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An Innovative Model for Measuring Attitudes towards Digital Technology Platforms

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Abstract:

Purpose: *The aim of the article is to present an innovative model for measuring attitudes towards digital technology platforms.*
Design/Methodology/Approach: *Such a model, based on a sample of 120 Polish companies, was developed as a result of research conducted in 2019. When building the model, a regression analysis of qualitative variables was applied, which involves predicting the values of specific variables. A top-down method was applied in this respect. In addition, an alternative version of the developed model was proposed.*
Findings: *The construction of the model made it possible to prove that the factor which most strongly influences the attitudes of the management staff of Polish enterprises towards digital technology platforms is an economic factor (i.e., financial benefits associated with the use of such platforms). Furthermore, space for further research was created, including with regard to company structure, the industry in which it operates and the number of employees working there as correlates of attitudes towards digital technology platforms.*
Originality/value: *The article discusses an innovative model for measuring attitudes towards digital technology platforms.*

Keywords: *Model, innovation, attitudes, measurement, digital technology platforms.*

JEL classification: *M10, M21, O12, O31.*

Paper Type: *Research study.*

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1. Introduction

Today, modelling plays an important role in the processes of managing organisations and improving their functioning and operations. This is because it enables the design of an organisational architecture as well as specific solutions and processes used and taking place within the organisation (Wynn and Clarkson, 2018). These include those that involve undertaking and intensifying cooperation between enterprises in order to combine various business models (Wikström, Artto, Kujala and Söderlund, 2010), solving various management-related and organisational problems (Szarucki, 2013), simulating activities and directions of development that are desired in the organisation in specific circumstances or market situations (Levinthal and Marengo, 2016), optimising the functioning of enterprises (Kamrani, Ayani and Moradi, 2011) or effective risk management (Bac, 2010). For this reason, models are used on a large scale in the practice of business operations.

Currently, special attention is paid to innovative models (i.e., those that are closely related to the use of modern technologies), including information and communication technologies (ICT) (Jetter, Satzger and Neus, 2009). In this respect, activities are undertaken within organisations regarding the creation of such models or the implementation of specific changes in traditional business models and their replacement with innovative ones (Birkinshaw and Ansari, 2015). Such trends include models that are based on digital technology platforms (DTP). It should be noted that models of this type are becoming increasingly more popular, which is due to a large number of mentioned platforms and the constant extension of their capabilities and functionalities (Kotarba, 2018).

The main aim of the article is to characterise the model of digital technology platforms created from scratch. In this respect, it will be crucial to describe its methodological assumptions, the construction process and the research results obtained using it. In this model, an attempt was made to describe the attitudes towards DTP that characterise the management staff of 120 Polish companies.

2. Material and Methods

The article is based on a self-developed, innovative model concerning digital technology platforms. This model was created for the first time and, importantly, no other researcher has yet attempted to build it based on the concept that involves digital technology platforms. This model takes into account the attitudes towards these platforms by the management staff of enterprises operating in Poland. The research was carried out in the period between the 18th and 28th of February 2019, with the participation of 120 Polish enterprises that were beneficiaries of the 'Innovative Economy' Operational Programme implemented by the Polish Agency for Enterprise Development. Those companies received grants for investment in the implementation and development of DTP. A CATREG (categorical regression)

regression analysis for qualitative variables, based on the top-down method, was used in the said model.

3. Explanation of Key Concepts

As part of the introduction to the subject matter of the article, it is necessary to define the basic concepts that will be used herein. It involves a model, a business model, a digital business model, an innovative business model and digital technology platforms.

As far as the definition of the model is concerned, it is worth referring to a proposal made by Zieleniewski (1979). According to him, a model is a theory that allows us not only to become familiar with the environment, but also to understand the reasoning in which the values of individual variables are subject to change and the impact of such activities on other variables is verified. Therefore, in a model, it becomes important to manipulate the various variables that make up the model. In this way, a model becomes useful for the application of specific theoretical solutions in practice.

In other words, a model is a type of a pattern in which certain elements or factors are taken into account. These include complementarity (combining activities to generate value), efficiency (determining the nature and scope of activities in such a way as to reduce the costs of business) and placing emphasis on innovation – including in relation to the organisational structure and enterprise management (Foss and Saebi, 2015).

As far as a business model is concerned, the following definitions – which emphasise what the term means – can be referred to as:

(a) a conceptual tool by means of which it becomes possible to present the logic of company operations, including the way in which it generates profits as a result of the created value, whereas the basic feature of this model takes into account all the components of the enterprise and the relations between them (Osterwalder *et al.*, 2005),
(b) revenue streams – including future ones – and the cost structure and margin level as well as the relations between these variables (Thompson and Strickland, 2003),
(c) the operating logic of an enterprise in which the generation of value towards the customer is predominant (Fielt, 2013).

The next definition refers to a digital business model. Brousseau and Penard (2007) claim that a model is modular, which means that newer and more innovative functions or packages of additional services can be introduced to it on an ongoing basis. What is important here is that these functions or packages can only generate value if they are integrated with the remaining elements of the model. Consequently, if they were to occur separately, it would be impossible to speak of such a value.

The authors mentioned above added that the customers themselves often participate in creating and developing a digital business model, which is visible when they share their knowledge and specific ideas. Zott, Amit and Massa (2011), on the other hand, claim that we can consider such a model from three basic perspectives. After taking into account the perspective of all enterprises, such a model refers to the implementation of a strategy that leads to the generation of value and competitive advantage. In the perspective which refers to technological enterprises, it is about effective management of innovations and modern technologies. From the perspective of online businesses, the model in question refers to the ways of application of the Internet in organisations, the use of information systems and how to run e-businesses.

An innovative business model is one in which the most important activities are focused on generating innovative ideas and then implementing them and creating modern products, services or production systems. This is possible by creating networks that bring many partners together (resulting in the formation of business ecosystems) and by using and developing innovative solutions on the broadest possible scale (Lindgren and Bandsholm, 2016). Such networks are created within an approach that is referred to as an 'open innovation' model. In this case, individual organisations are postulated to cooperate as widely as possible with other operators in developing and applying innovations. This may involve sharing knowledge, selling licences or acquiring specific solutions from other organisations (Saebi and Foss, 2014). Only through this, as Chesbrough (2003) pointed out, will it be possible to create the right conditions for the development of a given organisation. The open innovation model makes it possible to take advantage of all development opportunities and draw on the knowledge accumulated by other organisations, which creates a basis for implementing even more effective and functional innovations as well as neutralising risks and reducing the costs of implementing innovations.

Digital technology platforms are defined in scientific literature in many ways, but it is important to stress that it has not yet been possible to establish, in a clear way, what exactly this concept covers. This is mainly due to the intensive development of DTPs and the constant increase in their number and functionalities as well as the use of various concepts referring to these platforms by individual authors. The terms commonly used include digital platforms (Reuver, Sørensen, and Basole, 2015), technology platforms (Corin and Stig, 2015), IT platforms (Sun, Keating, and Gregor, 2015) and digital business technology platforms (LeHong, Howard, Gaughan, and Logan, 2016).

Some definitions specify that DTPs are digital tools that allow the establishment and intensification of relationships between different market players, including businesses and consumers – and even administrative bodies (public authorities). This takes place by enabling these entities to make transactions and establish interactions – including those which are business-related – and to communicate with each other via the Internet. The direct effect of this is to connect business partners and create business networks (Sun, Keating, and Gregor, 2015; Constantinides, Henfridsson, and Parker, 2018). It was indicated that digital technology platforms are a kind of base or foundation on which the framework of a given IT or technology system is built. A characteristic feature of DTP is the ability to implement new functionalities and develop complementary products, services and technologies (Gawer, 2014).

According to Reuver, Sørensen and Basole (2015), DTP can be defined from two perspectives. The first perspective – technical – indicates that these platforms are seen as code bases that are expandable, which means that it is possible to add new modules and functionalities to them at any time. In the second perspective – socio-technical – these platforms are considered to be all technical elements, including software and hardware, as well as related organisational processes and standards.

Due to the multitude, complexity and variety of definitions relating to DTPs, the authors' own approach was developed. It was assumed that these platforms are electronic (digital) tools that can take the form of services or content and through which it is possible to create a basis for establishing and intensifying contacts between different market players, with a very important feature of these platforms being the possibility of constantly expanding them with new modules or functionalities.

According to Morgan, Hintermann, and Vazirani (2016), it is worth noting that DTPs should be considered as separate business models. This can undoubtedly be accepted as DTPs have features that are characteristic of such models. In this respect, you can rely on a proposal made by Rothwell (Tidd, 2006), who analysed the development of business models in historical terms. Rothwell identified simple linear models (first- and second-generation models) that gradually evolved into solutions with increasing complexity and interaction between their components or stakeholders, including suppliers and customers (third- and fourth-generation models). The current fifth generation of business models is distinguished by the integration of various types of systems, a focus on innovation and the creation of highly developed networks. DTPs undoubtedly have such features, which is why they can be classified as fifth-generation models. This also applies to the model of attitudes towards digital technology platforms proposed in this article.

4. Building a Model of Attitudes towards Digital Technology Platforms

4.1 Methodological Assumptions for Model Building using iInductive Statistics

Creating a model of a phenomenon consists of 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 a so-called 'statistical space'. Such a model presents simplified yet the essential and most important links between the phenomena under consideration. For this purpose, inductive statistics tools are used – most often regression models. The concept of attitude is deeply rooted in social sciences – especially sociology – but is also widely used in economics (Soper and Walstad, 1983). Researchers agree that attitude has a three-part structure, affective (what you feel), cognitive (what you know) and behavioural (what you do) (Garcia-Santillan, Moreno-Garcia, Carlos-Castro, Zamudio-Abdala and Garduno-Trejo, 2012). The concept of attitude was used in the formulation of a question being an indicator of an independent variable:

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

This question made it possible to measure attitudes towards the phenomenon of digital technology platforms. There are both assessment elements which refer to knowledge as well as those concerning the evaluation of this phenomenon ("an increase in quality and intensity"). Interrelationships, which refer to the overall assessment of the impact of digital technology platforms on the increase in the quality and intensity of business operations and other assessment elements can be seen, including the cognitive (Questions 5 and 12 for the affective elements and question 9 for the affective-cognitive elements) and behavioural ones (Questions 1, 4, 8, 10, 11 and 14). The impact of sociodemographic variables concerning the company was also examined (Questions 22 and 23) and the potential influence of so-called 'latent variables' concerning the respondent was checked (Questions 16, 17, 18, 19 and 20). Individual indicators can also be classified from another significant perspective (i.e., aspects of company operations. The list of variables taken into account is presented in Table 1). It was assumed that a company can be transformed by digital technology platforms in the human dimension (assessment of the phenomenon, scope of its use, expectations etc.), in the cyber security 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).

Table 1. *Classification of indicators of entrepreneurs' attitudes towards the phenomenon of digital technology platforms*

Questionnaire question	**Dimension of company operations**	**Remarks**
Question 1. Does your company use digital technology platforms (i.e., tools that allow business partners to be connected and create a basis for intensifying contacts and	Human factor	Measurement level of the variable: ordinal

transactions between them)?		
Question 4. Please specify what type of digital technology platforms are or will be used (in the case of implementation plans) in your company? (Please check all possible answers)	Structural factor	Measurement level of the variable: nominal (multi-answer question) converted into a quotient variable – counting the number of indications
Question 5. Please specify the attitude of the staff in your company towards the implementation and use of digital technology platforms.	Human factor	Measurement level of the variable: ordinal
Question 8. Please indicate whether the following negative incidents and threats related to cyber security – directly arising from the use of digital technology platforms – have occurred in connection with the implementation of these platforms in the company where you perform your professional duties?	Cyber security factor	Measurement level of the variable: nominal (multi-answer question) converted into a quotient variable – counting the number of indications
Question 10. In which areas of your company are or will digital technology platforms be used (in the case of implementation plans)? (Please check all possible answers)	Structural factor	Measurement level of the variable: nominal (multi-answer question) converted into a quotient variable – counting the number of indications
Question 11. What are the main benefits generated by the use of digital technology platforms in your company?	Economic factor	Measurement level of the variable: nominal (not subject tofactor analysis, for example)
Question 12. Do you agree with the statement that digital technology platforms enable innovative business models to be created and developed?	Structural factor	Measurement level of the variable: ordinal
Question 14. Has the implementation of digital	Structural factor	Measurement level of the variable: ordinal

technology platforms in the company where you perform your professional duties forced or will force specific changes in the organisational structure of your enterprise?		
Question 22. Please specify which type of company, given the size of employment, you perform your professional duties. in.	Structural (sociodemographic) factor	Measurement level of the variable: interval
Question 23. In what industry does your company operate?	Structural (sociodemographic) factor	Measurement level of the variable: nominal (not subject to factor analysis, for example)
Question 16. Please state your gender.	Human factor (potential hidden variable influencing assessments)	Measurement level of the variable: nominal (not subject to factor analysis, for example)
Question 17. Please state your age.	Human factor (potential hidden variable influencing assessments)	Measurement level of the variable: interval
Question 18. Please specify your level of education.	Human factor (potential hidden variable influencing assessments)	Measurement level of the variable: interval
Question 19. Please specify your seniority in the company where you currently perform your professional duties.	Human factor (potential hidden variable influencing assessments)	Measurement level of the variable: interval
Question 20. Please specify how long the company where you perform your professional duties has been operating on the market.	Human factor (potential hidden variable influencing assessments)	Measurement level of the variable: interval
Question 21. Please specify the type of position you hold in the company where you currently perform your professional duties.	Human factor (potential hidden variable influencing assessments)	Measurement level of the variable: nominal (not subject to factor analysis, for example)

Source: *Own study.*

The model was built with the use of the above-mentioned variables whilst indicating which variables and how strongly they affected the independent variable. CATREG regression for qualitative variables was used for analysis. The analytical technique made it possible to reveal correlates of assessments of the degree of impact of digital technology platforms on company operations.

Optimal scaling belongs to the family of regression methods. It is a method that involves predicting the value of a selected variable on the basis of values taken by other variables – also indicated by the researcher. It is important to note that optimal scaling allows for the inclusion of variables at every measurement level in the analysis (i.e., nominal, ordinal, interval and quotient). This is undoubtedly an advantage of this method, which makes it impossible to include nominal variables in the analyses (thus it is impossible to know what role they play). The method can be considered as a sort of 'first choice' in social sciences a variables are generally measured on a qualitative level. The purpose of applying this method is to quantify the relationships between multiple independent variables and one dependent variable. This is called 'regression for qualitative variables' and its essence is that the cumulative effect of the variables is studied (an interaction means a 'product' of individual variables) (Kooij, 2007). The concept of optimal scaling comes from various sources – correspondence analysis (Greenacre, 1984) and multidimensional scaling (MDS) (Kruskal, 1964; Guttman, 1968), and is considered the successor to these methods. It is also statistically more correct and rigorous (Mider, 2017).

Optimal scaling is a technique that ensures multidimensional data mining: two hundred predictors are allowed, although only one independent (predictor) variable can be predicted. However, it is reasonable 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 of the regression line. This means that in this analysis, where the set counts N=120, a maximum of twelve independent variables can be used and no more than six can be used optimally.

This is important in the context of the number of sixteen variables identified above (Table 1). This means that at least four of them should be eliminated a priori. Those variables which – in various systems tested many times – showed the lowest level of interaction with other independent variables and the dependent variable were selected.

4.2 Procedures for Interpreting the Regression Model for Qualitative Variables

Interpretations of the regression model for qualitative variables are analogous to the normal regression model, although there are more indicators and they are more sublime. The following numerical results are subject to interpretation:

1) **Multiple R**, also known as the multiple correlation coefficient. It is a positive square root of R-squared (coefficient of multiple determination). It describes the collective relationship between a dependent variable and

independent variables. It takes values between 0 and 1, and is an indicator of model fit.

2) The **R-squared** coefficient is multiple R raised to the second power. It illustrates the total variability of the dependent variable explained by the cumulative effect of independent variables. It takes values from 0 to 1, can be expressed as a percentage and is a comparable value.
3) **Adjusted R-squared** is calculated on the basis of the R-squared coefficient while taking into account the number of factors in the regression model – the more factors, the lower the adjusted R-squared value.
4) The following pair of variables – **regression and the rest** – show the variability explained by the regression model and the magnitude of the unexplained variability (the rest). These values are subject to a visual evaluation. The greater the first value and the smaller the second value, the more the set of independent variables explains the variability of the dependent variable.
5) **Significance of the regression model** is interpreted in the same way as in other statistical tests. In social research, the risk of a first type of error totalling 5% ($p \leq 0.05$) is assumed.
6) The **beta coefficient (β)** is the so-called 'standardised regression coefficient' (independent of the range of the variable, calculated on the basis of the slope coefficient, also referred to as the slope value), which allows for a comparison of individual predictors in the regression model and takes values from -1 to +1. Such a scale means that values which oscillate around zero mean there is little or no relationship between the predictor and the dependent variable.
7) Significance is an important parameter that describes particular predictors (interpreted according to the definition in Item 5).
8) The **F statistic** shows the summarised goodness of fit and indicates the size of the explained variance. When creating a model, those variables that have the lowest values of this ratio are sequentially eliminated.
9) The correlation matrix – which consists of zero-order correlations, partial correlations and semipartial correlations – contains less relevant information. **Zero-order correlations** are isolated correlations between an independent variable and a dependent variable. In turn, **partial correlations** take into account the correlation of a given predictor as well as a dependent variable with other variables in the model. **Semipartial correlations**, however, take into consideration the interaction of a given independent variable with other variables in the model but do not take into account the correlation of the dependent variable with other predictors. They take values from -1 to +1.
10) **Validity** is the significance of individual variables in a model expressed as part of a unit (the maximum value is 1) – the higher the validity assigned to a given predictor, the greater the role it plays in the model. The value of this parameter can be expressed as a percentage.

11) **Tolerance** is a measure of the collinearity of variables. This is the inverse of R^2 (tolerance = 1 – R^2). It takes values from 0 to 1. The closer the tolerance of a predictor to one, the less collinear it is with the other variables in the model. Collinearity should be avoided – the closer the coefficient is to zero, the more redundant a given variable is and the more useless information it carries. The variables in the model should be strongly correlated with the dependent variable and poorly correlated with each other. The data validation phase is important for building a model and then the issue of outlier observation must be resolved. The CATREG regression model is very sensitive to outliers.

4.3 Modelling the Factors that Shape Attitudes towards Digital Technology Platforms

A CATREG-based model is usually constructed in the following iterative steps:

1) Placing a set of variables in the model that, in the researcher's opinion, affect the dependent variable (this set is determined already at the level of tool preparation for empirical research).
2) Manipulating the order of the variables in order to achieve the highest result (it is a repetitive iteration, a mechanical action).
3) Creation and evaluation of the model.
4) Reducing the number of variables by the weakest predictor.
5) Creating a reduced model.
6) Comparison of the previous and the next model (reduced).
7) Repeating steps 4 to 6 until the most satisfactory numerical results are achieved.

The procedure as above is a top-down method, which most often provides satisfactory results.

5. Research Results Using the Developed Model

5.1 Calculation Results as Part of Optimal Scaling with the Top-Down Method

The calculation results (the best final model) for optimal scaling with the top-down method are presented below.

Table 2. *Summary of overall coefficients of the optimal scaling model obtained using the top-down method*

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

Source: *Own study.*

Table 3. *ANOVA variance analysis for the optimal scaling model obtained using the top-down method*

	Sum of squares	**Degrees of freedom (df)**	**Average square**	**F**	**Significance**
Regression	53.971	35	1.542	1.955	$p \leq 0.01$
The rest	67.029	85	0.789		
Total	121.000	120			

Source: *Own study.*

The model was created by the nine variables presented in Table 4 (in order of validity of the individual variables making up the model).

Table 4. *The variables used to build the model of attitudes towards digital technology platforms*

Question 11. What are the main benefits generated by the use of digital technology platforms in your company?	Economic factor
Question 23. In what industry does your company operate?	Structural (sociodemographic) factor
Question 14. Has the implementation of digital technology platforms in the company where you perform your professional duties forced or will force specific changes in the organisational structure of your enterprise?	Structural factor
Question 19. Please specify your seniority in the company where you currently perform your professional duties.	Human factor (potential hidden variable influencing assessments)
Question 4. Please specify what type of digital technology platforms are or will be used (in the case of implementation plans) in your company. (Please check all possible answers)	Structural factor
Question 12. Do you agree with the statement that digital technology platforms enable innovative business models to be created and developed?	Structural factor
Question 10. In which areas of your company are or will digital technology platforms be used (in the case of implementation plans)? (Please check all possible answers)	Structural factor
Question 21. Please specify the type of	Human factor (potential hidden

position you hold in the company where you currently perform your professional duties.	variable influencing assessments)
Question 18. Please specify your level of education.	Human factor (potential hidden variable influencing assessments)

Source: *Own study.*

The model obtained included five variables belonging to the structural factor, three variables (although of lower explanatory power) belonging to the human factor and one variable being an economic factor (the strongest of all the variables).

Table 5. *Components of the optimal scaling model obtained using the top-down method*

Name of the model component (predictor)	**Beta coefficient**	**Degrees of freedom (df)**	**F**	**Significance**	**Zero-order correlation**	**Partial correlation**	**Semi partial correlation**	**Validity**	**Tolerance after transformation**	**Tolerance before transformation**
Question 11. What are the main benefits generated by the use of digital technology platforms in your company?	0.477	12	19.77	0.001	0.361	0.522	0.455	0.386	0.911	0.914
Question 23. In what industry does your company operate?	0.399	11	12.97	0.001	0.233	0.449	0.373	0.208	0.877	0.965
Question 14. Has the implementation of digital technology platforms in the company where you perform your professional duties forced or will force specific changes in the organisational structure of your enterprise?	-0.295	3	3.881	0.012	-0.162	-0.351	-0.279	0.107	0.890	0.866
Question 19. Please specify your seniority in the company where you currently perform your professional duties.	0.235	2	3.527	0.034	0.150	0.290	0.225	0.079	0.917	0.828
Question 4. Please specify what type of digital technology platforms are or will be used (in the case of implementation plans) in your company. (Please check all possible answers)	0.202	1	1.941	0.167	0.130	0.245	0.188	0.059	0.865	0.847
Question 12. Do you agree with the statement that digital technology platforms enable innovative business models to be created and developed?	0.209	2	1.675	0.193	0.116	0.265	0.204	0.055	0.955	0.914
Question 10. In which areas of your company are or will digital technology platforms be used (in the case of implementation plans)? (Please check all possible answers)	0.153	1	1.919	0.170	0.135	0.197	0.150	0.046	0.954	0.918

Question 21. Please specify the type of position you hold in the company where you currently perform your professional duties.	0.187	2	3.443	0.036	0.100	0.236	0.181	0.042	0.936	0.828
Question 18. Please specify your level of education.	-0.114	1	0.981	0.325	-0.066	-0.146	-0.110	0.017	0.934	0.931

Source: *Own study.*

The fit of the optimal scaling model expressed by multiple R was 0.668. This is considered to be moderate (significant) dependence but lying almost on the border of the so-called 'significant correlation', which extends from 0.7. The total variability of the dependent variable, explained by the total interaction of the independent variables, was as high as 0.218. This means that the model explains as much as 21.8% of the variability of attitudes towards digital technology platforms in enterprises. This is a significant value even though the model consists of a large number of coefficients. A significant yet acceptable number of factors in the model (9) reduces the original (R-squared) value of the coefficient. It is worth noting that the analysis involving an attempt to subtract individual coefficients from the model in order to reduce their number increases the explanatory power of the model.

Thus, the nine variables interact (at least in a mathematical sense) together, forming an inseparable whole. The model is statistically significant to more than a satisfactory extent (i.e., $p \leq 0.01$). The visual assessment of the sum of squares for regression and the rest in the ANOVA variance analysis shows that the regression model explains more than half (53%) of the variability, which makes its adoption justified. It is worth noting that an analogous way of creating the model became the basis for a highly regarded dissertation by Mider (2017). In that work, the fit of the optimal scaling model expressed by multiple R was much less than in this article and totalled 0.413. The model should, therefore, be considered valuable as it explains the correlations of positive opinions of digital technology platforms.

5.2 Analysis of the Result of Modelling Factors of Attitudes towards Digital Technology Platforms

The model covers three groups of factors: economic, structural and human. Positive attitudes towards DTP are mainly explained by **the number of benefits generated in the enterprise by digital technology platforms** (38.6% model fit). The technological factor has long been referred to as the company's strategic weapon as its importance stems from its deliberate use to increase added value as a result of changes in manufacturing and control processes (Porter and Millar, 1985; Wiseman, 1985). Positive attitudes towards DTP are also, to a large extent, determined by factors of a structural nature – primarily the industry in which the company operates and the intensity of changes in the company's internal structure (a total of as much as 47.5% – i.e., almost half of the components of the model). It is worth noting that the superior significance of the structural factor has long been widely recognised.

Figure 1. *Components of the optimal scaling model obtained using the top-down method – graphical interpretation taking into account the proportions of validity of individual factors in the model*

<table>
<tr><td rowspan="4">Benefits of Digital Technology Platforms (Q11)</td><td rowspan="4">Industry (Q23)</td><td>Changes in organizational structure (P14)</td><td colspan="2">Work experience (Q19)</td></tr>
<tr><td>Types of platforms used (Q4)</td><td rowspan="2">Platform operation areas (Q10)</td><td rowspan="2">Type of position held (Q21)</td></tr>
<tr><td rowspan="2">Enabling the creation and development of innovative business models (Q12)</td></tr>
<tr><td colspan="2">Education level (Q18)</td></tr>
</table>

Source: *Own study.*

Douglas North, a Nobel Prize winner in economics, argued that development is owed more to organisational rather than to technical progress (Acemoglu, 2009). In turn, the human factor (i.e., strictly sociopsychological and demographic factors of the respondent), plays a minor role (in the sense of explanatory power) and is represented by characteristics such as seniority, position and education (13.8%).

5.3 Alternative Proposal of Model Critirion

An alternative model was constructed using the bottom-up method (i.e., by attaching subsequent variables by trial and error). Correlation by the bottom-up method was attempted to be based on assumptions of a theoretical and cognitive nature. The main factor was sought both among the ‘hard’ elements concerning the measurable econographic characteristics of the enterprise and the ‘soft’ ones (i.e., those relating to the features of the researcher in his/her professional role – education, experience and other sociopsychodemographic characteristics). The selected groups of factors showed moderately high values in terms of the F statistic, correlation and validity, but were statistically insignificant (considerable risk of making a first type of error).

The model can based on synthetic indicators – indices or scales. In this case, synthetic values obtained from two or more direct indicators (questionnaire questions) would become independent variables. The direct advantage of this approach is the reduction of the number of independent variables, which makes it possible to reduce the distance between the R-squared coefficient and the adjusted R-squared coefficient. As a result, a model explaining the greater part of the variation of the dependent variable can potentially be obtained. A clear advantage of such an approach may be to achieve transparency by implementing order and structuring the various factors within groups.

The data was synthesised on the basis of simple arbitrary summation and then averaging the sets of indicators. From the point of view of methodology, these are so-called 'reflective indicators' (i.e., not linked by a common cause, but classified in a more general category in accordance with the researcher's assumptions).

The following five synthetic indices were distinguished: cyber security (represented by one indicator), economic (single indicator), human (eight partial indicators), structural (four indicators) and structural-demographic (two partial indicators).

Table 6. *Classification of indicators of entrepreneurs' attitudes towards the phenomenon of digital technology platforms*

Index	Questionnaire question	Remarks
… cyber security	Question 8. Please indicate whether the following negative incidents and threats related to cyber security, directly arising from the use of digital technology platforms have occurred in connection with the implementation of these platforms in the company where you perform your professional duties.	Measurement level of the variable: nominal (multi-answer question) converted into a quotient variable – counting the number of indications
... economic	Question 11. What are the main benefits generated by the use of digital technology platforms in your company?	Measurement level of the variable: nominal (not subject to factor analysis, for example)
... human	Question 1. Does your company use digital technology platforms (i.e., tools that allow to connect business partners and create a basis for intensifying contacts and transactions between them)?	Measurement level of the variable: ordinal
	Question 5. Please specify the attitude of the staff in your company towards the implementation and use of digital technology platforms.	Measurement level of the variable: ordinal
	Question 16. Please state your gender.	Measurement level of the variable: nominal (not subject to factor analysis, for example)
	Question 17. Please state your age.	Measurement level of the variable: interval
	Question 18. Please specify your level of education.	Measurement level of the variable: interval
	Question 19. Please specify your	Measurement level of

	seniority in the company where you currently perform your professional duties.	the variable: interval
	Question 20. Please specify how long has the company where you perform your professional duties been operating on the market.	Measurement level of the variable: interval
	Question 21. Please specify the type of position you hold in the company where you currently perform your professional duties.	Measurement level of the variable: nominal (not subject to factor analysis, for example)
... structural	Question 4. Please specify what type of digital technology platforms are or will be used (in the case of implementation plans) in your company? (Please check all possible answers)	Measurement level of the variable: nominal (multi-answer question) converted into a quotient variable – counting the number of indications
	Question 10. In which areas of your company are or will digital technology platforms be used (in the case of implementation plans)? (Please check all possible answers)	Measurement level of the variable: nominal (multi-answer question) converted into a quotient variable – counting the number of indications
	Question 12. Do you agree with the statement that digital technology platforms enable innovative business models to be created and developed?	Measurement level of the variable: ordinal
	Question 14. Has the implementation of digital technology platforms in the company where you perform your professional duties forced or will force specific changes in the organisational structure of your enterprise?	Measurement level of the variable: ordinal
... structural (sociodemographic)	Question 22. Please specify which type of company, given the size of employment, you perform your professional duties in.	Measurement level of the variable: interval
	Question 23. In what industry does your company operate?	Measurement level of the variable: nominal (not subject to factor analysis, for example)

Source: *Own study.*

An attempt to prepare the model using Question 13 as a dependent variable as well as the above-mentioned and described indices as independent variables generated the results contained in Tables 7 and 8.

Table 7. *Summary of overall coefficients of the optimal scaling model obtained using the top-down method*

Multiple R	0.361
R-squared	0.131
Adjusted R-squared	0.052

Source: *Own study.*

Table 8. *ANOVA variance analysis for the optimal scaling model obtained using the top-down method*

	Sum of squares	**Degrees of freedom (df)**	**Average square**	**F**	**Significance**
Regression	15.805	10	1.580	1.653	$p \leq 0.1$
The rest	105.195	110	0.956		
Total	121.000	120			

Source: *Own study.*

In social sciences, the results of calculations in the field of inductive statistics, with p value (probability value) above 0.05, are considered statistically insignificant. Sometimes a breakthrough is made in this rule and test results are quoted which, although they exceed 0.05, are not higher than 0.1. There is a high risk (approx. 10%) of making a first-type error, but such a result should at least be noted in the margin.

The model based on synthetic indices explains the variability in Question 13 to a much lesser extent than the model developed first. The most important factor explaining more than a quarter (25.4%) of the variability of the independent variable is the structural (sociodemographic) factor, which covers the size and industry of the enterprise. This is a premise for further exploration in this area. In the course of a systematic analysis of variables, the above-mentioned regularity at the level of single indicators of inductive statistics was confirmed by K. Pearson's chi-squared method. The result is presented in Table 9.

Table 9. *Structural (sociodemographic) index – Pearson's chi-squared test*

Structural index (sociodemographic)	**Question 13. To what extent do digital technology platforms increase the quality and intensity of relations established by the company?**													
	to a very large extent		**to a large extent**		**neither to a large nor a small extent**		**to a small extent**		**to a very small extent**		**I have no opinion**		**total**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
0-25	4	30.8	6	46.2	2	15.4	0	0.0	0	0.0	1	7.7	13	100.0
26 – 50	10	35.7	11	39.3	3	10.7	2	7.1	0	0.0	2	7.1	28	100.0
51 – 75	15	36.6	16	39.0	5	12.2	0	0.0	5	12.2	0	0.0	41	100.0
76 –	15	38.5	14	35.9	1	2.6	0	0.0	1	2.6	8	20.5	39	100.0

100						%								
Kruskal–Wallis test for intergroup comparison							ni.							
Materiality test for the relationship between the Pearson's chi-squared test and Cramér's V coefficient							χ^2 (15,N=121)=26.27; p≤0.05, V=0.269							

Source: *Own study.*

Table 10. *Components of the optimal scaling model obtained using the top-down method*

Name of the model component (predictor)	Beta coefficient	Degrees of freedom (df)	F	Significance	Zero-order correlation	Partial correlation	Semipartial correlation	Validity	Tolerance after transformation	Tolerance before transformation
Index – Structural factor (sociodemographic)	0.261	0.20	1	10.682	0.197	0.274	0.262	0.25	0.547	0.944
Index – Structural factor	0.147	0.16	3	0.816	0.488	0.140	0.154	0.14	0.157	0.975
Index – Human factor	0.141	0.16	2	0.749	0.475	0.145	0.148	0.13	0.157	0.972
Index – Economic factor	0.070	0.20	3	0.114	0.952	0.105	0.072	0.06	0.056	0.932
Index – Cyber security factor	-0.13	0.15	1	0.756	0.386	-0.07	-0.141	-0.1	0.083	0.928

Source: *Own study.*

6. Conclusions

The model discussed in the article refers to the measurement of attitudes of the management staff of 120 Polish companies towards digital technology platforms. The construction of such a model was important as the broadest possible implementation of DTP is of high significance for promoting innovation and increasing the level of competitiveness of individual companies and the entire economy. Attitudes of people who hold senior positions in companies can play a key role in the construction and use of digital technology platforms and thus contribute to economic development.

In the course of the analysis, the hypothesis of the total interaction of features – referred to in the statistical literature on the subject as interaction – was verified. For this purpose, a regression model for qualitative variables was built using the top-down method. It proved to be satisfactory in terms of the results obtained. When creating the model using the top-down method, all variables were included in the model in the first phase and then those with the lowest level of tolerance were systematically eliminated. After that, the authors proceeded to reject the variables with the lowest level of goodness of fit expressed by F statistic step-by-step. The most important factor, strongly linked to the attitude towards digital technology platforms, proved to be the economic factor (i.e., their financial benefits). The assessment of DTP is also affected by numerous structural elements of the company's external and internal environment. A small but important role is played by the characteristics of the evaluator – his or her seniority, role in the company and education.

Additionally, a model was made based on indices arbitrarily created by the researcher. It turned out to be on the verge of statistical significance and was not included in further considerations; however, the direction it set out was taken into account as useful for further exploration (factors related to the structure of the enterprise such as the industry and the number of employees as correlates of attitudes towards digital technology platforms).

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