The Digital Business Transformation Index Determining and Monitoring: Development of a National Online Platform

Iryna Strutynska[a], Lesia Dmytrotsa[a], Halyna Kozbur[a] and Liliya Melnyk[a]

[a] *Ternopil Ivan Puluj National Technical University, Ruska str., 56, Ternopil, 46001, Ukraine*

Abstract
The concept of the digital economy has become the ideology of the 21st century in developed countries. In Ukraine, the implementation of the transition to the digital economy at the level of small and medium-sized enterprises (SMEs) is rather difficult and time-consuming, since decision-makers do not have sufficient digital literacy and consider digital transformation as an incomprehensible and complex phenomenon, not seeing the place, role and advantages for their business. The introduction of information technology allows any company to flexibly change its own business model, ensure innovative development, achieve a competitive position, and quickly and efficiently integrate into the global digital market. Realizing the need to move to a new management concept, many small and medium-sized enterprises do not possess modern tools and capabilities of digital transformation in practice. The pace of innovation in Ukrainian entrepreneurship is slowing down due to the lack of understandable and accessible sources of information, services, platforms, applications or portals for digital transformation. In turn, this complicates the work of domestic business in the international economic arena. The purpose of the article, namely the development of a digital platform for small and medium-sized businesses, which would automatically determine the Digital Transformation Index and provide an individual "roadmap" for improving the digital development of an enterprise, is determined by the analysis of the identified problems.

Keywords 1
Digital Transformation, Digital Platforms, Index of Digital Transformation of Business Structures, DESI, Digital Instruments, Digital Transformation Roadmaps

1. Introduction

The use of digital technologies provides significant benefits in all spheres of life. The companies increase productivity and competitiveness, people acquire new knowledge and skills, receive job opportunities, governments improve the quality of public services for citizens and organizations.

The following digital initiatives (strategies and programs) have been supported and realized – in European Union «Digital Europe 2020» (2010 p.), in Germany «Industry 4.0.» (2011 p.), in China «Internet+» (2015 p.) and many others – there are more than 86 of them overall. There are more than 15 programs in the digital economy in foreign countries (including Germany, China, Japan, Brazil, USA, UK, Estonia, Nether-lands, Ireland, Sweden, Singapore, Philippines, Malaysia). Also, large industrial companies in the world implement development strategies in the concept of "Industry 4.0", "Internet +" (for example, Siemens, General Electric, SAP, Intel).

The European Union adopted the Digital Europe 2020 initiative in 2010, which is the first of seven most important initiatives under the Europe 2020 Strategy. Its aim is to develop an online economy to support economic growth in Europe and help European citizens and businesses to obtain maximum return from digital technologies. It is expected that the implementation of this initiative will lead to an increase in European GDP by 5%, or € 1,500 per capita.

Thus, foreign countries and major leading companies in the world have already responded to the challenges of the "Fourth Industrial Revolution" and approved appropriate strategies and action plans for the digitalization of economic activity. That is why Ukraine should intensify the use of digital technologies in order not to stay away from scientific and technological progress and gain additional benefits from the implementation of digital development strategies of the national economy. The purpose of the software is to increase the transformation of small and medium-sized businesses in Ukraine.

Currently, there are many ways for determining the level of digital potential:

- WEF Global Competitiveness Index [1];
- WEF Networked Readiness Index [2];
- WEF Technological Readiness Index [3];
- The UN Global E-Government Development Index [4];
- Digital Economy and Society Index [5];
- ICT Development Index according to the report of the International Telecommunication Union [6];
- The Web Index according to the data of International organization World Wide Web Foundation [7];
- Internet penetration rate according to the International Telecommunication Union and the World Bank [8].

Most of these methods are not adapted to Ukrainian realities and cannot reflect the current picture of the penetration of digital technologies in small and medium-sized businesses.

Aspects of the formation and development of the digital economy are covered in the works of such foreign researchers as W. Isaacson, B. Larralde, A. Toffler, H. Tof-fler, R. Hagen, A. Schwienbacher, T. Scholz. Ukrainian specialists, such as Yu. M. Bazhal, K. Yu. Kononova, N. M. Kraus, have also contributed to the grounding the concepts of digital economy.

The purpose of the study is to substantiate the need to design and develop a digital platform that would automate the process of data collection, processing and automatic determination of the Index of digital transformation of business structures and obtain specific recommendations (road maps) to increase the Index.

2. Research Methodology. Results

AD (Rapid Application Development) has been chosen as the underlying methodology. It uses object-oriented methods to describe the subject area.

In the context of the global digital transformation, it is impossible to avoid its impact – whether you are an ordinary citizen, business owner or civil servant [9].

Adaptation and transformation of business with the help of digital technologies is one of the main ways to increase the efficiency of business' activities and innovation. Digital tools, previously used only by large companies, are now available to small and medium-sized businesses. To calculate the Index of digital transformation of business, an innovative method for determining the Index of digital transformation of business structures was developed in previous research [10, 11].

In order to obtain up-to-date data and test the calculation methodology, an innovative questionnaire on the level of digital business transformation was designed [12].

To effectively collect and process survey data, we consider it necessary to develop a digital platform with signs of cyber-physical system (such as data flow, cybernetic processing, decision making [13, 14]) for automatic determination of the Index of digital trans-formation of business structures.

The main condition for the proper functioning of the platform, and therefore the automatic calculation of the Index and the display of individual recommendations for businesses is the need to comply with certain technical parameters.

First of all, all questions of the questionnaire were divided into 4 logical sections:

First section, «Information» – does not affect the result of the Index, however, the data are collected for statistics and in-depth analysis, to improve the performance of the platform algorithm in the future.

Second section, «Digital Infrastructure «T» (equipment, technologies) – questions related to the technical support of employees and the quality of the Internet.

Third section, «Digital tools «I» – 19 questions about the most common digital tools for doing business, from simple to specially designed software solutions.

Fourth section, «Digital literacy «H» – level of digital technology ownership of the organization's human capital.

Each question of the second, third and fourth sections has a certain value depending on the chosen answer. In addition, the sections differ in the coefficients of influence on the final result. Based on the answers received from the user, the Index of digital transformation of the business structure in the range from 0 to 1 is calculated and individual recommendations are provided to improve the level of the Index.

In order for the platform to function effectively, it is necessary to adhere to the basic user requirements:

1. A possibility to use the service without the need to install special software on your device, just go to the platform address [6];
2. The duration of the session, including creating an account and doing the survey, should not exceed 10 minutes;
3. The user must have access to his/her personal recommendations at all times.

From the perspective of a business, the system should:
- ensure the reliability of storage of personal data of users;
- relevance of personalized recommendations for each area of activity;
- constant access to the history of the results of previous surveys;
- provide comparative statistics for individual regions;
- the opportunity for each user to take regular surveys, but not more often than once every 30 days;
- be able to enter new questions and recommendations into the system with the help of the administrator's office.

It was decided to use modern language technologies to design this digital platform and namely the language of JavaScript. React, an open JavaScript library for creating user interfaces, was designed to solve the problems of partial updating of web page content encountered in the development of one-page applications.

React allows to create large web applications that use data that changes over time without reloading the page. Its goal is to be fast, simple, scalable. In addition, several assistive technologies and libraries were used:
- Firebase – to access the database;
- Chartist – to display graphics;
- Formic – to create forms;
- React-router – to navigate the website;
- Yup – to validate.

A database with four tables was created to implement the main functionality (see Figure 1).

Figure 1: Visualization of the created database*.
Source: author's own development

Tables 'database' and 'indicator' are services and available in the reading mode, in case of need of changes in the specified tables, editing occurs through an office of the administrator, or directly,

database tools. Table 'users' stores information about registered users of the system. Table 'answers' contains the results of all surveys ever done and a detailed history of answers.

When creating a user account (business organization) in the system, all data will be displayed and stored in the table 'users' as a complex object (see Figure 2) which contains the following fields:
1. 'all_index' – a collection of all indexes assigned to the user;
2. 'all_times' – collection with information about the time of all surveys;
3. 'cwed' – collection of Classification of Types of Economic Activity of the business entity;
4. 'kilkist' – number of employees;
5. 'last_index' – the last assigned index;
6. 'last_poll' – the last poll/survey done;
7. 'login' – the user's login, and therefore his/her e-mail;
8. 'name' – user's name;
9. 'number' – user's number;
10. 'oblast' – the region where the business entity operates;
11. 'org_form' – organizational form of business entity registration;
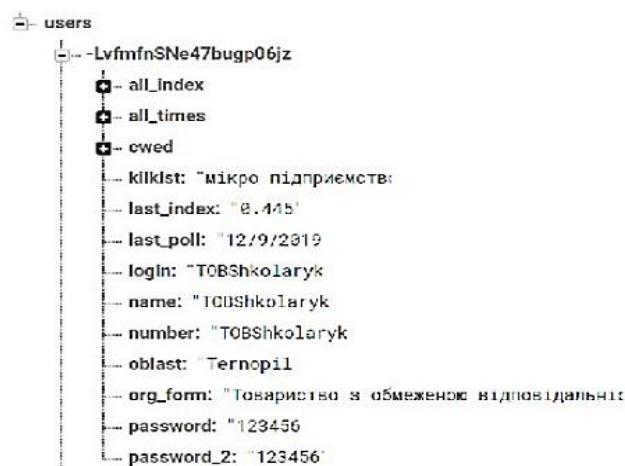12. 'password' – user's password.

Figure 2: Visualization of database storage in table 'users'*
Source: author's own development

After the survey is conducted by the business entity, a new record is created in the 'answers' table (see Figure 3).
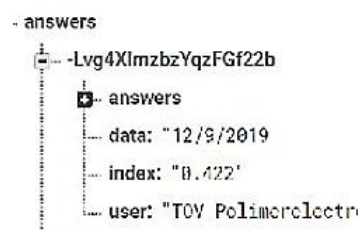
Figure 3: Visualization of database storage in table 'answers'*
Source: author's own development

Objects consist of 4 sections:
1. 'answers' – answers collection;
2. 'data' – date of doing a survey;
3. 'index' – calculated Index at the time of the survey;
4. 'user' – user's login.

In general, the digital platform should be user-friendly and easy to use, i.e. with an appropriate interface.

By interface we mean a set of agreements on the forms, methods, processes, rules of user interaction with the software. The interface should:

- Be compatible with user's needs and capabilities.
- Ensure the transition from one function to another.
- Provide a user with a high level of guidance on his/her possible actions, as well as generate appropriate feedback on his/her requests.
- Provide a user with different, complementary forms of presentation of results de-pending on the type of request or the nature of the decision.
- Take into account the characteristics of users of different levels.
- Acceptable user requests must be clear and unambiguous for users at all levels.
- The system's response to all types of requests should also be unambiguous and clear and, if possible, simple.
- The interface should not be overloaded with details about the solution of the problem.
- It should not contain unnecessary decorative details that distract from the main task.
- The interface must be consistent, i.e. based on the use of known, generally accepted methods and means of presenting information [15].

Here is a short description regarding the interface design of this digital platform. The design in the style of minimalism and the color scheme in the same style with the existing state web resources in Ukraine and similar platforms in the EU were chosen (see Figure 4). The list of controls and individual system modules is standard for modern web services.
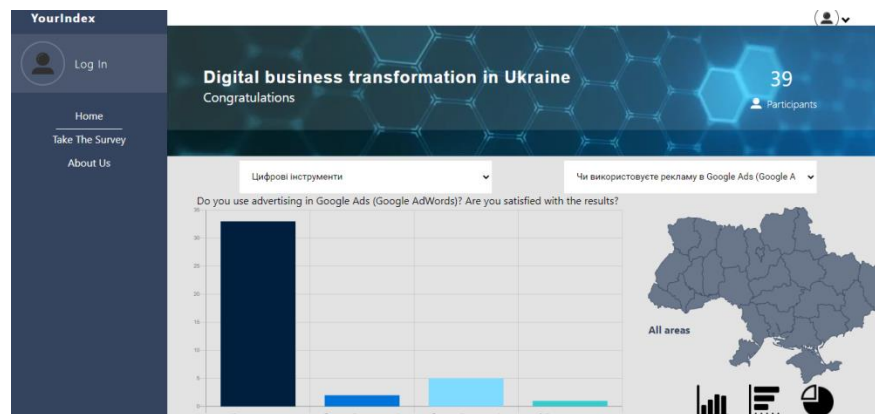

Figure 4: The main page of the digital platform for determining and monitoring the Index of Digital Transformation of Business Structures *
Source: author's own development

The main page has navigation elements that allow you to quickly access any functionality of the page.
- Logo;
- Side menu of navigation;
- Drop-down lists with available categories of information to display;
- Graphics with visualization;
- Interactive map for selecting a region;
- Diversified chart switches;
- Top navigation items.

The developed web service is as easy as possible to use, no additional software is required to get started.

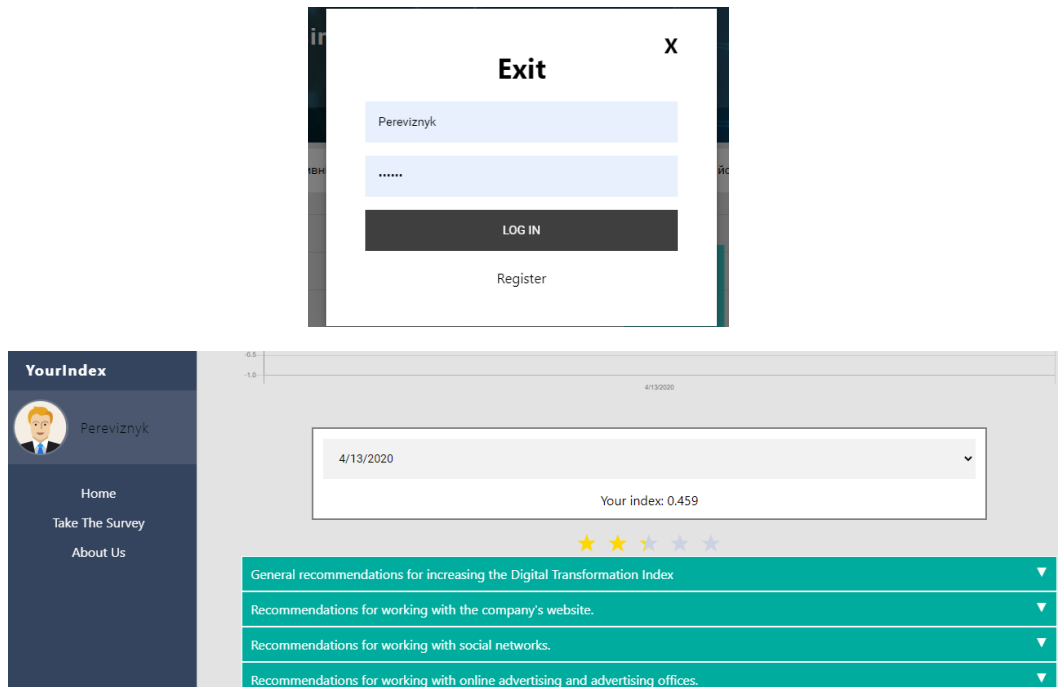After creating an account one can log in, using password (see Figure 5).

Figure 5: Visualization of the process of entering the office on a digital platform*
Source: author's own development

When a user logs in under their login, taking the survey becomes available. In the navigation menu, click 'Take Poll' (see Figure 6).
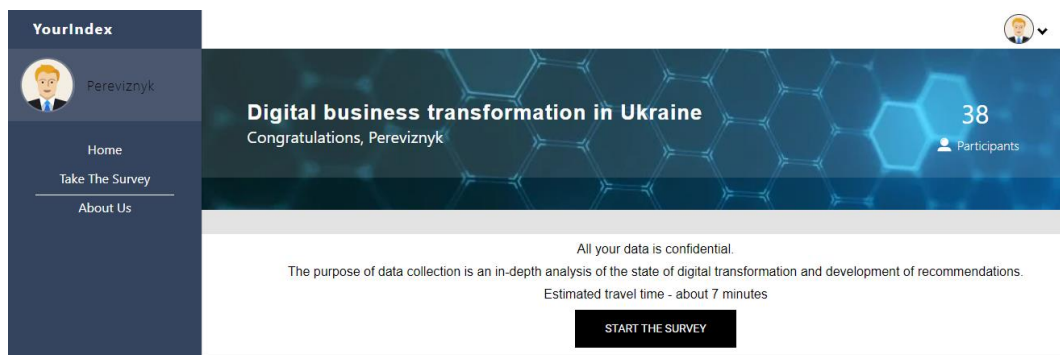

Figure 6: Visualization of the process of starting the survey*
Source: author's own development

After answering 31 questions, the respondent receives the calculated Digital Trans-formation Index and a link to the cabinet with individual recommendations (see Figure 7).
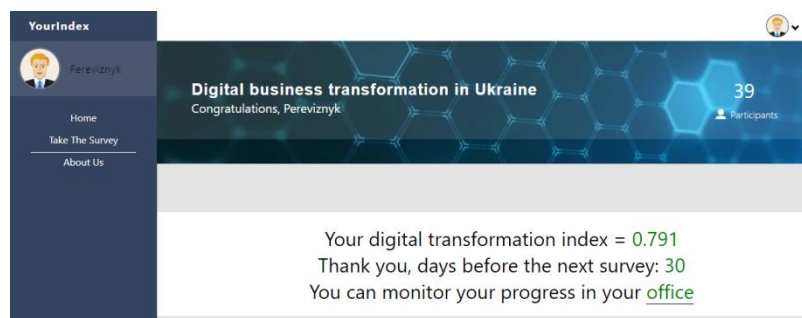

Figure 7: Visualization of the process of starting the survey *
Source: author's own development

To view the recommendations, follow the 'cabinet' link on the survey page or through the top navigation bar.

3. Conclusions and Prospects

The developed digital platform for determining and monitoring the Digital Business Transformation Index will be useful for all market stakeholders and there different ways to benefit from it:

1. For entrepreneurs there will be an opportunity, without creating an account, to gain access to general, non-personalized statistics for different regions and the prevalence of certain tools;
2. Opportunity to become a user of the system and receive personal recommendations based on the calculated Digital Transformation Index;
3. For government officials, the system (platform) allows to collect detailed and accurate data on the development of small and medium-sized businesses, statistics on the level of development of various sectors of the economy both in the region and in the country overall. The platform provides a realistic, generalized picture of the digital maturity of the business entity and digital literacy.
4. For educational organizations there will be an opportunity to know the problems of business and, thus, to structure the relevant courses and provide a high level of educational services;
5. For sponsors and partners, the platform provides an opportunity to place highly effective targeted advertising in the block of personal recommendations, with the ability to specify a certain course, desired field of activity or region.

In the future, research will be targeted towards collecting and analyzing real statistics of digital transformation of business structures for a particular region and the development of specific recommendations (road maps) to increase the level of the index. The introduction of appropriate roadmaps will help increase the index of digital transformation and increase the competitiveness of business. The results of this research will help to create an appropriate eco-culture for determining digital maturity, which will create healthy competition between respondents to compare the results of the index. This research is also trying to help increase digital literacy of business owners and, consequently, human resources of organizations.

4. References

[1] WEF Global Competitiveness Index, 2019. URL: http://www3.weforum.org/docs/WEF_TheGlobalCompetitivenessReport2019.pdf.
[2] Networked Readiness Index, URL: https://en.wikipedia.org/wiki/Networked_Readiness_Index.
[3] WEF Technological Readiness Index, 2016. URL: https://www.weforum.org/agenda/2016/07/what-is-networked-readiness-and-why-does-it-matter/.
[4] The UN Global E-Government Development Index, 2019. URL: https://digital.gov.ru/en/activity/statistic/rating/index-razvitiya-elektronnogo-pravitelstva/#tabs|Compare:Place.
[5] Digital Economy and Society Index, URL: https://ec.europa.eu/digital-single-market/en/desi.
[6] ICT Development Index 2020: A proposal, 2020. URL: https://www.itu.int/en/ITU-D/Statistics/Documents/events/egti2020/IDI2020_BackgroundDocument_20200903.pdf.
[7] The Web Index, URL: https://thewebindex.org/.
[8] Individuals using the Internet rate according to the International Telecommunication Union and the World Bank (% of population), URL: https://data.worldbank.org/indicator/IT.NET.USER.ZS.
[9] Digital of Ukraine vision 2025, URL: https://businessviews.com.ua/ru/get_file/id/digital-transformation-2019.pdf.
[10] I. Strutynska, H. Kozbur, L. Dmytrotsa, I. Bodnarchuk, O. Hlado, Small and Medium Business Structures Clustering Method Based on Their Digital Maturity, International Scientific-Practical

Conference Problems of Infocommunications. Science and Technology. October 10–11, 2019, pp. 278-282. URL: http://www.dut.edu.ua/uploads/n_7589_67076384.pdf (2019).

[11] I. Strutynska, L. Dmytrotsa, H. Kozbur, The main barriers and drivers of the digital transformation of Ukraine business structures. In: Ermolayev, V., Mallet, F., Yakovyna, V., Mayr, H., and Spivakovsky, A. (Eds.): 15 th Int. Conference on ICT in Education, Research and Industrial Applica-tions. Integration, Harmonization and Knowledge Transfer. Vol. I, Ukraine, June 12-15, 2019, CEURWS.org, Volume 2387, pp.50-64 (2019).

[12] Google Forms, URL: https://www.google.com/intl/uk_ua/forms.

[13] J. Zhou, Y. Zhou, B. Wang, J. Zang, Human–Cyber–Physical Systems (HCPSs) in the Context of New-Generation Intelligent Manufacturing, Engineering, Volume 5, Issue 4, 2019, pp. 624-636. https://doi.org/10.1016/j.eng.2019.07.015.

[14] F. Tonelli, M. Demartini, M. Pacella, R. Lala, Cyber-physical systems (CPS) in supply chain management: from foundations to practical implementation, Procedia CIRP, Volume 99, 2021, pp. 598-603. https://doi.org/10.1016/j.procir.2021.03.080.

[15] I. Strutynska, L. Dmytrotsa, H. Kozbur, R. Zozulya, O. Hlado, Certificate of copyright for the computer program "Digital Transformation of Business Structures" Ministry of Economic Development, Trade and Agriculture of Ukraine. Certificate of copyright registration for the work № 98279 dated 23.06.2020.