

Article

The Role of Digital Technology Platforms in the Context of Changes in Consumption and Production Patterns

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Abstract: The article focuses on issues relating to achieving sustainable development by promoting new consumption and production patterns based, for example, on sharing resources and doing business exclusively in a digital environment. This topic is extremely important because sustainable development is a fundamental concept aimed at improving the functioning of the present and future generations. The main focus of the article is to show the role played by digital technology platforms within this concept, including in relation to consumption and production patterns. The article is based on two research methods—CATI (i.e., computer-aided telephone interviews) and regression analysis for CATREG quality variables. It has been established that digital technology platforms significantly influence the creation and development of modern business models and increase the quality and intensity of relations between various company stakeholders, which is the basis for promoting new consumption and production patterns—including those based on the sharing economy, subscription to various products and services or the functioning of virtual markets, enabling purchase and sale transactions.



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1. Introduction

The intensive technological progress that we have been witnessing for many years implies numerous transformations in various areas of human functioning. This also applies to the sphere of consumption and production. The main aim of the article is to show the role of digital technology platforms in contemporary changes in consumption and production patterns. This will take into account the broader context of the concept of sustainable development. It should be noted that many of the aforementioned patterns fit into this concept by becoming a practical expression of its implementation (for example, sharing economy) [1]. This subject is important because sustainable development is currently strongly promoted around the world in becoming an effective response to various problems and challenges, including those related to environmental pollution and excess waste [2] or income inequalities or inequalities in people's access to specific resources [3]. The impact of digital technologies on sustainable development is noticeable, and its diverse impact is both a hindrance and a challenge to research [4].

ICT acts a mediating role in the process of realizing the sharing economy and sustainable development. There is a rapid development of the digital sharing economy, which is becoming an important field of ICT applications, a good example of which is the rapid development of digital platforms enabling the implementation of the sharing economy idea that takes into account both individuals and companies from various sectors of the economy [5]. The great potential of digital platforms of the sharing economy is indicated by Yaraghi and Ravi [6]. The sharing economy may become the dominant form of the

economy in the near future. Its particular advantage is the possibility of supporting sustainable development by improving the efficiency of resource use and changing the existing patterns and concepts of consumption [7]. The essence of sustainable development is that it meets the present social needs without worsening environmental conditions in the future. The implementation of this idea in practice requires both sustainable production and sustainable consumption [1], requiring the improvement of existing production patterns and consumption after taking into account the environmental impact. Although the ideas of sustainable development have been promoted for many years, traditional patterns of mass production and mass consumption, closer to traditional consumerism, still persist [8]. It seems reasonable to suppose that in the long run, however, the sharing economy will systematically change the existing system production and consumption by promoting changes in production and consumption patterns [7]. The sharing economy will change the way of life and the level of consumption will decrease and help to solve the problem of excessive consumption of raw materials, which is resulting in increasing environmental pollution [9]. In the process of balancing the entire production and consumption chain, an important role is played by social networks and discussions taking place on internet forums related to the need to protect the environment and striving for sustainable development. The internet is becoming a medium enabling the widespread promotion of new consumption patterns, indirectly also influencing by changing the demand for production patterns consistent with the spirit of sustainable development [10]. What is needed is a change in the traditional model of economic growth based on stimulating consumer demand, which generates an increase in demand for production. Often exceeding the actual needs, it has an adverse impact on the use of environmental resources and is a barrier to sustainable development [7]. Digital platforms offer new market opportunities and allow the idea of the sharing economy to be realized, thus moving away from “owning” to “using”, which, as a consequence, will lead to a reduction in consumption and a reduction in the negative impact on the environment. The article attempts to demonstrate that digital technology platforms by offering a service instead of a product have a chance to change the existing consumption and production patterns inconsistent with the idea of sustainable development. The rest of the article is organized as follows. Section 2 reviews the literature related to the topic of sustainable development and digital technology platforms and their impact on consumption and production patterns. Section 3 discusses the research method, and Section 4 presents the results of the analyzes performed. The discussion of the obtained results is presented in Section 5 and the conclusions resulting from the conducted research are presented in Section 6.

2. Literature Review

The literature indicates the high potential of the platform economy supporting sustainable development by making products available rather than buying them [11], as well as the numerous threats to companies, employees and the environment [12]. For sustainable consumption, digital platforms carry with them numerous risks [13] related to the revolution in the functioning of industries and industries taking place under their influence [14,15]. However, so far, the scientific literature has not given satisfactory consideration to the role digital technology platforms play in promoting new consumption and production patterns and, more broadly, the concept of sustainable development [16]. This is, undoubtedly, important and is influenced by the increasing popularity of DTPs (digital technology platforms) and their use in virtually all areas of human activity (professional and business, educational, family, social). Among the publications in this field, one can only mention the collective work on sustainable development in the context of digital platforms [12] and the UNCTAD report [17], as well as an article by Fuster Morell, Espelt and Cano [18] which deals with Sustainable Platform Economy (this term shows the strong relationships that exist between DTPs and sustainable development). It should be noted that individual authors focused more on issues related to digitisation [19,20] or the

digital revolution (digital transformation) [21,22] than on the role of DTPs in sustainable development. Therefore, there is a need to describe such a role in this article.

There has been a discussion in the literature for years on the impact of ICT and its digital transformation on sustainable development. Digital platforms are created as a result of the ongoing digital transformation of the economy and enterprises, which has a direct or indirect impact on the environment [23]. The direct impact is related to the use and disposal of information and communication equipment (ICT). In contrast, the indirect impact manifests itself in changes in production and consumption patterns caused by the operation of digital technology platforms in various areas of life. According to J. Bieser and L. Hilty, the research on indirect environmental effects so far focused mainly on individual fields of application and therefore did not allow the capture of systemic effects of ICT on lifestyle. They proposed that, in order to study the systemic environmental effects of ICT, the impact of these technologies on individual lifestyles, in particular on the ways and forms of use of time, should be investigated. According to them, individual lifestyle is the main determinant of the overall impact on the environment and the dissemination of ICT changes individual patterns of consumer behavior [23]. The approach based on studying the ways and forms of using time was the basis for simulating scenarios of ICT impact on sustainable development in the time horizon 2000–2020 in the context of modeling individual choice different modes of transport [24]. The simulation results led to the conclusion that ICT applications have a significant potential impact on sustainability at different levels and produce different effects: negative first order effects such as increasing electronic waste streams; positive second-order effects of energy savings from ICT-supported facility management and positive third-order effects such as switching from product to service leading to a less material-intensive economy [25]. Attempts are being made to conceptualize the digital sharing economy as an ICT-driven phenomenon in the context of the impact of ICT on sustainable development. The approach of treating the digital sharing economy as an ICT use case in the sense adopted by the Global e-Sustainability Initiative [26] was proposed by MJ Pouri and LM Hilty [5]. Digital platforms, which are a manifestation of the effective use of ICT in business, meet the challenges of the sharing economy and make possession of things—the basic premise of material consumption and market economy—which slowly lose its importance. We are currently seeing how digital platforms replace or change traditional markets and thus shape both consumption practices and change the current logic of companies' revenues [27]. As emphasized by Rynänen and Hyyryläinen, there is a need to focus on emerging consumption patterns and available data sets in order to track progress and technical knowledge—a methodical focus, enabling a holistic approach to the problem. One of the important research questions indicated in the literature is the question about the prospects for the development of digital technology platforms and their impact on the market and the consumer, in particular on production and consumption patterns [27]. It should also be emphasized that to achieve a sustainable sharing economy requires the existence of appropriate legal regulations attitudes and motivations of consumers taking into account environmental needs in their choices [28]. In the sharing economy, consumers interested in sharing, affordable prices and positive environmental impacts are driving innovation business models and, as Hasan and Birgach put it, a sustainable economic model [29]. According to Martin [30], the sharing economy, on the one hand, may support sustainable practices and patterns of consumption and production, and, on the other hand, may strengthen the existing economic imbalances in as a result of the emergence of unregulated markets. We can observe both positive and negative effects of digital platforms on the labor market, where platforms contribute to the increase in job insecurity by promoting the practices referred to as “fictitious self-employment”. As the analysis of many publications shows, the problem of the impact of digital technology platforms on production and consumption patterns as well as consumer behavior is being investigated, and the research results so far indicate the need to continue and deepen them. Therefore, the presented article attempts to answer the question about the impact of digital platforms on sustainable

development by promoting new consumption and production patterns based on, e.g., sharing resources and running a business exclusively in a digital environment.

As far as DTP-related topics are concerned, it is worth noting that, in general, the scientific literature has undertaken extensive deliberations on the subject, but, so far, even the essence of these platforms has not been sufficiently explained. There are various statements, including that DTPs are as follows:

- digital tools that allow the establishment and intensification of relationships between a variety of market players, including businesses and consumers, and even administrative entities (public administrations) by enabling these entities to carry out transactions and interact with each other—including business—and to communicate with each other using the internet; the direct effect of this is to connect business partners and create business networks [31,32]
- the type of base or framework on which the foundations of a given IT or technological system are built, with their characteristic feature being the possibility of implementing new functionalities and developing complementary products, services and technologies [17]
- code bases, which are expandable, meaning that it is possible to add new modules and functionalities to them at any time, or all technical elements, including software and hardware, as well as related organisational processes and standards [16].

Due to the multiplicity, complexity and variety of definitions related to DTPs, our own approach to them was developed. It has been asserted that these platforms are electronic (digital) tools that can take the form of services or content through which it is possible to create the basis for establishing and intensifying contacts between various entities operating on the market. A very important feature of these platforms is the possibility of constantly expanding them with new modules or functionalities. What is important is that the literature does not use the term “digital technology platforms” on too wide a scale, and, instead of that, undoubtedly less precise terms are used, such as digital platforms [16], technology platforms [33], IT-platforms [32] or digital business technology platforms [34].

The article will be based on our own research, during which, using regression analysis for CATREG qualitative variables—a model for which digital technology platforms were developed. This model takes issues relating to the impact of DTPs on the creation and development of modern digital business models into account, as well as the benefits it generates.

3. Materials and Methods

We observe the rapid development of DTPs, which affects both companies and consumers. Advancing digital technologies and computer networks have changed the seller's market to a buyer's market, where companies must solicit consumers and best meet their needs [14]. The main research problem formulated in the article is the identification and understanding of the impact of DTPs on the attitudes and patterns of production and consumption. Searching for a solution to this problem, a research question was formulated whether and to what extent digital technology platforms increase the quality and intensity of relationships established by the company's employees with its stakeholders, including mainly suppliers, contractors, distributors and customers. The second research question was whether new business relationships created thanks to DTPs support the promotion of new consumption and production patterns consistent with the sharing theory, such as using subscriptions for products and services, electronisation of customer service processes, production or purchase and sale transactions. In our own research, which was conducted from the 18th to the 28th of February 2019 on a group of 120 Polish enterprises which are beneficiaries of the Operational Programme Innovative Economy implemented by the Polish Agency for Enterprise Development (these enterprises received grants for investments in the scope of implementation and development of DTPs), two methods were used. The first one was CATI—a method of computer-assisted telephone interviewing. Their implementation was based on a survey questionnaire consisting of 23 questions. The

CATI method has a high degree of standardisation and is an element of the quantitative paradigm, with its main advantages being that its results can be generalised to the whole population [35].

The sample was random and the interviews were conducted with representatives of the management staff who had knowledge of the functioning and use of digital technology platforms by enterprises. Drawing was based on the lists of beneficiaries of the Operational Programme Innovative Economy implemented by the Polish Agency for Enterprise Development. Companies that received funding under this programme were selected for the sample. The final sample consisted of $n = 320$ records, of which it was assumed that effective interviews would be conducted with the number of entities $n = 120$. The randomisation algorithm built into the telephone survey software has given each record in the database an equal chance to be included in the sample. In the course of the survey, telephone contact was made with each of the enterprises. A total of 120 interviews were completed; 49 enterprises refused to participate in the survey, two enterprises declared that they did not implement any platforms, and, with the remaining enterprises, it was not possible to complete the interviews within the assumed survey deadlines.

Apart from CATI, the study was also based on the regression analysis for CATREG (categorical regression) qualitative variables, thanks to which a model for measuring attitudes towards DTPs was developed. Creating a model of a phenomenon consists of a specific mathematisation of hypotheses (in the form of an equation or a system of equations, respectively) and thus presenting them in a parameterised way in the so-called 'statistical space'. Such a model presents the simplified but essential and most important links between the phenomena under consideration. For this purpose, inductive statistics tools are used and, most often, regression models.

Optimal scaling belongs to the family of regression methods. It is a method which consists of predicting the value of a selected variable on the basis of values assumed by other variables also indicated by the researcher. It is important that the optimal scaling enables the inclusion of variables that are at each measurement level in the analyses: nominal, ordinal, interval and quotient. This is a key advantage of this method, which prevents the inclusion of nominal variables in the analyses (thus it is impossible to find out what role they play). This method can be considered a kind of 'first choice' in social sciences as the variables are generally measured here on a qualitative level. The purpose of using this method is to quantify the relationship between multiple independent variables and one dependent variable. It is a "regression for qualitative variables" and its essence is that the combined effect of the variables is investigated (interaction means the "product" of individual variables) [36]. The concept of optimal scaling comes from various sources—correspondence analysis [37] and multidimensional scaling (MDS) [38,39]—and is considered to be the successor of these methods. It is also statistically more correct and rigorous.

Optimal scaling is a technique that provides multidimensional data exploration: the number of predictors allowed is two hundred, although only one independent (predicted) variable can be predicted. It is reasonable, however, to limit the number of variables. There should be at least ten—or preferably twenty—units of analysis for each variable; otherwise, you may experience instability in the regression line. This means that in this analysis, where the set is $n = 120$, a maximum of twelve independent variables can be used and no more than six optimally.

This is important in the context of the number of sixteen variables identified. It means that at least four of them should be eliminated a priori. The choice was made for those variables, which in various variable systems tested many times showed the lowest level of interaction with other independent and dependent variables.

A model which uses CATREG is usually constructed in the following iterative steps:

- (1) Including a set of variables in the model that, in the opinion of the researcher, affect the dependent variable (this set is already established at the level of preparing the tool for empirical research)

- (2) Manipulating the order of variables to achieve the highest result (it is iterated repeatedly that it is a mechanical activity)
- (3) Model building and evaluation
- (4) Reduction of the number of variables by the weakest predictor
- (5) Creation of a reduced model
- (6) Comparisons of the previous and the next (reduced) model
- (7) Repeating Points 4 to 6 until the most satisfactory numerical result is obtained

The procedure above is a top-down (descending) method which usually gives satisfactory substantive results. In the discussed model, the attitudes of company executives towards DTPs were examined. The concept of attitude is deeply rooted in social sciences—particularly sociology, but it is also widely used in economics [40]. Scholars agree that the attitude exhibits a three-component structure: affective (what you feel), cognitive (what you know) and behavioral (what you do) [41]. The concept of attitude was used in the formulation of the question, which is an indicator of an independent variable:

Question 13. To what extent do digital technology platforms increase the quality and intensity of the relations established by the company in which you perform your professional duties with all stakeholders, mainly including suppliers, contractors, distributors or customers?

This question allowed attitudes towards the phenomenon of digital technology platforms to be measured. It includes both evaluation elements referring to knowledge as well as those concerning the evaluation of this phenomenon (“increase in quality and intensity”). Interaction can be seen in the overall assessment of the impact of digital technology platforms on the growth of the quality and intensity of business and other assessment elements, including behavioral and cognitive ones. It was assumed that a company can be transformed by digital technology platforms’ human dimension (assessment of the phenomenon, the scope of its use, expectations, etc.), in the cybersecurity dimension (new IT challenges, related to hardware and software), in the economic dimension (related to the account of actual and potential profits and losses) and in the social dimension (changes in the structure of the company and its layout, type and intensity of relations with the environment). The structural factor that relates to Question 12 (i.e., the cognitive element) (Do you agree with the statement that digital technology platforms enable the creation and development of innovative business models?) is of key importance for the considerations undertaken in this paper.

The CATREG model was supplemented with cross tables. They were also based on Question 13 of the questionnaire. They were compared, *inter alia*, with Question 4 (Please specify what type of digital technology platforms is or will be used in the enterprise). The analysis included two-variable tables and tables as supporting inductive tests of intergroup differences. In order to find the differences and similarities between the groups identified in the course of conceptual work, the Kruskal–Wallis test by ranks—commonly referred to as the non-parametric analysis of variance—and the Mann–Whitney test were used. The first statistical tools were introduced into scientific circulation in the middle of the last century by William H. Kruskal and Allen Wallis [42]. This test makes it possible to determine whether there are statistically significant differences between the elements in a large ($k > 2$) multi-element group. If this test shows such differences, then another one is used, the test introduced by Henry B. Mann and Donald R. Whitney to compare the pairs of elements making up the group [43]. It provides information between which elements there are statistically significant differences and between which there are no such differences. The tests can be used when the variables subjected to them are measured, at least, on an ordinal level but also on an interval or ratio level.

The recording of the Kruskal–Wallis test result is as follows [43,44]:

$$H(\chi^2([x], N = [y]) = [z]; p \leq [\alpha]),$$

where:

x —number of degrees of freedom

y —sample size on which the test was performed

z —value of the chi-square test

α —significance level of the Kruskal–Wallis test performed.

The recording of the Mann–Whitney test result takes the form [43,45]:

$$U(N = [x]) = [y]; \leq [\alpha],$$

where:

x —sample size on which the test was performed

y —value of the Mann–Whitney test

α —significance level of the test performed.

In these tests, as in other inductive tests, the following two statistical hypotheses are formulated: the null hypothesis (H_0), assuming that the compared groups are the same, and an alternative hypothesis (H_1), which proclaims the difference between the studied groups. The test is considered statistically significant if $p \leq 0.05$.

During the research, intergroup comparisons were also made in order to find specific ‘characteristics’ of the use of digital platforms from the perspective of different groups of respondents (multidimensional characteristics of the studied population). Question 2 is used as a variable (If in Question 1 you marked the answer ‘definitely yes’ or ‘rather yes’, please specify how long have digital technology platforms been used in the enterprise where you currently perform your professional duties?) and Question 22 (Please specify in which type of company, given the size of your employment, you perform your professional duties).

4. Results

Taking into account the CATI study, results should be provided for Questions 12–13. These results are in Tables 1 and 2.

Table 1. The impact of DTPs on the creation and development of innovative business models.

Question 12. Do You Agree with the Statement that Digital Technology Platforms Enable the Creation and Development of Innovative Business Models?	Frequency	Percentage
I strongly agree	63	52.1
I rather agree	45	37.2
I neither agree nor disagree	12	9.9
I rather disagree	1	0.8
Total	121	100.0

Table 2. The impact of DTPs on the increase in the quality of the intensity of relations established by the enterprise.

Question 13. To What Extent Do Digital Technology Platforms Increase the Quality and Intensity of the Relations Established by the Company in Which You Perform Your Professional Duties with All Stakeholders, Mainly Including Suppliers, Contractors, Distributors or Customers?	Frequency	Percentage
very much	44	36.4
to a large extent	47	38.8
neither to a great nor to a small extent	11	9.1
to a small extent	2	1.7
to a very small extent	6	5.0
I have no opinion on this	11	9.1
Total	121	100.0

The vast majority of respondents considered that DTPs influence the creation and development of modern business models—that is what 89.3 of them said.

Most of the respondents concluded that DTPs contribute to an increase in the quality and intensity of relationships established by enterprises with various stakeholders, including suppliers and customers.

Taking into account the CATREG model, the calculation results (the best, final model) for top-down (descending) optimal scaling are presented in Tables 3 and 4.

Table 3. A summary of the overall coefficients of the top-down optimal scaling model (descending).

Multiple R	0.668
R-squared	0.446
Adjusted R-squared	0.218

Table 4. ANOVA variance analysis for the optimal scaling model obtained by the top-down (descending) method.

	Sum of Squares	Degrees of Freedom (df)	Average Square	F	Relevance
Regression	53.971	35	1.542	1.955	$p \leq 0.01$
Residual	67.029	85	0.789		
Total	121.000	120			

The fit of the optimal scaling model expressed by multiple R was 0.668, which is considered to be a moderate (significant) dependence, but lies almost on the border of the so-called ‘significant correlation’, whose space extends from 0.7. The total variability of the dependent variable, explained by the total interaction of independent variables, was as much as 0.218. This means that the model explains as much as 21.8% volatility of attitudes towards digital technology platforms in enterprises. This is a significant value, even despite the fact that the model consists of a large number of coefficients. A significant but acceptable number of factors in the model (20) reduces the original (R-squared) value of the coefficient. It is worth noting that the analysis, which consists of an attempt to subtract individual coefficients from the model in order to reduce their number, increases the forces of explaining the model. Therefore, the nine variables interact (at least in a mathematical sense) together and form an inseparable whole. The model is statistically significant at a more than satisfactory level (i.e., $p \leq 0.01$). A visual assessment of the sum of squares for regression and residuals in ANOVA shows that the regression model explains more than half (53%) of the variability, which makes it valid. It is worth noting that the analogous method of creating the model became the basis for the highly rated habilitation thesis by Mider [46]. In that work, the adjustment of the optimal scaling model expressed with multiple R was much less than in this one as it was 0.413. The most important factor influencing attitudes towards DTPs is the economic factor (0.386, which means that it explains 38.6% of the variability of the independent variable) and the sociodemographic factor. In the case of Question 12, the significance is at a level of 0.055, which means that the attitudes in the surveyed enterprises are only, to a small extent, conditioned by the factor related to the creation and development of innovative business models as a result of using digital technology platforms.

With regard to the cross-tables, the analysis covered, inter alia, Questions 4 and 13. The results of this analysis are presented in Table 5.

The respondents noticed the greatest impact of DTPs on the increase in the quality and intensity of relations established by enterprises with stakeholders in relation to communication and information platforms.

The results of the study should then be presented in relation to intergroup comparisons. These comparisons concern, inter alia, Questions 2 and 12. The results are presented in Table 6.

Table 5. The impact of DTPs on the increase in the quality of the intensity of relations established by the enterprise in terms of the type of platforms used.

Types of DTP	Question 13. To What Extent Do Digital Technology Platforms Increase the Quality and Intensity of Relations Established by a Company?											
	To a Very Large Extent		To a Large Extent		Neither to a Great nor to a Small Extent		To a Small Extent		To a Very Small Extent		I Have No Opinion	
	N	%	N	%	N	%	N	%	N	%	N	%
communication	37	38.9	36	37.9	9	9.5	2	2.1	3	3.2	8	8.4
informative	28	32.9	36	42.4	7	8.2	2	2.4	4	4.7	8	9.4
for making comparisons	3	25.0	5	41.7	3	25.0	1	8.3	0	0.0	0	0.0
intended for entertainment	2	22.2	5	55.6	0	0.0	0	0.0	0	0.0	2	22.2
online markets	13	27.1	18	37.5	8	16.7	2	4.2	3	6.3	4	8.3
all of the above	0	0.0	2	100.0	0	0.0	0	0.0	0	0.0	0	0.0

Table 6. The development of innovative business models and the time of using digital technology platforms.

Question 12. Do you Agree with the Statement that Digital Technology Platforms Enable the Creation and Development of Innovative Business Models?	Question 2. Please Specify How Long Have Digital Technology Platforms Been Used in the Company Where you Currently Perform Your Professional Duties.			
	up to 3 Years		over 3 Years	
	N	%	N	%
I strongly agree	25	43.1	37	59.7
I rather agree	29	50.0	16	25.8
I neither agree nor disagree	4	6.9	8	12.9
I rather disagree	0	0.0	1	1.6
I strongly disagree	0	0.0	0	0.0

There are no statistically significant differences between the studied groups in this respect. Both (almost 100%) agree that digital technology platforms enable the creation and development of innovative business models. It is worth noting that the force of positive conviction to the statement is higher for enterprises of higher seniority level (over three years).

Table 7 presents data concerning Questions 2 and 13.

Table 7. The increase in the quality and intensity of relations between the company and its stakeholders and the time of use of digital technology platforms.

Question 13. To What Extent Do Digital Technology Platforms Increase the Quality and Intensity of Relations Established by a Company?	Question 2. Please Specify How Long Have Digital Technology Platforms been Used in the Company Where you Currently Perform Your Professional Duties.			
	up to 3 Years		over 3 Years	
	N	%	N	%
very much	21	36.2	23	37.1
to a large extent	22	37.9	24	38.7
neither to a great nor to a small extent	5	8.6	6	9.7
to a small extent	0	0.0	2	3.2
to a very small extent	3	5.2	3	4.8
I have no opinion on this	7	12.1	4	6.5

In the case of both studied groups of enterprises, the same position can be seen in terms of large or very large impact of the use of digital technology platforms on the increase in quality and intensity of relations established by companies. In this case, there are no statistically significant differences between the groups.

Another issue to be considered here concerns the impact of DTPs on the development of innovative business models depending on the size of the enterprise (comparison of Questions 4 and 22). The related data is shown in Table 8.

Table 8. The development of innovative business models and the size of the enterprise.

Question 12. Do You Agree with the Statement that Digital Technology Platforms Enable the Creation and Development of Innovative Business Models?	Size of the Enterprise							
	Micro		Small		Medium		Large	
	N	%	N	%	N	%	N	%
I strongly agree	10	83.3	18	64.3	15	36.6	19	48.7
I rather agree	1	8.3	5	17.9	24	58.5	15	38.5
I neither agree nor disagree	1	8.3	5	17.9	1	2.4	5	12.8
I rather disagree	0	0.0	0	0.0	1	2.4	0	0.0
I strongly disagree	0	0.0	0	0.0	0	0.0	0	0.0

The representatives of all the surveyed enterprises, regardless of the size of employment, agree (almost 100%) with the statement that digital technology platforms enable the creation and development of innovative business models.

The last issue concerns the company's relations with stakeholders when taking into account the size of the surveyed companies. Data on this issue is presented in Table 9.

Table 9. Relationships of the enterprise with the environment and the size of the enterprise.

Question 13. To What Extent Do Digital Technology Platforms Increase the Quality and Intensity of Relations Established by a Company?	Size of the Enterprise							
	Micro		Small		Medium		Large	
	N	%	N	%	N	%	N	%
very much	4	33.3	10	35.7	15	36.6	15	38.5
to a large extent	5	41.7	11	39.3	16	39.0	14	35.9
neither to a great nor to a small extent	2	16.7	3	10.7	5	12.2	1	2.6
to a small extent	0	0.0	2	7.1	0	0.0	0	0.0
to a very small extent	0	0.0	0	0.0	5	12.2	1	2.6

Regardless of the size of employment, there is a prevailing belief that the use of digital technology platforms has a very high or high impact on the quality and intensity of the relationships that businesses establish with other actors in the environment. There are no significant differences in this respect between the studied groups.

5. Discussion

The study sought to answer two research questions. The first question was whether and to what extent digital technology platforms increase the quality and intensity of relationships established by the company's employees with its stakeholders, including mainly suppliers, contractors, distributors and customers. The research results presented above prove that digital technology platforms have a significant impact on the creation and development of modern business models as well as on the increase in the quality and intensity of relations that enterprises establish with their stakeholders (suppliers, contractors or customers). This belief was expressed by the vast majority of respondents (Table 1), regardless of the time of using the platforms or the size of employment in enterprises. (Table 7) At the same time, it should be emphasised that the high quality and intensity of relations between the enterprise and its stakeholders is particularly noticeable in the case of using communication and information platforms (Table 5).

There is a high agreement in the attitudes of companies towards the quality and intensity of relations that companies establish with other entities from the environment, regardless of the size of the surveyed company (Table 9).

The second research question was whether new business relationships created thanks to DTPs support the promotion of new consumption and production patterns consistent

with the sharing theory, such as using subscriptions for products and services, electronization of customer service processes, production or purchase and sale transactions, which in the study were defined as innovative business models.

The majority of respondents (89.3%) believe that DTPs support the creation and development of innovative business models that enable the implementation of sustainable patterns of production and consumption (Table 1), regardless of the time of using the digital platform (Table 6). Moreover, the size of the enterprise did not affect the differentiation of respondents' attitudes towards the claim that DTPs support the creation and development of innovative business models (Table 8).

The article also presents the results of the CATREG model that allows one to measure the attitude of the management of the surveyed companies towards DTPs and to perform a general assessment of the impact of digital platforms on the increase in the quality and intensity of relations established with the company's stakeholders and other evaluation elements, including behavioral and cognitive. For the optimal model, a relatively high level of fit, expressed by the Multiple R coefficient and amounting to 0.668, was obtained, and this model explained 21.8% of the variability of attitudes towards DTPs as an effect of the sum of interactions of dependent variables. The model turned out to be statistically significant at a level higher than satisfactory (i.e., $p \leq 0.01$), and the ANOVA analysis performed showed that the regression model explains more than half (53%) of the variability of the studied phenomenon.

The subject matter discussed here is closely related to the issues of sustainable development. This applies to promoting new consumption and production patterns (SCP). It should be highlighted that currently these patterns are one of the most important goals that make up the SDG (i.e., Sustainable Development Goal). In this respect, it is underlined that SCP may significantly contribute to the reduction of resource consumption, opposing the ever-growing consumerism of contemporary society [47]. To this end, it is necessary to create appropriate mechanisms that will contribute to combining different resources and also creating strong links between the production and consumption spheres in order to develop appropriate, tailor-made, sustainable ways of working. Therefore, the concept of SCP promotes the implementation of innovations, including those of a systemic nature [48].

In particular, digital technology platforms should be considered as carriers for such innovation. Changes in contemporary consumption and production patterns contributing to the achievement of the goals of sustainable development are largely due to the development of DTPs. These changes are mainly the result of the convergence of various tools and channels, including communication. This results in the creation of large, integrated and multi-user platforms that operate in the digital environment [49]. In this way, a sustainable platform economy—in which the emphasis is on engaging as many resources as possible in order to promote cooperation—is created, the aim of which is, for example, to generate modern solutions and mechanisms to intensify the relationship between the business environment and consumers [12]. Digital platforms are also becoming useful for developing more and more modern earning models by providing access to cheaper services and products as well as developing social inclusion [2].

Undoubtedly, under the influence of digital technology platforms, patterns of production and consumption are being promoted completely differently to just a dozen or so years ago. In this respect, it should be stressed that these platforms offer unprecedented opportunities for cooperation between the producer and the consumer. The platforms initiate the functioning of business models in which the consumer becomes not only the recipient (purchaser) of specific products and services but also a co-creator and author of new ideas and innovations [32]. The consumer is increasingly taking responsibility for promoting modern models of consumption and production, and, what is particularly important, this fits in well with the objectives that are set for sustainable development. In this context, it is important to mention the concept of sharing economy, also called the economy of intermediation, in which the users of certain platforms exchange various goods so that these goods are not excessively consumed. Digital technology platforms play a key

role in this concept, acting as an intermediary between users wishing to exchange certain goods. The practical expression of the existence of this concept is platforms, based on the Access over Ownership model, in which access to specific services is possible without purchase. Such a model belongs to the hyper-disruptive business models that lead to the displacement of existing patterns and ways of functioning of the organisation on the market, described as ‘incumbent’. Such models, as Apple or the Freemium model, are also closed ecosystems (for example, the Dropbox platform, which enables data storage in a virtual environment) [45,50].

One of the most important features of DTPs is that they work only in a digital environment. This also has positive implications in the context of the Sustainable Development Goals. The functioning of the platforms allows the need to generate paper documents to be virtually eliminated—in modern models, invoices or other sales documents are sent electronically (e.g., via e-mail). In this regard, there are numerous consumption and production patterns including, but not limited to, the following models:

- Brokerage model—it creates virtual markets where it is possible to make buy and sell transactions, with brokers usually charging commission for organising these transactions
- Merchant model—the sale of products or services exclusively through the internet
- Infomediary model—collection, processing and provision of data on customers and producers’ offers by organisations for a fee (this is done via the internet)
- Advertising model—generating revenue by increasing the attractiveness of websites
- Affiliate network (affiliate model)—reaching a wide range of customers by establishing cooperation with affiliated partners who place links to the portal of a given organisation on their websites
- Subscription model—enabling periodic access to digital services in exchange for an appropriate fee
- Tariff (utility model)—a model similar to the subscription model with the difference that the amount of fees for using digital services depends on the actual use of them (for example, a fee for the volume of downloaded data)
- Virtual community model—the use of volunteering for marketing activities [44,51].

The above considerations show that digital technology platforms play an important role in relation to changes in modern consumption and production patterns and thus contribute to the achievement of sustainable development objectives.

6. Conclusions

Digital technology platforms are currently developing rapidly and are attracting many users. They can be considered in the context of the goals that have been set for sustainable development. The direct effect of their use is the promotion of innovative solutions functioning in the digital environment as well as the integration of many company stakeholders within ecosystems. As a result, completely different consumption and production patterns are promoted. These include the sharing of various resources and goods by platform users (intermediation economy), the creation of virtual communities that emphasise the use of volunteering for marketing activities and business ecosystems which offer access to specific products or services by subscription or creating developed sales platforms. DTPs significantly influence the creation and development of modern business models and increase the quality and intensity of relations established by all the company’s stakeholders (including consumers or suppliers), which promotes consumption and production patterns contributing to the achievement of sustainable development, with communication and information platforms playing a decisive role in this respect. That is why it is so important DTPs are constantly developing intensively. As part of the model of attitudes towards DTPs, it has been proven that the most important factor of this development is the economic factor related to the specific financial benefits that are achieved by users of these platforms.

Observing the rapid development of the sharing economy based on digital technology platforms that act as mediators between suppliers offering a good or service and buyers, we can see that digital platforms contribute to lower transaction costs. Therefore, the

digital sharing economy is of interest to both companies and consumers, who see it as both economic and social benefits in the form of environmental protection. Replacing many material elements of the production process and distribution of products and services with their information mapping via online platforms makes it possible to optimize the degree of resource use. Based on the research based on statistical modeling of attitudes towards the phenomenon of digital technology platforms of managers of the surveyed companies, it was shown that digital technology platforms, as an element of the sharing economy, affect changes in production and consumption patterns, leading to the implementation of the idea of sustainable development. In particular, such a positive role is played by innovative business models based on digital platforms, which allow companies to obtain higher economic efficiency and improve their competitive position, and offer consumers easier access, lower costs and meeting the need to act for sustainable development. On the basis of the results presented in the work as well as the research results, it seems reasonable to say that innovative business models based on digital platforms support sustainable patterns of production and consumption. Nevertheless, due to the multidimensional nature of the phenomenon under study, it is important to continue researching the impact of digital platforms and digital business models in many other respects. For example, research on the sustainability of the impact of digital platforms on sustainable development could be interesting—whether and to what extent it is a structural impact acting on a macro-scale and affecting the entire economy, or only bringing benefits on a micro-scale, for users of digital platforms.

It should be emphasized that a certain limitation of the conducted research is the purposeful sample of enterprises that applied for and received funding under the Innovative Economy Operational Program for investments in the implementation and development of DTPs, which may cause the management of the surveyed companies to have a positive attitude towards this phenomenon. Therefore, in order to confirm the obtained results, further research should be carried out also covering those companies that did not receive or did not apply for such funding. It should also be said that the results obtained concern the attitudes of managers of Polish companies and due to cultural, social and business conditions they should not be applied indiscriminately in other countries. The study concerned the attitudes of company management towards DTP and their impact on the shaping of production and consumption patterns. The results of the study of the strength of the impact of DTP on consumption patterns among platform users in the context of sustainable development could be interesting, differentiating the results according to the type of digital platform.

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