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Sergey A. Revyakin

srevyakin@hse.ru

HSE University

Maxim Kotsemir

HSE University

Denis Ananin

HSE University

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Digital Transformation in Business Research: Global Growth, Thematic Evolution, and Russia's Relative Position in Scopus, 2010-2024

Sergey A. Revyakin^a, Maxim Kotsemir, Denis Ananin.

^a HSE University, Moscow, 101000, Russia, srevyakin@hse.ru, 3029543@mail.ru, ORCID: 0000-0001-7977-5148

ABSTRACT

Digital transformation in business (DTB) is a rapidly expanding and interdisciplinary research area shaped by technological, organizational, and institutional change. This study maps a query-defined Scopus corpus related to DTB for 2010–2024 and compares the Russian-affiliated subset with global patterns in publication output, field-normalized citation impact, country participation, institutional activity, and thematic composition. The corpus comprises 150,635 articles, reviews, and conference papers retrieved from Scopus; thematic mapping uses SciVal Topics.

Publication output increased 10.2-fold between 2010 and 2024. The largest topics in 2022–2024 concerned cyber-physical systems in Industry 4.0, digital twins, and organizational digital-transformation frameworks. Emerging high-growth themes included artificial intelligence, blockchain, service robotics, metaverse applications, Industry 5.0, and human-centric sustainability. Publication output became less concentrated in North America and Western Europe as contributions from China, India, Indonesia, and several Middle Eastern countries expanded. Russian-affiliated output increased until 2021 and then declined relative to continued global growth. The Russian-affiliated subset overlapped with high-volume global topics but showed a relatively stronger presence in application-oriented and Russia-contextualized topics, alongside a smaller relative presence in selected AI-, blockchain-, metaverse-, and service-robotics topics.

The results provide a descriptive map of DTB research and Russia's relative position within it. They do not establish causal effects of technological-access restrictions, policy changes, or institutional conditions.

KEYWORDS: digital transformation in business; scientometric analysis; bibliometrics; Scopus; thematic evolution; Russia

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COMPETING INTERESTS

The authors declare no financial or non-financial interests that are directly or indirectly related to the work submitted for publication.

Author contributions

Sergey A. Revyakin: Conceptualization; methodology; writing – original draft preparation; writing – review and editing.

Maxim Kotsemir – data curation; formal analysis; visualization; review and editing.

Denis Ananin – data curation; formal analysis; visualization; review and editing.

Data availability

The bibliographic data underlying this study were retrieved from Scopus and are subject to Elsevier's licensing restrictions. Aggregated country-level indicators, the analytical protocol, and calculation outputs supporting the findings of this study are available from the corresponding author on reasonable request, subject to the applicable Scopus licence and institutional data-access conditions.

Code availability

No custom software code was generated for this study. Calculation procedures are described in the Methods section.

Ethics approval

Not applicable.

Consent to participate

Not applicable.

Consent for publication

Not applicable.

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INTRODUCTION

Digital transformation (DT) has become a central mechanism through which firms reconfigure value creation, operating routines, organizational capabilities, and relationships with customers, suppliers, and public institutions. It is not reducible to the adoption of discrete information technologies: rather, it denotes an organization-wide process in which digital technologies and data reshape strategic choices, business models, resource allocation, and organizational boundaries (Vial, 2019; Verhoef et al., 2021; Hanelt et al., 2021). Recent scholarship has further emphasized that the economic consequences of DT depend on complementary managerial and dynamic capabilities, organizational redesign, and ecosystem-level coordination, rather than on technology investments alone (Warner & Wäger, 2019; Nadkarni & Prügl, 2021; Gong & Ribiere, 2021). The Industry 4.0 agenda has intensified this transformation by coupling enterprise-level digitalization with interoperable cyber-physical systems, industrial Internet of Things (IoT), cloud and edge computing, advanced analytics, artificial intelligence (AI), robotics, and digital platforms. These technologies enable new forms of smart production, predictive maintenance, servitization, and data-driven decision-making, while simultaneously raising questions of integration, skills, cybersecurity, interoperability, and technological dependence (Xu et al., 2018; Culot et al., 2020; Ghobakhloo, 2020). More recent bibliometric evidence confirms that the intellectual structure of DT research is rapidly evolving: AI, machine learning, sustainability, and implementation-oriented studies have become increasingly prominent alongside the established Industry 4.0 and IoT streams (Kraus et al., 2021; Jalil et al., 2025). This growth has made DT a highly interdisciplinary domain. Its technological foundations lie in computer science and engineering, but its adoption and effects also concern management, innovation studies, economics, labor, regulation, and social sciences. Consequently, a fragmented body of literature has emerged: studies often focus on individual technologies, sectors, countries, or organizational outcomes, while the cumulative evolution of the field and the distribution of its scholarly influence remain harder to observe. Scientometric analysis is especially suitable for addressing this problem because it can quantify publication and citation dynamics, identify disciplinary and geographic configurations, map thematic linkages, and detect transitions in research priorities (Donthu et al., 2021; Aria & Cuccurullo, 2017; van Eck & Waltman, 2010). The present study maps a global Scopus-indexed corpus related to digital transformation in business (DTB) over 2010-2024. It combines longitudinal publication analysis with field-normalized citation impact, source-quartile, geographic, institutional, and thematic analyses. The design examines changes in publication output, field-normalized citation impact, country participation, institutional activity, and topic composition over time. Russia is examined as a substantively important comparative case within this DTB-related Scopus corpus. The case is analytically distinctive because Russian firms have pursued digitalization amid an unusually sharp disruption of access to foreign technologies, vendors, components, software, and technology-intensive capital goods since 2022. Export restrictions and the exit or suspension of activities by a range of international technology suppliers have increased the salience of domestic software, alternative supply chains, open-source solutions, and technology partnerships outside traditional Western channels. At the policy level, this has coincided with a shift from a service- and user-oriented digitalization agenda toward a stronger emphasis on technological sovereignty, domestic IT solutions, cybersecurity, and state-led coordination (Martynova & Shcherbovich, 2024; Dąbrowska, 2024). Importantly, this context should not be interpreted as evidence that Russia has become technologically self-sufficient. Independent evidence indicates that, for many technology products, firms have primarily replaced sanctioned imports with supplies from alternative countries; domestic substitution has been uneven, and constraints remain particularly acute for technologically sophisticated machinery, components, and software. Survey and product-level evidence also points to higher costs, quality trade-offs, and persistent dependency on imported inputs in a substantial share of firms (Simola, 2024). Russia provides a contextually distinctive case for comparing national participation in DTB research during a period of externally constrained technological access. It

permits examination of how a national research system is positioned within a global knowledge field when the country's business environment faces simultaneous pressures for digital adoption, import substitution, supply-chain reorientation, and technological sovereignty. This comparative framing does not imply a causal estimate of the effect of sanctions on either business digitalization or scientific output. Rather, the study uses Russia as a contextually bounded case to assess its position and evolution relative to global publication, citation, disciplinary, and thematic patterns. The comparison addresses a gap in DT scientometric research, where country-level patterns are often treated descriptively without systematic attention to differing institutional and technological contexts. Accordingly, the study does not estimate the causal effects of sanctions, publisher policies, or technology restrictions; rather, it describes Russia's changing relative position in the global DTB publication landscape during a period in which these conditions became salient.

LITERATURE REVIEW

Digital transformation as a multi-level organizational and technological phenomenon

The literature increasingly treats DT as a multi-level transformation involving technology, organizational capabilities, strategy, and institutions. Vial (2019) defines DT as a process triggered by digital technologies that produces structural changes in organizations and their value-creation paths. Verhoef et al. (2021) extend this perspective by emphasizing the multidisciplinary nature of the phenomenon and distinguishing digital transformation from narrower processes of digitization and digitalization. Hanelt et al. (2021) show that the literature converges around strategy, organizational change, and the reconfiguration of resources, while still lacking fully integrated explanatory frameworks.

A dynamic-capabilities perspective is especially relevant for interpreting these developments. Firms must sense technological opportunities and threats, seize opportunities through investment and business-model change, and reconfigure resources and routines as technologies, markets, and ecosystems evolve (Warner & Wäger, 2019). This perspective helps explain why similar technology portfolios can lead to divergent transformation outcomes. It also indicates why external constraints on technology access may matter: a firm's digital capabilities depend not only on its internal skills and investments but also on access to complementary assets, vendors, standards, technical support, cloud infrastructure, advanced hardware, and specialized knowledge.

Industry 4.0 research operationalizes this broad transformation through a set of converging technologies. The core architecture includes cyber-physical systems, IoT, data analytics, cloud computing, AI, robotics, additive manufacturing, and digitally integrated supply chains (Xu et al., 2018; Culot et al., 2020). Recent work has moved beyond technological descriptions toward implementation issues: the integration of legacy systems, skills and work redesign, business-model innovation, cybersecurity, sustainability, and the constraints faced by small and medium-sized enterprises (Mittal et al., 2018; Raj et al., 2020; Ghobakhloo, 2020). This change in emphasis is consistent with a maturing field in which technological feasibility is increasingly complemented by questions of organizational and institutional feasibility.

Scientometric evidence on digital transformation research

Scientometric and bibliometric methods provide a well-established basis for mapping fast-moving and interdisciplinary research areas. Publication and citation indicators describe output and scholarly influence, while co-citation, bibliographic coupling, co-authorship, and keyword co-occurrence reveal intellectual structures, research communities, and thematic change (Börner et al., 2003; Chen, 2017; Donthu et al., 2021). However, the interpretation of such indicators requires caution. Citation counts are affected by field, year, document type, database coverage, and publication practices; normalization through metrics such as Field-Weighted Citation Impact (FWCI) is therefore necessary when comparing heterogeneous sets of publications (Purkayastha et al., 2019).

Earlier reviews and mappings established that DT research grew rapidly but remained semantically and disciplinarily heterogeneous. A scoping review by Kraus et al. (2021) found technology-driven research avenues to be dominant, while calling for stronger conceptual integration. More recently, a large Scopus-based bibliometric study of 2,484 DT publications for 2015-2025 found that manufacturing and construction were among the most intensively studied sectors and identified virtual reality as an expanding topic; it also stressed the value of combining keyword co-occurrence, thematic evolution, and citation analysis (Jalil et al., 2025). These advances are important, but they do not replace a long-run analysis that links the emergence and maturation of the field with standardized impact measures, journal quality, disciplinary diversification, and national contributions.

The existing literature also demonstrates the methodological value of temporal comparison. Research fields do not only grow in volume; their concepts and knowledge bases are recombined as technologies mature and as organizational and societal problems become more visible. Comparing an early period with a later consolidation period can reveal whether initially central technologies persist, become infrastructural, or are subsumed into new application-oriented clusters. In the present study, the comparison of 2015-2017 and 2022-2024 is designed to capture that transition and to test whether the field's center of gravity has shifted from generic Industry 4.0 and infrastructure concepts toward AI, sustainability, and implementation.

Russia under restricted technological access

The Russian case adds an institutional and geopolitical dimension to the study of DT. In the period following 2022, firms and policymakers have confronted technology export controls, restrictions on access to selected foreign hardware and software, vendor withdrawal, and changes in international supply networks. Scholarly legal and policy analysis documents that these developments contributed to a reorientation of Russian digital transformation policy toward technological sovereignty, information security, domestic software, and increased state coordination (Martynova & Shcherbovich, 2024). In parallel, policy analysis describes an intensified push for domestic IT solutions and technology partnerships beyond established Western channels, while noting continuing constraints in advanced hardware and digital-economy cooperation (Dąbrowska, 2024).

Yet the available evidence cautions against equating policy commitments with achieved substitution. Simola (2024), using Russian firm surveys and product-level production and trade data, finds limited import substitution for much of the technology-product sample examined. The study reports that firms often substituted sanctioned imports with similar products from other countries, whereas domestic capacity and product quality were insufficient to compensate fully for lost access in many categories. Its analysis highlights the particularly difficult position of technologically sophisticated imports and notes measurement uncertainty due to restricted data availability. This evidence motivates a more precise conceptualization of the Russian case: it is not a binary shift from dependence to self-sufficiency, but a process of adaptation involving substitution, supplier diversification, localization efforts, open-source use, and potential capability constraints.

This setting is relevant to DT research because digital transformation rests on globally distributed technological ecosystems. Enterprise digitalization requires not only adoption decisions but also ongoing access to complementary technologies and services. Constraints on such access may alter firms' technology choices, implementation trajectories, and research demand. They may also affect national scientific participation by changing collaboration opportunities, publication channels, priority-setting, and the relevance of themes such as cybersecurity, domestic software, supply-chain resilience, and technological sovereignty.

Research gap and study positioning

Three linked gaps motivate this study. First, despite the rapid expansion of DT scholarship, few studies provide an integrated 2010-2024 mapping that combines publication trajectories, field-normalized citation impact, subject structures, journal strata, geographic patterns, and thematic evolution.

Second, although the literature documents a move toward implementation, AI, and sustainability, systematic comparison of the early Industry 4.0 phase (2015-2017) with the recent consolidation phase (2022-2024) remains limited. Third, country comparisons seldom interpret publication patterns against markedly different institutional and technological-access conditions.

The Russian case enables the third gap to be addressed without overstating what bibliometric evidence can establish. We do not infer that sanctions caused a particular change in Russian digitalization or research performance. Instead, the study asks whether Russia's contribution, disciplinary composition, citation profile, and thematic specialization differ from global patterns during a period in which technology-access constraints and technological-sovereignty policies became unusually salient. This question is empirically compatible with the article's existing data and results: the study reports geographical distributions, field-normalized citation impact, subject-category configurations, journal-quality differences, and temporal thematic shifts. The analysis can therefore identify patterns of relative position and thematic alignment, while reserving causal claims about sanctions, firm behavior, or policy effectiveness for future research based on firm-level, trade, procurement, and longitudinal policy data.

RESEARCH AIM, QUESTIONS, AND HYPOTHESES

This study maps global DTB research and compares the Russian-affiliated subset with the global corpus in terms of output, citation impact, subject composition, institutional participation, and thematic structure. The analysis treats post-2022 technology-access constraints as contextual background rather than as a causal treatment, examining publication patterns, citation dynamics, geographical contributions, and thematic evolution from 2010 to 2024 using Scopus database.

This research pursues the following objectives:

RQ1: How have global and Russian publication outputs evolved in digital transformation in business research from 2010 to 2024?

RQ2: Which countries contributed most to DTB research, and how did their shares of publication output and citation impact change over time?

RQ3: What combinations of publication volume, field-normalized citation impact, international co-authorship, and high-ranked-source publication characterize the leading contributing countries?

RQ4: How did the thematic composition of global and Russian-affiliated DTB research differ between 2015-2017 and 2022-2024?

RQ5: Which institutions contributed most to DTB research globally and in Russia, and how did their output and field-normalized citation impact compare?

The following hypotheses were formulated to guide the descriptive comparative analysis.

H1: Global DTB publication output increased substantially over 2010-2024, whereas the trajectory of Russian-affiliated output diverged from the global trajectory after 2021.

H2: DTB research became less concentrated in North America and Western Europe over time, with growing contributions from Asian and other emerging economies.

H3: Leading countries display distinct bibliometric profiles across output volume, FWCI, international co-authorship, and publication in highly ranked sources.

H4: Compared with 2015-2017, the 2022-2024 corpus shows greater representation of digital twins, AI-related themes, Industry 5.0, sustainability, and implementation-oriented research.

H5: The Russian-affiliated subset differs from the global corpus in its subject-area composition and thematic distribution.

DATA AND METHODS

Data Source and Search Strategy

This study used Scopus as the primary data source because of its broad coverage, curated indexing, and availability of citation, subject-category, and affiliation metadata (Baas et al., 2020).

Scopus provides citation, subject-category, and affiliation metadata suitable for the present multidimensional bibliometric analysis (Mongeon & Paul-Hus, 2016). This study analyzed a corpus of Scopus-indexed publications related to digital transformation in business (DTB) published between 2010 and 2024. The analytical corpus included articles, reviews, and conference papers. Search terms related to DTB were applied to publication titles, abstracts, and keywords. The search query comprised three term blocks. The first block contained terms directly related to digital transformation in business. The second block contained terms related to digitalization and selected digital technologies, including the industrial internet of things and digital twins. The third block contained general organizational and business-related terms. The three blocks were combined using the Boolean operator OR and the Scopus proximity operator W/5, as follows: (Block 1 OR (Block 2 W/5 Block 3)). For example, ‘Digitalisation W/5 business’ retrieves records in which the two terms occur within five words of one another. In the final query, terms from the second block had to occur within five words of terms from the third block. To improve recall while preserving conceptual relevance, the query used truncation and spelling variants. The search covered all Scopus subject areas and categories in order to capture the interdisciplinary scope of DTB research. The search was run across all Scopus source types, whereas the analytical corpus was restricted to articles, reviews, and conference papers¹. Data were extracted from Scopus and SciVal on 22 January 2026; citation-based indicators were calculated as of the same date. The final corpus comprised 150,635 records published between 2010 and 2024 and classified as articles, reviews, or conference papers. SciVal Topics and Topic Clusters were accessed using the classification available on 19 June 2025. Because the search strategy was designed to capture the interdisciplinary scope of digital transformation in business, the resulting dataset should be interpreted as a DTB-related Scopus corpus defined by the query rather than as a strictly bounded conceptual field.

Analytical Methods

The analysis used bibliometric indicators available in Scopus and SciVal.

Publication and Citation Analysis. Temporal publication patterns were analyzed using year-by-year publication counts to identify growth trends, inflection points, and stabilization phases. Annual growth rates were calculated as $\left(\frac{N_t}{N_{t-1}} - 1\right) \times 100$, where N_t is the number of publications in year t and N_{t-1} is the number of publications in the preceding year. When the preceding-year value was zero, an annual percentage change was not calculated. For small baselines, fold changes are reported descriptively and interpreted cautiously because they are highly unstable. Citation analysis examined total citations, average citations per publication, and citation distribution patterns across years. Average citations per publication were used as a descriptive, age-sensitive indicator because papers published in earlier years had more time to accumulate citations than papers published later in the 2022-2024 observation window. Cross-country comparisons of citation impact therefore rely primarily on Field-Weighted Citation Impact (FWCI), which normalizes for publication year, document type, and subject area.

Geographical Distribution Analysis. Author affiliation data were used to identify contributing countries, regional research concentrations, and the institutional affiliations associated with DTB publications. The analysis focused on the 50 countries with the highest publication volume and examined their output trajectories, field-normalized citation impact, and shares of internationally co-authored publications.

Field-Weighted Citation Impact (FWCI) indicator measures the average-weighted citation impact of a given set of publications (e.g. papers or a specific country, organisation, author, field of science, journal etc.), weighted by Scopus subject categories, relative to the global average citation level.

¹ As of 7 September 2026 in total 49 919 sources were indexed in Scopus. 45 311 (90.8%) of them were scientific journals, 2 784 (5.6%) - book series, 793 (1.6%) - trade publications.

The weighting used in calculating this indicator makes it possible to compare publication sets with different average citation levels across the publications they include. An FWCI of 1.00 denotes citation impact equal to the world average for publications of the same year, document type, and Scopus subject area. The FWCI of a selected corpus may be above or below 1.00; in this study, the DTB corpus had an FWCI of 1.55 for 2022-2024. FWCI values above 1.00 indicate citation impact above the Scopus world baseline, whereas values below 1.00 indicate below-baseline citation impact. FWCI was used as the principal normalized citation-impact indicator because it accounts for subject category, publication year, and document type (Purkayastha et al., 2019).

Source quartiles were based on CiteScore percentiles in Scopus (James et al., 2019). For multi-category sources, the best available CiteScore percentile and corresponding quartile across the source's assigned ASJC subject categories were used. Accordingly, Q1 denotes sources whose best available CiteScore percentile was in the top 25% of their assigned ASJC categories, whereas Q4 denotes sources whose best available percentile was in the bottom 25%. This rule was applied consistently to all source-quartile calculations.

Publications in **Top 1% Journal Percentiles** by CiteScore were defined as publications appearing in sources with a best available CiteScore percentile at or above the 99th percentile across assigned ASJC categories.

Internationally co-authored publications were defined as records with author affiliations from at least two countries. Full counting was applied to country- and institution-level analyses. For example, a publication co-authored by researchers affiliated with institutions in Russia, China, and India was counted once for each of the three countries. Because full counting was used, totals across countries and institutions exceed the number of unique publications. This choice measures participation rather than fractional contribution and may favor highly collaborative countries and institutions.

The thematic analysis of the "Digital Transformation in Business" corpus was conducted at the level of SciVal Topics. At the time of data extraction, SciVal assigned Scopus-indexed publications to 94,129 non-overlapping Topics, which were aggregated into 1,528 Topic Clusters. The Topic and Topic Cluster classification used in this study was the SciVal classification available on 19 June 2025. SciVal Topics are algorithmically generated clusters based on citation and semantic relations. They are useful for comparative mapping but should not be interpreted as fixed disciplinary categories or as direct measures of conceptual novelty. Topic Prominence percentile is a composite indicator of current momentum within a SciVal Topic. Higher values indicate greater recent attention and activity within the SciVal classification; 100 represents the highest percentile and 1 the lowest. The indicator is used here for comparative mapping and should not be interpreted as a direct measure of scientific importance, research quality, conceptual novelty, or societal relevance.

Russia-world comparative analysis. Russia was operationalized using author-affiliation country data. The Russian-affiliated subset was compared with the full global corpus and selected high-output countries. Given the descriptive design and the absence of firm-level exposure measures, these comparisons were interpreted as associations and relative patterns rather than as causal effects of sanctions.

RESULTS

Publication Dynamics on Digital Transformation in Business (*world*)

Publication output in the DTB-related Scopus corpus increased substantially over 2010-2024, indicating growing scholarly attention to the topic (Fig. 1). A steady increase through 2016, with an average annual growth rate of 11.4%, was followed by faster growth in 2017-2019, when the average annual increase reached 34.9%. In the following years (2020-2023), this indicator declined to an average annual growth of 13.9%, while in 2024 it rose again to 28.9%. Overall output in the query-defined DTB-related Scopus corpus increased 10.2-fold between 2010 and 2024. This change indicates a marked

expansion of the indexed literature, although publication growth does not directly measure researchers' interest or societal importance.

Publication Dynamics on Digital Transformation in Business (*Russia*)

Russian-affiliated DTB output followed the overall global growth trend until 2021 (Fig. 1). Until 2017, the annual output of Russian publications did not exceed 55, accounting for only 0.2%-1.1% of the global publication output. Russian-affiliated DTB output increased sharply between 2017 and 2021. In 2019, output was 10.6 times higher than in 2016, and it reached a peak of 699 publications in 2021. Russia's share of global DTB output increased to 4.3%-4.5% during 2019-2021. After the 2021 peak, annual Russian-affiliated DTB output ranged from 510 to 650 publications during 2022-2024.

Between 2021 and 2024, Russian-affiliated DTB output decreased by 27.0%. This decline occurred amid changes in international research collaboration, publishing conditions, institutional incentives, and technology access; the present analysis does not isolate the contribution of any one factor². Against the backdrop of continued growth in global DTB output, Russia's share of the worldwide corpus declined to 1.88% in 2024, approximately the level observed in 2017. The decline in annual Russian-affiliated output was smaller between 2023 and 2024 than in the preceding year; this descriptive pattern should be interpreted cautiously given annual fluctuations and potential indexing lags.

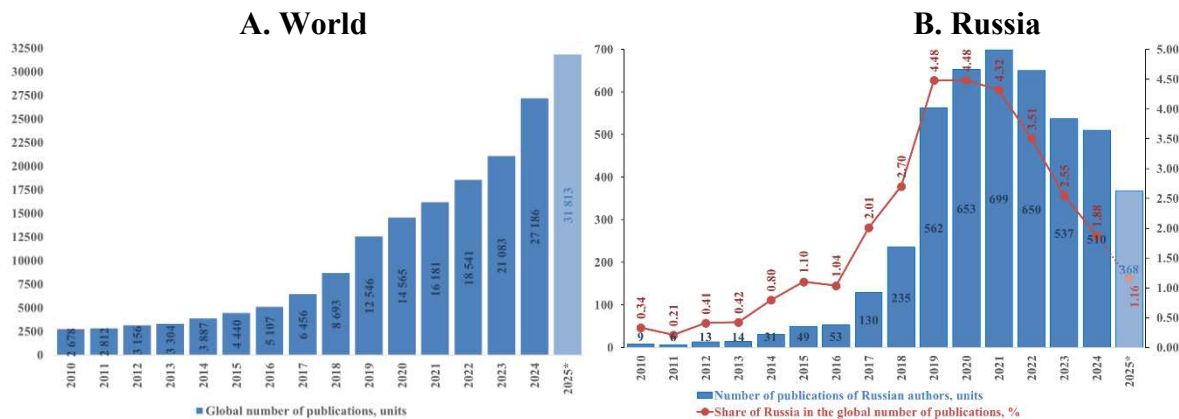


Fig. 1. Dynamics of Scopus-indexed publications in *Digital Transformation in Business* dataset: 2010-2024 (A. Global; B. Russian)

Note: all calculations are given for the following types of documents: articles, conference papers and reviews as of 22 January 2026.

Mapping the knowledge production on Digital Transformation in Business *Geographical distribution of countries' contribution*

The 25 countries with the highest DTB publication output in 2024 displayed markedly different growth trajectories over 2010-2024. Countries in North America, Europe, and Australia dominated the 2010 ranking, whereas China, India, and Indonesia occupied more prominent positions by 2024. In 2024, 18.9% of all DTB publications were authored by researchers from Mainland China³ (Fig. 2). The five most productive countries – Mainland China, India, the United States, Germany, and the United Kingdom – accounted for 47.1% of global DTB output in 2024.

² The total number of publications from Russia declined by 23.6% over the same period.

³ In Scopus Mainland China (named in the database as "China"), Special Administrative Region (SAR) Hong Kong China (named as "Hong Kong"), SAR Macao China (named as "Macao"), and Taiwan (China) are indexed as separate units of analysis in the Country/territory classifier.

Several countries – Indonesia, Saudi Arabia, South Africa, Russia, Poland, and the UAE – recorded high relative growth from small 2010 baselines (fewer than 15 publications). These fold changes should be interpreted cautiously because percentage growth rates are unstable when starting values are low. All of these countries recorded more than 30-fold growth between 2010 and 2024, reflecting high relative growth from small baselines. Indonesia provides the clearest example: its annual output increased from 6 publications in 2010 to 1,262 in 2024. The absolute increase, rather than the fold change alone, indicates the scale of its expansion. This increase moved Indonesia from 51st to 7th place in the global ranking by DTB publication output between 2010 and 2024 (+44 positions). The cases of Russia (+26 positions) and Saudi Arabia (+21 positions) are also noteworthy (Fig. 2). Taiwan (China) and the Netherlands experienced the largest declines in rank, falling by 15 and 13 positions, respectively, between 2010 and 2024. Taiwan increased its output by a factor of 3.3 and the Netherlands by a factor of 4.4 over the same period, well below the global growth factor of 10.2. In the United States, the number of publications increased 3.6-fold over the period 2010-2024. However, owing to its very high publication volume, the United States lost only two positions, falling from the first to the third place, as China took the leadership in 2021 and India overtook the second place in 2023.

Country	Number of publications of a country				Number of publications growth 2024 to 2010, times	Number of publications change 2024 to 2021, %	Share of a country in the global number of publications, %				Position of a country in the country ranking by number of publications				Position of a country change, 2024 to 2010
	2010	2015	2021	2024			2010	2015	2021	2024	2010	2015	2021	2024	
World Total	2 678	4 440	16 181	27 186	10.2	68.0	100	100	100	100	...	...	...	...	...
1. Mainland China	286	337	1 825	5 133	17.9	181.3	10.7	7.6	11.3	18.9	2	4	1	1	1
2. India	63	219	1 116	3 174	50.4	184.4	2.4	4.9	6.9	11.7	13	5	4	2	11
3. United States	690	970	1 657	2 460	3.6	48.5	25.77	21.85	10.24	9.05	1	1	2	3	-2
4. Germany	164	425	1 321	1 603	9.8	21.3	6.12	9.57	8.16	5.90	4	2	3	4	0
5. United Kingdom	229	350	1 054	1 522	6.6	44.4	8.55	7.88	6.51	5.60	3	3	5	5	-2
6. Italy	97	136	1 022	1 352	13.9	32.3	3.62	3.06	6.32	4.97	8	12	6	6	2
7. Indonesia	6	46	575	1 262	210.3	119.5	0.22	1.04	3.55	4.64	51-53	28	9	7	44
8. Spain	93	214	786	1 037	11.2	31.9	3.47	4.82	4.86	3.81	9	6	7	8	1
9. Malaysia	84	155	569	1 004	12.0	76.4	3.14	3.49	3.52	3.69	11	9	10	9	2
10. Australia	141	189	496	725	5.1	46.2	5.27	4.26	3.07	2.67	5	7	11	10	-5
11. France	70	127	422	688	9.8	63.0	2.61	2.86	2.61	2.53	12	13	13	11	1
12. Saudi Arabia	15	34	207	636	42.4	207.2	0.56	0.77	1.28	2.34	31-32	37-38	26	12	19
13. South Korea	46	156	378	610	13.3	61.4	1.72	3.51	2.34	2.24	15	8	15	13	2
14. Canada	100	145	375	594	5.9	58.4	3.73	3.27	2.32	2.18	7	10	16	14	-7
15. Portugal	34	76	402	563	16.6	40.0	1.27	1.71	2.48	2.07	20	16	14	15	5
16. Brazil	43	123	458	550	12.8	20.1	1.61	2.77	2.83	2.02	16	14	12	16	0
17. South Africa	17	65	319	545	32.1	70.8	0.63	1.46	1.97	2.00	30	20	18	17	13
18. Russian Federation	9	49	699	510	56.7	-27.0	0.34	1.10	4.32	1.88	44-45	26	8	18	26
19. Turkey	30	38	233	486	16.2	108.6	1.12	0.86	1.44	1.79	24	35	23	19	5
20. Poland	12	41	356	449	37.4	26.1	0.92	0.92	2.20	1.65	38-41	33	17	20	18
21. Taiwan (China)	134	141	297	446	3.3	50.2	5.00	3.18	1.84	1.64	6	11	19	21	-15
22. Sweden	25	68	259	412	16.5	59.1	0.93	1.53	1.60	1.52	25-26	18	21	22	3
23-24. Netherlands	90	113	261	395	4.4	51.3	3.36	2.55	1.61	1.45	10	15	20	23-24	-13
23-24. UAE	9	21	164	395	43.9	140.9	0.34	0.47	1.01	1.45	44-45	46	34	23-24	21
25. Thailand	14	37	154	355	25.4	130.5	0.52	0.83	0.95	1.31	33-36	36	36	25	8

Fig. 2. Key publication activity indicators for leading countries in *Digital Transformation in Business* dataset: 2010, 2015, 2021, 2024

Notes. 1. A publication is considered to belong to a specific country if the country name is included in the affiliation address of at least one author and is recognized by the country name recognition system. 2. Data are presented for the top-25 countries by number of publications on *Digital Business Transformation* in 2024. 3. In Scopus Mainland China, the Hong Kong and Macao Special Administrative Regions of China, and Taiwan (China) are indexed as separate units of analysis in the country/territory classifier.

Among the 25 countries selected by 2024 output, Russia was the only country whose observed full-count publication output declined between 2021 and 2024 (-27.0%). Mainland China, India, and Saudi Arabia recorded the highest observed growth rates between 2021 and 2024 (from 2.8-fold to 3.1-

fold). Germany, Brazil, and Poland recorded the lowest observed growth rates over the same period (from +20.1% to +26.1%).

Countries' impact on digital transformation in business research

The six countries with the highest citation counts for the 2022-2024 publication cohort were Mainland China, India, the United States, the United Kingdom, Italy, and Germany; these countries also ranked among the leading contributors by publication volume. Mainland China accounted for 20.6% of citations to DTB publications from 2022-2024 and 18.9% of global DTB output in 2024. Russia ranked 12th by publication output (2.5% of the global total) but 40th by citation count (1.1% of the global total). Russia recorded an average of 5.1 citations per publication for papers published in 2022-2024, compared with 12.1 for the global DTB corpus (Fig. 3). This unnormalized indicator is descriptive and age-sensitive because the 2022-2024 publication cohort contains papers with different citation-accumulation windows. Indonesia showed a similarly low average of 5.9 citations per publication, whereas the highest descriptive averages, ranging from 26.0 to 31.1, were observed for SAR Hong Kong China, Pakistan, and Australia. Cross-country comparisons of citation impact should therefore be based primarily on FWCI. Russia had the lowest mean citation count per publication among the 40 countries in this descriptive comparison; however, its FWCI was 1.03, indicating citation impact close to the Scopus world baseline but below the DTB-corpus average of 1.55.

Country	2022-2024			Field-weighted citation impact (FWCI)		
	Number of citations on publications of a country	Average number of citations per one publication	Share of a country in the global number of citations, %	2015-2017 FWCI value, points	2022-2024 FWCI value, points	FWCI value change 2022-2024 to 2015-2017, %
World Total	808 012	12.1	100.0	1.57	1.55	-1.3
1. Mainland China	167 627	15.6	20.75	1.73	1.73	0.0
2. India	101 034	14.0	12.50	1.06	1.83	72.6
3. United States	99 725	15.8	12.34	1.92	1.86	-3.1
4. United Kingdom	93 196	24.0	11.53	2.68	2.51	-6.3
5. Italy	59 227	17.0	7.33	2.28	2.13	-6.6
6. Germany	52 544	12.0	6.50	2.28	1.75	-23.2
7. Australia	50 088	26.0	6.20	1.85	2.67	44.3
8. Spain	40 758	14.5	5.04	1.85	1.69	-8.6
9. Malaysia	38 706	15.7	4.79	1.02	1.87	83.3
10. France	37 325	20.8	4.62	1.62	2.20	35.8
11. South Korea	28 671	17.9	3.55	1.41	1.77	25.5
12. Saudi Arabia	28 420	19.1	3.52	1.78	2.16	21.3
13. Canada	28 077	18.4	3.47	1.55	1.99	28.4
14. Pakistan	23 777	26.0	2.94	1.27	2.64	107.9
15. United Arab Emirates	22 787	22.6	2.82	1.40	2.53	80.7
16. Sweden	22 102	21.3	2.74	2.63	2.32	-11.8
17. South Africa	21 058	15.4	2.61	1.07	1.73	61.7
18. Turkey	19 354	17.1	2.40	1.58	1.87	18.4
19. SAR Hong Kong China	19 282	31.1	2.39	2.21	3.79	71.5
20. Portugal	19 052	12.5	2.36	1.79	1.63	-8.9
21. Brazil	18 985	11.9	2.35	1.31	1.29	-1.5
22. Taiwan (China)	18 779	16.4	2.32	1.34	1.86	38.8
23. Norway	17 738	23.8	2.20	1.90	2.48	30.5
24. Poland	17 698	14.2	2.19	2.03	1.94	-4.4
25. Finland	17 511	24.5	2.17	2.43	2.57	5.8
26. Greece	17 329	19.7	2.14	1.51	2.38	57.6
27. Indonesia	16 309	5.9	2.02	0.68	0.95	39.7
28. Netherlands	16 241	16.6	2.01	2.21	2.03	-8.1
29. Jordan	15 170	20.4	1.88	1.47	3.05	107.5
30. Denmark	12 468	21.8	1.54	2.16	2.35	8.8
31. Iran	11 075	16.6	1.37	0.80	1.75	118.8
32. Switzerland	10 974	17.6	1.36	3.30	1.98	-40.0
33. Viet Nam	10 701	14.6	1.32	1.78	1.82	2.2
34. Singapore	10 638	21.2	1.32	1.93	2.22	15.0
35. Bangladesh	10 168	22.0	1.26	1.16	2.34	101.7
36. Austria	10 051	13.4	1.24	2.57	1.89	-26.5
37. Ireland	9 820	18.4	1.22	1.83	2.09	14.2
38. Mexico	8 700	13.3	1.08	1.58	1.40	-11.4
39. Japan	8 649	14.8	1.07	1.47	1.57	6.8
40. Russian Federation	8 632	5.1	1.07	1.23	1.03	-16.3

Fig. 3. Key citation indicators for Scopus-indexed publications of leading countries in *Digital Transformation in Business* dataset: 2015-2017, 2022-2024

Notes. 1. The data are presented for the top 40 countries by the number of citations received by publications on the topic of business digital transformation published in 2022-2024. 2. For each publication, citations were counted from the date of Scopus indexing to 22 January 2026. Average citations per publication are reported as descriptive, age-sensitive values because publications from 2022 had a longer time to accumulate citations than publications from 2023 and 2024. FWCI is the primary indicator used for cross-country comparisons of citation impact because it normalizes for publication year, document type, and subject area.

For normalized cross-country comparison, the DTB corpus had an FWCI of 1.55 in 2022-2024, indicating citation impact 55% above the Scopus world baseline after normalization for field, publication year, and document type. Among the 40 countries with the highest citation counts, 24 had an FWCI above the DTB-corpus average of 1.55 (Fig. 3). The lowest FWCI values among the 40 countries were observed for Indonesia (0.95) and Russia (1.03); Brazil (1.29) and Mexico (1.40) were also below the DTB-corpus average of 1.55. The highest FWCI values were observed for SAR Hong Kong China (3.79) and Jordan (3.05), both of which had lower publication volumes than the largest producing countries. Between 2015-2017 and 2022-2024, the FWCI of the global DTB corpus remained broadly stable (-1.3%). The largest FWCI increases were observed in Iran (+118.8%), Pakistan (+107.9%), Jordan (+107.5%), and Bangladesh (+101.7%). India, which ranked second by both citation count and publication output, recorded a notable FWCI increase (+72.6%) and an 8.7-fold increase in publication output (Figs. 2 and 3). Similar patterns of high growth rates of FWCI indicator and publication output over this period are observed for Pakistan, the United Arab Emirates, Jordan, and Bangladesh. The most pronounced negative changes in FWCI indicator value over the last ten years were observed in German-speaking countries: Switzerland (-40%), Austria (-26.5%), and Germany (-23.2%), as well as in Russia (-16.3%). Russia's below-average FWCI relative to the DTB corpus was observed despite its long-run increase in publication output (Fig. 2). Mainland China provides another relevant comparison. The country increased its publication output by a factor of 17.9 over the ten-year period (Fig. 2), while the value of the FWCI indicator remained unchanged (Fig. 3).

A complementary venue-based indicator is the share of publications in Q1 Scopus-indexed sources by CiteScore. In 2024, 47.4% of global DTB publications appeared in Q1 Scopus-indexed sources by CiteScore (Fig. 4)⁴. This figure describes the distribution of publications across source quartiles; it does not, by itself, measure the quality of individual articles or the maturity of the field.

⁴ While describing Fig. 4 we mean that shares of publications in Q1, Q2, Q3 and Q4 are calculated for publications in Scopus-indexed sources with a CiteScore indicator. Also we treat terms “journals” and “Scopus-Indexed sources” for the sake of simplicity.

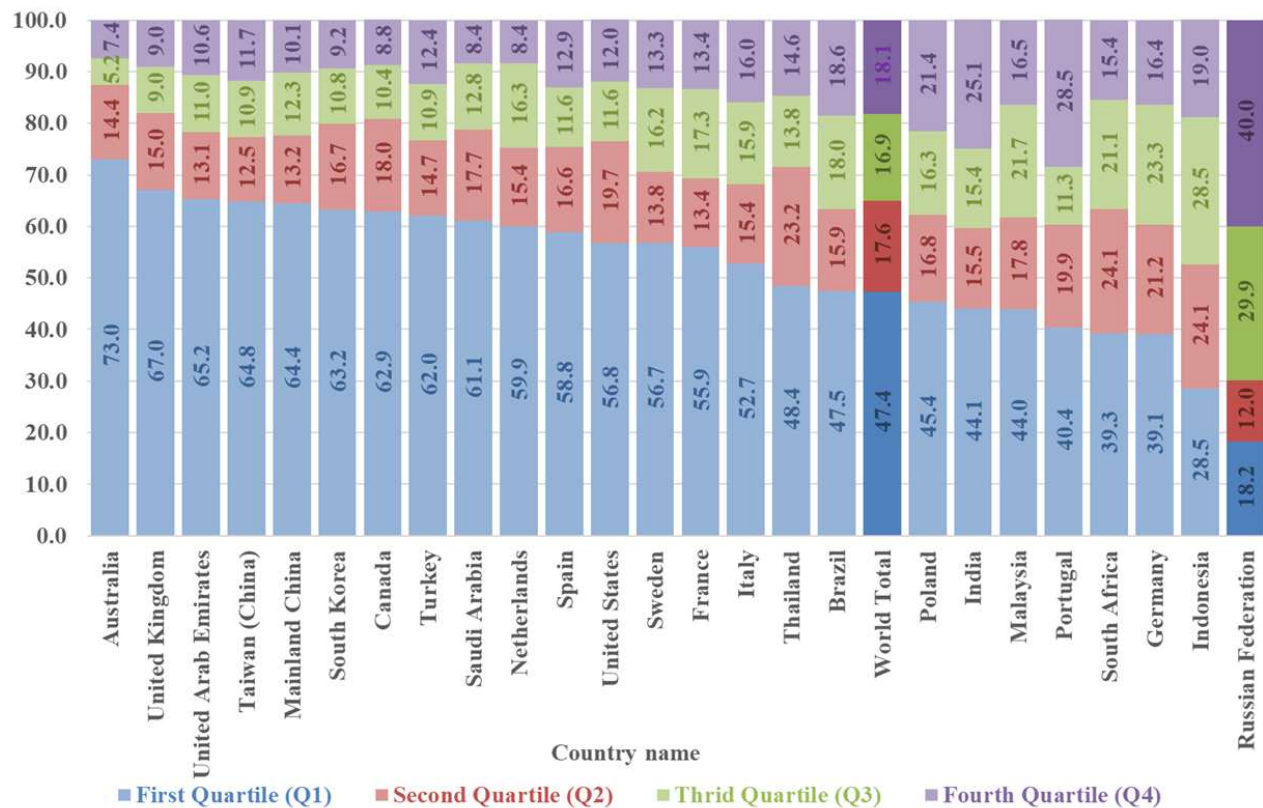


Fig. 4. Distribution of publications of leading countries in *Digital Transformation in Business* dataset by quartiles of Scopus-indexed sources: 2024, %

Notes. 1. The figure presents the global total and the 25 countries with the highest DTB publication output in 2024. 2. The distribution is calculated for publications in Scopus-indexed sources with a CiteScore indicator. For sources assigned to multiple ASJC subject categories, the best available CiteScore quartile was used.

Russia's Q1-source share was 18.2% in 2024, the lowest among the countries compared and well below the global DTB-corpus share of 47.4%. With the exception of Indonesia, the share of Russian publications in the top two quartiles (Q1 and Q2) is lower than the share of publications in the top quartile (Q1) alone for the other 23 countries. Russia had the highest share of DTB publications in Q4 sources among the 25 countries compared (40.0%), followed by Portugal (28.5%) and India (25.1%). This value was substantially higher than the global DTB-corpus share of 18.1%. These patterns indicate that Russian-affiliated DTB output was more concentrated in lower-quartile Scopus-indexed sources than the global corpus during the observed period (Fig. 4). Among the countries compared, the highest shares of DTB publications in Q1 Scopus-indexed sources were observed for Australia (73.0%), the United Kingdom (67.0%), the United Arab Emirates (65.2%), Taiwan (China) (64.8%), and Mainland China (64.4%).

Countries' research and publication strategies in digital transformation in business

To summarize country-level bibliometric profiles, we developed a four-indicator visualization (Fig. 5). The visualization combines four bibliometric indicators for the 25 countries with the highest DTB publication output in 2022-2024. The visualization is based on four indicators:

- total country-level publication output,
- Field-Weighted Citation Impact (FWCI),
- Share of internationally co-authored publications,
- Share of publications in Top 1% Journal Percentiles by CiteScore (%).

The visualization identifies descriptive bibliometric profiles across countries; it does not directly measure intentional national publication strategies. Several countries - Portugal, Spain, Germany, Italy, Poland, Turkey, the Republic of Korea, South Africa, Taiwan, Malaysia, and Canada – occupy a similar region of the four-indicator visualization (Fig. 5). Because no formal clustering model was estimated, these groupings should be interpreted as descriptive bibliometric profiles rather than as empirically established clusters. Australia, the United Kingdom, France, and the Netherlands were characterized by relatively high FWCI values, higher shares of internationally co-authored publications, and larger shares of publications in highly ranked Scopus-indexed sources. Pakistan, the United Arab Emirates, and Saudi Arabia showed comparatively high shares of internationally co-authored publications. Russia and Indonesia exhibited lower values on selected bibliometric indicators – particularly FWCI and/or shares of publications in Q1 sources – relative to the comparison group. These indicators should be interpreted as publication-impact measures, not as direct measures of research quality. Brazil and Thailand occupied comparable positions on selected impact- and venue-related indicators. The United States occupied a position characterized by relatively high output and comparatively strong performance on several impact- and collaboration-related indicators. China and India combined high publication output with comparatively lower shares of internationally co-authored publications. India's FWCI and source-quartile profile were closer to the middle of the country distribution than to the highest-performing group on those indicators.

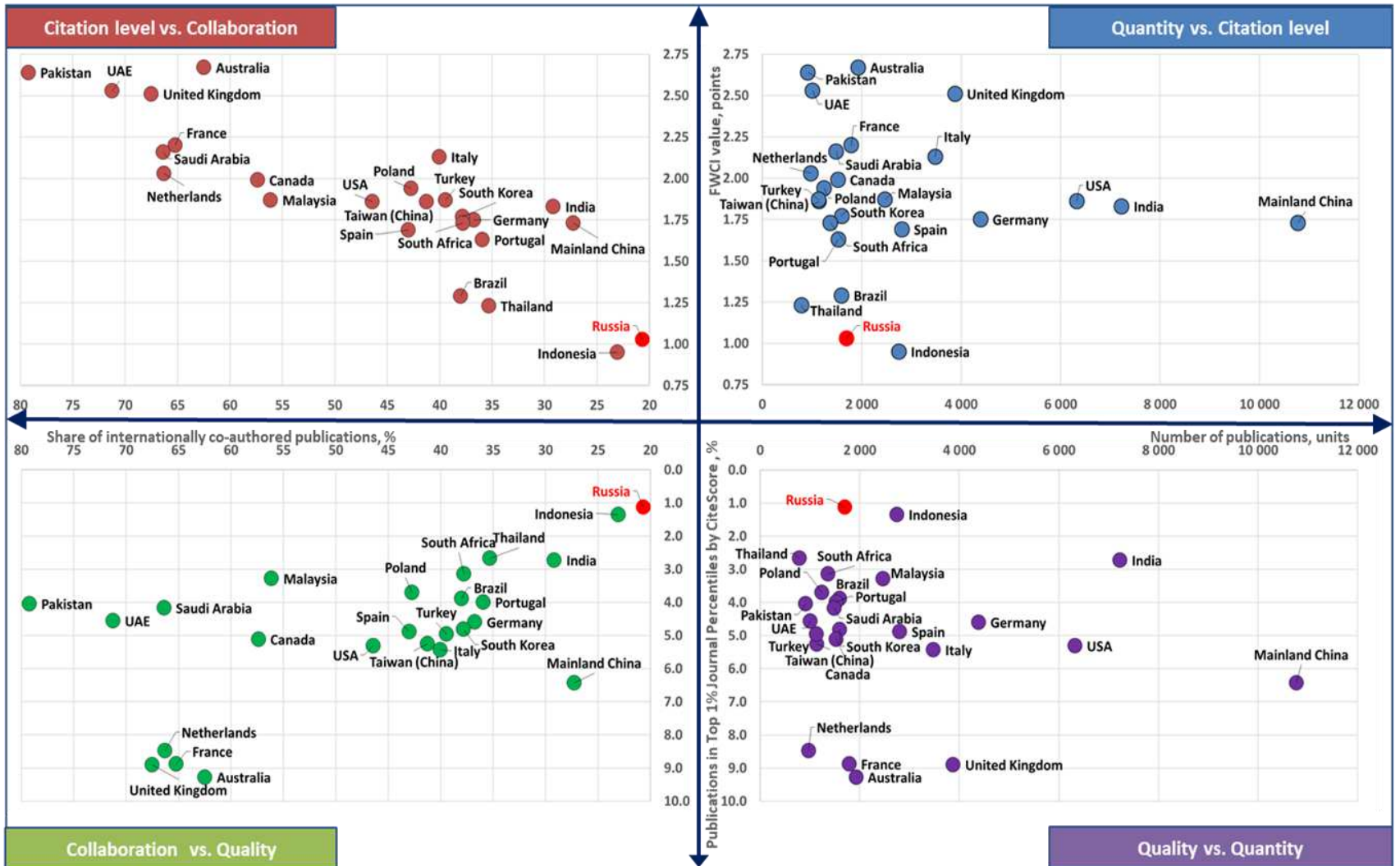


Fig. 5. Matrix of publication activity indicators for top-25 countries in *Digital Transformation in Business* dataset: 2022-2024

Note: The matrix is made for the top-25 countries by number of publications in *Digital Transformation in Business* dataset for 2022-2024.

Topical structure of the DTB-related Scopus corpus: actors and trends

The thematic analysis of the query-defined DTB-related Scopus corpus shows that publications from 2022-2024 were assigned to 11,867 SciVal Topics. The thematic core was defined as Topics with more than 40 DTB publications during this period; 200 Topics met this threshold. Figure 6 visualizes only Topics with more than 200 DTB publications in 2022-2024 in order to improve readability.

High-volume topics in the 2022-2024 DTB corpus included cyber-physical systems in Industry 4.0, digital twins, organizational digital transformation, e-learning, and digital competences. The largest DTB topic by publication volume in 2022-2024 was 'Integration of Cyber Physical Systems in Industry 4.0'. The third-largest topic, 'Digital Twin Technology in Cyber Physical Systems,' also expanded rapidly over the study period (Fig. 6). The cyber-physical-systems topic was already prominent in 2015-2017, ranking second by publication volume, whereas the digital-twin topic increased from a comparatively small base to become one of the largest topics in 2022-2024. Between 2015-2017 and 2022-2024, publication output increased 6.9-fold for the cyber-physical-systems topic and 46.7-fold for the digital-twin topic. The largest topic in 2015-2017, 'Technology Acceptance in E-learning Contexts,' remained among the high-volume DTB topics in 2022-2024, ranking fourth by publication volume. However, its growth rate was below the overall DTB-corpus growth rate (Fig. 6).

The second-largest topic by publication volume addressed general frameworks for implementing digital transformation in organizations. The topic 'Frameworks for Digital Transformation in Organization' covered cross-sectoral approaches to organizational digital transformation. Unlike the first and fourth ranked topics in 2022-2024, it had a relatively small publication volume in 2015-2017 and, like 'Digital Twin Technology in Cyber Physical Systems,' expanded rapidly over the study period.

Based on publication growth and FWCI, the displayed DTB topics with the strongest expansion and above-average citation impact were *Blockchain Technology in Sustainable Supply Chain*, *Human-Centric Innovations in Industry 5.0*, *Circular Economy Framework for Sustainable Development*, *AI-Enabled Service Robots in Customer Experience*, *Artificial Intelligence in Decision-Making and Management*, *Metaverse Integration in Digital Experiences and Education* (Fig. 6). "Publication output in these topics increased more than 100-fold between 2015–2017 and 2022–2024, and their FWCI values were more than twice the DTB-corpus average of 1.55. These topics had very low publication volumes in 2015-2017. These topics reflect increasing scholarly attention to blockchain, AI, metaverse applications, service robotics, circular-economy frameworks, and human-centric Industry 5.0 themes. Topics with below-average growth among the displayed set included 'Business Intelligence and Decision-Making Integration,' 'E-Government Services and Citizen Engagement Dynamics,' 'Innovative Business Models for Sustainable Value Creation,' and 'Technology Acceptance in E-Learning Contexts.' Although publication output also increased in these topics, their growth was below the overall DTB-corpus growth factor of 4.2 between 2015-2017 and 2022-2024 (Fig. 6).

Russia's three most frequent DTB topics correspond to the three highest-volume global topics and appear in the same order (Figs. 6 and 7). Russian-affiliated publications overlap with several high-volume global topics, particularly cyber-physical systems, digital twins, and organizational digital transformation. This overlap indicates thematic presence in the global DTB literature; it does not imply equivalent citation influence, technological capability, or integration into international research networks. Beyond these shared high-volume topics, the Russian-affiliated subset displays a distinct distribution across other topics, including a relatively stronger presence in application-oriented and Russia-contextualized research areas. In the displayed set of secondary topics, higher Russian publication shares tended to coincide with lower Topic Prominence percentiles. Some of these topics are devoted to Russian context, i.e., *Digitalization and Sustainable Development in Russia*, *Neural Network Applications in Arctic Risk Management*, *Digital Transformation in Russian Economic Development*. The other topics are rather general, i.e., *Innovative Technologies in Open Pit Mining Management*, *Innovative Management for Sustainable Economic Development*, *Digital Transformation in Sustainable*

Business Models. The prominence percentiles of these selected topics declined by 44.0%-79.4% between the two observation windows (Fig. 7).

Russian-affiliated publications accounted for 1.7%-9.5% of the selected topics with Topic Prominence percentiles above 99.3 (Fig. 7). Russian-affiliated publications accounted for a comparatively small share of the highest-prominence DTB topics displayed in Figure 6. The displayed results also indicate a comparatively limited presence of Russian-affiliated publications in selected high-prominence topics. This pattern was especially visible in ‘Artificial Intelligence in Decision-Making and Management’ and ‘Blockchain Technology in Sustainable Supply Chain’ (Fig. 6). These patterns are consistent with a relatively stronger orientation of the Russian-affiliated subset toward application-oriented and Russia-contextualized topics. The Russian-affiliated subset had a smaller relative presence in selected AI-, blockchain-, metaverse-, and service-robotics topics than the global corpus. Russian-affiliated DTB publications had a lower FWCI than the global DTB-corpus average for the selected topic set (Fig. 7).

Topic	Global number of publications on a specific topic		N. of publications growth 2022-2024 to 2015-2017, times	N. of publications of Russia, 2022-2024	FWCI value, 2022-2024, points	Topic Prominence percentile
	2015-2017	2022-2024				
Total	16 003	66 810	4.2	1 697	1.55	...
Integration of Cyber Physical Systems in Industry 4.0	509	3 493	6.9	61	1.81	99.971
Frameworks for Digital Transformation in Organizations	62	1 780	28.7	54	2.43	99.948
Digital Twin Technology in Cyber Physical Systems	31	1 449	46.7	33	2.32	99.972
Technology Acceptance in E-Learning Contexts	582	1 380	2.4	5	2.03	99.843
Digital Competence Frameworks in Education	93	766	8.2	22	1.44	99.393
Trust and Adoption in Mobile Payment Technologies	91	597	6.6	0	2.25	99.933
Blockchain Technology in Sustainable Supply Chains	4	540	135.0	3	2.18	99.951
Big Data's Influence on Decision-Making and Performance	126	521	4.1	2	1.71	99.837
Robotic Process Automation in Business Transformation	7	464	66.3	4	1.38	97.753
Blockchain Innovations in Healthcare Data Security	21	424	20.2	4	1.68	99.958
Human-Centric Innovations in Industry 5.0	4	397	99.3	15	4.12	99.446
Circular Economy Framework for Sustainable Development	3	394	131.3	5	3.62	99.988
AI-Enabled Service Robots in Customer Experience	2	390	195.0	4	3.49	99.973
Human-Robot Collaboration in Industrial Environments	22	355	16.1	0	2.71	99.529
Artificial Intelligence in Decision-Making and Management	1	352	352.0	4	3.24	99.905
Digital Platforms and Ecosystem Innovation Dynamics	38	316	8.3	8	1.68	99.580
Automation's Impact on Employment and Skills	32	307	9.6	10	2.39	99.585
Business Intelligence and Decision-Making Integration	251	287	1.1	1	1.01	97.268
Resilience and Risk Management in Supply Chains	12	272	22.7	2	3.18	99.932
E-Government Services and Citizen Engagement Dynamics	69	244	3.5	12	1.83	98.924
Innovative Business Models for Sustainable Value Creation	71	242	3.4	5	1.69	99.716
Metaverse Integration in Digital Experiences and Education	0	242	242.0	2	3.93	99.921
Consumer Engagement in Social Media Marketing	32	231	7.2	1	1.16	99.877
Sustainable Supply Chain Management for Industry Advancement	43	218	5.1	3	1.88	99.886
Deep Learning Models for Remaining Useful Life Prediction	8	218	27.3	3	1.81	99.842
Augmented Reality Systems for Enhanced User Interaction	26	207	8.0	1	1.48	98.794
Smart City Frameworks for Sustainable Urban Development	27	205	7.6	6	2.13	99.874
Green Innovation Strategies for Sustainable Development	28	202	7.2	0	3.11	99.924

Fig. 6. Key topics in the global dataset of publications on *Digital Transformation in Business* dataset: 2015-2017, 2022-2024

Note: A total of 66,810 DTB publications from 2022-2024 were assigned to 11,867 SciVal Topics. The thematic core comprised 200 Topics with more than 40 DTB publications. To improve readability, Figure 6 displays only Topics with more than 200 DTB publications during 2022-2024.

Topic	Number of publications of Russia on a specific topic		Share of Russia in the world, 2022-2024, %	FWCI value, 2022-2024, points	Topic Prominence percentile
	2015-2017	2022-2024			
Total	232	1 697	2.54	1.03	...
Integration of Cyber Physical Systems in Industry 4.0	7	61	1.7	1.85	99.971
Frameworks for Digital Transformation in Organizations	2	54	3.0	0.89	99.948
Digital Twin Technology in Cyber Physical Systems	1	33	2.3	1.20	99.972
Digital Competence Frameworks in Education	0	22	2.9	0.57	99.393
Digital Transformation in Russian Economic Development	0	21	87.5	0.27	65.441
Digital Transformation and Sustainable Economic Development	1	19	90.5	0.32	81.491
Digital Transformation in Sustainable Business Models	1	17	100.0	0.28	54.706
Human-Centric Innovations in Industry 5.0	0	15	3.8	4.41	99.446
E-Government Services and Citizen Engagement Dynamics	2	12	4.9	1.40	98.924
Digital Economy Transformation for Sustainable Development	1	12	60.0	1.27	69.348
Challenges and Innovations in Online Learning During COVID-19	0	11	6.3	0.88	99.742
Signal Processing and Communication in Modern Networks	0	11	100.0	4.30	79.398
Innovative Management for Sustainable Economic Development	2	11	100.0	0.20	62.618
Innovative Risk Management in Construction and Energy Sectors	0	11	91.7	0.87	57.049
Automation's Impact on Employment and Skills	0	10	3.3	0.21	99.585
Social Media Influence on Adolescent Development	1	10	90.9	0.70	67.291
Innovative Management Systems in Aerospace Enterprises	0	10	90.9	0.51	72.492
Innovative Technologies in Open Pit Mining Management	1	10	100.0	0.59	56.030
Neural Network Applications in Arctic Risk Management	0	9	100.0	0.24	46.153
Digital Transformation in Commerce and Logistics	1	9	81.8	1.26	71.637
Fintech Innovations and Regulatory Frameworks in Banking	0	8	5.8	0.34	99.760
Digital Platforms and Ecosystem Innovation Dynamics	0	8	2.5	0.53	99.580
Digital Divide and Social Inclusion Challenges	0	8	9.5	0.46	98.604
Digitalization and Sustainable Development in Russia	0	8	100.0	0.43	44.043

Fig. 7. Key topics of Russia's publications in *Digital Transformation in Business* dataset: 2015-2017, 2022-2024

Note: A total of 1 697 Russian publications on the topic of *Digital Business Transformation* from 2022-2024 are distributed across 905 topics. Calculations are presented for topics where the number of Russian publications on *Digital Business Transformation* exceeded eight items during the 2022-2024 period.

Institutional impact

The world's major contributors to the research on business digitalization at the institutional level are predominantly universities (Fig. 8). The leading institutions' overall Scopus profiles frequently included engineering and computer science, although several also had substantial activity in medicine and other fields (Table A.1). The institution with the highest DTB publication output in 2022-2024 was Bina Nusantara University in Indonesia. With 605 DTB publications, Bina Nusantara University accounted for 22.0% of Indonesia's DTB output under full counting. The institutional concentration of DTB publication output varied substantially across countries. Hong Kong Polytechnic University had the highest institutional share of its territory's DTB publication output for 2022-2024 – 48.1%. High institutional concentration was also observed for the University of Johannesburg, which accounted for 37.9% of South African DTB publications, and for the Norwegian University of Science and Technology, which accounted for 31.4% of Norway's DTB publications. The French National Centre for Scientific Research (CNRS), an aggregated research structure, accounted for 28.7% of France's DTB publications, whereas organizations affiliated with the Russian Academy of Sciences accounted for 12.0% of Russia's DTB publication output.

Against the background of overall DTB growth, all institutions in the displayed ranking increased their publication output between the two observation windows (Fig. 8). This applied both to recently prominent institutions, such as Jawaharlal Nehru Technological University Hyderabad and Symbiosis International University, and to longer-established contributors, including RWTH Aachen University, Universiti Teknologi Malaysia, the Technical University of Munich, and the University of Minho. Against a global growth factor of 4.2, several Indian universities displayed high relative growth. Because some began from small publication volumes, these ratios should not be interpreted without reference to their absolute output. Several Indian universities expanded from small 2015-2017 baselines to substantially higher output in 2022-2024. Chandigarh University increased from 0 to 234 publications (234-fold), Graphic Era University from 1 to 221 (221-fold), Uttaranchal University from 1 to 165 (165-fold), and Symbiosis International University from 9 to 400 (44.4-fold). These fold changes should be interpreted cautiously because they are sensitive to small starting values. Several longer-established contributors nevertheless recorded growth below the global DTB-corpus growth factor.

Growth in institutional publication output did not always coincide with higher field-normalized citation impact. Bina Nusantara University, the institution with the highest publication output, had the lowest FWCI among the institutions displayed (0.70) (Fig. 8). It was followed by Universiti Teknologi MARA (0.94) and the Russian Academy of Sciences (1.08). FWCI values below, but close to, the DTB-corpus average of 1.55 were observed for RWTH Aachen University (Germany), the University of Minho (Portugal), Visvesvaraya Technological University (India), University of Porto (Portugal), and Universiti Kebangsaan Malaysia.

Among the institutions displayed, Hong Kong Polytechnic University had the highest FWCI (3.60) and an average of 38.5 citations per publication. Other institutions with high FWCI values included Graphic Era (India; FWCI 3.56; 18.7 citations per publication), the University of Naples Federico II (Italy; FWCI 2.69; 29.7 citations per publication), and Zhejiang University (Mainland China; FWCI 2.48; 26.6 citations per publication). Average citations per publication are descriptive and age-sensitive; FWCI provides the normalized basis for cross-institutional comparison. These institutions exceeded the DTB-corpus average FWCI of 1.55.

Universities accounted for a substantial share of the Russian-affiliated DTB corpus (Fig. 9). Among Russian institutions, Peter the Great St. Petersburg Polytechnic University ranked first by DTB publication output, accounting for 7.54% of Russia's DTB publications in 2022-2024. The institutional composition of the Russian list differed from that of the global list. As shown in Table A.2, St. Petersburg Polytechnic University had a substantial engineering profile: 47.7% of its overall publication output in

2022-2024 was assigned to Engineering. However, the key subject area for the next three ranked institutions, namely, for Higher School of Economics, the Financial University under the Government of the Russian Federation, Plekhanov Russian University of Economics, and the Russian Presidential Academy of National Economy and Public Administration, is Social Sciences (See Table A.2 in Appendix). The Russian institutional list combines universities with economics, management, and social-science profiles with technically oriented universities, e.g. Moscow State Aviation Institute, Moscow State University of Civil Engineering, Don State Technical University etc. (Fig. 9).

Against the background of an overall decline in the Russian publication output since 2022, the majority of the most productive Russian universities in the ranking experience a decline in publications (Fig. 9). The sharpest decline (2019-2021 to 2022-2024) was recorded in ITMO University (St. Petersburg) at -70.9% . Only a small number of institutions with low initial output recorded positive growth, especially Samara State University of Economics (220.0%), and Moscow State University of Civil Engineering (91.3%).

Relative to the global DTB-corpus averages, many leading Russian institutions had lower FWCI values in 2022-2024 (Figs. 8 and 9). Average citations per publication were also lower for many of these institutions, but this unnormalized indicator should be interpreted descriptively because it is sensitive to the age composition of the publication set. Only several Russian institutions had FWCI values at or above the DTB-corpus average: South Ural State University (FWCI 1.62; 22.3 citations per publication) and Ural Federal University (FWCI 1.93; 14.3 citations per publication). Russia's aggregate FWCI was 1.03 – slightly above the Scopus world baseline of 1.00 but below the DTB-corpus average of 1.55. Moscow State University of Civil Engineering had an FWCI of 4.48; this value should be interpreted together with its publication count because FWCI can be unstable for small publication sets. Many of the most productive Russian institutions had FWCI values below Russia's aggregate FWCI of 1.03 (Fig. 9).

Organisation name (city, country)	Number of publications of organisation		Number of publications growth 2022-2024 to 2015-2017, times	Share of organisation in all publications of its country, %	Average number of citations per one publication	Field-Weighted Citation Impact (FWCI) value, points
	2015-2017	2022-2024				
World total	16 003	66 810	4.2	...	12.1	1.55
Standalone organisations						
1. Bina Nusantara University (Jakarta, Indonesia)	35	605	17.3	22.0	3.4	0.70
2. University of Johannesburg (Johannesburg, South Africa)	33	519	15.7	37.9	22.9	2.35
3. Symbiosis International University (Pune, India)	9	400	44.4	5.5	15.6	2.39
4. Jawaharlal Nehru Technological University Hyderabad (Hyderabad, India)	14	372	26.6	5.1	6.8	2.25
5. Polytechnic University of Milan (Milan, Italy)	57	349	6.1	10.0	12.0	1.90
6. Hong Kong Polytechnic University (SAR Hong Kong China)	55	298	5.4	48.1	38.5	3.60
7. RWTH Aachen University (Aachen, Germany)	141	284	2.0	6.5	9.3	1.45
8. Zhejiang University (Hangzhou, Mainland China)	38	267	7.0	2.5	26.6	2.48
9. Universiti Sains Malaysia (Gelugor, Malaysia)	47	265	5.6	10.7	21.7	2.42
10. Tsinghua University (Beijing, Mainland China)	57	262	4.6	2.4	19.6	1.89
11-12. University of Minho (Braga and Guimaraes, Portugal)	80	252	3.2	16.5	8.7	1.51
11-12. Universiti Teknologi Malaysia (Johor Bahru, Malaysia)	99	252	2.5	10.2	20.5	2.03
13-14. Chandigarh University (Mohali, India)	0	234	234.0	3.2	9.9	2.12
13-14. Norwegian University of Science and Technology (Trondheim, Norway)	55	234	4.3	31.4	26.9	2.56
15-16. Technical University of Munich (Munich, Germany)	71	225	3.2	5.1	14.5	2.03
15-16. Vellore Institute of Technology (Vellore, India)	30	225	7.5	3.1	25.4	2.14
17. Universiti Teknologi MARA (Shah Alam, Malaysia)	42	224	5.3	9.1	6.9	0.94
18. Graphic Era (Dehradun, India)	1	221	221.0	3.1	18.7	3.56
19. Lovely Professional University (Phagwara, India)	6	218	36.3	3.0	12.3	2.73
20. Visvesvaraya Technological University (Belagavi, India)	11	217	19.7	3.0	5.6	1.42
21-22. Amity University, Noida (Noida, India)	30	202	6.7	2.8	9.9	1.69
21-22. Shanghai Jiao Tong University (Shanghai, Mainland China)	39	202	5.2	1.9	15.7	1.65
23. University of Naples Federico II (Naples, Italy)	22	200	9.1	5.7	23.7	2.69
24. University of Porto (Porto, Portugal)	48	198	4.1	13.0	10.7	1.45
25. Universiti Kebangsaan Malaysia (Bangi, Malaysia)	38	197	5.2	8.0	14.9	1.46
Associations of organisations						
CNRS (France)	145	512	3.5	28.6	13.0	1.66
Chinese Academy of Sciences (Mainland China)	66	255	3.9	2.4	15.2	1.60
Russian Academy of Sciences (Russian Federation)	49	204	4.2	12.0	6.0	1.08
National Research Council of Italy (Italy)	33	156	4.7	4.5	13.7	1.68

Fig. 8. Key indicators of publication activity of leading organizations in *Digital Transformation in Business* dataset: 2015-2017, 2022-2024

Notes. 1. The data are presented for each organization's main profile in SciVal, automatically generated by Scopus affiliation recognition algorithms. 2 The indicators for associations of organizations (CNRS, Chinese Academy of Sciences, National Research Council of Italy) are presented for the profile of a given association in SciVal, which integrates the indicators of individual organizations within the association (group), as identified by Scopus affiliation recognition algorithms. 3 The sum of the specific weights of publications from all organizations of a specific country exceeds 100%, as a publication may be prepared by authors from different organizations.

Organisation name (city, country)	Number of publications of organisation		Number of publications growth 2022-2024 to 2015-2017, times	Average number of citations per one publication	Field-Weighted Citation Impact (FWCI) value, points
	2015-2017	2022-2024			
Russia Total	232	1 697	7.3	5.1	1.03
Standalone organisations					
1. Peter the Great St. Petersburg Polytechnic University (Saint Petersburg)	12	128	10.7	4.8	0.99
2. Higher School of Economics (Moscow)	16	101	6.3	10.9	1.92
3. Financial Academy of the Russian Federation Government (Moscow)	4	81	20.3	4.8	0.84
4. Plekhanov Russian University of Economics (Moscow)	8	65	8.1	4.5	0.64
5. Samara State University of Economics (Samara)	0	64	64.0	1.0	0.37
6. Russian Presidential Academy of National Economy and Public Administration (Moscow)	6	61	10.2	3.6	0.92
7. Ural Federal University (Ekaterinburg)	6	57	9.5	14.3	1.93
8. Moscow State Aviation Institute (Moscow)	1	48	48.0	5.0	1.23
9. Moscow State University of Civil Engineering (Moscow)	3	44	14.7	5.8	4.48
9. Lomonosov Moscow State University (Moscow)	12	44	3.7	3.3	0.44
11. People's Friendship University of Russia (Moscow)	4	42	10.5	6.0	0.99
11. Kazan Volga Region Federal University (Kazan)	7	42	6.0	5.4	1.10
13. Don State Technical University (Rostov-on-Don)	2	37	18.5	2.4	0.76
13. St. Petersburg State University (Saint Petersburg)	11	37	3.4	10.8	1.23
13. Bauman Moscow State Technical University (Moscow)	0	37	37.0	3.9	0.77
16. The State University of Management (Moscow)	1	33	33.0	2.3	0.40
17. ITMO University (Saint Petersburg)	12	32	2.7	7.0	1.17
18. South Ural State University (Chelyabinsk)	4	31	7.8	22.3	1.62
19. Southern Federal University (Rostov-on-Don)	1	29	29.0	2.1	0.52
20. Moscow State Institute of International Relations (MGIMO-University) (Moscow)	2	27	13.5	4.4	0.65
21. Siberian Federal University (Krasnoyarsk)	3	24	8.0	6.0	0.76
22. MIREA - Russian Technological University (Moscow)	0	23	23.0	1.7	0.40
22. Moscow Polytechnic University (Moscow)	2	23	11.5	8.2	1.89
24. RAS - Institute of Economics, Ural Branch (Ekaterinburg)	4	22	5.5	8.3	2.52
25. Russian University of Transport (Moscow)	0	21	21.0	1.9	0.43
25. Samara State Technical University (Samara)	1	21	21.0	1.6	0.41
25. Volgograd State Technical University (Volgograd)	4	21	5.3	4.6	0.67
25. RAS - Institute of Control Sciences (Moscow)	2	21	10.5	3.4	1.28
29. Kuban State Agrarian University (Krasnodar)	0	20	20.0	3.2	1.44
Associations of organisations					
Russian Academy of Sciences	49	204	4.2	6.0	1.08
RAS - Ural Branch	3	28	9.3	6.9	2.06

Fig. 9. Key indicators of publication activity of leading Russian organizations in *Digital Transformation in Business* dataset: 2022-2024

Notes. 1. The data are presented for the main profile of each organization, automatically generated by the affiliation recognition algorithms in SciVal. 2. The indicators for associations of organizations (e.g., the Russian Academy of Sciences and its regional branches, the Ministry of Health of the Russian Federation, etc.). 3. The indicators for associations of organizations are presented for the profile of a given association, which integrates the indicators of individual organizations within the association, in the same way as these organizations were identified by the affiliation recognition algorithms in SciVal. 4. The sum of the specific weights of publications of all organizations in the country exceeds 100%, since a publication may be prepared by authors from different organizations.

DISCUSSION

The growth of global DTB publication output indicates that the field has attracted increasing scholarly attention. Publication growth was particularly rapid in the pre-pandemic period, especially in 2019. This phase coincided with the maturation of Industry 4.0 research and the expansion of organizational digital-transformation initiatives worldwide. The acceleration observed in 2024 coincided with a period of rapid growth in scholarly attention to generative AI; however, the present data do not identify the mechanisms underlying this increase. Russian-affiliated DTB output broadly followed the global growth trajectory until 2021, with particularly rapid growth after 2017. After 2021, continued global growth contrasted with a decline in Russian-affiliated DTB output. This pattern coincided with a broader decline in Russian-affiliated publication output and does not by itself indicate a decline in substantive interest in DTB. The smaller year-on-year decline in 2024 may be consistent with short-term stabilization, although this interpretation is limited by annual fluctuations and indexing lags. The decline in Russian-affiliated output after 2021 coincides with multiple changes, including publication practices, international collaboration conditions, indexing dynamics, and institutional incentives. The present design does not permit attribution to any single mechanism. Although Russia's share of global DTB output declined, Russian-affiliated publications remained present in the international Scopus-indexed corpus.

The results also show changes in the geographic distribution of DTB publication output. Countries that were among the leading contributors in the early period – including the United States, Germany, the United Kingdom, and Spain – were joined and, in some cases, overtaken by China, India, and Indonesia in publication-output rankings. Indexed DTB output became less concentrated in North America and Western Europe, with large increases in China, India, Indonesia, and several Middle Eastern countries. This pattern reflects a redistribution of publication output across countries; it does not, by itself, establish differences in firms' adoption of digital transformation or in countries' technological capabilities. Several countries in South and East Asia, the Middle East, and Africa—including Iran, Pakistan, Jordan, Bangladesh, Malaysia, the United Arab Emirates, India, Hong Kong, and South Africa – recorded positive trends in publication output and/or FWCI. By contrast, several countries in Western and Central Europe, together with the United States, recorded slower publication growth or declining relative positions in the DTB output ranking. The pattern was particularly visible in Germany, Austria, Switzerland, the United Kingdom, Sweden, the Netherlands, Poland, Spain, and Portugal.

The four-indicator matrix reveals distinct descriptive bibliometric profiles among the 25 countries compared. Australia, the United Kingdom, France, and the Netherlands combined relatively high FWCI values with higher shares of international co-authorship and publication in highly ranked sources. Pakistan, the United Arab Emirates, and Saudi Arabia had comparatively high shares of internationally co-authored publications. China and India combined high publication output with comparatively lower shares of international co-authorship than several European and Gulf-country comparators. Within the selected four-indicator framework, Russia and Indonesia occupied the lower range on several impact- and venue-related indicators among the countries compared.

The query-defined DTB-related Scopus corpus includes high-volume and rapidly expanding topics related to smart manufacturing, digital twins, AI, blockchain, service robotics, Industry 5.0, and sustainability. Cyber-physical systems, e-learning, and digital-education topics also remained visible across both observation windows. The topical analysis indicates partial overlap between the Russian-affiliated subset and the global DTB-related Scopus corpus defined by the search strategy. Although Russian-affiliated publications overlapped with several high-volume global topics, the subset showed a relatively stronger presence in application-oriented and Russia-contextualized topics. The observed thematic differences may partly reflect variation in the institutional and disciplinary composition of the two corpora. The selected global institutional contributors include many engineering-intensive universities, whereas the Russian institutional landscape combines technical universities with institutions

oriented toward economics, management, and social sciences. The Russian-affiliated subset showed a relatively stronger presence in application- and localization-oriented topics, whereas the global corpus included a larger share of publications in selected technology-development-related topics. This pattern is descriptive: bibliometric evidence alone cannot establish whether it is associated with firms' access to emerging technologies, policy incentives, institutional specialization, or other contextual factors.

CONCLUSION

This scientometric analysis documents sustained publication growth, heterogeneous field-normalized citation impact, and thematic evolution in the query-defined DTB-related Scopus corpus between 2010 and 2024. The descriptive results are consistent with H1. Global DTB publication output increased substantially over 2010-2024, whereas Russian-affiliated output diverged from the global trajectory after 2021. This divergence should be interpreted cautiously because bibliometric data alone cannot identify the relative roles of publication conditions, collaboration patterns, indexing dynamics, institutional incentives, or technology-access constraints.

The descriptive results provide partial support for H2. The geographic distribution of DTB research became less concentrated in North America and Western Europe, while China, India, Indonesia, and several Middle Eastern countries recorded substantial growth in publication output. At the same time, field-normalized citation impact and publication in highly ranked sources remained heterogeneous across countries.

The country-level comparison is consistent with H3: leading contributors displayed distinct bibliometric profiles across publication volume, FWCI, international co-authorship, and publication in highly ranked sources. These profiles should be interpreted as descriptive configurations rather than as direct evidence of national publication strategies.

The observed thematic patterns are consistent with H4 within the defined Scopus corpus and SciVal Topic classification. Compared with 2015-2017, the 2022-2024 query-defined DTB-related Scopus corpus showed stronger representation of digital twins, AI-related themes, Industry 5.0, sustainability, and implementation-oriented research. H5 was only partially supported. The Russian-affiliated subset differed from the global corpus and showed a stronger relative orientation toward application- and Russia-contextualized topics; however, the expected prominence of technology sovereignty, domestic software, cybersecurity, industrial digitalization, and supply-chain resilience was not consistently observed.

The differences between the global and Russian-affiliated corporations may also reflect variation in institutional specialization. The selected global institutional contributors included many engineering-intensive universities, whereas the Russian institutional landscape combined technical universities with institutions oriented toward economics, management, and social sciences. This interpretation remains associative rather than causal.

Methodologically, the study integrates publication trajectories, field-normalized citation impact, source-quartile profiles, geographic participation, institutional output, and SciVal Topic mapping. The framework may be adapted to other rapidly evolving interdisciplinary domains, subject to topic-specific search-query validation and sensitivity analysis. The four-indicator matrix provides a descriptive tool for comparing country-level bibliometric profiles; it should not be interpreted as a direct measure of national knowledge-production strategies.

LIMITATIONS OF THE STUDY AND FUTURE RESEARCH DIRECTIONS

Several limitations should be considered when interpreting the findings. The study has limitations inherent to bibliometric data and descriptive scientometric analysis. First, there are dataset constraints, including data coverage, indexing delays, and insufficient citation accumulation. While Scopus provides comprehensive indexing and robust analytical tools, it introduces potential coverage bias due to its

preference to English-language publications, international journals, and established publishing outlets. In addition, the focus on Scopus-indexed articles, reviews, and conference papers excludes grey literature, technical reports, policy documents, and industry publications. Second, bibliometric analysis identifies publication and citation patterns but cannot establish causal mechanisms. Third, the broad search query was designed to capture the interdisciplinary scope of DTB research, but it may retrieve publications that address digital technologies in organizational settings without focusing centrally on digital transformation in business. The absence of a formal manual relevance assessment or sensitivity analysis using narrower alternative queries is therefore an additional limitation. The findings should therefore be interpreted as describing a query-defined DTB-related Scopus corpus rather than a strictly bounded conceptual field.

These limitations point to several directions for future research. The application of different methods can mitigate the shortcomings of our study and give new insights into DTB, e.g. longitudinal impact assessment, qualitative content analysis of highly cited papers, multi-database comparative analysis (WoS, Dimensions, OpenAlex), and network and collaboration pattern analysis. The focus of future studies can shift to conceptual innovation assessment, innovation diffusion and implementation, societal impact, comparison of diverse institutional, economic, and cultural contexts or modeling and forecasting of DTB strategies. These prospective research directions would substantially enhance the understanding of digital transformation, scholarly impact, and knowledge production, transfer and implementation, contributing to field advancement and more effective practical application.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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APPENDIX

Appendix Box 1. Strategy for the Formation of the “Digital Transformation in Business” (DTB) Corpus of Publications in Scopus

To construct the final Scopus query used to identify publications related to digital transformation in business (DTB) during 2010-2024, we applied Boolean, proximity, and truncation operators.

The final query executed in the Scopus advanced-search interface was as follows:

Pubyear > 2009 and Pubyear < 2025 and doctype(ar OR re OR cp) and title-abs-key(
("business* digitalis*" OR "business* digitaliz*" OR "digital* adoption*" OR "digital* business strateg*" OR "digital* business transformation*" OR "digital* capabilit*" OR "digital* innovation*" OR "digital* maturit*" OR "digital* readines*" OR "digital* strateg*" OR "Digital transformation in industry" OR "Digital* transformation* of business model*" OR "enterprise* digital* transformation*" OR "Fourth Industrial Revolution*" OR "Index of Digital Transformation of Business Structures" OR "Digit* Business* Model*" OR "Value Chain* Reconfigurat*" OR "digital* competenc*" OR "Digital* Government*" OR "digital* leadership*" OR "technolog* governance*" OR "Digit* Marketing*" OR "business* process* automation*" OR "business* process* digitali?ation*" OR "digital* process* innovation*" OR "digital* suppl* chain*" OR "Robot* Process Automation*" OR "smart manufacturing*" OR "business* intelligence*" OR "Data Governance" OR "governance of data" OR "data management strateg*" OR "Data-Drive* Decis* Mak*" OR "real-time analytic*" OR "digital* risk management*" OR "digital* competitiv*" OR "operational* performance*" OR "organi*ational* performance*" OR "technolog* acceptance*" OR "Industr* 4.0*" OR "Industr* 5.0*" OR "Technolog* change*")

OR (("Digitalizat*" OR "Digitalisat*" OR "Digitalized" OR "Digitalised" OR "Digitizat*" OR "Digitisat*" OR "Digitized" OR "Digitised" OR "5G Connectivit*" OR "5g Infrastructur*" OR "infrastructur* of 5g" OR "Infrastructur* for 5G" OR "5G technolog*" OR "AI adopt*" OR "adopt* of artificial intelligence" OR "artificial intelligence adopt*" OR "adopt* of AI" OR "AI-enabled transformation*" OR "API econom*" OR "API manag*" OR "econom* of API" OR "manag* of API" OR "artificial intelligence*" OR "augmented reality*" OR "blockchain* technolog*" OR "Chatbot*" OR "chat bot" OR "Virtual Assistant*" OR "Cloud and infrastructure" OR "cloud* computing*" OR "cloud-enabled transformation*" OR "Cognitive Computing" OR "cyber*-physical* system*" OR "deep learning*" OR "Digit* Twin*" OR "distributed ledger technolog*" OR "Edge Comput*" OR "extended reality*" OR "Hybrid* Cloud*" OR "hybrid cloud strateg*" OR "Infrastructur* As A Servic*" OR "Platform* as a service*" OR "softwar* as a service*" OR "industrial internet of things*" OR "IIoT" OR "Industr* IoT" OR "intelligent* automation*" OR "Internet of Thing*" OR "connected system" OR "machine learning*" OR "Metaverse*" OR "microservice* architecture*" OR "multi-cloud strateg*" OR "Quantum Computing*" OR "Real-Time Data Process*" OR "Serverless* Architectur*" OR "smart contract*" OR "Smart Device*" OR "virtual reality*" OR "predictive analytic*" OR "Digit* Transformation*" OR "Digital* Transformation* Roadmap*" OR "digital* transformation strateg*" OR "digital* transformation* success factor*")

W/5 (enterprise* OR entrepreneur* OR business* OR corporation* OR corporative OR firm)))

The list of terms in our query search consists of three blocks.

First block – the terms directly related with Digital Transformation in Business (Green highlighting).

Second block – the terms that are related with digitalization, industrial internet of things, digital twins (grey highlighting).

Third block – are the general terms that describe business (orange highlighting).

The above-mentioned three blocks of terms are merged via search operators “OR” and “W/5” as follows: (Block 1 OR (Block 2 W/5 Block 3))

W/5 operator works as follows: (Digitalisation W/5 “business”) search would find publications in which "Digitalisation" and “business" are no more than 5 terms apart.

Pubyear > 2009 and Pubyear < 2025 - the search for the period of 2010-2024.

doctype(ar OR re OR cp) - the search of three types of publications - articles (AR), reviews (RE) and conference papers (CP).

title-abs-key(...) - the search in titles, abstracts and keywords sections of the Scopus-indexed publications.

The asterisk was used as a truncation operator to retrieve alternative word endings. For example, ‘digital strateg*’ retrieves variants such as ‘digital strategy’ and ‘digital strategies’.

Table A.1. Subject Profiles of the Most Productive Organizations in Digital Transformation in Business

Organization name (City, Country)	Share of Top-5 Subject Areas in Organization's Publication Output (2022-2024), %
1. Bina Nusantara University (Jakarta, Indonesia)	COMP (64.8%); ENGI (33.8%); DECI (31.7%); MATH (19.7%); BUSI (16.2%)
2. University of Johannesburg (Johannesburg, South Africa)	SOCI (27.8%); ENGI (23.1%); COMP (15.1%); ENVI (12.2%); BUSI (12.2%)
3. Symbiosis International University (Pune, India)	COMP (49.6%); ENGI (34.6); BUSI (19.6%); DECI (19.3); MATH (17.6%)
4. Jawaharlal Nehru Technological University Hyderabad (Hyderabad, India)	ENGI (44.7%); COMP (37.3%); MATE (15.6%); PHYS (14.4%); MATH (14.1%)
5. Polytechnic University of Milan (Milan, Italy)	ENGI (51.1%); COMP (27.5%); PHYS (19.6%); MATE (16.7%); MATH (16.5%)
6. Hong Kong Polytechnic University (SAR Hong Kong China)	ENGI (40.8%); COMP (23.9%); MATE (16.3%); SOCI (13.5%); ENVI (11.7%)
7. RWTH Aachen University (Aachen, Germany)	ENGI (30.9%); MEDI (24.5%); COMP (17.6%); PHYS (15.8%); MATE (15.0%)
8. Zhejiang University (Hangzhou, China)	ENGI (30.5%); MEDI (20.3); COMP (19.2%); BIOC (15.4%); MATE (14.4%)
9. Universiti Sains Malaysia (Gelugor, Malaysia)	ENGI (22.7%); MEDI (20.5%); COMP (14.3%); SOCI (13.6%); MATE (13.5%)
10. Tsinghua University (Beijing, China)	ENGI (39.0%); COMP (26.7%); PHYS (19.1%); MATE (16.5%); ENVI (12.1%)
11. University of Minho (Braga and Guimaraes, Portugal)	ENGI (31.0%); COMP (21.1); SOCI (16.0%); MATE (14.8%); MEDI (14.0%)
11. Universiti Teknologi Malaysia (Johor Bahru, Malaysia)	ENGI (37.0%); COMP (23.3); MATE (18.4%); PHYS (17.3%); ENVI (16.5%)
13. Chandigarh University (Mohali, India)	COMP (38.1%); ENGI (36.6); MEDI (18.0%); PHYS (15.9%); MATH (15.2%)
13. Norwegian University of Science and Technology (Trondheim, Norway)	ENGI (30.2%); MEDI (20.0%); COMP (18.4%); SOCI (13.3%); ENVI (10.9%)

15. Technical University of Munich (Munich, Germany)	MEDI (26.4%); ENGI (24.8%); COMP (23.4%); PHYS (16.1%); BIOC (12.2%)
15. Vellore Institute of Technology (Vellore, India)	ENGI (43.8%); COMP (38.2%); MATE (17.1%); MATH (15.8%); PHYS (15.0%)
17. Universiti Teknologi MARA (Shah Alam, Malaysia)	ENGI (26.7%); COMP (18.5%); SOCI (15.6%); PHYS (12.9%); MATE (12.7%)
18. Graphic Era (Dehradun, India)	COMP (56.6%); ENGI (44.1%); DECI (25.4%); MATH (22.7%); MEDI (19.5%)
19. Lovely Professional University (Phagwara, India)	ENGI (32.0%); COMP (27.4%); PHYS (15.6%); AGRI (15.0%); ENVI (13.0%)
20. Visvesvaraya Technological University (Belagavi, India)	ENGI (54.3%); COMP (46.5%); MATE (19.6%); PHYS (15.4%); MATH (15.2%)
21. Amity University, Noida (Noida, India)	ENGI (33.9%); COMP (31.1%); MEDI (16.7%); BIOC (14.7%); AGRI (11.4%)
21. Shanghai Jiao Tong University (Shanghai, China)	ENGI (30.6%); MEDI (29.6%); COMP (17.6%); BIOC (16.1%); PHYS (14.5%)
23. University of Naples Federico II (Naples, Italy)	MEDI (30.6%); ENGI (20.2%); BIOC (15.1%); PHYS (13.9%); COMP (12.9%)
24. University of Porto (Porto, Portugal)	MEDI (29.4%); ENGI (18.6%); BIOC (14.6%); COMP (14.0%); AGRI (12.0%)
25. Universiti Kebangsaan Malaysia (Bangi, Malaysia)	ENGI (22.9%); MEDI (19.1%); COMP (15.3%); MATE (12.5%); ENVI (12.4%)
CNRS (France)	PHYS (22.0%); ENGI (18.5%); COMP (15.3%); MEDI (14.5%); MATE (13.1%)
Chinese Academy of Sciences (China)	ENGI (24.4%); PHYS (22.8%); MATE (21.6%); CHEM (18.3%); EART (15.0%)
Russian Academy of Sciences (Russian Federation)	PHYS (24.1%); MATE (16.3%); CHEM (16.2%); ENGI (14.9%); EART (13.1%)
National Research Council of Italy (Italy)	PHYS (22.9%); ENGI (20.9%); COMP (18.9%); MATE (17.8%); BIOC (17.3%)

Note: Abbreviations and Full Names of Subject Areas (ASJC). AGRI - Agricultural and Biological Sciences; ARTS - Arts and Humanities; BIOC - Biochemistry, Genetics and Molecular Biology; BUSI - Business, Management and Accounting; CENG - Chemical Engineering; CHEM - Chemistry; COMP - Computer Science; DECI - Decision Sciences; DENT - Dentistry; EART - Earth and Planetary Sciences; ECON - Economics, Econometrics and Finance; ENER - Energy; ENGI - Engineering; ENVI - Environmental Science; HEAL - Health Professions; IMMUN - Immunology and Microbiology; MATE - Materials Science; MATH - Mathematics; MEDI - Medicine; NEUR - Neuroscience; NURS - Nursing; PHAR - Pharmacology, Toxicology and Pharmaceutics; PHYS - Physics and Astronomy; PSYC - Psychology; SOCI - Social Sciences; VETE - Veterinary; MULT - Multidisciplinary

Table A.2. Subject Profiles of the Most Productive Russian Organizations in Digital Transformation in Business

Organization name (City)	Share of Top-5 Subject Areas in Organization's Publication Output (2022-2024), %
2. Higher School of Economics (Moscow)	SOCI (35.3%); ARTS (22.7%); MATH (18.5%); COMP (16.4%); PHYS (13.9%)
3. Financial Academy of the Russian Federation Government (Moscow)	SOCI (30.4%); ENGI (24.9%); ECON (20.8%); BUSI (17.4%); ENVI (15.7%)
4. Plekhanov Russian University of Economics (Moscow)	SOCI (26.8%); ENGI (22.7%); ENVI (16.0%); COMP (15.8%); ENER (13.4%)
5. Samara State University of Economics (Samara)	ENGI (72.5%); COMP (35.6%); ENER (13.6%); EART (11.1%); ENVI (10.0%)
6. Russian Presidential Academy of National Economy and Public Administration (Moscow)	SOCI (53.6%); EARTS (32.5%); ECON (24.7%); BUSI (10.8%); COMP (9.4%)
7. Ural Federal University (Ekaterinburg)	PHYS (33.3%); MATE (29.5%); ENGI (22.0%); CHEM (20.3%); SOCI (11.7%)
8. Moscow State Aviation Institute (Moscow)	ENGI (51.6%); PHYS (26.6%); COMP (17.0%); MATH (16.1%); MATE (15.5%)
9. Moscow State University of Civil Engineering (Moscow)	ENGI (38.0%); ENER (31.4%); ENVI (31.4%); EART (28.5%); PHYS (19.9%)
9. Lomonosov Moscow State University (Moscow)	PHYS (23.3%); CHEM (17.5%); EART (13.3%); BIOC (12.8%); MATE (12.7%)
11. People's Friendship University of Russia (Moscow)	MEDI (28.5%); SOCI (16.2%); BIOC (12.0%); COMP (11.2%); CHEM (11.0%)
11. Kazan Volga Region Federal University (Kazan)	CHEM (18.5%); PHYS (18.0%); SOCI (15.9%); ENER (14.5%); EART (12.9%)
13. Don State Technical University (Rostov-on-Don)	ENGI (42.3%); ENER (25.1%); COMP (26.3%); ENVI (24.4%); AGRI (21.6%)
13. St. Petersburg State University (Saint Petersburg)	PHYS (19.0%); SOCI (15.5%); CHEM (14.7%); MATE (13.2); COMP (13.0%)
13. Bauman Moscow State Technical University (Moscow)	ENGI (41.7%); PHYS (41.6%); COMP (21.0%); MATH (20.7%); MATE (20.7%)
16. The State University of Management (Moscow)	ENGI (50.6%); COMP (44.4%); SOCI (17.6%); ENVI (12.8%); EART (12.3%)
17. St. Petersburg National Research University of Information Technologies, Mechanics and Optics (ITMO) (Saint Petersburg)	PHYS (43.4%); ENGI (37.1%); COMP (34.0%); MATH (19.4%); CHEM (12.6%)
18. South Ural State University (Chelyabinsk)	ENGI (31.3%); MATE (22.1%); COMP (17.4%); PHYS (15.7%); CHEM (14.4%)
19. Southern Federal University (Rostov-on-Don)	ENGI (27.8%); MATE (21.7%); PHYS (21.5%); COMP (19.5%); CHEM (14.3%)
20. Moscow State Institute of International Relations (MGIMO-University) (Moscow)	SOCI (66.4%); ECON (30.3%); ARTS (29.0%); BUSI (13.8%); ENVI (9.8%)
21. Siberian Federal University (Krasnoyarsk)	PHYS (22.0%); ENGI (20.5%); MATE (18.0%); CHEM (16.2%); SOCI (16.1%)

22. MIREA - Russian Technological University (Moscow)	ENGI (32.0%); PHYS (26.8%); CHEM (25.5%); MATE (25.3%); COMP (22.0%)
22. Moscow Polytechnic University (Moscow)	ENGI (40.8%); MATE (27.4%); PHYS (19.4%); ENER (17.8%); ENVI (16.9%)
24. RAS - Institute of Economics, Ural Branch (Ekaterinburg)	BUSI (40.2%); ENVI (35.2%); ECON (35.2%); SOCI (23.1%); COMP (21.6%)
25. Russian University of Transport (Moscow)	ENGI (44.5%); PHYS (31.6%); COMP (28.2%); SOCI (16.5%); ENER (14.0%)
25. Samara State Technical University (Samara)	ENGI (46.1%); CHEM (24.2%); PHYS (24.1%); COMP (20.0%); MATH (15.3%)
25. Volgograd State Technical University (Volgograd)	ENGI (38.3%); COMP (24.6%); MATE (18.0%); ENVI (13.9%); CHEM (13.6%)
25. RAS - Institute of Control Sciences (Moscow)	ENGI (61.3%); MATH (60.6%); COMP (47.5%); DECI (18.4%); BUSI (13.0%)
29. Kuban State Agrarian University (Krasnodar)	ENVI (35.6%); EART (27.5%); ENGI (27.3%); ENER (22.8%); COMP (20.7%)
Russian Academy of Sciences	PHYS (24.1%); MATE (16.3%); CHEM (16.2%); ENGI (14.9%); EART (13.1%)
RAS - Ural Branch	MATE (28.1%); PHYS (25.5%); CHEM (19.7%); ENGI (15.2%); AGRI (13.3%)

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