Science and technology agenda of Russian business magazines: Topical and thematic analysis (2017-2021)[1]

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Abstract
The study of the science and technology agenda of leading Russian business magazines *Expert, Profile,* and *Forbes Russia* covered the period between 2017 and 2021 and used analytical publications on technology innovations as an example. The study showed that the main driver of innovative development of the economy from the perspective of business media outlets are digital technologies at the stage of implementation and diffusion, developed and embraced by experts from Russia and leading innovation countries, most particularly the U.S. and China. However, certain current trends in science and technology development were underreported by business media, and the smallest number of publications addresses innovations in the basic sectors of Russia's economy.

Keywords
Science and technology development, technology innovation, science journalism, analytical journalism, business journalism, business media, business magazines.

Introduction
Due to the rapid advances and spread of new technology and its unprecedented impact on the economy and society, the editorial boards of business media

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outlets have increased their focus on topics related to scientific innovations. By performing their key function of providing useful for making business decisions information (Terchenko, 2021) and ensuring communication between business process participants (Amirov, 2018; Business Journalism, 2012), the business media inform them about commercially viable research and development and analyze the performance of high-tech companies and innovation policy issues. Notably, the target audience of the business media includes entrepreneurs, investors, scientists, engineers, public servants, and representatives of civil society, that is, all the main actors of the national innovation system (Kudina, 2018). Therefore, the business media can act as a tool for responding to the challenges of Russia's scientific and technological development, first of all, by "supporting all stages of the 'life cycle' of knowledge through an efficient system of communication in the field of science, technology and innovation, higher susceptibility of the economy and society to innovation, and the development of knowledge-intensive business"[3].

Research has shown that high-quality business media outlets can impact decision-making in the innovation policy of the state (Waldherr, 2012, Nordfors, 2004a; 2004b) and the development of knowledge-intensive sectors of the economy, such as medicine (Haider, 2004) or the nuclear industry (Gamson, 1989). The impact is partly due to the lack of in-depth knowledge of high technology in most readers, so they are forced to rely on information from the media, which are the main channel providing information on scientific and technical achievements and challenges to society (Vakhrameeva, 2018; Latov, & Latova, 2018). Since business media outlets both reflect and impact processes in the economy, it is important to study their science and technology agenda not only for practitioners and theorists of the media sphere but also for innovation policy experts (Ilchenko, & Frolova, 2021).

Despite the relevance of the topic, scientific and technological issues in the business media rarely become the subject of media research. The attention of researchers is mainly focused on studying the media representation of individual thematic blocks, for example, physics (Kristensen et al., 2021), energy technologies (Ter v inen, 2014) or the work of science and technology centers (Illman, & Clark, 2008). The empirical base is often news messages (Strooban et al., 2019; Weaver et al., 2009) published in print and online news media, the content of which is often analyzed using specially designed software (Groves et al., 2016). Analytical journalistic materials published in the journal-format

[3] State Program "Scientific and Technological Development of the Russian Federation". Available from: http://government.ru/docs/36310/

media are practically not studied. The exceptions are popular science journals (Ricci, 2010).

In Russian scientific media discourse a small number of works are devoted to the study of media discourse on innovation-driven growth and its individual trends based on the analysis of a wide range of mass media, including some business media (Toganova et al., 2016; Latov, & Latova, 2018). These papers have identified a steady growth in the number of publications on technology innovations and analyzed the topics of publications and the relationship between technology and socioeconomic factors reflected in them. However, the research methodology used by the authors raises a number of questions. The publications were analyzed using Exactus Expert and Medialogiya intelligent systems over the entire range of the selected media outlets. The decision to include completely different outlets, e.g. the popular newspaper *Moskovsky Komsomolets* and the business weekly *Expert*, in the total sample and to consider short news items on a par with long analytical publications does not seem quite correct. We believe that if the specific features of text genres, types and kinds of mass media were taken into account, the findings would be more precise and the conclusions more correct. Our research focuses on overcoming the chaotic and ambiguous nature of the topical and thematic empirical basis and providing more specific and in-depth content-related characteristics of the array of texts on science and technology innovations, which is presented in business magazines and potentially relevant to our objectives.

Research topics can be divided into three groups: the study of the phenomenon of science popularization in the media, the science popularization as a type of mass communication, its history, current state, and development prospects (Diveeva, 2014; Vaganov, 2014; Anikina et al., 2015; Emelyanova, & Omelaenko, 2015; Lobodenko et al., 2022, etc.); typological and profile features of popular science media (Makarova, 2013; Ovchinnikova, 2015; Parafonova, 2017; Ilchenko, 2018; etc.); professional duties of science journalists, principles of creation and evaluation of the quality of popular science content in the media, the study of science news (Frolova, 2015; Frolova et al., 2016; Gurova, 2016; Ilchenko et al., 2017; Kolesnichenko et al., 2018; Yudina et al., 2019; etc.). One thing that the above studies have in common is their approach to defining the concept of science "as a sphere of human activity, the general function of which is the development and theoretical systematization of objective knowledge of reality. The immediate goals of science are description, explanation, and prediction of processes and phenomena of reality" (Frolova, 2015). When researchers consider science as an object of reflection in the media, they determine the problem and theme-related aspects that form the

subject area of journalistic texts: scientific knowledge as such; people of science as subjects of scientific activity; facts of science, sensational discoveries, and the inception of new disciplines; the social role of science as a social institution and a special sphere of spiritual production; the socioeconomic platform of science (Suvorova, 2013).

However, when considering the topical and thematic areas of publications, authors often limit themselves to ranking the social/liberal, natural, and engineering sciences discussed in journalistic texts (Makarova, 2013), without going further to analyze the process of scientific and innovation activities, their various stages and nuances that may be reflected in publications. This approach can hardly be applied to the study of journalistic publications focusing on knowledge-intensive business and the impact of new technology on the economy and society, where descriptions of the fundamental and applied results of scientific work are not the only aspect of the presentation. This leads to the understanding that researchers should focus on the study of analytical journalistic texts about technology innovations. The key difference between business media and other types of mass media is their analytic character and high quality of journalistic examination of topics (Vyrkovsky, 2009). These are the texts where business journalism rises to eminence in its profession and fulfills its social functions to the full; science and technology issues are examined more deeply and thoroughly, revealing features that were never known before.

As part of the research project "Technology Innovations as an Object of Journalistic Analysis in Business Media", a methodology was developed to study analytical publications on technology innovations using a wide range of parameters, including topical and thematic, functional, genre, and visual characteristics of publications (Ilchenko, & Frolova, 2021). During the first stage, a quantitative analysis of journalistic publications on technology innovations was made in printed issues of business magazines for the period between 2017 and 2021 (Frolova et al., 2022). The next stage allowed us to identify the key areas of science and technology development that are the focus of analytical journalists of business mass media and to rank the economic sectors developed by them.

Methods and interim research results

The timeframe of the research spans from 2017 to 2021. The five-year period makes it possible to describe the present-day media image of the innovation technology sector after the Strategy for Scientific and Technological Development of the Russian Federation, which outlines the national science and technology

policy, was approved by Presidential Decree No. 642 of December 1, 2016. The empirical basis of the study was the journalistic content of three business journals of the universal theme, which occupy a leading position in the Russian media market in their typological niche both in terms of circulation and citation: the monthly *Forbes Russia* and the weekly *Profile* and *Expert*. During this time period, we analyzed all 481 copies of *Forbes Russia, Profile*, and *Expert* magazines printed in this period, including 60 copies of *Forbes Russia*, 198 copies of *Profile*, and 223 copies of *Expert*.

During the content analysis, we selected journalistic publications that met two main criteria. *The first criterion* is related to the publication genre: the sample included texts of exclusively analytical journalistic genres, such as expert interviews, recommendations, forecasts, comments, reviews, ratings, opinion columns, case studies, news features (or trend articles), and analytical articles (Business Journalism, 2021). All these genres are distinguished by their analytical way of reflecting reality, which has specific target, topical and methodological features (Tertychnyy, 2013), i.e. it presents not only a description of a subject or phenomenon in the text, but also offers an explanation or evaluation for such a subject or phenomenon and suggests how it may develop and, in some cases, what should be done. *The second criterion* identifies the subject boundaries of publications, i.e. the development, implementation, application or potential use of technology innovations.

It is worth noting that this paper only considered *technology innovations* represented in the theory of innovation management by two types, product and process innovations. (Innovation Management, 2019). *Product innovation* is the development and introduction of technologically new or significantly improved goods and services. It can include new uses or combinations of existing knowledge and technology. Product innovations include new goods and services; significant improvements in the functional or user characteristics of existing goods and services; new uses; new designs. *Process innovation* is the implementation of technologically new or significantly improved production methods, including product delivery methods. Process innovations include new or significantly improved production methods; new delivery methods; new or significantly improved methods for the creation and provision of services.

The final sample consisted of 1,068 publications of analytical genres specifically devoted to new technologies (see sample publication: Krasnova, 2021) and publications with an explicit science and technology narrative (see sample publication: Proskurnina, 2017) (Table 1). The latter category of texts includes, in particular, publications on knowledge-intensive business

development, which, in addition to an overview of the technology (either developed or used), refer to companies' development strategies and financial performance (see sample publication: Geval, 2018).

Considering the challenges faced by traditional print media around the world (Okon et al, 2022; Rani, & Naik, 2022), it is worth noting that all the selected publications about technological innovations were published not only in print versions, but also in electronic versions of the studied business journals that are more in demand among modern audiences.

Table 1

Number of analytical publications on technology innovations in 2017-2021 (abs.)

Media outlet / Year	2017	2018	2019	2020	2021	Total
Forbes Russia	31	28	32	15	34	140
Profile	43	63	76	59	52	293
Expert	112	108	134	126	155	635
Total	186	199	242	200	241	1068

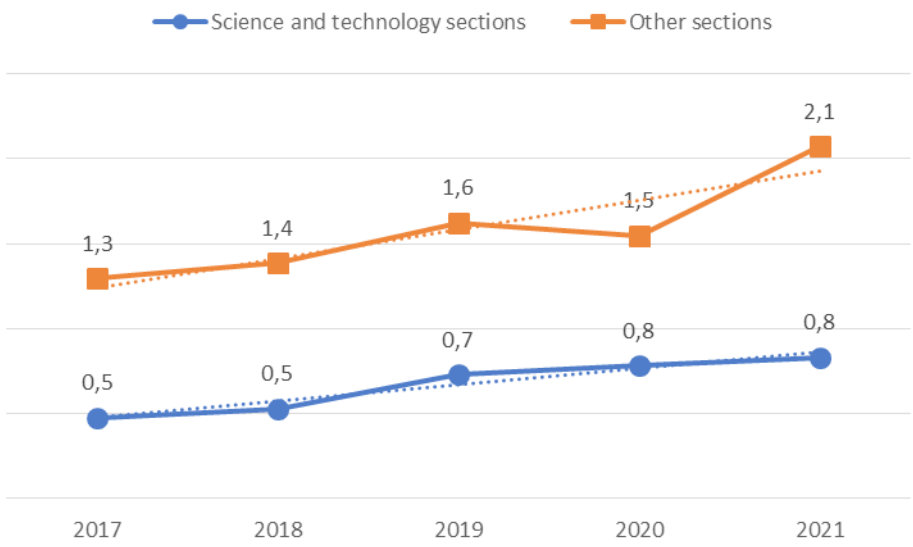
In addition to the number of publications, the following parameters were recorded: the volume of each publication (page count), the number of magazine issues per year, and the total number of magazine issues per year (number of pages). This data made it possible to mitigate the COVID-19 pandemic factor represented by the decline in the number of copies and the volumes of business magazines in 2020-2021. To make a relevant assessment of science and technology topics in the content of business magazines, the average number of analytical publications on innovative technologies per magazine issue and a similar indicator for the average share of such publications by volume (% of the magazine volume) were calculated. Both indicators trended steadily upward, with the average number of analytical publications on new technologies per magazine issue growing from 1.8 in 2017 to 2.9 in 2021, and the average share of analytical publications by volume increasing from 8.6% in 2017 to 11.9% in 2021.

We reviewed the headings of the sections where analytical journalistic publications on technology innovations appeared and come to an unexpected conclusion: most of the texts under study were published in sections such as *Entrepreneurs, Business and Life, Investments, Economics and Finance,*

International Business, etc., where business development, main events, business problems and trends are discussed, rather than in specialized science and technology sections (*Technologies, Science, Innovations, Space*, etc.). Moreover, the identified increase in the volume of science/technology topics was, to a greater extent, due to non-specialized sections. This is corroborated by the data on the changes in the average number of publications in the science and technology sections vs. other sections per magazine issue per year (Graph 1). For non-specialized sections, this indicator increases faster. This can be explained by the unprecedented influence of the new technological revolution on social and political processes, the economy and business, which results in an increasingly important role of the science and technology aspect in the journalistic analysis of the business sphere (see Frolova, Ilchenko, & Striga, 2022).

Graph 1

Average number of publications on technology innovations: Growth dynamics



The purpose of the next stage of our research was a topical and thematic analysis to identify the main areas of innovation and technology activity. In addition, each publication was examined to determine the geographical location and stage of the life cycle of the technology innovation described in the publication. Content analysis was used as the main method of text analysis. Hence, the categories of analysis included *"areas of science and technology*

development", "geolocation of innovations", and *"stages of the life cycle of innovations"*. Codifiers, i.e. features of the categories of analysis, were based on the study of academic literature and supplemented during the content analysis of publications. Identification, i.e. assignment of the publication to a certain feature of the analysis category, was determined by the content of the text: the factors that improve the definition accuracy for these parameters were the large volume (4.2 pages on average) and analytical nature of the texts under study, which suggests that the subject of the publication was given full consideration.

Let us discuss the sources of the codifiers in more detail. To identify the *areas* of science and technology development, we relied on a wide range of theoretical research on the issues of innovative economic development (Dezhina, & Ponomarev, 2020; Innovative Economy, 2019; Oganesyan et al., 2018; Maslennikov, 2017; New Technological Revolution, 2017; Ponomarev, & Dezhina, 2016; Schwab, 2016; Glazyev et al., 2014; Lebedev, & Kovylin, 2012; Averbukh, 2010, etc.). The trends in science and innovation activity are largely shaped by the typical features of the current fifth and the emerging sixth techno-economic paradigm: bio-, neuro-, and nanotechnology, genetic engineering, photonics, optoelectronics, additive manufacturing, new materials, global information networks, multimedia, etc. Promising technology areas are also driven by the transition to a digital economy, with the accelerating processes of automation, robotization, and production intellectualization. End-to-end technology areas that are expected to have a key impact on future markets include big data, artificial intelligence, blockchain systems, quantum technology, new and portable energy sources, new production technology, sensorics and robotics components, wireless communication technology, technology for managing properties of biological assets, virtual and augmented reality technology[4].

The model list of the main *areas* of science and technology development is based on the analytical report "The Technological Future of the Russian Economy" (Technological Future of the Russian Economy, 2018). It comprises both platform (end-to-end) cross-industry technologies, such as ICT (information and communication technologies), bio-, nano-, aerospace, nuclear technology, etc., and technologies related to the focus areas that form the basis of Russia's economy and are aimed at addressing the most important social and economic challenges, including health, food, natural resources and the environment, new energy, and transportation systems.

The geographic location was determined by the name of the country where the innovative technology was developed, implemented, applied, or discussed.

[4] The National Technological Initiative. Available from: https://nti2035.ru/

The process could use imported equipment or hardware components (see sample publication about the introduction of 5G mobile networks in Russia using imported equipment, among other things: Dvorak, 2019). *Stages of the life cycle* of technology innovations were identified using a four-stage diagram (Kudina, 2018: 25). Since the boundaries between the stages of development are blurred, preference was given to the dominant stage at which the technology discussed in the publication was: Stage I – *development of innovation*; Stage II – *implementation of innovation*; Stage III – *diffusion of innovation*: Stage IV – *socialization of innovation*.

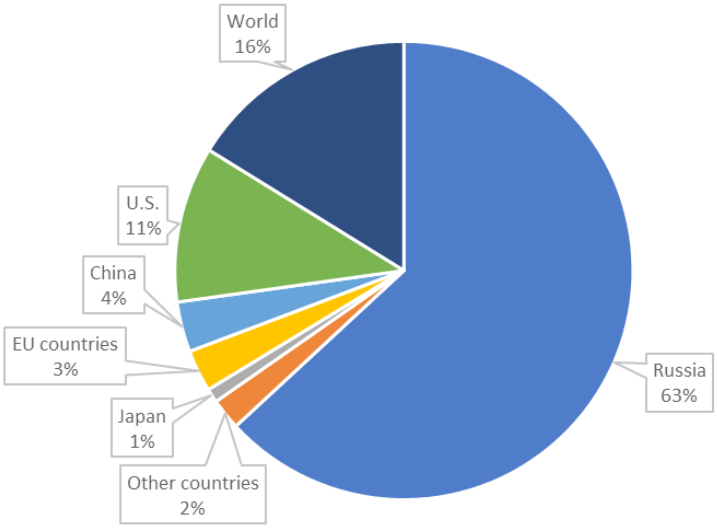
When presenting our key findings, we move from simple and easy-to-understand categories to more complex ones that require detailed comments.

Results

Geolocation. The analysis of this category showed that most of the publications (63%) refer to the development and implementation of new technology goods and processes by professionals from Russia (Figure 1). Emerging technology currently developed in the U.S. is discussed in 11% of the publications; China, 4%; EU countries (most of all, Germany, France, Italy, Sweden and Switzerland), 3%; Japan, 1% of the publications. Other countries featured in less than 1% of the publications: United Kingdom, 0.8%; the Republic of Korea, 0.5%; India, 0.4%, etc.

Figure 1

Geolocation of technology innovations (%)

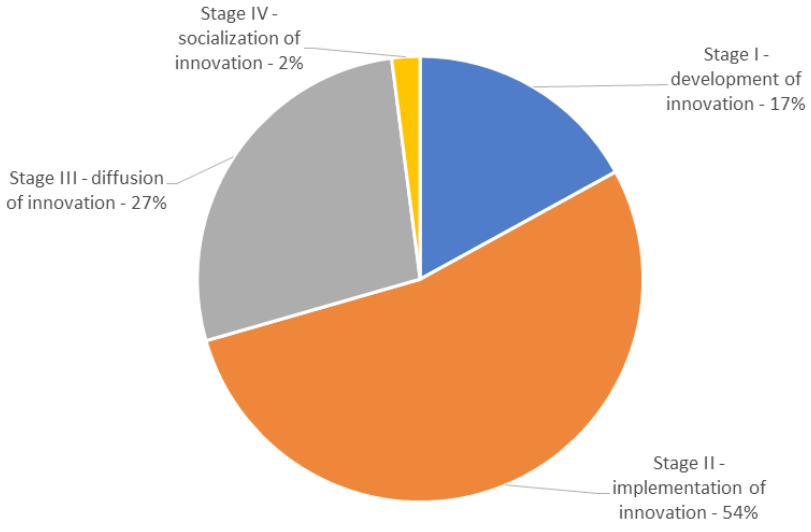


For 16% of the publications, we were not able to give preference to a single country (*World* in Figure 1). This group includes review texts analyzing the innovation and technology experience of companies, laboratories, or governments of several (three or more) countries at once (see sample publication about the global trends in alternative energy: Pazi, & Leybin, 2021). For the most part, these are industrialized states of North America, East Asia, and Europe, the achievements of which are compared with the situation in the sphere of technology in Russia.

Life cycle stages. More than half of the texts under study are about technology innovations at the innovation *implementation* stage (54%), when new technology products or processes are launched on the market by startups (see for example Kinyakina, 2019) or mature companies (see for example Mekhanik, 2018) and put into production by some enterprises (see for example Yurshina, 2019) or the industry as a whole (see for example Novikova, 2021) (Figure 2). The authors of almost a third of all publications (27%) describe innovations at the stage of *diffusion and replication*. The basis of this text corpus is publications about the development of medium and large high-tech companies, whose innovative solutions are already in demand on the market; moreover, the demand for them continues to grow (see for example Yuzbekova, 2021).

Figure 2

Life Cycle Stages of Technology Innovations (%)

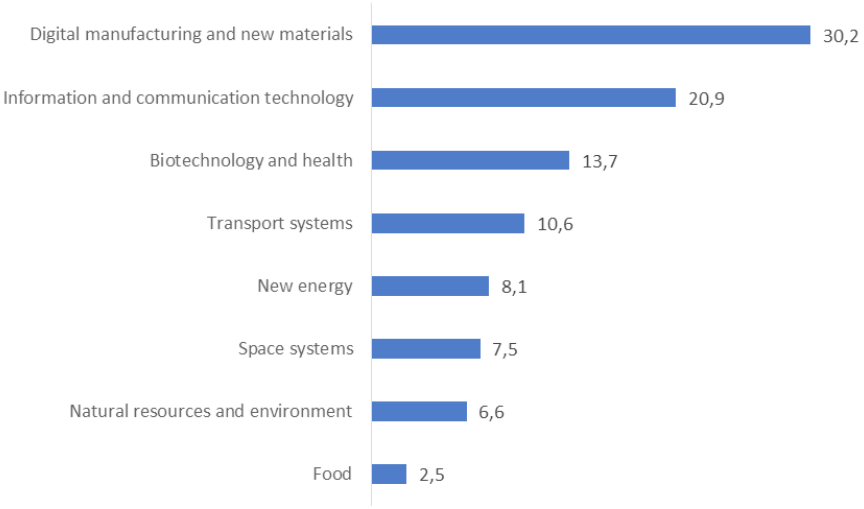


The object of a significantly smaller number of publications are promising technologies at the stage of innovation *development*, i.e., at the initial stage of fundamental and applied research (17%). Texts in this group are devoted to pilot projects of scientists and engineers from government academic and research institutions and employees of R&D centers of private companies (see for example Baulin, & Alekseenko, 2018). We found that the smallest number of publications were about technologies at the *socialization* stage (2%). This category includes texts about well-known high-tech products and services demonstrating a decline in once-high market demand at the time of publication (see for example Mamedyarov, 2018). It also included historical publications about technology innovations that had passed through all phases of development, up to their withdrawal from production (Kotov, 2021).

Areas of science and technology development. The analysis of areas of science and technology development of the economy identified thematic preferences of the editorial boards of business magazines. As can be seen from Figure 3, clearly dominant areas are related to the use of information technology, first and foremost, intelligent control systems and "smart" infrastructures based on AI and "big data"; information security; new hardware components and electronic devices (Table 2[5]).

Figure 3

Areas of science and technology development (%)



[5] The table includes technology areas to which at least five analytical publications were devoted during the period under study (on average, one publication per year).

Publications about digital technologies in medicine (health-related information technology and medical robotics), transportation (intelligent control technology and transport safety), energy (intelligent energy systems), and food ("farms of the future") account for a sizable share. It can be said that the topic of "digital transition" dominates the science and technology agenda of business magazines.

The obtained data about representation of the processes of digitalization of the economy by business media can be used to clarify and solve the problems that arise in this case, in particular the problem of digital inequality, digital divide and digital inclusion that are remaining timely issues in various cultural contexts, as current research shows (Vartanova, & Gladkova, 2020; Vartanova at al., 2021; Gladkova, Argylov, & Shkurnikov, 2022).

Table 2

Target and platform technologies within science and technology areas they develop (%)

Areas of science and technology development	% of pub.	Target and platform technologies
Digital manufacturing and new materials	34.4	Intelligent control systems and "smart" infrastructure technology, machine-to-machine connectivity and Internet of things technology
	22.8	New hardware components and electronic devices technology, quantum technology
	13.9	Structural, functional and metamaterials
	13.6	Mechatronics and robotics technology
	8.2	Computer modeling of materials and processes
	7.1	Additive and hybrid technologies
Information and communication technology	37.7	Data mining technology
	27.0	Information security technology
	15.7	Human-computer interaction technology, neurocognitive technology
	12.3	High speed data transfer technology and communication infrastructure
	7.4	High performance computing architectures and systems

Biotechnology and health	24.1	Advanced pharmaceutical pre-formulations
	21.1	Health-related information technology and medical robotics
	20.3	Genomic and post-genomic technology
	15.8	Cell technology and tissue engineering
	9.0	Organ and system function monitoring and control
	6.8	Industrial biotechnology and biomaterials
Transport systems	42.7	Energy-efficient and zero-emission vehicles technology
	39.8	Intelligent control technology and transport safety
	17.5	High-speed passenger and cargo transportation technology
New energy	27.8	Efficient use of renewable energy sources
	16.5	Efficient accumulation of electric and thermal energy
	11.4	Hydrogen energy
	11.4	Intelligent energy systems
	10.1	Efficient transportation of hydrocarbons, fuel and energy
	8.9	Efficient and safe nuclear power
	7.6	Efficient and clean thermal energy
	6.3	Efficient energy consumption
Space systems	34.2	Technology for space vehicles and systems development and operation
	27.4	Advanced launch vehicles technology
	23.3	Ground and space support infrastructure technology
	9.6	Advanced space vehicle propulsion systems technology for launch vehicles
Natural resources and environment	73.4	Preservation of a healthy environment and environmental safety
	15.6	Subsurface studies, prospecting, exploration and integrated development of mineral and hydrocarbon resources and technogenic raw materials
Food	41.7	Agrotechnology for crop farming
	37.5	Agrotechnology for a wide range of applications in agriculture and related industries (“farms of the future”)
	20.8	Agrotechnology for livestock farming

Other areas of science and technology development meet global challenges in healthcare (advanced drug design, genomic and cell technologies, etc.) and ecology (use of renewable energy sources, "green" technologies to preserve a healthy environment and ensure environmental safety) and are also in line with global technology trends, such as the development of electric transport, efficient electric energy storage, hydrogen energy, new space technology, etc.

Our research made it possible to identify important science and technology areas that are not widely covered by business magazines. They include neurotechnology, quantum technology, nuclear energy, high-speed transport, industrial biotechnology and biomaterials, and the biotechnology area in general. This is partly the reason for a relatively small number of publications about agrotechnologies, where the biotechnology research findings are used extensively. Besides, the *Study and Development of the World Ocean, Arctic and Antarctic Resources*, a technology area of strategic importance for Russia, has not passed the threshold of five analytical publications.

Conclusions

Research showed that most analytical publications on technology innovations (63%) are devoted to the development and implementation of new technology goods and processes by professionals from Russia, which meets the information needs of the national audience of business publications. In addition, they also discuss the experience of innovation leader countries, primarily the U.S. and China, but also Germany, the United Kingdom, Japan, the Republic of Korea, and other highly developed nations, which is important for decision-making in the science and technology area.

The analysis of representations in analytical publications at different stages of the life cycle of technology innovations showed that the business media prefer "ready-made" technologies: both those that are introduced into production and brought to market, and those that have proven effective and are already in demand on the market. Much less attention is paid to emerging "breakthrough" technologies at the research and development stage and technologies that are past their golden age or are no longer in use. This data meets the objectives of the business media to provide readers with information to make the most pragmatic and reliable business decisions. However, this state of affairs can exacerbate the problem of underfunding early-stage innovation projects and "groundwork" research, which can be a stepping stone to future technological breakthroughs but are at high risk in terms of delivering results (New Technological Revolution, 2017: 92).

Business publications consider the state as one of the most important subjects of innovative development, and the main drivers of innovative development of the economy are digital technologies, which, as indicated above, will help overcome the digital inequality. Most publications on technology innovations are devoted to the Information Industry and Public Administration sectors. The technological development of several economic sectors is covered mainly from the perspective of digitalization (Finance, Electric Power Industry, and Trade). As expected, more attention is paid to science and technology development in traditionally high-tech sectors, such as medicine, transport, electronics, defense industry, etc.

Furthermore, digital manufacturing and ICT are the leaders among the areas of science and technology development in the analytical agenda of the business media. Publications on information technology in medicine, transport, energy, and food account for a significant share. Other areas of science and technology development meet global challenges in healthcare, ecology, and energy and are in line with global technology trends.

Finally, the industries with the least publications (less than 3%) on innovative development include basic sectors of the Russian economy with a high GDP (gross domestic product): energy production, trade, metallurgy, construction, and forestry. Our research also identified a number of important areas of science and technology development that rarely become the subject of analytical publications in the business media: neurotechnology, quantum technology, nuclear energy, high-speed transport, biotechnology in general and its related agrotechnology. Besides, the Study and Development of the World Ocean, Arctic and Antarctic Resources, a technology area of strategic importance for Russia, receives little to no coverage.

All in all, the findings shed light on the structure and content of the science and technology agenda of Russia's leading magazine-format business media and can be used to optimize their agenda by the media industry and innovation policy experts.

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