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The role of blockchain technologies in the social practices of contemporary science: a theoretical and methodological analysis

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Problem statement[1]

Blockchain technology (or, as it is technically more accurately called, DLT, digital ledger technologies[2]) has moved beyond niche and experimental developments, and gained global significance in the mid-2010s[3]. Blockchain is essentially a set of blocks of data connected by cryptographic tools in such a way as to make it impossible to change the contents of one block without changing the rest. In a DLT registry, information is stored in a network of decentralized nodes, and all recorded transactions are transparent to each member of the network. This approach to data processing (decentralized and distributed) prevents retroactive modification of data (e.g., for fraudulent purposes).

In fact, blockchain relies on a consensus mechanism to ensure the accuracy of transactions without the need to trust the actions of network members[4]. Blockchain allows the verification of the status of any kind of data (time of creation or modification, authorship, content) – and the verification is performed by a distributed network of computers (nodes) that do not belong to a single person or organization. Thus, this technology provides a system that is resistant to dishonest interference and manipulation, and at the same time, an open system of confirmation of data and operations with it[5]. To summarize, in a distributed registry, the data is:

- transparent;
- verifiable;
- immutable (it is technically impossible to change them retroactively, without leaving an obvious trace in the system);
- distributed in different nodes, in multiple copies;
- decentralized (included and removed from the system subject to the consensus of all participants, not one central node of power).

[1] The author thanks N. Podorvanyuk, V. Kartavtsev, N. Gordiychuk, and I. Tarkhanov, as well as the members of the dissertation committee, for their inspiration and invaluable help in conceiving, writing, and defending this work.
[2] Distributed registry technology is a more general, umbrella term for databases that use independent nodes to record and exchange data in a decentralized network, with blockchain as only one of these types of databases (it uses cryptographic tools). In this paper, the terms blockchain and distributed ledger are used as synonyms.
[3] Voshmgir, Sh. Token Economy: How the Web3 reinvents the Internet. Berlin: BlockchainHub Berlin, 2020; Cowen, N. Market for rules: the promise and peril of blockchain distributed governance // Journal of Entrepreneurship and Public Policy. 2019. 9, 2. P. 213-226; Campbell-Verduyn, M., and Hütten, M. Beyond scandal? Blockchain technologies and the legitimacy of post-2008 finance // Finance and Society. 2019. https://doi.org/ 10.2218/finsoc.v5i2.4137; Herian, R. Regulating blockchain: Critical perspectives in law and technology. Routledge, 2018
[4] Werbach, K. The Blockchain and the New Architecture of Trust; MIT Press: Cambridge, MA, USA, 2018.
[5] Waal, M.B., Ribeiro, C.D., Ma, M., Haringhuizen, G., Claassen, E., & Burgwal, L.V. Blockchain-facilitated sharing to advance outbreak R&D // Science. 2020. 368, 719 -721.

DLT has become a socially and economically successful technology primarily due to cryptocurrencies (Bitcoin, Ethereum and others). The latter have combined several important properties: cryptographic tools, a mechanism for achieving consensus within the system when users do not trust each other, remuneration to network participants for maintaining its operation (the so-called "mining"). In fact, the cryptocurrencies have won the attention and resources of thousands of people (their money, time, machine power) by creating a payment instrument that supposedly does not depend on the authority and tools of the central banks, courts and police – where the computer algorithm itself ensures valid and reliable financial transactions[6]. We emphasize that it is decentralization and transparency that are positioned as the core values and advantages of this technology. At the same time, blockchain, like any new technology, is not a neutral tool and does not develop by itself. It is described, promoted, and developed in a "shell" of different, often conflicting values and models of society[7].

But while blockchain technologies in the financial sphere (DeFi, cryptocurrencies) have already gone a long way towards scientific understanding (primarily from the perspective of economics and economic sociology), the collision of such digital projects with other institutional spheres[8] of social space, the ideology of these projects and their reception by a professional audience and the general public, are only beginning to be conceptualized and empirically studied in the social sciences.

The relevance of studying the social practices accompanying the introduction of blockchain for studies of the social organization and institutional infrastructure of contemporary science is due primarily to the fact that, in the multidirectional transformations and increasing managerialist control of science[9], interest in blockchain initially arose because the scientific community hoped to improve the efficiency of practices for assessing the validity and quality of

[6] Swartz, L. What was Bitcoin, what will it be? The techno-economic imaginaries of a new money technology // Cultural Studies. 2018. 32(4). P. 623-650; Karlstrøm, H. Do libertarians dream of electric coins? The material embeddedness of Bitcoin // Distinktion: Journal of Social Theory. 2014. 15, 1. P. 23-36. https://doi.org/10.1080/1600910X.2013.870083; Nakamoto, S. Bitcoin: A peer-to-peer electronic cash system. White Paper. 2008. https://bitcoin.org/bitcoin.pdf

[7] As an example of a successful implementation of these principles outside of cryptocurrencies, and under the patronage of a large corporation, IBM created BikeBlockchain, a blockchain application to solve bicycle theft problems in the Netherlands: as soon as a bike is stolen, it sends information to the police and insurance companies. In this case, blockchain reduces administrative costs and makes it easier for different types of entities (cyclists, police, insurance companies) to interact without revealing private processes and their data to each other or to the app developer. See Koens, T., Aubel, P.V., & Poll, E. Blockchain adoption drivers: The rationality of irrational choices // Concurrency and Computation: Practice and Experience. 2021, 33).

[8] Abrutyn, S. Institutional spheres: The macrostructure and culture of social life. In S. Abrutyn (Ed.), Handbook of contemporary sociological theory (pp. 207–228). Springer, 2016.

[9] The managers in public institutions restructure universities in accordance with the norms of the new public policy: efficiency, metrics, transparent criteria of quality of scientists (Spence, C. 'Judgement' versus 'metrics' in higher education management // Higher Education. 2016, 77. P. 761-775; Shore C. Audit culture and Illiberal governance: Universities and the politics of Accountability // Anthropological Theory. 2008. Vol. 8. No. 3. P. 278-298.

scientific results[10] (including because it has become apparent in recent years). Finding out how these projects are implemented and perceived by scientists, and what social practices emerge when blockchain technology penetrates the institutional sphere of science, which is problematic, are important tasks for our sociological research.

The object and subject of the research

The *theoretical object* of the thesis research is the blockchain technology and related existing and prospective projects of organization and management of science.

The *empirical object* of the research is the stakeholders involved in the development and application of the above projects: blockchain enthusiasts and evangelists; executives of existing startups that use blockchain technologies intensively; academic researchers of DLT technologies; representatives of faculty, IT specialists, management of Russian universities and editors of Russian scientific journals, who somehow have encountered blockchain and tried to implement this technology.

The *subject* of the dissertation research is the processes of blockchain technology acceptance and social practices resulting from the implementation of blockchain-related projects in scientific and educational organizations.

Aims and objectives of the research

The aim of this dissertation research is to analyze the social processes associated with the reception and application of blockchain technologies and related projects in the field of science organization, as well as social practices resulting therefrom.

Within the framework of this goal, the following scientific objectives are planned:

1) To describe the institutional and ideological landscape of blockchain projects in science;
2) To identify the possible applications of blockchain-related innovations;
3) To identify implicit normative models of science organization; to describe blockchain-related experimental models of decentralized self-management and group decision-making in science;
4) To analyze the main reactions of the scientific community arising from the reception of blockchain technologies (distributed registry, tokens, smart contracts, DAO);

[10] Девятко И. Ф. Новые данные, новая статистика: от кризиса воспроизводимости к новым требованиям к анализу и представлению данных в социальных науках // Социологические исследования. 2018. № 12. С. 30-38.

5) To determine what significant features of the organizational and value structure of Russian science can be indicated by the experience of contact with blockchain in 2017-2020.

Statements to be defended

1. In banking, financial transactions, gaming, and international logistics, blockchain solutions are already much more tightly integrated than in the relatively dependent on government budgets, the highly unevenly digitalized and generally conservative field of science. In spite of this, however, a number of projects to implement blockchain solutions in science have emerged around the world between 2017 and 2020. As a result of the analysis of the practices of the implementation of such projects in science and other institutional areas carried out in this dissertation, three main institutional ideologies of blockchain were identified, namely:

a) "statist", which sees DLT as a new technology of public administration, increasing accountability, transparency and control over processes;

b) corporate, in which blockchain is interpreted as a tool to platform business and reduce transaction costs and

c) democratic. The blockchain solutions that emerged during the period under review in the field of science were closest to the third of the ideologies described.

The blockchain solutions in academia that emerged in the period under consideration were closest to the third of these ideologies. These ideologies, which we reconstructed by analyzing the academic literature, as well as various texts about the application of blockchain technologies in science (manifestos, posts, white papers, etc.), were localized in the institutional landscape in the course of the study. Among the founders of blockchain projects we interviewed, as well as blockchain evangelists for science, representatives of the third ideology certainly prevail. However, the same can be said for representatives of universities and research institutes that have had experience with blockchain. In fact, the blockchain field in science is quite far from the corporate and statist ideologies of the implementation of this technology (unlike, for example, blockchain for finance, where all three forces - decentralized cryptocurrencies, corporate financial solutions and government digital currencies - are competing about equally).

2. The dissertation research showed that the interest in blockchain technology among the key actors of science as an institutional field can be described through the thematization by these actors of the following key problems: reproducibility crisis, scientific fraud, pursuit of quantitative indicators, fear of theft of ideas; lengthening of publication cycle, monopoly of large publishing houses, poor remuneration of reviewers, lack of science funding, red tape and bias in

the allocation of research funds. To address these problems, the following institutional design options are proposed by the project representatives we studied:

a) Stating when an object was created in a distributed registry could be a new way to protect ideas, faster than a patent or publication in a peer-reviewed journal, In addition, blockchain allows tracking of the entire research cycle, from hypothesis formulation to data collection.

b) Uploading information to a public registry, allowing the scientific community to verify its creation (modification) date and integrity, reduces the likelihood of data tampering. The principles of decentralization and elimination of intermediaries, important to blockchain ideology and practice, have led to the development of independent publishing platforms where authors and reviewers interact directly with each other, without publishers, and receive fair compensation for their work.

c) Finally, on the part of both blockchain evangelists and part of the academics we interviewed, the expectation was that entering the cryptocurrency economy would allow members of the academic community to raise funds from investors whose interests and views are very different from those of universities. Thus, according to our informants, new independent economic agents emerge in science, in addition to states, large grant funds and philanthropists (which goes in line with the libertarian ideology shared by many blockchain projects).

3. It is shown that, in addition to many applied solutions, blockchain projects explicitly or implicitly claim to establish new, fairer rules of the game in science and to "restructure" its management practices. They propose to extend to science the principles of republican self-government already in place in other online communities, and thus encourage open science and create new academic communities, based on transparent rules fixed in the software code. The basic principles of the new normative image of science in blockchain projects are as follows: transparency; debureaucratization; decentralization; participative democracy; communitarianism; collaborativeness.

4. The analysis of empirical material shows that there is a significant gap between the sensational reputation of blockchain technology and the actual integration of DLT into the work processes of institutions and organizations. The logic of blockchain solutions assumes values of individual benefit and efficiency, whereas academics, unlike, for example, traders or gamers, work within complex institutional structures for which the cost of radical innovation is very high. Moreover, an analysis of new projects points to a dilemma: blockchain is supposed to build an autonomous, self-regulating system of science run by scientists themselves, i.e. a self-governing institutional infrastructure that stimulates scientific progress – but it is based on a race for

material incentives. The market logic is perceived by scientists (our informants) as the one atomizing the scientific community and striking at the ethos of the collective search for truth.

5. Among Russian scientists, the criticism was met primarily by the new image of science behind the blockchain projects, with transparency, decentralization, and academic self-governance declared to be its main attributes. The main argument that our respondents and informants gave about the problematic nature of digital self-government was that the existing "mafias" and "cliques" in science, even in conditions of collective, decentralized and debureaucratized decision-making, would be able to maintain influence and adapt any technological and communication tools to their needs, that is to use them instrumentally in their personal and group interests, without accepting the declared values of the new image of science. The model of open and transparent self-government is perceived by the key actors as fraught with the risks of creating even more disunity among scientists and disrupting the well-adjusted system of reciprocal relations.

The author's contribution to the development of the research problem and data collection

The dissertation research was mainly carried out on the material collected personally by the defender and his colleagues within the research project "Network contracts (smart contracts) as a way to regulate and organize scientific activities" in 2018-2021[11]. The project was implemented on the basis of the Laboratory of Blockchain Research in Education and Science (LIBON) of the State Academic University of the Humanities. Along with this, the thesis used the materials and results of the project "Digital mechanisms of management and self-organization of the scientific community as a necessary condition for scientific and technological breakthrough" (implemented in 2019-2020)[12]. As a result of these projects a number of articles were published, including four on which this dissertation is being defended; the defender was either the only or the first (main) author of these articles, undertaking the conceptualization of the material, data processing and writing of the texts.

[11] The project was supported by grant #18-29-16184 from the Russian Foundation for Basic Research.
[12] The project was supported by a joint grant from the Russian Foundation for Basic Research and the Expert Institute for Social Research #19-011-31522 opn.

Theoretical framework. Literature review.

The spread of new technologies, the interactions they enter into with various elements of the economy, society, culture, and, finally, the complex changes they undergo in the course of this process are a classic topic that never loses its relevance in the sociology of science and technology, as well as in the interdisciplinary field of STS (science and technology studies), which emerged at the interface of sociology, anthropology, history and psychology[13]. However, unlike most scientists working in this direction, we do not consider an established technology with a solid infrastructure, but one that is still in the process of formation – its goals, its actors, the policy of its application, its localization, the attitude of people and institutions to it have not yet become self-evident and are actively transforming. This approach - to consider infrastructure in the process of formation and the associated conflicts and barriers - is quite legitimate and widespread in the social sciences[14].

Moreover, Bruno Latour's distinction between two approaches to the analysis of technological innovation is relevant for this study. Latour contrasts the model of translation with the simplified model of diffusion (new technologies in a complete and finished form descend into society and "disperse" through it, meeting resistance from well-formed groups whose interests the innovation contradicts): innovation comes as a working idea, as a prototype, not in perfect working form, but as a mixture of different projects, solutions and even ideologies that mobilize networks of allies (people and material objects), are modified through interactions with these networks and then win success, take hold in different segments of society, become the new norm - or, conversely, are discarded and forgotten as a non-functional anachronism[15]. Technological innovation is interpreted in the research literature not as a neutral progressive process, but as a set of contingent clashes, agreements, politically colored social actions[16]. In the case of this study, we could say that certain groups of scientists (mostly young scientists), dissatisfied with a number of problems in the development and organization of science, have

[13] See, inter alia: Латур, Б. Наука в действии: следуя за учеными и инженерами внутри общества. Пер. с англ. К. Федоровой. СПб.: Издательство Европейского университета в Санкт-Петербурге, 2013; Knorr-Cetina, K. Epistemic Cultures. How Sciences Makes Knowledge. Harvard University Press, 1999.

[14] Kennedy, D. The machine in the market: Computers and the infrastructure of price at the New York Stock Exchange, 1965–1975. Social Studies of Science. 2017, 47(6). P. 888–917; Collier, S. J. Post-soviet social: Neoliberalism, social modernity, biopolitics. Princeton: Princeton University Press, 2011; Law, J. and Mol, A. Globalisation in practice: On the politics of boiling pigswill. Geoforum. 2008. 39(1). P. 133-143.

[15] Латур Б. Наука в действии: следуя за учеными и инженерами внутри общества. Пер. с англ. К. Федоровой. СПб.: Издательство Европейского университета в Санкт-Петербурге, 2013; Latour, B. Aramis, or the love of technology. Cambridge, Massachusetts: Harvard University Press, 1996.

[16] Faria, I. Trust, reputation and ambiguous freedoms: financial institutions and subversive libertarians navigating blockchain, markets, and regulation // Journal of Cultural Economy. 2019, 12(2). P. 119-132; Hassan, S. and De Filippi, P. The expansion of algorithmic governance: From code is law to law is code // Field Action Science Reports. 2017, 17. P. 88–90; Bijker, W. E. Of Bicycles, Bakelites, and Bulbs: Toward a Theory of Sociotechnical Change. Cambridge, MA: MIT Press, 1997.

tried to ally themselves with a new (and external to science) technology in order to change the rules of the game by means of it. However, the coalition they have built has not been strong enough to "win over" large scientific institutions and make blockchain an element of everyday life, of "normalcy," rather than an exotic tool that evokes mixed emotions.

Then, in the sociological tradition of innovation research, we rely primarily on two approaches. First, works based on the concept of contingency have shown how organizational structures change under the influence of new technologies and, in turn, change the relationships between people in work processes. The authors of this trend have shown that decentralized and less formalized organizational structures favor technical innovations because they respond faster to a changing environment[17]. We also rely on the research that emerged in the mainstream of social constructivism in the 1980s and that challenged the notion that technological progress is natural: innovation exists only in the process of constant interaction between technology and practices, perceptions and habits of people and institutions, on which the success or failure of technological projects depends to a large extent[18].

As for Russia, the work of the St. Petersburg sociologist M. Sokolov is relevant for this dissertation research. Although he does not work with information technologies, his analysis of the practices of scientometrics in Russia, within the framework of comparative sociology of quantification[19], reveals a similar process: how and why a foreign "objective" management tool is introduced into Russian universities, which changes the game rules, but causes resistance from agents[20]. Finally, a theoretical and methodological framework similar to ours is used by the authors of a collective monograph, "The Adventures of Technology: Barriers of Digitalization in Russia," which deals with various cases of the introduction and absorption of new IT technologies (from drones to data applications) in domestic contexts.

Due to the fact that blockchain projects offer not just narrow-specific technical solutions "under the hood" for science, but a more or less serious restructuring of its social organization and management processes, that is, they change relations between its actors, bring new principles (transparency, decentralization), some aspects of the sociology of management (governance) are also important for us. First of all, in the 2000s-2010s, due to the acceleration of scientific and technological progress, rapid development of "hot" innovative directions (nanotechnologies,

[17] Burns, T. and Stalker, G. M. The Management of Innovation. London: Tavistock, 1961; Lawrence, P. R., and Lorsch, J. W. Organizations and environment: Managing differentiation and integration. Harvard University, Boston: Graduate School of Business Administration, 1967; Donaldson, L. The contingency theory of organizations. Thousands Oak, CA: Sage Publications, Inc., 2001.

[18] Bijker, W., Hughes, T., and Pinch, T. The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology. MIT Press, Cambridge, MA, 1994.

[19] Berman, E. P. and Hirschman, D. The Sociology of Quantification: Where Are We Now? // Contemporary Sociology: A Journal of Reviews. 2018. 47, 3

[20] Sokolov, M. Can Russian Research Policy be Called Neoliberal? A Study in the Comparative Sociology of Quantification // Europe-Asia Studies. 2021, 73. P. 989-1009.

biomedicine), the establishment of new links between science and industry in Europe and the USA, it became clear that "strict" regulation and the *dirigiste* approach to managing science and technology are not productive, and various experiments with management practices, regulation mechanisms, and the search for optimal organizational forms were launched[21]. In response to this demand, the field of sociology of science and science policy has developed several concepts, such as shared governance, in which all groups within the university (not just the superiors) take an active part in decision-making as full partners[22], and digital governance: this paradigm involves digitalization of relations between citizens, and between state and citizens, and the automation of processes[23].

In addition, an important parallel to the story we are describing here (the reception of blockchain projects in science in 2017-2020, the conflict of different ideologies) can be drawn to the history of the "open access" movement in science, from the 1990s to the present.

Initially, the principles of open access were promoted by librarians, enthusiasts of the first online journals, and representatives of some disciplines (physics and astronomy above all) interested in the preprint culture (e.g., arXiv.org). This was followed by the decade 2000-2009, a 500% growth due to the explosive expansion of scientists' access to the Internet, or more precisely, the transition from the Internet of e-mail to the Internet of web-accessible resources; and then the emergence of open access as a business model, where the publisher pays not the readers, but the authors of articles (contrary to the idealistic intentions of enthusiasts who believed that information would be free for all).

Now the confrontation between the two images of open access is only increasing: on the one hand, the growing number of articles and journals in paid open access, with increasing prices for authors; on the other hand, the destruction of publishing models, launched primarily by the anarcho-communist project Sci-Hub, and the "backdoor" to free open access for all. In addition, the set of ideas, technological solutions, and practices behind open access has gone beyond the realm of scientific publications - we are now talking about "open science," with open data (the imperative to make the entire research process public) and open peer review. The values of transparency and democratization of science (against big structures and monopolistic publishers) behind this have also affected blockchain projects in science, as we will show below[24].

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[21] C. Sabel, J. Zeitlin (eds.), Experimentalist Governance in the European Union: Towards a New Architecture, Oxford UP, Oxford, 2010.

[22] Участие в управлении университетом. Ответ. ред. О. Бычкова. СПб.: Норма, 2016.

[23] Margetts, H. and Dunleavy, P. The second wave of digital-era governance: a quasi-paradigm for government on the Web // Philosophical transactions of the Royal Society A. 2013, 371: 20120382

[24] For more detailed studies of open access, it past and present, see: Трищенко Н.Д. Открытый доступ к науке. Екатеринбург: Кабинетный ученый, 2017; Laakso, M., Welling, P., Bukvova, H., Nyman, L., Björk, B., & Hedlund, T. The Development of Open Access Journal Publishing from 1993 to 2009 // PLoS ONE, 2011, 6; Tennant, J.P., Waldner, F., Jacques, D.C., Masuzzo, P., Collister, L.B., & Hartgerink, C. The academic, economic

However, as we worked on our dissertation, a theoretical framework that shows not the successful implementation and diffusion of new technology, but rather the opposite, a combination of inflated expectations with a deficit of real practices of use, became even more relevant. Such processes are described, in particular, in the sociology of organizations with the help of the so-called "garbage can" model[25]. The latter interprets decision-making as a product of spontaneous interaction between actors who simultaneously create and overcome difficulties that arise in the course of their activities (and problems and solutions simultaneously accumulate in "garbage cans" from which they are extracted or put back now and then). If we talk about the blockchain landscape in academia, then, as we will show below, problems and solutions go separately. In other words, a bright new solution appears, and agents are suddenly hopeful - whether blockchain will solve their painful problems (for some it is p-hacking, for some it is insufficient remuneration of reviewers' work, for some it is administrative barriers). But then, for various reasons, it turns out that blockchain technology is a solution without a problem, and the initial enthusiasm fades away[26].

If we turn directly to the subject of our research, this dissertation relates to an emerging area of research on blockchain adoption in various fields, including transportation, finance, and education. At the intersection of sociology, economics, and management, this research area explores the factors that limit DLT's ability to digitally transform different areas of life. These factors include, among others, a lack of understanding of the technology by a broad audience, cultural factors (mistrust, antipathy to the values of decentralization and transparency), regulatory practices (the need for new legal forms), governance issues (who owns and operates the DLT network), and technical issues, especially scalability and security[27].

In recent years, more conceptual work in the vein of social theory has begun to emerge, critically examining key concepts of blockchain technology. An article by de Filippi, Mannan and Reuters analyzes how true the claim of DLT as a guarantor of trust is in a situation of mutually mistrustful actors. The authors show that a decentralized (more precisely, polycentric)

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and societal impacts of Open Access: an evidence-based review // F1000Research, 2016, 5; Nicholas, D., Boukacem-Zeghmouri, C., Xu, J., Herman, E., Clark, D.J., Abrizah, A., Rodríguez-Bravo, B., & Świgoń, M. Sci-Hub: The new and ultimate disruptor? View from the front // Learned Publishing, 2019, 32; Foster, E.D., and Deardorff, A. Open Science Framework (OSF) // Journal of the Medical Library Association. 2017. 105. P. 203-206.

[25] Cohen, M.D.; March, J.G.; Olsen, J.P. (1972). "A garbage can model of organizational choice". Administrative Science Quarterly. 17 (1): 1–25.

[26] The discourse about blockchain as a "solution without a problem/in search of a problem" is quite common, even outside the academic community. See, for example: Frederik, J. Blockchain, the amazing solution for almost nothing // The Correspondent. 21 August 2020 (https://thecorrespondent.com/655/blockchain-the-amazing-solution-for-almost-nothing).

[27] Upadhyay, N. Demystifying blockchain: A critical analysis of challenges, applications and opportunities // International Journal of Information Management. 2020. 54, 102120; Yeoh, P. Regulatory issues in blockchain technology // Journal of Financial Regulation and Compliance. 2017, 25. P. 196-208; Ølnes S.; Ubacht J.; Janssen M. Blockchain in government: Benefits and implications of distributed ledger technology for information sharing // Government Information Quarterly. 2017, 34. P. 355–364.

model of governance is actually guaranteed to result in a small number of powerful actors beginning to implicitly control the system[28]. Heister and Yuthas demonstrate how implicit notions of self and human agents (the perception of self as a commodity and time as a monetizable resource, the commodification and mediatization of relationships, reputation as a basic form of capital) are embedded in blockchain projects[29]. Rejters and Coeckelbergh examined blockchain as a narrative technology gaining credibility and influence through the new myth of replacing untrustworthy people with automated code[30].

Nevertheless, most academic papers on blockchain and related technologies are still constructed either as applied projects (what blockchain can and might do) or as critical reviews of the literature[31]. What is noticeably lacking in the field of social science is texts that use the explanatory resources of sociological theory and qualitative research methodology[32] to explore the practical experiences of DLT implementation – the problems that arise in this process, and, equally important, the non-obvious structural features of the areas in which DLT is implemented and thereby shed light on their functioning.

In the Russian social sciences, quite a few works are devoted to the blockchain problem, but if we remove reviews[33], studies on technical sciences and economics (mainly devoted to cryptocurrencies[34]), as well as many articles outside the RSCI core, very few relevant texts remain. Perhaps the most significant and conceptually independent is the work "Blockchain and social concepts: exposition of the problem field" by M. Pantykina[35], where the key concepts with which blockchain technologies are "promoted" (trust, block time, responsibility, mining) are

[28] Filippi, P., Mannan, M., & Reijers, W. Blockchain as a confidence machine: The problem of trust & challenges of governance // Technology in Society. 2020. 62, 101284.
[29] Heister, S., & Yuthas, K. The blockchain and how it can influence conceptions of the self // Technology in Society. 2020, 60, 101218.
[30] Reijers, W., & Coeckelbergh, M. The Blockchain as a Narrative Technology: Investigating the Social Ontology and Normative Configurations of Cryptocurrencies // Philosophy & Technology. 2018, 31. P. 103-130.
[31] E.g., Leible, S.; Schlager, S.; Schubotz, M.; Gipp, B. A Review on Blockchain Technology and Blockchain Projects Fostering Open Science // Frontiers in Blockchain. 2019, 2, 16.
[32] Among other things, this state of affairs is due to the rapidity of change in blockchain technology, where events sometimes outpace the plans of researchers who honestly admit that their object has been irreparably transformed in the course of their work - as, for example, the author of the text DuPont, Q. Experiments in algorithmic governance: A history and ethnography of "The DAO," a failed decentralized autonomous organization. In: Campbell-Verduyn M. (ed.) Bitcoin and Beyond: Cryptocurrencies, Blockchains, and Global Governance. London: Routledge, 2017. P. 157-177.
[33] E,g, Талапина Э. В. Применение блокчейна в государственном управлении: перспективы правового регулирования // Вопросы государственного и муниципального управления. 2020. № 3. С. 96-113; Горбунова М. В., Омётов А. Я., Комаров М. М., Беззатеев С. В. Обзор проблем внедрения технологии распределенного реестра // Информационно-управляющие системы. 2020. №2 (105). С. 10-19.
[34] Дёрр Д., Ковальски О., & Невский С.И. Цифровизация и денежный порядок. Проблемы и перспективы регулирования рынка криптовалют // Terra Economicus. 2019. №17 (4). С. 6-22; Фролов Д. П. Постинституциональная теория блокчейна // Журнал экономической теории. 2019. №16 (2). С. 262-278; Баранов И. С. Конструирование доверия на российском рынке криптовалют // Экономическая социология. 2018. №19 (5). С. 90-112
[35] Пантыкина М. Блокчейн и социальные концепты: экспозиция проблемного поля // Социологическое обозрение. 2019. №18 (1). С. 158-185.

deconstructed through the actor-network theory. The results close to our conclusions were found in a study on the prospects of blockchain in the Russian labor relations system, the methodology of which partly coincided with ours (a series of expert interviews with the initiators of the new technology and industry representatives)[36]. The author emphasizes the gap between the potential of the new technology, the expectations from it, and the extremely pessimistic views on the prospects of its use. In addition, the researcher (and his respondents) consider the main problem not technical (development and adoption of new technology), but social - the inertia of existing institutions, poor understanding of digitalization by potential stakeholders.

Thus, while there are a number of works in related fields of social science (economics and management, first of all), both in the world and in domestic science, there is a clear lack of sociological understanding of blockchain-related social processes and institutional changes. Hence, the purpose of this dissertation is to fill the existing gap.

In general, about two dozen works (since 2015) have been devoted to the application of blockchain technologies in science[37]. However, no comprehensive studies focused on the application of sociological methods and explanatory models of sociology have been conducted so far. The vast majority of the publications available so far are more or less elaborated calls or suggestions of how blockchain could be applied in one sphere or another (from clinical drug trials to the organization of the publishing process), but not an analysis of real experience (the same is typical of the only early Russian-language work on the topic[38]). A notable exception is a recent study that tried to systematize the activities of modern blockchain projects for science, to identify their innovations, strengths and weaknesses, and to question the difficulties of this process - but, alas, this work is also a literature review and lacks empirical research[39]. Of the existing studies in Russian, the first one was carried out by the thesis's colleagues, within one of the above-mentioned projects - and it is just dedicated to expert points of view on the use of blockchain and smart contracts in scientific and educational activity (in Western Europe and the USA)[40], and the other largely uses the results obtained by the author of this thesis[41].

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[36] Долженко Р. А. Блокчейн в системе экономических и трудовых отношений: перспективы и сдерживающие силы // Проблемы теории и практики управления. 2021. №9. С. 138-156.

[37] See, first of all: Janowicz, K., Regalia, B., Hitzler, P., Mai, G., Delbecque, S., Fröhlich, M., Martinent, P., & Lazarus, T. On the prospects of blockchain and distributed ledger technologies for open science and academic publishing // Semantic Web. 2018. #9. P. 45-555; Van Rossum, J. Blockchain for Research: Perspectives on a New Paradigm for Scholarly Communication. Digital Science. 2017. URL: https://digitalscience.figshare.com/articles/Blockchain_for_Research/5607778; Dhillon, V., Metcalf, D., Hooper, M. Blockchain in Science. In: Blockchain Enabled Applications. Apress, Berkeley, CA, 2017. P. 111-124.

[38] Чернозуб С.П. Идеология открытой науки и перспективы блокчейна // Общественные науки и современность. 2018. № 6. С. 87–97

[39] Leible, S.; Schlager, S.; Schubotz, M.; Gipp, B. Op. cit.

[40] Бычкова О.В., Евсеева И.К., Малюшкин Р.В. Международные оценки перспектив технологии блокчейн и смарт-контрактов в научно-образовательной среде: возможности и ограничения // Мониторинг общественного мнения: экономические и социальные перемены. 2019. №4. С. 245-261.

Scientific novelty of the thesis research

The scientific novelty of the thesis research is determined by the fact that, for the first time in sociology, a comprehensive study was made of the possibilities of applying blockchain technologies to the restructuring of the institutional and organizational landscape of science. What is noticeably lacking in the contemporary social sciences is texts that use the explanatory resources of sociological theory to explore, among other things, the practical experience of blockchain implementation - the problems that arise in this process, and, equally important, the non-obvious structural features of the domains into which blockchain is introduced, thereby shedding light on their functioning.

In the international context, the proposed dissertation study is the first to examine blockchain and science sociologically, drawing on the opinions and positions of the scientific community, identified through both quantitative and qualitative methods. Finally, in Russia, the author of this paper pioneered blockchain research in science, becoming the first to systematically begin a sociological analysis of the problems and prospects of DLT technologies in science, initiating several research projects on this topic as well as writing a seminal article[42].

Selection of empirical data. Methods of data collection and analysis.

The empirical basis for this study was primarily a series of interviews and focus groups conducted in 2018-2020, their key topic being the respondents' perceptions of blockchain technology in science. Equally important was the analysis of respondents' main narratives and, based on them, the identification of key barriers to technological innovation, both organizational and ideological. Purposeful sampling[43] was used to ensure that the study represented the views of various stakeholders: blockchain enthusiasts and evangelists; executives of operating startups, both domestic and Western; academic researchers of DLT technologies; representatives of faculty, IT specialists and management of Russian universities, who had encountered blockchain and tried to implement this technology in one way or another. A total of 30 in-depth semi-

[41] Тульчинский Г.Л. Гуманитарные науки и цифровизация // Человек. Культура. Образование. 2020. №2 (36). С. 43-57.
[42] Космарский А.А. Блокчейн для науки: революционные возможности, перспективы внедрения, потенциальные проблемы // Мониторинг общественного мнения: экономические и социальные перемены. 2019. №2 (150). С. 388-409.
[43] Palinkas, L., Horwitz, S., Green, C., Wisdom, J., Duan, N., Hoagwood, K. Purposeful Sampling for Qualitative Data Collection and Analysis in Mixed Method Implementation Research // Administration and Policy in Mental Health and Mental Health Services Research. 2013. #42. P. 533-544.

structured interviews were conducted, lasting from 30 to 120 minutes (the author of this study personally conducted 13 interviews). Interviews were conducted in person or remotely (via Skype, Zoom). Respondents were recruited via email and social media. .

In addition, focus groups (N=3) were conducted with representatives of Russian universities where blockchain technologies are actively being developed: St. Petersburg National Research University of Information Technologies, Mechanics and Optics (ITMO University), St. Petersburg Polytechnic University and Skolkovo Institute of Science and Technology. A total of 19 informants participated in focus groups. Finally, to find out the requests of the scientific community for the introduction of blockchain in the sphere of scientific journals, the author of this study personally conducted focus groups (N = 3) with scientists, editors and publishers of scientific journals – about the pressing problems of the industry, and about the prospects of solving them through new digital tools (in particular, smart contracts).

Recordings of interviews and focus groups were transcribed and then parsed through thematic analysis. The data were handled using D. Gioia's methodology[44] (a species of grounded theory), from categorizing opinions and narratives to highlighting themes and clustering them.

Then, in the course of the 2019 study, five scientific/educational organizations were selected that differed from one another in their main scientific areas of activity (natural, humanities, and technical sciences), organizational structure (universities or research institutes), and geographic location (two organizations in Moscow and one each in St. Petersburg, Makhachkala, and Chelyabinsk). Five to eight people of different gender, age, and academic status participated in focus groups conducted at these institutions with the author of this study, and it was separately stipulated that respondents should not belong to the same structural unit (department, laboratory, department, etc.). The average length of a discussion was 120 minutes. The recordings were transcribed and underwent a coding procedure.

Finally, based on the materials of the focus groups, the author and his colleagues developed a questionnaire for an online survey, the object of which was a set of scientists, academic staff, and university professors living in the Russian Federation. The questionnaire was designed on the SurveyMonkey service and was distributed through channels that were relevant to the scientific community: the media, specialized websites for scientists, groups on social networks, closed and open group chats in the main messengers, and mailing lists. The survey questions covered both the opinions and practices of the respondents' scientific life – attitudes toward scientometrics, the bureaucratic burdens, various platforms for scientific communication, the principles of peer review, all kinds of digital innovations, and ideas about the goals,

[44] Gioia, D., Corley, K.G., Hamilton, A. Seeking Qualitative Rigor in Inductive Research // Organizational Research Methods. 2013. #16. P. 15 - 31.

assessment criteria, and future development of domestic science. A total of 6166 questionnaires were collected (3605 questionnaires were fully completed). Characteristics of the sample: non-random, conformal, streaming[45]. In order to reduce the influence of outliers in the data and their bias on the final results of the study, a procedure was performed to adjust the array taking into account the main characteristics of the general population (distribution of candidates and doctors of science in the six main fields of science and technology, according to Rosstat)[46].

Analysis of data and findings

This dissertation is defended on the sum of the articles, which identified the range of problems affecting the emergence of blockchain technology in science, its perception by scientists and the conflicts arising in this process. The Results section is structured with the research objectives outlined above in mind. It begins with a description of the institutional and ideological landscape of projects related to the application of blockchain technologies in science (based primarily on the article "Blockchain for Science: Revolutionary Opportunities, Implementation Prospects, Potential Problems"). Next, the proposed blockchain technology solutions to the problems of science (based on the article "Blockchain Adoption in Academia: Promises and Challenges," as well as "Token-Curated Registry in a Scholarly Journal: Can Blockchain Support Journal Communities?") will be considered.

Next, a move to a higher level of abstraction is made; an analysis of the images and ideology of science in blockchain solutions will be presented (drawing on the work "Traubes and Transparency: Prospects for Digital Self-Organization Mechanisms in Russian Science"). Finally, the last and most detailed section of "Results" is devoted to the analysis of the reactions of the scientific and educational community (worldwide and especially in Russia) when confronted with the new technology. From the most simple, technical problems we will move on to conflicts of values, and to what significant features of the structure of Russian science have been revealed by this contact. We will also focus on why the new image of science "embedded" in blockchain projects and their political implication have been criticized. This section builds on the ideas outlined in the articles: "Trails and Transparency: Prospects for Digital Self-Organization Mechanisms in Russian Science," "Blockchain Adoption in Academia: Promises

[45] Baker, R., Brick, J., Bates, N.J., Battaglia, M., Couper, M., Dever, J., Gile, K.J., & Tourangeau, R. Summary Report of the AAPOR Task Force on Non-probability Sampling // Journal of Survey Statistics and Methodology. 2013, 1. P. 90-143.

[46] Федеральная служба государственной статистики. Наука и инновации. 2019. URL: https://rosstat.gov.ru/folder/14477?print=1; Наука. Технологии. Инновации: 2020: краткий статистический сборник / Л.М. Гохберг, К.А. Дитковский, Е.И. Евневич и др. М.: НИУ ВШЭ, 2020.

and Challenges," "Evading Transparency, Doubting Democracy, Dreaming Big: Grassroots Perspectives on Science Governance in Russia.

1. Institutional and ideological landscape of projects related to the application of blockchain technologies in science[47]

The practical application of blockchain technologies in the routine activities of the agents of a particular institutional sphere depends on the degree of its digitalization, on its proximity to online finance, on the presence or absence of opportunities to generate and increase profits there, and on the presence of strong corporate stakeholders. Therefore, blockchain solutions are already much more tightly integrated in banking, financial transactions, gaming, and international logistics than in the relatively dependent on government budgets, the highly unevenly digitized and generally conservative field of science. The first academic publications on the topic began to appear only in 2016-2017. At the same time, on the wave of hype for cryptocurrencies and ICOs, there were several waves of partly opportunistic, partly idealistic startups that promised to solve all the problems of science with blockchain – by freeing it from oligopolies and corporate interests, providing powerful material incentives for scientists, and creating a more fair and responsive system of publications. Some of them terminated their activities due to a lack of funds and a mismatch between ambitious goals and their own capabilities, while others reformatted their tasks into a more concrete and modest shape[48].

In parallel, in 2017-2020 there was a process of building a network of scientists and interested IT professionals, for whom the topic of blockchain and science seems promising for the future arrangement of academic life. Blockchain for Science (blockchainforscience.com), an association based in Berlin but bringing together experts working in Europe, the United States, and Asia, plays an important role in this process. Several specialized research centers have opened and are operating (a department of the Research Institute for Cryptoeconomics at the Vienna University of Economics and Business, the Laboratory of Blockchain and Society Research at the University of Amsterdam, the Laboratory of Blockchain Research in Education and Science at the State Academic University of Humanities); many of the scientists included in

[47] For more details on the results outlined in section 1, see : Космарский А. А. Блокчейн для науки: революционные возможности, перспективы внедрения, потенциальные проблемы // Мониторинг общественного мнения: Экономические и социальные перемены. 2019. №2. С. 388-409; Космарский А. А. Внедрение блокчейн-технопогий в сферу науки: проблемы и трудности // Информационные ресурсы России. 2021. № 1 (179). С. 9-14.

[48] The most comprehensive and up-to-date list of relevant startups is: Keck, I.R.; Heller, L.; Blümel, I. Distributed Science Infrastructure Projects, Version 1.1 . Zenodo. 2020. URL: https://zenodo.org/record/3695199#.YP21B-gzY2w

the topic work within such structures as the Dublin City University School of Physical Sciences or the Fraunhofer Institute for Applied Information.

Large corporations have for some time studied and even tried to develop projects in this area (IBM patented an algorithm on blockchain technology for scientific data collection and analysis, Springer Nature developed a cross-corporate platform for peer review that guarantees the security of information about reviewers). However, markedly democratic and anti-corporate spirit of blockchain projects seems to have affected them, and their development remained at the level of prototype models (proof of concept). This fact points, in our view, to an existing and even growing gap between the three ideologies that provide different answers to the question of why, who and what blockchain is needed (not only in science, but also in other institutional spheres):

- governmental: DLT as a new technology for public administration, increasing accountability, transparency and accountability of processes;

- corporate: the same goals as for the state, only within a single business, and, in addition, automation (through smart contracts, especially in logistics and supply chain) and monopolization (creating platforms where all players in a particular industry will come in);

- cyber-democratic: the priority here is not efficiency, but decentralization, the successful example of cryptocurrencies as an alternative to state-issued money, technology as a guarantor of trust and security of interactions between people and institutions, blockchain as the basis for cross-border forms of cooperation and digital self-government. It was the projects created under the third ideology that were the most ambitious: the restructuring of many spheres - science, film industry, medicine, journalism - on the model of successful crypto-projects[49]; the involvement of all players (e.g. authors, reviewers, editors, publishers in scientific journals) on new decentralized platforms, with transparent processes, absence of oligarchies and oligopolies[50].

As for Russia, blockchain aroused a certain interest in the scientific and educational community back in 2017-2018, but the lack of legal regulation of blockchain and related technologies, as well as other reasons, which will be discussed below, "froze" many ventures. Nevertheless, initiatives at the Siberian Federal University (IPUniversity intellectual property protection platform), the Center for Distributed Registry Technologies at St. Petersburg State

[49] Beutel, T. Decentralising Power, Competence and Incentives – A Case Study on Emerging Visions in the Blockchain Space. MA Thesis, University of Edinburgh Business School. 2018. (https://www.researchgate.net/publication/327427029).

[50] For a more detailed analysis of these three ideologies of blockchain see: Manski, S., Manski, B. No Gods, No Masters, No Coders? The Future of Sovereignty in a Blockchain World. // Law Critique. 2018. #29. P. 151–162; Herian, R., Regulating blockchain: Critical perspectives in law and technology. Routledge, 2018; Faria, I. Trust, reputation and ambiguous freedoms: financial institutions and subversive libertarians navigating blockchain, markets, and regulation // Journal of Cultural Economy. 2014. #12(2). P.119-132.

University (CryptoVeche voting system), and the State Academic University of Humanities (blockchain for scientific journals) have survived and continue to develop actively.

2. Analysis of blockchain technology solutions for the problems of science[51]

2.1 Talking about the reproducibility crisis[52] associated with fitting empirical information to a hypothesis and "fishing" out the necessary statistical significance from data (p-hacking)[53], about preventing scientific fraud and accelerating scientific communication (while protecting rights to ideas), blockchain projects claim to create tools that can make the research cycle more open and transparent, and facilitate data exchange. Discoveries and new ideas could be registered in a distributed registry, indicating authorship. A time-stamp on blockchain could be a new way to protect ideas, faster than a patent or publication in a peer-reviewed journal[54]. Moreover, blockchain makes it possible to track (with verified timestamps) the entire research cycle, from hypothesis formulation to data collection (the principle of data stability is at work here). Uploading the information to the registry, allowing the broad scientific community to check the date of its creation (change) and integrity, is designed to reduce the likelihood of data manipulation, post factum modification of hypotheses, deletion of sharply deviating values, etc[55]. In the cases described, blockchain acts as the technological basis for long-discussed measures in the scientific community to create a "Big Statistical Brother" and tools for mutual oversight of scientists' work with data[56]. As of 2021, the most effective projects of this type include the American platform ARTiFACTS and bloxberg, a global network (managed by a consortium of universities and scientific organizations) that provides a data certification system and tools to develop decentralized applications for scientists.

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[51] For more details on the results outlined in section 2, see Космарский А. А. Блокчейн для науки: революционные возможности, перспективы внедрения, потенциальные проблемы // Мониторинг общественного мнения: Экономические и социальные перемены. 2019. №2. С. 388-409; Kosmarski, A. Blockchain Adoption in Academia: Promises and Challenges // Journal of Open Innovation: Technology, Market, and Complexity. 2020. Vol. 6. No. 4. Article 117

[52] Ioannidis J. P.A. Why Most Published Research Findings Are False // PLOS Medicine. 2005. https://doi.org/10.1371/journal.pmed.0020124

[53] Head M. L., Holman L., Lanfear, R., Kahn A. T. Jennions M. D. The Extent and Consequences of P-Hacking in Science // PLOS Biology. 2015. https://doi.org/10.1371/journal.pbio.1002106 ; Simmons J. P., Nelson L. D., Simonsohn U. False-Positive Psychology: Undisclosed Flexibility in Data Collection and Analysis Allows Presenting Anything as Significant // Psychological Science. 2011. Vol. 22. No. 11. P. 1359-1366

[54] Benchoufi, M.; Ravaud, P. Blockchain technology for improving clinical research quality // Trials. 2017. 18, 335; Furlanello, C.; De Domenico, M.; Jurman, G.; Bussola, N. Towards a scientific blockchain framework for reproducible data analysis // 2017. arXiv:1707.06552

[55] Bartling, S. Blockchain for Open Science and Knowledge Creation—Static version 4. Zenodo. 2018. URL: https://zenodo.org/record/60223#.WznpSE0Um70

[56] Young. C. Model Uncertainty and the Crisis in Science // Socius: Sociological Research for a Dynamic World. 2018. Vol. 4: 1–7.

2.2 The modern system of journal publications, according to many scientists, publishers, and editors, is in crisis. It is most often noted that the publication cycle (time from submission of a manuscript to a journal to publication) is constantly lengthening, and at the same time representatives of many sciences are in no hurry to open their results in preprints, fearing the theft of ideas. Further, the formal anonymity of blind reviewing is faulty (reviewers understand whose work they are reviewing); finally, reviewers are increasingly overburdened and their work is not rewarded[57].

To solve the problems of the scientific publishing process (increasingly slow speed of publications, increasing price tags for reading articles and especially fees for publishing in open access journals, monopolization of the publishing business –i.e., all the work of writing and reviewing articles is done by scientists, and all the money goes to corporations) blockchain projects offer, in the most minimal variant, the same time-stamping. It is argued that writing a text or even a draft of an idea on a blockchain allows the scientist to confirm the priority in the discovery and intellectual property rights, after which he can freely share the text as a preprint - and so the publication cycle is accelerated[58].

Finally, the principles of decentralization and elimination of intermediaries, important to blockchain ideology and practice (as well as the hopes of the scientific community that it is possible to correct the system using blockchain as an institutional design tool), have led many developers to create independent publishing platforms where authors and reviewers interact directly with each other, without publishers, and receive fair compensation for their work, and where reputation and reward systems work in addition to the publication functionality.

However, as our study has shown, the creators of such platforms have not paid enough attention to the fact that scientists prefer to publish in the "old" journals they know, not only because these journals are indexed in Scopus and Web of Science and have an impact factor, but also because their research community crystallizes around each of them, there are important discussions for the discipline and so on. Many ambitious blockchain-based publication platforms (scienceroot.com, eurekatoken.io, pluto.network) have not reached the MVP stage or have been

[57] Kovanis, M., Porcher, R., Ravaud, P., and Trinquart, L. The global burden of journal peer review in the biomedical literature: Strong imbalance in the collective enterprise // PLoS One, 2016. 11(11), e0166387. https://doi.org/10.1371/journal.pone.0166387; Ware, M. Peer review survey 2015. Publishing Research Consortium, 2016. http://publishingresearchconsortium.com/index.php/134-news-main-menu/prc-peer-review-survey-2015-key-findings/172-peer-review-survey-2015-key-findings ; Prüfer J., Zetland D. An auction market for journal articles // Public Choice. 2009. Vol. 145. #3 P. 379-403.

[58] Gipp, B.; Breitinger, C.; Meuschke, N.; Beel, J. Cryptsubmit: Introducing securely timestamped manuscript submission and peer review feedback using the blockchain. In: Proceedings of theACM/IEEE Joint Conference on Digital Libraries (JCDL), Toronto, ON, Canada, 19–23 June 2017.

closed, with the exception of the Orvium[59] project (orvium.io), which has survived several crises and is actively developing.

2.3 The mechanisms of funding science in the modern world have also fell under much criticism lately. Those who allocate funds (states, foundations) strive for ever greater transparency and accountability and, most importantly, efficiency of spending – within the paradigm of new public management – the expansion of business models into social spheres (science, education, health care), when managers of science began to demand measurable, quantifiable results as well as planning of these results[60]. Scientists themselves express dissatisfaction with biased, cumbersome, non-transparent and inefficient funding procedures. Researchers have to spend more and more of their time writing reports, applications, and other bureaucratic tasks[61]. In addition, the state is gradually moving away from large-scale research funding[62].

In terms of saving time, reducing administrative costs and increasing the independence of scientists in funding their own projects, blockchain projects offer, at the very least, the possibility of creating an automated system of payment of funds through smart contracts, reducing the burden on the accounting department and scientists themselves. The same smart contracts allow tying, for example, the payment of grant funds when the conditions set by the funder or project manager (submission of a manuscript or publication of an article, provision of open data, a certain level of citation) or automatic return on non-fulfillment[63] – such an approach was implemented on the DEIP platform (deip.world). Another successful example, already from the public sector, is a project of the National Research Council of Canada, where Ethereum blockchain was used to publish amounts and purposes of government and private grants, in real time, available to the public[64].

However, automation and transparency are far from the most innovative possibilities offered by today's blockchain milieu. Entering the cryptocurrency economy is expected to allow scientists to raise funds from investors whose interests and views are very different from those of universities: that is, to publicly raise funding for scientific projects (even those related to basic

[59] Its white paper: https://docs.orvium.io/Orvium-WP.pdf
[60] Plerou V., Nunes Amaral L. A., Gopikrishnan P., Meyer M., Stanley H. G. Similarities between the growth dynamics of university research and of competitive economic activities // Nature. 1999. No. 400. P. 433-437; Shore, C. Op. cit.
[61] Widener A. Paperwork Paralysis. Federally funded scientists are overwhelmed by administrative tasks, but attempts to rescind regulations face challenges // Chemical and Engineering News. 2014. Vol. 92. No. 22. P. 20-21; Link A. N., Swann C. A., Bozeman B. (2008). A time allocation study of university faculty. Economics of Education Review. Vol. 27, No. 4. P. 363—374 https://doi.org/10.1016/j.econedurev.2007.04.002.
[62] Stephan, P. How Economics Shapes Science. Cambridge, Massachusetts: Harvard University Press. 2012.
[63] Van Rossum, J. Op. cit. P. 14.
[64] NRC-IRAP - Blockchain publishing prototype. URL: https://nrc-cnrc.explorecatena.com/en

science) by describing them in a way that interests a relatively wide range of people. Here, blockchain, according to the arguments of its enthusiasts, provides investors with some guarantee of protection against fraudulent projects: the original data and process of research development can be tracked, and fundraising can be tied to the achievement of certain results. Molecule Catalyst, a crowdfunding platform for basic research in drug development, is perhaps the most advanced project of its kind. Crowdfunding and the functionality of NFT-tokens[65] are thought to engage the general public in science, thereby realizing the goals of open science, accountable not only to the government, but also to society[66]. In addition, tokens[67], as a new and sufficiently flexible financial instrument, could be configured so that the confirmation of scientific research results by independent experts or their use in other works are immediately rewarded. In other words, within this circle of ideas and projects, it is assumed that tokenomics creates an additional channel for financing and implementing breakthrough ideas not only in applied, but even in basic science[68], and in this sense cryptoeconomic instruments can supposedly make scientists more independent, as new independent economic agents emerge in science, besides states, large grant funds and philanthropists (the latter goes in line with the libertarian ideology shared by many blockchain projects).

3. The image and ideology of science in blockchain solutions[69]

However, just as important as specific applied solutions, contemporary blockchain projects explicitly or implicitly claim to establish new, fairer rules of the game in science, and to "restructure" its administration[70], criticizing both the tyranny of scientometrics[71] and the growth of fake and unreproducible research, as well as the precarity of scientists. They propose to extend to science the principles of republican self-government already in place in other online

[65] Non-fungible token - a type of cryptographic token (see below for an explanation of this term), each instance of which is unique (specific) and cannot be exchanged or replaced with another similar token. It is a certificate of uniqueness of a digital object, which confirms the right to own a digital asset (artifact).
[66] Lyall, C., Tait, J. Beyond the limits to governance: New rules of engagement for the tentative governance of the life sciences // Research Policy. 2019. Vol. 48. #5. P. 1134-1137.
[67] Tokens are units of account within blockchain projects that are not cryptocurrency. They can also be defined as technologically secure abstract units of value, whose meaning and rules of circulation are determined by the user community. Most of the tokens that exist today are formed on the Ethereum protocol. Tokens enable tokenization - the creation of digital counterparts for real values in order to work with them quickly and securely.
[68] Bartling, S. Op. cit. P. 25.
[69] For more details on the results outlined in section 3, see Космарский А. А., Картавцев В. В., Подорванюк Н. Ю., Боде М. М. Трайбы и транспарентность: перспективы цифровых механизмов самоорганизации в российской науке // Мониторинг общественного мнения: Экономические и социальные перемены. 2019. №6. С.65-90.
[70] Bartling. S. Op. cit. P. 40.
[71] Muller, J. Z. Op. cit.

communities[72], and thus encourage open science, create new communities of scientists based on transparent rules fixed in the program code[73], and finally allow scientists themselves, through voting, to determine the priorities in their disciplines[74].

Our analysis of the interviews, as well as the corpus of manifestos and white papers of blockchain projects, allowed us to deduce the basic principles of the new normative image of science implicitly present there:

a) transparency;

b) de-bureaucratization (reduction of administrative costs, simplification of management procedures);

c) decentralization (no single point of decision-making);

d) participative democracy (group members contribute to decision-making, influencing the life of the group)

e) communitarianism (reliance on the opinion, voice and importance of the community in opposition to individual scientists)

f) collaborativity (instead of competition for status and priority - joint work on new problems, while the priority of discoveries is fixed quickly and reliably with, for example, blockchain).

Let us illustrate these principles of science organization with a list of selected influential examples of their realization - examples that often appeared in our interviews, as well as in the texts we analyzed (manifestos and white papers of blockchain projects):

1) Johan Bollen's model: In 2014. The SOFA (self-organized fund allocation) concept[75] was proposed by an Indiana University IT researcher to offer an alternative to the established grant system with its inertia, time-consuming application process, and often controversial principles of winner selection. Bollen's scheme eliminates the very need to pursue grants: it divides the entire research budget among scientists in equal, fixed shares. However, each of them is obliged to allocate a predetermined share of the sum to those whose projects he considers worthy. Thus, according to the SOFA concept, each year a scientist will receive, in addition to a fixed unconditional grant, a "floating" amount of funding from his or her colleagues - the "nodes" of the scientific community network (peers). Decisions in the model are made by human

[72] Бычкова О., Космарский А. (2021) Блокчейн как res publica: к политической генеалогии распределенного реестра // Философия. Журнал Высшей школы экономики. Том 5. №4. 2021. С. 175-200
[73] Berg, C. Delegation and Unbundling in a Crypto-Democracy. 2017. URL: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3001585
[74] Leible, S. et al. Section 5.3.2.
[75] Bollen, J.; Crandall, D.; Junk, D.; Ding, Y.; Börner, K. An efficient system to fund science: From proposal review to peer-to-peer distributions // Scientometrics. 2017. 110. P. 521–528.

participants of the platform, but mathematical algorithms can be used within it to avoid abuses. Bollen's scheme, although not yet implemented in public policy, has been extremely influential among the creators of new models of science funding, primarily due to its reliance on peer-to-peer funding of scientists to each other as equals (peer-to-peer funding, named by analogy with p2p networks)[76].

2) The mathematical blog Polymath: based on the principles of decentralized collaboration, it is an online platform, a collective blog together with a wiki-project, for the collaboration of theoretical mathematicians. Anyone is free to join: just start making suggestions for one of the existing projects (for example, proposing new proofs of a certain theorem). According to the results of the open discussion, the comments, depending on their quality and completeness, are either taken into account, or not taken into account in the general work. The results of research conducted on Polymath are published, as a rule, under the collective pseudonym D.H.J. Polymath, in honor of the first theorem to be proved by the project participants, the Hales ─ Jewett density theorem. The creator and participants of the project emphasize that this is a principled decision: joint participation in solving the problem is more important than personal authorship and a line in the CV. Instead of accumulating "merits" - building a reputation among participants.

3) Decentralized autonomous organizations (DAO) - one of the promising blockchain technologies: open, self-organizing networks of participants, the rules of interaction between which are prescribed in the code (smart contracts), and whose actions are carried out through tokens. They have been working for several years in the crypto-economic (financial) and IT sphere (Aragon projects, Genesis DAO). DAO for science may look like a network of scientists who come together for a common goal (collaboration), define the rules (what we do and how it is evaluated), fix the rules in smart contracts. Then activities begin: producing and curating ideas and texts, gaining reputation, voting and making decisions (about money, content, community composition, etc.).

4) European Open Science Datastream: Martin Etzrodt of the Swiss Federal Institute of Technology Zurich in 2017-2019 proposed a model of collective decentralized peer-to-peer work with scientific data, which would be an open-access data stream that accumulates the scientific

[76] Heller L., Blümel I. Co-Creating the Future of Research Funding? Observations & Ideas from the Literature (And What Else We Need). Talk Given at SEED 2019 in Davos, 25—28.02.2019. Hannover: Institutionelles Repositorium der Leibniz Universität Hannover, 2019. https://doi.org/10.15488/4457

work of connected researchers, research centers, and laboratories. Within the system, individual scientists will have the opportunity to compile and further enrich sets of the most promising, from their point of view, texts and databases, taking on a curatorial function. Anyone would be free to subscribe to such streams of scholarly content on disciplines and topics of interest to them. According to Etzrodt's idea, technologically the system will be based on a distributed registry (blockchain), which will make it possible to verify the origin of materials and their credibility (fixing the priority of discovery), as well as to avoid duplication of content - thanks to decentralized identifiers and cryptographic signatures. In addition, blockchain mechanisms will enable the recording and accounting of additional indicators for each scientific paper, including the number of views, downloads, and citations, to facilitate the formation of reliable "sub-streams" of scientific publications in a particular field. The system also provides opportunities for scholarly journals: it is from the continuous flow of texts and data that they will be able to select materials for publication, sponsoring curators who conduct the initial compilation of content.

It seems that the image of science behind these digital mechanisms is close to Michael Polanyi's classic work, The Republic of Science (implicitly directed against John Bernal)[77]. In this manifesto, polemically sharpened against planning and generally state - or other external - leadership of research, the scientist defended the model of science as an "independent coordination of independent initiatives," a spontaneous movement of collectives and individuals responding to each other's results, "guided by an invisible hand" along the path of progress. That is, blockchain solutions, especially the "republican" and decentralization-focused group of them, assume reliance on a community of individuals actively interested in the common good and shared decision-making[78].

4. The reaction of the scientific community. Fundamental reasons for the distrust towards new technology[79].

[77] Polanyi M. The Republic of Science: Its Political and Economic Theory // Minerva. 1962. Vol. 1. No. 1. P. 54-73. One of the leading blockchain theorists for science, Martin Etzrodt, writes about the importance of Polanyi.

[78] However, it is important to note that there is no unconditional relationship between the ideas and ideologies presented here, on the one hand, and blockchain technology: both our informants and ourselves (in Kosmarski, A. and Gordiychuk, N. Token-curated registry in a scholarly journal: Can blockchain support journal communities? // Learned Publishing. 2020, 33. P. 333-339) have drawn attention to the fact that these principles can be implemented by a variety of practical (and, in particular, technological) means. However, here it is important for us to emphasize precisely the importance of clarifying the ideologies and images of the science behind blockchain projects, since social and theoretical reflection on this topic is sorely lacking. On the implicit "republicanism" as the political ideology of other blockchain projects, primarily the popular cryptocurrencies Bitcoin and Ethereum, see our paper: Бычкова О. В., Космарский А. А. Блокчейн как res publica: к политической генеалогии распределенного реестра // Философия. Журнал Высшей школы экономики. Том 5. №4. 2021. С. 175-200.

[79] For more details on the results outlined in section 3, see: Космарский А. А., Картавцев В. В., Подорванюк Н. Ю., Боде М. М. Трайбы и транспарентность: перспективы цифровых механизмов самоорганизации в

4.1 The problem of "hype" and the immaturity of projects. Institutional inertia.

The analysis of empirical material collected in the above projects has shown that there is a tangible gap between the sensational reputation of blockchain technology (what even in academic publications is called "hype"[80]), and the real integration of DLT in the work processes of institutions and organizations, when its benefits are not obvious: "*It does not take much intelligence to simply say that our university will be the first to implement blockchain. But then what? Not every dean can even understand what it is. And those who do, know how much it costs to implement*"[81]. Importantly, at the time of this study, blockchain technology was in a transition from peak expectations to disillusionment and slow correction of deficiencies (within the Gartner cycle[82]), which created both a hype problem – abuse, by startups and marketers, of the term "blockchain" as a fashionable signboard, supposedly providing progressiveness, reliability, lower costs, new opportunities and other benefits[83] – and a mismatch between promises and expectations to concrete results[84].

Moreover, the functionality and interface of existing applications is still noticeably inferior to collaborative tools such as Google Docs or Facebook, which is actively used for scientific communication in Russia. Nevertheless, according to our survey, there is a certain demand among Russian scientists for new, unusual digital tools for scientific publications[85].

российской науке // Мониторинг общественного мнения: Экономические и социальные перемены. 2019. №6. С.65-90; Kosmarski, A. Blockchain Adoption in Academia: Promises and Challenges // Journal of Open Innovation: Technology, Market, and Complexity. 2020. Vol. 6. No. 4. Article 117; Kosmarski, A., Kartavtsev, V., Odinstov, A. Evading transparency, doubting democracy, dreaming big: grassroots perspectives on science governance in Russia // Problems of Post-Communism. 2022 (in print)

[80] Ralston S. Postdigital Prospects for Blockchain-Disrupted Higher Education: Beyond the Theater, Memes and Marketing Hype // Postdigital Science and Education. 2020, 2. P. 280-288.

[81] Interview with Russian informant #11, project "Network contracts (smart contracts) as a way to regulate and organize scientific activity.

[82] Pérez, J.M., Kreinovich, V. Gartner's Hype Cycle: A Simple Explanation // International Journal of Computing. 2018. 5, P. 1-4.

[83] Notably, several projects have quietly removed the word "blockchain" from their websites and descriptions as they pursue more or less specific and limited objectives, .e.g. the online university Woolf University (Gerard D. Woolf, the University on the Blockchain - or not. 26 May 2019. https://davidgerard.co.uk/blockchain/2019/05/26/woolf-the-university-on-the-blockchain-or-not/).

[84] См.: Condos, J., W.H. Sorrell, and S.L. Donegan Blockchain Technology: Opportunities and Risks. Vermont(Vermont), 2016. P. 1–35; Barber, G. What's blockchain actually good for, anyway? For now, not much. Wired, 28 October, 2019. https://www.wired.com/story/whats-blockchain-good-for-not-much/

[85] Here is the distribution of answers to the question of our survey: "In your opinion, what format of publication of the results of scientific work is the most relevant for a scientist at the moment (please, specify not more than 3 answer options)? ", sorted by frequency: "Scientific article in an authoritative open access journal" - 69.82%; "Scientific article in an authoritative journal" - 50.85%; "Monograph published digitally" - 28.74%; "Monograph published on paper" - 24.99%; "**It is necessary to completely review the way scientific research materials are published now and look for new formats to present the obtained knowledge with reliance on the Internet" - 20.97**%; "Publications in electronic media devoted to science" - 15.76%; "First of all, one should try to publish short communications or preprints on electronic platforms with open access" - 11.21%; "Publications on personal scientific blogs with general open access" - 7.32%; "Publications in specialized paper media devoted to science

Finally, the logic of cryptocurrencies and blockchain solutions developed in the same IT environment assumes values of individual utility and efficiency, whereas scientists, unlike, for example, traders or gamers, work within complex institutional structures. And the effectiveness of new digital solutions doesn't necessarily make them attractive to organizations: "*Yes, smart contracts can effectively regulate and count lab expenses and allocate the necessary funds. But we have an accounting department that's been working with these tasks for years, there are 50 people there, who's going to fire them?*"[86]. A separate problem is created by the uncertain legal status of cryptocurrencies, smart contracts and other blockchain tools in the Russian Federation: science belongs mainly to the public sector, and few are willing to take risks, because even using applications on Ethereum, including those far from financial transactions, involves buying "gas" (like cryptocurrency), and creates the risk of wrongdoing.

4.2 A conflict of values: science is not a business.

From an organizational and psychological point of view, the key element in the development of blockchain systems is incentive design: the creators consider what behavior of system participants would be rewarded and what behavior would be penalized[87]. This mechanism itself is built on tangible incentives. In Bitcoin, the most influential cryptocurrency now, incentives are "sewn into" the system so that people are not required to make decisions all the time, but when this logic is extended to other areas where non-human actors, in Latour's terminology, operate, difficulties arise: people are far from the ideal rational subject model, subject to cognitive distortion, herd behavior[88], and often prefer short-term benefits for themselves to long-term benefits for everyone.

In addition, the "tokenization" of science is repulsive for the reason that for scientists the thirst for recognition and the pursuit of truth, as well as intangible stimuli for activity in general, are no less and sometimes more important than material ones, which, incidentally, also applies to other creative spheres of human activity[89]. The introduction of quantitative metrics and market mechanisms is perceived by many scientists among our informants as a profanation of science. And the market logic (when everyone strives to maximize their own profits) atomizes the

(journalistic/educational publications)" - 5.52%; "Publications in traditional paper media of wide profile" - 2.39%; "I find it difficult to answer" - 1.05%.

[86] Interview with Russian informant #3, project "Network contracts (smart contracts) as a way to regulate and organize scientific activity.

[87] McConaghy T. Can Blockchains Go Rogue? (February 27, 2018). URL: https://blog.oceanprotocol.com/can-blockchains-go-rogue-5134300ce790

[88] Banerjee, Abhijit V. A Simple Model of Herd Behavior // Quarterly Journal of Economics. 1992. 107 (3). P. 797-817.

[89] Jindal-Snape D., Snape J. B. Motivation of scientists in a government research institute: Scientists' perceptions and the role of management // Management Decision. 2006. Vol. 44, No. 10. P. 1325-1343.

scientific community, undermining the already crumbling ethos of the collective search for truth (where the common goal is more important than individual career success)[90]. In fact, an analysis of the new projects points to the dilemma of an emerging social practice: blockchain is supposed to build an autonomous, self-regulating system of science run by scientists themselves, a self-governing sphere stimulating scientific progress – but it is based on the race for material rewards (and the imperative to constantly attract investment from the "crowd" of anonymous potential "sponsors").

4.3 Rejection of the new image of science and its political implications

According to the data we collected, the most frequent and well-reasoned criticism was met not by technical solutions in the framework of blockchain projects (i.e. efficiency), but by the new image of science behind them and the principles of governance they imply – transparency, decentralization, academic self-governance[91]. The Russian scientists we surveyed have a negative or indifferent attitude towards the practice of self-governance (including its digital form), which is intended to democratize the sphere of their professional activity and provide tools to defend their own position in the dialogue with the authorities. The main argument that was made about the problematic nature of digital self-governance was that the existing "mafias" and "cliques" in science, even in a collective, decentralized and debureaucratized decision-making environment, would manage to maintain influence and adapt any technological and communication tools to their needs. Moreover, an open and transparent model of self-governance runs the risk of creating an even greater divide among scientists and disrupting the established system of reciprocal relationships:

Respondent № 2: When we held a competition for papers at our institute, there was also a voting system, and a very respectable, elderly employee of the institute came up to me and said: "Seryozha, it's not who casts the vote that matters, but who counts.

Moderator: And everyone is counting?

Respondent #2: The system, which is made up of the same people, counts anyway, you know.

Respondent #3: Absolutely, that's how to deal with these clicks, it's completely unclear.

[90] Merton R. K. The Normative Structure of Science. In: The Sociology of Science: Theoretical and Empirical Investigations. University of Chicago Press: Chicago, IL, USA, 1973, P.. 267–278; Higginson A. D., Munafò M. R. Current Incentives for Scientists Lead to Underpowered Studies with Erroneous Conclusions // PLOS Biology. 2016 https://doi.org/10.1371/journal.pbio.2000995

[91] Leible, S. et al. Op. cit.

Respondent #2: You see, Semyon Semyonovich will come to me and say, "Well, you know, there is such a word as 'must'. I say straight away that this model will work this way a priori. Knowing our mentality. Yes, I think that even not our mentality, I think that in Europe it will be the same[92].

Respondent No. 1: Just pile up those who know who. The same factions.

Moderator: Are we just giving another tool here for these factions to form in essence?

Respondent #1: The consensus won't come out, just the opposite, right?

Respondent #2: A strong one will emerge and squeeze the others out at the vote.

Respondent #3: Not strong, but brazen.

Respondent #1: There will be coalitions formed that will help each other in exactly the same way. They will do anything to solve their problems[93].

Distrust of colleagues and unwillingness to participate in a system where funding of your research depends on them (an analogue of the peer-to-peer funding model) was also evident in the survey, where the hypothetical model of such a system was not approved by 53.04% of respondents (supported – 26.74%, found it difficult to answer – 20.22%)[94].

Also actively articulated on the part of the informants is the rejection of the very need for civic engagement within science, including public discussions, as inconsistent with the goals and objectives of a scientist, or rather, with the lifestyle of a scientist (in the respondents' worldview):

Respondent #1: What's all this for? There are people who don't like to play.

Respondent #2: It's not a game. It's an obligation to take part in the life of the scientific community.

Respondent #1: The main duty of a scientist is to do science, not to participate in the community. That is, not games, but the real thing. Work on the task at hand. To solve problems[95].

[92] Focus group, scientific institute (natural sciences, Moscow), held as part of the project "Digital mechanisms of management and self-organization of the scientific community as a necessary condition for a scientific and technological breakthrough".

[93] Focus group, university (technical sciences, St. Petersburg), held as part of the project "Digital mechanisms of management and self-organization of the scientific community as a necessary condition for a scientific and technological breakthrough".

[94] An option "A system where there is no need to compete for grant funding and no need to apply; instead, all scientists receive an equal share of the research budget allocated to them from the state. At the same time, they are required to donate a fixed percentage of that amount (e.g., 50%) to colleagues whose work they respect and consider important" from the survey question "Do you agree that the following initiatives to digitize scientist interaction would be useful (please give one answer for each line)?" (rather agree, rather disagree, difficult to answer).

[95] Focus group, scientific institute (humanities, Moscow), held as part of the project "Digital mechanisms of management and self-organization of the scientific community as necessary conditions for scientific and technological breakthrough". The survey, however, showed a more contradictory picture - at least at the level of

In the course of the dissertation research it became clear that transparency and open public discussion are threatening factors for Russian scientists, because they imply an escalation of the conflict within the community, a Hobbesian war of all against all[96]. Such a position runs counter to Bourdieu's important argument[97]: the main struggle in the field of science between competing forces is over determining the rules of the game, which are binding for all (what is "good" and "bad" science, what is prestigious and what is not, etc.). Any active work on framing a public discussion, formulating the objectives of science, its goals, and self-governance, is viewed with suspicion. That is, no matter who demands transparency, accountability and publicity from scientists - it could be the state, it could be new digital tools, it could be Dissernet - such demands are met with hostility. With all the possible benefits, these mechanisms appear to the Russian scientists we surveyed as a Pandora's Box, the opening of which threatens to disrupt a system that is far from optimum, but functional. It is likely that these results indicate a high basic level of distrust of scientists toward their closest colleagues and the scientific community as a whole. And, for the same reasons, when speaking out about DAOs and new self-governance mechanisms on blockchain, informants speak of their lack of time and reluctance to participate in community activities that require active participation, discussion, voting, and other commitments of participatory democracy[98]:

"*The state is motivated to use blockchain to investigate research fraud. The state, the university, not the scientists themselves. We planned to build the whole process of evaluating publications and dissertations at our university on blockchain. But the project failed because no one was motivated. Everyone cares only about their own data, not about checking and evaluating the contributions of their colleagues.*"

Scientists (at least in Russia) carve their own criteria for the quality of scientific papers, and systems to assess the personal qualities of individual colleagues. At the same time, as a rule,

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declarations. With the closure of the "Online platform for discussing scientific papers and making decisions regarding the distribution of funding. The platform is divided into platforms according to scientific disciplines. Decision-making within each discipline relies on the consensus of the entire community, rather than the opinion of individual experts or the administrative weight of leaders. The main focus of the platform is for scientists to present their research projects and for the community to discuss and community voting" of the above question 57.48% of respondents agreed, 24.88% disagreed, and 17.64% found it difficult to answer.

[96] Thivet D. Thomas Hobbes: a Philosopher of War or Peace? // British Journal for the History of Philosophy. 2008. 16(4). P. 701-721

[97] Бурдье П. Клиническая социология поля науки // Социоанализ Пьера Бурдье. Альманах Российско-Французского центра социологии и философии Института социологии Российской Академии наук. СПб., 2001. С. 19-35.

[98] Pateman, C. Participatory Democracy Revisited // Perspectives on Politics. 2012. No. 10. P. 7-19.

members of the community try not to disclose these criteria themselves, probably because visibility and accountability, from their point of view, can destroy the established foundations of their existence.

Respondent #1: We perfectly well understand who is who and what we are.

Respondent #2: And the state does not.

Respondent #3: And the state won't.

Respondent #2: Semyon Semyonovich is an academician, but my personal evaluation is enough for me as a scientist. I know what Semyon Semyonovich is.

Moderator: Is it possible to transform this intuitive internal reputational system into something more visible and formalizable?

Respondent #3: Is that really necessary?

Respondent #2: My answer is no and no. Neither is it necessary, nor is it possible[99].

It turns out that scientists, while criticizing the existing system of applied scientometrics and reporting (it is imposed by the state, cumbersome, requires quantity rather than quality, does not take into account monographs and publications in many accessible journals, etc.), do not want the state to replace external, "vertical" scientometrics with a "grassroots" horizontal one, one that can be provided by decentralized DAO mechanisms, based on the consensus of a particular professional community and operating on transparent rules.

Key conclusions of the study

1. This dissertation study is the first in Russian academia to analyze the possibilities of applying blockchain technology to the organization of scientific activities. The main difficulties and problems arising from the integration of blockchain into the daily practices of scholars are considered: the conflict between the democratic potential of the new technology and its use in the new tools of reporting and control over researchers; the danger of exclusively monetary motivation for scientists (tokenization), etc. The obstacles and problems described above do not necessarily mean that blockchain solutions have no future in academia. However, these solutions should be accepted by the academic community and, even before that, discussed and tested.

[99] Focus group, scientific institute (natural sciences, Moscow), held as part of the project "Digital mechanisms of management and self-organization of the scientific community as a necessary condition for a scientific and technological breakthrough".

2. Our results lead us to a number of sociologically important generalizations. First, there is a profound contradiction between two images of the network (a metaphor going back to J. Barnes[100]) – in blockchain projects and in the academic community. Developers of digital solutions that involve scientists (or other agents/users, as in cryptocurrencies) perceive the network (the multitude) as relatively "smooth" and homogeneous. This implies equal "weight" of interactions between its nodes – there is an image of a multitude of independent individuals easily and freely entering into relations with each other; the network is thought of as an open, unstable structure with impermanent membership, permeating institutional boundaries. Other agents (including our respondents) see the structure of the network as dense, full of stable tribes (cliques) – i.e., the areas of increased and decreased tension. In other words, transparency and decentralization of governance is doomed in advance because the structure of power relations, the gap between influential and ordinary members, will be reproduced in the "digital" milieu as well; it is remarkable that these fears are present in crypto-projects too – in discussions that behind the many ordinary participants (nodes, token holders, etc.) are oligarchs, "whales"[101] who actually manipulate the system in their favor, thanks to the resources concentrated in their hands. This intuition certainly requires further elaboration in new research.

3. Second, blockchain and what is happening around it is one of the newest episodes of the macro-historical process of quantification, forced transparency and unification that characterizes modern societies, as well as resistance to this process[102]. Like compulsory scientometrics in modern universities, blockchain projects in science transform, for example, scientific reputation or communication - what used to be informal, relying on personal contact and tacit knowledge[103], and closed to outsiders - into something open, taking place in transparent digital environments, relying on explicit rules, up to and including automation.

This process, in turn, is caused not only by the desire for control and predictability on the part of managerial forces outside the relatively autonomous field of science, but also by the macro-historical shift of science from small communities of knowing scientists to a large mass of outsiders (by analogy with the modern city in G. Simmel's interpretation) who need quick "read-

[100] Barnes, J. Class and Committees in a Norwegian Island Parish // Human Relations. 1954. Vol. 7. No. 1. P. 39-58.
[101] Das, L. Crypto whales — why they matter and how you can track them // https://www.okex.com/academy/en/crypto-whale-transaction-analysis-ways-to-monitor/
[102] In the political economy tradition, this approach goes back to Karl Marx and his conceptualization of capitalism; in the micro-practices of power and resistance, to M. Foucault's work on biopolitics. If we talk about more neutral and more close to the sociology of science and technology, then for this tradition are important, first of all, the following works: Hacking, I. The Taming of Chance. Cambridge: Cambridge University Press, 1990; Mitchell, T. Colonizing Egypt. California University Press, 1991; Porter, Th. Trust in numbers the pursuit of objectivity in science and public life. Princeton: Princeton University Press, 1995.
[103] Collins, H. Tacit and explicit knowledge. Chicago: The University of Chicago Press, 2013.

out" heuristics of a counterpart's status and simple rules of contractual interaction to communicate adequately. The fact that blockchain projects have the greatest response in rapidly developing disciplines, where many "outsiders" work (biomedicine, first of all), rather than in small communities of, say, philologists, is evidence of the connection with this process.

4. Third, our study (especially sections 4.2-3) makes us take a fresh look at the current debate on the principles of science organization, which is built primarily around the opposition of collegiality (academic self-government) vs. managerialism: scientists around the world are quite critical of the introduction of KPI-based principles of science management, since this trend leads to precarity and impinges academic freedom. On the other hand, managers of academia believe that the development of science at the present stage of social production of knowledge is impossible in traditional formats (invisible college, republic of scientists, science of gentlemen, etc.), and science should be controlled: transparent, accountable (to administrators and management), and its results – productive and quantifiable in the form of metrics and ratings.

However, the data collected in the course of this dissertation research show that the opposition of "collective self-governance of scientists vs. managerial management" is not functioning properly in Russia. Scientists (at least, Russian scientists), on the one hand, do not like when external rules of the game are imposed on them (metrics, necessity of publishing, increase of reporting and, accordingly, purely bureaucratic work), and on the other hand, they do not want to engage in self-government because in most cases "self-government" is understood as shifting administrative work and responsibility from managers to scientists themselves (this was pointed out in his studies of Russian universities by M. Sokolov[104]). Looking at the situation from this angle, the (sometimes paradoxical) conservatism of the scientific community becomes understandable, rejecting both attempts to establish external hierarchical management and innovations associated with the idea of participatory and decentralized management. Scientists see their purpose as being to do science, not “politics”, or trying to make their work transparent to an abstract “society”. In Russia the level of social atomization is extremely high[105], which also raises the question of the existence of a collective subject (“society” or “scientific community”) for whose benefit any efforts should be made. Thus the low popularity of those digital tools of scientific production which are not related to the organization of bibliography, access to texts,

[104] Соколов М. М., Лопатина С. Л., Яковлев Г. А. От товарищества к учреждениям: конституционная история российских вузов. // Вопросы образования. 2018. № 3. С. 120-145.
[105] See numerous studies indicating a relatively low level of generalized trust in Russia, e.g. World Values Survey: Авдеева, Д. А. Доверие в России и его связь с уровнем экономического развития // Общественные науки и современность. 2019. № 3. С. 79-93.

data-mining, etc., but to the possibilities of academic self-management – DAO and the like – becomes more understandable.

5. The materials presented in this dissertation study were collected in 2018-2020, during the "first wave" of blockchain's venturing outside the cryptocurrency sphere – and this wave and our results are interesting not as a series of success stories, but rather as lessons from the collision of two different worldviews. The main limitation of our research has more to do with the limited and sporadic contact between the blockchain and science fields than with the scarcity of cases or respondents. However, it is too early to describe the above conflicts as a thing of the past. Despite the global turn toward "state-run" blockchain in 2020-2021 (e.g., the simultaneous introduction of a ban on mining and the transition to the digital yuan in China), and, more generally, the increase in state sovereignty in the era of the pandemic, there is now a new wave of international blockchain projects – related primarily to DAO and tools to attract funding for scientific research. They do not appear to be moving through the stages of the Gartner cycle toward practical implementation and prevalence, but rather represent a new rise on the cusp of expectations and unusual solutions. Therefore, the problems we have identified (the conflict between the idea of science as a business and its communitarian-value dimension, the rejection of transparency, the skeptical attitude to self-governance) do not lose their relevance. It seems that an in-depth research (case studies) of individual blockchain projects and, in particular, those aimed at the commercialization of scientific developments with the tools of cryptoeconomics – research carried out in the paradigm of economic sociology –could be a fruitful development of the problems raised in this dissertation.

List of publications by the author of the dissertation that reflect the main research findings of the dissertation

Articles presented to the defense:

1) Космарский А. А. Блокчейн для науки: революционные возможности, перспективы внедрения, потенциальные проблемы // Мониторинг общественного мнения: Экономические и социальные перемены. 2019. №2. С. 388-409. https://monitoringjournal.ru/index.php/monitoring/article/view/580/550
2) Космарский А. А., Картавцев В. В., Подорванюк Н. Ю., Боде М. М. Трайбы и транспарентность: перспективы цифровых механизмов самоорганизации в российской науке // Мониторинг общественного мнения: Экономические и социальные перемены. 2019. №6. С.65-90.

   https://doi.org/10.14515/monitoring.2019.6.05
3) Kosmarski, A. and Gordiychuk, N. Token-curated registry in a scholarly journal: Can blockchain support journal communities? // Learned Publishing. 2020, 33. P. 333-339. https://onlinelibrary.wiley.com/doi/abs/10.1002/leap.1302
4) Kosmarski, A. Blockchain Adoption in Academia: Promises and Challenges // Journal of Open Innovation: Technology, Market, and Complexity. 2020. Vol. 6. No. 4. Article 117

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Additional publications:

1. Kosmarski, A., Kartavtsev, V., Odinstov, A. Evading transparency, doubting democracy, dreaming big: grassroots perspectives on science governance in Russia // Problems of Post-Communism. 2022 (accepted for publication)

2. Kosmarski, A. and Gordiychuk, N. (2021), Anthropology and blockchain. Anthropology Today, 37: 1-3. https://doi.org/10.1111/1467-8322.12683

3. Бычкова О. В., Космарский А. А. Блокчейн как res publica: к политической генеалогии распределенного реестра // Философия. Журнал Высшей школы экономики. Том 5. №4. 2021. С. 175-200. https://doi.org/10.17323/2587-8719-2021-4-175-200

4. Космарский А. А. Внедрение блокчейн-технопогий в сферу науки: проблемы и трудности // Информационные ресурсы России. 2021. № 1 (179). С. 9-14.

5. Антопольский А. А., Космарский А. А., Гордийчук Н. В. Смарт-контракты в научной деятельности: правовые аспекты // Информационные ресурсы России. 2019. №5. С. 37-43.

Approbation of research findings

1) Report "Blockchain for Science in 2022: Problems, Chances, Prospects," Interdisciplinary Conference "Blockchain Technologies in Science and Education: Achievements, Problems, Prospects" (22.01.2022, State Academic Institute of Humanities, Moscow), https://gaugn.ru/media/news/blokcheyn-tekhnologii-v-nauke-i-obrazovanii-dostizheniya-problemy-perspektivy/

2) Report "Blockchain and Smart Contracts in Academic Activity: Transparency and Decentralization as Images of Future Science" (XVII Taurida Philosophical Readings "ANAHARSIS", section "Duty, Norm and Scientific Knowledge in Foreseeable Future" (Feodosia, 17.09-19.09.2021), http://anacharsis.cfuv.ru/pdf/ISBN_Sbornik_Anakharsis_2021.pdf

3) Online paper "Trust, Data, Decentralization: fundamental problems of blockchain implementation beyond cryptocurrencies" (with participation, as a discussant, of I. A. Tarkhanova, Ph. FIC IS RAS, Associate Professor of the Department of Engineering Cybernetics of the National Research University MISIS), 29.10.2020, https://neon.university/en/seminarDetail/45678

4) Presentation at the section "Naukometrics 2.0: Digital Reboot" at the Gaidar Forum, 15.01.2020, https://mrm.ranepa.ru/news/?ELEMENT_ID=277698

5) Presentation at the extended collegium of the Ministry of Science and Higher Education of the Russian Federation, 16.12.2019

6) Report "Digitalization of science and self-organization of scientific community: what do scientists want?", general meeting of interregional public organization "Society of scientific workers", 13.12.2019 (video broadcast: https://www.youtube.com/watch?v=p6lKs2NdJHw)

7) Paper "Introducing blockchain to academia: why scientists are so hostile and wary - and what can we do about it" at the 2nd International Conference on Blockchain and Web3 for Science, Research and Knowledge creation, Berlin, 4-5.11.2019 (https://www.youtube.com/watch?v=ipRdX6p9kx0)

8) Report: ""Science is not a game": challenges of introducing novel funding and evaluation tools in academia", organized under the auspices of the Open Science Lab at the Technische Informationsbibliothek (TIB) of the University of Hannover, 30.10.2019 (https://www.tib.eu/en/service/events/details/moscow-researcher-artyom-kosmarski-gives-lecture-on-blockchain-topic-in-science-at-the-tib/)

9) Paper "Blockchain and smart contracts for scientific journals: hype or salvation?" at the scientific conference "SCIENCE ONLINE: electronic information resources for science and education", May 26 - June 2, 2019, Spain (https://elibrary.ru/projects/conference/majorca2019/program.pdf).

10) Paper "DAO and smart contracts as tools for scientists' self-organization", as part of the workshop "Blockchain and smart contracts in science organization: promising cases and unsolved problems", European University in St. Petersburg, St. Petersburg, May 20, 2019 (https://eusp.org/news/blokchejn-i-smart-kontrakty-v-organizatsii-nauki-perspektivnye-kejsy-i-nereshennye-problemy)

11) Presentation at the round table "Problems and Prospects of Blockchain Application in Science and Scientific Journals" (as part of the IX Grushin Sociological Conference, Moscow, March 21-21, 2019 (https://profi.wciom.ru/fileadmin/image/page/nauka/grusha2019/New%20programms/26.pdf)