

Article

Current and Expected Development of Corporate Strategies for Managing Environmental Risks in Hungary

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Abstract: Environmental challenges often present businesses with unexpected situations, and in order to address them, innovation in the direction of sustainability must become an unavoidable activity. This entails the transformation and development of the existing business models, assuming a great business risk. The occurrence of the risk and its extent can only be estimated, which is why it is important to have management models that are able to handle the challenges posed by new, constantly arising risk factors. We analyzed the largest companies based on the number of employees with headquarters or sites in Hungary with regard to the management methods used by them to manage environmental risks. The methods used were the analysis of variance and cluster analysis. Based on the results of the research it is clear that the companies surveyed are already very concerned with environmental opportunities and risks, and they expect that the role of innovations applied to manage them to play a more prominent role in their future target system. However, the level of this is significantly different and does not depend on the financial performance, and at the same time companies can be divided into distinct groups according to the level of environmental risk management.

Keywords: environmental risk; environmental innovation; sustainability; management models; grouping according to the level of corporate sustainability



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1. Introduction

In response to the world's environmental challenges, innovation coupled with sustainable development offers new opportunities for the corporate sector to adapt or improve their processes and products in ways that deliver environmental, business and social benefits (McCausland 2021). Traditional strategies focused on shareholder value remain essential, but strategies that are more beneficial to a broader range of stakeholders focusing on total societal impact can be more resilient (Bhattacharya et al. 2020), which bring the natural environment into the mainstream of the companies' objectives, alongside many other stakeholders. The environmental challenges, risks and the interconnected nature of their social and economic drivers require a systemic approach to innovation as a key for solving problems.

In their research, Nidumolu et al. (2013) have found that many enterprises believe that environmental innovation impairs competitiveness. The reason for this, in their opinion, is that environmental innovation increases costs, requiring a large amount of initial investment, which has a long payback period and does not bring any immediate financial benefit (Cai and Li 2018; Hojnik and Ruzzier 2016). Moreover, environmental regulations only impose an extra administrative burden on businesses, limiting their activities in the business environment (Csath 2019). It is true that environmental innovation brings serious social benefits, but at the same time it also poses a great risk to companies in the business environment (García-Sánchez et al. 2019). Companies operating in developed

countries often see it as a disadvantage compared to their rivals in developing countries, which do not face as much environmental pressure.

The finding of Nidumolu and his co-authors in 2009 represents the basis for much further scientific research, as evidenced by the nearly 3000 citations. Nowadays, their finding is also referred to by Araújo et al. (2022). In a 2013 study, Nidumolu et al. states that sustainability is an incentive for organizational and technological innovation. Managers do not have to choose between the social benefits of sustainability and the costs of its implementation, because companies' costs are reduced as the use of inputs decreases. In this context, it is important for companies to combine sustainability metrics with concrete financial and operational results, e.g., investing in sustainability increases the recycling of product components, which reduces the need to purchase virgin materials (Harvard Business Review Analytic Services 2022). The process generates extra revenue through better products and new business opportunities. The initial goal of becoming sustainable is a better image, but at the same time most companies can reduce costs and achieve new business opportunities with better, more environmentally friendly products. Many studies examine the impact of environmental innovation on competitiveness, mostly from two perspectives (Figure 1).

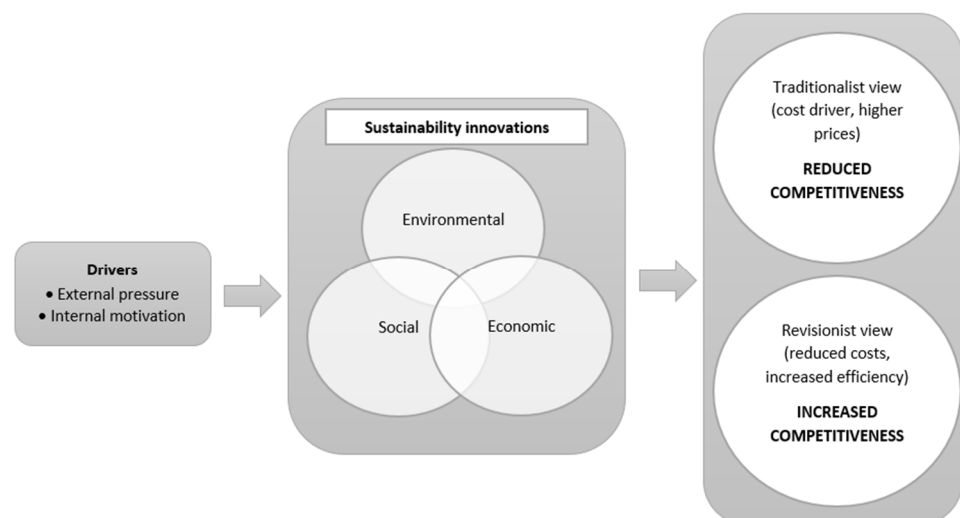


Figure 1. Aspects of sustainability innovations. Source: based on Hermundsdottir and Aspelund (2020), edited by the authors.

Hermundsdottir and Aspelund (2020) found after a qualitative analysis of more than a hundred peer-reviewed scientific publications that the results of various research reveal common factors that can be used to characterize sustainability innovation and its impact on competitiveness (Table 1):

Table 1. Sustainability innovations and their competitiveness factors. Source: based on [Hermundsdottir and Aspelund \(2020\)](#), edited by the authors.

Sustainability Innovation		Competitive Advantage	
Product	Quality improvement	Increased value creation	Market share
	Reduced material and energy use		Profitability
	More environmentally friendly materials		Sales growth
	Environmentally friendly packaging		First mover advantage
	Recycling and reuse		New market opportunities
	Eco-labeling (can increase sales)		Productivity
Process	Reduced emissions	Reduced costs	Efficiency
	Reduced waste		Reduced costs
	Recycle and reuse		Reputation
	Reduced energy and materials consumption	Non-financial assets	Image
	Reduced resources		Quality
	Lower consumption of water, electricity, gas patrol, coal		Customer satisfaction
Managerial	Environmental management		
	ISO certifications		
	Green marketing		
	Organizational methods		

The research results presented above also point to the fact that taking the sustainability approach into account when measuring competitiveness is inevitable nowadays. At the company level, activities that make it increasingly possible to reduce the environmental burden in a given legal and social context are becoming a priority. Innovation and technological diffusion are some of the tools to achieve this ([OECD 2017](#)).

However, the issue of financial performance indicators should not be neglected. Several studies deal with the possible connections between financial performance and sustainability. In their research among 80 Slovenian companies, [Ermenc et al. \(2017\)](#) found a close significant correlation between sustainability and the financial performance of the companies in the three years following the measurement of sustainability. The relationship is positive with return on assets (ROA) and negative with the company's indebtedness. This means that a higher level of sustainability leads to a higher level of income generated by the operation of total assets and may also imply a higher level of business risk-taking in the long run. An increase in the level of sustainability also implies a decrease in indebtedness, which leads us to conclude that in the long run, environmentally responsible businesses gain competitive advantages that provide a more stable income. At the same time, the research found no connection between the past value of the financial indicators and the future level of corporate sustainability. Company size also has a significant and positive effect on sustainability ([Forcadell et al. 2019](#)). [Araújo et al. \(2022\)](#) examined 202 South American companies and verified the relationship with indebtedness. This is explained by the fact that ROA is a one-year indicator, while innovation related to sustainability and environmental protection brings benefits in the long term. The above research clearly demonstrate that ROA, indebtedness and company size influence the amount of resources that can be devoted to environmental innovation.

Arbelo et al. (2014) demonstrated among 199 companies operating in the mineral manufacturing industry in Spain that being responsible for the environment is positively related to economic efficiency, and increases the profit of the company, but they could not demonstrate that it reduces the company's costs.

In a meta-analytical study, Kuzma et al. (2020) synthesized 15 articles based on a quantitative analysis and found a positive, moderately strong relationship between innovation and sustainability performance, and a strong, positively significant correlation with social, environmental and economic variables.

In their study, Vasileiou et al. (2022) investigated the relationship between environmental innovation and financial performance in four innovation areas: product, process, organizational and marketing innovation. Their analyses showed that the correlations between different innovation areas and environmental innovation affect financial performance in different ways, with different direction or strength.

The presented research all lead to the conclusion that sustainability issues have some effect on the operation of businesses. This effect also influences the wealth, income and financial situation through production processes. The results also suggest that a sustainability approach also implies a willingness to take risks according to the degree of innovation within the organization. These two factors lead to the level of corporate strategy making. Compared to the presented research, this study approaches the issue of the sustainability from the point of view of businesses. The authors assume that the sustainability approach appears in the medium-term strategy of large enterprises through conscious planning. However, the extent of this may differ, and on this basis the businesses can be classified into well-defined clusters.

In the framework of the Literature Review, in Section 2.1, we provide an overview of environmental risks and their management, and in Section 2.2 we present the strategies for managing environmental risks, with special focus on the approach that forms the basis of our empirical research. At the end of the Literature Review, as an added value to the literature, we analyze the factors that appear with similar and different weights in the models of environmental strategies. In Section 3, we describe the Materials and Methods of the empirical research, which covers the basic statistics of the examined sample, the applied statistical methods, and the research questions and hypotheses. In Section 4, we present the Results and Discussion, which includes the basic characteristics of the responses, the results of the cluster analysis for the present and the results of the cluster analysis for the future. Finally, we summarize the results and draw conclusions.

2. Literature Review

2.1. Environmental Risks and Their Management

When a business commits its activities to sustainability, it also undertakes to continuously measure, evaluate and manage the level of environmental risks. Businesses consider as a risk any hazard which can be characterized as having a probability of occurrence and a harmful effect as a result. In the case of environmental risk, the hazard factor is some harmful environmental effect, and the degree of risk is determined by the probability of occurrence and the degree of the harmful effect (Bakosné 2016). The range of risks is very wide, and businesses must not only ensure that their activities do not have a harmful impact on the environment, but they must also address new problems as they arise. Such a new problem can be, for example, the detection of new pollutants, but also the increasingly frequent extreme-weather phenomena. Technological innovation is key to managing environmental risks. It is easy to see the long-term social effects of environmental risks. One of the most striking examples is the disaster at the Aurul gold mine (Baia Mare, Romania) in 2000. One hundred thousand cubic meters of wastewater containing cyanide and heavy metals caused enormous environmental damage. This disaster was the trigger for the large campaign against the cyanide mining at Roșia Montană (Romania). The fact that the mining company communicated its activities as a project with a high level of environmental safety also contributed to the tragedy (Alexandrescu et al. 2022; Vesalon and Crețan 2013; Rîșteiu

et al. 2022). In addition to the ecological effects, there were also significant social effects, since the perception of the enterprise was strongly influenced by its ability to generate jobs and income. Thus, the disadvantaged areas, where mining activity has been suspended, are characterized by deepening social problems. The key to the economic shift in these areas may be the operation of foreign companies with strong capital (Crețan et al. 2017).

Technology largely determines the demand for raw materials and energy, production methods and efficiency, product performance, waste reduction and management, health and safety, transport and infrastructure, etc., thus having a significant impact on the economy, and on the environmental and social dimensions of industrial development (Huang 2021). Today, the transformation of the energy system, which has become a key element of economic competitiveness, is a prominent risk factor, therefore it is essential to reduce emissions and energy costs on both the consumer and corporate side, to transform the energy mix, and to increase the proportion of renewable energy sources (Bognár and Böcskei 2022).

The risk management activities of businesses are also greatly influenced by the fact that the European Union wants to develop the EU economy into a resource-efficient, environmentally friendly and competitive low-carbon economy with the help of strict environmental protection standards, while protecting and increasing the EU's natural capital and protecting the inhabitants from environmental pollution, as well as from risks endangering health and well-being (EU.hu/1 2022). It follows from the above that risk analysis is a complicated activity, the result of which is greatly influenced by the chosen methodology, and which must always be subject to both national and community regulations (EU.hu/2 2022). In general, however, it can be stated that risk analysis consists of five distinct steps (Figure 2).

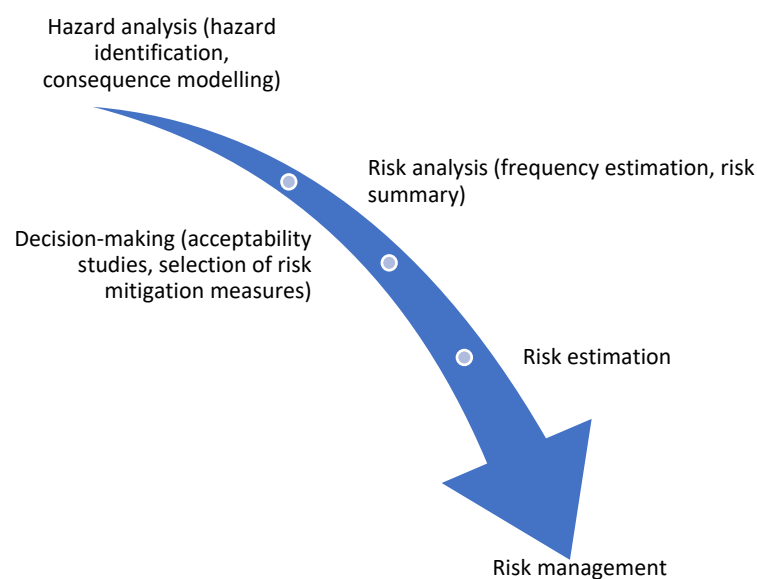


Figure 2. Steps of the risk analysis. Source: based on (Czakó 2016), edited by the authors.

In accordance with the ISO 31000:2018 (2018) standard, risk is defined as follows (Fekete 2015): a risk can be an event, an activity or the absence of an activity that may occur in the future and, if it occurs, will positively or negatively affect the achievement of goals. When defining risks, it is necessary to make sure that the wording is future-oriented and can be interpreted along some goal. It is also very important that in common parlance, risks are usually interpreted as having negative outcomes, but the outcomes of the risks can also be positive (Fekete 2022). In the opinion of the authors, this is also true for environmental risks, since a growing eco-awareness and its communication to consumers can also lead to increasing sales figures.

However, it is not enough to operate the risk management system once it is in operation; it must also be improved due to the rapid changes in the environment. Thus, the process of risk management is cyclical and recurrent (PMI 2019). Identifying potential risks should be the basis of risk management. Recent studies suggest the combination of traditional and innovative risk assessment procedures. For example, Bognár and Benedek (2022) recommend the AHP (Analytic Hierarchy Process) and PRISM (Partial Risk Map) methods to increase the reliability of the risk assessment. These can also be used when the decision-making problem is on the strategic level and dealing with increased complexity.

The efficiency of the system depends to a large extent on the resources that the company allocates to risk management and the extent to which it is integrated into the corporate governance system. When integrated into the corporate governance system, risk management achieves its goal, because the appropriate level of risk management means a value-creating process for the future of the enterprise (Verzuh 2021). In its research carried out in 2019 (Eciiia.eu 2020), The Alliance for Corporate Transparency examined the published information on environmental and social risks and the impacts of 1000 European companies in accordance with the EU directive on non-financial reporting (Eur-lex 2022, Directive 2014/95/ EU). According to the results, nearly 40% of the companies included in the research formulated climate-related objectives, and only a quarter of them address risks related to environmental impact (eciiia.eu). All of this means that many businesses must realize that risk analysis and risk management not only make it possible to prevent damage, but can also deliver significant cost savings. This makes it possible to operate more efficiently, since the handling of a potential damaging event would hinder and slow down the operation of the business.

2.2. Levels of Development, Innovation, Strategies for Managing Environmental Risks

The study conducted by Renner et al. (2022) reveals that 58% of the more than 200 companies they examined consider as the drivers of the significance of the sustainability issue to be consumer needs, customer behavior and expectations (53% of them consider their own organization, driven mainly by own employees, 50% the external reporting obligations, 43% the capital market). The research demonstrates that sustainability will become an existential issue for companies in the coming period. A total of 93% of managers believe that companies that are not yet seriously engaged in transformation towards sustainability will suffer a competitive disadvantage in the medium term. Among the dimensions of sustainability, ecological goals are the most important for 79% of the companies involved in the research (as distinct from social or economic aspects). All this means that the pursuit of sustainability transforms competition, forcing companies to change the way they think about products, technologies, processes and business models (Nidumolu et al. 2013). At the same time, this also means that companies must make room for the integration of risk management into their corporate governance system, in order to meet the expectations of sustainability and thus increase their competitiveness. The importance of bringing the sustainability perspective to the fore is also proven by the research of Loredó et al. (2019), which demonstrated, based on a sample of 82 Spanish utility companies, that sustainability orientation increases the likelihood of implementing both product and process innovations. It is therefore no coincidence that numerous qualitative and quantitative studies involving companies have been conducted in this area in the past period.

For example, the concept of sustainability-oriented innovation (SOI) was defined by Adams et al. (2016) as an approach that “involves making intentional changes to an organization’s philosophy and values, as well as to its products, processes or practices, to serve the specific purpose of creating and realizing social and environmental value in addition to economic returns”.

Adams et al. (2016) also found that the development of innovation areas affecting sustainability is realized along

- product innovation;
- product and process innovation;

- and product, process and organizational innovation factors.

In their research, they integrated the empirical literature on SOI and developed a synthesized conceptual framework to map SOI practices and processes, based on the examination of 100 scientific publications and 27 gray sources. Their model (see Table 2) focuses on the day-to-day practices that comprise the SOI. The authors point out that firms may be engaged in more than one context-specific practice and that the model cannot be considered a stage model or typology, as it cannot take into account changes over time. The authors define the model mainly as a conceptual and theory-building scientific framework, on the basis of which company managers can understand the practical aspects of SOI.

Table 2. The model and activities of sustainability-oriented innovation. Source: based on [Adams et al. \(2016\)](#), edited by the authors.

	Operational Optimization “Eco-Efficiency”	Organizational Transformation “New Market Opportunities”	Systems Building “Societal Change”
Innovation Objective	Compliance, efficiency “Doing the same things better”	Novel products, service or business models “Doing good by doing new things”	Novel products, service or business models that are impossible to achieve alone “Doing good by doing new things with others”
Innovation Outcome	Reduces harm	Creates shared value	Create net-positive impact
Innovation’s Relationship to the Firm	Incremental improvements to business as usual	Fundamental shift in firm purpose	Extends beyond the firm to drive institutional change
Strategy	Complying with regulations or pursue efficiency gains	Embedding sustainability as a cultural and strategic norm in a shaping logic that goes beyond greening	Logic of wide collaborations and investing in system solutions to drive new, co-created value propositions
Process	Focus on internal and incremental innovations	Adopting new values, platforms and new ideation practices (e.g., biomimicry)	Adopting new collaborative process platforms with diverse stakeholders

Research in the field of sustainability innovation was also conducted by [Mead et al. \(2022\)](#), who, examining the application of nature-inspired innovation (NNI), identified three types of organizational narratives related to SOI:

- Ambiguous;
- Accountable;
- and aspirational.

In the case of organizations characterized by an ambiguous narrative, there are no clear definitions, drivers, motivations or responsibilities for sustainability, and their level of ecological consciousness is low. The organization’s sustainability efforts are limited, usually addressed by an individual or a team, and have little impact on overall operations. On the whole, these enterprises are characterized by a general lack of cohesion in relation to the sustainability strategy at all levels of the organization.

Organizations belonging to the accountable narrative group are characterized by highly institutionalized quantification methods and rely on extensive reporting structures created by sustainability departments. The ecological principles are applied to product and packaging innovations and management processes. The impact of all organizational activities on sustainability is measured, for e.g., the return on investment in the innovation project. The sustainability approach has a very strong culture, and sustainability and innovation are considered to be the same thing. At the same time, they are rigidly tied to specific metrics or historical narratives and sustainability models. However, a strategy strongly tied to metrics, the highly institutionalized objectives, complicated accounting systems, rigid, formal processes and metric-driven results inhibit the innovative and

creative spirit of these companies, the continuous development capabilities, and through them the progress of SOI within the organization.

The aspirational narrative moves away from metrics-centered thinking and strives for the ecological embeddedness of the organization, making sustainability the goal and intrinsic motivation of the organization. To achieve this, businesses allocate significant resources and skills, relying on both radical and incremental innovations. The company's overall sustainability strategy is typically "net positive" or "restorative", so the main goal is not only to reduce the environmental burden to a minimum level, but in parallel they also want to develop their sustainability-supporting activities. They start with theories arising from the system-level functioning of ecosystems and translate them into products, services, and business models (biomimicry) as best as possible. NNI was most effective among companies where the integration of socioecological systems into business strategy was used as a broad ethical guideline.

It can be concluded that the NNI and SOI are seen as philosophies that influence the mission of the company. In several cases, they strive for conceptual sustainability goals that are difficult to achieve, but are attractive to sustainability-motivated consumers, who value the vision of businesses that focus on this. The core values of the organization are the stimulation of innovation, flexibility, freedom, risk-taking, experimentation, continuous learning and change. The innovation culture is flexible and decentralized, without strong leadership hierarchies, and supports the exploration of radical innovations that are not tied to metric-driven results. Aspiring organizations may be criticized by external stakeholders for pushing the boundaries of sustainability in their industry and thus demonstrating their willingness to take high risks.

In recent years, several studies were conducted that define corporate sustainability at different levels of development. Landrum's (2017) Stages of Corporate Sustainability model was established based on the integration of the development stages of 22 micro- and macro-level models found in the literature of corporate sustainability, social responsibility, environmental management and sustainable development. The model distinguishes five stages:

Stage one—Compliance: sustainability activities are externally enforced, the company continues business-as-usual, and only carries out sustainability activities that are subject to regulated standards.

Stage two—Business-centered sustainability: characterized by the adoption and internal enforcement of sustainability initiatives to increase strategic competitiveness and to achieve the business objectives, e.g.: cost, profit, image, reputation, employee recruitment and retention, risk management). This stage is growth- and consumption-oriented, continues business-as-usual with incremental improvements, and aims to "do less bad".

Stage three—Systemic sustainability: it is based on the approach according to which the enterprises are also part of a larger industry and community, so they strive for systemic change, where they cooperate with other systems, but are still characterized by a growth, production and consumption orientation with limited integration of environmental or ecological science.

Stage four—Regenerative sustainability: extends beyond growth and consumption, integrating environmental and ecological sciences. Although many activities are aimed at restoring and regenerating nature, the position of control over nature is still characteristic. At the same time, qualitative development comes to the fore, pushing quantitative growth into the background, acknowledging the limits of growth and the planet's carrying capacity.

Stage five—Coevolutionary sustainability: applies the concept of "participating" in rather than "managing" the relationship between man and nature, based on the symbiosis of consumption and resources. The emphasis is on establishing a mutually reinforcing and beneficial relationship of balance, harmony and synergy as part of nature.

Young and Reeves (2020) distinguishes four phases in terms of corporate maturity (Figure 3). Their model builds on the innovation of the traditional business model but applies it in an expanded context.

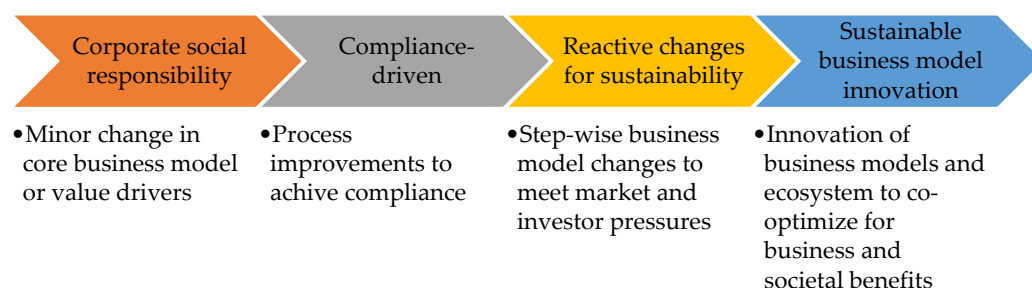


Figure 3. From compliance to sustainable competitive advantage. Source: [Young and Reeves \(2020\)](#).

Based on the model, it can be concluded that the sustainable business model is characterized by the following:

- can be applied effectively by increasing the return;
- increases differentiation and competitiveness;
- generates an environmental and social surplus;
- remains resistant to emerging social and environmental trends;
- and shows network effects, promotes stakeholder engagement ([Young and Reeves 2020](#)).

The present study is based on the model of [Nidumolu et al. \(2013\)](#), according to which becoming sustainable is a five-stage process. In the authors' view, businesses that choose the path of sustainability need to develop new capabilities at each of the five stages in order to cope with different challenges. This, in turn, leads to the fact that the model formulates the possibility of innovation already at the first stage, raises it to the organizational level and continues to develop from there. The model clearly states that traditional business models do not serve sustainability, so a complete change of approach is necessary at the entire organizational level. The curve of the model therefore represents a research opportunity that is suitable for analyzing the degree of environmental innovation for any company size, regardless of time and space. For this reason, when developing the model, the authors of this study also tried to supplement the various levels of Nidumolu's model with the findings and research results of other authors.

Stage 1: Green Compliance as Opportunity

The first steps that companies must take on the long road to sustainability usually stem from laws and regulations ([Hamburg 2020](#)). In the first step of becoming sustainable beyond legal regulations, focusing on complying with, surpassing and influencing industry and other protocols carries the possibility of innovation. Given that environmental protection regulations differ from state to state and region to region, it is therefore worth choosing the strictest of the regulations for the company's units located in different geographical areas, as the introduction of these regulations in the given territorial units is becoming more and more common these days. Another important finding of [Nidumolu et al. \(2013\)](#) is that the application of uniform procedures throughout the company and in the supply chain increases the benefits from economies of scale. Compliance with stricter standards has significant benefits in terms of fostering innovation. Companies focusing on increasingly strict standards have more time to experiment with resources, technologies and processes to develop more environmentally friendly versions ([Nidumolu et al. 2013](#)). In the first stage of the development process, the most important managerial tasks according to [Isensee and Michel \(2011\)](#) are to promote environmental innovation by exceeding mandatory regulations, creating transparency, using resources and achieving emissions, to evaluate opportunities and risks related to environmental protection, and to develop incentives for daily operational activities. In Stage 1, in order to advance to the next stages of development, it is essential to establish the right organizational culture to address environmental and social problems appropriately ([Geradts and Bocken 2018](#)). In order to promote sustainability-focused innovation, it is necessary for managers to clearly explain the goals to employees, to have adequate resources (e.g., training) and space for

cooperation, in order to be able to work with other areas of the company, with suppliers, and with customers. In addition to the above, positive reinforcement and accountability come to the fore.

Stage 2: Making Value Chains Sustainable

Sustainable business models show network effects and reshape value chains (Young and Reeves 2020). Kennedy et al. (2017) identified five critical organizational practices through which strategic management enabled the innovation process: “technology super-scouting throughout the value chain, search heuristics that favor radical sustainability solutions, integration of sustainability performance metrics in product development, championing the value chain to build demand for radical sustainability oriented product innovation, and harnessing the benefits of open innovation”.

With green compliance, companies become more proactive, which helps reduce the use of non-renewable energy. The next step in becoming more efficient is the extension to value chains, where suppliers and traders develop environmentally friendly materials and components and reduce the amount of their waste. Businesses analyze every link in the value chain; new methods are also being developed in the field of returned products (Hamburg 2020). Most of the large companies offer incentives to their suppliers to help them become more environmentally conscious and also help in the development of sustainable practices. Incentive tools can include compliance aspects fixed in contractual conditions (e.g., preferred status, order volume), setting sustainability performance targets, collaboration on sustainability improvement strategies, on-site audits, sharing of sustainability-good practices (e.g., reduce energy, water, waste or packaging, etc.) (Stanford Graduate School of Business, Ecovais 2021). Today, large companies are building a platform, a digital ecosystem in the value chain, with which they are breaking down the traditional boundaries, often containing globally connected data, reaching across industries, for e.g., in the automotive industry.

Many tools help companies identify sources of waste in supply chains, such as carbon management, carbon and energy footprint analysis, and a very useful tool is the life-cycle assessment, which encompasses the inputs and outputs of the entire value chain, from the supply of raw materials to product use and return. The central issues of sustainable supply chains are innovations that support energy efficiency and reduce dependence on fossil fuels. Partly for environmental reasons, many companies encourage their employees to work from home, which requires less travel time, less travel costs and less energy consumption. The monetary benefits of creating environmentally friendly supply chains are manifested in increased energy efficiency and reduced waste. Environmental awareness is taking root in the company, which will help it prepare for the next step (Nidumolu et al. 2013). The management tasks at this level include the creation of transparency of direct and indirect environmental impacts, and the development of incentives and obligations for partners in the value chain (Isensee and Michel 2011), so that they too become sustainable.

Pásztor (2022) identified four levels of addressing green issues in supply chains:

- Passive: little or no consideration is given to sustainability aspects.
- Event-driven: sustainability is integrated into the business process in an ad hoc, reactive manner.
- Practice-oriented: sustainability goals are met with practices implemented at the operational level.
- Strategically managed: sustainability aspects are treated as a strategic goal, as a differentiator in the market competition.

Stage 3: Designing Sustainable Products and Services

Radical innovation that replaces current harmful products and services is an extremely costly process with a high degree of uncertainty and risk, so it is important to examine the details of the product innovation process and the impact of fitting it into the context of corporate strategy (Kennedy et al. 2017). One of the most important activities in the early stages of product and service design is evaluation. In these early stages most of the costs are

determined, i.e., production costs, maintenance costs and end-of-life costs (this also appears in the approach of life-cycle costing and target costing), similarly to the environmental and social effects of innovation (Geibler et al. 2019).

Company managers realize that a significant number of consumers prefer environmentally friendly offers, and their company can gain a competitive advantage if they are the first to redesign their existing products or develop new ones. So, it is about the development of a sustainable offer, or making the existing ones more environmentally friendly. In order to determine the priorities of product development, companies need the competences and tools required for the previous steps. The process begins with the identification of the most environmentally damaging products and services. The requirements for company management include the development of truly environmentally friendly offers, the avoidance of “greenwashing” and the evaluation of product alternatives. In order to develop sustainable products, it is also essential to examine the product life cycle. Another task is to determine consumers’ willingness to pay for more environmentally friendly products/services and the ecological pricing of products and services (Nidumolu et al. 2013; Isensee and Michel 2011; Hamburg 2020).

Stage 4: Developing New Business Models

The fourth step is changing the competitive environment through the development of new ways of creating and preserving value (Isensee and Michel 2011) and new business models. In the system of the business model, business activity transforms inputs into outputs and results, while focusing on the fulfillment of strategic goals and short-, medium- and long-term value creation (Baldarelli et al. 2017). Changing business models is now a fundamental approach to innovation for sustainability (Evans et al. 2017). Sustainable business models harness or reshape business ecosystems (Young and Reeves 2020). In the supply chain of sustainable business models, suppliers also feel responsible towards the stakeholders of the focal company and promote sustainable consumption. The concept shows “how an organization creates, delivers, and captures value, in economic, social, cultural, or other contexts, in a sustainable way”, so the industry and nature of the business is very decisive in what sustainable business models they can use (Nosratabadi et al. 2019). In the literature, many authors (e.g., Evans et al. 2017; Geissdoerfer et al. 2016; Biloslavo et al. 2018; Oskam et al. 2018; Joyce and Paquin 2016; Roman et al. 2018) tried to provide a conceptual framework for the development of a sustainable business model, seeing the solution in value-based concepts, such as value provided to consumers, value ideation, value shaping, value triangle, encouraging businesses to rethink their value creation, value delivering and value-capturing processes.

At the level of Developing New Business Models, company leaders must learn to question their current business models and develop new mechanisms. The process requires the exploration of alternatives to the current way of doing business, and the determination of new opportunities for satisfying consumer needs, which also requires the involvement of business partners (Nidumolu et al. 2013; Hamburg 2020). At this stage, innovation can be aimed at developing new distribution/delivery technologies that will significantly change the relationships within the value chain. Innovation often focuses on developing revenue opportunities linked to services rather than products, and on developing business models that combine digital and physical infrastructure. At this level, the management is responsible for supporting the development of green business models, their evaluation and the preparation of business plans based on the green business models. The experiences of the fourth step lead to the achievement of the fifth step, where products and processes extend beyond the boundaries of individual markets (Nidumolu et al. 2013).

Stage 5: Creating Next-Practice Platforms

In the fifth stage of becoming sustainable, the focus is on questioning the dominant logic of today’s business, changing the existing paradigms and assumptions, our conventional knowledge and the status quo. This step imposes a number of requirements on management, such as understanding the impact of renewable and non-renewable re-

sources on the business ecosystem and the industry, and synthesizing business models, technologies and regulations into different industries. Innovation at this stage is aimed at developing business platforms that allow energy to be managed in a radically different way from suppliers to consumers, including technologies that allow industry to use the energy produced as a by-product (Nidumolu et al. 2013). Management tasks on the fifth step are the creation of new markets, systemic market analysis from the point of view of environmental protection, establishing a green market leadership role and market influence (Isensee and Michel 2011). Sommer (2012) states that the ranking order of types of sustainability innovation proposed by Nidumolu et al. is very simplistic, for which he cites as an example that green innovations in value chains can be much more meaningful and significant than some green product innovations. At the same time, he agrees with the authors on the issue that many types of green business model innovations require competencies that many businesses do not possess.

The fourth step and, above all, the fifth step, make it clear that the old formulas and theories are no longer sufficient for companies, i.e., new strategies and operating standards are needed. In terms of their growth strategies, operating models and organizational structure, companies must break with the past, which is a fundamental transformation, a revolutionary change. The constant need to change influences every decision, which means flexibility, resilience, and last but not least, continuous investment. Companies reaching the fifth level of development are redefining the concept of outstanding performance, where the most cost-effective distribution centers and manufacturing plants are no longer sufficient for superior performance, nor is the sale of differentiated products and services, but rather customized solutions must be offered and flexible networks must be built. Digital technologies and capabilities, business digital platforms and connected business partners and customers via the use of data algorithms show that technology is no longer a means of improving performance or processes, but a new production factor (Katona et al. 2019). It is now not only used to get information about all operational activities but is an essential component in the business model. The issues raised here are challenging, but also create a series of opportunities. In connection with the fourth and fifth stages, the concept of disruptive innovation should be mentioned, which is used in the literature as a synonym for radical, discontinuous or breakthrough innovation. In the opinion of the authors, this may include some of the sustainability and environmental innovations. Briefly, we present Christensen's concept of disruptive innovation, without discussing its limitations and the wide-ranging academic debate surrounding it. According to McDowall (2018), the theory is relevant, but it is not sufficient on its own to fully embrace the transition to a radical, low-carbon economy. Marinova et al. (2017) conclude that innovations are the building blocks of the transition towards sustainability, covering a wide range of technologies including incremental, disruptive, breakthrough and revolutionary (or radical) technological innovations. Christensen (1997) initially referred to disruptive technological developments, which are generally inferior in many areas in terms of quality and service to products based on the current market-leading technology; however, they provide services or have characteristics that are perceived as new value to a layer of existing users, or to new users. Developments continue alongside ever-increasing demand, so over time the new technology can approach or surpass the leading solutions, even in the field of weaker parameters (Christensen et al. 2015). Later, the concept of disruptive technology was extended to broader applications, e.g.: disruptive product innovations and disruptive business model innovations. Christensen et al. (2018) emphasize the theory of technology change in the context of facilitated network businesses, (businesses that operate via a type of platform). Disruptive innovations can fundamentally change how businesses operate (Rasool et al. 2018). According to Nasiri et al. (2017), IOT solutions are expected to revolutionize business markets by promoting the emergence of disruptive innovations for sustainability, for e.g., in the circular economy, intelligent energy services, transport solutions, etc. Kivimaa et al. (2021) argues that similar to disruptive innovation, where companies have to renew their skills and competencies in order to survive, sustainability

transitions also require new knowledge, resources and skills. The sustainability transition process also disrupts the dominant system configurations. In the definition produced by Kivimaa et al. (2021), disruption in the context of sustainability transitions is a “high-intensity effect in the structure of the sociotechnical system(s), demonstrated as long-term change in more than one dimension or element, unlocking the stability and operation of incumbent technology and infrastructure, markets and business models, regulations and policies, actors, networks and ownership structures, and/or practices, behavior and cultural models”.

In the literature, we can find many stage-based models similar to the model of Nidumolu et al., among which we mention the model of Pavie et al. (2014), whose steps are:

1. Comply with the law.
2. Anticipate future legal requirements.
3. Think the value chain as an ecosystem.
4. Develop responsible products and services.
5. Lead the change.

Isensee and Michel (2011), in a survey of 295 medium- and large-sized enterprises in Germany, based on the five steps in becoming sustainable, identified four types of strategies according to the different weights of green issues (Table 3).

Table 3. Isensee and Michel’s (2011) green strategies. Source: based on Isensee and Michel (2011) and Michel et al. (2014). Edited by authors.

Stage	Green Compliance	Wait-and-See Strategy	Green Products and Services	Completely Green Strategy
Goals	Compliance, risks and costs goals	All five stages are of low importance, image and social goals	Focusing on green products and services, innovation, competitive advantage and turnover growth targets	All five stages are above average and balanced in importance
Stakeholders	Outside of legislation, there is little external influence	The influence of external stakeholders is still low	Above-average influence of market players	Strong influence of all stakeholders
Share among the investigated enterprises	20%	27%	26%	27%

Based on the literature review, Table 4 summarizes the differences and similarities between the authors and their classifications of strategies, since, as can be seen from the above analyses, there are often recurring elements in various works, they just appear with a different weight. Among the similarities, it should be highlighted that quite a few authors deal with compliance at the beginning of the ranking, e.g., Landrum (2017), Nidumolu et al. (2013), Young and Reeves (2020), Isensee and Michel (2011) and can also be classified here as they comply with the law category of Pavie et al. (2014). In many implementations, the requirement of sustainability appears in the value chain, for e.g., in Landrum (2017) and Nidumolu et al. (2013). Quite a few authors emphasize revolutionary innovations, which result in changing the business model, for e.g., in Young and Reeves (2020) and Nidumolu et al. (2013). Some of them, for e.g., the aspirational narrative of Mead et al. (2022) and Landrum’s (2017) category of coevolutionary sustainability see the vision of sustainability as a kind of holistic philosophy at higher stages of development. Some studies have a strong focus on the creation of new platforms based on technological and digital achievements, collaborative processes, for e.g., Adams et al. (2016). Both of the latter criteria are integrated in the category Creating Next-Practice Platforms by Nidumolu et al. (2013).

Table 4. Related relevant publications on the sustainability strategies and their classifications. Source: edited by the authors.

Author	Basis of Grouping	Grouping Criteria	Groups
Adams et al. (2016)	Sustainability-oriented innovation (SOI) SOI practices and processes	based on the examination of 100 scientific publications and 27 gray sources	Operational Optimization— “Eco-Efficiency”
			Organizational Transformation—“New Market Opportunities”
			Systems Building—“Societal Change”
Mead et al. (2022)	Types of organizational narratives related to SOI	Using data generated from semi-structured interviews (n = 52)	Ambiguous
			Accountable
			Aspirational
Landrum (2017)	Stages of corporate sustainability	Based on the integration of developmental stages of 22 micro- and macro-level models	Compliance
			Business-centered sustainability
			Systemic sustainability
			Regenerative sustainability
Young and Reeves (2020)	Spectrum of company maturity from corporate social responsibility (CSR) to “sustainable business model innovation” (S-BMI)	Non applicable	Coevolutionary sustainability
			Corporate social responsibility
			Compliance-driven
Nidumolu et al. (2013)	Stage model of becoming sustainable	Studying the sustainability initiatives of 30 large corporations	Reactive changes for sustainability
			Sustainable business model innovation
			Green Compliance as Opportunity
			Making Value Chains Sustainable
			Designing Sustainable Products and Services
Isensee and Michel (2011)	Based on the five steps of becoming sustainable by Nidumolu et al.	A survey of 295 medium- and large-sized enterprises in Germany	Developing New Business Models
			Creating Next-Practice Platforms
			Green Compliance
Pavie et al. (2014)	Integration of responsibility at all levels of the organization	Via four workshops: ‘theoretical’ approach; Deductive; analyzed by academics; ‘Practical’ approach; Inductive; analyzed by banking- and insurance-sector users and professionals	Wait-and-see Strategy
			Green Products and Services
			Completely green strategy
			Comply with the law
			Anticipate future legal requirements
			Think the value chain as an ecosystem
			Develop responsible products and services
			Lead the change

3. Materials and Methods

The findings presented in the literature review inspired the authors to conduct similar company-level research in Hungary. The analyses were based on the model developed by [Nidumolu et al. \(2013\)](#). In the present study, the authors specifically focused their attention on large enterprises, assuming that they can be considered vanguards in the field of environmental innovation. The population of the survey consisted therefore of the largest enterprises in terms of number of employees with headquarters or premises in Hungary. The answers to the research questions are based on an analysis of the results of a primary, electronically sent questionnaire survey. Companies were asked to rate their attitudes to the research questions on a six-point Likert scale, representing their attitudes towards the research questions. A total of 4606 questionnaires were delivered, of which 202 were returned. The sample on which the analyses are based covers a wide range of businesses of different types and sizes. In terms of size, nearly 70% of enterprises have between 50 and 250 employees, and 30% have more than 250 employees. The largest respondent company has more than 37,000 employees. Nearly 40% of the responding enterprises operate in the manufacturing industry, with a very diverse main field of activity. Several companies are active in metalworking and metal structure production or are engaged in the production of vehicles and vehicle engine parts. Regarding the annual net turnover, the deviation between the companies is very large. Among the business organizations included in the sample, HUF 342 billion (~EUR 840.3 million) was the largest and HUF 48 million (~EUR 118 thousand) was the company with the smallest net sales. The Return on Assets was 5.04% on average, also with significant differences between companies. All this shows that the sample on which the analyses are based covers a wide range of businesses of different types and sizes.

One of the main goals of the analysis was to group the investigated companies based on the current state of their environmental protection strategies and for the next 3–5 years. The analyses were carried out by using the SPSS software. The grouping was conducted by using the cluster analysis method. Among the methods of cluster analysis, we used the non-hierarchical K-means approach, which is less cumbersome and more appropriate for larger samples in contrast to hierarchical methods using a tree-like structure. The validity of the cluster analysis was also checked in each case. The number of elements in the clusters was based on the authors' preliminary assumptions and the significance level of the F-test. The significant difference between the centers of the created clusters was established based on the significance level of the F-statistics ([Molnár, Tamás 2015](#)). Based on the verification of the conditions of the cluster analysis, the available database is suitable for drawing relevant conclusions. The authors used the analysis of variance method ([Molnár, Tamás 2015](#)) to investigate the relationship between clustering and the financial indicators of firms. The analysis focused on answering two main research questions:

Q1: What are the corporate goals and strategies for managing the economic risks related to environmental protection, and what is their level of development among Hungarian businesses?

Q2: In the medium term (3–5 years horizon), in what direction are company goals and strategies expected to move?

Based on the research questions, it can be assumed that there are differences between companies in terms of environmental-risk management and future strategy due to the different risk-management attitudes. Because large companies are involved, these differences are likely to emerge at a higher level, when new business models are developed. The reason for this is that today, large companies strive to assess and evaluate environmental risks, as well as to develop products and services taking into account environmental aspects and social expectations. Taking all of this into account, the research focused on examining two hypotheses:

H1: *Examining the current and expected strategies, the biggest difference can be seen when reaching the fourth stage of becoming sustainable (Developing New Business Models).*

H2: *The investigated enterprises can be classified into different clusters in terms of their strategies related to the management of environmental risks.*

4. Results and Discussion

4.1. Basic Characteristics of the Responses (Distribution Ratio, Mode)

The questions included in the questionnaire were adapted from the model of [Nidumolu et al. \(2013\)](#) (Table 5). The companies surveyed were asked to rate their management's role in setting forward-looking environmental objectives on a Likert scale of one to six. The rating was based on the same methodology in the case of each question, i.e., the smallest value on the Likert scale (one) was assigned to the given variable by the companies if it was not considered to be a managerial task. Contrary to this, when the management of the variable was considered an important task for the manager, the highest Likert scale value (six) was assigned to the variable in question.

Table 5. Variables included in the questionnaire. Source: edited by authors.

Stage 1	1/a. Promoting environmental innovation by exceeding mandatory regulations
	1/b. Creating transparency regarding the resource use and emissions
	1/c. Assessment of opportunities and risks related to environmental protection
	1/d. Creating incentives for daily action
Stage 2	2/a. Creating transparency of direct and indirect environmental impacts
	2/b. Creating incentives and obligations for partners in the value chain
Stage 3	3/a. Evaluation of environmentally friendly product alternatives
	3/b. Determining consumers' willingness to pay for more environmentally friendly products/services
	3/c. Ecological pricing of products and services
Stage 4	4/a. Evaluating and encouraging the development of a green business model
	4/b. Preparation of business plans according to the green business model
Stage 5	5. Creation of new markets, systemic market analysis from the point of view of environmental protection, establishment of a green market leadership role, market influence

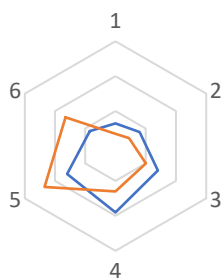
In the case of the variables measured at Stage 1, it can be said as a whole that a rating of four and above according to the Likert scale was the most typical in terms of both the present and the future. It also emerges that businesses judge their current performance more cautiously and apparently score more “strongly” in their assessment of the future:

- For the question “1/a. Promoting environmental innovation by exceeding mandatory regulations”, the most frequently given score (mode) for the present was four (26% of the respondents); however, for the future, the highest proportion gave a rating of five (33 %). It can therefore also be seen that the ratio of the most characteristic scores of the present and the future also differs, so the promotion of environmental protection innovation is even more often classified as a management task by enterprises. This is confirmed by the fact that even for the highest possible score (six), the difference between the current score (12%) and the expected future score (23%) is more than double (Figure 4). From the above, it can be concluded that in the future, businesses intend to place a much stronger emphasis on innovation, and it also shows that, at present, innovation is still not among the most important strategic factors in many cases.
- “1/b. Creating transparency regarding the resource use and emissions” is currently a more important factor in the life of businesses compared to the previous variable. Almost a third of the businesses included in the analysis gave a rating of five on this question. For the future, the rating of five appears in a similar proportion, but here

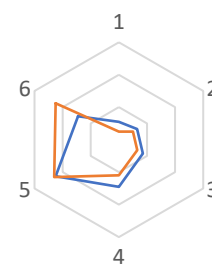
too there is a striking increase in the frequency of the highest value (six) (32%). The enterprises therefore consider that their operations are currently transparent in relation to the use and emission of resources, but they still see the opportunity for development in the system, so they shape their strategies in the medium term accordingly.

- The highest proportion of scores for the question on “1/c. Assessment of opportunities and risks related to environmental protection” also fall into the 4–6 category (four–25%; five–30%; six–22%). The assessment of this variable is similar to that of the variable “1/a. Promoting environmental innovation”. Businesses are already dealing with the assessment of environmental risks, but at the same time, development is essential. This is not necessarily only due to the need for methodological improvements, but also due to the emergence of new risk factors that are not yet known and are likely to emerge in the future. For this reason, the two highest scores on the Likert scale (5–6) received 64% of the evaluations in the case of future value.
- In the case of “1/d. Incentives for daily action”, there is an even greater difference in the responses regarding the present and the future. For answers concerning the present, the average assessment is also displayed (20%), but almost half of the answers rate this indicator as a four or five. The proportion of the highest value (six) is relatively small (6%); however, companies consider that the development of incentives should play a very important role in the next 3–5 years, as reflected in the more than threefold increase in the share of businesses giving a score of six.

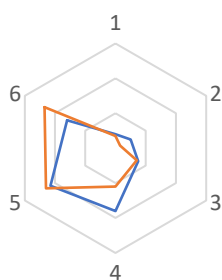
1/a. Promoting environmental innovation by exceeding mandatory regulations



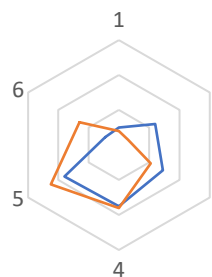
1/b. Creating transparency regarding the resource use and emissions



1/c. Assessment of opportunities and risks related to environmental protection



1/d. Creating incentives for daily action



— Present
— Expected for the future (for the next 3–5 years)

Figure 4. The spider web diagram of the scores given by the respondents at Stage 1 of becoming sustainable. Source: edited by authors.

All this means that at Stage 1 the system of incentives developed for day-to-day action is the one that needs to develop the most, and business leaders see it as a key area for medium-term strategy.

In the case of the variables measured at Stage 2, almost half of the enterprises characterized their current situation with a value of four or five, and the future strengthening of the variables is considered an important strategic aspect with a slightly different value judgment:

- The highest value was given for the future role of “2/a. Creating transparency of direct and indirect environmental impacts” by nearly 55% of the companies. All of this suggests that companies clearly consider the measurement and management of environmental impacts to be an important strategic factor that should be given even stronger emphasis in the coming years.
- In the case of incentives and obligations created for the partners in the value chain (2/b.), there is also a significant shift towards higher Likert scale values for the future (four: 24%, five: 30% six: 13%).
- However, the assessment can be said to be cautious, as the frequency of the highest score is visibly lower than the one for the previous indicator both in terms of the present and the future (Figure 5).

2/a. Creating transparency of direct and indirect environmental impacts

2/b. Creating incentives and obligations for partners in the value chain

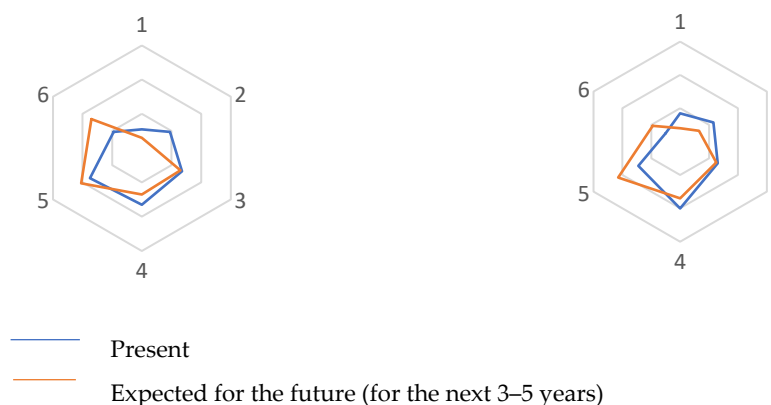


Figure 5. The spider web diagram of the scores given by the respondents at Stage 2 of becoming sustainable. Source: edited by authors.

The more cautious assessment of the second indicator also reflects the fact that, although businesses typically prioritize green aspects, they still need to develop more specific ways of managing emerging risks.

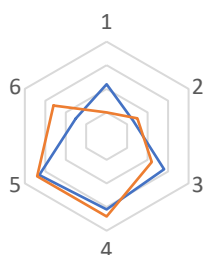
Stage 3 of becoming sustainable is about designing sustainable products and services. The companies are clearly committed to more environmentally friendly products and services, and in this regard, a more critical assessment of the current situation is also evident:

- Nowadays, the role of environmentally friendly product alternatives (3/a.) is indisputable, but half of the economic organizations participating in the research believe that nowadays it does not receive enough emphasis among managerial tasks: most of them rated it as a five (23%) or a four (22%). It is therefore no coincidence that the frequency of both rankings for the future is 24%, while at the same time a significant increase of the value six can be observed (from 11% to 18%).
- Determining consumers’ willingness to pay for more environmentally friendly products/services (3/b.) shows a more diverse picture than the previous ones. Unusually, here the most frequently given scores are not the values 4–5, but 3 (26.1%). All of this means that the majority of businesses have not yet taken systemic steps in this area, however, in a 3–5-year perspective, as can be seen in the spider web diagram (Figure 6), a very strong shift in favor of the value of five can be seen (from 11% to 26%). The lower values also show that this issue will be a significant management

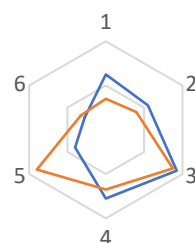
focus in the future, considering that the proportion of companies giving a value of one is 18%, while the same proportion will decrease to 10% in the future.

- The ecological pricing of products and services (3/c.) was also evaluated differently by enterprises. The ratio of values one and two currently hovers around 20%, looking into the future; however, the ratio of these values will decrease and the share of enterprises with the two lowest values for this variable is 11–12%. The growing importance of the question is shown by the fact that most respondents gave a value of five for the future (29%), which is also clearly visible on the spider web diagram (Figure 6).

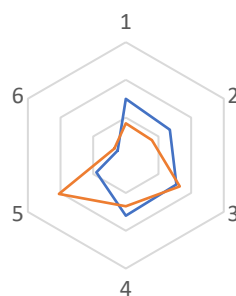
3/a. Evaluation of environmentally friendly product alternatives



3/b. Determining consumers' willingness to pay for more environmentally friendly products/services



3/c. Ecological pricing of products and services



— Present
— Expected for the future (for the next 3–5 years)

Figure 6. The spider web diagram of the scores given by the respondents at Stage 3 of becoming sustainable. Source: edited by authors.

At the next stage of development (Stage 4), evaluating and encouraging the development of a green business model (4/a.), significant changes can be seen in the spider web diagrams of Figure 7 in relation to current and future management tasks. At this level, it becomes more apparent that the enterprises consider the realization of “green management” as an important strategic goal, which is shown by the increase in the proportion of the higher values of the Likert scale for the future.

- For the current situation, evaluating and encouraging the development of a green business model (4/a.) was most often rated three and four, so almost half of the enterprises clearly consider the need for development as a strategic factor. This is proven by the fact that for the future the most frequently given ranking is four (25%), but particularly strongly—almost doubling—appear the proportions of score five (from 13% to 21%) and score six (8% from to 16%). This is accompanied by a significant decrease in the proportion of score one (from 18% to 6%).
- A very similar pattern can be seen in the Figure 7 for the preparation of business plans according to the green business model (4/b.).

4/a. Evaluating and encouraging the development of a green business model

4/b. Preparation of business plans according to the green business model

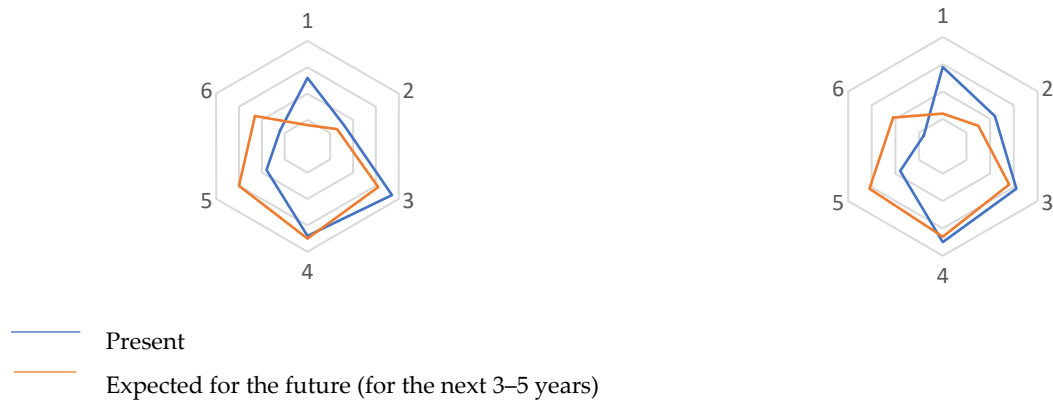


Figure 7. The spider web diagram of the scores given by the respondents at Stage 4 of becoming sustainable. Source: edited by authors.

The spider web diagram (Figure 8) shows the most interesting pattern at the highest level of development (Stage 5). The largest proportion of the responding companies gave the value four (23%) to the establishment of a green market leadership role and market influence, but the score of one was not far behind (20%). These are the companies that are not dealing with this issue at all in the present. Here, the organizations included in the analysis are also organized into groups, as opposed to those for whom the market influence is important in the present. The companies that are lagging behind will also feel the need to influence the market in the future, since the ratio of value one for a 3–5-year period is 6%, almost a quarter of the current value. The highest value for the future is five (26%), which is almost double the value for the present (13%). The increase in value six is also noticeable on the spider web diagram, which also indicates a strengthening of the role in the future.

5. Creation of new markets, systemic market analysis from the point of view of environmental protection, establishment of a green market leadership role, market influence

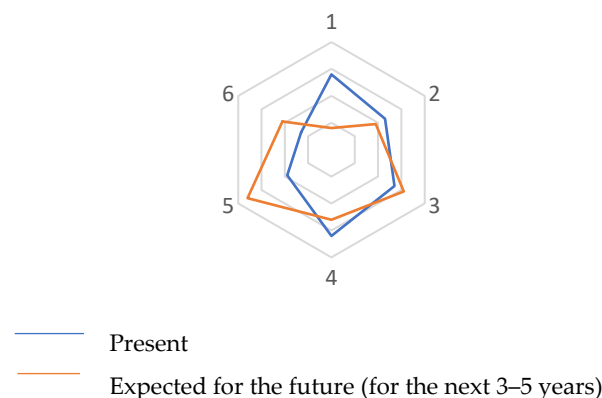


Figure 8. The spider web diagram of the scores given by the respondents at Stage 5 of becoming sustainable. Source: edited by authors.

Based on the basic statistics, it can be concluded that, overall, for each of the investigated variables, the respondents expect a greater role for environmental-risk management in the future. This also implies that companies are already aware of the importance of the examined variables and are seriously planning to strengthen them in the medium term.

Based on the evaluation on the Likert scale, it is clear that there is a very large difference between enterprises in the evaluation of certain variables:

- Preparation of business plans according to the green business model.
- Evaluating and encouraging the development of a green business model.
- Creation of new markets, systemic market analysis from the point of view of environmental protection, establishment of a green market leadership role, market influence.
- Creating incentives for daily action.
- Promoting environmental innovation by exceeding mandatory regulations.
- Ecological pricing of products and services.

Examining the individual stages of development as a whole, based on the differences between the sum of the multiplications of the examined variables (the given scores multiplied by the frequency of occurrence of each), it can be concluded that the biggest gap between the current situation and the respondents' perception of the future's management tasks expected in a 3–5-year time frame can be seen in the cases of Stage 4 and Stage 5 (Figure 9). So, the management's tasks in the areas of Developing New Business Models and Creating Next-Practice Platforms will be significantly different in the future compared to the current ones. The results of the study thus prove that the H1 hypothesis is a correct assumption, i.e., the biggest difference between the current and expected strategies can be found when reaching the fourth stage of becoming sustainable.

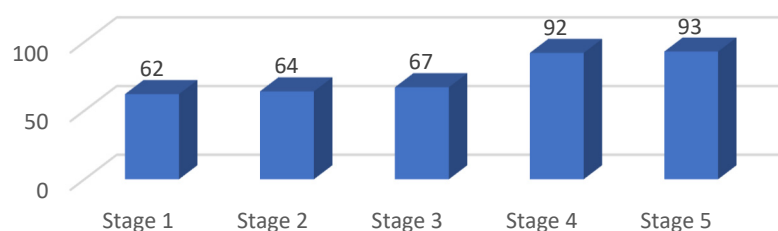


Figure 9. Difference between the current and expected strategies. Source: edited by authors.

4.2. The Results of the Cluster Analysis for the Present

The purpose of the cluster analysis was to examine the assumption that the examined enterprises can be classified into different clusters in terms of their strategies for managing environmental risks (H2). The cluster analysis resulted in three significantly different clusters. The clusters were formed using standardized variables; the expected value of the standardized variables is zero, so the individual clusters can be characterized by the relative deviations from this value; see Table 6.

The data in the table show that the companies of the first cluster significantly differ from zero in the positive direction for all cluster-forming variables, so therefore this cluster was named Pioneers. This group included 39% of the sample. They are the ones who deal with the highest steps in becoming sustainable; they are the best in terms of green compliance compared to the other clusters; they require and encourage environmental awareness in the supply chain; they develop environmentally friendly product alternatives, which also create market opportunities; they develop green business models; and they apply conscious market influence in the field of environmental protection.

The enterprises of the second cluster were called Awakeners because companies with average values were included in this group (39% of the sample). Based on the cluster centers, it can be seen that each variable moves around the expected value, slightly exceeding it in the variables of Stage 1, and slightly below it in the higher stages of becoming sustainable.

The companies of the third cluster (22% of the sample) perform deeply below the expected value in terms of all variables, as shown by the negative values of Table 5, so they form the group of Laggards.

Table 6. The cluster centers in the examined sample for the present. Source: edited by authors.

Final Cluster Centers			
	Cluster		
	1 Pioneers	2 Awakeners	3 Laggards
1/a. Promoting environmental innovation by exceeding mandatory regulations	0.7589	0.0491	−1.3919
1/b. Creating transparency regarding the resource use and emissions	0.6941	0.1008	−1.3911
1/c. Assessment of opportunities and risks related to environmental protection	0.6146	0.0250	−1.1562
1/d. Creating incentives for daily action	0.7869	−0.0943	−1.1875
2/a. Creating transparency of direct and indirect environmental impacts	0.7864	−0.0490	−1.2644
2/b. Creating incentives and obligations for partners in the value chain	0.9069	−0.2169	−1.2008
2/a. Evaluation of environmentally friendly product alternatives	0.7858	−0.1309	−1.0969
3/b. Determining consumers' willingness to pay for more environmentally friendly products/services	0.8575	−0.2457	−1.0170
3/c. Ecological pricing of products and services	0.9430	−0.2723	−1.1063
4/a. Evaluating and encouraging the development of a green business model	0.9075	−0.1760	−1.2519
4/b. Preparation of business plans according to the green business model	0.9485	−0.2234	−1.2026
5. Creation of new markets, systemic market analysis from the point of view of environmental protection, establishment of a green market leadership role, market influence	0.9657	−0.3251	−1.0608

According to the conclusions that can be drawn from the ANOVA table of the cluster analysis, the cluster centers are significantly different along all the cluster-forming variables, which is also indicated by the significance level for the F statistic ($p = 0$). This means that the enterprises included in the sample can indeed be grouped based on the cluster-forming variables. Based on the F values, the effect of each individual variable on the clustering process can be established, based on which the strongest cluster-forming variables are:

1. Preparation of business plans according to the green business model ($F = 154.41$).
2. Evaluating and encouraging the development of a green business model ($F = 151.80$).
3. Creating incentives and obligations for partners in the value chain ($F = 137.17$).
4. Promoting environmental innovation by exceeding mandatory regulations ($F = 134.46$).
5. Creation of new markets, systemic market analysis from the point of view of environmental protection, establishment of a green market leadership role, market influence ($F = 131.68$).

From the above, it follows that the environmental protection strategies of the examined companies differ mostly along the above listed variables. Most of these variables (variables one, two, and five) belong to becoming sustainable Stage 4 (Developing New Business Models) and Stage 5 (Creating Next-Practice Platforms), so the result points back to the acceptance of hypothesis H1. The weakest cluster-forming variable is the evaluation of chances and risks related to environmental protection ($F = 54.94$), which means that the strategies of the investigated companies differ the least in the case of this factor. Of course, the reason for this is that the evaluation of chances and risks is the basis for the development of environmental protection strategies; on the other hand, businesses recognize that the assessment, evaluation and management of environmental risks must become the basis for the efficient operation of the company.

Examining the sustainability clusters based on the number of employees, it can be seen that enterprises belonging to clusters characterized by a lower level of sustainability employ on average fewer employees (Pioneers: 599 people; Awakeners: 463 people; Laggards: 272 people). During the research, the financial indicators of sustainability clusters were

also analyzed (Table 6). It is an interesting observation that, contrary to expectations, the financial performance of the Pioneers is not always the best.

- The Return on Assets (RoA) indicator shows the degree of efficiency in the use of assets. In the case of the enterprises included in the research, the enterprises belonging to the Laggards cluster perform best in terms of profitability relative to assets.
- The Return on Sales (RoS) indicator represents the net-profit ratio, so it measures profitability through the proportion of net sales that contributed to the after-tax result. Based on this profitability indicator, the Awakening cluster performed the best.
- In the case of the headcount-related profitability indicators, the cluster of Pioneers performed best, as expected.

The results of the variance analysis showed that there is no significant correlation between cluster membership and profitability indicators (Table 7). The result indicates that the level of commitment to sustainability in the case of Hungarian enterprises included in the sample is not driven by financial performance but depends on the attitude of the management.

Table 7. Financial results of the clusters. Source: edited by authors.

Clusters	Return on Assets (%)	Return on Sales (%)	Earnings per Head (Thousand Ft)	Turnover per Head (Thousand Ft)
1—Pioneers	4.90%	4.08%	1521	46,569
2—Awakeners	3.54%	4.41%	1029	33,436
3—Laggards	6.13%	3.83%	1251	28,446

4.3. The Results of the Cluster Analysis for the Future

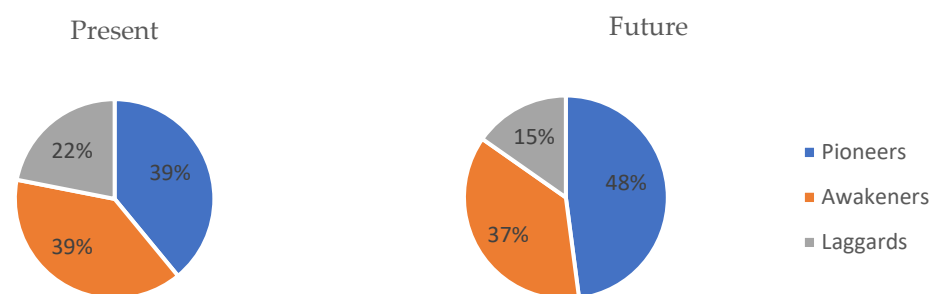
The analyses regarding the strategies for managing environmental risks were also extended for the future, from the point of view that strategic factors related to environmental protection are expected to be strengthened by the respondents in the next 3–5 years. In the course of this, a new cluster analysis was carried out (Table 8), and at the same time, the characteristics of each cluster were compared for the present and the future. Based on the cluster centers, the same clusters emerged; however, it can be concluded that the Awakening cluster is weaker compared to the current situation, as it is characterized by slightly negative values for the becoming-sustainable Stage 1 variables. The following movements can be observed between the clusters:

- Seven enterprises from the cluster of Pioneers (1) were classified in a lower sustainability cluster, of which five enterprises fell into the cluster of Laggards (3).
- The greatest movement took place in the Awakeners (2) cluster; there was a shift in both directions, apart from a few enterprises; the range of companies belonging to this group changed significantly. However, 65% of the reclassifications took place in the direction of the lower cluster.
- A significant reorganization also took place in the cluster of Laggards (3); 60% of the group was placed in a higher-level cluster (in the Awakeners cluster), with the exception of three enterprises.

It can be seen in Figure 10, as mentioned earlier, that based on the respondents' evaluation of the current situation, both the Pioneers and the Awakeners represent 39% of the sample; the lowest is the proportion of the Laggards, accounting for less than a quarter of the sample (22%). When evaluating this result, it should not be forgotten that the base population was the 5000 largest Hungarian companies based on the number of employees, and it is also clear that the sustainability approach among Hungarian companies has already been established or is being developed, and is expected to grow. This is confirmed by the element number of clusters created on the basis of the environmental goals expected by respondents over a 3–5-year time horizon, according to which the number of elements in the cluster of Pioneers shows a significant increase of 9%, at the detriment of Laggards (−7%) and Awakeners (−2%).

Table 8. The cluster centers in the examined sample for the future. Source: edited by authors.

Final Cluster Centers			
	Cluster		
	1 Pioneers	2 Awakeners	3 Laggards
1/a. Promoting environmental innovation by exceeding mandatory regulations	0.6587	−0.2012	−1.5996
1/b. Creating transparency regarding the resource use and emissions	0.5952	−0.1390	−1.6180
1/c. Assessment of opportunities and risks related to environmental protection	0.5663	−0.1865	−1.4876
1/d. Creating incentives for daily action	0.5991	−0.1366	−1.5622
2/a. Creating transparency of direct and indirect environmental impacts	0.6174	−0.2321	−1.4464
2/b. Creating incentives and obligations for partners in the value chain	0.6843	−0.3098	−1.3831
3/a. Evaluation of environmentally friendly product alternatives	0.6926	−0.3222	−1.3939
3/b. Determining consumers' willingness to pay for more environmentally friendly products/services	0.5214	−0.1884	−1.1748
3/c. Ecological pricing of products and services	0.7061	−0.3927	−1.2728
4/a. Evaluating and encouraging the development of a green business model	0.7443	−0.3915	−1.4594
4/b. Preparation of business plans according to the green business model	0.7629	−0.3830	−1.4875
5. Creation of new markets, systemic market analysis from the point of view of environmental protection, establishment of a green market leadership role, market influence	0.7389	−0.4517	−1.2368

**Figure 10.** Sustainability clusters in the sample for the present and for the foreseeable future. Source: edited by authors.

All of this shows that those companies that treat environmental management variables as a priority in the present will continue to focus on this in the future. Some of the enterprises, despite the fact that they have not yet been able to characterize each sustainability indicator with the highest level of commitment, are aware that it should be given more emphasis in the coming period. However, the Awakeners cluster is very unstable, and more decisive management measures are needed for these enterprises in order to ensure that their activities continue to meet socio-economic expectations.

Given that becoming sustainable is a gradual development process, all of this can be interpreted as some of the Awakeners becoming Pioneers, and some of the Laggards

becoming Awakeners. This can also explain the weaker performance of Awakeners in the cluster analysis for the future, as they scored slightly below average on each of the four variables, while in the analysis for the present they showed minimally better than average on three of the four variables of the becoming-sustainable Stage 1.

4.4. Limitations of the Research and Further Research Directions

Our further research plans include two main directions. In our previous studies, we have investigated the implementation of the principles of a circular economy in Hungarian companies. In the future, we plan to analyze the relationship between the clusters of environmental strategies and the compliance with the basic principles of the circular economy. The second main direction of our further research is the examination of the relationship between environmental strategies and the use of management control tools in companies.

The limitations of the present survey include the non-representative nature of the sample, and in the future, we aim to increase the number of respondents and thus make the sample more representative.

5. Conclusions

According to the frameworks presented in the literature and the logic of the research, the stages of development have progressively moved from being internally oriented to more radical and systemic, emerging as new business models and new ways of creating value in corporate practice.

Based on the results of the research, it is clear that the examined companies are already strongly concerned with the opportunities and risks related to environmental protection, and in the future, they expect that the role of the innovations applied to their management will appear more emphasized in their target system. Creating transparency regarding the use of resources and emissions is currently an important issue, but further development and improvement of related systems is expected in the future. The incentives within the company to deal with environmental protection on a day-to-day basis are perceived to be weaker than they should be, and in the future the topic is definitely expected to be of greater importance. In the field of making supply chains more environmentally friendly, greater importance is expected in the future in creating transparency of direct and indirect environmental effects, and also in creating incentives and obligations in the value creation network. Evaluating environmentally friendly product alternatives as a management task for managing market risks is already an important task for businesses, and a smaller increase in this regard is expected in the future. However, the assessment of consumers' willingness to pay for more environmentally friendly products/services and the current state of ecological pricing of products and services is rather weak among Hungarian companies. They are preparing for a significant increase in the role of these tasks in the future. At higher levels of development, a kind of separation of enterprises can be perceived. The development of green business models and the preparation of corresponding business plans is lagging behind in the majority of companies, but they expect a significant increase in these tasks in the future. A similar proportion of businesses already place a significant emphasis on these issues. Market creation based on market manipulation is on the highest rung of development, and we also see a similar picture here.

After evaluating the basic statistics, the authors conducted a cluster analysis, which outlined three significantly different clusters in the sample. These are: the Pioneers, the Awakeners and the Laggards. The Pioneers perform well above average in each of the environmental objectives assessed, while the Awakeners perform averagely. They have a minimally positive rating in the becoming-sustainable Stage 1, while the companies in the Laggards cluster have a strongly below average rating on all the factors. Based on the number of elements of the clusters, it can be concluded that the sustainability approach has largely been developed among Hungarian companies, since the Pioneers are represented with a weight of 39% in the analyzed sample and the Awakeners also represent 39%. The

percentage of Laggards is the lowest, 22%. When expanding the interpretation of the results, it should be taken into account that the base population included the 5000 largest Hungarian enterprises based on the number of employees. Descriptively, we explained that companies with a higher number of employees are included in the Pioneers cluster. The strongest clustering variables according to Nidumolu et al. (2013) were the factors belonging to Developing New Business Models and Creating Next-Practice Platforms; the strategies of the examined companies differed the most in this regard and the least in the evaluation of chances and risks related to environmental protection, which is a fundamental factor in strategy creation.

Analyses for the future (3–5-year time horizon) show that a significant increase in the number elements of the Pioneers cluster is expected, based on the definition of forward-looking environmental protection goals, at the expense of the Awakeners and Laggards clusters. In the Awakeners cluster, each step in becoming sustainable is rated slightly lower for the future than for the present, which is due to the slow catch-up of the Laggards, who also have a weak environmental goal orientation in the present.

The authors therefore interpreted the emergence of the sustainability approach at the management level of the enterprises and examined its appearance at the strategic level and its impact on the financial performance. In contrast to previous research (Adams et al. 2016; Mead et al. 2022; Landrum 2017; Young and Reeves 2020; Pavie et al. 2014), we analyzed large enterprises, assuming their strong commitment to prioritizing sustainability aspects. The sample was therefore narrowed down, and this made it possible—unlike in the studies published so far—to show a more nuanced picture, according to which even in the case of the largest companies, there are significant differences between the current situation and the future medium-term strategies.

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