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Improving the Methodology for Assessing the Digital Maturity Index of Russian Regions, Taking into Account Aspects of the Second and Third Stages of Digital Transformation of PMA Based on Foreign Experience

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ABSTRACT

The purpose of the study is to identify and determine the directions and accounting factors included in the algorithm for assessing the digital maturity index of Russian regions to improve this methodology, taking into account aspects of the second and third stages of digital transformation of public and municipal administration (PMA). In the course of the work, **methods** of analysis, generalization and systematization were applied. The authors noted the problem of inconsistency of the target directions of the PMA digital transformation with the actual activities, indicated the expediency of taking into account the indicators in the proposed directions when assessing the digital maturity index in the regions of Russia. The paper defines digital ecosystems, reflects the relationship between their features and the methodology for assessing the digital transformation of public and municipal administration, the stages of which are characterized and specified by the example of foreign experience. **The relevance** of the research lies in the strategic need to find growth points to increase the efficiency and effectiveness of PMA in the context of digital realities.

The practical significance of the results lies in the possibility of using the proposed directions and accounting factors in the methodology for assessing digital maturity in the constituent entities of the Russian Federation by public authorities while they are being modernized.

Keywords: digitalization; digital transformation; digital ecosystem; stages of digital transformation of state and municipal government; digital maturity

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INTRODUCTION

In the times of the establishment of the sixth technological paradigm and the emergence of "Industry 4.0", which are characterised by massive processes of digitalisation and digital transformation of the institutions of vital life sustenance of the citizens, businesses and governments taking into account the multiplier effects [1], in a BANI world,[1] analysing, evaluating and systematising aspects of the digital economy is a strategically relevant and useful practice for identifying points of growth and sustainable functioning in an unstable environment. Digital transformation is nowadays a key aspect in building the productive power of life support institutions [2].

Evaluation methodologies are the effective tools to improve the quality of management decisions and, consequently, policy making, taking into account the sanctions pressure and the focus of domestic state and municipal structures on achieving results [3] in the context of the need for information support of the management process with relevant data through the tools of digital economy [4] and the need to build a global distributed management system [5]. This tool contributes to the reduction of the cost of resources that are necessary to maintain the digital macro environment [6]. Synchronization and standardization of digital transformation in the development of different spheres of regional activities is a highly effective tool for the sustainable development of the constituent subjects of the Russian Federation [7].

The feasibility of upgrading digital transformation assessment methodologies lies in the need for greater flexibility and adaptability in the assessment of management decisions made using it in the context of rapidly changing realities, for all public and municipal administration (PMA) institutions [8]. To this should be added the tasks of eliminating the inconsistency between the indicators used to determine the digital maturity index,[2] and achieving the goals set for the data management centres in the Russian regions.

The scientific novelty of the work consists in proposing ways to improve the above methodologies at the level of the constituent entities of the Russian Federation based on the analysis of similar successfully implemented tools in Australia, Singapore, Estonia, the USA, and the DESI index.[3] The choice of countries is conditioned by the presence of successfully implemented cases, which are the examples of confirming the rationality of taking the directions into account for building digital ecosystems in the second and third stages of digital transformation.

STATEMENT OF THE PROBLEM

The need to consider relevant indicators when assessing the digital maturity index in Russian regions is due to such factors as:

The discrepancy between the target areas of the digital transformation of the PMA and the actual measures [9] specified in the Strategies of Digital Transformation of Key Sectors of the Economy, Social Sphere and Public Administration of the Constituent Entities of the Russian Federation (hereinafter, Digital Transformation Strategies),[4] the implementation of which

[1] The BANI world is a fragile, unsettling, non-linear, incomprehensible world characterised by the variability of systems' functioning. The name is suggested by a futurologist Jamais Kashio.

[2] Digital Maturity Index — a tool to assess and improve PMA's digital transformation policies.

[3] Daily Economic Stress Index — DESI.

[4] Strategies for digital transformation. Ministry of Digital Development, Communications and Mass Media of the Russian Federation. URL: https://digital.gov.ru/ru/activity/directions/1064 (accessed on 17.02.2023).

is planned until 2030. In particular, they identify the need to create regional data management centres, which imply organizing a mechanism for collecting and working with data at the RF subject level in real time, which corresponds to the second stage of PMA digital transformation, while the indicators used to assess digital maturity and the planned activities correspond to the first [10].

Table 1 characterises the stages of PMA digital transformation and the respective effects of implementing each of them.

The evidence it contains suggests that each stage of digital transformation has a number of strategic benefits, and when implemented, it provides additional opportunities for the state (all other things being equal).

The methodology for assessing the digital maturity index in Russia's regions after adjusting the order of the Russian Ministry of Digital Development, Communications and Mass Media,[5] allowing regions to incorporate *additional areas and directions* in addition to the five key sectors and indicators if they so wish. This methodology is part of a set of measures to assess governors' performance and is a tool to improve the effectiveness of their policies in the digital transformation of sectors such as education, healthcare, urban transport, urban economy and state and municipal administration. Separately, it is worth noting that a qualified analysis of the authorities' performance makes it possible to form meaningful priorities, goals, activities, and strategies in the field of regional development [12].

Building digital ecosystems in the second and third stages of digital transformation. Such experiences are inherent in technologically and economically developed countries, and there is a trend today at the international level to create such ecosystems — digital macro environments for citizens, businesses, and governments, capable of influencing the real world through the digital one with the corresponding strategic effects, allowing the state to position itself on the world stage [13].

RESEARCH METHODS AND RESULTS

PMA Digital Transformation Assessment Methodologies are the effective tools for conducting a competent policy in the field of digital development, enabling Russian regions and the entire state to create conditions for increasing the reproduction of social and economic benefits through digitalization and digital transformation tools.

The methodology for assessing the digital maturity index of Russian regions involves finding the arithmetic average of indicators (*Table 2*) in each of the five sectors: education, healthcare, urban economy, public transport, and public administration.

The data in *Table 2* shows that the indicators in each sector reflect the share of electronic processes in the different activities.

[5] Order of the Ministry of Digital Development of Russia No. 600 dated 18.11.2020 (revised on 14.01.2021) "On Approval of the Methods for Calculating the Target Indicators of the Russian Federation National Development Target "Digital Transformation" (together with the Methodology for Calculating the Indicator "Achieving "Digital Maturity" in Key Economic and Social Sectors, Including Health and Education as well as Public Administration", Methodology for calculating the indicator "Achieving digital maturity in key sectors of the economy and social sphere, including healthcare and education, as well as public administration» for the constituent entity of the Russian Federation", Methodology for calculating the indicator "Increasing the share of mass socially important services available in electronic form to 95%", "Methodology for calculating the indicator «Share of households provided with broadband Internet access", Methodology for calculating the indicator «Increasing investment in domestic information solutions", Methodology for Calculation of the Indicator "Increased Investment in Domestic Information Technology Solutions" at the Level of Constituent Entities of the Russian Federation"). URL: https://www.consultant.ru/document/cons_doc_LAW_372437/e486e5c863f60c7faf76a471a7ea0b957b1772b8/?ysclid=le5et4173x603409804

Table 1

Characteristics of the stages of digital transformation of public and municipal administration

Stage	Characteristics	Examples of indicators	Examples of effects
The architecture of electronic government	Transfer of state and municipal processes into electronic format with the provision of electronic services	Share of electronic communications; share of data openness in electronic resources	Reduced costs for citizens, businesses, authorities as a result of electronic communications
PMA based on the data	Move towards and transition to information sharing based on a mechanism for automated data collection from the state's infrastructure through digital devices, systems, solutions	Proportion of data available in real time for analysis; proportion of data that is generated automatically	Increasing the speed and quality of management decisions
Digital PMA	The emergence of the possibility of influencing the real world through the digital environment with digital devices, systems, solutions	Proportion of automation of government infrastructure processes; proportion of data that can be managed in real time (online) in a digital environment	Optimisation of budgets, increased objectivity of management based on up-to-date data

Source: compiled by the authors based on [11].

The Digital Transformation Strategies adopted by 82 Russian regions[6] (data for Moscow, Khanty-Mansiysk Autonomous District and Chukotka Autonomous District are not available) reflect target indicators for assessing the digital maturity index of industries until 2024 (in the long-term prospect until 2030); these documents provide for measures aimed at forming an e-government architecture in each constituent entity of the Russian Federation, which corresponds to the first stage of PMA digital transformation, while also noting the need to build a regional data management system with a real-time data collection mechanism across all sectors of government, which refers to the second phase of PMA digital transformation and implies the organisation of data-driven public administration, which may be difficult, however, as the actual indicators aim to assess the construction of the established e-government architecture, and hence to assess electronic communications in key sectors.

This paper presents an analysis of methodologies for assessing the digital transformation of PMA in those countries where the second (or third) phase has been formed, and provides examples of its effectiveness. On the basis of the research conducted, it proposes areas and aspects that should be taken into account in order

[6] Strategies for digital transformation. Ministry of Digital Development, Communications and Mass Media of the Russian Federation. URL: https://digital.gov.ru/ru/activity/directions/1064 (accessed on 17.02.2023).

Table 2

List of indicators for determining the digital maturity index

Industry/ Sector	Indicators
Healthcare	Proportion of doctor's appointments made by citizens remotely; proportion of citizens who have integrated electronic medical records available on the CPPS (consolidated portal of public services and functions); proportion of citizens under dispensary care who are provided with remote health monitoring; proportion of medical organisations that centrally process and electronically store diagnostic test results; proportion of medical consultations and conciliums conducted by constituent entities of the Russian Federation using video conferencing; proportion of consultations held by a doctor with a patient, including on the CPPS, using video-conferencing; share of citizens who have access to medical prescriptions in the form of an electronic document, including on the CPPS; share of medicines and drugs purchased for budget funds, for which centralised accounting of their distribution and use is ensured; share of emergency medical aid stations (departments) connected to the unified electronic dispatching system
Education	Proportion of students for whom a digital profile is maintained; proportion of students who are offered recommendations on improving the quality of learning and shaping individual trajectories using data from the student's digital portfolio; proportion of teaching staff who have been able to use verified digital learning content and digital learning services; proportion of students who have free access to verified digital learning content and services for self-study; proportion of electronic assignments for students who are monitored and checked using automated checking technologies
Urban economy	Share of general meetings of premises owners in apartment buildings held through electronic voting in the total number of general meetings of owners held; share of apartment building management and common property maintenance services paid online; share of utilities services paid online; share of management organisations disclosing information in full to the state information system of housing and communal services; share of resource supplying organisations disclosing information in full to the state information system of housing and communal services; share of emergency housing stock entered into the digital register of emergency housing; share of city residents over 14 years of age registered on specialised information resources on urban development issues
Public transport	Share of buses providing regular urban, suburban and intercity (within the constituent entity of the Russian Federation) passenger transportation equipped with non-cash fare payment systems; share of buses providing regular urban, suburban and intercity (within the constituent entity of the Russian Federation) passenger transportation for which information on their actual route traffic is publicly available; share of buses providing regular urban, suburban and intercity passenger transportation (within the constituent entity of the Russian Federation) that are equipped with video cabin surveillance systems (with recording function) that meet personal data protection requirements
Public administration	Share of types of information in state or regional information systems available in electronic form required for the provision of mass socially significant services; share of electronic legally significant document turnover between executive authorities, local authorities and their subordinate institutions and in the constituent entity of the Russian Federation; share of state and municipal services provided without violating the regulatory deadline when providing services electronically on the CPPS and/or regional public services portal; share of inspections as part of control and oversight activities carried out remotely, including using checklists in electronic form; share of applications for mass socially important state and municipal services in electronic form using CPPS, without the need to personally visit government bodies, local authorities and multifunctional centres for state and municipal services, in the total number of such services; share of mass socially important state and municipal services, that are electronically accessible and are provided through CPPS in the total number of such services provided electronically

Source: compiled by the authors based on the Resolution of the Government of the Russian Federation of 03.04.2021 No. 542 (ed. of 30.11.2022) "On Approval of methods for calculating indicators for evaluating the effectiveness of the Activities of Senior Officials (Heads of Supreme Executive Bodies of State Power) of the Subjects of the Russian Federation and the Activities of Executive Authorities of the Subjects of the Russian Federation, as well as on Invalidation of Certain Provisions of the Decree of the Government of the Russian Federation of 17.07.2019 No. 915". URL: http://www.consultant.ru/document/cons_doc_LAW_382080 (accessed on 08.09.2022).

to assess the effectiveness of the established requirement and to adjust the course in this area. The identified trends should be taken into account when improving the calculation of the Digital Maturity Index in Russian regions under sanctions pressure, when it is necessary to meet their own needs through domestic resources.

The indicators presented in *Table 2*, reflect the peculiarities of the current digital PMA transformation (*Table 1*) both at the level of the region and the state as a whole, as this process is evaluated on the basis of their values, and further activities in this direction until 2030 will be aimed at achieving the target values [14].

Let us present the PMA digital transformation assessment methodologies in several foreign states (based on indicators) and in the European Union (DESI) (*Table 2*); for each of them the stages of digital transformation are defined, and examples of their effectiveness are considered.

Australia is chosen because it is one of the leaders in digital transformation [15]. The country has developed a digital ecosystem (with aspects of PMA Phase 2 digital transformation), which is expressed by the availability of tools to gather information through the Internet of Things into a single macro environment in which AI structures, depending on their functionality, typify, instantiate and distribute data. The second phase of PMA's digital transformation has a number of strategically significant benefits, expressed in social and economic terms. In particular, in Australia, thanks to an investment by the authorities (of $ 30 million) to establish the National Digital Agriculture, the implemented digital solutions are planned to automate infrastructure processes in the industry in order to implement a remote management system via digital twins, which will contribute to the goal of becoming a $ 100 billion sector by 2030. The use of blockchain technology in the National Digital Agriculture will (through digital supply chain traceability) reduce food losses by 30 million tonnes by 2030. It is also estimated that in the country over the next decade, innovations in the digital transformation of the state will collectively add about $ 315 billion to GDP.[7] Australia's examples demonstrate the effectiveness of the PMA's digital transformation and the country's medium-term transition to its third phase, with the corresponding effects and implementation of real-world impact mechanisms through the digital world.

The choice of Singapore is due to the fact that it is the first subject of implementation of the *digital twin* city-state (the third stage of PMA digital transformation), which allows: modelling the state functions; organising data integration from its infrastructure; reflecting infrastructure processes (for example, work of aggregates for rubbish collection); realising planning and forecasting of various procedures and phenomena; influencing the real world with management decisions of authorities, business and citizens (Internet of things). The functioning of the digital twin generates effects of social and economic nature[8] [16]: reduction of the continuous topographical survey for authorities from 35 to 6 million Singapore dollars, by 2030 a 20% reduction of pollutant emissions in school construction; possibility for 96% of citizens to receive a number of socially important service packages, formed by the AI system on the basis of the previous requests (from 2021).

The choice of Estonia is due to the fact that in the UN e-government development ranking and in the international digital

[7] National Agricultural Innovation Agenda. Digital Foundations for Agriculture Strategy. URL: https://www.agriculture.gov.au.

[8] Singapore Green Plan 2030. URL: https://www.greenplan.gov.sg/key-focus-areas/overview#resilient-future

Table 3

Directions and indicators for assessing the digital transformation of public and municipal administration in Australia, Singapore, Estonia, USA and DESI methodology

Methodology in Australia [a]		
Direction	**Characteristics**	**Indicators**
Research expenditure	Evaluation of ICT (information and communications technology) investments in public administration and municipal governance	Expenditure on ICT (information and communications technology) research and development by public authorities; expenditure on research and development by non-profit organisations; assessment of investments in human resource development in the digital economy
Assessment of business development in the IT sector	Evaluating the activities of individuals involved in the development of the state's digital macro-environment	Proportion of organisations involved in IT innovation activities; proportion of private organisations using artificial intelligence (AI) to generate data; proportion of organisations with digital data collection tools; proportion of private organisations using digital devices, systems, solutions in their activities; proportion of organisations using data processing centres; proportion of organisations using internet of things to generate data; proportion of electronic commerce
Use of the internet	Assessment of internet accessibility for citizens	Share of broadband subscribers (DSL, ITTH, GPON); data volume; share of cellular subscribers; share of citizens with internet access (wired or wireless); share of households with internet access
Use of data	Assessment of data flows in state and municipal authorities	Specific weight of government databases integrated into a single system; volume of data integrated from digital devices into a single digital government system; specific weight of state and municipal entities, businesses and citizens who have access to real-time data via individual and single digital systems; specific weight of government entities that use internet of things devices to generate infrastructure data; specific weight of data generated by internet of things devices in the overall structure of the data received
Methodology in Singapore [b]		
Direction	Characteristics of the direction	Direction indicators
Performance assessment	Evaluating the effectiveness of digital transformation activities	Citizens' satisfaction with digital services, in %; business satisfaction with digital services, in %
Assessment of cross-cutting (end-to-end) digital technologies	Assessment of the accessibility of the authorities' electronic systems for various operations	Proportion of digital public services offering electronic payment options, in %; proportion of digital public services that are generated by data obtained by the government using the internet of things and artificial intelligence (AI), in %; proportion of digital public services offering digital signatures, in %
Evaluating digital transactions	Assessing the capacity of digital government systems to carry out digital transactions	Authorities' digital transactions from the total number, in %; share of incoming and outgoing transactions through digital systems by authorities, in %

Table 3 (continued)

Methodology in Australia [a]		
The capacity of the authorities	Assessment of human resources capable of mastering the tools of the digital economy	Proportion of civil servants able to master digital economy tools, %; number of civil servants able to master digital economy tools, pcs.
Digital projects	Accounting for (Mainstreaming) digital transformation projects	Number of digital transformation projects, pcs.; share of digital transformation projects of all, %
Evaluation of the data	Evaluation of data flow, evaluation of AI and data processing systems	Proportion of civil servants using AI to develop and deliver services and policies, in %; number of high-impact data generation projects; main data fields in machine-readable format that can be transmitted by AI, in %; time required to exchange data for inter-agency projects, in seconds, in minutes, in hours, in days; proportion of data generated by internet of things devices; proportion of data processed by AI
Assessing the extent of migration to the digital cloud	Assessment of the overall integration of all digital systems in a single system	Proportion of digital systems in the digital cloud, integrated into a single digital space for data generation, exchange and transformation (public and private information systems), in %; proportion of digital devices managed through the digital cloud; number and proportion of citizens with access to information in the cloud
Methodology in Estonia [d]		
The stage of digital transformation of PMA	**Indicators**	
Building the architecture of e-government	Structural units with Internet access, in%; employees with Internet access, in%; maximum contractual upload, download and maximum average upload and download speeds; structural units satisfied with the quality of the Internet connection, in%; Internet connection speed which does not provide the structural units with their needs (up to 30 Mb/sec; 30 to 100 Mbps; 100 to 500 Mbps; 500 Mbps to 1 Gbps; over 1 Gbps); structural units with a website, in %; structural units placing online orders, service catalogue, providing customisation, distributing information about other structural units, in%; structural units using social networks, using Wikipedia, using blogs, in %; share of interactions with citizens and businesses through electronic document management system, in %; structural units having their own applications, in %; share of structural units having EDM (e-document management), in %; share of structural units interacting with other administrations of other countries through EDM (e-document management), in %; share of structural units having ERP and CRM systems, in %; share of citizens and businesses using electronic public services, in%; share of officials with mobile communication and access to mobile phones, in%; share of domestic software, in %; reduction of paper used; reduction of energy consumption of ICT architecture; share of officials using electronic communications; structural units with remote access to email systems, in%; accessibility to citizens and businesses of all government systems, in %; staff with knowledge of ICT use, in%; structural units with cyber-attack protection systems, in %	
PMA based on the data	Structural units with cloud computing (for all government activities), in %; structural units integrated into a single database, in %; structural units with their own digital platform for data management, in %; problems with data access, in %; data chaos, in %; proportion of staff able to work with data collection and management tools, in %; structural units holding electronic accounts with automatic processing using AI tools, in %; share of open source software, in %; probability of cyber-attacks when using data, in %; structural units using biometric data, in %; structural units using VPN, in %	

Table 3 (continued)

Methodology in Australia [a]	
Fully digital PMA	Use of RFID by authorities, in % (including for identification of individuals, for production purposes, for product or service identification); organisational units analysing their own big data from IoT devices (including: geolocation data, social media data, data from devices with AI), in %; organisational units analysing their own big data with AI systems (including: social media data, data from other sources, data in natural language processing), in %; structural units using 3D printing in data analysis, in%; structural units using robots (including: for service needs; for surveillance and security; for transporting people and goods; for scavenging and refuse collection; for warehouse management; for assembly work; for construction), in %; organisational units using internet of things devices (including: smart lights, smart thermostats; smart meters; RFID or IP-based sensors; internet-controlled cameras; motion or maintenance sensors for vehicle tracking; sensors for monitoring or automating production processes; room security devices; other internet of things devices), in %; organisational units using AI (including: for speech; for identifying objects or persons; for machine learning; for process automation; for moving machines; for personnel management), in %
Methodology in the USA [e]	
Direction	**Indicators**
Telephony and broadband internet access and penetration estimates	Broadband penetration rate, in%; fixed network penetration rate, access speed, in %
Assessment of mobile internet penetration	Share of population able to use 3G, 4G, 5G mobile network, in %; network access speed
Assessment of electronic communications	Share of electronic communications in total for a certain type of activity, in %
Assessment of the digital divide	Share of male and female population with internet access, %; share of population of different age categories using the internet, %
Evaluating data flow	Share of organisational units with access to real-time data, in %; amount of data available for real-time processing, in %; share of data that can be processed by several organisational units, in%; share of digital platforms that can provide real-time data management; share of data available to citizens, in different directions
Assessment of the use of AI systems	Share of data processed and automated, in %; share of structural units using AI, in %; share of public services provided using AI, in %
Evaluating the use of internet of things devices	Number of IoT devices, pcs; share of operations performed to transform infrastructure using IoT devices; share of organisational units using the IoT, %
5G penetration assessment	Share of IoT devices running on 5G, in %; share of wireless network subscribers using 5G, in %; share of business units with access to 5G network, in%; share of AI solutions running on 5G, in %

Table 3 (continued)

Methodology in Australia [a]	
Satellite communication penetration assessment	Share of US territory covered by satellite communications, in%; share of business units using satellite communications, in %; share of operations performed via Internet of Things using satellite communications, in %; number of devices, systems using satellite communications, pcs.
Assessment of cloud computing and data centres	Number of data processing centres (DPCs), pcs.; share of business unit operations processed in DPCs, %
Assessment of blockchain technology	Share of business unit transactions processed using blockchain technology in databases, in %
DESI methodology [e] (EU)	
Direction	Characteristics of indicators
Assessment of human capital	Determination of the number and percentage of people with basic or specific digital skills in data management, communications, software issues; determination the number and percentage of people hired, graduates (including women and men), businesses providing training on digital economy tools
Communication assessment	Determination of the percentage of households with wired internet access up to 100 Mbit/s, in%; determination of the percentage of households with wired internet access from 100 Mbit/s, in%; determination of the percentage of 3G, 4G, 5G wireless coverage, in %; determination of the percentage of wired internet use and wireless penetration, in %
Assessment of digital inclusion	Determination of the share of electronic communications and processes, in %; determination of the share of information used as big data, in %; determination of the share of processes and actions processed by AI, in %; determination of the share of digital systems, devices, solutions that function for environmental sustainability, in %
Evaluation of digital public and municipal digital services	Share of civil servants participating in electronic communications, in %; share of electronic services for citizens and businesses, in %; share of government data generated using digital big data devices available to businesses and citizens, in %

Source: compiled by the authors.

Note: a — based on data of Australian Bureau of Statistics. URL: https://www.abs.gov.au/statistics; b– based on data of Digital government blueprint. URL: https://www.tech.gov.sg/files/media/corporate-publications/dgb-public-document_30dec20.pdf /; c — based on data of Statistics Estonia. URL: https://www.stat.ee/en /; d — based on data of Digital economy report 2021. United Nations. URL: https://unctad.org/system/files/official-document/der2021_en.pdf /; e — based on data of The Digital Economy and Society Index (DESI). European Commission. URL: https://digital-strategy.ec.europa.eu/en/policies/desi/.

economic indicator it is the leader in many aspects [17]. Due to the fact that the country does not have separate assessment areas, each indicator is correlated with a particular stage of digital transformation. Estonia has implemented aspects of the three stages of PMA digital transformation, as evidenced by the respective effects of each stage. The country has developed a digital ecosystem with a mechanism for data collection and transformation; the PMA digital transformation assessment methodology includes indicators for digital penetration and use of the internet of things for three-way

communication and assessment of AI systems and the degree of robotisation.

As a result of the second and third phases of digital transformation in Estonia:

• the "digID" smart card was introduced, allowing citizens and companies to integrate into the digital ecosystem of public services (where future services are improved on the basis of previous requests and their package is automatically generated). The card is used via smart devices and is projected to reach around 76% of the country's population by 2025, i.e., the proportion of citizens using an additional source of social security, all other things being equal, will be high [18]. The authorities, based on the mass use of certain services, the data of which are formed in a single digital space, modernise the mechanisms and specifics of providing further services.

• Digital devices in the state provide around 99% of the authorities' needs: around 20 vehicles are identified every day and around seven people are apprehended or detained by Interpol using video surveillance cameras, information from which is processed and transmitted to a single data centre using AI, and the total number of requests to security structures is around 20,000. This effect is achieved through the operation of IoT devices in the state's infrastructure [19].

• As a result of government investment (cumulative investment of around $ 3.5 billion between 2021 and 2027[9]) in the robotisation of the companies that produce goods from waste, the output increases by 3% annually without increasing costs and production expenses — the green economy is stimulated through digital transformation in the public interest.

These examples confirm that for Estonia, the PMA digital transformation assessment methodology with the second and third stage aspects is an effective tool for improving policy in this area. Qualitative improvement occurs by objectifying information on the penetration and the use of digital tools with an assessment of the results of the formation and functioning of the digital ecosystem.

The USA were chosen because they were among the first ones to implement a digital ecosystem with aspects of PMA Phase II and Phase III digital transformation. It was born and developed simultaneously with the growth of companies: Facebook, Amazon, Apple, Microsoft, and Alphabet, which developed and implemented the tools of digital transformation at the level of the whole state. Today, the authorities are direct participants in it [20]. In general, the third stage of PMA digital transformation is presented in the United States. This fact is confirmed by the presence in its methodology of indicators of the degree of data penetration, real-time aspects of data collection and transformation, the degree of implementation of the Internet of Things, AI systems and blockchain technology in the digital ecosystem of citizens, businesses, and governments.

Examples of the effectiveness of the third phase of PMA's digital transformation in the country include:

• Around 100 million US citizens were informed of vaccination points during the pandemic, based on geolocation data through Apple's services in the nation's digital ecosystem [21].

• Rhode Island has increased the number of simultaneous claims processed from 75 to 2,000 as a result of moving the unemployment insurance claim flow to the cloud computing infrastructure, which has accelerated the social security processes for the unemployed many times over [22].

These examples show that operating a digital ecosystem with aspects of the third phase of digital transformation provides PMA activities with relevant strategic advantages,

[9] Tree of Truth. URL: https://tamm.stat.ee

Table 4

Areas of accounting for improving the methodology for assessing digital maturity in Russian regions

Direction	Justification of expediency and specificity of indicators
Data flows	Evaluation of data flows generated by end-to-end digital technologies allows information to be accumulated, systematized and classified in a single digital source. Direction indicators should assess the proportion of data generated and accessible in real time in relation to all information flows in the digital environment
Penetration of end-to-end digital technologies for each type	In analysing the penetration of end-to-end digital technologies, the devices of the internet of things, AI systems, blockchain systems, cloud computing, etc. in the PMA system in shaping data flows should be taken into account. Indicators should assess the share of penetration and provision of needs by end-to-end digital technologies
Integration of individual digital systems in a single digital environment	The assessment includes the proportion of all state and municipal digital systems integrated in a single digital space, which the indicators should reflect

all else being equal, ensuring long-term success and efficiency of a social and economic nature.

In the European Union, the DESI methodology is applied, which is generalised and touches upon the basic indicators for assessing the digital transformation. Its peculiarity is to take into account the share of the use and implementation of big data and AI systems as end-to-end technologies that provide a mechanism for data processing in the second stage of PMA digital transformation, in particular in the direction of assessing the integration of digital public and municipal services. Despite the fact that the methodology is generalised, on the basis of the indicators presented in it, we can conclude that European countries have established a mechanism for collecting and transforming information through big data, which indicates the second stage of digital transformation of state and municipal administration with its positive social and economic effects.

It is worth noting that EU countries define internal methodologies individually, apart from the presented index. Such experience should be taken into account in domestic practice and as a result we should include the aspects related to the assessment of data flows and their penetration into information collection and handling mechanisms in the methodology for determining the digital maturity index of Russian regions.

Based on the analysis of various methods for assessing PMA digital transformation and the above success stories in this area, suggestions (*Table 4*) were formulated and substantiated on the areas to be considered in eliminating the mismatch between PMA digital transformation targets in Russian regions for the actual activities specified in 82 Digital Transformation Strategies,[10] whose implementation is planned in perspective until 2030.

When integrating the above areas of accounting into the methodology, the specifics of inconsistency in the digital transformation document formation process in Russia must be taken into account [23]. Registration of information flows is necessary to assess the

[10] Strategies for digital transformation. Ministry of Digital Development, Communications and Mass Media of the Russian Federation. URL: https://digital.gov.ru/ru/activity/directions/1064 (accessed on 17.02.2023).

performance of the real-time data collection mechanism in PMA, and understanding the degree of penetration of end-to-end digital technologies (Internet of Things, blockchain, AI), each of which is responsible for a specific process (data collection, analysis and transformation) in the digital environment, and makes it possible to assess it as a whole. The assessment of the formation of the digital macro environment is driven by the need to systematise and cluster information transformed into big data.

CONCLUSIONS

The analysis of PMA digital transformation assessment methodologies, life institutions, and the study of the experience of successful implementation of digital ecosystems with second- and third-stage aspects on the example of foreign states that are leaders in this area are related to the need to solve the problem of inconsistency between the PMA digital transformation target areas in Russian regions and the actual activities specified in the 82 Digital Transformation Strategies. It can be argued that the expediency of introducing the areas and aspects of consideration indicated in the article into the methodology for assessing the digital maturity of Russian regions is that this methodology is an important and serious tool for shaping effective policies in the field of PMA digital transformation. Objective quantitative information on non-compliance with the legislative requirements for building regional data management centres will become a catalyst for launching processes related to their relevant formation, and will enable amendments to be made to regional digital development measures. The creation of such centres, as elements of a digital regional ecosystem, will accelerate the transition to the second stage of PMA digital transformation and provide the constituent entity of the Russian Federation with strategic advantages in the creation and reproduction of social and economic benefits through digital transformation tools.

These transformations in the context of sanctions pressure will have a positive impact on the stimulating development of the regions and Russia as a whole.

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