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# EU-Funded IT Projects and Sustainable Development in Poland

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**ABSTRACT**

The research relevance of the topic analyzed is predefined by the significant impact on the sustainable economic development of Poland of IT projects financed by the European Union, and the related need for a qualitative assessment of the extent of this impact. The research aims to study the environmental impacts of IT projects implemented with EU funds and assess the prospects for sustainable development in the implementation of these projects. The methodological approach of the research is based on an empirical study of the impact of IT projects on sustainable development. The study assessed 152 IT projects from various applications to determine how they influence sustainable development, focusing on factors like enterprise size, project region, and industry, while excluding projects with evident sustainability benefits like renewable energy. The study concluded that many IT companies underestimate the importance of sustainability, erroneously assuming that their technologies are environmentally neutral, when in fact their environmental impact should be assessed by comparing pre- and post-project states. The study highlights the need for IT companies to critically assess and prioritize sustainability in their projects, especially in regions with limited environmental protections, to ensure holistic development and responsible technology integration.

## 1. INTRODUCTION

The research problem is related to the fact that Polish entrepreneurs implementing IT projects financed with European Union (EU) funds are obliged to present their impact on the implementation of the principle of sustainable development. In this context, it is essential to find a solution to the question of whether Polish entrepreneurs, when submitting the applications, limit themselves to mere empty declarations or they credibly analyse the environmental impact of planned projects and intend to take effective measures to ensure that this impact is not negative. When implementing an IT project, the environmental component must be considered. However, optimum results can be achieved if this is done already at the planning and preliminary project preparation stage. Sustainable development in any area requires projects to be fully compliant with environmental regulations and free from negative environmental impacts [1-3]. It should be considered that sustainable development necessarily requires a balancing of all existing economic, social, and ecological development models. Implementation of sustainable development is of utmost importance for achieving the required efficiency in the operation of industrial enterprises [4-7]. This is a complex undertaking, and it is important to have a clear understanding of the impact of EU-funded IT projects on sustainability.

The assumption adopted as the working hypothesis of the study is:

H.1. Polish entrepreneurs applying for EU funding only declare the positive impact of projects on the implementation of the principle of sustainable development.

H.2. The impact of IT projects on the sustainability principle depends on the industry to which the project belongs.

H.3. The impact of IT projects on the sustainability principle depends on the environmental awareness in the region where the project is implemented.

H.4. The impact of IT projects on the sustainability principle depends on the enterprise size where the project is implemented.

McGilvray [8], in a study aimed at examining several problematic aspects of performing data quality projects, notes that a structured and flexible approach to data quality management is needed in any organisation. At the same time, following the author, IT projects with data quality problems regularly lose billions of dollars, which prevents them from achieving sustainable development in their field.

Shen and Xue [9], in joint research, examined a set of issues related to the management of inter-project interfaces for large-scale programmes. Following the authors, good management of modern information technology projects plays an essential role in the coordination between similar projects for the success of large-scale programmes. Programme funding plays a secondary role, in the context of future sustainability prospects.

Iao-Jorgensen [10], in a case study on the sustainability of inter-organisational projects in the IT sphere, notes that the

concept of sustainability has become popular in many project studies. He points out that organizational science in a broader sense defines the concept of sustainability as the ability of systems to adapt to adverse conditions and to function in a mode of constant change.

Whyte et al. [11], in a collaborative research study, examined several problematic aspects of project management in information technology. Following the researchers, project management involves many risks that have a significant impact on its eventual effectiveness. Change requires adaptability, especially as projects become more complex and are seen as interventions in larger-scale systems.

Miller [12], in a study of the stakeholder role in AI projects, notes that algorithmic decision-making through AI and IT projects has the potential to replace or supplement human decision-making in many industries. It is important to note, however, that artificial intelligence projects involving IT technology fundamentally impact society's prospects for sustainable development [13, 14].

The study of the impact of EU-funded IT projects on sustainable development is essential, as Polish entrepreneurs are obliged to demonstrate the alignment of their projects with sustainability principles. This alignment is crucial for the positive evaluation of co-financing applications. Without a rigorous study, there's a risk that companies will make superficial commitments to sustainability rather than real efforts to mitigate environmental impacts, especially at the beginning of the project. True sustainable development requires the alignment of economic, social and environmental models. As IT projects become increasingly integral to our socio-economic fabric, understanding their impact on sustainability can guide policy frameworks, drive industry best practices, and shape future research to ensure that projects not only comply with environmental regulations, but also truly promote holistic development.

In addition, as eminent researchers identify various challenges in IT projects, from data quality issues leading to significant financial losses to the complexity of project management, it's imperative to understand how EU funding can influence these projects towards sustainability. This is even more pressing as IT and AI projects play an increasingly important role in societal decision-making, underscoring the need to ensure that these projects are aligned with sustainable development goals.

The research aims to examine the extent to which EU-funded IT projects have contributed to the implementation and improvement of sustainable development measures.

## 2. MATERIALS AND METHODS

An empirical study was conducted to investigate the extent to which information technology projects influence the sustainable development agenda coherently. The empirical research block consisted of experimental testing of the hypotheses underlying the research work. The research focused on the industry sector, the environmental awareness of the project region and the scale of the enterprise where the project was implemented. The application forms submitted under the Smart Growth Operational Programme (POIR) in tenders organised by Bank Gospodarstwa Krajowego (Polish development bank), the National Centre for Research and Development, the Digital Poland Project Centre and the Polish Industrial Development Agency have been assessed in the research. A total of 152 projects, implemented in the field of information technology, were analysed. The opinions were allocated randomly among experts according to their competencies. The total number of applications submitted as of 6 October 2022 is 46367. The number of submitted applications is determined by a public information request. This number can be considered as the size of the study population. Projects whose product was renewable energy or energy management systems were not included in the analysis, as for these projects the positive impact on the implementation of the principle of sustainable development was obvious and there was no need to demonstrate it.

Consequently, with an assumed fractional size of 0.5 and a 95% confidence level, the tests are subject to a maximum error of 8%. This allowed the statistical tests to be as accurate as possible for the projects implemented in small, large, and micro-enterprises. To test the hypothesis, the following amount of data was extracted from the available findings:

(1) Enterprise size sorted as micro, small, medium, and large enterprises (based on European Commission Regulation No 364 of 25 February 2004) [15].

(2) The province to implement the project.

(3) The specific industry in which the project was implemented.

(4) Information on whether the positive impact of the project is a result of the project, or a product derived from the project.

(5) Has the impact of implementing sustainable development been quantified or not?

(6) Was a method for verifying the impact of the project on the implementation of the principle of sustainable development presented or not?

(7) Is the impact pronounced through a reduction in energy consumption?

(8) Whether the impact is expressed in terms of reduced use of raw materials.

(9) Whether the impact is expressed through promotional activities.

(10) Whether the impact is expressed in terms of a reduction in the emission of harmful and poisonous substances.

(11) Whether the impact is expressed by a reduction in waste generation.

The data was statistically examined and cross-referenced using chi-square tests, comparative means, and correlation analysis to determine patterns and relationships among variables. The rationale behind this approach was to offer a comprehensive understanding of how IT projects, categorized by their different attributes, contribute to sustainable development. Visual representations in the form of tables and charts were used to elucidate findings and ensure clarity in understanding the relationship between the examined variables.

## 3. RESULTS

This research analyses IT projects implemented under tenders organised by Gospodarka Krajowej Bank (Polish development bank), the National Research and Development Centre, the Digital Poland Project Centre, and the Polish Industrial Development Agency.

Hypotheses 1. Domestic entrepreneurs applying for EU funding only declare the positive impact of projects on the implementation of the principle of sustainable development.

52 enterprises, i.e., more than 34%, did not declare compliance with the principle of sustainable development either in terms of the project implementation method or the resulting product, or the declaration was inadequate, i.e., related to activities carried out outside the scope of the project. 22 enterprises, representing over 14%, declared their satisfaction with the project method. 64 enterprises-via product created. 14, i.e., more than 42% through both sales and product created.

Among the enterprises that have declared in some (but adequate) way (Table 1) compliance with the principle of sustainable development (100 in total), only 15 have estimated the extent of this impact, for example by providing the value of energy saved, the mass of waste, etc., and only six have indicated the way of verification.

Hypotheses 2. The impact level of IT projects on the sustainability principle depends on the industry to which the specific project belongs. Furthermore, its management model consistency to the enterprise's core values also matters. The enterprise itself can choose and set additional priorities (principles) which are in line with these values, as well as with generally known ethical constraints and sustainability management.

Based on the PKD number (Polish Classification of Activities) of the activities to which the project belongs, the sectors indicated in the assessed applications have been combined, with the following groups and the number of enterprises which only declared compliance with the principle of accessibility, assessed impact and indicated method of verification respectively [16, 17]. The classification of activities by specific sectors is presented in Table 2.

**Table 1.** The declaration of sustainable development principles by businesses

| | |
|---|---|
| **Lower electricity consumption** | 54 |
| **Lower resource consumption** | 70 |
| **Increased pro-ecology activity** | 12 |
| **Lower environmental pollution** | 27 |
| **Lower waste amounts** | 11 |

Notes: the number of enterprises in the table exceeds 100, as some of them indicated several factors that contribute to the implementation of the principle of sustainable development. As such, the H1 hypothesis is confirmed.

It should be noted that, although the projects were in the IT field, the activities declared were in the sectors in which they were directly used. A Chi2 statistic of 0.008175188 indicates that the variables in the table are independent and therefore the H2 hypothesis is debunked.

Hypotheses 3. The impact of IT projects on the sustainability principle depends on the environmental awareness in the region where the specific project is implemented. In this context, the environmental security performance of enterprises and organisations in the region should be considered, as well as the enforcement of environmental safety standards. The specific measures to ensure safe environmental management, including the real needs of each project, are relevant. The data from the applications were supplemented by the area of areas with special natural values protected by law in the voivodship (Natura 2000 areas), expressed in square metres per 1 inhabitant of the voivodship, where the project is to be implemented as an indicator of environmental care in the region [18].

A coefficient has also been developed to quantify the impact of the project on the implementation of the principle of sustainable development, with a value of 1 for impacts attributable to the project implementation method, 2 for impacts attributable to the project product (higher value because the product is more impact resistant) and 3 when impacts are attributable to both the project implementation method and the product itself.

As it follows from the analysis of Table 3, enterprises, regardless of the area of protected areas in the voivodeship in which they implement the project, are more often characterized by coefficient 2 than others. The values of the Chi-square criterion (Chi2=0.363, $p<0.05$) indicate a significant influence of the area on the coefficient (Figure 1).

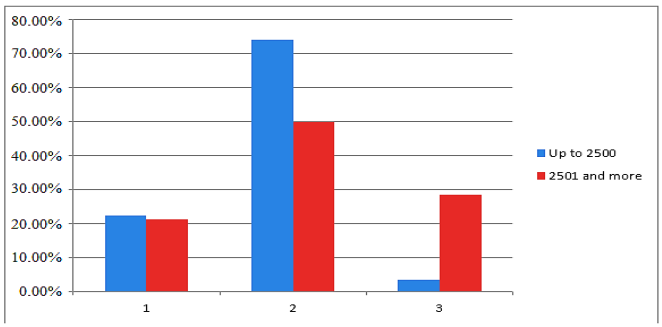


**Figure 1.** Small enterprise: Area*Coefficient2

**Table 2.** Activity type classification

| Industry | Declared | Implementation | Inspection | Total |
|---|---|---|---|---|
| Administrative, law, finance | 17 | 1 | 4 | 22 |
| Construction | 5 | 0 | 4 | 9 |
| Energy | 1 | 1 | 0 | 2 |
| Mining | 0 | 1 | 0 | 1 |
| Trading, including digital commerce | 9 | 2 | 5 | 16 |
| Hospitality and food | 4 | 0 | 14 | 18 |
| Information and communications | 6 | 0 | 2 | 8 |
| Culture and entertainment | 0 | 1 | 3 | 4 |
| Marketing | 5 | 1 | 3 | 9 |
| Science and education | 7 | 0 | 4 | 11 |
| Industrial processing | 4 | 2 | 5 | 11 |
| Agriculture | 0 | 0 | 1 | 1 |
| Sport and tourism | 7 | 0 | 4 | 11 |
| Transportation and car manufacturing | 5 | 0 | 0 | 5 |
| Health and medicine | 14 | 0 | 3 | 17 |
| Total | 84 | 9 | 52 | 145 |

**Table 3.** Small enterprise: Area*Coefficient2

| | | | Factor | | | Overall |
|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | |
| Surface area | Up to 2500 | Number | 13 | 43 | 2 | 58 |
| | | Area, % | 22.4% | 74.1% | 3.4% | 100% |
| | | Factor2, % | 59.1% | 67.2% | 14.3% | 58% |
| | | % from the total number | 13% | 43% | 2% | 58% |
| | 2501 and more | Number | 9 | 21 | 12 | 42 |
| | | Area, % | 21.4% | 50% | 28.6% | 100% |
| | | Factor2, % | 40.9% | 32.8% | 85.7% | 42% |
| | | % from the total number | 9% | 21% | 12% | 42% |
| | Overall | Number | 22 | 64 | 14 | 100 |
| | | Area, % | 22% | 64% | 14% | 100% |
| | | Factor2, % | 100% | 100% | 100% | 100% |
| | | % from the total number | 22% | 64% | 14% | 100% |
| Chi-square independence criterion Chi2=0.363, df=2, p=0.001 | | | | | | |

As the analysis of Table 4 shows, enterprises implementing the project in the province, where the population density of protected areas per inhabitant is up to 2500 people per square kilometre, are more often characterized by coefficients 2 and 1 than entrepreneurs implementing the project in the province, where the population density of protected areas per inhabitant is 2501 and more. The Chi-square test values (Chi2=1.095, p>0.05) indicate an insignificant influence of area on the coefficient (Figure 2).

As it follows from the analysis of Table 5, enterprises, regardless of the area of protected areas in the province in which they implement the project, are more often characterized by coefficient 2 than others. The values of the Chi-square criterion (Chi2=0.392, p<0.05) indicate a significant influence of the area on the coefficient (Figure 3). Following the data presented, hypothesis 3 is confirmed.

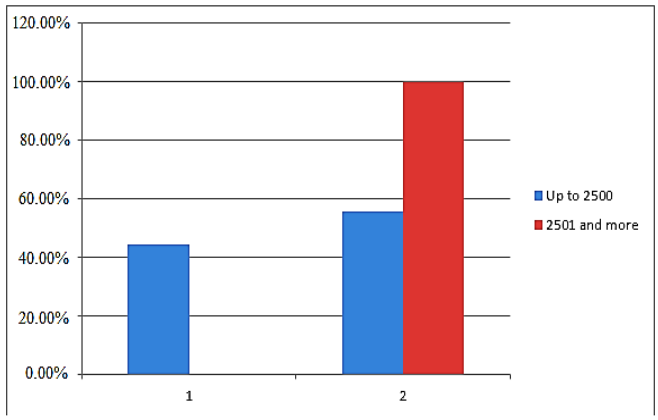


**Figure 2.** Large enterprise: Area*Coefficient2

**Table 4.** Large enterprise: Area*Coefficient2

| | | | Factor2 | | Overall |
|---|---|---|---|---|---|
| | | | 1 | 2 | |
| Surface area | Up to 2500 | Number | 4 | 5 | 9 |
| | | Area, % | 44.4% | 55.6% | 100% |
| | | Factor2, % | 100% | 83.3% | 90% |
| | | % from the total number | 40% | 50% | 90% |
| | 2501 and more | Number | 0 | 1 | 1 |
| | | Area, % | 0% | 100% | 100% |
| | | Factor2, % | 0% | 16.7% | 10% |
| | | % from the total number | 0% | 10% | 10% |
| | Overall | Number | 4 | 6 | 10 |
| | | Area, % | 40% | 60% | 100% |
| | | Factor2, % | 100% | 100% | 100% |
| | | % from the total number | 40% | 60% | 100% |
| Chi-square independence criterion Chi2=1.095, df=1, p=0.259 | | | | | |

**Table 5.** Micro-enterprise: Area*Coefficient2

| | | | Factor | | | Overall |
|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | |
| Surface area | Up to 2500 | Number | 5 | 21 | 2 | 28 |
| | | Area, % | 17.9% | 75% | 7.1% | 100% |
| | | Factor2, % | 38.5% | 61.8% | 14.3% | 45.9% |
| | | % from the total number | 8.2% | 34.4% | 3.3% | 45.9% |
| | 2501 and more | Number | 8 | 13 | 12 | 33 |
| | | Area, % | 24.2% | 39.4% | 36.4% | 100% |
| | | Factor2, % | 61.5% | 38.2% | 85.7% | 54.1% |
| | | % from the total number | 13.1% | 21.3% | 19.7% | 54.1% |
| | Overall | Number | 13 | 34 | 14 | 61 |
| | | Area, % | 21.3% | 55.7% | 23% | 100% |
| | | Factor2, % | 100% | 100% | 100% | 100% |
| | | % from the total number | 21.3% | 55.7% | 23% | 100% |
| Chi-square independence criterion Chi2=0.392, df=2, p=0.009 | | | | | | |

**Table 6.** Full list of analysed projects

| Enterprise | Province | Population Density | Industry |
|---|---|---|---|
| Medium enterprise | Masovian | 1962 | Administrative, law, finance |
| Micro-enterprise | Lesser Poland | 2372 | Industrial processing |
| Micro-enterprise | Lublin | 2684 | Health and medicine |
| Small enterprise | Kuyavian-Pomeranian | 2735 | Energy |
| Micro-enterprise | Podkarpackie | 3763 | Culture and education |
| Micro-enterprise | Lublin | 2684 | Science and education |
| Small enterprise | Lesser Poland | 2372 | Trading, including digital commerce |
| Small enterprise | Masovian | 1962 | Culture and education |
| Large enterprise | Silesian | 598 | Mining |
| Micro-enterprise | Lublin | 2684 | Agriculture |
| Micro-enterprise | Podkarpackie | 3763 | Health and medicine |
| Micro-enterprise | Świętokrzyskie | 6104 | Science and education |
| Micro-enterprise | Lublin | 2684 | Sport and tourism |
| Micro-enterprise | Lublin | 2684 | Health and medicine |
| Micro-enterprise | Świętokrzyskie | 6104 | Information and communications |
| Micro-enterprise | Podlaskie | 5393 | Trading, including digital commerce |
| Micro-enterprise | Lublin | 5393 | Administrative, law, finance |
| Micro-enterprise | Podkarpackie | 6104 | Trading, including digital commerce |
| Micro-enterprise | Podlaskie | 2684 | Science and education |
| Micro-enterprise | Podlaskie | 3763 | Sport and tourism |
| Micro-enterprise | Podlaskie | 5393 | Transportation and car manufacturing |
| Small enterprise | Lublin | 5393 | Trading, including digital commerce |
| Micro-enterprise | Lublin | 5393 | Science and education |
| Micro-enterprise | Lublin | 2684 | Information and communications |
| Micro-enterprise | Masovian | 2684 | Administrative, law, finance |
| Micro-enterprise | Masovian | 2684 | Administrative, law, finance |
| Large enterprise | Lesser Poland | 1962 | Health and medicine |
| Large enterprise | Lesser Poland | 1962 | Health and medicine |
| Micro-enterprise | Masovian | 598 | Sport and tourism |
| Micro-enterprise | Masovian | 2372 | Transportation and car manufacturing |
| Micro-enterprise | Kuyavian-Pomeranian | 2372 | Health and medicine |
| Micro-enterprise | Masovian | 1962 | Information and communications |
| Large enterprise | Masovian | 1962 | Science and education |
| Medium enterprise | Lesser Poland | 2735 | Administrative, law, finance |
| Large enterprise | Łódź | 1962 | Culture and education |
| Large enterprise | Świętokrzyskie | 1962 | Administrative, law, finance |
| Micro-enterprise | Masovian | 2372 | Administrative, law, finance |
| Large enterprise | Pomorze | 1447 | Science and education |
| Large enterprise | Masovian | 1962 | Culture and education |
| Large enterprise | Lesser Poland | 2572 | Administrative, law, finance |
| Micro-enterprise | Opole | 1962 | Health and medicine |
| Micro-enterprise | Masovian | 2372 | Trading, including digital commerce |
| Large enterprise | Greater Poland | 2624 | Health and medicine |
| Micro-enterprise | Masovian | 1962 | Sport and tourism |
| Micro-enterprise | Łódź | 2703 | Health and medicine |
| Large enterprise | Lower Silesian | 1962 | Health and medicine |
| Micro-enterprise | Pomorze | 1447 | Administrative, law, finance |
| Micro-enterprise | Pomorze | 1280 | Administrative, law, finance |
| Small enterprise | Masovian | 2572 | Administrative, law, finance |
| Micro-enterprise | Masovian | 2572 | Transportation and car manufacturing |
| Large enterprise | Masovian | 1962 | Science and education |
| Large enterprise | Masovian | 1962 | Science and education |
| Large enterprise | Masovian | 1962 | Culture and education |
| Medium enterprise | Lower Silesian | 1962 | Construction and real estate |
| Large enterprise | Podkarpackie | 1962 | Administrative, law, finance |
| Large enterprise | Podlaskie | 1280 | Science and education |
| Micro-enterprise | Podlaskie | 3763 | Health and medicine |
| Micro-enterprise | Warmian-Masurian | 5393 | Trading, including digital commerce |
| Micro-enterprise | Łódź | 3763 | Administrative, law, finance |
| Micro-enterprise | Łódź | 3763 | Information and communications |
| Micro-enterprise | Podlaskie | 7879 | Trading, including digital commerce |
| Micro-enterprise | Łódź | 1447 | Industrial processing |
| Small enterprise | Łódź | 1447 | Industrial processing |
| Micro-enterprise | Łódź | 5393 | Trading, including digital commerce |
| Small enterprise | Lower Silesian | 1447 | Marketing |
| Medium enterprise | Łódź | 1447 | Transportation and car manufacturing |
| Micro-enterprise | Podlaskie | 1447 | Trading, including digital commerce |
| Medium enterprise | Łódź | 1280 | Industrial processing |

| | | | |
|---|---|---|---|
| Small enterprise | Podlaskie | 1447 | Trading, including digital commerce |
| Medium enterprise | Podlaskie | 5393 | Information and communications |
| Micro-enterprise | Lower Silesian | 1447 | Marketing |
| Micro-enterprise | Podlaskie | 5393 | Marketing |
| Micro-enterprise | Podlaskie | 5393 | Transportation and car manufacturing |
| Micro-enterprise | Podlaskie | 1280 | Industrial processing |
| Micro-enterprise | Łódź | 5393 | Industrial processing |
| Medium enterprise | Podlaskie | 5393 | Industrial processing |
| Micro-enterprise | Łódź | 5393 | Energy |
| Micro-enterprise | Lower Silesian | 1447 | Trading, including digital commerce |
| Micro-enterprise | Łódź | 5393 | Administrative, law, finance |
| Medium enterprise | Lower Silesian | 1447 | Trading, including digital commerce |
| Micro-enterprise | Podlaskie | 1280 | Health and medicine |
| Medium enterprise | Łódź | 1447 | Hospitality and food |
| Medium enterprise | Łódź | 1280 | Industrial processing |
| Small enterprise | Podlaskie | 5393 | Marketing |
| Medium enterprise | Lower Silesian | 1447 | Marketing |
| Small enterprise | Podlaskie | 1447 | Information and communications |
| Micro-enterprise | Lower Silesian | 5393 | Information and communications |
| Small enterprise | Lower Silesian | 1280 | Marketing |
| Micro-enterprise | Podlaskie | 5393 | Industrial processing |
| Micro-enterprise | Łódź | 1280 | Marketing |
| Small enterprise | Lower Silesian | 1280 | Health and medicine |
| Micro-enterprise | Lower Silesian | 5393 | Health and medicine |
| Small enterprise | Lower Silesian | 1447 | Hospitality and food |
| Micro-enterprise | Łódź | 1280 | Construction and real estate |
| Micro-enterprise | Łódź | 1280 | Health and medicine |
| Micro-enterprise | Łódź | 1280 | Marketing |
| Small enterprise | Lower Silesian | 1447 | Administrative, law, finance |
| Micro-enterprise | Łódź | 1447 | Construction and real estate |
| Micro-enterprise | Podlaskie | 1447 | Marketing |
| Micro-enterprise | Łódź | 1280 | Administrative, law, finance |
| Small enterprise | Łódź | 1447 | Trading, including digital commerce |
| Micro-enterprise | Podlaskie | 5393 | Construction and real estate |
| Micro-enterprise | Podlaskie | 1447 | Health and medicine |
| Micro-enterprise | Łódź | 1447 | Health and medicine |
| Micro-enterprise | Lower Silesian | 5393 | Administrative, law, finance |
| Small enterprise | Lower Silesian | 5393 | Industrial processing |
| Micro-enterprise | Podlaskie | 1447 | Administrative, law, finance |
| Small enterprise | Podlaskie | 1280 | Hospitality and food |
| Micro-enterprise | Podlaskie | 1280 | Sport and tourism |
| Medium enterprise | Łódź | 5393 | Hospitality and food |
| Micro-enterprise | Łódź | 5393 | Construction and real estate |
| Micro-enterprise | Łódź | 5393 | Construction and real estate |
| Medium enterprise | Podlaskie | 1447 | Hospitality and food |
| Medium enterprise | Lower Silesian | 1447 | Hospitality and food |
| Medium enterprise | Łódź | 1447 | Hospitality and food |
| Small enterprise | Łódź | 5393 | Industrial processing |
| Micro-enterprise | Lower Silesian | 1280 | Administrative, law, finance |
| Small enterprise | Łódź | 1447 | Hospitality and food |
| Micro-enterprise | Lower Silesian | 1447 | Hospitality and food |
| Micro-enterprise | Lower Silesian | 1280 | Information and communications |
| Micro-enterprise | Lower Silesian | 1447 | Sport and tourism |
| Micro-enterprise | Lower Silesian | 1280 | Trading, including digital commerce |
| Small enterprise | Podlaskie | 1280 | Administrative, law, finance |
| Micro-enterprise | Lower Silesian | 1280 | Science and education |
| Micro-enterprise | Łódź | 1280 | Sport and tourism |
| Medium enterprise | Lower Silesian | 5393 | Hospitality and food |
| Micro-enterprise | Lower Silesian | 1280 | Sport and tourism |
| Micro-enterprise | Podlaskie | 1447 | Construction and real estate |
| Micro-enterprise | Greater Poland | 1280 | Construction and real estate |
| Micro-enterprise | Lower Silesian | 1280 | Hospitality and food |
| Micro-enterprise | Podlaskie | 5393 | Trading, including digital commerce |
| Small enterprise | Lower Silesian | 2703 | Hospitality and food |
| Small enterprise | Lower Silesian | 1280 | Hospitality and food |
| Small enterprise | Łódź | 5393 | Hospitality and food |
| Small enterprise | Łódź | 1280 | Sport and tourism |
| Small enterprise | Lower Silesian | 1280 | Administrative, law, finance |
| Micro-enterprise | Podlaskie | 1447 | Hospitality and food |
| Medium enterprise | Lower Silesian | 1447 | Hospitality and food |
| Medium enterprise | Podlaskie | 1280 | Sport and tourism |

| | | | |
|---|---|---|---|
| Micro-enterprise | Podlaskie | 5393 | Hospitality and food |
| Micro-enterprise | Podlaskie | 1280 | Sport and tourism |
| Medium enterprise | Podlaskie | 5393 | Construction and real estate |
| Medium enterprise | Lower Silesian | 5393 | Sport and tourism |
| Micro-enterprise | Lower Silesian | 5393 | Trading, including digital commerce |
| Micro-enterprise | Łódź | 5393 | Health and medicine |
| Small enterprise | Podlaskie | 1280 | Administrative, law, finance |
| Small enterprise | Podlaskie | 1280 | Trading, including digital commerce |
| Micro-enterprise | Podlaskie | 1447 | Science and education |
| Micro-enterprise | Lower Silesian | 1280 | Hospitality and food |
| Micro-enterprise | Lower Silesian | 1280 | Hospitality and food |
| Micro-enterprise | Łódź | 1447 | Science and education |
| Micro-enterprise | Lower Silesian | 1280 | Hospitality and food |

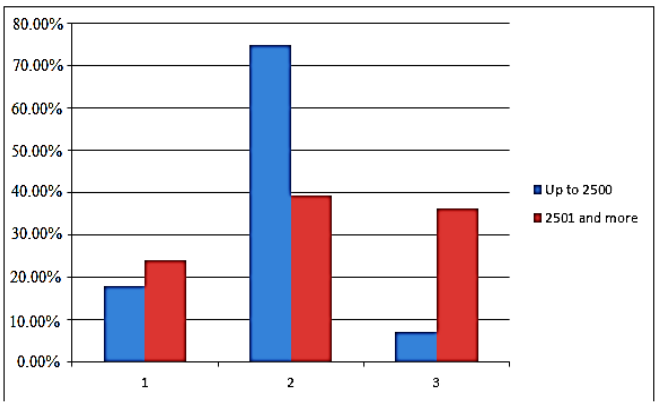


**Figure 3.** Micro-enterprise: Area*Coefficient2

Hypotheses 4. The impact of IT projects on the implementation of sustainability principles depends on the size of the company in which each project has entered its implementation phase and has been completed. The calculated Spearman coefficient of 0.11 does not support hypothesis H.4 (Table 6).

The impact of IT projects implemented with EU funds is assessed according to the key principles of the concept of sustainable development. The main areas of this concept include [19]:

(1) Economic.
(2) Social.
(3) Ecological.

In terms of the economic direction of the sustainable development concept, all projects must consider economic regularities, which makes them more successful than projects that do not take these regularities into account. The social dimension of the sustainable development concept implies preserving social and cultural stability and reducing the overall amount of conflict that contains destruction. This factor must be considered in information technology projects. The environmental dimension of the sustainable development concept involves achieving and maintaining a stable state of ecological and physical systems when implementing projects in the IT sector. Otherwise, the result may be environmental damage and threats to the environment [20-22].

Thus, all sustainability issues and challenges in the implementation of IT projects with EU funds must be solved by applying specific methods and without considering the specific industry in which a particular project is being implemented. Moreover, the choice of these methods is dictated by the real needs of the enterprise within which the project is implemented, as well as the degree of maturity of the sustainable development process in each case [23-25]. In a consistent implementation of the principles of the concept of sustainable development, the impact of IT projects on this process is expressed in the formation of conditions under which the maximum effect can be achieved. At the same time, the assessment of such an effect should be carried out considering how the sequence of implementation of specific projects corresponds to the above-mentioned key principles of the concept of sustainable development. The impact of IT projects implemented with the direct financial participation of the European Union on sustainable development should also be determined by the concrete practical results achieved during the implementation of a particular project.

## 4. DISCUSSION

Melton et al. [26], in their joint research on general principles of project management in the context of linking IT projects with business, point out that successful projects become the core business of many organizations. At the same time, the authors note that sustainability through project implementation can only be achieved since the specialists implementing the project have sufficient professional knowledge. Otherwise, the expected effect may not be achieved. The authors' conclusions fundamentally echo the results obtained in this research study, while noting that professional competence in project implementation is a necessary, but not the only sufficient condition for successful project completion.

Delise et al. [27] conducted a joint study on the general principles of understanding project management effectiveness in the information technology sector. The scholars point out that any externally funded project needs quality support in the context of diagnostics of management efficiency problems. At the same time, effective diagnosis occurs when project managers learn about specific parameters of previous management effectiveness, using external information about past projects to identify key aspects in the context of past project management [28]. The views of the research scientists are fully consistent with the findings of this research, while their conclusions regarding the determination of the effectiveness of project implementation diagnostics appear controversial and require further testing in practice.

Bougheas and Wang [29] in a joint scientific study, examined several problematic aspects of the funding project's management. According to academics, the likelihood of success of any financed project is determined both by the degree of effort put into its implementation and by the fulfilment of financing conditions at all stages. In addition, for certain quality problems in project financing, the optimal financial contract requires that investors retain ownership of a certain portion of the equity in the financed project [30, 31].

The scientists' conclusions regarding the success of the project, if the financing conditions are met at all stages, correlate with the results of this research, while the criteria for the optimality of the financial contract need to be tested on a case-by-case basis.

Kim et al. [32], in a joint research study on the role of information signals in determining the results of investment injections as indicators of successful project financing, note that progress in financing any project from the perspective of the concept of sustainable development can be achieved if the funding status and the amount of sponsorship infusion into the project are increased. According to the researchers, the difference between the two different types of projects is that the overall number of supporters decreases if the projects are content-oriented, provided that the projects achieve their final funding goal. However, if projects are product-oriented, the number of supporters increases after the goal is achieved, which has a positive effect in terms of the concept of sustainable development. The conclusion of scholars regarding the criteria for assessing the difference between the two different projects is controversial and needs to be tested theoretically and practically.

Chen et al. [33] conducted a joint research study on the principles of generating long-term stock valuation and profitability projections for an IT project based on a demographic factor. According to scientists, the inclusion of low-frequency information based on demographic data in the predictive model to estimate the value of the real assets of the project allows for optimizing the financing process. This is based on the fact that demography is the most important factor determining the value of project shares, in particular, the ratio of received dividends to the final price of the finished product [34-36]. The scientists' opinion is fundamentally consistent with the results of this research study; however, the extent to which the demographic factor affects the share price of a specific project requires a detailed study in a subsequent study.

King et al. [37] conducted an academic study of the efficiency of financing IT projects and assessing the risks that arise as they are implemented. Following the findings of the researchers, investment in various IT projects is influenced by certain formal and informal institutions, with the regulatory environment playing a significant role like investment attraction. It is also noted that project financing can change significantly in the context of changes in the external and internal environment, with corporate leverage having a significant effect on risky decisions to allocate capital to certain areas of project activity [38]. This shows the positive dynamics of projects in terms of the concept of sustainability. The conclusions drawn by the researchers are fundamentally consistent with the findings of this research.

Angoua and Soumaré [39] in a joint study on the characteristics of the choice of risk degrees in financing projects with private guarantees point out that the risk appetite of a project always increases significantly when there are contractual arrangements for debt repayment, which causes a conflict of interest between the individual company and the guarantors. In this case, if shareholders have a significant stake in the company concerning long-maturity debt, all parties benefit if they agree to finance projects with low financial risk. The researchers' conclusions fully correlate with the findings of this research study.

Chibane et al. [40] conducted a scientific study of the peculiarities of financial asset movements in crisis conditions during the financing of several projects. While studying the subject, the scientists concluded that the problems of project financing in crisis conditions are largely caused by a decline in the price of assets, while in the boom phase of the business cycle, these events are not so noticeable. According to scholars, the shift in the correlation should be considered a consequence of exogenous shock and risk accumulation, which is caused by changes in macroeconomic policy instruments and credit expansion during boom times. Their conclusions are consistent with the findings of this research paper, while the observations on the correlation of risks in financing individual projects need to be considered in more detail, considering the specifics of individual projects and their asset values.

Mazzuca et al. [41] jointly examined several problematic aspects of investor participation in project financing. The scholars point out that the financing risks of projects in general and IT are shared between several investors, with the commitment of the philanthropic investor entailing large amounts of investment. Innovation in finance has deep roots, with sustainability in financing IT projects being achieved by combining two important innovations in finance, such as sustainable financing and impact financing [42, 43]. The academics' views concur with the findings of this research study, while the allocation of funds among investors in the financing of individual projects needs to be studied in more detail, considering the specifics of individual projects.

Jin et al. [44] jointly examined the general principles of digital finance and material resource allocation among individual firms. They concluded that the misallocation of investment resources between projects leads to losses in the productivity and efficiency of these projects. Following the scientists, the situation can be fundamentally improved by mitigating the misallocation of financial resources among projects using digital finance and careful control of investment funds. Their conclusions are fundamentally supported by the results obtained in this research, with the role of digital finance in project finance requiring more detailed study in the future.

Thus, a discussion of the results obtained in this research in the context of their analytical comparison with the results and conclusions of several scholars who have researched project finance and its impact on sustainable development has demonstrated their fundamental convergence on several key parameters.

## 5. CONCLUSIONS

The study tested four key hypotheses regarding the integration of sustainability into IT projects. Hypothesis 1 found that while a significant 34% of organizations didn't acknowledge sustainability in their projects, a remarkable 42% declared both methodological and product compliance. However, only a fraction of these (15%) quantified their sustainability impact, and only 6% detailed verification methods. Hypothesis 2, examining industry-based variations in sustainability practices, was rejected with a Chi^2 statistic of 0.008175188, indicating industry independence.

When examining the influence of regional environmental awareness on sustainability integration (Hypothesis 3), a notable trend was found: regions with fewer protected areas saw a more pronounced sustainable approach, implying a reactive stance to visible environmental issues. Meanwhile, Hypothesis 4, which examined company size as a determinant of sustainability focus, found no correlation, as evidenced by a Spearman coefficient of 0.11. The study revealed a worrying

trend: many IT companies are overlooking sustainability and may be misinterpreting IT's environmental neutrality. However, tangible results against the core pillars of sustainability (economic, social, environmental) remain the primary metric for assessing the sustainable impact of EU-funded IT projects.

Among the companies that considered the impact of the project on the implementation of the principle of sustainable development, this impact depended on the environment in which the project was implemented. The principle was considered to a greater extent when implementing the project in voivodships with a smaller area of legally protected areas per capita. The reason for such a situation may be a direct perception of the negative impacts of project implementation on the environment by the project developers. In this case, all possible causes and consequences of the negative impacts of economic activities on the environment as well as the extent of the project executors' responsibility for the occurrence of such impacts must be identified.

The impact of IT projects funded directly by the European Union on the implementation of sustainable development is determined in terms of the compliance of these projects with the main areas of sustainable development, which are economic, social, and environmental. The degree of impact in each specific case is determined by the results that were obtained directly during the implementation of the project.

The study highlights the intertwined relationship between IT projects, EU funding and sustainable development. It shows that many IT projects don't adequately prioritize or measure their sustainability, challenging the notion that IT is environmentally neutral. This suggests that the EU may need to re-evaluate its funding guidelines to emphasize sustainability. The results also show that regional environmental challenges influence sustainability efforts and that sustainability encompasses economic, social and environmental aspects. Policymakers should strengthen sustainability guidelines and tailor policies to regional needs. IT professionals need to acknowledge the environmental impact of their projects, possibly using third-party sustainability assessments, especially in regions with pressing environmental issues. For researchers, the study signals the need for broader research across regions and industries, underscoring the central role of sustainability in IT efforts.

The prospects for future research on the impact of EU-funded IT projects on the implementation of the principles of sustainable development in society lie in the study of the key features of such impact, concerning specific areas of public life. This will allow to achieve optimization of measures on the development of the national economy employing systematic implementation of IT technologies in various spheres of life of modern society.

While insightful, the study had several limitations. It analyzed only 152 IT projects out of 46,367 applications, which could affect the generalizability of the findings. Its reliance on companies' self-reported sustainability measures could be biased, and the criteria for sustainability compliance weren't standardized. The study's geographic focus on Poland may not reflect global sustainability impacts, and the PKD-based industry classification may have missed nuanced differences between sectors. In addition, the emphasis on quantitative data may have sidelined a deeper qualitative understanding.

Future research could benefit from a larger sample size, third-party sustainability verification, standardized definitions, cross-regional analysis, detailed industry classifications, and a mix of qualitative and quantitative methods. External factors such as government policies, cultural attitudes, or the local economy, along with temporal analyses of sustainability impacts, would provide more complete insights and pave the way for a more nuanced understanding of sustainability in IT projects.

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