


## Article

# Pharmaceutical Companies in the Light of the Idea of Sustainable Development—An Analysis of Selected Aspects of Sustainable Management

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**Abstract:** The strategy of creating value and increasing the competitiveness of economic entities under the idea of sustainable development entails the need to provide access to up-to-date knowledge, which is to strengthen the decision-making basis and increase the level of properties of economic decisions. This argument strengthens the legitimacy of undertaking a research problem, oriented towards an overview of contemporary business challenges in the light of sustainable development, to assess the direction of activities undertaken by enterprises in the economic and socio-environmental sphere in connection with their activities. The need to undertake sustainable activities—with an emphasis on the environmental aspect—is particularly relevant to the pharmaceutical industry, which, in implementing activities oriented towards the protection of human health and life in connection with drug production, treats the issue of concern for the health of the planet as an extremely important challenge. The literature on the subject generally and insufficiently discusses sustainability issues for companies operating in this industry. Recognising the pharmaceutical sector as an area of economy of key importance in the socio-economic dimension at the level of national economies and at the international level, it became reasonable to scientifically identify the indicated issues in relation to pharmaceutical industry enterprises, with particular emphasis on entities operating in Poland. Hence, the main aim of the study, in response to the diagnosed gap, was to assess the directions of improvement of business models of Polish pharmaceutical enterprises, with consideration given to determinants of sustainable development. This study draws attention to the significance of practical choices of pharmaceutical entities—determined by their activity strategy, on sustainable development, as well as the impact of performance on the practice of sustainable development in the light of the assessment of the companies' managerial effectiveness, demonstrating their significant importance. The realisation of the objective was based on a thorough review of the literature on the topic explored, as well as on the results of a diagnostic survey conducted among Polish pharmaceutical companies. An in-depth analysis of the findings in the area explored was conducted using statistical testing, including statistical ordering of variables, variable correlation matrix, logistic regression, odds ratio, and PQstat software. The main conclusion of the study is the finding that the business models of Polish pharmaceutical enterprises are continuously improving towards increasing the level of sustainable development, and the main determinant for the realisation of the above is the development of innovation, strongly correlated with the category of particularly good results on operations, constituting their managerial effectiveness.



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**Keywords:** sustainability; innovation; business model; efficiency; sustainable value; pharmaceutical business challenges; competitiveness

## 1. Introduction

Socio-economic modernity creates many challenges. These concern the growing demands of the market, driven by technical and technological progress, determining the pace and direction of civilisational development. Responding to the growing demands of

customers is increasingly complex. In addition to the appropriate quality of a product or service correlated with an attractive price, social and economic expectations—relate to a company's environmental impact. What is important, therefore, is the creation of activities determining innovativeness, increasing the economic effectiveness of processes enabling the handling of margin levels, as well as environmental responsibility, supported by a set of efforts to minimise the negative impact of economic activity on the natural environment. Hence, the contemporary set of business requirements touches upon a new dimension of value created for the beneficiaries of their activities—a multidimensional bundle of benefits created by the entity, considering all the aspects mentioned above. Considering all the requirements for an enterprise in business strategy is a difficult challenge. In addition to the basic business need to realise profitable activities and the consequent need to optimise costs or strengthen productivity, entities must orient their activities towards corporate social responsibility, which is created by a set of principles and values related to concern for people, care for the environment and the transparency [1] of market cooperation (business ethics). In this respect, the contemporary management model refers to a business strategy in which competence plays a key role in fulfilling the expectations of the widest possible group of beneficiaries of the activity, as a source of sustainable market advantage. This is because offering the expected bundle of values ensures market interest in the offer, determining the essence and meaning of the functioning of the business.

The requirements of the environment determine the required direction of development, contributing to the need to modify adopted strategies. Under the influence of environmental pressures [2], business models are subject to revision [3]. The focus on sustainability-oriented activities is increasingly emphasised in business practice. Solutions of a socially or economically innovative nature are constantly being sought [4], in each case considering environmental aspects, oriented towards sustainable development [5]. Viewed in this way, the essence of innovation makes it possible to achieve satisfactory results in several fields of action, considering key aspects that integrate the temporal expectations of the environment.

The global problem of natural resource availability and environmental pollution has created an urgent need to act [6] to protect the planet Earth. Formal and legal regulations have charted a path for sustainable development, integrating and articulating the challenges for business development globally [7]. The acquisition, creation, and delivery of value [8] takes on a broad spectrum of reference in modelled business concepts. Sustainable business models adopt a multi-criteria character in the realisation of corporate objectives, where sustainability is not the only determinant of development (integration of objectives [9] of the value bundling process). Highlighted in the literature as a tool for assessing the effectiveness of green growth-oriented activities is the ESG, focusing attention on [10]:

- the corporate environment (E),
- corporate social responsibility (S),
- performance on operations (G).

In environmental terms, ESG attributes significant importance to the resource-intensive aspects of operations in optimising the parameters of raw material and energy demand and consumption, waste management—including recycling, and measuring the impact of business activities on the environment. In the sphere of social responsibility, it focuses on the system of the entity's relations with its environment (stakeholder system). In the economic dimension, it points to the standardisation of mechanisms for organising activities and implementing processes, by strengthening the enterprise's competencies enabling it to achieve its goals [1]. The above forms the background for the creation of a strategy enabling an effective business response in times of resource and environmental crisis, whereby opening to the market in the long term, correlated with the promotion of sustainable development, requires the supply of innovation. Hence, this view, an innovation-oriented business model is a crucial aspect of it [8] and can be a source of competitiveness [11]. Developing a green economy based on green technologies creates a wide area of challenges for innovation, and innovative green technologies drive sustainable development [12].

The search for an answer to the question of how contemporary companies cope with the challenges of the environment, considering the growing pressure to conduct activities in harmony with the environment, is an interesting and important research thread. The strategy of creating a bundle of values and strengthening competitiveness in line with the idea of sustainable development enforces the need for an information supply that, through access to up-to-date knowledge, will raise the level of decision-making processes, determining the higher appropriateness of economic decisions. The above justifies the need for an overview of contemporary business challenges in the light of sustainable development and an assessment of the direction of the challenges taken and the level of adaptation of the business models of enterprises, to achieve economic and socio-environmental goals in connection with their activities.

A particular need for action towards sustainable activities—with particular emphasis on the environmental aspect—applies to the areas of the economy involved in producing or processing chemical substances. These fields include the pharmaceutical industry, which, while implementing activities oriented towards the protection of human health and life in connection with the production of medicines, should be particularly concerned about the planet's health in connection with its activities.

Studies of the literature on the subject demonstrate that the sustainability of pharmaceutical entities and the management challenges associated with it are discussed in general terms and to an insufficient extent. This problem particularly concerns pharmaceutical companies operating in Poland. Therefore, recognising the pharmaceutical sector as an area of economy of key importance in the socio-economic dimension at the level of national economies and the international dimension, it has become reasonable to scientifically identify the indicated problem to pharmaceutical industry enterprises, with particular emphasis on pharmaceutical enterprises operating in Poland. The above was considered the leading aim of the present study in response to the diagnosed research gap.

The area and scope of the study create its limitations. The content and conclusions of the study constitute a response to the identified information gap in the area of the explored issues, with reference to enterprises of the pharmaceutical sector operating in Poland.

## 2. Materials and Methods

The purpose of the study determined its layout. The concept of the study is presented in the introduction. The background to the study was developed in the literature review. The literature survey included research studies, and industry reports, including statistical summaries. Literature was extracted from leading databases such as Google Scholar, Web of Science, Scopus, and Eurostat, among others, using a combination of keywords adopted for this paper.

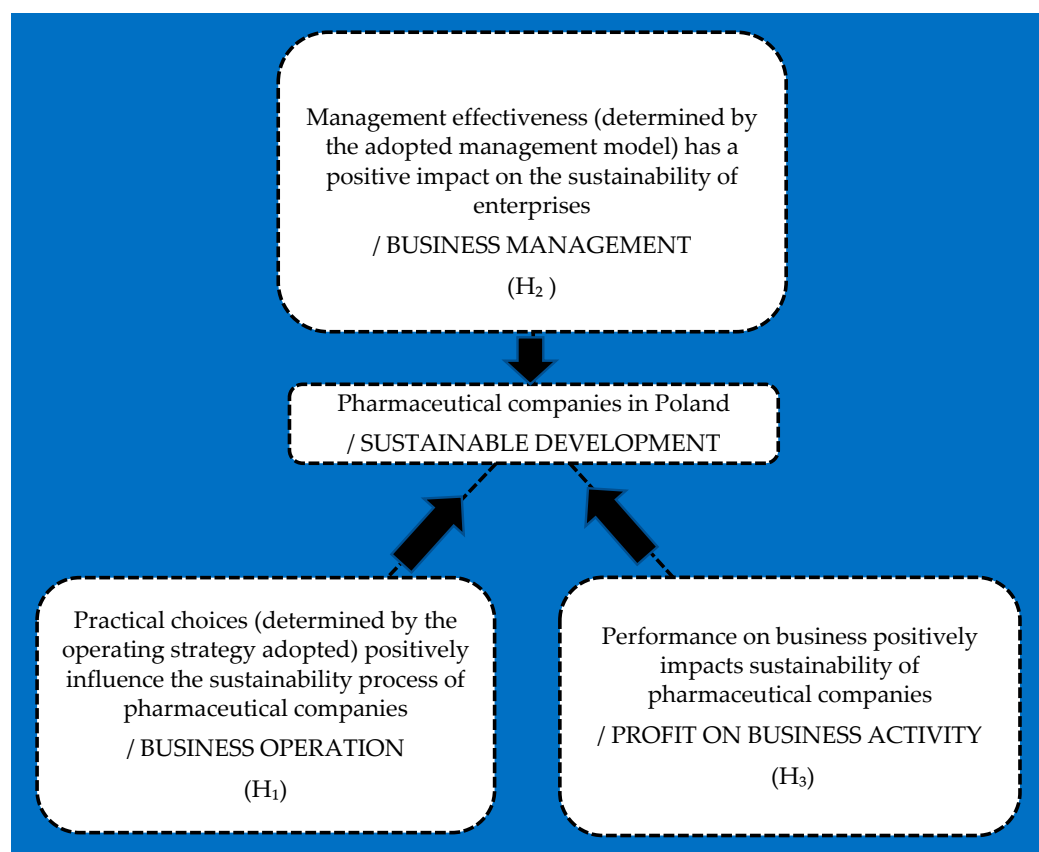
In the empirical and analytical area of the study, research was conducted according to the rules of economic analysis, taking into account statistical inference. The system of analytical principles provided the basis for a diagnosis of the state, spatial dissection of the phenomena and their analysis to establish research assumptions. The theoretical model including hypotheses is presented in Figure 1.

The arrangement of hypotheses adopted for the study is as follows:

- $H_1$ —practical choices (determined by the adopted operational strategy) positively influence the process of sustainable development of pharmaceutical enterprises,
- $H_2$ —managerial effectiveness (determined by the adopted management model) has a positive impact on the sustainability of enterprises,
- $H_3$ —business performance (profit) has a positive impact on the sustainability of pharmaceutical companies

Orientation towards the improvement of activity parameters expressed in the reduction of resource intensity and improvement of production parameters (improvement of productivity, efficiency, and quality indicators)—driven by the development of innovation, creating technical and technological progress as a result of, among other things, the above, is closely related to management aimed at sustainable development. Verification of the

hypotheses related to the presented relationship relates to the necessity of examining and evaluating the practical choices of enterprises (factors X1–X3) and comparing them with the obtained results on activity (factors Y1–Y3). The number of choices in a specific group of results provides a basis for assessing the degree of convergence of implemented activities with sustainable development. A diagnostic survey with in-depth analysis of findings conducted using statistical testing, including statistical ordering of variables, variable correlation matrix, logistic regression, odds ratio, and PQstat software, is the basis for research in this area to verify the validity of the adopted hypotheses.



**Figure 1.** Research model.

For the findings, the diagnostic survey covered a group of 96 enterprises operating in the Polish pharmaceuticals market (pharmaceutical production and distribution at national level—55 entities, and production and distribution at national and international level—41 entities). The selection of enterprises for the survey was random, referring to the set of enterprises operating in the pharmaceutical sector (with assignment according to the number of the National Official Register of National Economic Entities in Poland—REGON), with an error of  $\pm 5\%$ , at the confidence level of 95%. This made it possible to establish the sample in terms of its aggregated characteristics, while closely replicating these characteristics for the entire population of enterprises in the sector (a sample of 40.58% concerning the existing population of enterprises according to the adopted criteria [13]). The above gives grounds for accepting it as a representative. The survey, which was anonymous in nature, was aimed at identifying current management challenges—including aspects of sustainable development—faced by Polish pharmaceutical enterprises, as well as analysing and assessing the direction of the challenges, including instruments to support management processes. The survey was conducted in the month of November 2022. The material obtained during the survey for analytical purposes was used in the part determined by the scope of the study.

The research was conducted in the following steps:

1. Review of the available literature, touching on the issue of the area of sustainable development, including the sustainable development of enterprises operating in the pharmaceutical sector—in international and national terms, using simple methods, practised in analytical processes on practical grounds,
2. Causal analysis of the challenges created by the idea of sustainable development of enterprises in the pharmaceutical sector to critically assess their significance and level of implementation on practical grounds,
3. Analysis and evaluation of practical indications for the assessment of the essence of sustainable development in pharmaceutical enterprises operating in Poland and the potential for its development, based on the findings of own research. In this respect, a logical aggregation of the indications of enterprises was made. Then the established diagnostic characteristics were assigned to objects ordered according to the financial results obtained to determine the importance of the various aspects undertaken within sustainable development framework.
4. Conclusions and recommendations.

The main objective of the study is to extend the current knowledge in the area of sustainable development to strengthen the information supply for decision-making processes, for increasing the effectiveness of business decisions. Conclusions and recommendations are included in the final part of the study.

### 3. Literature Review

#### 3.1. *The Concept of Sustainable Development—A Review of the Literature on the Subject*

The complicated situation related to the constantly limited availability of natural resources [14,15] and the degree of environmental degradation has contributed to the need to take measures to limit the extraction of non-renewable resources and minimise the negative impact of human activities on the environment [6]. A very significant part of the problem concerns energy production [16,17], still very much based on conventional production in some countries [18–22], which, in addition to strongly interfering with the structure of the earth's crust, violates the functioning of ecosystems due to the extraction of fossil fuels, has a strong negative impact on the environment due to emissions and discharges of harmful substances into the environment as a result of conventional production. Increasing energy demand and the need to base its production on renewable, clean, and environmentally safe generation forms [23], is one of the world's key challenges. The dimension of the necessary transformation of the world's economies [24] is captured in formal and legal regulations, detailing economic and environmental goals in this regard [25], with the leading regulation in this area being the Paris Agreement [6] and the 2015 UN agenda—The 2030 Agenda for Sustainable Development [26]. Development policies have been directed towards sustainable development, where decarbonisation of systems has become a core objective while seeking to increase manufacturing flexibility, economic security, and economic security [27–30]. In doing so, attention was paid to international cooperative systems [31]. Renewable resources and green technologies [32–34] have begun to gain increasing recognition [35].

Green technologies have created a challenge for economies [36] and institutional actors [37], as well as a conscious need to function in harmony with the environment expressed by small consumers (household level). Public awareness has begun to grow [38–40]. This has been reflected in growing social expectations of economies, institutions, and businesses, indicating the need to reduce negative environmental impacts [41]. The idea of saving raw material and energy resources and the greening of activities in the broadest sense (waste management including recycling, reduction of harmful emissions and discharges, and measures to protect or restore ecosystems) began to gain momentum. Public institutions, particularly those of the European Union, have strongly promoted this trend and encouraged companies to operate sustainably [42]. Awareness among the public and the business world has grown strongly. Environmental protection has become a universal challenge and responsibility, as the devastation of the environment and the resulting climate change have begun to threaten humanity with increasing intensity.



The need to act in harmony with the environment was transferred to business. The cooperation of economies in the field of resource management was directed towards increasing the efficiency of their use. Environmental (external environment and internal environment—working environment), social and economic aspects were integrated into business objectives. Business strategies were opened up to the increasing demands of the environment in these areas, among others. The organisation's competitiveness took on a new dimension. The classic quality of the offer and its attractive price on the market was strongly complemented by the security of operations, related to the above-mentioned spheres. A new, unique bundle of values became desirable on the market, bringing together the effect of economic efforts in harmony with social, economic, and environmental requirements (sustainable value).

The development of businesses towards the possibility of creating and delivering a sustainable bundle of value to the beneficiaries of economic activity began to be included in policies capturing the mission and vision of development. Business models embedded in a sustainable strategy were created. Corporate sustainability became an absolute necessity. The eco-trend became a determinant of a range of conscious consumer choices. Keeping abreast of the changes began to determine the direction of successful development. The need for green solutions is reflected in increasingly restrictive legal regulations relating to the scale of environmental impact (the problem of waste and the aspect of its segregation and collection costs, the problem of emissions and discharges and the aspect of limiting their scale, supported by the motivating level of environmental charges on the rights in question, etc.). Supporting or achieving sustainable entrepreneurship's organisational and environmental goals has begun to be sought in green innovation [43–45]. The need to comprehensively grasp the challenges of sustainable development has also extended to economic and social themes, including, among others, those related to counteracting discrimination in many dimensions, reducing inequalities and enhancing social cohesion [46], as well as business transparency in market cooperation, linked to ethical behaviour (transparent networks).

Sustainability is a complex issue. Creating a business model capturing all its aspects—economic, social, and environmental (sustainable business model) [2,47], is an extremely demanding task, related to improving the organisation on a number of levels and strengthening its culture. Perfecting the integrated value bundle is a critical goal of modern economics, and the temporal degree of its fulfilment as an indicator of the degree of competitiveness; hence making efforts to build management solutions enabling the implementation of the above is fully justified. In this respect, it is still emphasised that there are no universal guidelines for creating good solutions [48], so it is important to share knowledge in this area, enabling the improvement of a common vision for the design of such solutions. This reinforces the validity of these considerations.

### *3.2. Sustainability in the Pharmaceutical Industry*

The ability to fulfil the expectations of the environment should be linked to an orientation towards sustainable development, enabling the creation and delivery of a balanced bundle of value. This contributes to improving the competencies of enterprises and strengthening their organisational satisfaction, in connection with the creation of satisfactory economic, social, and environmental results. The above particularly applies to entities characterised by a high degree of organisational culture, strongly oriented towards strengthening the culture of innovation, which include entities of high-technology sectors, including pharmaceutical entities [49]. In this development dimension, the pharmaceutical business sees how to improve its economic performance and strengthen its position in the global market.

The pace of response to the environment's expectations requires precise identification of the organisation's competencies, uninterrupted access to above-average resources and openness to novelty, which is a key determinant of competitiveness, in the creation of the result of the pharmaceutical business [50]. In addition to providing innovative product

solutions—in line with the current knowledge and drug demand of the environment, innovation in pharmacy reinforces corporate responsibility, by seeking solutions that contribute to optimising the resource intensity of the entire supply chain [50], as well as minimising its negative impact on the environment. The aspect of the social mission of the pharmaceutical industry cannot be overlooked, where actions to protect human health and life are carried out according to the rules of business ethics [51], and, therefore, regarding the idea of ensuring the universal market availability of medicinal products. This dimension of action makes it possible to achieve a competitive advantage in the pharmaceutical market [52], which expects innovative—safe and effective—medicines in the volume demanded and at an accessible price. In this context, social safety correlated with the economic effect on action creates the success of the pharmaceutical business, considered as a result of balancing socio-economic objectives [53]. The value bundle thus created gives rise to a high capitalisation of the company [54], reinforcing the economic effect globally [55]. Particularly distinctive effects are obtained in areas touching on specific dimensions of health security [56], i.e., those with a strategic dimension in global health policy [57,58], where the recently explored challenge of finding a vaccine, or a cure for COVID-19, may serve as an example [59].

Acting under sustainable development in the indicated scope is important in the pharmaceutical industry. The literature emphasises the role of this idea, with particular emphasis on environmental principles [60], according to which a pharmaceutical manufacturer working for health care should not pollute the environment in connection with its production. The pressure from the environment in this regard prompts a continuous effort towards sustainability, which translates into a positive impact on business performance [61]. In this activity, the objectives of multi-faceted improvement of the offer, strengthening of the efficiency of operations, rationalisation of resource management or minimising the negative impact on the environment are integrated by the idea of ensuring the security of human existence, realised based on innovation [62]. A multi-faceted organisational efficiency is developed [63], correlated with the expected level of value, strongly emphasised in the pharmaceutical business. Hence, the improvement of the integrated bundle of value created against the background of the above, is motivated by the aspiration to improve the market position and economic performance, which is declared in the organisations' missions and established strategies of their operation [53]. Therefore, the construction of a sustainability-oriented business model in the pharmaceutical industry draws from the arrangement of expectations of the environment, achieved based on the mechanisms outlined above. It relates to the classic concepts of competitiveness (quality, quantity, safety, price of medicine) based on innovation, as well as aspects of the creation of social trust—in the area of customers, and the system of cooperation (partnership cooperation) [64].

Building social trust according to the idea of sustainable development is done by focusing the pharmaceutical industry's attention on research into green technologies of drug manufacturing processes. The literature emphasises that this research is given the same priority as research into a new or improved medicinal preparation [65]. Strengthening environmental safety in the area of manufacturing methods (e.g., aimed at reducing harmful discharges and emissions—e.g., decarbonisation), by orienting technical-technological development and technical-technological innovation in this direction, provides the basis for creating a multidimensional bundle of value for the stakeholders of the sector's activities, responding to defined expectations to the highest degree. The above results from sustainable management, determining economic, social, and environmental performance, and motivating further action towards sustainable entrepreneurship [66].

The current promoting actions for strengthening sustainable development of the pharmaceutical sector in Europe is, among others, the Pharmaceutical Strategy for Europe, which focuses particular attention on increasing the environmental safety of drug production—with particular emphasis on minimising the volume of production waste, reducing emissions and discharges of pollutants into the air, water and soil, reducing the resource intensity of manufacturing processes, and strengthening the safety and efficacy

of medicinal preparations [67]. The development of technology and techniques in this sphere is to ensure access to innovative and affordable medicines, to increase the level of disease control—with a particular focus on civilisation diseases, and to reduce the level of social exclusion in the sphere of access to medicines. Therefore, this idea fully integrates business aspects with the activity of protecting human health and life, considered in a broad perspective, creating a framework for sustainable development at the company level.

The responsibility dimension of the pharmaceutical business is constantly evolving. Increased activities are being undertaken to protect people and the planet. In this regard, the initiative to incorporate and increase the share of renewable energy in the energy supply of pharmaceutical operations, undertaken as part of the Schneider Electric Corporation's 'Energize' project [50], is noteworthy. The result of this initiative is expected to be a reduction in the energy intensity of the sector and improved performance in the areas of economic, environmental, and social objectives.

Activities and initiatives to enhance sustainable development indicate a high degree of responsibility of the pharmaceutical sector, which manifests itself in the compliance of the direction of the realised development with the observed general trends in the world of resource and environmental protection (e.g., decarbonisation), demonstrating openness to the market and its expectations.

## 4. Results

### 4.1. Companies of the Polish Pharmaceutical Sector in the Light of the Idea of Sustainable Development

All Development oriented towards meeting current needs must allow the ability to meet them for future generations [46]. Hence efforts oriented towards sustainable entrepreneurship are desirable and necessary.

Pharmaceutical enterprise strategies are constructed with reference to the Pharmaceutical Law, together with a set of regulations applicable to the pharmaceutical sector. These regulations apply to a number of spheres of operation and create a framework for modelling strategies in line with the letter of the applicable law. This means that a significant part of the activity undertaken to pursue economic, environmental, and social goals involves implementing the relevant guidelines.

The creation of business models oriented towards sustainable development promotes, develops, and improves overall goals, determining how they are to be achieved. The effectiveness of solutions in this respect determines stable development that strengthens the competitive position.

The activities of companies in the Polish pharmaceutical sector are carried out responsibly. It involves a high awareness of conducting business, in which social and environmental challenges are correlated with economic goals. However, sustainable actions are implemented through the prism of efforts to fulfil the mission of protecting human health and life, which is at the forefront of all other activities.

Pursuing balance in the economic, social, and environmental dimensions necessitates taking measures to reduce the negative impact of activities on the environment, either directly or indirectly (at each stage of the value creation chain).

The directions of challenges undertaken by pharmaceutical entities in Poland correspond to the general direction of activities undertaken for sustainable development. They involve activities to improve environmental and social impact, in correlation with an orientation towards increasing the economic effect. The results of our research (survey), carried out in November 2022 on a group of 96 companies operating on the Polish pharmaceutical market (pharmaceutical production and distribution—including supporting, at the national level—55 entities, and pharmaceutical production and distribution—including supporting, at the national and international level—41 entities), revealed a number of indications in terms of activities for sustainable development.

The significant number of sources of information (companies surveyed) and determinants of sustainable management for sustainable development (indications of companies) justify the need for appropriate data processing to increase indications' informative use-



fulness for substantive inference. In this respect, the logical aggregation of data, practised in the analysis of phenomena described by a set of factors, enables the identification of interrelationships between determinants of a given phenomenon, based on a purposeful selection of information about the determinants modelling a given community, was considered helpful. Such a presentation of the regularities captured in the communities, offers the possibility of reducing the number of data and information piled up by reducing them to a set of basic categories and capturing homogeneous areas of study. This approach makes it possible to limit the cognitive process to key aspects.

In the presented context, the studied set of ( $\Omega$ ) enterprises  $\{O_1, \dots, O_{96}\}$  is described by the set:

$$\Omega = \{O_1, \dots, O_{96}\} \quad (1)$$

The diverse indications from companies led to the identification of seven problem groups, shaping the layout of sustainable management challenges. These indications created the diagnostic characteristics (variables) that will serve as a reference in the following part of the study:

$$X = \{X_1, X_2, X_3, X_4, X_5, X_6, X_7\} \quad (2)$$

where: no bullet in original

- $X_1$ —efficient energy management and reaching for renewable energy sources in the energy supply of pharmaceutical production,
- $X_2$ —development of innovation and reduction of resource intensity and improvement of production parameters (productivity, efficiency, quality),
- $X_3$ —development of the green technology dimension to reduce toxic emissions and discharges,
- $X_4$ —strengthening the co-operative system in line with the concept of sustainable development,
- $X_5$ —maintaining a policy of informed purchasing choices,
- $X_6$ —strengthening the attributes of a green working environment
- $X_7$ —promoting attitudes that coincide with the sustainable idea of social, environmental, and economic objectives.

It should be noted in this connection that the reduction of resource intensity is understood as the optimisation of the consumption of the quantities of raw materials and media required in the company's resource-intensive transformation chain, per unit of process/product output [68].

The diagnostic features captured according to the above sets are characterised by a high information capacity, creating a relatively limited number of elements in the set. Their conative value is determined by the following criteria adopted for their grouping:

1. the importance of the feature, a, b, c, d in original
2. the universality of the feature
3. the spatial variability of the trait, providing a basis for differentiating research objects in relation to the information obtained,
4. comparability of the feature, determining an undistorted picture of the research results.

The diagnostic features, as indicated by the enterprises, are captured in the matrix (Table 1).

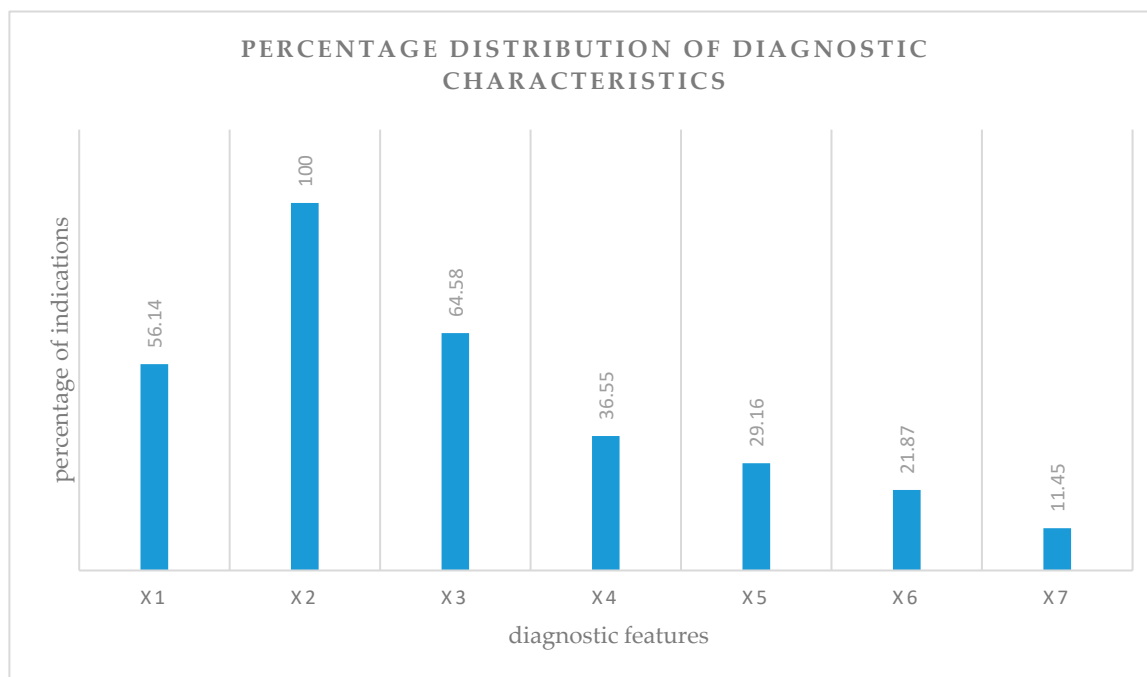
**Table 1.** The diagnostic features, as indicated by the enterprises—matrix.

Company	Diagnostic Characteristic							Company	Diagnostic Characteristic						
	$X_1$	$X_2$	$X_3$	$X_4$	$X_5$	$X_6$	$X_7$		$X_1$	$X_2$	$X_3$	$X_4$	$X_5$	$X_6$	$X_7$
$O_1$	X	X	X	X		X	X	$O_{49}$	X	X	X				
$O_2$		X						$O_{50}$	X	X	X				
$O_3$	X	X	X	X	X	X	X	$O_{51}$	X	X	X	X		X	
$O_4$	X	X		X	X	X		$O_{52}$		X					

Table 1. Cont.

Company	Diagnostic Characteristic							Company	Diagnostic Characteristic						
	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>4</sub>	X <sub>5</sub>	X <sub>6</sub>	X <sub>7</sub>		X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>4</sub>	X <sub>5</sub>	X <sub>6</sub>	X <sub>7</sub>
O <sub>5</sub>	X	X	X	X		X	X	O <sub>53</sub>		X	X		X		
O <sub>6</sub>		X						O <sub>54</sub>	X	X			X		
O <sub>7</sub>		X	X		X			O <sub>55</sub>	X	X	X	X		X	
O <sub>8</sub>	X	X		X	X			O <sub>56</sub>	X	X					
O <sub>9</sub>		X	X					O <sub>57</sub>		X	X	X			
O <sub>10</sub>	X	X	X					O <sub>58</sub>		X	X		X		
O <sub>11</sub>	X	X	X		X			O <sub>59</sub>		X					
O <sub>12</sub>	X	X	X	X	X	X	X	O <sub>60</sub>	X	X	X				
O <sub>13</sub>		X	X					O <sub>61</sub>	X	X	X		X		
O <sub>14</sub>		X		X				O <sub>62</sub>		X	X				
O <sub>15</sub>		X						O <sub>63</sub>	X	X	X	X		X	
O <sub>16</sub>	X	X	X	X				O <sub>64</sub>		X					
O <sub>17</sub>	X	X						O <sub>65</sub>		X	X				
O <sub>18</sub>		X						O <sub>66</sub>		X	X				
O <sub>19</sub>	X	X	X	X	X			O <sub>67</sub>		X					
O <sub>20</sub>		X						O <sub>68</sub>		X					
O <sub>21</sub>		X	X		X		X	O <sub>69</sub>	X	X	X	X			
O <sub>22</sub>	X	X		X				O <sub>70</sub>	X	X	X		X	X	
O <sub>23</sub>	X	X	X	X		X		O <sub>71</sub>		X	X				
O <sub>24</sub>	X	X	X		X	X	X	O <sub>72</sub>	X	X					
O <sub>25</sub>		X	X					O <sub>73</sub>		X	X	X	X		
O <sub>26</sub>		X						O <sub>74</sub>		X	X	X	X	X	X
O <sub>27</sub>	X	X						O <sub>75</sub>	X	X	X	X			
O <sub>28</sub>		X	X	X	X		X	O <sub>76</sub>	X	X	X				
O <sub>29</sub>	X	X						O <sub>77</sub>	X	X			X		
O <sub>30</sub>	X	X				X		O <sub>78</sub>	X	X					
O <sub>31</sub>		X	X	X	X			O <sub>79</sub>		X	X	X	X	X	
O <sub>32</sub>	X	X	X	X				O <sub>80</sub>		X					
O <sub>33</sub>	X	X	X	X	X			O <sub>81</sub>		X					
O <sub>34</sub>	X	X	X		X			O <sub>82</sub>	X	X	X				
O <sub>35</sub>		X						O <sub>83</sub>	X	X	X	X			
O <sub>36</sub>		X	X	X		X	X	O <sub>84</sub>	X	X	X				
O <sub>37</sub>	X	X	X				X	O <sub>85</sub>	X	X	X	X		X	
O <sub>38</sub>	X	X	X					O <sub>86</sub>	X	X	X				
O <sub>39</sub>		X			X			O <sub>87</sub>	X	X	X	X	X	X	X
O <sub>40</sub>	X	X						O <sub>88</sub>		X	X				
O <sub>41</sub>		X	X	X				O <sub>89</sub>		X	X				
O <sub>42</sub>		X						O <sub>90</sub>	X	X		X	X	X	X
O <sub>43</sub>	X	X	X		X			O <sub>91</sub>		X			X	X	
O <sub>44</sub>	X	X	X	X				O <sub>92</sub>	X	X	X				
O <sub>45</sub>	X	X	X	X		X	X	O <sub>93</sub>		X	X	X	X	X	X
O <sub>46</sub>	X	X	X					O <sub>94</sub>	X	X					
O <sub>47</sub>		X	X	X				O <sub>95</sub>		X	X				
O <sub>48</sub>	X	X	X					O <sub>96</sub>		X					

The percentage arrangement of the above indications is presented in Figure 2.



**Figure 2.** Percentage arrangement of diagnostic features.

The juxtaposition of the variables with the results in the area of company profitability indicates the importance of each of them. Hence, the order of the companies belonging to the three groups of profitability in the industry on the Polish market, as defined in this category (according to the companies' indications), was first ordered. A summary of this allocation is presented in Table 2.

**Table 2.** A summary of the companies' category (according to the companies' indications).

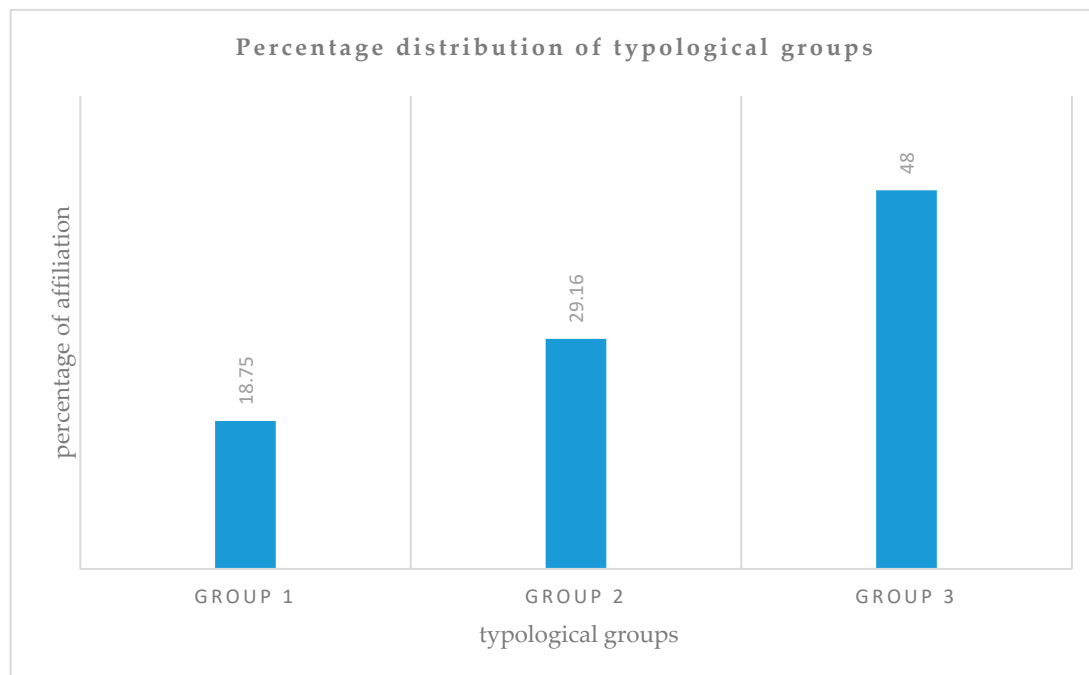
Performance Group— by Classification Key	Set of Objects—by Affiliation
Group 1: very good results	$O_1, O_3, O_{12}, O_{16}, O_{23}, O_{24}, O_{27}, O_{36}, O_{40}, O_{41},$ $O_{43}, O_{45}, O_{67}, O_{74}, O_{82}, O_{87}, O_{90}, O_{93}$
Group 2: good results (above-average performance in terms of activities)	$O_4, O_5, O_8, O_{11}, O_{14}, O_{19}, O_{25}, O_{28}, O_{32}, O_{33}, O_{34}, O_{37}, O_{38},$ $O_{39}, O_{44}, O_{47}, O_{48}, O_{49}, O_{53}, O_{59}, O_{61}, O_{66}, O_{70}, O_{73}, O_{79}, O_{83}, O_{85}, O_{91}$
Group 3: average and poor financial performance (average, fluctuating profit; volatility; loss)	$O_2, O_6, O_7, O_9, O_{10}, O_{13}, O_{15}, O_{17}, O_{18}, O_{20}, O_{21}, O_{22}, O_{26}, O_{29},$ $O_{30}, O_{31}, O_{35}, O_{42}, O_{46}, O_{50}, O_{51}, O_{52}, O_{54}, O_{55}, O_{56}, O_{57}, O_{58},$ $O_{60}, O_{62}, O_{63}, O_{64}, O_{65}, O_{68}, O_{69}, O_{71}, O_{72}, O_{75}, O_{76}, O_{77}, O_{78},$ $O_{80}, O_{81}, O_{84}, O_{86}, O_{88}, O_{89}, O_{92}, O_{94}, O_{95}, O_{96}$

The percentage distribution of the above typological groups is shown in Figure 3.

The grouping and grading of companies into typological groups, established in relation to the profitability parameter, and their juxtaposition with diagnostic characteristics, as indicated by individual entities, provides a basis for inferring the nature of the variable in question in the sphere of sustainable development.

Profitable operations are a key determinant of business operation and growth. F. Teramae et al. points out that increasing income and financial effect on activities determines sustainability [69], which, among others, R. R. Ahmed et al. is considered an important current of activity because contemporary social expectations create new conditions for competing on a global level [70]. J. Caraca et al. emphasizes, that the ability to meet the growing demands, with a particular focus on openness to wide-ranging improvement—determining the competitive advantage of pharmaceutical entities [71] requires financial

power. The above justifies attempts to link sustainable development directions with the effects on activities.



**Figure 3.** Percentage arrangement of typological groups.

The range of sustainable development activities undertaken by pharmaceutical companies varies. However, an important and accentuated aspect of this approach in research is the management of economic, social, and environmental sustainability conditions, rather than reacting to an already realised threat. In this respect, a proactive approach is promoted in the shaping of business models, captured in sustainable management, which is widely emphasised in the literature, including by B. Forés, O. Seroka-Stolka et al., or B. H. Min et al. [72–74]. Important in this respect are aspects of improving production parameters, reducing energy consumption, minimising discharges, and emissions, reducing hazardous substances, and others [68], the potential for optimisation of which is highlighted in the literature [75,76]. The presented research approaches fully correspond to the research concept adopted in this article. Aggregating the determinants of sustainable management and juxtaposing them with the profit of the activity gives the findings a new quality.

The findings unequivocally show that the strongest indication of enterprises is an orientation towards the development of innovation and reduction of resource intensity, including improvement of production parameters (productivity, efficiency, quality). This condition can be regarded as a key aspect of sustainability orientation, as it is strongly accentuated by enterprises achieving differentiated results on their activities (100% of indications qualified within the scope of characteristic diagnostic  $X_2$ ). The above coincides with S. Guennif et al.'s observation emphasising the importance of pharmaceutical companies' innovative potential [77].

The research also revealed that the determinants taken on by both financially strong companies and those with a weak track record include: a, b in original

- the development of a green technology dimension to reduce toxic emissions and discharges (64.58% of indications qualified for the diagnostic characteristic— $X_3$ ),
- efficient energy management and use of renewable energy sources in the energy supply of pharmaceutical production (54.16% of indications allocated to the diagnostic characteristic— $X_1$ ).

Reducing emissions of harmful substances is considered an extremely important aspect of sustainable pharmaceutical development, given that the pharmaceutical industry emits a significant proportion of greenhouse gases. This fact is signalled and explored in research by, among others, A. Booth et al., who emphasise the importance of efforts to reduce the negative environmental impact of pharmaceutical production [78], pointing to the progress made by pharmaceutical companies in implementing green technologies [79].

Determinants of sustainable management undertaken mainly by financially stable companies include: a, b in original

- strengthening the co-operative arrangement in line with the idea of sustainable development ( $X_4$ ; 36.55% indications),
- maintaining a policy of informed purchasing choices ( $X_5$ ; 29.16% indications).

The above assumes particular importance in the sphere of R&D, as noted by X. Guan et al. [80], and knowledge sharing more broadly—key determinants of pharmaceutical industry development.

The determinants of sustainable management articulated by companies with good and very good financial performance include: a, b in original

- strengthening the attributes of a green working environment ( $X_6$ ; 21.87% indications)
- promoting attitudes that converge with the sustainable idea of social, environmental, and economic objectives ( $X_7$ ; 11.45% indications).

This range is complemented by activities for sustainable development, which is linked to care for the image of the pharmaceutical manufacturer. As a rule, it is connected with relatively significant expenditures to promote activities converging with the policy of sustainable development and is raised in internal documentation and reports describing activities in the sphere of sustainable development of pharmaceutical companies. This can be seen as an essential aspect of enhancing the reputation of a pharmaceutical company that cares about social safety and the planet's health.

#### 4.2. Companies of the Polish Pharmaceutical Sector in the Light of the Idea of Sustainable Development—Statistical Tests

The picture presented in Section 4.1 of the research results is the input for in-depth statistical research using logistic regression models, allowing the adopted hypotheses to be verified and substantive inferences to be made. For the study thus defined, explanatory and explanatory variables were adopted.

The explanatory variables are the determinants of shaping the sustainable development of the studied set of enterprises, according to the adopted sample. They were established based on the results of the diagnostic survey discussed above.

It was determined that sustainable development is most strongly shaped in the area of the complex measurement category, i.e., within the parameter  $X_2$ —"development of innovativeness, reduction of resource intensity, improvement of production parameters (productivity, efficiency, quality)". Based on the above, three elementary explanatory variables were isolated:

1. development of innovation, 1, 2, 3 in original
2. reduction of resource intensity,
3. improvement of production parameters (productivity, efficiency, quality).

The close relationship between the development of innovation, the reduction of resource intensity and the improvement of production parameters (productivity, efficiency, quality) stems from the idea of technical and technological progress driven by innovation. New manufacturing methods are oriented towards improving performance parameters (lower resource intensity, higher energy efficiency, higher precision of operation, higher level of automation, etc.), which directly shapes the presented relationship. Studies presented in the literature confirm [81,82] that the development of innovation induces a reduction in resource intensity and an improvement in production parameters (the subject range of factors  $X_1$ – $X_3$ ), shaping economic regularity, the essence of which is assumed in



the paper. Improving performance and strengthening performance on operations are key aspects of modelling business strategy towards sustainable operations. The adoption of the assumption in question for this article is justified.

The explanatory variables were identified in the area of financial performance on a scale of 1–3, where 1 means disagreement and 3 means full agreement. The characteristics of the variables are included in Table 3.

**Table 3.** The characteristics of the variables.

Variable Number	Description Variable	Variable Designation	Type of Attribution
1	Development of innovation	$X_{0,1}$	Numerical (scale 1–3)
2	Reducing resource intensity	$X_{0,2}$	Numerical (scale 1–3)
3	Improvement in production parameters (productivity, efficiency, quality)	$X_{0,3}$	Numerical (scale 1–3)
4	Very good performance (profit)	$Y_1$	Dichotomic
5	Good performance (profit)	$Y_2$	Dichotomic
6	Poor and bad performance (profit)	$Y_3$	Dichotomic

The mapping matrix of the variable to the study objects is presented in Table 4.

**Table 4.** The mapping matrix of the variable to the study objects.

Subject	Explanatory Variable			Subject	Explanatory Variable		
	$X_{0,1}$	$X_{0,2}$	$X_{0,3}$		$X_{0,1}$	$X_{0,2}$	$X_{0,3}$
$O_1$	X	X	X	$O_{49}$		X	X
$O_2$		X		$O_{50}$			X
$O_3$	X	X	X	$O_{51}$	X		
$O_4$	X	X		$O_{52}$		X	
$O_5$	X		X	$O_{53}$		X	X
$O_6$		X		$O_{54}$		X	
$O_7$			X	$O_{55}$		X	
$O_8$	X	X		$O_{56}$	X		
$O_9$		X		$O_{57}$			X
$O_{10}$	X			$O_{58}$		X	
$O_{11}$	X	X		$O_{59}$		X	X
$O_{12}$	X	X	X	$O_{60}$	X		
$O_{13}$	X		X	$O_{61}$	X	X	
$O_{14}$		X	X	$O_{62}$			X
$O_{15}$		X		$O_{63}$	X		
$O_{16}$	X	X	X	$O_{64}$		X	
$O_{17}$	X			$O_{65}$			X
$O_{18}$		X		$O_{66}$		X	X
$O_{19}$	X		X	$O_{67}$	X	X	X
$O_{20}$			X	$O_{68}$		X	
$O_{21}$		X		$O_{69}$		X	
$O_{22}$	X			$O_{70}$	X	X	

Table 4. Cont.

Subject	Explanatory Variable			Subject	Explanatory Variable		
	$X_{0,1}$	$X_{0,2}$	$X_{0,3}$		$X_{0,1}$	$X_{0,2}$	$X_{0,3}$
O <sub>23</sub>	X	X	X	O <sub>71</sub>			X
O <sub>24</sub>	X	X	X	O <sub>72</sub>	X		
O <sub>25</sub>		X	X	O <sub>73</sub>		X	X
O <sub>26</sub>		X		O <sub>74</sub>	X	X	X
O <sub>27</sub>	X	X	X	O <sub>75</sub>	X		
O <sub>28</sub>		X	X	O <sub>76</sub>	X		
O <sub>29</sub>	X			O <sub>77</sub>	X		
O <sub>30</sub>	X			O <sub>78</sub>		X	
O <sub>31</sub>			X	O <sub>79</sub>		X	X
O <sub>32</sub>	X	X		O <sub>80</sub>		X	
O <sub>33</sub>	X	X		O <sub>81</sub>	X		
O <sub>34</sub>	X		X	O <sub>82</sub>	X	X	X
O <sub>35</sub>		X		O <sub>83</sub>		X	X
O <sub>36</sub>	X		X	O <sub>84</sub>			X
O <sub>37</sub>		X	X	O <sub>85</sub>	X	X	
O <sub>38</sub>	X	X		O <sub>86</sub>		X	
O <sub>39</sub>		X	X	O <sub>87</sub>	X	X	X
O <sub>40</sub>	X	X	X	O <sub>88</sub>			X
O <sub>41</sub>	X	X	X	O <sub>89</sub>		X	
O <sub>42</sub>		X		O <sub>90</sub>	X	X	X
O <sub>43</sub>	X	X	X	O <sub>91</sub>	X	X	X
O <sub>44</sub>	X	X		O <sub>92</sub>	X		
O <sub>45</sub>	X	X	X	O <sub>93</sub>	X	X	X
O <sub>46</sub>			X	O <sub>94</sub>	X		
O <sub>47</sub>		X	X	O <sub>95</sub>			X
O <sub>48</sub>	X		X	O <sub>96</sub>		X	

The findings in terms of descriptive statistics of the variables are presented in Table 5.

Table 5. The findings in terms of descriptive statistics of the variables.

	Mean	SE	SD	SD <sup>2</sup>	Min.	Max.
Y1	0.188	0.040	0.392	0.154	0	1
Y2	0.292	0.047	0.457	0.209	0	1
Y3	0.521	0.051	0.502	0.252	0	1
X01	0.521	0.051	0.387	0.150	0	3
X02	0.646	0.049	0.370	0.137	0	3
X03	0.500	0.051	0.387	0.150	0	3

The impact of the explanatory variables ( $X_{0,1}$ —development of innovation,  $X_{0,2}$ —reduction of resource intensity,  $X_{0,3}$ —improvement of production parameters: productivity, quality, efficiency) on a dichotomous explanatory variable  $Y_1$ —very good business

performance (profit),  $Y_2$ —good business performance (profit),  $Y_3$ —poor and bad business performance (profit) was determined using a logit regression model, according to the notation [83]:

$$\ln \frac{p_i}{1 - p_i} = Z_i = x_i^T \beta = \beta_0 + \beta^1 + \beta^2 X_i^1 + \beta^2 X_i^2 + \dots + \beta_k X_{ki}$$

where:

$$\ln \frac{p_i}{1 - p_i} = \text{logit}(p_i)$$

In the presented model, the estimated categories are the parameters  $\beta_0 \dots \beta_k$ -components of the vector  $\beta$ . For the purpose of interpreting the estimation results, the odds ratio (OR) was adopted, with the odds notation:

$$\ln \frac{p_i}{1 - p_i} = \exp(x_i^T \beta) = \exp(\beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \beta_k X_{ki}) = \Omega(x_i)$$

to test whether the odds ratio for a variable ( $X_{mi}$ ) increased by one unit and the odds ratio without such an increase are equal [80]:

$$\exp(\beta_m) = \frac{\Omega(x_i^m, X_{mi} + 1)}{\Omega(x_i^m, X_{mi})}$$

where:

$x_i^m$ —the vector of the variable  $x_i$  is a vector without the variable  $X_{mi}$ .

The above reveals that a one-unit increase in the  $X_{mi}$  variable (with other factors unchanged) is determined by a  $\exp(\beta_m)$ —fold change in the odds ratio. Then, if:

4.  $\exp(\beta_m) > 0$ , there is an increase in the odds ratio, 1, 2, in original
5.  $\exp(\beta_m) < 0$ , there is a decrease in the odds ratio.

Accordingly, in the case of the binary variable  $X_m$ ,  $\exp(\beta_m)$  reveals the OR change multiplicity for " $Y_i = 1$ " in the "1" category area for the  $X_m$  variable, relative to the OR in the "0" category area for the  $X_m$  variable. Whereby the findings of the logit model parameters  $\hat{\beta}_j$  (OR change multiples), take the values of the odds ratio  $\exp(\hat{\beta}_j)$  (average OR change determined by a unit increase in the variable) [84].

Predicted values lying in the range  $<0.1>$  can be taken as the probability of the sustainability process involving the individual categories. In the concept adopted, a probability value of  $\leq 0.5$  classifies sustainability as independent of the financial performance of companies, and findings with predictive values  $> 0.5$  as sustainability dependent on the financial performance of companies. Using the classification of findings and an odds ratio  $> 1$ , it is possible to assess the classification into random measures, and it is possible to estimate the predictive values of the concept adopted [85].

Estimation of logit regression models was performed using PQstat software version 1.8.4.164.

## 5. Discussion

A preliminary analysis of the data was used to examine the degree of correlation in the area of variables adopted for the findings. The correlation matrix of the variables building the models is presented in Table 6.

The numerical analysis shows varying results in the sphere of interdependence of variables. The relationships recorded assume both a positive and negative character in terms of the strength of the linear relationship, with the highest positive level of interdependence assuming a score of 0.461 ( $Y_1$ - $X_{01}$ )—average strength, where collinearity is not a problem (scores below 0.5), while in the case of the inverse correlation—correlation  $Y_3$ - $X_{03}$ , it assumes high strength, with a score of  $-0.669$ .

**Table 6.** The correlation matrix of the variables building the models.

	Y <sub>1</sub>	Y <sub>2</sub>	Y <sub>3</sub>	X <sub>01</sub>	X <sub>02</sub>	X <sub>03</sub>
Y <sub>1</sub>	1.000					
Y <sub>2</sub>	−0.308	1.000				
Y <sub>3</sub>	−0.501	−0.669	1.000			
X <sub>01</sub>	0.461	0.019	−0.377	1.000		
X <sub>02</sub>	0.300	0.284	−0.492	−0.187	1.000	
X <sub>03</sub>	0.427	0.183	−0.500	−0.083	−0.044	1.000

The logistic regression findings within each category are presented below: the model for category Y<sub>1</sub>—very good business performance (Table 7), the model for category Y<sub>2</sub>—good business performance (Table 8), the model for category Y<sub>3</sub>—poor and bad business performance (Table 9). The tables present the findings by category:

1. vector  $\beta$ , 1, 2, 3, 4, 5 in original
2. error scale: b,
3. confidence interval—CI,
4. results of the Wald statistic,
5. odds ratio—OR.

**Table 7.** Logistic regression model for category Y<sub>1</sub> (very good performance on activities).

	$\beta$	Error b	−95% CI	+95% CI	Wald's Statistics	Odds Ratio OR
X <sub>01</sub>	5.456	20.628	−11806.772	11848.027	0.000	234.140
X <sub>02</sub>	2.523	1.054	−0.946	5.992	5.728	1.746
X <sub>03</sub>	3.249	1.055	−0.221	6.720	9.492	25.774
Pseudo R2	0.787					

**Table 8.** Logistic regression model for category Y<sub>2</sub> (good performance on activities).

	$\beta$	Error b	−95% CI	+95% CI	Wald's Statistics	Odds Ratio OR
X <sub>1</sub>	0.084	0.450	−1.396	1.565	0.035	1.088
X <sub>2</sub>	1.555	0.593	−0.395	3.506	6.886	4.737
X <sub>3</sub>	0.824	0.464	−0.702	2.351	3.156	2.280
Pseudo R2	0.811					

**Table 9.** Logistic regression model for category Y<sub>3</sub> (poor and bad performance on activities).

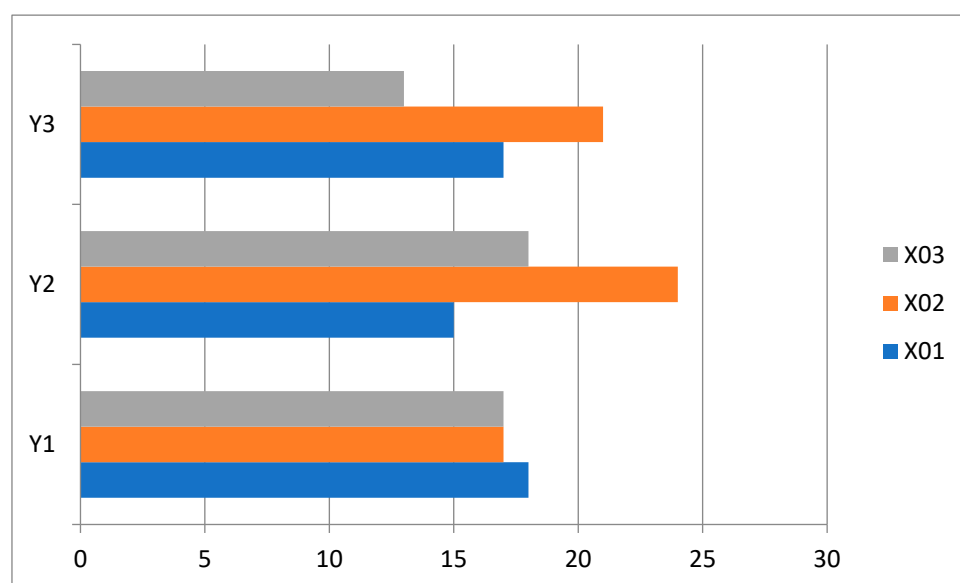
	$\beta$	Error b	−95% CI	+95% CI	Wald's Statistics	Odds Ratio OR
X <sub>1</sub>	−1.594852	0.443	−3.053	−0.137	12.954	0.203
X <sub>2</sub>	−2.426908	0.554	−4.249	−0.605	19.217	0.088
X <sub>3</sub>	−2.203421	0.473	−3.759	−0.648	21.730	0.110
Pseudo R2	0.959					

A logistic regression model for category Y<sub>1</sub> (“very good performance on activities”) with reference to sustainability determinant variables (X<sub>01</sub>–X<sub>03</sub>) was considered basic. Subsequently, category Y<sub>2</sub> (“good business performance”) was introduced for estimation, and the model for category Y<sub>3</sub> (“poor and bad business performance”) is the culmination of the estimation. The reliability tests performed confirm the nature of the significance of the estimated models. The odds ratio allows the estimation results to be assessed and the

amplification of the findings with additional results (Pseudo R2) more strongly indicates the level of fit of the estimation.

Based on the findings, the significance of all variables ( $X_{01}$ – $X_{03}$ ) can be acknowledged, but the final value of the function of variable  $X_{01}$  (“innovation development”) within category  $Y_1$  (“very good performance on activity”) indicates a very high potential for occurrence (OR = 234.140), but with a very high level of error ( $b = 20.628$ ), with a recorded limit of collinearity. Hence, the variable  $X_{03}$ —“improving production parameters (productivity, efficiency, quality)” should be considered the most likely to correlate with “very good performance on the activity” ( $Y_1$ ;  $b = 1.055$  and OR = 25.774), as well as the variable  $X_{02}$ —“reducing resource intensity” in correlation in the same category ( $b = 1.054$  and OR = 1.746).

The distribution of variables  $X_{01}$ – $X_{03}$  within the different categories  $Y_1$ – $Y_3$  is presented in Figure 4.



**Figure 4.** The distribution of variables  $X_{01}$ – $X_{03}$  within the different categories  $Y_1$ – $Y_3$ .

The research themes addressed in the study are determinants of the development of modern companies. The challenges in question are motivated by restrictive legal regulations, the system of restrictions growing out of which links efforts to enhance sustainable development (e.g., environmental protection) and the potential for shaping financial results on business increasingly clear. A similar observation in a study of pharmaceutical companies was made by D.-J. Son et al. [86]. This mechanism motivates the creation of innovative business models [87], oriented towards the creation of new value for the benefit of its recipients, as emphasised by L. M. Chuanh et al. based on studies of this industry, while confirming that the creation of innovative business models in the pharmaceutical sector oriented towards sustainability is an important challenge [88]. In this context, C. Cavicchi et al. articulate the need to implement sustainability into operational pharmaceutical practice [89], where it is important to orient to a number of management considerations, including, among others, process management, as highlighted by S. Qin et al. [90], or F. Teramae et al. investigating the factors influencing the sustainability of pharmaceutical companies, focusing on the determinants of R&D strategy as the main thrust of the changes in question, highlighting R&D productivity in pharmacy [69].

At the same time, it is worth emphasising that the indications of companies analysed in this study may express, in significant part, the aspirations of pharmaceutical entities rather than actual activities. A similar caveat to the research in assessing the quality of sustainability reporting in pharma was put forward by A. Booth [78]. The aspect indicated reinforces the need for a broad exploration of this issue. which is also highlighted by



Vesela Veleva et al. [91]. It seems particularly useful to explore the sustainability attributes of pharmaceutical companies in relation to the parameters of their profitability, in line with the focus of this paper.

## 6. Conclusions

Polish pharmaceutical companies pursue economic, social, and environmental objectives in line with the requirements and trends in the industry. It is important in this respect to comply with environmental regulations and standards, as well as to undertake actions oriented towards the improvement of technology and techniques—including its development towards green technologies, as well as care for rational and effective management of resources, creation of a green working environment, and multifaceted innovation. Such action aims to orient towards low-carbon production, enabling the market to be supplied with innovative and affordable medicines, manufactured under conditions of maximum low environmental impact. In addition, in the Polish pharmaceutical sector, it is important to create green cooperation networks in which sustainable development goals are understood and realised. The overriding aim of such business models is to ensure the country's drug security while taking care of economic, social, and environmental goals. The specific nature of the pharmaceutical industry obliges to improve the efforts made to protect human health, with simultaneous care for the sphere of broadly understood safety in the spheres mentioned above in connection with the implementation of business activities. Business models of pharmaceutical entities operating in Poland are constantly being improved towards increasing the level of sustainability of activities. This is most strongly realised based on innovation. This is the right course of action, as innovation—especially in the sphere of green technologies—is recognised as an appropriate formula for improving solutions [6] and achieving sustainable goals.

The results of the study confirm that sustainable management implemented at the level of Polish pharmaceutical companies addresses key aspects of sustainability. The concepts developed are subject to development by further aspects of sustainable management, in connection with sustainable initiatives at the enterprise level. This indicates a continual strengthening of efforts to improve performance in the economic, social, and environmental spheres, resulting in a continually reinforced corporate responsibility.

An important observation from the study is the apparent causal relationship in the sphere of sustainability activities undertaken and corporate performance on pharmaceutical activities. The development of innovation ( $X_{01}$ ), correlated with the category of very good performance on activities ( $Y_1$ ), as indicated by the result of the opportunity quotient findings, should be taken as the primary determinant in this respect. However, it is the improvement of production parameters (productivity, efficiency, quality)— $X_{03}$ , that is the leading determinant of sustainable development and very good profitability of enterprises, as indicated by the relation of the error rate (b) to the odds ratio (OR) established in the logistic regression for the adopted categories, followed by the reduction of resource intensity ( $X_{02}$ ) within the same category and analogous reference parameters. In doing so, it is important to emphasise the conclusion of the research that the probability of a sustainability process involving individual categories is limited by poor and bad performance on the business. This means that the sustainability of companies depends on the availability of capital for sustainability activities. The above applies to a varying extent to the individual determinants of such development. The findings presented here indicate the strength and direction of such influence, which may be useful in creating sustainable development strategies for pharmaceutical companies on a practical basis.

It is also worth pointing out other determinants of sustainable development of pharmaceutical enterprises, discussed in this work, such as: the development of the dimension of green technologies to reduce toxic emissions and discharges ( $X_3$ ), or effective energy management and reaching for renewable energy sources in the energy supply of pharmaceutical production ( $X_1$ ). The realisation of the above seems to be an absolute necessity for the possibility of functioning in the current economic conditions, which is confirmed

by a significant percentage of indications of companies in the practice of the pharmaceutical business in Poland. Number of the surveyed companies relate to these conditions. Furthermore, important are

Conditions such as strengthening the cooperation system in accordance with the idea of sustainable development, ( $X_4$ ), and strengthening the attributes of a green working environment ( $X_5$ )—correlated with entities with satisfactory results on activity, which constitute the direction of activities, determined by the financial stability of entities, necessary for strengthening their position on the market. In turn, the maintenance of a policy of conscious purchasing choices, ( $X_6$ ) and the promotion of attitudes converging with the sustainable idea of social, environmental and economic objectives ( $X_7$ ), are attributes that can be linked to the availability of resources for the objectives thus defined, or to actions that determine the achievement of greater economic stability in the market. Indications in this area were mostly articulated by companies with very good financial performance. The above confirms that the strength and scope of sustainable development of pharmaceutical enterprises in Poland, is determined by the availability of capital, in relation to a wide range of important activities for its benefit. The above gives grounds for positive verification of the hypotheses adopted in the introduction to the work, that practical choices (determined by the adopted strategy of action) positively influence the process of sustainable development of pharmaceutical enterprises ( $H_1$ ). The management efficiency thus achieved has a positive impact on the sustainable development of enterprises ( $H_2$ ), and the results on operations (profit) positively influence the sustainable development of pharmaceutical enterprises ( $H_3$ ).

These findings are expected to contribute to the expansion of current knowledge in the area of sustainable development, to strengthen the information supply of decision-making processes, for more effective business decisions. This may become a motivation for the creation of innovative business models, oriented towards shaping new value for the benefit of its recipients, as also articulated by L. M. Chuang et al. while confirming that the creation of innovative sustainability-oriented business models in the pharmaceutical sector remains a significant challenge [87,88].

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