack of a universally accepted classification (Porter, 1990; Ma, 2000; Nowacki, 2015, 2017; Sołoducho-Pełc, 2016). R. Śliwiński (2011) proposes a categorization of competitiveness determinants into three groups: material resources, intangible resources, and their combinations. Material resources include employees with their experience, skills, resilience, and motivation; leadership and managerial abilities; physical capital such as buildings, land, and machinery; IT systems; computer equipment; and financial capital. Intangible resources cover knowledge, competencies, techniques and technologies, registered patents, utility models, intangible assets, sales models, product distribution systems, product characteristics, corporate culture, and organizational structure. The third group comprises factors like a company's strong reputation linked with quality and reliability, and market entry barriers for new competitors.

Among the factors influencing a company's competitiveness, innovation and creativity stand out, as they can significantly shape both material, intangible, and mixed resources. Innovative companies tend to be highly dynamic and successful in their activities (Morais et al., 2021). Innovation itself does not create competitiveness but can greatly enhance it (Szymanik, 2016; European Commission, 2022).

In production enterprises, innovation may manifest in the introduction of new products and services, modernization of existing technologies, and improvement and optimization of operational processes. The adoption of new solutions often involves substantial financial investment. One way for companies to foster development is through research and development (R&D) activities (OECD, 2023; Dutta et al., 2023). R&D has a multi-dimensional nature as it enables growth, access to new resources, brand building, and the establishment of competitive advantage and corporate competitiveness in the fast-evolving market environment (Vrontis, Christofi, 2021).

According to the Higher Education and Science Act (Ustawa Prawo o Szkolnictwie Wyższym i Nauce, 2018), scientific research includes both fundamental and applied research. Fundamental research, comprising empirical or theoretical work, aims to acquire new knowledge about the foundations of observable phenomena without immediate application. Conversely, applied research seeks new knowledge and skills directed at developing or significantly improving products, processes, or services. The Act also defines development work as activities involving the acquisition, combination, formation, and utilization of available knowledge and skills for planning production and designing modified, improved, or new products, processes, or services, excluding routine and periodic changes made to them.

The Frascati Manual (OECD, 2015) also serves as a knowledge source on the specifics of R&D activities, outlining five distinguishing features: novelty, creativity, uncertainty, systematic nature, and transferability or reproducibility.

In recent years, Poland has seen an increase in corporate R&D activities, potentially driven by tax incentives and programs providing EU funding for R&D projects. Data from Statistics Poland (GUS) indicates that since 2015, investment in R&D within Polish enterprises has been rising. Gross domestic expenditure on R&D in 2022 was 44.7 billion PLN, marking an 18.6% increase compared to the previous year. In 2015, this expenditure was just over 18 billion PLN. The R&D intensity ratio, representing the share of internal R&D expenditure in GDP, reached 1.46% (compared to 1.43% in 2021 and 1.00% in 2015). The gross domestic expenditure on R&D per capita in 2022 was 1,182 PLN, a 19.2% increase from the previous year. Additionally, the number of entities engaged in R&D rose by 0.8% in 2022 compared to the previous year, reaching 7,431 entities (up from 7370 in 2021 and 4427 in 2015) (GUS, 2023).

3. Competitiveness and Investment in R&D within Enterprises[1]

For the purposes of this article, in order to answer the research question posed in the introduction: whether and to what extent investments in the company's R&D department can be a tool for building and improving the company's competitiveness? this article presents an analysis of Northwood's operations in the town of Strzykocin, West Pomeranian Voivodeship.

Founded in 1992 by Bronisław Misikonis, Northwood specializes in producing wooden pallets, pallet boxes, and selling firewood and fuelwood. With a state-of-the-art machinery park, including an innovative gas drying system, the company meets international quality standards, as evidenced by its IPPC certificate (No. PL 32 436). Northwood collaborates with business partners across Europe, offering products made from resources acquired through contracts with the State Forests. The company prioritizes sustainable development, for example, by using solar energy in production processes and deploying vehicles that meet Euro VI emissions standards.

As an innovative company in the wood industry, Northwood has been conducting extensive research and development (R&D) on implementing a circular economy (CE) approach since 2020. The evolving environmental regulations, increasing consumer demands, and long-standing partnerships with Danish companies—pioneers in sustainable production—have motivated Northwood to adopt a strategy focused on maximizing resource utilization, minimizing waste, and optimizing production energy use.

In 2018, Northwood established an in-house Research and Development (R&D) department dedicated to innovation, testing, and optimizing both products and production processes. This R&D department plays a crucial role in maintaining the company’s competitiveness and

[1] Prepared based on data provided by Northwood.

meeting the market's evolving needs for new technologies, improved products, and entirely new solutions. The R&D department focuses on scientific research and technical work aimed at:

- Development of new products – from concept to design, prototype testing, and implementation in production.
- Process optimization – identifying and eliminating waste sources, improving production efficiency, and reducing production costs.
- Enhancement of product durability and functionality – products are tested for strength, aesthetics, and user convenience.
- Sustainable development practices – minimizing environmental impact by employing technologies that save energy, conserve resources, and reduce waste.

The R&D Department at Northwood has consistently executed a broad range of projects aimed at implementing advanced technological solutions aligned with circular economy (CE) principles and sustainable development. These projects include:

3.1. Optimization of Energy Efficiency

With the support of the Enea Optima monitoring system, Northwood analyzes energy consumption every minute of the production process, allowing for the swift identification and elimination of waste. This system also provides detailed data that supports the development of cost-saving strategies. As part of its energy optimization efforts, Northwood introduced energy production from its own photovoltaic plant, significantly powering the facility. Charging of electric equipment, such as forklifts, electric vehicles, and pallet drying, primarily occurs during off-peak hours, minimizing operational costs.

3.2. Use of Recycled Materials and Lower-Grade Wood

Northwood has developed a production system that maximizes the use of recycled materials and lower-grade wood. Sawdust and wood chips, treated as secondary raw materials, are repurposed for manufacturing MDF boards, primarily produced by Kronospan in Poland, to whom Northwood supplies these materials. High-quality materials are carefully selected for production to ensure that even by-products maintain quality standards. New products, such as newly designed pallet types, undergo a complete production introduction phase involving prototype design, prototype testing, and production trials to ensure quality and durability. This approach enables Northwood to produce durable single-use pallets, suitable for multiple uses, enhancing the environmental profile of its products.

3.3. Testing, Prototyping, and Quality Control Processes

Before any new product series is launched, Northwood undertakes a multi-stage process of testing and prototyping, beginning at the design phase with technical drawings and 3D modeling. Each product is first developed in visual and technical form to optimize

functionality and quality. Subsequent stages include durability and functionality tests, with prototypes subjected to load testing to confirm resilience under real-world conditions. Finally, before mass production, each series undergoes testing as a trial batch to eliminate any material or technological imperfections. This rigorous evaluation process allows Northwood to produce high-quality products with extended life cycles that meet stringent environmental standards.

Since establishing the R&D Department, Northwood has continuously adapted its production policies to meet CE requirements. The integration of circular economy principles at Northwood involves:

- Eliminating Waste of Materials and Energy – Wood drying is supported by a heat recovery system, which recaptures and reuses heat, thereby reducing energy consumption. Sawdust and wood waste generated during production are converted into semi-finished products like particleboard, which can be used in other manufacturing processes.
- Just-In-Time Production – With streamlined logistics and production processes, Northwood has implemented a Just-In-Time model, reducing the need to store finished products and minimizing costs associated with handling and internal transport.
- Transparency and Waste Elimination – The production process is organized to minimize material, time, and energy losses. This enables Northwood to operate in line with Kaizen and Just-In-Time principles, reducing bottlenecks and optimizing each production stage.

A key factor in Northwood's innovative solutions is inspiration drawn from sustainable practices adopted by international partners. In 2012, Northwood began collaboration with the Danish Standards Foundation (DS), which facilitated the integration of the latest technologies and production methods used across Europe. DS, a standardization organization, supports the development of standards compliant with international requirements (ISO, IEC) and promotes an ecological and sustainable approach. Although Northwood no longer produces DS-certified pallets, it has retained practices acquired through collaboration, such as rigorous product testing and quality work before serial production, which continue to be applied.

Examples of initiatives resulting from Danish practices and Northwood's R&D activities include:

- Implementation of the IMH Production Line – The energy-efficient IMH production line, developed by a Swedish manufacturer, allows Northwood to reduce energy consumption and enhance production efficiency.
- Optimization of Production Logistics – Inspired by Danish production layouts, Northwood has simplified internal logistics, reducing unnecessary handling and using a Just-In-Time storage model.

- Recycling Technology Integration – Northwood has adopted advanced recycling technologies, enabling material recovery and reuse, significantly reducing waste. These technologies allow production waste to be converted into valuable products for new manufacturing processes.

3.4. Life Cycle Analysis (LCA) and Compliance with Circular Economy

The R&D Department at Northwood also focuses on life cycle assessment (LCA) to evaluate environmental impact at every stage—from production through use to recycling. In practice, this involves:

- Durability Assessments and Material Analysis – Products like single-use pallets are designed to meet high durability standards, allowing for prolonged use even though they are technically single-use items.
- Lifecycle Optimization – Northwood continually optimizes product longevity to reduce the need for new resources and minimize waste generation. LCA allows Northwood to assess product recyclability and environmental impact, supporting CE principles.

As part of Northwood's R&D initiatives, the company invests in employee education and training, recognizing that the long-term success of CE implementation depends on employee engagement at every production stage. Northwood provides training on environmental protection, resource management, and sustainable production.

Northwood's management invests in R&D as a foundation for innovation and growth. In highly competitive industries, where rapid improvements are essential, these actions respond to market realities. The R&D Department allows Northwood to improve product quality and competitiveness, reduce production costs through material and energy efficiency, meet environmental and legal standards increasingly required in international markets, and adapt to market trends and changing demands, such as ecological and technological advancements.

In the context of Northwood's primary product, pallets, the R&D Department focuses on:

- Developing More Durable Pallets – Pallets are subjected to load and durability testing to ensure longevity even under challenging conditions.
- Optimizing the Use of Wood and Recycled Materials – Solutions are implemented to maximize resource use, crucial for producing single-use pallets.
- Recycling and Sustainable Resource Management – The R&D team works on technologies for recovering and reusing materials that no longer fulfill their original purpose.
- Designing New Types of Pallets – Adapted to diverse market needs, such as environmentally friendly, reusable, or single-use pallets optimized for greater durability.

Through this approach, the R&D Department enables Northwood to develop environmentally friendly products while supporting economically efficient resource management.

4. Summary and Conclusions

The establishment of the R&D Department and the implementation of related initiatives at Northwood have had a profound impact on the company's growth, positively influencing customer and partner perceptions and contributing to the improvement in both the quality and volume of orders fulfilled. Northwood's R&D activities underscore the positive impact of its strategic decision in 2018 to focus on research and development as a core growth strategy.

The initiatives presented demonstrate that a carefully planned, company-specific R&D approach—executed methodically and systematically—can significantly enhance a company's competitiveness in the marketplace. The benefits Northwood has realized from its R&D endeavors may serve as a signal to other institutions and organizational leaders of the value of supporting core activities with a strong R&D foundation.

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