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QUALITY OF DIGITAL PRODUCT: THEORY AND PRACTICE

Abstract: *The purpose of the research is to develop the scientific and theoretical basis for measuring the quality of various digital products, determining this quality in modern Russia, and compiling recommendations for their management in the interests of their increase. The author performs differentiation of quality of various digital products and evaluation of the current quality of digital products in Russia and develops recommendations for increasing the quality of digital products in Russia. The author also develops the scientific and methodological approach to measuring the quality of digital product. Difference between the characteristics of quality for digital products of various types is substantiated, and the scientific and theoretical basis for measuring this quality is formed. By the example of the digital economy of modern Russia it is shown that quality of digital products of various types is too differentiated and differs from quality of a generalized digital product. The algorithm of managing the quality of digital products is developed, which allows optimizing spending of managerial resources and taking into account the specifics of digital products of all types.*

Key words: *Quality of products; Digital product, Digital economy; Quality evaluation; Interested parties; Quality management.*

1. Introduction

Under the influence of the technological progress, the digital economy, in which the object of market relations is digital product, formed. The notion of digital product is a complex scientific category, which is subject to changes. Originally, when digital technologies were developed, they were a digital product themselves. Thus, digital products included digital devices (e.g., mobile devices) and connected (complementary) goods and services (e.g., software and Internet). After that, in the course of dissemination of digital technologies, typologization of digital products became more complex. As of now, they include not only digital devices but also digital services and manufactured and sold goods.

The attitude of the interested parties to digital product is contradictory. For the state, this product is a means of development of the digital economy, which stimulates the increase of global competitiveness of an economic system, acceleration of its economic growth, and increase of its effectiveness. An example of macro-economic advantages that are obtained due to replacement of the traditional (pre-digital) products by digital (these products are substitutes) products is increase of transparency of the economic activities and prevention of tax evasion. Another example

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is reduction of state's expenditures for the money supply during the transition to electronic money.

In its turn, entrepreneurship also supports popularization of digital products, as they create advantages for business. One of these advantages is reduction of entrepreneurial risks. For example, online trade (unlike the traditional trade) allows for minimization of reserves (optimization of logistics) and for more precise forecasting of the demand (optimization of marketing). Another advantage is connected to expansion of the activities: diversification of sales markets and obtaining the "scale effect". For example, online trade companies could conduct business cooperation (purchases) and sell their products even in remote markets – which is very difficult in case of the usual retail trade. Another advantage is expansion of opportunities for creation and keeping the competitive advantages. Digital technologies are the most perspective directions of innovative development of the modern entrepreneurship and thus are considered by most entrepreneurial structures as the basis of managing their competitiveness.

Modern consumers also show high interest in digital product – due to its higher accessibility and lower price (as compared to pre-digital product). Thus, popularity of online trade, online finances, and online state services grows. However, consumers prefer digital product only in case of it's of high quality. While the advantage of lower price for digital product is not always gained by consumers, in most cases they face such drawbacks of digital product as high risk of its purchase and usage (due to novelty, unclear legal field, and other reasons).

This contradiction restrains the production and realization of digital products and hinders the development of the digital economy. The attempts to overcome by increasing the quality of a generalized digital product in the modern digital economies are ineffective, due to poor elaboration and underdevelopment of the scientific vision of quality of digital product as an economic category.

That's why an important scientific and practical problem is overcoming the determined contradiction with the fullest, most precise, and most correct determination of quality of digital product as an economic category and outlining of the perspectives of its increase. The following hypothesis is offered - hypothesis H_0 – digital products are highly differentiated and thus their universalization is inadmissible – measuring and quality management should be performed separately for each specific type of digital product.

The purpose of the research is to develop the scientific and theoretical basis for measuring the quality of various digital products, to determine this quality in modern Russia, and to compile recommendations for their management in the interests of their increase. For this, the author performs differentiation of quality of various digital products and evaluation of the current quality of digital products in Russia and develops recommendations for increasing the quality of digital products in Russia.

2. Literature review

Digital product is studied in a lot of modern scientific works. In some of them, digital product is considered as a generalized scientific category. Kim (2019) notes the necessity to pay attention to knowledge and information management during promotion of digital product as a specific modern form of goods and services. Wang et al. (2019) develops and offers the evolutional algorithm of solving the task of production planning for digital products (shown by the example of the aviation and space products). Oygür Ilhan and Karapars (2019) points out the necessity for specific skills and their receipt with the help of education, for successful design and manufacture of digital industrial products. Trilar et al. (2019) states

that the family approach to manufacture of goods and services should be reconsidered due to the specifics of digital product. Feng and Yu (2019) notes that digital products are subject to unique pricing trends (shown by the example of smarthphones) and thus their markets (demand and offer) develop according to new economic laws.

Gustafsson et al. (2019) comes to the conclusion that digital product occupies the central position in the modern supply chains. Wehmöller and Rothgang. (2018) points out the existence of a vivid need for development and popularization of digital products as the most effective (shown by the example of dentist services) products. Mu et al. (2018) write that social media technologies have significant influence on formation of demand and consumption of digital product. Ehikioya (2018) substantiates that digital products could and should be differentiated (divided into different markets) and studied with the help of different economic models. Sierla et al. (2018) write of preferability of digital product due to the possibility of automation of planning of its production and consumption.

In other publications, digital products are differentiated, and the researchers' attention is paid to their certain types. Remotely purchased product (online trade) is studied in Zhang (2019). Online product or service is considered in Liu et al. (2012). Digital devices (hi-tech products) are studied in Guo et al. (2019) and Petrenko et al. (2018). Services that are provided with the help of digital technologies are analyzed in Juric and Lindenmeier (2019) and Sierra et al. (2019). Remote training (digital education) is considered in Wang (2014), Stefanovic et al. (2009) and Stefanovic et al. (2015). Digital finances (electronic banking and non-banking financial services) are studied in Huei et al. (2018). Digital state services (e-government) are studied in Ashaye and Irani (2019).

Quality of digital product is less elaborated, being a new category for the modern economic science. Waldfogel (2016) writes that quality of digital product is very specific, being different from quality of the traditional (pre-digital) product. However, the scholar does not offer the methodology of its measuring (shown by the example of cinematographic product). Lee and Bae (2012) notes that necessity for increased control over quality of serial digital products with the help of engineering. Bravi et al. (2018) deems it necessary to create and use specialized production laboratories for managing the quality of digital product.

Singla et al. (2018) points out the expedience of strategic management of the quality of digital product for sustainable development of entrepreneurship in the conditions of digital economy (shown by the example of the processing industry). Vasilyeva et al. (2018) deem it necessary to perform systemic analysis of quality of digital product. Shojaei et al. (2019) and Mulema and García (2018) offer to perform cyclic quality management of digital product. Certain aspects of determination, assessment, and analysis of quality of digital product as a specific form of goods and services are considered in Popkova et al. (2019), Garina et al. (2018), Popkova (2019), Popkova and Sergi (2019), Sergi et al. (2019), and Popkova and Sergi (2018).

Thus, the performed literature review showed that while the notion of digital product is well-known in the modern economic science, there are still a lot of gaps, including the characteristics of this quality and significance for various types of digital products. That's why quality of digital product requires further theoretical and practical research, for filling the determined gaps.

The specific feature of this research, as compared to other studies of the quality of digital product is refusal from its universalization (generalization) and the differentiated analysis of the quality of

digital products of various types. This will allow for the fullest, precise, and correct determination of quality of digital product from the positions of all interested parties, including consumers (whose opinion is not taken into account as of now).

3. Materials and method

At present, quality of digital product is considered primarily from the positions of entrepreneurship and the state and thus is a macro-economic category. Indirect statistical accounting could be adapted to measuring of the quality of digital product. The most accessible source of information on quality of digital product is the IMD global report "World Digital Competitiveness Ranking".
Apart from the rating of global digital competitiveness of top 63 countries of the world with the most developed and dynamic digital economy, this report contains deciphering and rating of countries as to each of many indicators. One of these indicators is quality of digital product in the national economy, which is characterized by the following:

- Digital/Technological skills. Characterizes simplicity of purchase and usage of digital product: absence of necessity for special and rare skills. The more developed the population's digital skills, the simpler (absence of special training) the purchase and usage of the digital product in the economy;
- Intellectual property rights. Characterizes the level of protection of consumer rights: confidentiality of information, uniqueness of digital product, and possibility, simplicity, and speed of return and exchange. The more protected the rights for intellectual property objects, the more attractive the digital product for consumers;
- Communications technology. Characterizes the consumers' possessing the necessary equipment for consumption of the digital product: absence of necessity for special and rare equipment and software. The more accessible and popular the modern information and communication technologies in the society, the simpler the purchase of the digital product and the more attractive it is for the consumers;
- Use of Big Data and analytics. Characterizes the hi-tech level (in the unity of complexity, innovativeness, and effectiveness) of the digital product. Usage of breakthrough digital technologies (e.g., Big Data) during production, distribution, and consumption of digital product determines its hi-tech level. the higher the hi-tech level of the digital product, the larger advantages for the consumers it creates and, therefore, the more it is attractive and preferable as compared to the usual (pre-digital) product;
- Cyber security. Characterizes the level of digital security and protection of digital product, the process of its purchase and consumption (usage): confidentiality (protection of personal data and other information regarding the purchase and consumption of the digital product), fighting cyber criminals (preventing the damage to the digital product and its usage for illegal purposes, which contradict the consumers' interests), stability (possibility of continuous receipt and usage of the digital product). The higher the level of cyber security, the lower the risk of purchase and consumption of the digital product and, therefore, the higher its attractiveness as compared to the usual (pre-digital) product;

- Software piracy. Characterizes quality and accessibility (including pricing) of software (convenience, speed, and absence of excessive ads) for digital devices and purchase usage of digital goods and services. Presence and cost of licensed software determine the possibility and comfort of purchase and usage of digital product. The more popular the pirate (without a license) software, the more attractive the digital product in the economy.

Though the above indicators are distinguished and subject to systemic statistical accounting, they are not connected to quality of digital product in the economy. That's why the scientific and methodological basis (provision) of measuring of quality of digital product is absent in the modern economic theory. Here the author has developed a scientific and methodological approach to measuring the quality of digital product. This approach envisages usage of weight coefficients for determining the significance of various characteristics for quality of digital products of various types. Characteristics are universal: simplicity of purchase and usage, protection of buyer's rights, presence of equipment, hi-tech character of the product, digital security and software. Characteristics are connected to statistical indicators (calculated by the IMD) of quality of digital product, which allows evaluating this quality in the economy.

Digital products are differentiated according to the existing typologization, at which the following types are determined:

- Remotely purchased product (online trade – e-commerce): retail products that are purchased in Internet;
- Online product or service (ICT product – e-goods, e-services): software for digital devices, virtual assets;
- Digital devices (hi-tech products, DigiTech): technical devices that function based on digital technologies (e.g., PC and mobile phone);
- Services that are provided with the help of digital technologies (e.g., digital energy sphere, digital medicine – smart greed, MedTech): hi-tech services and services for "smart" devices;
- Remote training (digital education – EdTech): receipt of educational services via the Internet;
- Digital finance (online banking and non-banking financial services – FinTech): receipt of financial services through mobile communication means, the Internet, and other digital communication technologies;
- Digital state services (e-government): receipt of state services in the electronic form (remotely).

Quality of digital product of the set type is measures with the help of the following formula:

$$Qdp_i=\sum_{j=1,\dots 6}(CQdp_j*WC_{ij}), \quad (1)$$

where Qdp_i – quality of digital product of the i-th type;
$CQdp_j$ – j-th characteristics of quality of digital product in the economy;
WC_{ij} – weight coefficient (weight) of j-th characteristics of digital product of the i-th type.

As is seen in Formula (1), according to the developed author's scientific and methodological approach, quality of digital product is determined by finding the sum of the product of six universal characteristics (for the economy on the whole) and their weight coefficients (weights) for the digital product of the set type. This allows

differentiating the quality of digital products of various types and determining their specific features within the studied economy. The research is performed in two consecutive stages. At the first stage, for assigning weight coefficients to characteristics of quality for digital products of various types, the author has conducted a sociological survey among 2,000 Russian consumers. Within this survey, the consumers were offered to rank the characteristics of quality for digital products of the distinguished types. The sum of weights of all characteristics of digital product of the set type should constitute 1. Weights reflect significance of the characteristics.

Processing and qualitative treatment of the obtained results is performed with the help of the variation method. This envisages calculation of direct average (WC_{aver}), standard deviation (D_{WC}) and coefficient of variation (V_{WC}) for each characteristic of quality (for digital products of all types). Analysis of variation is aimed at determining the differences in significance of characteristics for digital products of various types.

At the second stage, evaluation of the current quality of digital products in Russia is performed with the usage of formula (1). Quality is evaluated according to the generalized digital product based on initial values of the indicators that are calculated by the IMD. Then, quality of digital product of each type is evaluated, and its variations are analyzed. As a result, ratio of direct average of quality of digital products of all types to quality of the generalized digital product (Dif) is calculated. Based on the calculated separate characteristics of quality of digital product of each type and based on the aggregate digital product, integral quality is calculated by finding direct average of all characteristics of quality.

As the IMD materials provide not absolute but relative (positions in the global rating of 63 countries of the world) values of the indicators that characterize quality of digital product, their preliminary processing is performed here. The following formula is used:

$$CQgdp_j=1-(CQimd_j/63), \quad (2)$$

where $CQgdp_j$ – estimate j-th characteristics of quality of a generalized digital product in the economy;
$CQimd_j$ – initial j-th characteristics of quality of a generalized digital product in the economy according to IMD (position in the rating of 63 countries of the world).

For proving the offered hypothesis H_0, variation of the shares of Russian population that purchase digital products of various types in 2019 (Vsp) should exceed the critical (threshold, maximum admissible for acknowledging variation insignificant) value of 10% (Vsp>10%). Variation coefficients (Vc) for digital products of all types should exceed the critical (threshold, maximum admissible for acknowledging the variation insignificant) value of 10% (V_C>10%). Ratio of direct average of quality of digital products of all types to quality of generalized digital product (Dif) should not be below 0.5 or above 1.5, which shows that quality of digital products of various types differs from quality of a generalized digital product in the economy by more than two times (Dif<0.5 or Dif>1.5).

From the mathematical point of view, the logic of proving of the offered hypothesis H_0 could be presented as the following system of equations:

$$H_0=\begin{cases} Vsp>10\%; \\ V_C>10\%; \\ Dif<0.5 \text{ or } Dif>1.5. \end{cases}$$

If all conditions from the given system of equations are observed, hypothesis H_0 is proved; in the opposite case it is disproved.

4. Results

4.1. Differentiation of quality of various digital products

Statistical data on activity of usage of digital products of various types in Russia in 2019 are shown in Figure 1.

As is shown in Figure 1, digital devices (hi-tech products – e.g., PC's and mobile devices) are purchased and used by 99.9% of the population in Russia in 2019 – as well as services that are provided with the help of digital technologies and devices. Electronic and services (e.g., Internet) are used by 76.3% of Russian consumers. Digital finances are used by 31% of Russian consumers. Digital state services are obtained by 29% of Russian population. Variation of the shares of Russian population that purchase digital products of various types in 2019 constituted 64.66%, exceeding the critical value (Vsp>10%). This is one of the confirmations of the offered hypothesis H_0 and emphasizes the heterogeneity of digital products and, therefore, the necessity for their differentiation during quality measuring and management.

As a result of systematization of the results of the performed sociological survey, the following results were obtained (Table 1).

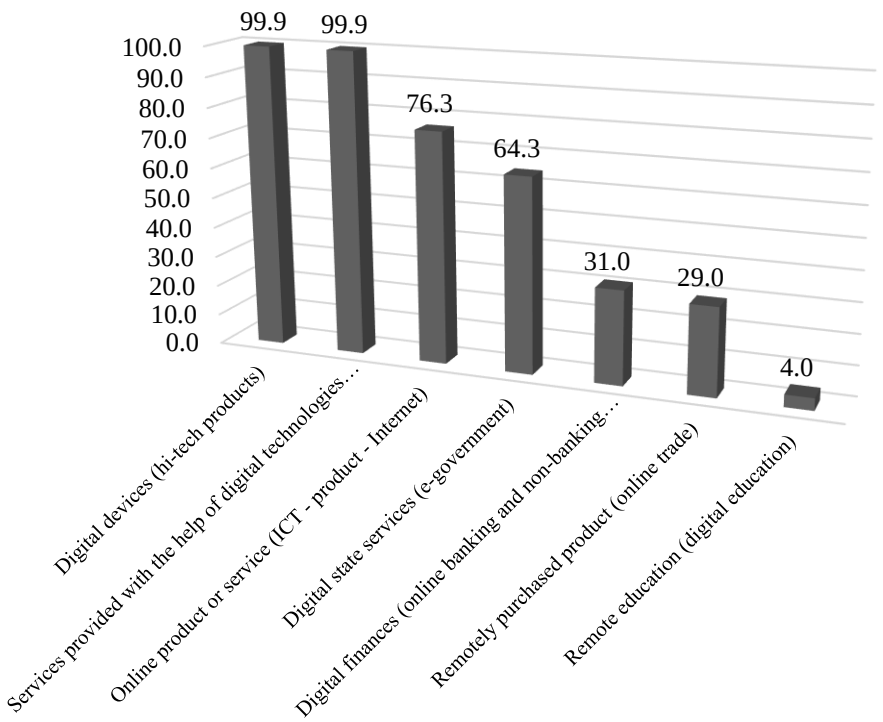

Figure 1. Share of Russian population that purchases digital products of various types in 2019, %

Source: compiled by the author based on National Research University "Higher School of Economics" (2019).

Table 1. Significance characteristics of quality for digital products of various types

Digital product	Characteristics of quality and their significance (weight) for digital products, shares of 1, sum of shares for each product equals 1					
	Simplicity of purchase and usage	Protection of buyer's rights	Availability of equipment	Hi-tech character of product	Digital security	Software
Remotely purchased product	0.35	0.25	0.15	0.01	0.14	0.10
Online product or service	0.05	0.30	0.25	0.05	0.30	0.05
Digital devices	0.20	0.05	0.10	0.40	0.05	0.20
Services that are provided with the help of digital technologies	0.15	0.30	0.15	0.30	0.05	0.05
Remote training	0.30	0.10	0.20	0.05	0.05	0.30
Digital finances	0.20	0.05	0.20	0.05	0.40	0.10
Digital state services	0.35	0.10	0.15	0.10	0.20	0.10
Direct average (VC_{aver}), shares of 1	0.23	0.16	0.17	0.14	0.17	0.13
Standard deviation (D_{VC}), shares of 1	0.11	0.11	0.05	0.15	0.14	0.09
Coefficient of variation (V_{VC}), %	48.68	69.66	28.46	109.76	81.37	70.49

Source: Developed and compiled by the author based on the results of independent sociological survey

As is shown in Table 1, for remotely purchased product (online trade), the key characteristics of quality (with the largest weights) are simplicity of purchase and usage of (0.35), protection of buyer's rights (0.25), and availability of equipment (0.15). For online goods and services (ICT products), the key characteristics of quality are protection of buyer's rights (0.30), digital security (0.30), and availability of equipment (0.25). For digital devices (hi-tech products), the key characteristics of quality are hi-tech character (0.40), simplicity of purchase and usage (0.20), and software (0.20).

For services that are provided with the help of digital technologies (e.g., digital energy sphere and digital medicine), the key characteristics of quality are protection of buyer's rights (0.30) and hi-tech character (0.30). For remote training (digital education), the key characteristics of quality are simplicity of purchase and usage (0.30), software (0.30), and presence of equipment (0.20). For digital finances (electronic banking and non-banking financial services), the key characteristics of quality include digital security (0.40), simplicity of purchase and usage (0.20), and availability of equipment (0.20). For digital state services (e-government), the key characteristics of quality include simplicity of purchase and usage (0.35), digital security (0.20), and presence of equipment (0.15).

Coefficient of variation (V_{CV}) of direct average of significance (weights) for simplicity of purchase and usage constituted 48.68%, for protection of buyer's rights – 69.66%, for availability of equipment – 28.46%, for high-tech character of the product – 109.76%, for digital security – 81.37%, and for software – 70.49. All coefficients of variation exceed the critical value of 10%, which is a proof of the offered hypothesis H_0. Therefore, significance of the distinguished characteristics of quality for digital products of various types differs. The obtained direct averages of significance of the characteristics of quality of digital products are shown in Figure 2.

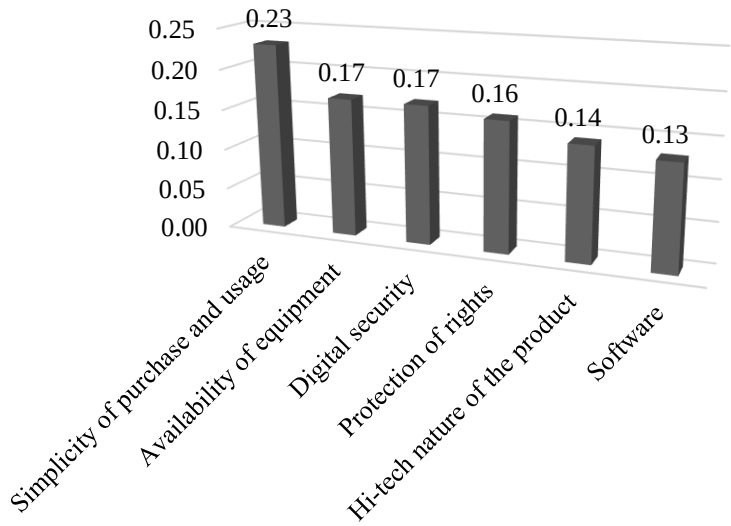

Figure 2. Direct averages of significance of the characteristics of quality of digital products, shares of 1
Source: calculated and built by the author

As is shown in Figure 2, the most significant feature for digital products of all types is simplicity of purchase and usage of (0.23). The second position belongs to availability of equipment (0.17) and digital security (0.17), which are followed by protection of buyer's rights (0.16), hi-tech character of digital product (0.14), and software (0.3). As is seen, the sum of weights is 1: 0.23+0.17+0.16+0.14+0.13=1, which confirms correctness of the performed calculations.

4.2. Evaluation of the current quality of digital products in Russia

The results of the performed evaluation of quality of digital products of various types in Russia in 2019 are shown in Table 2.

Let us present an example of calculations from Table 2. The characteristics of the generalized digital product are obtained in the following way. According to the indicator "Digital skills", Russia is ranked 29th among 63 countries of the world in 2019. That's why the characteristic "Simplicity of purchase and usage" is determined with the help of formula (2) in the following way: $CQgdp_j=1-(29/63)=0.54$. According to the indicator "Intellectual property rights", Russia is ranked 52nd among 63 countries of the world in 2019. That's why the characteristic "Protection of buyer's rights" is determined with the help of formula (2) in the following way: $CQgdp_j=1-(52/63)=0.17$. Integral quality of the generalized digital product is calculated by finding direct average of its characteristics in the following way:

$Qdp_i=0.46+0.83+0.48+0.92+0.59+0.86=$

$=0.69$.

For remotely purchased product (online trade), significance (weight) of the characteristic "Simplicity of purchase and usage" constituted 0.35. That's why this characteristic is determined in the following way: 0.54*0.35=0.19. For remotely purchased product (online trade), significance (weight) of the characteristic "Protection of buyer's rights" constituted 0.25. That's why this characteristic is

determined in the following way: 0.17*0.25=0.04. Integral quality of remotely purchased product (online trade) is calculated with the help of formula (1) in the following way:

Qdp_i=(0.35*0.16)+(0.25*0.21)+(0.15*0.07)+(0.01*0.01)+(0.14*0.08)+ +(0.10*0.09)=0.10.

Quality of the generalized digital product and on average for digital products in Russia in 2019 is shown in Figure 3.

Table 2. Evaluation of quality of digital products of various types in Russia in 2019.

Digital product	Characteristics of quality (product of the values of the indicators of quality and their weights), shares of 1						Integral quality, shares of 1
	Simplicity of purchase and usage	Protection of buyer's rights	Availability of equipment	Hi-tech character of product	Digital security	Software	
Generalized digital product	0.54	0.17	0.52	0.08	0.41	0.14	0.31
Remotely purchased product	0.19	0.04	0.08	0.00	0.06	0.01	0.06
Online product or service	0.03	0.05	0.13	0.00	0.12	0.01	0.06
Digital devices	0.11	0.01	0.05	0.03	0.02	0.03	0.04
Services that are provided with the help of digital technologies	0.08	0.05	0.08	0.02	0.02	0.01	0.04
Remote training	0.16	0.02	0.10	0.00	0.02	0.04	0.06
Digital finances	0.11	0.01	0.10	0.00	0.16	0.01	0.07
Digital state services	0.19	0.02	0.08	0.01	0.08	0.01	0.06
Direct average, shares of 1	0.12	0.03	0.09	0.01	0.07	0.02	0.06
Standard deviation, shares of 1	0.06	0.02	0.03	0.01	0.06	0.01	0.01
Coefficient of variation, %	48.68	69.66	28.46	109.76	81.37	70.49	18.05
Ratio of direct average to generalized digital product (Dif)	0.23	0.16	0.17	0.14	0.17	0.13	0.18

Source: Developed and compiled by the author based on IMD (2019) and the results of an independent sociological survey

As is shown in Figure 3, for all characteristics of quality the generalized digital product exceeds direct average for digital products in Russia in 2019. According to the data from Table 2, coefficients of variation of the characteristics of quality of digital products of various types are very high: for simplicity of purchase and usage the coefficient of variation constituted 48.68%, for protection of buyer's rights – 69.66%, for availability of equipment – 28.46%, for high-tech character of the product – 109.76%, for digital security – 81.37%, and for software – 70.49%. Coefficient of variation of integral quality of digital products of various types in Russia in 2019 constituted 18.05%.

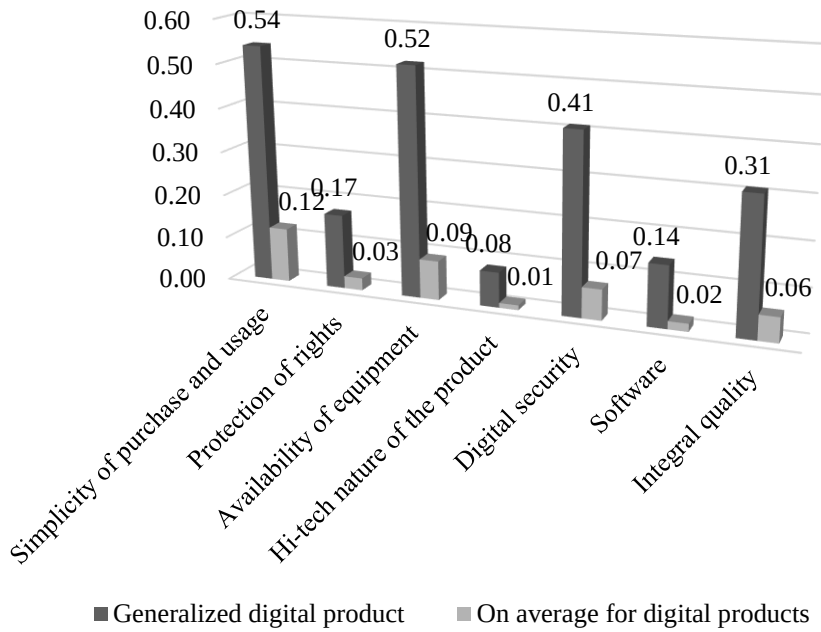

Figure 3. Quality of generalized digital product and on average for digital products in Russia in 2019
Source: calculated and built by the author

Ratio of direct average to the generalized digital product (Dif) is very small: for simplicity of purchase and usage this ratio constituted 0.23, for protection of buyer's rights – 0.16, for availability of equipment – 0.17, for high-tech character of the product – 0.14, for digital security – 0.17, for software – 0.13, and for integral quality – 0.18. Therefore, quality of digital products of various types differs by two times from quality of the generalized digital product in the economy.

Thus, all necessary proofs of the offered hypothesis H_0 are present: Vsp>10%, all V_{VC}>10%, Dif<0.5 - therefore, the hypothesis is correct. Digital products are too differentiation, and their quality is specific (differs from each other), and this quality management of digital products of various types should be performed separately.

4.3. Recommendations for increasing the quality of digital products in Russia

The following algorithm is offered for managing the quality of digital products (Figure 4).

As is shown in Figure 4, the developed algorithm envisages systemic management, which includes state and corporate management which is conducted in two consecutive stages. At the first stage, the managerial measures are implemented at the level of macro-economy, and the subject of management is the state. Management is aimed at development of the characteristics of the generalized digital product – i.e., at improvement of the value of the indicators of the economy's global digital competitiveness (j): digital/technological skills (j_1), intellectual property rights (j_2), communications technology (j_3), use of big data and analytics (j_4), cyber security (j_5), and software piracy (j_6).

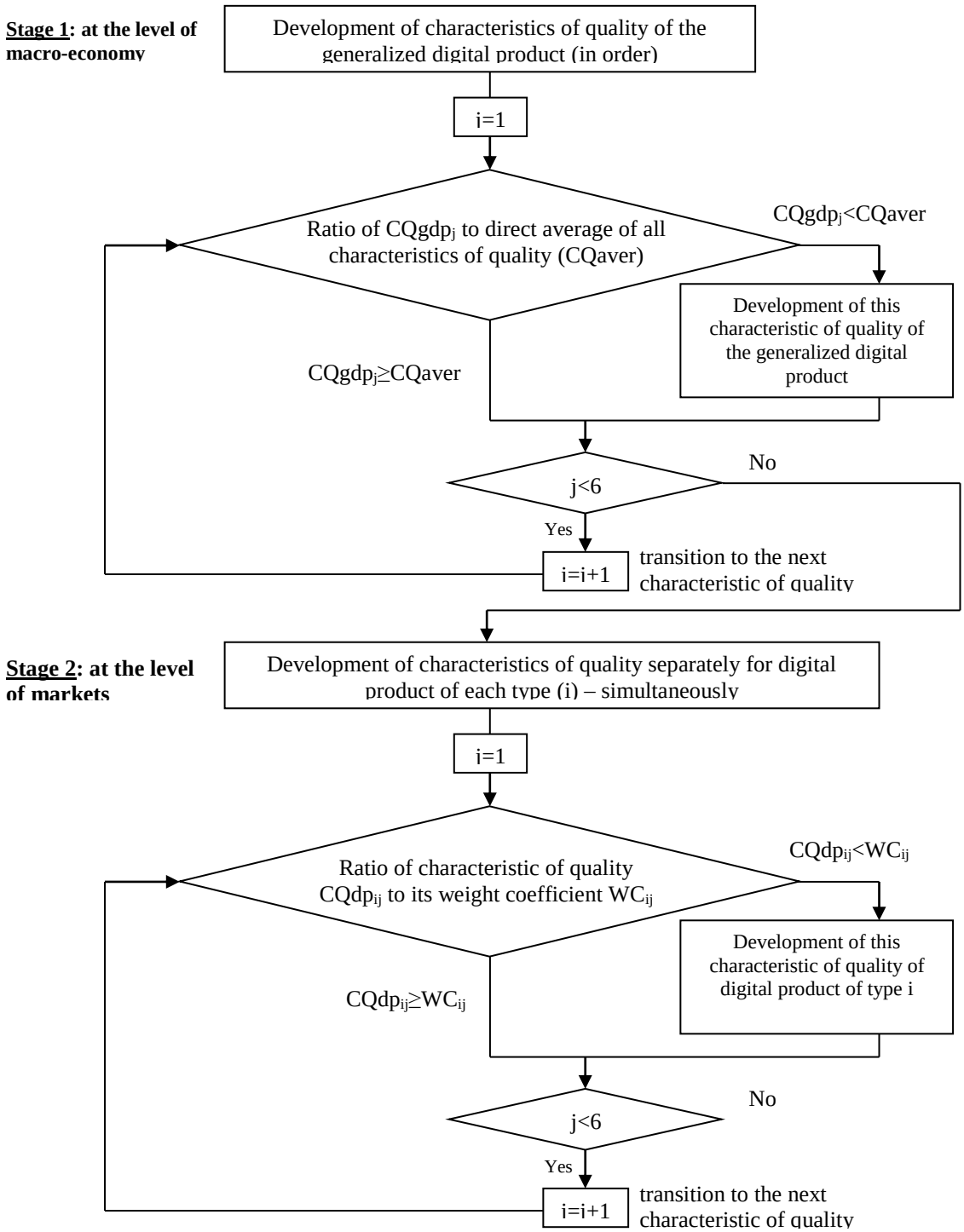

Figure 4. Algorithm of managing the quality of digital products
Source: developed and compiled by the author

It should be noted that for accelerating growth and stimulating development of the digital economy, as well as for supporting its global competitiveness at the high level, it is necessary to constantly improve all characteristics of quality of the generalized digital product. At the same time, deficit of resources which is constantly faced by the economic systems, requires ranking of these characteristics for determining the ones that need development the most. They are determined in the following way.

The first characteristic is considered (digital/technological skills) – i.e., j=1. Its value ($CQgdp_j$) is compared to direct average of the values of all characteristics of quality (CQaver). If CQgdpj<CQaver, development of this characteristic of quality of the generalized digital product is necessary. In the opposite case, this characteristic could be developed in the next time period after development of other characteristics (if there are free resources). Then, transition to the next characteristic takes place: j=j+1=2 (intellectual property rights).

After the implementation of all managerial measures at the level of macro-economy, transition to the second stage take place – at which management is conducted at the level of the markets of digital products of the corresponding types. Management is aimed at development of the characteristics of quality of for digital product of each type (i) simultaneously. The characteristics include simplicity of purchase and usage, protection of buyer's rights, availability of equipment, hi-tech character of the product, digital security, and software.

Ratio of the characteristics of quality $CQdp_{ij}$ to its weight coefficient WC_{ij} is determined. If $CQdp_{ij}<WC_{ij}$, it is necessary to develop this characteristic of quality of digital product of type i. Then, transition to the next characteristic of quality of this digital product takes place. As a result of practical implementation of the offered algorithm, the following advantages are achieved:

- optimization of spending (economy) of managerial resources: characteristics of the generalized digital product and digital products of all types develop in the order of priority (depending on the current need for them in the economy and in the market). This allows for precise determination and for effective spending of the managerial budget, achieving the target results that are connected to acceleration of development of the digital economy;
- taking into account the specifics of digital products of all types: for digital product of each type the characteristics of quality that are most significant and least developed at present are subject to development. Taking into account the consumers' opinion allows increasing the attractiveness of digital products and stimulates their production and realization in the market. Thus, pre-digital products are replaced by digital products.

5. Conclusion

Thus, the offered hypothesis has been proved. For taking into account the consumers' opinion it is offered to use weights which reflect significance of each characteristic of digital product of the set type. A sociological survey in Russia in 2019 allowed determining that the most significant characteristic on average for digital products of all types is simplicity of their purchase and usage. That's why at the macro-economic level it is necessary to focus on increasing the level of population's digital (technological) competencies.

The second position – as to significance – belongs to availability of equipment for purchase and usage of digital products and digital security. Therefore, the state should stimulate the dissemination of the modern information and communication

technologies in society and raise the level of the national digital (cyber) security. It has also been established that quality of digital products of various types is too differentiated; it differs from quality of a generalized digital product. Integral quality of the generalized digital product in Russia (measured based on general macro-economic characteristics of the digital economy: digital/technological skills, intellectual property rights, communications technology, use of big data and analytics, cyber security, and software piracy) constituted 0.31 (maximum: 1). It is moderate (medium, normal).

At the same time, average quality of digital products of all distinguished types (remotely purchased product, online goods and services, digital devices, services that are provided with the help of digital technologies, remote training, digital finances, and digital state services) is lower by 18 times – 0.06. It is very low. Variation of quality of digital products of various types is high – 18.05%. This shows that when measuring and managing the quality of digital products it is necessary to distinguish general macro-economic conditions and conditions in separate markets of digital products, as well as to take into account consumer preferences for quality of each digital product (differences in significance of characteristics of its quality). The author has presented the recommended algorithm of managing the quality of digital products, which allows complying with both conditions.

The assessment allowed determining that the highest quality in Russia in 2019 is peculiar for digital finances, and the lowest – for digital devices and services that are provided with the help of digital technologies. Therefore, state and corporate management of quality of digital products in these markets is very important. The most significant characteristics of quality for most (on average) digital products are as follows: simplicity of purchase and usage of digital products, availability of equipment for this, and digital security. Thus, it is recommended to adopt development of digital society (stimulation of mass mastering and improvement of digital competencies), dissemination of digital equipment, and provision of cyber security as the national strategic priorities of the Russian digital economy.

It should be noted that significance of the characteristics of digital products of various types could be different in the modern economic systems. These differences could be caused by the level of consumer awareness and the specific features of the digital economy (including digital society), situation in the markets of digital products, and the level of quality of the generalized digital product (macro-economic conditions). That's why it is expedient to conduct sociological surveys for determining the significance of the characteristics of quality for digital products of various types in each economic system. The scientific and theoretical basis should be the fundamental bass for future empirical research in this direction.

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