Journal of Digital Science

ISSN 2686-8296

Volume 4 Issue 1 **June 2022**

CONTENTS

Some Features of Social Structures and Institutions Transformation in the Digital Age

Artem Balyakin[1][0000-0002-8655-7998],
Marina Nurbina[1][0000-0002-8063-9706], Sergey Taranenko[1]

[1] NRC Kurchatov Institute, Moscow, Russia

https://doi.org/10.33847/2686-8296.4.1_3

Received 13.03.2022/Revised 28.04.2022/Accepted 22.05.2022/Published 12.06.2022

Abstract. The paper examines the peculiarities of digitalization processes influence on the architecture of emerging socio-economic relations. The legal regulation issues of digital technologies and the shifts they cause in public life are considered. The relations arising in connection with the regulation of big data are compared. The evolution of big data into smart content is described. The phenomenon of the "digital twin" is considered, as well as its impact on the social sphere. The tendency to move away from the policy of direct prohibitions in the field of digital technologies and the transition to the control of physical entities (data centers) and the regulation of methods and approaches to data processing (algorithms) is shown. It is noted that the existing expectations from digitalization are overstated. At the same time, the increasing influence of digital technologies significantly changes the existing socio-economic landscape, generating new risks. The answer to these challenges should be the joint work of authorities, business, society and the expert community on the formation of digital culture. It is shown that an important aspect should be the development of expert systems that translate qualitative characteristics into quantitative indicators.

Keywords: Big data, legal regulation, artificial intelligence, digital twin, digitalization, social systems, transformation.

1. Introduction and Literature Review

Digitalization intrudes in all aspects of life, and the fundamental importance of these processes is recognized both by business, society, and authorities [1,2,3]. Digitalization processes are based on scientific and technical developments in the field of data processing (big data technologies, artificial intelligence, decision-making systems, etc.). In the short term, we can expect the formation of a global infrastructure, an important element of which is correctly collected, structured and purposefully processed information that allows making optimal (or seemingly so) management decisions [4,5,6,7].

The most important elements of digitalization are, first of all, big data technologies and elements of artificial intelligence technology as a fundamental guarantee of the possibility of processing big data, as well as artificial intelligence in general as a decision-making tool, also based on "big data".

The downside of an excessive amount of information is the problem of sorting and choosing optimal solutions. One of the approaches being implemented is expert systems that translate qualitative characteristics into quantitative parameters. In particular, the methods of interviewing experts and forming a matrix of mutual influence [8,9] are increasingly being used in mathematical modeling of socio–economic processes [10].

Crucial point the authors stand for is the understanding that social and economic structures change constantly under the influence of digital technologies. That leads to the perception of non—neutrality of such technologies for the foresight purposes, both

theoretical-economic and societal. We stress that making a forecast without taking into account the processes and effects described below (following only the previously drawn trends) is erroneous.

Technically, the concept of "Big Data" aggregates a large number of different technologies that are actively used in all spheres of life, related to various fields of activity and, according to some viewpoint do not have signs of innovation [1]. Thus, the main criterion for referring to "big data" was the volume of processed information, "the size of which exceeds the capabilities of typical databases for entering, storing, managing and analyzing information" [3], and "big data" was defined by indicating the following main characteristics: volume, velocity and variety - the so-called 3 Vs [8].

Gradually, the definition of big data began to get rid of the restrictions focused on the current capabilities of machine information processing, and the focus moved to methods and approaches to processing primary and secondary data. The authors of [12] share the position that big data technologies are a complex phenomenon that involves both the development of technical solutions and understanding the humanitarian aspects of high technologies.

In our opinion, it is the humanitarian component of big data technology and the AI associated with it that is a perilous challenge generated by technological development. The risk of deceptive, false progress, when social changes caused by technological development must be considered as a regression, is a fact of our life. It is enough to mention the phenomenon of uberization, which consists in the fact that primitive social practices are revived through the most advanced technologies, returning the social fabric of society to primitive forms [13,14].

Thus, the importance of taking into account the social dimension of digital technologies is obvious: from the methods and approaches used, to the consequences of the practical implementation of digitalization achievements [14,15,16].

2. Obtained results

It is noteworthy that the term "big data" has not yet received an unambiguous legal definition in any of the world's jurisdictions. From a legal perspective, big data is currently not a legal term, but rather a description of a phenomenon that has many different implications for disciplines such as economics, engineering, legal sciences, and social sciences [1]. This circumstance is direct evidence of an incomplete understanding of the phenomenon of "big data" in changing societal and economic structures. In order to understand this role, in our opinion, it is necessary to trace a number of moments of the genesis and dynamics, including transformational dynamics, of this phenomenon. At the same time, it is immediately necessary to emphasize the symbiotic nature of the relationship between big data and artificial intelligence (AI) since the emergence of the “big data” category [16,17].

Currently, in relation to the symbiotic relationship of big data and individual AI technologies, the process of "data intellectualization", called the phenomenon of smart content, is intensifying. In our opinion, smart content is primary and secondary data of one or several subject areas processed and structured in a certain way based on big data technologies that are adequately interpreted with the help of intellectual procedures immanent to the subject area despite their immensity and irremediable heterogeneity [18]. Hereafter we note a number of characteristic features of this process, both allowing us to interpret data as smart, distinguishing them from mere data, and forcing us to consider smart content as a differently functioning object than “pure” data. Main characters of turning big data into smart content are illustrated in the Fig. 1.

Firstly, the impetus for the development of the technology of smart content was the technology of intelligent networks (i.e. smart grids), within which, by combining

heterogeneous data, building a complex of hierarchies, connections, potential completeness based on interpretation belonging to one or another notable area or several subject areas, a qualitative transition from "data" to "knowledge" was carried out.

At the same time, here the term "knowledge" must be understood in a different sense than in the term "human knowledge". Rather, it is a knowledge environment in which there is a part of the systemic connections that we interpret as "understanding". But this does not mean understanding as such, understanding immanent in the knowledge environment itself, the presence of a built-in "understanding" or any other equivalent of qualia. Understanding, as before, is an integral part of the human. Unfortunately, in recent times, in connection with the hopes for the expected (super)power of AI, such an approach is obscured. Thus, there is an expected, and due to expectations - imposed, change in the role of a person, including in the field of decision-making: production, economic, and others. The theoretical and economic "rational person" (despite all its controversy) is replaced by "a person with a rational decision-making system", and this rationality is external in relation to the person.

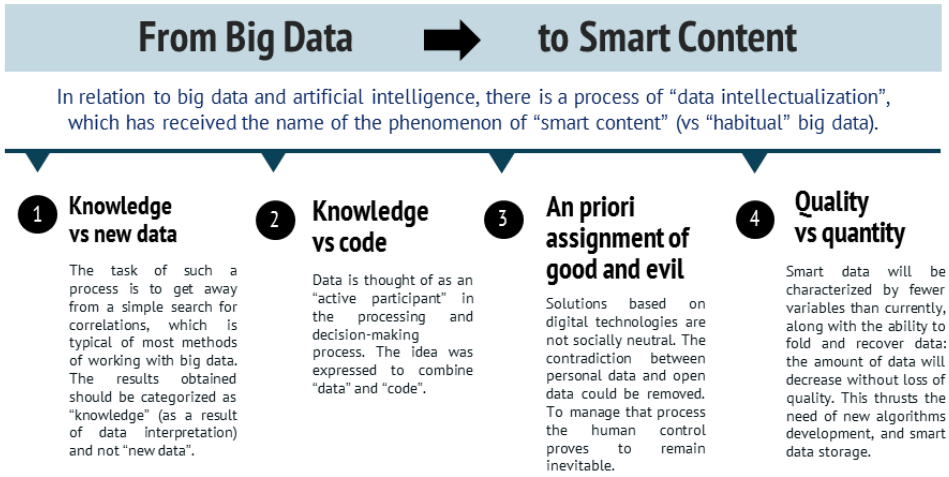

Fig. 1. The evolution of big data to smart content with main traits.
Source: original authors' design.

Secondly, the flow of big data and metadata from their previously inherent environments to others, in particular to technological environments and jurisdictions with the most convenient management protocols, has intensified. Data "behaves" in a reasonable way, giving "preferences" to get accumulated where it is "convenient" to get stored. In practical terms, there is an auto-accelerating concentration of big data in the form of "blue oceans" - isolated territories with their own rules. We note that such behavior is similar to memes [19].

Here, as part of the construction of predictive models, we must take into account two effects that lead to the differentiation of spatial, technological and cultural zones. The first one is significant for zones outside the "blue oceans", and it can be conditionally called the emasculation effect. The concentration of knowledge in some spaces is a source of possible changes in the qualities and role of other territorial and social spaces that are alienated from the "territory of knowledge".

The second characteristic of "oceans" is the potential presence of different routines and rules for handling data, including interpretative rules that separate "oceans" from each other. Knowledge potentially ceases to be an external effect, useful and applicable for everyone, if not equally, then to some significant extent, loses the universality of both access and meaning. Both can be an additional basis for the fragmentation of the World, or at least the presence of zones subject to independent analysis within a potentially unified forecasting system. In other words, the complexity of the predictive model increases inevitably.

Thirdly, not only the data itself, but also the algorithms that accompany this data and make it "smart", grow and begin to live their own lives and determine the evolution of the systems that they are destined to analyze. In science, the implementation of this approach is the FAIR principle (Findable, Accessible, Interoperable, Reusable) [20].

This is true both in terms of algorithms for interpreting data, when the evolution of meaning is determined not only by the evolution of data, but also by the evolution of algorithms, and in terms of algorithms for accessing data, their applicability or prohibition thereof [21].

In particular, in this regard, there is a problem of potential algorithmic unfairness, when approaches a priori embedded in algorithms evolve over time towards tightening and strengthening existing inequalities or begin to participate in decision-making [22].

The effect of algorithmic injustice, in our opinion, should be understood more broadly. In predictive models, we will be forced to abandon solutions focused on human behavior and the properties of human society that we understand (be it a model of rational behavior, the results of a social survey of the population, etc.) and derive the results (forming the picture of the future) from the dynamics of decision-making systems that we poorly comprehend [23,24].

Fourth, the process of "socialization" of data becomes obvious, meaning that with the growth of computing power and progress in analytics, there will happen a loss of meaning in the concept of "data protection", and access to information is going to be considered as one of "natural" rights [3].

Meanwhile, the potential general lack of data control, in our opinion, is a serious social challenge that requires its solution. For authorities, the process described above means a gradual transition from control over data to the grip over the means of storing, processing and transmitting information (for example, through a localization policy). At the same time, and in opposition to these potential limitations, a supranational big data circulation environment is emerging, one example of which is AIPO (OECD AI Policy Observatory), a comprehensive analytical platform for policy review and various national initiatives in the field of artificial intelligence.

The shift in the emphasis of state control over the key economic resource of our time, data and knowledge, its role in the construction of predictive systems requires its own understanding. The question whether the change in the flow of "data" will lead to a change in the dynamics of the flows of "knowledge" and, subsequently, to a change in the global structure of the quality of human capital remains open.

Continuing the list of features of the process of symbiotic interpenetration of big data and AI to be analyzed in the construction of predictive systems, one cannot but touch upon the issue of changing the quality of data in the technical, functional, as well as social areas.

Thus, fifthly, from the “technical” side, smart content will become “smaller”, more compact, not only without loss of quality, but also with the acquisition of additional

characteristic properties. Issues of coherence, consistency and completeness of information will be addressed simultaneously with issues of compactness (density reduction). This involves the development of data convolution and recovery algorithms, primarily based on AI technologies. However, the problematic of convolution is at the same time the problematic of separating the essential from the non-essential, and therefore depends on the interpretation that we supposedly entrusted to AI. Taking into account this risk, it should be noted that the "convolution" also changes the dynamics and mobility of "knowledge" obtained through big data, the possibility of its operational application, which, presumably, can affect a variety of social and production processes and technologies, in including in terms of the width of the geographical and social coverage.

Confirming what has been said, sixth, big data, being AI-processed, becomes "useful", turning from "information" into "knowledge". This approach involves transferring the experience of working with big data available in the field of scientific research, where they are a priori selected according to specified algorithms within specific models, to other economic and social environments, including the business environment.

And in addition to changing social and technological practices, we should expect the emergence of fundamentally new ones. This is probably the most difficult moment to take into account in predictive models.

Seventh, the fundamental importance of the social and institutional role assumed by big data should be emphasized. There is no uniform understanding of what moral and ethical imperatives should underlie the evolution of big data. There is an agreement on the non-neutrality of digital technologies and the need for their "adjustment" in the direction necessary for society [22,25].

Such a possible adjustment is itself the subject of the forecast, the result of predictive models. Thus, we have a potential deadlock when building a predictive model and building a picture of the future. Avoiding this loop requires a prior understanding of the impact of digital technologies, at least at the scenario level.

For example, by now there is a scenario with probable danger of digital dictatorship and the system of new globalism [25]. A possible way to avoid this threat – and this is an alternative scenario – is to transfer key information to open data mode. The beginning of such a regime can be seen in such a concept as "open science". Within this approach, the idea of exemption from any restrictive legal regimes prevails, which some analysts describe as "nobody's data" [3,4].

At the same time, this decision can fairly be considered as a palliative, which does not solve the issue of moral and ethical imperatives underlying big data and AI, and which can become the basis for other scenario forks to be taken into account by predictive systems.

The foundation of the base scenario, within which it is possible and necessary to build predictive systems, according to the authors, should be based on the following assumptions. It can be taken for granted that in the nearest future, in practical terms, information ("data") will be produced from data lakes, understood as "nobody's data", using computing power and specialized methods and algorithms. According to the authors, the state policy in the field of digital technologies will be based on the logic of regulation of those entities over which physical control is possible. This raises the question of abandoning prohibitions that are not implemented in practice and focusing on the mandatory localization of processing centers with the possibility of providing their services to external customers.

A significant role will be played by the problems of ethical assessment of the big data and AI technologies usage, which will affect not only the dynamics of the relevant technologies, but also significantly impact their quality [22,26,27].

Research papers deal mostly with technical issues of data processing. The socio-economic aspects of high technologies are neglected or under-estimated, discussed fragmentarily and, for the most part, are considered as dependent, continuing the already developed trends (thus not changing the socio-economic landscape).

For instance, the author of [28] gives big data technology a "humanitarian connotation", proposing to adopt the concept of cultural and social capital developed by P. Bourdieu in relation to big data.

General philosophical issues of responsibility are considered, for example, in [29,30]. These authors proceed from the fact that algorithms silently structure our lives, removing responsibility from the actor, including the official, "impersonalizing" decisions. Instead of reliability and objectivity in relation to other uncertain procedures, the susceptibility of algorithmic models to human bias increases [29]. The way out seems to be both testing of algorithmic models used in practice [30], and the growth of "internal responsibility", increasing the involvement of employees developing algorithms and imposing ethical responsibility on them for the solutions being developed [30]. This approach looks controversial, if only because it does not mention the responsibility of the "customer" who sets the terms of reference. As a rule, this is the authorities [31], which, depending on its goals and objectives, implements different approaches (and, as a result, demonstrates the demand for different algorithms).

Despite the obvious fragmentation of socio-economic ideas in the ethical component, which is also poorly developed, in practical terms, we can talk about the formation of different ethical models.

Nowadays three main model approaches to ethical problems in general can be distinguished: an anthropocentric approach, characteristic of the EU; orientation to commercial interests (typical of the USA); the idea of the common good according to Confucius in the PRC (Fig. 2). So, in the EU, algorithms are divided into three categories: permitted, prohibited and partially permitted. There are no restrictions on algorithms in the USA, but the results obtained are regularly checked for compliance with socially approved norms, including gender aspects, issues of discrimination of social groups, etc. This position leads to an absurd situation when the results in a number of scientific fields turned out to be dependent on the prevailing socio-political discourse [22].

As a result of such a diversity of approaches, the created digital technology management systems are focused on and support different values and, in fact, create different digital worlds (divided into filter bubbles) with various related technologies, including AI [32]. So, in predictive models, it is necessary to take into account both points: firstly, the multi-variance of technological, including socially conditioned, development; secondly, different value orientations [27].

It should be noted that the novelty of emerging challenges is apparent [24]: this has already taken place in human history. Thus, it is enough to mention the value differences of different cultures, primarily marked by confessional differences. What is new at the present time is that the space, which we previously considered homogeneous, will not be same in the future. Moreover, the existing political tensions only contribute to the growing divergence between the main actors: filter bubbles receive legislative support. For example, according to the Chinese program for the

development of science and technology, the methods and approaches being introduced, the scientific ethics used should be "Chinese" ethics [33].

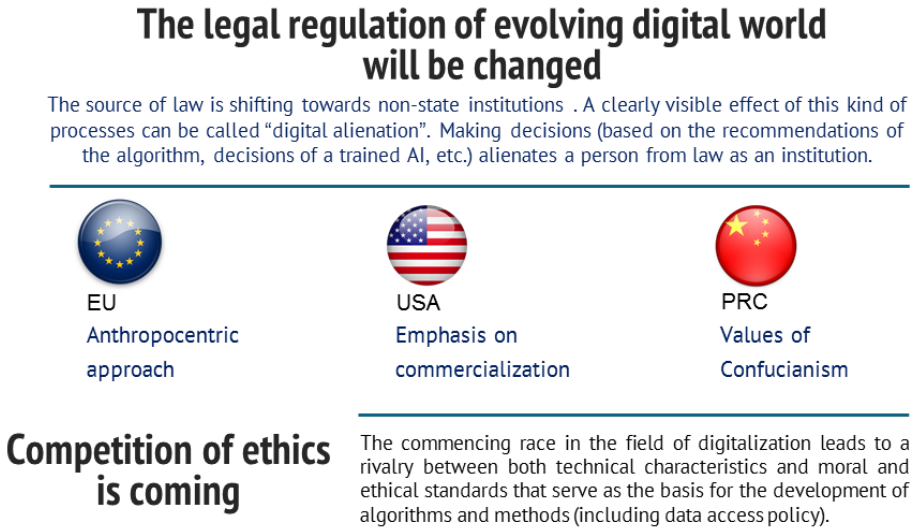

Fig. 2. Approaches to legal regulation of big data in main World jurisdictions. Source: original authors' design.

This, as previously stated, is a serious argument in favor of the hypothesis of the digital defragmentation of the world, despite the persistent idea that the "digit" leads to the unification, globalization of all societal processes. Also social and technological changes generated by the phenomenon of big data can and should find their imprint in a fixing social institution, the institution of law.

These features of the development of digital technologies lead to the fact that within the framework of these processes a new law can and should be formed as a fundamental social institution of boundary conditions and potential development opportunities, which is of fundamental importance in forecasting constructions. It should be emphasized that this new law is based on the phenomena of digital reality, which in modern times did not have a decisive value or are considered as non-legal.

In terms of the analysis of the institution of law, the following can be said.

The large-scale use of the results of scientific research leads to the formation of a new complex branch of law - the law of science. This is a special area of knowledge, located in the system of the humanities, but comprehensively and inextricably linked with the legal regulation of scientific research [34].

Legal relations in the field of science, solving specific, but new tasks characteristic of science, contributed to the formation of fundamental law. Thus, in the field of scientific research, and characteristic of recent international cooperation and co-financing, the need to share risks and rights to the results of work, it is much easier for participants to agree on the conditions for participation and work at the beginning of the project [34].

The source of law is shifting towards non-governmental institutions. A well-marked effect of such processes can be called "digital alienation" as a new manifestation of alienation proposed by late Marxism [18,28].

In general, big data, as a mature phenomenon, is now a necessary component in making responsible decisions both at the large companies and at the government level [28]. But at the same time, decision-making based on the recommendations of an algorithm, decisions of a trained AI, etc. alienates a person from law as a social

institution, replacing the latter with the ideas of a generalized "programmer" ("coder"), including AI. Reliance on a "computer solution" as an explanatory factor of denial and/or acceptance is a common feature of our time [22]. Thus, there is a transition to a new, "impersonal" form of regulation, tied to algorithmic approaches.

The second aspect of law deformation is associated with a change in the nature of production processes. Degradation processes of different genesis are taking place within the digital economy [5,27]. Thus, there is a displacement effect when market players use digital technologies to circumvent existing laws, working conditions and fiscal systems. There is a real danger of uncontrolled development and unethical use of technologies, and it is still unclear how to avoid this [35].

Another genesis of possible deformations is a shift justified by the development of digital business, which requires the removal of previously existing institutional barriers, which today have become an obstacle to the introduction and use of digital technologies. Here we should expect the legalization of the institution of "corporate law", dictated by corporate interests and aimed at everyone who has relations with the corporation [36].

Concluding from above mentioned, we should also expect the effect of law fragmentation: the law will be different in different parts (by geographical, technological or sectorial characteristics). In general, there is an acceleration of the process of shifting the law from the model of "rules" to the model of "operational management", or, as emphasized, the seigniorate, which is a prerequisite for possible deep social transformations [13,36]. Moreover, the concept of "seigniorate" ceases to be exclusively geographical. In various sectors of human activity, primarily economic, the simultaneous existence of independent "seignorates" is possible.

Thus, in addition to the "knowledge" fragmentation described above, we also assume a possible legal defragmentation of society occurring parallely.

The economic order as part of the development of big data and AI technologies, taking into account what has already been described, will undergo a number of changes. Drivers of economic changes are, in particular, innovations. So, in addition to changing regulatory mechanisms, the development of digitalization is associated with a number of innovative solutions [5,24]. Thus, one of the ways to improve efficiency is the active introduction of methods and approaches of computer modeling. It is assumed that advances in the field of data processing, in the field of artificial intelligence will make it possible to transfer the identification of "real" problems to the virtual world, testing systems in it, analyzing them and working out decision-making strategies [2,37,38]. In the future, digital platforms are expected to come into use, while gradually adjusting into digital ecosystems (in order to consolidate all participants in the value creation process) [39].

Among such "modelling" approaches is the phenomenon of "digital twins", which is understood as "the real display of all components of the product life cycle using physical data, virtual data and data of interaction between them" [40]. The choice of digital twins as an object of research is fundamentally important for understanding the nature of the digital economy: we are not following a phenomenon, but are inclined to its copy or model.

According to 2019 estimates, three-quarters of the surveyed companies plan to use digital twins in the near future (e.g., a Gartner survey shows that digital twins are becoming mainstream [41]). The annual growth of the digital twin market from 2020 to 2026 is predicted to reach 58% [42].

The digital twin in science opens up the possibility of access to a unique scientific facility for a wide range of users and enhances the educational component [43,44]. In particular, in Russia, in order to support the operation of the world-class International Center for Neutron Research reactor, a new course "Methods based on synchrotron radiation in interdisciplinary research" is being developed using digital twin technologies of unique research equipment. The existing mega-installations, such

as the European X-ray Free Electron Laser (XFEL, Hamburg, Germany) and the Synchrotron Center of the National Research Center of the Kurchatov Institute (Moscow) will be used as a background [44].

Thus, the formation of the phenomenon of the "digital twin" can be considered to have taken place. According to the authors, it is premature to talk about its role from the point of view of the forecast, in addition to the above. This is a potential black swan. The digital twin, as well as the digital footprint (copy of an entity) is not the object under consideration, and, therefore, it leaves the possibility of misinterpretation. At the same time, the results (data) produced by them are attributed to a real object, which hypothetically leads to an incorrect interpretation. Solutions that look obvious when they are developed are likely to produce unplanned results and errors when launched in real life. As an example, we can cite various legal conflicts accompanying UAVs and automatic systems in medicine and transport [46]. For today, the possible effect of an error (substitution model and a real-life object to draw a conclusion) of a digital twin has not been described. Thus, the predictive value of this phenomenon is yet unknown.

Another significant innovative solution is the reuse of data in order to obtain new knowledge from them. This approach is based on the FAIR principles [44]. Similar processes are already being observed in the social sphere, when a person's "digital footprint" is being formed, and used for targeted advertising, risk assessment of reoffending or for the formation of an individual educational trajectory. Unlike physical systems, in this case, the question of the fullness of "data lakes" (initial unstructured arrays of information) inevitably arises. In order to ensure their uniform filling, the simplest method seems to be the introduction of forced formation of a digital footprint. That, remaining within the framework of moral and ethical assessments of modernity, should be considered as a serious challenge.

The implementation of this approach has become possible due to significant progress in the creation of storage systems and remote access to lakes and databases, as well as a significant reduction in the cost of information transfer and storage procedures. Note that in this case, the problem of interpreting the results, developing algorithms or models becomes secondary (postponed "for later"), and the most important tasks are recording, storing and providing remote access. This approach provides a link between the model and the algorithm with the real world (experimental data). It is essential that it is implemented only in the case of systems where redundancy of experimental data is possible. This situation is typical for high-energy physics and astronomy, but raises doubts about socio-economic systems. The reason for this is the variability of quantitative characteristics and the lack of an unambiguous transition of qualitative indicators into quantitative ones (including due to moral and ethical assessments external to the study).

4. Conclusion

Our study allows us to formulate a number of conclusions.

Firstly, the digital economy, AI technologies, big data, etc. have not yet become a fundamentally new area; they highlight pre-existing trends, challenges and risks. The perception of them as a revolutionary new tool is erroneous; they are only a technical way of solving current problems [6,24].

Secondly, there is currently a process of data accumulation, uncontrolled growth of information, methods, approaches, etc. Critical reflection on the impact of emerging data lakes is the next step in the development of the digital economy. This process should be accompanied by the formation of data processing standards, which will ultimately allow us to talk about the emergence of a new institution of digital technologies, an integral part of which will be “smart content”.

Thirdly, the development of digitalization reflects another manifestation of globalization. In this regard, control over individuals (for example, the policy of localizing data centers in Russia) can serve as a deterrent to prevent the flow of "data lakes" to countries with different legal and political conditions for using such data.

Fourth, the policy of prohibitions and restrictions seems to be the simplest solution to the problems that arise, but this approach proves to be not effective. It is necessary to look for other methods and approaches to regulation, including a clear ethical framework for interaction with digital technologies. In practice, a new culture of the digital society must emerge. In the current conditions of science, technology and, above all, ethics, a universal artificial intelligence (equally strong in all areas and equally responsive to the same inputs) is impossible. In a pessimistic future scenario, decision-making systems will be based on implicit algorithms that exist in non-overlapping realities (filter bubbles) [25,32].

Fifth, such a phenomenon as a "digital twin" is becoming increasingly widespread. This means both a universal model of a real system and a set of technological solutions. In the social and educational sphere, a digital double is often understood as a digital footprint.

Sixth, there is an increase in personalization processes: from medicine to education. The combination of data (primarily digital footprint), algorithms and robotic production makes it possible to make a unique product for any need at a mass price [17]. This is expressed, among other things, in the personalization of artificial intelligence: in the EU, in May 2019, the AI-on-demand platform was launched, within which 6 artificial intelligence projects are being implemented [46].

Awareness of the described processes is not enough to overcome the challenges posed by digitalization. There should be an understanding at the imperative level that society, society (represented by the state) establishes rules and norms for business as a social institution, and not vice versa. That is why it becomes socially necessary to form a well-thought-out and effective regulatory system through the law of the relationship between man, science, the state, society and nature.

The next stage in understanding the processes of digitalization should be the study of possible socio-economic changes in society caused by the reformatting of ethical norms, and the formulation of proposals to curb negative trends in line with the primacy of social and humanitarian challenges [13,25,28]. In this regard, the authors actively support the idea of developing a set of international ethical principles for the use of advanced digital technologies. We believe that such a set of rules can be based on the Report on the Ethics of Robots, artificial intelligence and Algorithms of the UNESCO World Commission on the Ethics of Scientific Knowledge and Technology (signed in Paris on September 14, 2017).

The importance of studying the ethical aspects of AI is related to the limitations they produce [26]. The most alarming situation is in the case of codification of moral and ethical rules. A striking example is the GDPR (General Data Protection Regulation), which, according to experts, hinders scientific progress in Europe. As of 2019, more than 5,000 projects were affected by the restrictions prescribed in the GDPR, primarily in the field of personal information control [47,48]. Currently, discussions have been initiated on how to respond to this challenge. One of the options proposed during these discussions, shared by the authors, is the focus on improving the overall digital culture. The authorities actively interfere in this process: for example, in 2015-2020, 117 approaches in the field of ethics and morality were developed, of which 91 were in the EU and the USA [49]; China and Russia are following suit.

In general, the ongoing introduction of digital technologies carries a number of risks, dramatically changing social practices. It is required both to clearly articulate emerging challenges and develop responses to them, using both the arsenal of engineering sciences and applying the methods of the humanities and social sciences.

One of the possible solutions should be the active use of expert systems, laying the ethical component in the developed elements of the digital system and translating qualitative characteristics into quantitative indicators. Schematically the approach to digitalization the authors support and promote is presented in the Fig. 3. To our viewpoint, each component is important, and none can be neglected. Only joint efforts of society, business community, and authorities would lead to successful development and further implementation of digital technologies.

Fig. 3. The digitalization process (authors' design).

The figure reflects the importance of data (as a source), experts' system and scientific facilities (as a tool), and society in total (as a beneficiary of progress in digital technologies).

Acknowledgments

This work was supported by RFBR grant № 20-010-00576.
Authors thank Zhulego V.G. for useful discussions.

References

1. Walker, M., Burton, B.: Hype Cycle for Emerging Technologies (2015), https://www.gartner.com/en/documents/3100227, last accessed 2022/03/31.
2. Gartner Top 10 Strategic Technology Trends For 2020, https://www.gartner.com/smarterwithgartner/gartner-top-10-strategic-technology-trends-for-2020/, last accessed 2022/02/21.
3. Manuka, J., Chui, M., Brown, B., Bughin, J., Hobbs, R., Roxburgh, C., Byers, A.: Big data: The next frontier for innovation, competition, and productivity / McKinsey Global Institute (2011).
4. Measuring the Digital Transformation: A Roadmap for the Future (2019), https://www.oecd.org/publications/measuring-the-digital-transformation-9789264311992-en.htm, last accessed 2022/03/31.
5. Melnik, M., Antipova, T. (2020) Organizational Aspects of Digital Economics Management. In: ICIS 2019. Lecture Notes in Networks and Systems, vol 78, pp. 148-162. Springer, Cham. https://doi.org/10.1007/978-3-030-22493-6_14.

6. Ross, G., Antipova, T., Konyavsky, V. (2022) Methodology for Innovative Projects' Financing in IT Business. Lecture Notes in Networks and Systems, 381, pp. 257–268. https://doi.org/10.1007/978-3-030-93677-8_22.
7. Nurakhov N.N. (2020) The Basic Processes of Creating a Megascience Project. Lecture Notes in Networks and Systems, 78, pp. 329-339. https://doi.org/10.1007/978-3-030-22493-6_29.
8. Saaty, T.L.: Decision making with dependence and feedback: The Analytic Network Process. Pittsburgh: RWS Publications (1996).
9. Saaty, T.L. (2008) The Analytic Hierarchy and Analytic Network measurement processes: Applications to decisions under risk / European Journal of Pure and Applied Mathematics, 1(1), pp. 122-196.
10. Balyakin A.A., Domnich A.S., Zhulego V.G., Taranenko S.B. Designing the Future: Nonlinear Dynamics in Economic Models. Integral Scientific and Practical Interindustry Journal. 2011. No. 1 (57), pp. 33-35.
11. Lynch, C.: Big data: How do your data grow? Nature, 455, 28-29 (2008).
12. Mayer-Schönberger, V., Cukier, K.: Big Data: A Revolution That Will Transform How We Live, Work, and Think. Moscow: Mann, Ivanov & Ferber (2014).
13. Balyakin, A.A., Nurbina, M.V., Taranenko, S.B. (2021) Ethics in Big Data: Myth or Reality. In: Á. Rocha et al. (eds.) Information Technology and Systems, AISC 1330, pp. 14–22.
14. A. Pentland Social Physics: How Social Networks Can Make Us Smarter. Penguin Books. 2015
15. Cathy O'Neil Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy Crown, 2016
16. Ivanov V.V., Malinetskii G.G. Contours of digital reality. Humanitarian technological revolution and the choice of the future. Lenand, Moscow, 2018, 344 p.
17. Kai-Fu Lee, AI Superpowers: China, Silicon Valley, and the New World Order, Boston, Mass, 2018
18. Balyakin, A.A., Nurbina, M.V., Taranenko, S.B. (2021) Some Current Aspects of Big Data Evolution. In T. Antipova (Ed.). ICADS 2021, AISC 1352, pp. 444–450. https://doi.org/10.1007/978-3-030-71782-7_39.
19. Dawkins, Richard: The Extended Phenotype, Oxford University Press, p. 109 (1982).
20. FAIR Principles, https://www.go-fair.org/fair-principles/, last accessed 2022/05/13.
21. Balyakin, A.A., Malyshev, A.S.: Big data management in research infrastructures. In: Open Systems. DBMS. 2020(3), pp. 40-42. Moscow (2020).
22. Birhane, A.: Algorithmic injustice: a relational ethics approach. Perspective, Patterns 2, vol. 2(2), 100205, February 12 (2021).
23. Griffy-Brown C., Chun M., Miller H., Lazarikos D. How Do We Optimize Risk in Enterprise Architecture when Deploying Emerging Technologies? J. Digit. Sci. **3**(1), 3 – 13 (2021). https://doi.org/10.33847/2686-8296.3.1_1.
24. Balyakin A.A., Malyshev A.S., Nurbina M.V., Titov M.A. (2020) Big Data: Nil Novo Sub Luna. In: ICIS 2019. Lecture Notes in Networks and Systems, vol 78, pp. 364-373. Springer, Cham. https://doi.org/10.1007/978-3-030-22493-6_32.
25. Harari, Y.N: 21 Lessons for the 21st Century. p. 416, Vintage Digital (2018).
26. Ustinova, Y. (2021) The true and fair view concept: the palette of controversial points (of «worth banning» to «worth keeping»). J. Digit. Art Humanit., **2**(1), 39-47. https://doi.org/10.33847/2712-8148.2.1_4.
27. Balyakin, A.A., 1, Taranenko, S.B., Nurbina, M.V., Titov, M.A. Social Aspects of Big Data Technology Implementation. J. Digit. Sci., **1**(1), 15-24 (2019). https://doi.org/10.33847/2686-8296.1.1_2.
28. Sadowski, J.: When data is capital: Datafication, accumulation, and extraction. Research Article, 6(1), 1-12 (2019).
29. Kemper, J., Kolkman, D.: Transparent to whom? No algorithmic accountability without a critical audience. Information, Communication & Society, 2081-2096 (2018).
30. Kirsten, M.: Ethical Implications and Accountability of Algorithms. Journal of Business Ethics, 160(4), 835–850 (2019).
31. Engin, Z., Treleaven, Ph. (2019). Algorithmic Government: Automating Public Services and Supporting Civil Servants in using Data Science Technologies. The Computer Journal, 62(3), pp. 448–460.
32. Pariser, E.: The Filter Bubble: What the Internet Is Hiding from You. New York: Penguin Press. (2011).
33. Viewpoint: China risks damaging science ties by forging own path on research ethics. https://sciencebusiness.net/news/viewpoint-china-risks-damaging-science-ties-forging-own-path-research-ethics, last accessed 2021/09/23.

34. Chetverikov, A.O. (2018). Organizatsionno-pravovye formy bolshoy nauki (megasayens) v usloviyakh mezhdunarodnoy integratsii: sravnitelnoe issledovanie. Legal forms of big science (megascience) in the context of. Legal science, 1 (1), 13-27; 2 (2), 34-50.
35. Von Weizsaecker, E., Wijkman, A.: Come On! Capitalism, Short-termism, Population and the Destruction of the Planet. Springer Science+Business Media LLC. (2018).
36. Balyakin, A.A., Nurbina, M.V., Taranenko, S.B. (2020) Comparative legal features of the formation of a digital ecosystem. Int. Legal Courier 1–2(37–38), 42–45.
37. The decree of the President of the Russian Federation. About the strategy for the development of the information society in the Russian Federation for 2017-2030. No. 203, 09.05.2017
38. Order of the Government of the Russian Federation of July 28, 2017 No. 1632-r Program "Digital Economy of the Russian Federation", http://static.government.ru/media/files/9gFM4FHj4PsB79I5v7yLVuPgu4bvR7M0.pdf, last accessed 2022/02/02.
39. URL: https://e-cis.info/news/568/82077/, last accessed 2019/05/20.
40. Fei Tao et al. (2018). Digital twin-driven product design framework. International Journal of Production Research, 57(12), pp. 3935–3953.
41. Gartner Survey Reveals Digital Twins Are Entering Mainstream Use (2019) / Gartner. https://www.gartner.com/en/newsroom/press-releases/2019-02-20-gartner-survey-reveals-digital-twins-areentering-mai, last accessed 2019/03/31.
42. Digital Twin Market by Technology, Type (Product, Process, and System), Application (predictive maintenance, and others), Industry (Aerospace & Defense, Automotive & Transportation, Healthcare, and others), and Geography - Global Forecast to 2026. (2020), https://www.marketsandmarkets.com/Market-Reports/digital-twin-market-225269522.html, last accessed 2020/05/13.
43. Singh, M., Fuenmayor, E., Hinchy, E.P., Qiao, Y., Murray, N., Devine, D.: Digital Twin: Origin to Future. Appl. Syst. Innov, 4, 36 (2021).
44. Balyakin, A.A., Nurakhov, N.N., Nurbina M.V. (2021). Digital Twins vs Digital Trace in Megascience Projects. In Á. Rocha et al. (Eds.). ICITS 2021, AISC 1330, pp. 534–539.
45. Crease, R.P., Westfall, C.: The New Big Science Physics Today, 69 (5), pp. 30-36 (2016).
46. URL: https://digital-strategy.ec.europa.eu/en/news/new-projects-enrich-ai-demand-platform, last accessed 2022/03/31.
47. URL: https://www.feam.eu/wp-content/uploads/International-Health-Data-Transfer_2021_web.pdf, last accessed 2021/10/10.
48. URL: https://sciencebusiness.net/news/data-protections-rules-harming-eu-leadership-health-research-says-report, last accessed 2022/05/22.
49. URL: https://sciencebusiness.net/news/time-harmonise-artificial-intelligence-principles-experts-say, last accessed 2022/03/10.

Aims and Objectives

Published online by ICS two times a year, Journal of Digital Science (JDS) is an international peer-reviewed journal which aims at the latest ideas, innovations, trends, experiences and concerns in the field of digital science covering all areas of the scholarly literature of the sciences, social sciences and arts & humanities. The main topics currently covered include: Artificial Intelligence Research; Digital Economics, Education, Engineering, Finance, Health Care.

The main goal of the journal is the effective dissemination of original incites/results generated by the human brain and presented/reflected in articles using modern information/digital technology.

Contact information

Website: https://ics.events

Email: conf@ics.events