Advances in Economics, Business and Management Research, volume 81
1st International Scientific Conference "Modern Management Trends and the Digital Economy: from Regional Development to Global Economic Growth" (MTDE 2019)

Formation of digital platform in the glass industry and assessment of its efficiency

Gubernatorov A.
Vladimir State University
Vladimir, Russian Federation
gubernatorov.alexey@yandex.ru

Timofeeva E.
Financial University under the Government of the Russian Federation
Vladimir, Russian Federation
e-mail ekaterinat60@list.ru

Vlasova N.
Financial University under the Government of the Russian Federation
Vladimir, Russian Federation
e-mail vlasovavib@mail.ru

Abstract – **The article discloses the features of the digital transformation in the glass industry, which today is the key to building a digital economy and obtaining digital dividends, that is, achieving measurable economic results through the implementation of digital technologies. Article purpose – definition of the directions of transition of the glass industry from the traditional business models to the new digital platforms and justification of their importance, being in demand and efficiency. The methodical support of the glass industry transition to the digital platform is presented. It is proved that digital transformation, as a systemic improvement of all business processes and business models in the entire glass industry, accompanied by large-scale "smart" transformations of the usual technological operations in the glass production, is possible through creating a digital glass factory of the future and moving from "Glass Industry 4.0" to "Glass Industry 5.0", which contributes to the transition to a new technological mode. The expert assessment of digitalization factors in the glass industry is provided for.**

Keywords – digital economy, digital platform, information technology, digital transformation of the glass industry.

I. INTRODUCTION

To ensure the maximum benefits of digital transformation in the development of innovation, accelerate economic growth and social prosperity, it is required to acknowledge the concern that current macroeconomic statistics may not fully take into account the benefits, provided for by the digital products and the products, created on the basis of the digital technologies or the cross-border operations. The issues of how to estimate contribution of economy of sharing, platforms to GDP and increase in the labor productivity, remain unsolved. Countries with a high level of development and implementation of digital technologies are also involved in the measurement of their impact. China National Bureau of Statistics has published an index of China's digital economy. In the Republic of Korea, it is planned to add a sharing economy to GDP in 2019. USA Bureau of Economic Analysis (BEA) develops tools for the best measurement of impact of rapidly changing technologies on the economy of USA and global supply chains. BEA aims to calculate contribution of digital economy to GDP and improve the indicators concerning hi-tech goods and services, international trade, sharing economy and free digital content, as well as to study the economic indicators, besides GDP, for the better general understanding of contribution of digital economy to welfare. [10] Digital transformation of the glass industry is key to creation of digital economy and receiving digital dividends, that is, achievement of measurable economic results by means of implementation of digital technologies. The transformation of the glass industry at the branch level is characterized by the minimization of participation of the person in production and the transition to the data-based efficient management. In addition to the widespread implementation of ERP solutions, technologies that contribute to the transformation of traditional production into digital and characterized by the full digital integration of production and logistics chains, as well as the supply chains, include: - digital design and modeling as set of technologies of computer design development, computer and supercomputer engineering, mathematical modeling, the optimization and technology preparation of production, oriented to the additive production, and developments of "smart" models and "smart" digital doubles; - use of new synthetic materials, especially composition materials, silicates, metamaterials and metal powders for the additive production; - additive technologies: additive manufacturing systems, materials, processes and services; - industry sensitive automation means: implementation of "smart" sensors and management instruments (controllers) in the production equipment, to the premise at the level of workshop or the enterprise in general; - industrial robotics: firstly, the flexible production cells; - generation, collection, storage, management, processing and transmission of

"smart" big data; - industrial Internet of things; - virtual, augmented and mixed reality; - expert systems and artificial intelligence. None of the advanced production technologies, taken separately, is capable to provide for the long-term competitive benefit in the market. The systems of complete technology solutions, providing for the design and production of globally competitive glass products of new generation in the shortest possible time, are required. These solutions are integrated in the so-called "Glass Industry 4.0". The unique solutions in the field of current innovations in the production, processing and finishing of glass were the source and basis for creating 3D concept in the glass industry, which is a new production model, based on a multidisciplinary approach to creating advanced production [2].

II. THE TECHNIQUE OF RESEARCH FRONTS INDENTIFICATION

Breakthrough technologies in the glass industry are the powerful catalysts capable of changing the configuration of all settled technology trends and industry branch routes. Breakthrough technologies have a crucial role in increase in competitiveness of the separate enterprise, engaged into manufacturing the products of glass, and, in general, the economic growth of all glass industry due to multiplicative effect.

In 2018, there are 31 organizations making glass products in the Vladimir region [1].

Leading enterprises in the branch are Experimental Glass Plant LLC, producing vessels for drinking, a variety of glass dishes, OJSC “OS Steklovolokno”, continuous fiberglass manufacturer, chopped fiber, roving, fiberglass, Branch of LLC Rusdzham Glassware Holding in Gorokhovets (glass containers), LLC “Krasnoye Echo" (0.3-1.75 l bottles, cans), LLC "Wienerberger Brick" (ceramic brick, ceramic blocks), CJSC "Kovrov Silicate Brick Plant" (technological lime, silicate building brick), JSC "Vladimirsky Plant of Reinforced Concrete Products" (prefabricated reinforced concrete), OJSC "House-building combine" (large-panel housing construction products) [2].

The possible list of breakthrough technologies and sub-technologies in the glass industry includes:

1. Product lifecycle management (PLM) [7,6].
2. HPC simulation, modelling and analysis; CAE.
3. Additive manufacturing, rapid prototyping.
4. 4D-printing.
5. Intelligent/smart production, industrial robotics.
6. Control systems, command & control systems.
7. Precision manufacturing
8. New materials, including the nano-, composite materials and creation of materials with predetermined properties (Composite materials).
9. Flexible production lines & rates.
10. Platform solutions & business models [5].

III. TESTING OF THE TECHNIQUE AND ANALYSIS OF RESULTS

The expert evaluation of factors, affecting the digitalization of the Vladimir region enterprises, engaged in the production of glass products, was performed to assess the efficiency of the digitalization of the glass industry enterprises. The expert review was participated by the heads and specialists of 20 glassware companies,(LLC Khrustalnoye nebo, LLC of Gusevskaya Crystal Factory n.a.Maltsov, CJSC Svet, LLC Experimental Glass Plant, JSC OS Steklovolokno, LLC Krasnoye Ekho, LLC Velikodvorsky Glass-container Plant etc.)

The assessment was made based on a 5-point scale. As factors of assessment of the glass industry digitalization assessment efficiency, seven factors were selected and ranged as follows:

K1 - regulatory and administrative indicators of digitalization,

K2 - specialized personnel and training programs,

K3 - research competencies and technological groundworks

K4 - information infrastructure

K5 - cyber security

K6 - financial and economic efficiency of digitalization development

K7 - social efficiency of digitalization development

The assessment of the reliability and consistency of expert opinions was performed on the basis of the calculation and analysis of the concordance coefficient W, which was calculated according to the formula:

$$W = \frac{12\sum_{i=1}^{n}(r_i - \bar{r})^2}{N^2(n^3 - n)}$$

where: 12 - constant in formula of calculation of the concordance coefficient, offered by Kendall;
N – number of experts;
n – number of evaluation criteria;
ri- i- sum of ranks of i-th indicator;
r- average total score of all indicators.

Coefficient W belongs to interval from 0 to 1, where its equality to one whole means full coherence of expert opinions, and its equality to zero demonstrates that there is no connection between the experts’ estimates. In case, if $0.2 \le W \le 0.4$, there is a weak coherence of expert opinions, and at $W \ge 0.6$ it is possible to speak about availability of a strong coherence of expert opinions.

Further, we will use the Fishburn method (method for assessment of clinical efficiency of medicines) for determination of coefficients of weightage of each factor:

ai = 2 * (n-ri+1) / n*(n+1), (for all i from 1 to n)

where: ai – weighting coefficient of i-th criterion,

n - amount of evaluation criteria

ri– rank assigned to i-th indicator

Table 1 provides for the results of expert assessment of weightage of digitalization factors of the glass industry enterprises in the Vladimir region. Verification was performed on the example of LLC Khrustalnoye nebo.

TABLE I. ASSESSMENT OF WEIGHTAGE OF FACTORS OF DIGITALIZATION OF THE GLASS INDUSTRY ENTERPRISES IN THE VLADIMIR REGION (ON THE BASIS OF DATA OF LLC KHRUSTALNOYE NEBO)

	Expert assessment																			
Evaluation criteria	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Regulatory control and administrative digitization indicators	5	5	4	4	5	4	5	5	5	5	5	5	4	5	5	5	5	5	5	4
Specialized personnel and training programs	4	2	3	3	3	3	2	3	3	2	3	2	2	2	3	2	2	2	3	3
Research competencies and technological background	4	3	4	2	4	4	4	4	3	3	3	3	3	3	4	3	4	3	4	4
Information infrastructure	5	4	5	5	5	5	5	5	4	4	4	4	5	4	5	4	5	4	5	5
Cyber security	5	5	4	4	5	4	5	5	5	5	5	5	4	5	5	5	5	5	5	4
Financial and economic efficiency of digitalization development	4	2	3	3	3	3	2	3	3	2	3	2	2	2	3	2	2	2	3	3
Social efficiency of digitalization development	4	3	4	2	4	4	4	4	3	3	3	3	3	3	4	3	4	3	4	4

Regulatory control and administrative digitization indicators	95	18	324	1	0.40
Specialized personnel and training programs	52	-25	625	4	0.10
Research competencies and technological background	69	-8	64	3	0.20
Information infrastructure	92	15	225	2	0.30
Cyber security	95	18	324	1	0.40
Financial and economic efficiency of digitalization development	52	-25	625	4	0.10
Social efficiency of digitalization development	69	-8	64	3	0.20
Total	310	0	1238		

$$W = \frac{12\sum_{i=1}^{n}(r_i - \bar{r})^2}{N^2(n^3 - n)} = \frac{12*1238}{20^2(4^3 - 4)} = 0.80$$

The degree of coherence of expert opinions may be considered as quite acceptable, since W = 0.80> 0.6

According to experts, the most significant is the normative regulation and administrative indicators of digitalization, and the least important are the financial and economic efficiency of digitalization development.

Moreover, the connections between the factors, characterizing the digitalization of the glass industry enterprises of the Vladimir region, are determined.

The determination coefficient, the lower margin of which can be 0.7, is one of the used equation adequacy indicators. More reliable forecast result can be achieved at high values of R (0.8-0.9).

$$K0 = \alpha K1+\beta K2+\gamma K3+\delta K4+\varepsilon K5+\varphi K6+\omega K7, \text{ where}$$

α, β, γ, δ, ε, φ, ω – weight coefficients
Determination coefficient
$R^2 = 0.9997$

The value of the determination coefficient, close to one whole, demonstrates high reliability of multi-factorial model.

Further, all the factors were divided by levels of digital efficiency (high, medium and low).

The maximum weighting factor, calculated by the Fishburn criterion, is taken as the high level value. For a low level, a maximum weighting factor divided by three (the number of levels) is assigned; then, the value *d* - step is found according to the formula. The latter value is calculated as the difference between the high level indicator and the low level indicator divided in half. The indicator of the average level is equal to indicator of the lower level, increased by step as per formula:

d = (*high level value - low level value*)/2

The following boundaries of digitalization efficiency for LLC Khrustalnoye nebo were obtained during the calculations:

Z<0 digitalization level is low;
Z(0;0.333) digitalization level is below average;
Z (0.333;0667) average digitalization;
Z (0.667;0.999) high digitalization.

TABLE 2. INTEGRATED ASSESSMENT OF LEVEL OF DIGITAL DEVELOPMENT OF LLC KHRUSTALNOYE NEBO WITH USE OF FISHBURN RULE IN 2018.

Enterprises	Fishburn index	Z<0 digitalization level is low	Z(0;0.333) digitalization level is below average	Z (0.333;0667) average digitalization	Z (0.667;0.999) high digitalization
LLC "Khrustalnoye nebo"	0.326		+		
Gusevskaya Crystal Factory n.a. Maltsov	-0.566	+			
CJSC “Svet”	0.002		+		
LLC Experimental Glass Plant	0.005		+		
OJSC “OS Steklovolokno”	-0.159	+			
LLC "Krasnoye Ekho"	-2.522	+			
LLC Velikodvorsky Glass-container Plant	0.304		+		

IV. CONCLUSION

Digital transformation of the glass industry is key to creation of digital economy and receiving digital dividends, that is, achievement of measurable economic results by means of implementation of digital technologies.

References

[1] World Bank. 2018. Report on the Development of the Digital Economy in Russia, September 2018, “Competition in the digital era: strategic challenges for the Russian Federation". World Bank, Washington, DC. License: Creative Commons Attribution CC BY 3.0 IGO

[2] The results of the socio-economic development of the Vladimir region in 2018 [Electronic resource]. – Access mode: https://avo.ru/web/guest/promyslennoe-proizvodstvo

[3] National Technology Initiative (NTI) [Electronic resource] - Access mode: http://fea.ru/compound/national-technology-initiative

[4] DECA Russia – World Bank product, developed in April - November 2017 in collaboration with the Institute of the Information Society Development. [Electronic resource]. – Access mode: https://istina.msu.ru/download/91398706/1edwY0:aH7_sIBQMK4oz2JriGg3dEbeYOo/

[5] Millions of digitalization: how Russian companies are transformed? [Electronic resource]. – Access mode: https://www.cio.ru/news/300119-Milliony-tsifrovizatsii-kak-transformiruyutsya-rossiyskie-kompanii

[6] Still, K., M. Seppänen, H. Korhonen, K. Valkokari, A. Suominen, and M. Kumpulainen. Business Model Innovation of Startups Developing Multisided Digital Platforms. 2017 IEEE19th Conference on Business Informatics (CBI).

[7] Evans, David S. 2013. “Economics of Vertical Restraints for Multi-Sided Platforms.” Coase-Sandor Institute for Law & Economics Working Paper No. 626. https://chicagounbound.uchicago.edu/cgi/viewcontent.cgi?article=1187&context=law_and_economics

[8] World bank. 2018. Report on the development of the digital economy in Russia, September 2018, "in the Competitive digital age: strategic challenges for the Russian Federation". World Bank, Washington, DC. License: Creative Commons Attribution CC BY 3.0 Igoo the results of the socio-2018 2018 [[electronic resource]. – Access mode: https://avo.ru/web/guest/promyslennoe-proizvodstvo

[9] National technology initiative (NTI) [Electronic resource] - access Mode: http://fea.ru/compound/national-technology-initiative

[10] DECA Russia is a product of the world Bank, developed in April-November 2017 in cooperation with the Institute for the development of the information society. [Electronic resource.] – Access mode: https://istina.msu.ru/download/91398706/1edwY0:aH7_sIBQMK4oz2JriGg3dEbeYOo/

[11] Millions of digitalization: transformirovalsya as a Russian company? [Electronic resource.] – Access mode: https://www.cio.ru/news/300119-Milliony-tsifrovizatsii-kak-transformiruyutsya-rossiyskie-kompanii