HSE UNIVERSITY

HSE GLOBAL CITIES INNOVATION INDEX

2024

HIGH TECH AND CREATIVITY MAP OF THE WORLD

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HSE ISSEK, Moscow, 2025

УДК 332.122:001.895(1-21)(083.41)
ББК 65.051(0-2)
Н35

Editorial Board: Leonid Gokhberg and Evgeniy Kutsenko

Authors: Evgeniy Kutsenko and Leonid Gokhberg (heads of the authors' team), Viktoria Boos, Kristina Boyakova, Ekaterina Ivanova, Tatyana Ostashchenko, and Kirill Tyurchev

With contributions by: Evgeniya Evpak, Kristina Kondakova, Maxim Kotsemir, Zaur Mamediarov, Anna Moiseeva, Sergey Revyakin, and Pavel Solomatin

HSE Global Cities Innovation Index: 2024 / E. Kutsenko, L. Gokhberg (heads of the authors' team), V. Boos et al.; ed. by L. Gokhberg, E. Kutsenko; National Research University Higher School of Economics. – Moscow : HSE ISSEK, 2025. – 432 p. – 950 copies. – ISBN 978-5-7598-3023-8 (pbk).

Н35

HSE Global Cities Innovation Index (HSE GCII 2024) has been developed by the Russian Cluster Observatory of the National Research University Higher School of Economics Institute for Statistical Studies and Economics of Knowledge. It presents a measurement tool to evaluate the competitive edge of cities in terms of their attractiveness for the innovation economy leaders in technological development and creative industries.

The study covers over 1,000 agglomerations from 144 countries, where at least one of 27,925 leaders of the innovation economy is present – top enterprises (mega corporations, disruptive startups, and leading universities) and exceptional individuals (Nobel Prize laureates, highly cited researchers, popular designers, architects, artists, musicians, filmmakers, and developers).

The ranking is based on a unique system of 90 indicators calculated with the use of recognized international data sources (excluding expert estimates, surveys, and administrative data) that were grouped into three key blocks: Technological Development, Creative Industries, and Urban Environment. To affirm the reliability of the used data sources, a special statistical audit was conducted.

The report presents the ranking scores and examines key factors of attracting the world's most successful representatives of the innovation economy to cities. It also discloses the ranking algorithm and provides detailed methodological comments. The publication includes 50 city profiles with the full information about their scores, benchmarking against the leader, and technological specializations.

The publication will be of practical interest to a wide range of readers, including technology entrepreneurs and researchers, artists and representatives of creative industries, urban governance practitioners, and professionals involved in the development of specific innovation economy sectors.

УДК 332.122:001.895(1-21)(083.41)
ББК 65.051(0-2)

This publication was distributed with the support of the Development Fund for Applied Research of the HSE University.

doi:10.17323/978-5-7598-3023-8

ISBN 978-5-7598-3023-8

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Acknowledgements

We express our sincere gratitude to the employees and partners of the Institute for Statistical Studies and Economics of Knowledge within the HSE University for their significant contribution to preparing HSE GCII 2024.

Invaluable advice and recommendations were provided by the members of the Advisory Board: Marcus T. Anthony, Jonathan Calof, Mlungisi Cele, Steven Griffiths, Michael Kahn, Keun Lee, Iwao Ohashi, Mohamed Ramadan A. Rezk, Fernando Rizzo, Muddassar Sarfraz, Ozcan Saritas, Surachai Sathitkunarat, and Kuniko Urashima, who helped look at the results from another angle and contributed to honing the Index methodology. The work of Advisory Board was artfully managed by Maria Rukhalenko.

The authors appreciate the help of distinguished experts: Anastasia Abolina, Vladimir Artemenko, Vasily Auzan, Sergey Baldin, Alexey Baranov, Maria Bogomolova, Alexander Bodrov, Marina Boykova, Vasily Bychkov, Nikita Danilov, Alexander Gagiev, Ruslan Goncharov, Kirill Ilnitski, Andrey Kolosov, Kristina Kostroma, Stanislav Lauk-Dubitsky, Alexandra Lekomtseva, Ilya Lepeshkin, Irina Mastusova, Dirk Meissner, Dmitry Ontoev, Alexey Parabuchev, Liliana Proskuryakova, Kirill Puzanov, Anastasia Rybkina, Leyla Sautieva, Ruslan Shagaleev, Murat Sharafutdinov, Yury Simachev, Alexander Sokolov, Vitaly Stavitsky, Pavel Timoshin, and Nikolay Vasiliev, who dedicated a lot of their time to discussing the most complicated issues of measuring innovation in global cities.

Patent and publication activity analysis has a special place in the report. The work of Sergey Revyakin, Ekaterina Streltsova, Maxim Kotsemir, Denis Martynov, and Anastasiia Nesterenko helped us gather the most complete collection of data for 200 cities within agglomerations.

A considerable help in the searching, understanding, and describing in great detail the success stories of cities' innovation development was provided by Arina Demidenko, Egneniya Evpak, Viktor Kolbin, Vladislav Kolbin, Kristina Kondakova, Ekaterina Lysenko, Zaur Mamediarov, Anna Moiseeva, Ksenia Poleeva, Anastasia Sharapova, Pavel Solomatin, and Makar Trunov.

We are grateful to the editor of this report Maria Sokolova who helped us explain all ideas and results of the study in a more understandable and convincing way.

The HSE GCII 2024 is intended for an international audience. For the English version of this report, the credit goes to Maria Rukhalenko (translation and editing) and Caitlin Montgomery (proofreading).

Exceptional graphic design has been provided by a team of designers who developed the visual concept (Galina Podzolkova, Anastasia Sevodneva, Ivan Tsygankov, and Oleg Vasiliev), created unique illustrations (Tatyana Kasimova), and prepared the layout for the printing (Tatyana Koltsova, Vladimir Puchkov, and Natalia Shabanova).

The HSE GCII 2024 is based on a unique database, with numerous indicators calculated at the city level for the first time ever. We are grateful to the interns of our project: Ali Abbasov, Kamilla Abdullina, Artur Ambartsumjan, Aleksandra Anokhina, Valeria Arsenova, Irina Artyukhina, Alina Azaeva, Bubakhan Babaev, Varvara Bolshakova, Elizaveta Borodulina, Maria Bychkova, Katerina Chemodanova, Maksim Dedyaev, Milena Drozdenko, Ksenia Egorova, Irina Eremeeva, Ekaterina Fedorova, Marina Fedorova, Philipp Glumov, Olga Gorbacheva, Semyon Groza, Ruslan Guseinov, Mirzomurod Isokov, Sofia Janis, Viktoria Kalinina, Aleksandra Kapitanova, Maria Koldasheva, Anastasia Kolonina, Margarita Koptelova, Kristina Koshechko, Aleksej Kosychev, Elizaveta Krymova, Julia Ksenofontova, Anastasiia Kurina, Viktoria Ligaj, Daniil Lyalin, Eldar Makarlamov, Ilya Makarov, Olesia Maksimova, Ekaterina Malkova, Valentina Mazurkevich, Anastasia Melnik, Maria Mihajlova, Angelina Mikhailovskaya, Stanislava Mogilevskaya, Zohirdzhon Muhtarov, Rustam Nasimov, Polina Obukhova, Nikolaj Panin, Maria Petrachenkova, Vladislava Podkovko, Vlada Ratai, Elizaveta Rimsha, Polina Romanycheva, Ksenia Rozhkovaya, Julia Rubtsova, Arina Rusina, Gleb Semenov, Ekaterina Serdyukova, Mikhail Seregin, Mariia Shapovalova, Artyom Shchyokotov, Mark Simankov, Alena Slavogorodskaia, Alina Smilyanets, Elizaveta Soldatova, Ertan Somundzhu, Anton Sorokin, Julia Stepanova, Julia Stetsjuk, Elizaveta Susaeva, Jana Terre, Elizaveta Tikhonova, Nikita Timilidi, Ksenia Timofeeva, Ashot Tonojan, Daniil Valialov, Ekaterina Vasileva, Diana Vakhnenko, and Jaroslav Zaharov. Without them, we would not have been able to analyze so many cities and aspects of their innovation development.

HSE GCII Advisory Board

In 2024, an Advisory Board was formed to enhance the calculation methodology of the HSE Global Cities Innovation Index, conduct comprehensive discussions of the obtained ranking results, and assist with their dissemination on a global scale. The Board included internationally recognized scholars, urban governance practitioners, and experts involved in the development of the innovation economy. Their inspiring ideas, valuable suggestions, and practical recommendations widened the scope of the study, enriched its interpretation, and helped compile the ultimate map of high tech and creative industries.

Members of the Advisory Board

Marcus T. Anthony

Associate Professor, Beijing Institute of Technology, China

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Research Fellow, Stellenbosch University, South Africa

Keun Lee

Distinguished Professor, Seoul National University, Republic of Korea

Iwao Ohashi

Strategic Development through International Cooperation Expert, Industrial Parks and Special Economic Zones of Russia, Russia

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Kuniko Urashima

Visiting Professor, Nagoya University, Japan

Opening Remarks from Members of the HSE GCII 2024 Advisory Board

Marcus T. Anthony
Associate Professor,
Beijing Institute of Technology, China

The HSE Global Cities Innovation Index is an important development for organizations and individuals wishing to locate their work and lives during this increasingly mobile era of the 21st century. The strength of the HSE GCII lies in its simplicity, where each of the 200 cities is given a global rank based on three indicators – Technological Development, Creative Industries, and Urban Environment. In turn, each of these indicators is ranked, providing a convenient and efficient overview of the "attractiveness" of the world's great cities in terms of working and living. The Index will also be of great value to national, regional, and city leaders worldwide, as it provides insights and empirically-grounded indices which suggest why a significant proportion of the globe's innovation leaders are clustered only in 10 countries. It thus presents a potential prompt for re-thinking developmental strategies in the increasingly important struggle to attract and retain talent.

Jonathan Calof
Full Professor,
University of Ottawa, Canada

Congratulations to the National Research University Higher School of Economics Institute for Statistical Studies and Economics of Knowledge (ISSEK) on the release of their 2024 edition of the HSE Global Cities Innovation Index. This index is a valuable resource that recognizes the importance of understanding innovation at the city and regional levels. By focusing on these levels, the index provides insights that are useful for both researchers studying innovation and practitioners working to make their cities and regions more innovative. The HSE Global Cities Innovation Index is a testament to HSE's ongoing leadership in the field of innovation research and measurement, and I look forward to seeing how the index continues to evolve in the future.

Steven Griffiths
Professor and Vice Chancellor for Research,
American University of Sharjah, UAE

As we examine the landscape of global urban innovation through the lens of the HSE Global Cities Innovation Index 2024, it is clear that cities are the cornerstone of technological advancement and creativity in an increasingly geopolitically complex, yet interconnected, world. The index provides a comprehensive view of how cities are

fostering environments that are conducive to innovation, from technological development to creative industries and urban livability.

In the context of the Middle East, Dubai stands out as a source of innovation, ranking in the top 50 global innovation centers. However, it is important to recognize that Dubai represents a specific city archetype – a relatively small, wealthy, and dispersed city that has leveraged its resources and strategic vision to create a hub for innovation and creativity.

While Dubai's success offers valuable insights, it is not a one-size-fits-all model for urban innovation in the Middle East. Other cities in the region must consider their own distinct social, political, economic and cultural contexts when striving to enhance their innovation ecosystems. The HSE GCII 2024 provides a comprehensive framework that these cities can use to assess and improve their performance across various dimensions of innovation.

For instance, while Dubai excels in areas like startup ecosystems and venture capital, other Middle Eastern cities might focus on leveraging their historical and cultural assets to boost creative industries. Cities with larger populations and different urban layouts may prioritize developing excellent public transportation systems and enhancing digital infrastructure to improve urban mobility and connectivity.

The index's emphasis on factors such as the presence of leading universities, R&D organizations, and highly cited researchers underscores the importance of knowledge creation and diffusion. Middle Eastern cities can use these metrics to guide investments in education and research, tailored to their specific strengths and goals.

Moreover, the inclusion of indicators related to quality of life, such as cost of living, public services, and environmental factors, highlights the holistic approach needed for innovation. Cities in the region can focus on creating livable urban environments that attract and retain talent, a key factor in building innovative ecosystems.

As we move forward, it is essential for Middle Eastern cities to embrace their unique identities while striving for innovation excellence. By understanding their specific archetypes and socio-technical systems, these cities can develop targeted strategies that enhance their innovation capabilities, contribute to economic diversification, and improve the quality of life for their residents. The HSE Global Cities Innovation Index 2024 serves not just as a ranking system, but as a source of inspiration for cities to navigate the complex landscape of urban innovation.

Keun Lee
Distinguished Professor,
Seoul National University, Republic of Korea

It is great that this year's data on innovativeness of cities around the world is finally published. Definitely, it is a very unique and most comprehensive data set of about 1,000 global cities across as many as 90 indicators, capturing technological development, creative industry and urban living conditions. Given that such work takes a lot of time and efforts, it is amazing that this institute at HSE University has been doing this work for many years. It is a valuable and useful contribution for city officials, citizens, and policy makers around the world.

Iwao Ohashi
Strategic Development through International Cooperation Expert,
Industrial Parks and Special Economic Zones of Russia, Russia

I welcome the publication of the HSE Global Cities Innovation Index 2024 and express my sincere respect to its production team and all authors for their significant contribution!

There are global city rankings being published around the world quite regularly, but after taking a small part in preparing HSE GCII 2024, it became obvious to me that this report is by no means less valuable that those published in other countries, considering the scale of gathered data, the high quality of analysis, as well as objectivity and neutrality of its researchers. No doubt, this report will attract the attention of experts and specialists in the field of urban development and innovation and be readily implemented in many countries of the world.

In the context of unprecedented geopolitical turbulence, Russian cities face serious challenges. For further sustainable development of the heavily sanctioned Russian economy and industry, it is essential to introduce innovations without stopping, and it is namely cities that are the fittest to provide that. The modern "turn to the East" and the International North–South Transport Corridor open Russian cities to international relations and they have got to find a way to enhance their urban environment and reinvigorate the creative, scientific, technological, and innovative activities by uniting their limited resources in the most effective way. It is, of course, a big challenge, but considering the potential of Russian cities and their residents, we may also expect big opportunities waiting ahead.

I am convinced that the HSE GCII 2024 ranking will make a solid input into expert research in urban development and innovation around the world and into the future strategic development of Russian cities.

Mohamed Ramadan A. Rezk
Director, Egyptian Science, Technology and Innovation Observatories,
Academy of Scientific Research and Technology, Egypt

Urban innovation comes to the global foreground, with cities increasingly turning into basic planks for technological advancement, sustainable development, and growth in economies. Urban innovation plays a crucial role in shaping modern economies by driving productivity, attracting investments, and fostering entrepreneurship. By integrating advanced technologies and sustainable practices, innovative cities enhance efficiency and create environments conducive to business growth. This not only boosts local economies but also positions these cities as competitive hubs on the global stage, attracting talent, capital, and new industries that further stimulate economic development.

The HSE Global Cities Innovation Index 2024 is a significant initiative aimed at capturing the evolving dynamics of innovation by evaluating and ranking 200 cities across 55 countries. This is not an index of rankings but an in-depth, almost guide-like exposure to the mechanisms and strategies behind the great, thriving cities in the contemporary world. It gives insights into how urban areas can harness innovation to solve pressing challenges and improve the quality of life for their residents. The HSE GCII 2024 provides a multifaceted

analysis of urban innovation, leveraging a broad spectrum of indicators to assess the performance of cities across various domains.

In HSE Global Cities Innovation Index 2024, five African and Middle Eastern cities were included in the top 200: Dubai (United Arab Emirates), Cape Town (South Africa), Jeddah (Saudi Arabia), Cairo (Egypt), and Beirut (Lebanon). These cities reflect the growing influence of the region in the global innovation landscape. For example, Dubai and Cairo, have demonstrated significant advancements in various indicators, reflecting their growing influence on the global innovation landscape. Dubai ranks 4th globally in the Urban Environment Subindex, which is bolstered by its top position in mobile Internet speed (1st) and its high safety level, ranked 10th globally. In contrast, Cairo, ranked 91st overall, also showcases strengths in technological development, ranking 45th, with a notable presence in leading universities (ranked 10th), but struggles with environmental issues, ranking 199th in ecology and health systems. Cape Town, on the other hand, faces different challenges and opportunities in the Global Cities Innovation Index. With an overall rank of 194, it is particularly hindered by poor mobility, ranking 192nd in public transport and 192nd in digitalization, with fixed broadband Internet speed ranked 178th.

Looking ahead, there is reason to hope that future editions of the Index will include a larger number of cities from both Africa and the Middle East. Of course, the challenge will lie in how to find indicators that best grasp these very different urban milieus and their respective potentials. As cities in these regions move forward and become more innovative, their inclusion in future rankings will indeed underscore their achievements, while at the same time increasing global knowledge about innovation in cities.

Fernando Rizzo
Director, Center for Management and Strategic Studies, Brazil

The HSE Global Cities Innovation Index uses a comprehensive set of indicators that cover various aspects of infrastructure, technology, urban environment, and innovation, but also topics that are not so conventional in city assessments, such as aspects of the creative industry (fashion, design, literature, and games) and tourism.

It uses multivariate criteria for evaluating the sampled cities, which require different data sources. In some cases, the sources indicated have a user collaboration profile, such as the Numbeo and Tripadvisor platforms. These collaboration tools are useful and necessary, but there can be significant variation in terms of the collaboration between users from developed and developing countries. The low participation of users from countries outside the global North may, in some cases, affect the performance of cities on the aforementioned tools.

In addition, we observed that some indicators that characterize flourishing areas in regions of the Global South (such as the music, fashion or games industry, for example) consider aspects specifically related to commercial performance, which can be characterized as a barrier to achieving better ranking results for Latin American, African or Asian cities; they may have an intense and productive market in local creative industry sectors, without necessarily showing good commercial performance on international platforms.

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Executive Summary

1. Overcoming the "High Base" Effect

The main centers of innovation attractiveness strengthened their positions with respect to the previous ranking results

The tech leaders and mega-creative cities of HSE GCII 2024 thrived even more across many aspects of innovation development, overcoming their own achievements in 2023 ranking.

San Francisco had 46 new unicorns, which made the total "headcount" reach 325 enterprises, increased the overall investment in R&D by 84.5 billion euros for a total of 222.5 billion euros, the total volume of venture capital deals – by 41.3 billion USD (338.7 billion USD), and the number of business angels – by 3,257 persons (7,841 persons). New York upped its number of innovation support funds by 767 enterprises (for total of 3,858). Suzhou made headway in propelling inventive activities by preparing 656,656 patent applications – 186,803 more than in the previous period. Beijing managed to stretch its lead significantly in publication activity by adding another 239,447 scientific publications (947,908 documents). Moscow's universities attracted another 392,764 students – 41,606 people more than a year before; London increased the number of highly cited researchers by 47 individuals (for a total of 212 scientists) and doubled the number of startups (to 16,934 companies).

The fashionable London brands represented on websites of global online retailers were reinforced with 49 new companies, and their total number broke the record threshold of 400 companies (New York, its closest competitor, has 304 of them). Developers in Tokyo issued five new computer games and made it onto Steam's top 100. Apart from that, the Japanese capital welcomed seven new painters whose works brought them leadership in auction sales. Moscow increased its number of leading higher education institutions in the arts from four to 11. The number of the most-streamed artists on Spotify went up in Los Angeles by 46.7%, in New York – by 75%.

The changes in indicators featuring high tech and creative industries in the top HSE GCII 2024 cities are comparable to, or even overcome, those of entire countries. For instance, when it comes to the increase in the number of corporations from R&D Scoreboard, San Francisco (+18), Shanghai (+17), and Beijing (+12) by far upstage Israel and the Netherlands (+6 and +3, respectively). London, San Francisco, and New York gained 9,018, 6,749, and 6,396 new startups, respectively, which is on par with Canada (+ ca. 7,000) and twice as productive as Australia (+3,528). Boston and Beijing delivered another 13 unicorns, which is more impressive than the Republic of Korea (+11) or India (+10).

In Los Angeles the number of fashion brands represented on FARFETCH,

NET-A-PORTER, Luisa Via Roma, and Mytheresa was increased in a year by 33 exemplars, in Paris – by 38. Just for comparison, the retail platforms of Stockholm and Amsterdam altogether have 37 and 36 brands, respectively. The number of most-streamed artists was likewise increased in New York by six people – which is the same total figure for Milan, Sydney, Stockholm, and Toronto, each.

The main innovative cities keep expanding despite the "high base" effect and demonstrate the autocatalytic nature of their achievements: the current postindustrial economy leaders – CEOs, startup founders and venture capitalists, researchers, inventors, outstanding designers, musicians, developers, and artists – attract the next generations of innovators with their inspiring breakthroughs.

2. The Golden Mean

The progress of Western cities on the map of global innovation was provided not only by megapolises, but small and medium-sized cities as well

Traditionally, the absolute majority of internationally recognized representatives of high tech and creative industries has been attributed to the most powerful centers of innovation attractiveness in human history – New York (1,353) and London (1,342). Year after year, these megacities intensify their magnetic force: the growth in the number of "super-star" individuals and enterprises compared to HSE GCII 2023 was 15% and 28%, respectively. However, matching the number of postindustrial economy leaders with the population number of their locations has brought cities with the best innovation efficiency and the maximum concentration of those driving the use of intellectual property or development of products and services based on creative potential under the spotlight. Out of the top 50 HSE GCII 2024 cities with the highest density of innovation economy leaders (the per capita ratio), 46 are located in European countries and the United States with an average population of a little over 2 million people, and if we exclude 16 million-plus cities – around 400,000 people make up typical populations.

All small and medium-sized[1] innovative cities in HSE GCII 2024 with a high concentration of innovation economy leaders could be called university cities: the share of students at tertiary institutions in the total population of top 20 of such centers exceeds the same indicator for the rest of sampled cities by 3.5 times (Leuven – 40%, Ithaca – 25%, Durham – 16%). In these 20 locations, the share of international students in the total number of students also exceeds the rest of the top 200 HSE GCII 2024 cities by 1.3 times (Lausanne – 46%, Rochester – 34%). By the levels of salaries and gross

[1] According to the OECD, the population of medium-sized agglomerations ranges from 200,000 to 500,000 people [OECD, 2012].

metropolitan products, they are comparable to the countries where they are located, and by bandwidth and ecological well-being – they outweigh them [Kutsenko et al., 2024]. Here, universities are the chief mainstay of the economy, as they hold one of the key roles not only in nurturing the cities' own leaders of the innovation economy, but also in retaining those foreigners who came for a higher education. To illustrate that, over a half of the unicorns in the United States, United Kingdom, Germany, and other countries were co-founded by immigrants. A third of immigrants founded billion-dollar startups in countries where they received their higher education, of whom 87% are graduates of US universities [Kutsenko et al., 2022].

The allure of small and medium-sized cities for innovators is visible in the creative industries as well. Despite the stable concentration of leading creatives in the largest agglomerations, there are some creative areas, where their greatest share is found in less populated locations. Such small cities are especially popular with representatives of the fashion industry: almost 40% of Italian brands, including Benetton Group, Max Mara, Liu Jo, and Calzedonia, are located in cities with population of fewer than 250,000 people.

The maximum concentration of outstanding high tech and creative representatives in European and US cities that vary in size allows us to point out the success of the latter as the main magnets for talent: most of the cities in the full sample of HSE GCII 2024, where at least one leader of the innovation economy was found, are the United States (267), Italy (187), United Kingdom (145), and Germany (131).

3. The Orient Express

Asian cities expanded their presence in the vanguard of technological and creative leadership and compete for the title of a global innovation attractor by excelling in urban environment

Amid European leadership with regard to the 2,167 localities hosting innovation economy leaders (47.4%), Asian centers are prevailing in top 50 by the level of technological development (38%). Within the technological top 20 of HSE GCII 2024, the shift is even greater in Asia's favor – 11 cities vs. six in the United States and three in Europe.

Mainland China cities' upper hand in patent and publication activity is overwhelming: their share in the total number of patent applications for 200 innovation centers of HSE GCII 2024 is 76.7%, in scientific publications – 30.6%. Within a decade, the Celestial Empire outperformed other countries and is speedily closing the gap with the United States in terms of the number of highly cited researchers: if in 2014, every other such researcher (49.4%) was affiliated with the United States, by 2023, the United States' share shrunk to 37.2%, while China's share shot up five times – from 4.6% to 19.8%.

The "Eastern Wind" has brought changes on the creative shore as well: if in HSE GCII 2023 the top 10 creative cities only had three Asian centers – Tokyo, Beijing, and Seoul – now, they are backed up by Hong Kong and Shanghai. An impressive upward trend was demonstrated by cities in East and Southeast Asia outside the creative top 10: Taipei, Singapore, and Guangzhou became new creative centers of the world and made a name for themselves through various factors, among which are their achievements in design, advertising, and PR.

Shortlisted cities with the greatest conditions for innovators were supplemented by four Asian centers, for which assessments of the quality of the urban environment improved due to catching up with higher positions in mobility and digitalization (Tokyo and Istanbul) and having an extraordinary level of safety (Hsinchu and Nagoya).

4. Renaissance Innovators

HSE GCII 2024 cities are demonstrating similarly high levels of technologies and creativity

What truly distinguishes the main centers of innovation attractiveness is their remarkable universalism: like geniuses of Antiquity and the Renaissance who combined achievements in exact sciences, philosophy, medicine, and the arts, the top ranking cities' accomplishments are not limited solely to high tech or creative specializations.

The leader of HSE GCII 2024, London, achieved unparalleled results in music (30 opera singers and troupes won The International Opera Awards) and architecture (29 world famous architects and architecture bureaus recognized by World Architecture Festival Awards), and also took 1st place in the number of startups (16,934) and international students (169,856 people).

New York is a leader in fashion (20 largest fashion companies and 304 brands represented on the websites of global online retailers), advertising and PR (11 finalists of Effie Awards, 56 companies from the Top 250 of PRovoke Media, 15 winners of Cannes Lions, and 63 D&AD listers), and arts (138 – Praemium Imperiale laureates, the most commercially prolific painters and the most influential people in contemporary art – 23.8% of their world total) and won the "silver" medal in terms of venture capital investments (142 unicorns, 3,858 innovation support funds, 5,377 business angels, and 120.1 billion USD in venture capital).

Tokyo combines global leadership in the gaming industry (15 developers of the Game of the Year, 11 finals in the largest e-sports tournaments, seven companies that created the most popular computer games according to Steam, 24 participants of international electronic games trade shows) and 2nd place in the Technology companies section (151 corporations listed on the R&D Scoreboard with total R&D expenditures of over 80 billion euros).

Paris is the first in the world by the number of leading R&D organizations (87), animation and film production companies that won international festival awards (34 and 75, respectively).

Shanghai won the "silver" medal for the productivity of the innovative class (500,894 patent applications and 432,729 scientific publications) and split the third place in industrial design with Taipei (66 recipients of A' Design Award, iF Design Award, and Red Dot Design Award). Los Angeles hosts the world's main "dream factory", ranking 1st by the number of film production companies that have top-rated movies according to IMDb and is one of the recognized centers in gaming and music (ranked 2nd in both) and venture capital (4th). Moscow is in the top three strongest cities by the number of universities and R&D organizations (26 and 60, respectively), in the top 10 among leaders in the music industry (eight winners of The International Opera Awards) and the arts (six internationally recognized artists, 11 universities that participated in international rankings in Architecture, Art, Design, Languages, and Performing Arts), and Seoul is among the top 10 leading megacities that were recognized for technology businesses (ranked 9th), film and animation (8th), gaming industry (6th), industrial design (6th), and the arts (9th).

Even the main contemporary techno hubs stood out in the creative arena: San Francisco is in the top three by the number of developers of the best video games and the most influential animation studios (seven and eight companies, respectively), and Beijing is a runner-up for the number of top artists by auction revenue (36 people) in two consecutive years.

Among the strongest linkages in global cities was the combination of venture capital, arts, filmmaking, and animation: San Francisco, New York, London, Los Angeles, and Paris are in the top 10 in these sections of the Global Cities Innovation Index, which proves the point that some creative industries have extraordinary capital capacity and best thrive in places of dense concentration of investment opportunities and special financial tools, such as the securitization of intellectual property or the use of NFTs.

Polymathy is equally endemic to cities outside the overall top 10, combining technology and creativity specializations. Istanbul (ranked 18th in HSE GCII 2024) demonstrated global leadership by the number of effective advertising agencies (19 enterprises) and made the top 10 by the number of leading universities (21) and the number of students (432,728 persons). Madrid (ranked 17th) became 4th by the number of leading R&D organizations (34) and 6th by the number of film production companies that made the IMDb top-rated movies (12). Suzhou (ranked 25th) is a two-time champion in patent activity (656,656 documents) and ranked 4th by the number of largest esports tournaments (17 events). Melbourne (ranked 35th) and Sydney (26th) are 2nd and 3rd, respectively, by the number of international students (86,753 and 71,683 persons) and share a "silver" medal for the number of architecture bureaus and architects who achieved worldwide recognition (17, each). Dubai (ranked 32nd) entered the top 10 by the number of startups (4,360 companies) and video streaming services that participate in the FlixPatrol portal rankings (two platforms).

The presence of global leaders of the high tech and creative industries lies at the foundation of megacities' ability to attract new representatives of the business, creative, and intellectual establishments.

5. The Flipside of Being Attractive

Global centers of innovation attract talent not solely due to their advanced urban infrastructure but rather due to the opportunities they provide for people to make a name for themselves

The leaders of HSE GCII 2024 demonstrate equally high levels of development of modern technology and creative industries, but not everyone is capable of holding top positions in the quality of urban services and the availability of infrastructure at the same time. Exceptions include London (ranked 1st in the overall ranking and 3rd – in the Urban Environment Subindex), Tokyo (3rd and 9th, respectively), Shanghai (7th and 5th), Moscow (9th and 6th), Singapore (14th and 1st), and Madrid (17th and 2nd). Out of top 20 cities in the overall HSE GCII 2024, eight have not made it to the top 20 by the quality of the urban environment, and three of them – San Francisco, Los Angeles, and Boston – did not enter even the first one hundred of the Subindex, taking 177th, 151st, and 176th places, respectively, which, however, does not impede exceptional representatives of innovation economy from choosing these cities for work, business, and creativity.

The top ranking cities especially attract tourists and expats by having a high level of e-government services, which makes them hostages to their own fame, as attracting new innovators goes hand in hand with an increase in expenses for local city dwellers. Thus, the cost of living in San Francisco, New York, or London for locals will cost over 4,000 USD per month. The most expensive rent for an apartment – over 3,000 USD per month – was recorded in Boston, San Francisco, and New York. The cost of mobile phone services will cost residents of Los Angeles, New York and Boston over 55 USD per month. It is most often megacities that "cave in" in such respects as the affordability of doing business, safety level, ecological well-being, and the quality of healthcare.

One could not find a city that is perfect by every measure, however, even with a high price to pay for global openness, the top HSE GCII 2024 cities continue to be the main centers of attraction on the ultimate map of global innovation: they already host every fourth leader of the innovation economy on the planet – 8,017 people and enterprises.

Introduction

The strengthening of the leaders in high tech and creative industries, Eastern and Western paths to success, the multifactorial foundation of innovation attractiveness, and the basic role of the urban environment

There are around 10,000 cities in the world, half of which originated less than half a century ago [OECD / European Commission, 2020]. During that time, the Earth's urban population has almost tripled and today amounts to about 4.5 billion people, or more than 55% of the world's inhabitants [United Nations, 2023]. People are moving to cities more and more enthusiastically. From time immemorial, the city was a focal point of talent where business, intellectual, and creative activity converged and created advanced knowledge, disruptive technologies, avant-garde cultural trends, modern artifacts, and cutting-edge infrastructure. These elements all contributed to creating an appealing lifestyle for city dwellers. The special role of cities in the emergence and spread of innovations has long been discussed by the expert community,[1] and some urban economists even attributed the success of *homo sapiens* as a species to their predominant residence in megacities, which bring out the best in them.[2]

Since 2020, HSE University has published the Global Cities Innovation Index (GCII). Its purpose is to provide a comprehensive assessment of the world cities' attractiveness for creators of new technologies and representatives of the creative economy. The research focuses on the best enterprises (largest innovation companies, breakthrough startups, leading universities and R&D organizations, infrastructure facilities) and outstanding individuals (Nobel Prize laureates, highly cited researchers, internationally recognized leaders in film and animation, electronic games industry, music, fashion, advertising and PR, architecture, industrial design, and arts).

> The third issue of HSE GCII presents the ultimate map of global innovation, including over 1,000 cities from 144 countries that host the main technology and thought leaders, whom have been identified on the basis of international rankings or were awarded industry or professional prizes.

[1] See, for example, [Jacobs, 1969; Feldman, Audretsch, 1999; Hospers, 2003; McCann, 2008; Florida et al., 2017; Balland et al., 2020; OECD, 2021; Fritsch, Wyrwich, 2021].

[2] Glaeser E. Cities: Engines of Innovation. Available at: https://www.scientificamerican.com/article/engines-of-innovation (Accessed: 04.02.2024).

Their success metric – the presence of the most renowned representatives of postindustrial economy – is evenly applied across two key aspects of innovation: high tech and creativity, taking into account the features of the urban environment.

The sharp growth in the number of cities is accompanied by the emergence of new centers of innovation attractiveness. Among them is Nagoya, the safest city in the HSE GCII 2024 ranking; Dallas, Austin, and Houston, the global leaders in the number of relocations by companies from the R&D Scoreboard; Riyadh, Auckland, and Dongguan, which have become a second home for foreigners from all over the world through the creation of elaborate compounds and corporate R&D campuses for expats that match their lifestyle; cities of the Global South – Abu Dhabi, Johannesburg, Cape Town, etc. – are places of repatriation for renowned leaders of contemporary art; Santiago and Mexico City, the trendsetters in musical fashion, whose performers made the whole world dance to the rhythm of reggaeton.

Despite the individual breakthroughs in the niches of high tech and individual creativity, the global balance of power in the world of innovation is relatively stable. The leaders of the previous editions of HSE GCII – London, New York, Tokyo, Beijing, San Francisco, Paris, Shanghai, Los Angeles, Moscow, and Seoul – claimed the top 10 of the 2024 ranking yet again, multiplying previous achievements and challenging each other for the crown in several indicators for technological development and creative industries. London displaced San Francisco from the world's pinnacle in terms of the number of startups; San Francisco deprived Tokyo of leadership in the number of headquarters of the largest innovation corporations; New York took away Beijing's "silver" medal in venture capital investment; Beijing ousted San Francisco from its 2nd place in terms of the number of highly cited researchers; Tokyo leaped from 5th to 1st place in terms of the number of developers of the most popular computer games, sharing it with Stockholm and leaving behind last year's competitors – Los Angeles, San Francisco, and London; New York rivaled London for 2nd place in the number of most-streamed artists; Los Angeles bypassed Paris in the number of the most influential people in contemporary art; Moscow outperformed New York, Tokyo, and Beijing by the number of leading higher education institutions in the arts. These changes in the ranking reshuffled, among other things, the top 10 HSE GCII 2024, compared to 2023 results – San Francisco, Shanghai, and Moscow pushed back Paris, Los Angeles, and Seoul from 5th, 7th, and 9th places, respectively.

> The fierce competition between the best of the best that drives the city innovation attractiveness despite the "high base" effect, has again resulted in a super-concentration of leaders in the top 10 HSE GCII 2024 cities: they collectively account for 8,017 globally recognized individuals and enterprises.

They include over 25% of Nobel Prize laureates and Fields Medal winners, 30% of the companies with the highest R&D expenditures, 50% of unicorns, 45% of the largest PR agencies, famous fashion brands, and developers of the best video games, 68% of producers of highly rated films, 45% of Pritzker Architecture Prize winners, 55% of internationally recognized artists, 57% of most-streamed artists, and 70% of commercially successful artists.

The Eastern and Western centers of innovation attractiveness have demonstrated different approaches to achieving ranking excellence. Asian megacities have strengthened their positions due to an impressive increase in the number of unicorns (Beijing, Seoul, Guangzhou), patent applications (Suzhou, Shenzhen, Shanghai), scientific publications (Beijing, Shanghai, Guangzhou, Nanjing), the number of highly cited researchers (Beijing, Shanghai, Hong Kong), achievements in the gaming industry (Tokyo, Guangzhou, Hong Kong, Istanbul), industrial design (Taipei, Singapore, Istanbul, Hong Kong, Shanghai), arts (Tokyo, Guangzhou), advertising (Shanghai, Hong Kong), architecture (Shanghai), and fashion (Hong Kong).

In turn, small and medium-sized cities in Europe and the United States, the core of which host internationally recognized universities, were distinguished by the highest number of the best representatives of the innovation economy per capita. University cities attract high tech businesses (for example, Heidelberg with a population of 355,470 people hosts the headquarters of four companies that are leaders in terms of R&D expenditures), unicorns (in Boulder and Santa Barbara, where 329,543 and 446,475 people live, respectively, there are three unicorns in each of the cities), and prominent researchers (Cambridge in the UK has 78 highly cited researchers per 376,139 inhabitants, nine Nobel Prize laureates and Fields Medal winners collectively; Durham, Boulder, and Santa Barbara each have four holders of these prestigious awards).

> Regardless of the location, the leaders of innovation attractiveness are distinguished by the harmonious development of two components – high technology and creative industries. The presence of globally recognized representatives of high tech and creative leaders lies at the foundation of securing a competitive edge in the struggle for new talent.

London, New York, and Tokyo, the main centers of attraction for the leaders of the innovation economy, demonstrate the maximum level of development of both the creative sector (ranked 1st, 2nd, and 3rd, respectively) and high technologies (5th, 3rd, and 4th). London, which scored the absolute best in creative leadership, is doing well in many areas of venture capital, education, and science. New York, on top of being the top city in fashion, advertising, art, and one of the music, architecture, and

film centers of the modern world, is also demonstrating great progress in terms of high tech corporations, startups, and venture capitalists, as well as the elite of the world of science. Tokyo enjoys combining achievements in high tech with global leadership in gaming and high positions in architecture and industrial design. The strongest universities and cutting-edge infrastructure in Beijing, Paris, and Moscow go hand in hand with numerous creative industries, prospering on the furtile soil of their high culture. The example of innovation attractiveness leaders is set and followed by the rest of the top 200 cities in the ranking, which add creative and technological specializations to separate niches within their innovation profiles.

> In the pursuit of excellence in high tech or creative activities, many HSE GCII 2024 cities have begun modernizing their urban environment and creating preferential conditions to attract innovators.

Dubai, Singapore, and Moscow were among the first to pioneer the metaverse. Metaverse Dubai copies the map of the most prestigious areas of the city, recreates their aesthetic and topography, and provides its users with an opportunity to participate in mass events or lead communities and business projects. The Singapore authorities use the city's digital twin to modernize infrastructure, optimize energy consumption processes, design buildings, and prevent natural disasters. Moscow's metaspace is represented by the Meta Moscow platform that incorporates photorealistic, extremely precise models of the city's tourist attractions to undertake virtual excursions and at the same time uses the city's digital copy to manage its utilities, plan the construction of residential, industrial, and social areas, and regulate transport flows based on the real-time data.

On top of that, Moscow now has the country's first urban supercluster – a massive cluster initiative that gathers its economic entities under the roof of the same digital platform and provides access to various tools encouraging cooperation irrespective of the sectoral or territorial affiliation, size, and form of incorporation.

Munich has begun to combat traffic jams and CO_2 emissions through the transition to sustainable mobility by introducing the concept of MaaS (Mobility as a Service), a single service that integrates various modes of transportation and their operators and transforms the transport habits of city residents.

Boston, Shenzhen, Dublin, and Amsterdam are introducing Artificial Intelligence (AI) into city government systems. They trust the developing technology with monitoring public opinion, sending citizens' applications to the correct departments, analyzing hotline calls, preparing official documents as well as textual and visual information materials, and even automating local tax collection.

Dallas engages local residents in testing innovations in the field of street lighting, resource conservation, city parking, and environmental monitoring, and uses the Smart Cities Living Lab to work on friendliness in the interactions between the municipality and the population.

Mumbai is establishing itself as a leader in the film industry by erecting film cities: Mumbai Film City with an area of over 2 km^2 includes 42 full-scale studios and 16 closed film pavilions, which employ about 800 people daily.

In Dongguan, Huawei has built the Ox Horn corporate R&D campus on an area of 1.4 km^2 for 25,000 employees, recreating on its territory the famous architectural sites of Paris, Verona, Bologna, Granada, Bruges, Tallinn, and Freiburg, connected by a specially designed 7.8 km railway. Huawei attracts innovators from all over the world through the Seeds for the Future educational program, through which they have a chance to develop their competencies in the field of ICT and digital solutions.

Shanghai focuses its innovation attraction policy on offering a generous one-time compensation of up to 2 million yuan (about 274,900 USD) and an annual remuneration of up to 5 million yuan (approximately 687,300 USD), in addition to providing them with advanced infrastructure, comfortable living conditions, and the opportunity to become a permanent resident. Thanks to these measures, the city has become the absolute leader in the Celestial Empire in terms of the number of foreign talented workers who have relocated. Shanghai is especially interested in those who have already managed to achieve recognition abroad – gifted international students, outstanding researchers, specialists who have experience working in the world's largest Fortune 500 companies, technology entrepreneurs, and engineers.

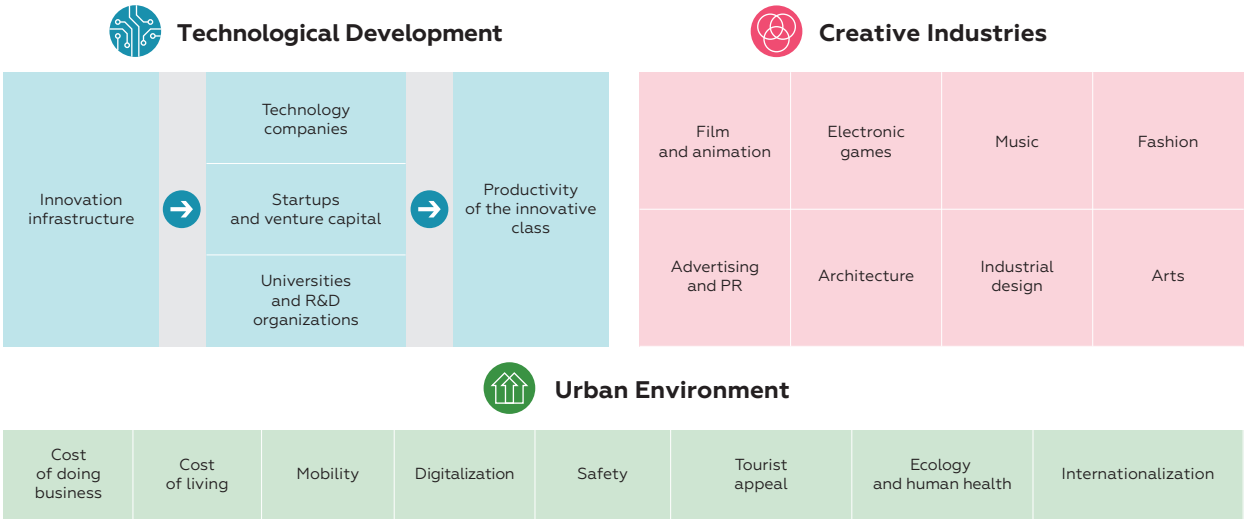
As incredible as it may seem, not all high tech and creative industries centers can boast a comfortable and friendly urban environment. The tourist appeal, advanced digitalization, and mobility of London, New York, Beijing, Tokyo, and Paris are taking their toll by way of a high tax burden and cost of living, as well as problems with security, ecology, and healthcare. However, these downsides of the urban environment are not keeping these megacities from becoming the main magnets for talent.

> The provision of a decent level of comfort and infrastructure in cities still plays a basic function, the decisive factor for innovators in choosing their "own" place continues to be the chance to talk to the best people in the postindustrial economy, whose knowledge, ideas, competencies, and enthusiasm provide avenues for new individual breakthroughs.

How HSE GCII 2024 works: the indicator system, data sources, and sampled cities

The HSE Global Cities Innovation Index 2024 is based on an integrated approach to measuring innovations in a city that encompasses the analysis of technological and creative potential, as well as infrastructure development. The index is based on 90 indicators grouped into 21 sections over three blocks – Technological Development, Creative Industries, and Urban Environment (Figure 1). Each block has a corresponding subindex adding to the overall value of HSE GCII, which is then used to score and rank the cities.

Figure 1. Ranking Structure of HSE GCII 2024



Source: HSE ISSEK.

The Technological Development block has five sections featuring corporations, startups and unicorns, leading universities, and R&D organizations. It analyzes the publication and patent activities of city residents and estimates the number of clusters, science parks, and other innovation infrastructure.

The Creative Industries block consists of eight sections. They measure economic activities related to filmmaking, electronic games, music, fashion, advertising and PR, architecture, industrial design, and arts.

The Urban Environment block covers eight sections, which reflect the variety of factors that determine the attractiveness of a city for representatives of the innovative class. These include the accessibility of doing business and the cost of living,

mobility, digitalization, security, tourist attractiveness, environmental conditions, the quality of healthcare, and internationalization.

When creating the indicator system for the Index, we used international databases with which we could objectively compare the sampled cities without arbitrary public or expert opinion polls, and the internal data of city administrations sources hidden from the public eye that could not be used to benchmark the cities (Figure 2). The data for country or regional breakdowns were recalculated for the cities.

Figure 2. Database of HSE GCII 2024

Technological Development

R&D Scoreboard | Crunchbase | StartupBlink | CB Insights | QS | THE | ARWU | SCImago | Clarivate | The Nobel Prize | IMU | PATSTAT Global | Scopus | TCI Network | IASP | TOP500

Creative Industries

IMDb | FIAPF | Annecy International Animation Film Festival | Animation Career Review | FlixPatrol | The Game Awards | Esports Earnings | Steam | Gamescom | Spotify | The International Opera Awards | Fashion United | FARFETCH | NET-A-PORTER | LuisaVia Roma | Mytheresa | Effie Awards | PRovoke Media | Cannes Lions | D&AD | The Pritzker Architecture Prize | World Architecture Festival Awards | A' Design Award | iF Design Award | Red Dot Design Award | Praemium Imperiale | Artprice | ArtReview | QS | THE | Wikipedia | Goodreads

Urban Environment

Nomad List | PwC | Numbeo | OpenFlights | Speedtest | WiFi Map | PlugShare | UN E-Government Knowledgebase | STC Database | Brand Finance | Tripadvisor | World Stadiums | International Baccalaureate Organization | ICCA | Education First | Columbian College of Arts & Sciences | CDP

Source: HSE ISSEK.

To estimate the level of cities' technological development, the R&D Scoreboard was used as a data source encompassing the largest innovation companies. Startups and unicorns were measured according to Crunchbase, StartupBlink, and CB Insights. Leading universities were determined based on the QS, THE, and ARWU rankings; and research institutes were evaluated using SCImago. Patent data was gathered from the PATSTAT Global database and publication data was obtained from Scopus. Finally, innovation infrastructure facilities were analyzed with the help of TCI Network, the International Association of Science Parks, and TOP500.

The development of the film and animation industry was rated using the data from IMDb, the official websites of international film festivals as well as the Annecy Animation Film Festival, and the ratings of FlixPatrol video streaming services. The leaders of the gaming industry were identified by the lists of Steam players, Esports Earnings participants, and the recipients of the Game of the Year as shown on the websites of awards. The top members of the music world were determined via Spotify and The International Opera Awards. The major fashion industry players and popular fashion brands were assessed according to information from Fashion United, FARFETCH, NET-A-PORTER, Luisa Via Roma, and Mytheresa. Leading advertising companies were taken from the websites of the Effie Awards, PRovoke Media, Cannes Lions International Festival of Creativity, and D&AD. To find leaders in architecture and industrial design, we used information about the recipients of The Pritzker Architecture Prize, World Architecture Festival Awards, A' Design Award, iF Design Award, and Red Dot Design Award. The Arts section indicators were calculated according to the data of the Japanese Art Association, ArtReview, Artprice, Goodreads, QS and THE, and Wikipedia.

Finally, the quality of infrastructure and the urban environment was estimated with the help of international databases – Nomad List, PwC, and Numbeo (most of the cost of living and the cost of doing business indicators), OpenFlights (number of airline routes), PlugShare (EV charging stations), Speedtest (bandwidth), United Nations E-Government Knowledgebase (digital public and municipal services), STC Database (natural disaster risk), Tripadvisor and World Stadiums (number of venues for cultural entertainment and sports), CDP (green energy), the International Baccalaureate Organization, Columbian College of Arts & Sciences, and the International Congress and Convention Association (Internationalization indicators).

Changes in the HSE GCII 2024 algorithm and indicator system

The new issue of the Global Cities Innovation Index introduces a few novelties designed to improve the accuracy of the rankings and the visibility of results.

- Firstly, the indicator system was adjusted, which affected all three subindices.

Technological Development Subindex

In HSE GCII 2024, the value of the "Leading R&D organizations" indicator is determined by a new data source – SCImago (in the 2023 ranking, the Nature Index was used), which made it possible to cover 1,545 organizations engaged in research activities, instead of 500 as was covered a year earlier.

To avoid duplication, the "Leading business schools" indicator has been excluded from the Universities and R&D organizations section, since such organizations are often founded and work within universities that participate in international rankings.

The "Clusters" and "Technology and Science Parks" indicators have been combined, and the calculation now factors in operating infrastructure facilities that have been members of the TCI Network or the International Association of Science Parks over the past three years.

Creative Industries Subindex

The Film and Animation section has been supplemented with the "Most influential animation film production companies" and "Top-rated streaming services" indicators that now help include more markets and products related to the film industry in the analysis. When calculating the "Top-rated film production companies (audience)" indicator, instead of taking information from numerous portals and websites of film production companies, a single source was used – IMDb, whose extended profiles have ample information, allowing one to avoid looking for clarifications on external websites and search engines.

In the Gaming industry section, the "The Game Awards winners" indicator has been replaced by the "Developers of the best video games". Thanks to this change, we could focus on companies whose products were considered the most prestigious in the industry: games of the year. According to the "Companies participating in electronic games trade shows" indicator, the number of sources has been expanded: in addition to Gamescom, we used Capcom Showcase Livestream, Devolver Direct, Future Games Show Summer Showcase, OTK Games Expo, PC Gaming Show, Summer Game Fest, Ubisoft Forward, Wholesome Direct, Xbox Games Extended Showcase,

and Xbox Games Showcase & Starfield Direct. This transformation made it possible to increase the number of participating organizations from 189 in the previous ranking to 1,360.

In the Fashion section, the ranking of the most expensive companies, both public and private, was used to determine the "Fashion brands" indicator instead of just the most expensive public companies listed on stock markets.

In the Advertising and PR section, the number of advertising agencies that participated in the Cannes Lions rankings were included to calculate the "Creative production agencies" indicator, instead of just the number of companies that won the Cannes Lions awards. In doing so, we used not only the winners of first prizes, but the recipients of Gold, Silver, and Bronze Lions as well.

In the Industrial design section, under the "Internationally recognized designers and design firms" indicator, the sample was expanded from the top 200 participants in the R+ Designer Rankings (A' Design Award) to the top 1,000. This provided the opportunity to expand the coverage of designers and design firms from 379 in HSE GCII 2023 to 1,882.

The Literature section was excluded from the current indicator system, and its indicator, "Best-selling authors", was moved to the Arts section. This adjustment helped reduce the weight of this indicator, which takes into account, among other things, authors who have already passed away, and, consequently, have a smaller impact on the global innovation attractiveness of their cities of residence. In addition, the Arts section has been supplemented with a new indicator – "Most popular authors", which managed to cover 595 authors instead of 271 a year before.

Urban Environment Subindex

The Urban Environment Subindex has been supplemented with 18 new indicators reflecting the cost of living in a city ("Hotel accommodation", "Travel pass", "Taxi fare", "Cellular telephone subscriptions", "Internet access", "Tuition at an international school"), mobility opportunities ("Public transport", "Metro", "EV charging stations"), the level of digitalization ("Wireless Internet", "Remote employment", "Digital public and municipal services"), safety ("Safety rate", "Crime rate"), tourist appeal ("International tourists"), ecology and human health ("Green energy", "Quality of healthcare services provision"), and the degree of internationalization ("Foreign born population"). The "Visitors to international business events" indicator was excluded due to a significant correlation with the "International business events" indicator. It was also decided to abandon the "Homicide rate" indicator, since its data have not been updated since 2021. The source for the "English proficiency" indicator was replaced with Education First (last year the STC Database was used), which made it possible to collect relevant data for a larger range of sampled cities.

The current indicator system is presented in the Methodology and statistical audit section.

- Secondly, the innovation profiles of cities are supplemented with new elements – the normalized values of the overall HSE GCII 2024, and the Technological Development, Creative Industries, and Urban Environment subindices.

- Thirdly, for the first time ever, we describe the changes in positions of cities in the ranking relative to HSE GCII 2023 for all these elements, as well as for their comprising sections. The interpretation of these changes is what formed the analytical focus of this study.

- Fourth, the innovation profiles of cities are complemented by technology profiles, which allows one to assess the world innovation centers' rank in terms of the total number of patent applications in 2019–2021 for each of the 35 technological areas as per the international patent classification[1]; and pinpoint their specialization and correlate the results with the leading cities. The innovation and technology profiles of the top 50 HSE GCII 2024 cities are presented in the City Profiles section.

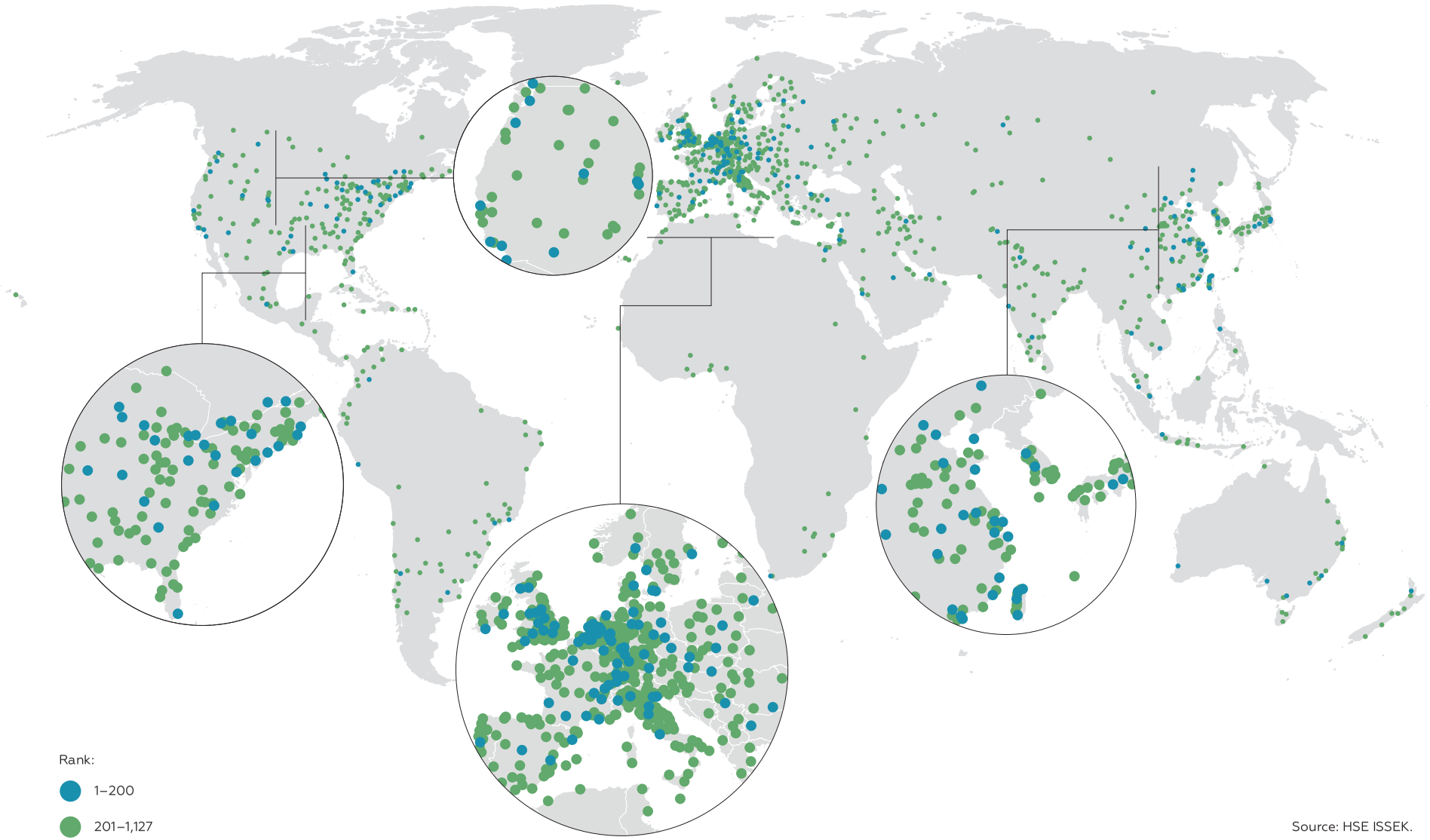
- Fifth, HSE GCII 2024 presents the scores of a wider sample of cities – 1,127 (Figure 3). As in the previous issue, the ranking positions of the top 200 cities are presented at the beginning of each thematic section. The ranks of 1,000+ centers of innovation attractiveness are given in the Appendix to the report.

There are three sections in the report. The first section provides an analysis of the innovation attractiveness of global cities. It contains the results of the final scoring and the key factors behind the attractive force of cities for innovators (levels of technological development, creative industries, and urban environment). For each of the blocks, subindex values were calculated. The second section describes the algorithm for building the ranking, including some comments on the methodology of finding the calculated indicators and the results of a statistical audit. The third section provides individual profiles of the top 50 global HSE GCII 2024 centers, which helps to tell the story of each city's development and rank it according to all indicators and benchmark them against the leader.

The authors hope that this work will serve as an analytical support for city governance and management in specific sectors of the innovation economy, including in knowledge-intensive business services and creative industries.

[1] According to the Technology Concordance Table approved by the World Intellectual Property Organization [Schmoch, 2008].

Figure 3. Sampled Cities of HSE GCII 2024



Source: HSE ISSEK.

Abbreviations

AGI	Artificial General Intelligence
AI	Artificial Intelligence
ARWU	Academic Ranking of World Universities
AutoCAD	Autodesk Computer-Aided Design
BCG	Boston Consulting Group
CDB	China Development Bank
CDP	Carbon Disclosure Project
DeepTech	Deep Technologies – science- and knowledge-intensive innovation based on the basic research and development to solve the global issues of economy and society
DIA	The Dallas Innovation Alliance
D&AD	Design and Art Direction – Award in design and advertising of a non-profit organization under the British Association of Designers and Art Directors (London, United Kingdom)
EDA	Electronic Design Automation
EIC	European Innovation Council
EU	European Union
FIAPF	Fedération Internationale des Associations de Producteurs de Films – International Federation of of Film Producers Associations
FUA	Functional Urban Area
FZI	Forschungszentrum Informatik – Research Center for Information Technology (Karlsruhe, Germany)
GCII	Global Cities Innovation Index
GDP	Gross Domestic Product
GITIS	Russian Institute of Theatre Arts
GMP	Gross Metropolitan Product
GPT	Generative Pre-trained Transformer
GRP	Gross Regional Product
G7	Group of Seven
HSBC	Hongkong and Shanghai Banking Corporation (Birmingham, United Kingdom)

HSE	Higher School of Economics (Moscow, Russia)
HX	Houston Exponential – Non-profit organization developing Houston's innovation ecosystem
IASP	International Association of Science Parks
ICCA	International Congress and Convention Association
ICICI Bank	Industrial Credit and Investment Corporation of India
ICT	Information and Communications Technology
IDBI Bank	Industrial Development Bank of India
IFPI	International Federation of the Phonographic Industry
IMDb	Internet Movie Database
IMPF	Independent Music Publishing Forum
IMU	International Mathematical Union
IPO	Initial Public Offering
ISSEK	Institute for Statistical Studies and Economics of Knowledge (Moscow, Russia)
JETI	The Jobs, Energy, Technology, and Innovation program (United States)
KU Leuven	Katholieke Universiteit Leuven – Leuven's Catholic University (Belgium)
MaaC	Mobility as a Commons
MaaS	Mobility as a Service
MIC	Moscow Innovation Cluster
MINGA	Münchens automatisierter Nahverkehr mit Ridepooling, Solobus und Bus-Platoons – Munich's Automated Public Transport with Ride Pooling, Solo Buses, and Bus Platoons (Germany)
MIT	Massachusetts Institute of Technology
MOBA	Multiplayer Online Battle Arena
mRNA	Messenger Ribonucleic Acid
MVG	Münchner Verkehrsgesellschaft – Munich Transport (Germany)
NFA	NALAC Fund for the Arts (Texas, United States)
NFT	Non-Fungible Token
NTT	Nippon Telegraph and Telephone – Telecommunications company in Japan

OECD	Organisation for Economic Co-operation and Development
PhD	Philosophiæ Doctor
ProE	Pro Engineer – Software for automated design from Parametric Technology Corporation
PwC	PricewaterhouseCoopers
QS	Quacquarelli Symonds (QS World University Rankings)
R&D	Research and Development
SDGs	Sustainable Development Goals
SMEs	Small and Medium-Sized Enterprises
SSI	Scientific Specialization Index
TCI	The Competitiveness Institute – Global network of people and organizations working in clusters and innovation ecosystems (Barcelona, Spain)
THE	Times Higher Education World University Rankings
TIM	Telecom Italia
TSI	Technology Specialization Index
TUM	Technische Universität München – Technical University of Munich (Germnay)
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNESCO	United Nations Educational, Scientific, and Cultural Organization
VC	Venture Capital
VR	Virtual Reality
VDNKh	Vystavka Dostizheniy Narodnogo Khozyaystva – Exhibition of Achievements of the National Economy (Moscow, Russia)
Web3	Third generation (of Internet)
5G	Fifth generation (of cellular networks)

RANKING SCORES

1

Overall Global Cities Innovation Index

Cities' Ranking by the Overall HSE GCII: 2024

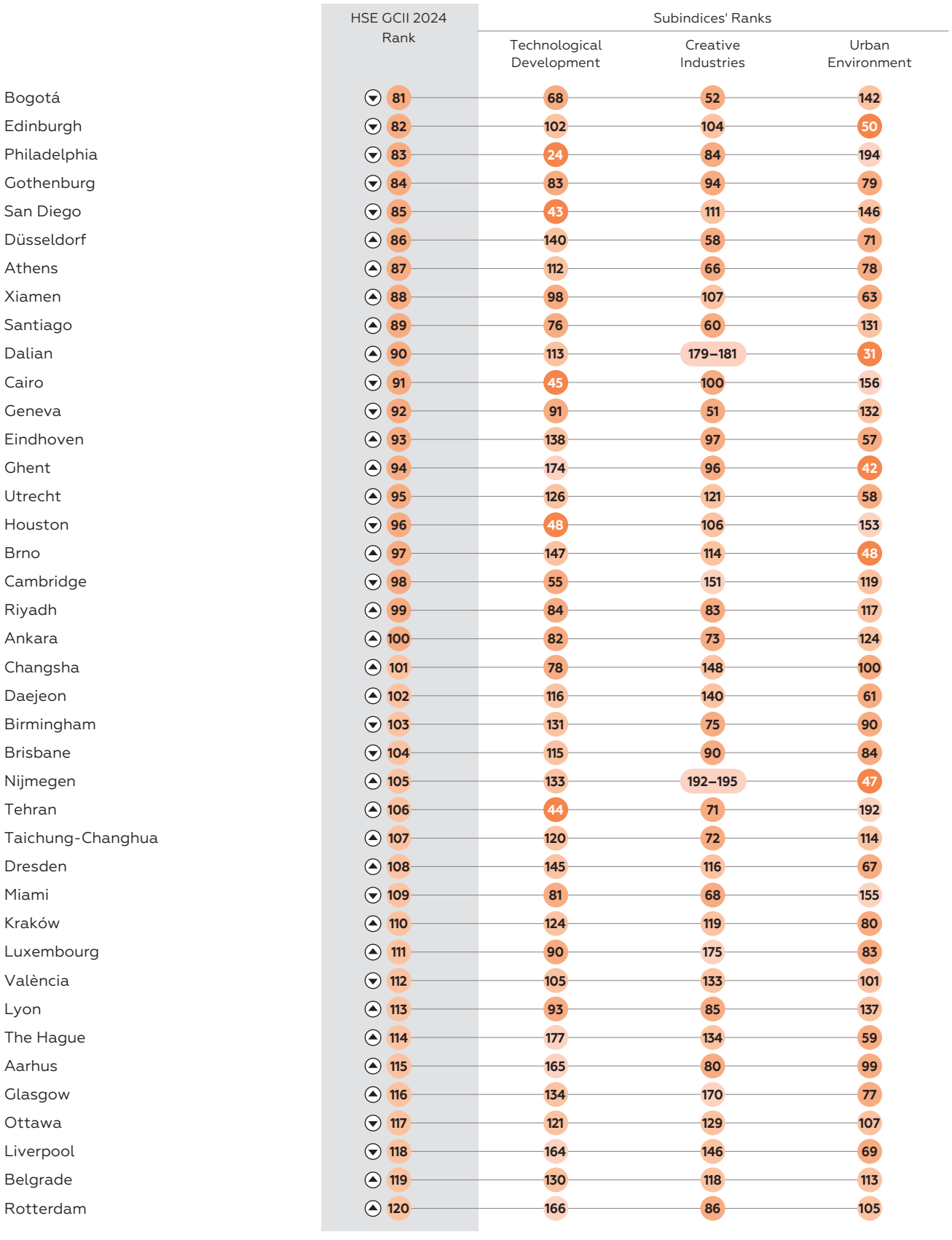
(continued)

	HSE GCII 2024 Rank	Subindices' Ranks		
		Technological Development	Creative Industries	Urban Environment
Budapest	41	62	41	34
Chicago	42	19	48	167
Vancouver	43	79	32	41
Wuhan	44	29	135	49
Mumbai	45	57	36	73
Helsinki	46	85	57	16
Chengdu	47	50	88	25
Hamburg	48	100	30	52
Nagoya	49	58	122	15
Bangkok	50	64	67	27
Lisbon	51	72	77	19
Buenos Aires	52	52	62	56
Dublin	53	47	49	109
Seattle	54	34	29	188
Hsinchu	55	74	157	14
Rome	56	49	63	88
Vilnius	57	157	99	8
Zürich	58	66	44	94
Frankfurt am Main	59	114	46	40
Brussels	60	53	53	93
Xi'an	61	37	110	81
Kyiv	62	87	54	53
Porto	63	96	70	29
Dallas	64	42	56	134
Rio de Janeiro	65	59	69	74
Tianjin	66	38	156	76
Mexico City	67	41	33	184
Stuttgart	68	109	42	72
Essen-Dortmund	69	106	74	32
Delhi	70	33	103	136
Qingdao	71	63	166–167	45
Bucharest	72	128	59	55
Saint Petersburg	73	97	92	43
Sofia	74	67	128	62
Cologne	75	151	37	75
Chongqing	76	51	127	89
Austin	77	36	113	138
Tel Aviv	78	56	82	110
Auckland	79	152	45	85
Kuala Lumpur	80	54	78	122

— Rank Change

1–10 11–50 51–100 101–150 151–200

(continued)


HSE GCII 2024 Rank
Subindices' Ranks
Technological Development
Creative Industries
Urban Environment
Bogotá 81 68 52 142
Edinburgh 82 102 104 50
Philadelphia 83 24 84 194
Gothenburg 84 83 94 79
San Diego 85 43 111 146
Düsseldorf 86 140 58 71
Athens 87 112 66 78
Xiamen 88 98 107 63
Santiago 89 76 60 131
Dalian 90 113 179–181 31
Cairo 91 45 100 156
Geneva 92 91 51 132
Eindhoven 93 138 97 57
Ghent 94 174 96 42
Utrecht 95 126 121 58
Houston 96 48 106 153
Brno 97 147 114 48
Cambridge 98 55 151 119
Riyadh 99 84 83 117
Ankara 100 82 73 124
Changsha 101 78 148 100
Daejeon 102 116 140 61
Birmingham 103 131 75 90
Brisbane 104 115 90 84
Nijmegen 105 133 192–195 47
Tehran 106 44 71 192
Taichung-Changhua 107 120 72 114
Dresden 108 145 116 67
Miami 109 81 68 155
Kraków 110 124 119 80
Luxembourg 111 90 175 83
València 112 105 133 101
Lyon 113 93 85 137
The Hague 114 177 134 59
Aarhus 115 165 80 99
Glasgow 116 134 170 77
Ottawa 117 121 129 107
Liverpool 118 164 146 69
Belgrade 119 130 118 113
Rotterdam 120 166 86 105
— Rank Change
1–10
11–50
51–100
101–150
151–200

(continued)

	HSE GCII 2024 Rank	Subindices' Ranks		
		Technological Development	Creative Industries	Urban Environment
Lima	▲ 121	110	65	147
Toulouse	▲ 122	99	187	108
Denver	▼ 123	71	147	152
Mainz	▲ 124	178	160	64
Atlanta	▼ 125	65	50	197
Nuremberg	▲ 126	153	93	111
Groningen	▲ 127	195	182	54
Leipzig	▲ 128	187	138	68
Braunschweig-Salzgitter-Wolfsburg	▲ 129	172	163	66
Leuven	▲ 130	183	185	60
Heidelberg	▲ 131	136	192–195	82
Bengaluru	▲ 132	70	152	165
Basel	▼ 133	127	81	140
Islamabad	▲ 134	80	186	141
Boulder	▼ 135	137	183	98
Hanover	▲ 136	193	108	91
Malmö	▲ 137	119	144	121
Oxford	▼ 138	111	131	130
Hefei	▲ 139	101	179–181	127
Ithaca	▼ 140	197	174	70
Manchester	▼ 141	118	87	159
Leeds	▼ 142	161	159	103
Fuzhou	▲ 143	135	190–191	112
Kaohsiung	▲ 144	185	91	123
Strasbourg	▲ 145	182	158	96
Exeter	▲ 146	154	192–195	102
Bristol	▼ 147	158	112	125
Marseille	▼ 148	75	184	171
Adelaide	▼ 149	159	142	118
Bordeaux	▲ 150	179	165	104
Tsukuba	▲ 151	155	196–198	106
Ningbo	▲ 152	92	166–167	161
Nottingham	▲ 153	149	162	120
Bonn	▼ 154	190	178	95
Leiden	– 155	188	192–195	92
Ho Chi Minh City	▲ 156	132	95	164
Jinan	▲ 157	88	199–200	157
Jakarta	▲ 158	129	126	154
Bologna	▲ 159	139	109	160
Minneapolis	▼ 160	108	143	163

▼▲ — Rank Change 1–10 11–50 51–100 101–150 151–200

(continued)

	HSE GCII 2024 Rank	Subindices' Ranks		
		Technological Development	Creative Industries	Urban Environment
Columbus	161	168	89	149
Calgary	162	163	150	128
Antwerp	163	194	76	148
New Haven	164	122	123	170
Bern	165	180	125	133
Canberra	166	170	164	126
Salt Lake City	167	141	171	144
Harbin	168	104	179–181	166
Portland	169	123	117	180
Lille	170	175	141	143
Ede	171	199	196–198	115
Manila	172	95	102	193
Ann Arbor	173	146	177	150
Lausanne	174	148	136	169
Padua	175	186	155	139
Cork	176	184	173	135
Kansas City	177	192	149	145
Phoenix	178	69	145	199
Perth	179	142	124	178
Turin	180	117	120	190
St. Louis	181	144	154	174
Venice	182	200	169	129
Novosibirsk	183	162	196–198	162
Jeddah	184	191	161	158
Santa Barbara	185	189	130	172
Beirut	186	167	101	186
Pittsburgh	187	125	105	195
Durham	188	107	189	189
Changchun	189	143	190–191	175
Montpellier	190	171	153	173
Florence	191	196	115	179
Grenoble	192	150	168	185
Detroit	193	103	139	198
Cape Town	194	169	79	196
Nashville	195	176	137	187
Cleveland	196	156	188	183
Rochester	197	198	199–200	168
Madison	198	181	172	182
Kitchener	199	160	176	191
Raleigh	200	173	132	200

— Rank Change

1–10 11–50 51–100 101–150 151–200

In HSE GCII 2024, the main centers attracting talent are yet again London, New York, and Tokyo. They are the embodiment of diversity: business cultures, creative traditions, and wholesome practices from three parts of the world that never fail to demonstrate the triumph of creativity and high tech, inspiring the brightest representatives of the postindustrial economy for new generations to come.

These leaders of innovation attractiveness are followed by agglomerations looking for their own way to combine the advancements in high tech and individual artistry, where many technology and thought leaders are striving to come – students and researchers, startup founders, investors and CEOs, designers and architects, gamers and filmmakers, musicians and writers.

Although the world of innovation attained a relatively stable balance of power, we can observe astounding growth in some of its centers. Each new business project, scientific discovery, creative product, or beautification initiative are immediately increasing a city's innovation attractiveness.

London – Bicampió[1] of HSE GCII

In 2024, the British capital became the two-time champion of the Global Cities Innovation Index

The symbiosis of creative industries and high technologies remains the number one factor behind London's attractiveness to innovation economy leaders from around the world. The city claimed first prize on 23 out of 44 indicators in corresponding sub-rankings and held first place in the HSE GCII 2024 sample by the scale of the creative industries sector, third by the quality of the urban environment, and fifth by the level of technological development.

[1] Bicampió (from Portuguese, "Double champion"), a term that was adopted by sports commentators after Brazil's second triumphant victory in the 1962 World Cup.

The success of the British capital as the main center of innovation attractiveness is tied to the 1,342 exceptional individuals and enterprises that came into the spotlight in international rankings or were recognized by professional awards. London is the absolute record-holder when it comes to the number of world leaders in music and architecture; it is one of the key centers of modern art, fashion, advertising, gaming and filming; and the main airport hub.

There are 400 fashion brands represented on the websites of global online retailers like FARFETCH, NET-A-PORTER, Luisa Via Roma, and Mytheresa that call London their home. It not only holds the absolute record in the whole HSE GCII 2024 sample (the nearest competitor is New York with 304), but also experienced almost 15% growth from its previous global record (351). London fashion companies include Alexander McQueen, Jimmy Choo, Manolo Blahnik, Stella McCartney, Victoria Beckham, and many other names associated with the city's identity: Harris Wharf London, Harrys of London, Kurt Geiger London, Labrum London, Paper London, Solace London, Temperley London, and so on.

The name "London" is uttered with fervor by leading advertising agencies – participants of the D&AD rating, the Oscar of the advertising world. The British capital has more of those than any other HSE GCII 2024 city (71), and a third of them suggest the key element to their success lies in the name (Engine Group London, Havas London, Mother London, Wieden+Kennedy London, Droga5 London, R/GA London, The&Partnership London, McCann London, Saatchi & Saatchi London, VMLY&R London, 21GRAMS London, Leo Burnett London, RAPP London, Grey London, Iris Worldwide London, BETC London, The Corner London, Anomaly London, BBH London, BMB London, Pablo London, etc.).

According to the calculations of HSE GCII 2024, London universities yet again attracted the largest number of international students – almost 169,856, which is 36,957 more than in the previous year. Furthermore, a two-fold increase in startups – from 7,916 to 16,934 – brought the city accolades in the corresponding indicator that used to belong to San Francisco. Innovators have everything they might need set up in fully equipped co-working spaces, of which London has 175 – and which is six times as many as in the last year (28).

Apart from witnessing the unprecedented prosperity of creative industries and dynamic growth of high tech, London attracts global talent by having a great urban environment: the best mobility (ranked 1st by the number of airplane routes, 4th – by the popularity of metro among city residents) and the abundance of leisure activities, whether private or business (ranked 3rd by the number of cultural and sports places, and 10th – by the number of international business events conducted in the city).

London's leadership in selected HSE GCII 2024 indicators

~17,000
startups

400
fashion brands

175
co-working spaces

~30
leaders in opera, design, and architecture

~170,000
international students

70+
best advertising agencies

350+
airline routes

20
leading higher education institutions in arts

Source: HSE ISSEK, based on Crunchbase, StartupBlink, FARFETCH, NET-A-PORTER, Luisa Via Roma, and Mytheresa, The International Opera Awards, A' Design Award, iF Design Award, Red Dot Design Award, World Architecture Festival Awards, D&AD, OpenFlights, QS, and THE.

Steady Peloton

The HSE GCII 2024 composition remained the same, however, the distribution of ranks within it has changed

The leading global centers of innovation attractiveness that scored the first ten places on the overall ranking are yet again London, New York, Tokyo, Beijing, San Francisco, Paris, Shanghai, Los Angeles, Moscow, and Seoul. They secured their positions at the top, in the same way they did a year before, by obtaining high scores in Technological Development and Creative Industries (for example, New York ranked 3rd and 2nd, respectively; Tokyo – 4th and 3rd; Beijing – 2nd and 9th; San Francisco – 1st and 8th) (Figure 4).

The top 10 HSE GCII 2024 cities combined have 8,017 innovation economy leaders – individuals and enterprises. The geography of the main centers of business, intellectual,

8,017

innovation economy leaders (individuals and enterprises) are located in the top 10 cities of the overall ranking

and creative activity remain evenly distributed across Europe, North America, and East Asia. Cities and agglomerations that made the top ten as per the study results are also among the most densely populated places on the planet: the overall number of people living there exceeds 200 million. Seven centers are located in high income countries (France, Japan, Republic of Korea,

Countries where the top 10 HSE GCII 2024 cities are located

United States

267

sampled cities

United Kingdom

145

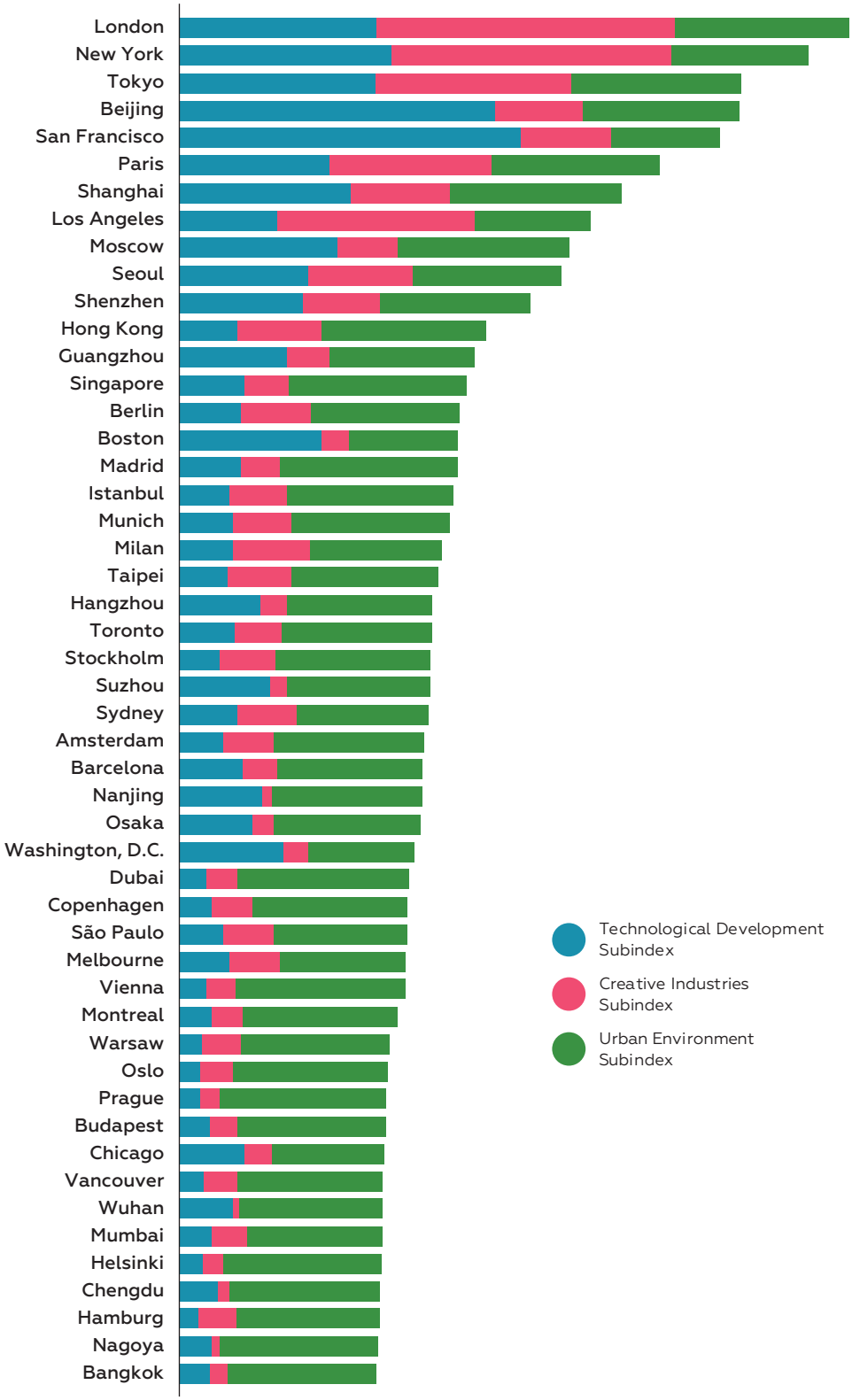
sampled cities

Mainland China

129

sampled cities

Figure 4. Subindices' Contribution to the Overall HSE GCII 2024: Top 50 Cities



Source: HSE ISSEK.

United Kingdom, and United States), and the other three – in above average income countries (China, Russia). In addition to that, countries where the top 10 HSE GCII 2024 cities are located gave the largest number of cities in the full city sample of our index: United States – 267, United Kingdom – 145, Mainland China – 129.

Still, despite the steady composition of top cities that are attractive for innovators, there are some changes in the ranking positions within the first ten: cities that ranked from 5th to 10th in the 2023 ranking changed their positions in HSE GCII 2024 between each pair (Figure 5).

Such movements within the ranking may speak about the highest level of competition between the best of the best. As such, according to the HSE GCII 2024 results, London displaced San Francisco from the ranking's pinnacle for the number of startups (16,934 vs. 15,845 enterprises). San Francisco took the leadership position from Tokyo for the number of headquarters of companies from the R&D Scoreboard (212 vs. 151 corporations). New York stripped Beijing of the "silver" medal in the volume of venture capital investment (120.1 billion USD vs. 81.2 billion USD). Beijing pushed San Francisco from the runner-up position in the number of highly cited researchers (362 vs. 356 persons).

Tokyo moved on the ranking by the number of developers of popular computer games from 5th place that it used to share with Los Angeles, San-Francisco, and London (seven vs. five, four, and two companies, respectively) to 1st, this time sharing it with Stockholm. New York displaced London from 2nd place in the number of most-streamed artists on Spotify

Figure 5. Top 10 HSE GCII Cities' Ranks in the Overall Index: 2023, 2024

Source: HSE ISSEK.

(14 vs. seven singers). Los Angeles outperformed Paris by the number of influential people in modern art (11 vs. four people). Moscow outran New York, as well as Tokyo and Beijing, by the number of leading higher education institutions in arts (11 organizations vs. nine and eight, respectively).

The competition between the leading centers in each aspect of innovation attractiveness is exacerbated by the "high base" effect where every ranking's competitor by default is starting from a top position with a significant accumulated potential in a form of innovation economy leaders present in the city. So much so that the one growing faster (or losing more slowly) is crowned the winner, even if changes in the numeric values are miniscule when compared to its nearest competitors.

Patterns of Leaders' Innovation Attractiveness

Cities from the HSE GCII 2024 top ten and Shenzhen (ranked 11th) have a distinct set of characteristics that could be called a recipe for ranking success

In the limelight of HSE GCII 2024 were 1,127 centers of high tech, creative industries, and advanced urban environment from 144 countries with at least two innovation economy leaders – enterprises or individuals that were acclaimed by professional awards or high positions in specific rankings. The degree of their presence helps evaluate this or that aspect of the city's innovation attractiveness for talent.

After analyzing the results we received, we split the ranking's cities into four groups to identify the success factors of HSE GCII leaders and estimate the room for growth for those that achieved moderate positions. For the first ten cities in HSE GCII 2024, as well as Shenzhen (ranked 11th), we identified three "patterns of attractiveness", a set of cities' characteristics that contributed to a high ranking result.

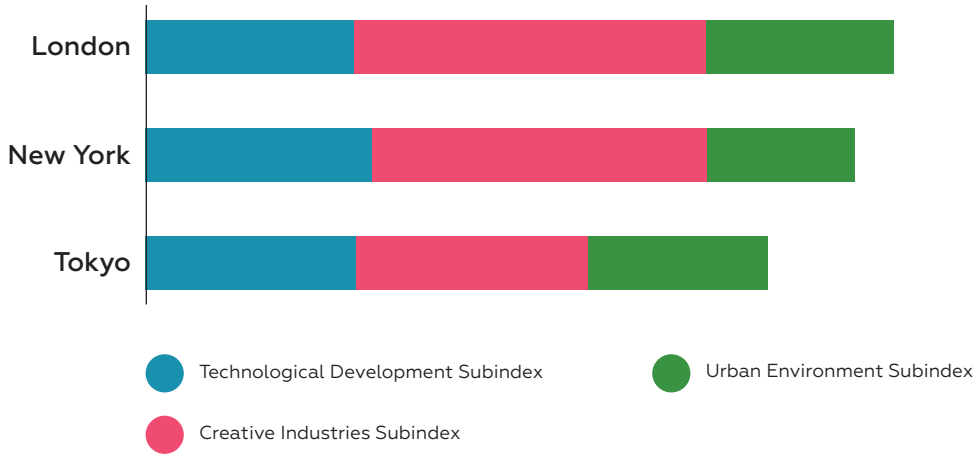
"Innovation creators"

The first group consists of main centers of talent attraction – London, New York, and Tokyo, whose innovation profiles combine top positions in the development of both creative industries (ranked 1st, 2nd, and 3rd, respectively) and high tech (5th, 3rd, and 4th). The progress of these cities in key artistic activities – music, fashion, advertising, architecture, art, computer, and video games – proved to be unachievable for most other cities (Figure 6).

London 1
New York 2
Tokyo 3

London, New York, and Tokyo took the pedestal in 10 out of 18 indicators in the Technological Development Subindex and 24 out of 26 indicators of the Creative Industries Subindex. These megacities were chosen by the leading technology and thought leaders of the modern era.

Figure 6. Subindices' Contribution to the Overall HSE GCII 2024: "Innovation Creators"



Source: HSE ISSEK.

> New York became the absolute champion of HSE GCII 2024 by the number of postindustrial economy leaders: 1,353 exceptional enterprises and individuals are making their contribution to the Big Apple's innovation attractiveness.

New York has 3,858 funds to support venture capital activity (25% more than in the previous year); the 20 largest fashion companies among which are multi-brands Authentic Brands Group and Tapestry, legendary Ralph Lauren and Tom Ford, and niche The Children's Place Inc.; the 56 largest PR companies according to PRovoke Media and 15 creative advertising producers were highlighted at the Cannes Lions International Festival of Creativity.

Exceptional people from the world of art chose "the city that never sleeps" over other centers of innovation. There are 69 artists leading in auction revenue who have chosen to live and work in New York (for example, Cecily Brown, one of the highest paid modern painters who relocated from London[1]), in addition to 38 internationally-recognized artists (one of them is Yo-Yo Ma, a famous American cellist of Chinese heritage who was born in Paris), 31 participants from Power 100, a list of the most

[1] Art record-breakers: 8 most expensive modern female artists. (In Russian). Available at: https://www.interior.ru/art/6453-art-rekordsmenki-8-samykh-dorogikh-sovremennykh-khudozhnits.html (Accessed: 08.07.2024).

influential people in modern art (in particular, Rirkrit Tiravanija, who is a pioneer of esthetic relationships and an enthusiast of participatory acts, born in Buenos Aires to Thai parents who received education in Chicago, New York, and Toronto, is now living between New York, Berlin, and Chiang Mai).

New York strengthened its positions in the Technological Development and Creative Industries Subindices in several indicators compared to HSE GCII 2023:

- 120.1 billion USD was the volume of venture capital investment deals with local companies, which is 14 billion USD more than in the previous Index, which allowed New York to push Beijing from 2nd place;
- the number of co-working spaces has increased over six times (from 23 to 148), and that pushed the city from 53rd to 8th place by the quality of innovation infrastructure;
- the number of film production companies that won awards at international film festivals increased from three to eight. Among them are Access Entertainment and A24 with "The Zone of Interest", which won the Gran Prix Award at the Cannes Film Festival in 2023; Neon, by which "Triangle of Sadness" won the Golden Palm Branch at Cannes a year before; and TSG Entertainment where "Poor Things" was shot and won the Golden Lion at the 80th Venice Film Festival in 2023.[1] Due to these achievements, as well as the leadership in the number of popular video streaming services (seven companies take part in FlixPatrol portal rankings),

New York's ranking changed from 5th to 4th place in the Film and animation section, thus raising its own, already high, bar in the creative sector.

Tokyo is still at the summit by the number of leading, globally recognized universities (44, followed by Seoul, which has 27, and London and New York – 25 and 19, respectively). As for the remaining parts of Technological Development, save for the Startups and venture capital section, the Japanese capital continues to make it into the top 10, as the traditionally strong side of Tokyo is high tech corporations from the R&D Scoreboard (151 companies, including those in the first one hundred: Honda Motor Co., Ltd., NTT, Sony Group Corporation, Takeda Pharmaceutical Company Limited, Nissan Motor Co., Ltd., Hitachi Ltd., Daiichi Sankyo, and SoftBank Group Corp.). The biggest improvements compared to HSE GCII 2023 were achieved in creative industries, where it climbed two positions up in the corresponding sub-ranking:

- became a global leader in the gaming industry, sharing the first place with Stockholm in the number of developers of the popular computer games from the top 100 by the number of players in the Steam online store (seven companies);
- kept a "silver" medal in industrial design, losing by a slim margin to the double winner Shenzhen in the total number of participants in the A' Design Award, iF Design Award and Red Dot Design Award (72 and 73, respectively). Among prominent Tokyo designers is Morita Yasumichi, the general director of GLAMOROUS Co., Ltd., who was awarded the Design Hero prize for

[1] Cannes Film Festival / 2023. Available at: https://www.imdb.com/event/ev0000147/2023/1/; Cannes Film Festival / 2022. Available at: https://www.imdb.com/event/ev0000147/2022/1/; Venice Film Festival / 2023. Available at: https://www.imdb.com/event/ev0000681/2023/1/ (Accessed: 08.07.2024).

contributing to the quality of life and community development through design[1]; his interior and art projects have been repeatedly acknowledged with silver, gold, and platinum A' Design Awards;

- ranked 2nd by the number of film animation studios participating in the Top 100 Most Influential Animation Studios of All-Time, lagging behind the leader – Los Angeles – only by seven companies (21 and 28, respectively), and demonstrating a 2.6-fold leg-up on the "bronze" leader London, which has eight such studios.

"Tech leaders of the Pacific"

The second group has Beijing and San Francisco – two major tech hubs of our age located on the opposite ends of the Pacific Ocean (Figure 7). They are represented on the pedestal in all five sections of Technological Development, occupying 2nd and 1st places in this Subindex.

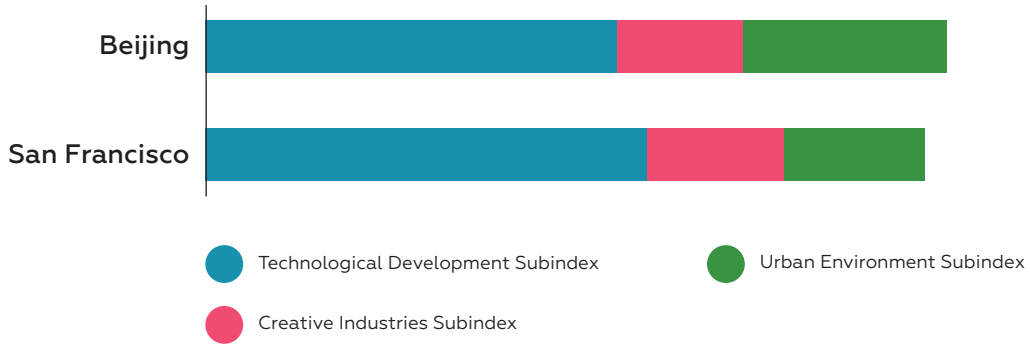
Beijing 4
San Francisco 5

Beijing is confidently proving its right to be called the main science center in the world: the city rose from 5th to the 1st place in the Universities and R&D organizations section, thus pushing New York out of the way. The Celestial Empire's capital has 79 leading R&D organizations (ranked 2nd after Paris), and the majority of them falls under the Chinese Academy of Sciences[1], and 26 leading universities (ranked 3rd after Tokyo and Seoul). Beijing is keeping its leadership in the number of scientific publications (947,908 papers, which is 239,447 more than in the previous period, the runner-up Shanghai had 432,729), and strengthening its positions in the number of highly cited researchers (362 vs. 318 persons, ranked 2nd after Boston) and in the number of patent applications (455,000 vs. 342,989, ranked 4th after Suzhou, Shenzhen, and Shanghai).

[1] Morita Yasumichi, a design developer. Available at: https://competition.adesignaward.com/design-hero.php?profile=134825 (Accessed: 08.07.2024).

[2] China has become a scientific superpower. Available at: https://www.economist.com/science-and-technology/2024/06/12/china-has-become-a-scientific-superpower (Accessed: 01.07.2024).

Figure 7. Subindices' Contribution to the Overall HSE GCII 2024: "Tech Leaders of the Pacific"



Source: HSE ISSEK.

San Francisco is ramping up the capital-output ratio of innovations: the city maintained its leadership in the number of unicorns, while increasing their "headcount" by 16% compared to last year's result (325 vs. 279) and was ranked 1st in the number of companies leading by R&D expenditures (212 vs. 194) moving Tokyo from the spotlight. San Francisco also showed a 60% growth rate in aggregated R&D expenditures of the largest innovation corporations – from 138 to 222.5 billion euros.

Despite a clear inclination toward high tech, these cities also have creative specializations. For example, Beijing was chosen by every seventh artist leading in auction revenue; here, the Chinese capital is still a runner-up to New York (36 persons; among them is Zeng Fanzhi, one of the most financially successful modern Chinese painters, whose works were sold collectively for over 19 million USD in 2023). San Francisco is in the top three by the number of the best video game developers (seven companies, including Double Fine Productions with a game "Psychonauts 2", distinguished with a New York Game Award in 2022) and the most influential animation studios (eight companies, including Pixar with the first ever full-length animation movie "Toy Story" (1995), shot using exclusively computer animation,[1] and Lucasfilm Animation Ltd. LLC that produced one of the Star Wars films: "Star Wars: The Clone Wars", which was followed by the spin-off TV series).

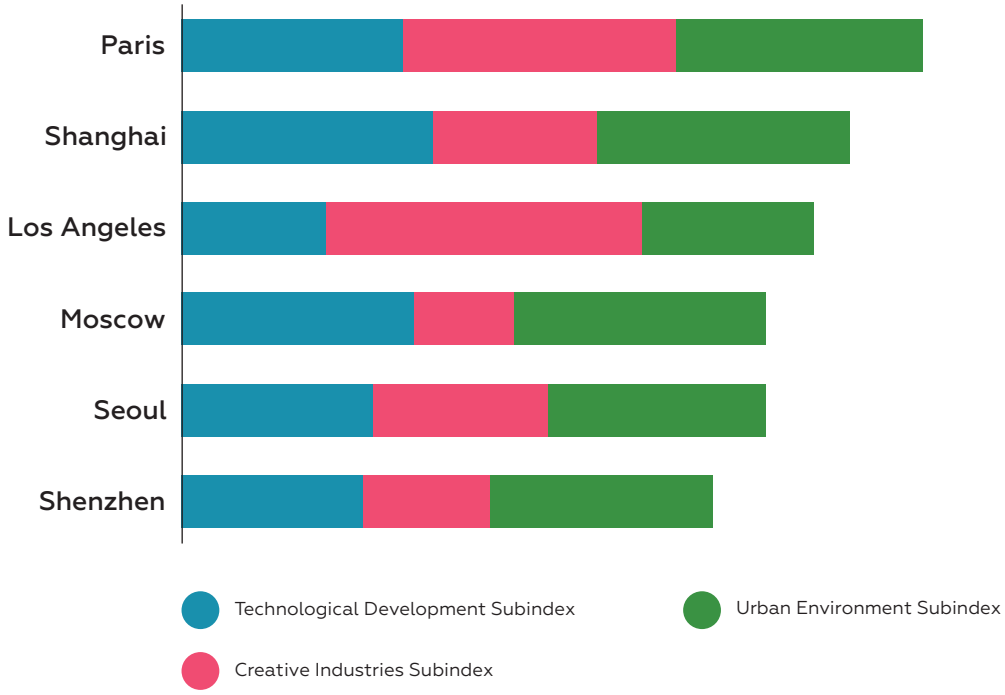
[1] Toy Story. Available at: https://www.pixar.com/toy-story (Accessed: 01.07.2024).

“Points of high tech and creativity equilibrium”

The third group combines the most important megacities of the global macro regions – Europe, East Asia, and North America. They are in top 10 in many sections of the Technological Development and Creative Industries Subindices (Startups and venture capital, Universities and R&D organizations, Film and animation, Electronic games, Music, Industrial design, and Arts) and in both subindices they demonstrate relatively steady progress (Figure 8).

Paris 6
Shanghai 7
Los Angeles 8
Moscow 9
Seoul 10
Shenzhen 11

Figure 8. Subindices’ Contribution to the Overall HSE GCII 2024: “Points of High Tech and Creativity Equilibrium”



Source: HSE ISSEK.

Against the background of a balanced development of innovation attractiveness components in these cities, their creative and technological sectors were telling a different story in terms of the HSE GCII 2023 results.

Paris, for example, achieved the biggest breakthrough in high tech: the French capital outdid itself by the number of R&D organizations operating in the city (87). A unique example of which is The Paris Observatory, the oldest

observatory currently in operation (founded in 1667 by order of King Louis XIV). Paris also entered the top three in the number of supercomputers (11).

Shanghai, in contrast, strengthened its positions in the Creative Industries Subindex by moving four positions up – from 11th to 7th place, thus demonstrating the biggest climb in the ranking ladder among all top 10 HSE GCII 2024 cities by this component of innovation attractiveness. The key city's achievement in the creative sector was the "bronze" medal in industrial design, which it shared with Taipei (66 recipients of the A' Design Award, iF Design Award, and Red Dot Design Award).

Moscow was building up its potential in both areas, highlighting the accumulation and transfer of knowledge: the city entered the top three by the number of leading R&D organizations (60) and took 4th place in the number of education leaders in arts (11), among which are the renowned Gnessin State Musical College, Russian Institute of Theatre Arts–GITIS, and Moscow P.I. Tchaikovsky Conservatory.

"Niche innovation centers"

The fourth and the largest group was comprised of the cities ranked from 12th to 200th place in the HSE GCII 2024 ranking. The competition posed by leaders with the densest concentration of talent is likely to prevent them from climbing to the top positions of the ranking, however this does not mean that they cannot prove themselves in technological or creative niches. An example of that is Istanbul, which demonstrated global leadership in the number of effective advertising agencies (19 companies, five more than a year prior), entered the top 10 by the number of leading universities (21 universities, including the oldest higher education institution in Türkiye – Istanbul University), and the number of students. Madrid became 4th in the number of R&D organizations and 6th in the number of film production companies that shot films among the most highly rated movies (such as Mogambo that produced "1917" in 2019 together with DreamWorks Pictures, Reliance Entertainment, and several other studios that is rated 8.2 on IMDb[1]). Suzhou held on to its leadership in patent activity (656,656 applications, 40% more than in HSE GCII 2023) and ranked 4th by the number of largest e-sports tournaments. Melbourne and Sydney ranked 2nd and 3rd, respectively, by the number of international students and took "silver" by the number of architecture bureaus and architects that achieved international recognition (17 enterprises and individuals each).

[1] 1917. Available at: https://www.imdb.com/title/tt8579674/ (Accessed: 01.07.2024).

More than a Cluster[1]

How a supercluster helps Moscow's innovators exploit the megacity's advantages

Rethinking Clusters: Features of the "Cooperation Package" in a Big City

One of the widespread approaches to the spatial organization of the economy and the propulsion of innovation is the identification and support of clusters. They are associated with high performance and the accumulation of knowledge resulting from co-opetition in some functional niches of companies and institutes located in close proximity to one another.

Since the 1990s, clusters have become a frequent object of consideration from an organizational point of view as the term implies the coordination of the efforts of businesses, the authorities, and academia to create and develop existing or potential initiatives and manage them. Their main purpose is to implement joint projects. As a rule, cluster initiatives work around one or several similar types of activities and gather ca. 100 participants located within a 200 km radius [OECD, 2013] of one or several adjacent regions and formalize their membership by signing a corresponding agreement, which quite often means paying regular fees.

Amid intensifying urbanization and an increasing number of megacities in the world [OECD / European Commission, 2020; HSE University, 2023] that concentrate business, intellectual, and creative activity, advanced infrastructure, and various public goods, the traditional approach to constructing and developing cluster initiatives needs to be adjusted to suit the specifics of the urban economy.

The features of megacities in the context of the cluster approach include many economic agents, sectoral diversification, high transaction costs, dependence on external interactions, and diverse funding programs.

Firstly, megacities have a significant concentration of economic agents that represent various industries, which creates urbanization effects, when cities with a more diverse economic structure grow faster. A broader variety of sectors in the urban economy provides more opportunities to create

new types of activities or cross-sectoral combinations that were previously unknown. It is namely in megacities that we at various times have gone through the so-called uberization of the economy, the experience industry, an e-sports trend, and continue to witness the appearance of many smart services.

However, along with the positive effects of agglomeration in large centers, negative consequences may also appear. The growth of cities can often come back to haunt its citizens with overpopulation and traffic jams, environmental pollution, labor market disparities, rising real estate prices, deficit of public goods, and so on. Another problem that is inherent in cities is high transaction costs that emerge over the course of the contractual relationships between businesses, which is proportionate to the scale of the city's economy. The more participants that interact with one another and the less they know about each other, the higher the total cost of searching and verifying information, negotiating, compliance control, and combating opportunism will be.

Another megacity trait is its openness to outside contacts and, simultaneously, the need for them. The economic development of a city, especially a large one, in many ways rests on cooperation with outside partners and the role of the local network and proximity may be, conversely, overestimated. Innovation needs not only the "local buzz" circulating within a close-looped system, but the intellectual exchanges with the outside that occurs via "global pipelines."

Finally, the cities have many ways to facilitate cooperation after diversifying institutes and infrastructure facilities. Funding agencies compete with each other and, therefore, need to have their own niches for the financial and non-financial stimulation of various economic agents. The organization of their effective cooperation in the megacity climate may become the new public good in the city.

Urban Supercluster: a Cluster Initiative in Megacity Settings

The traditional format of the cluster initiative is more likely to ignore the advantages of the modern urban economy that come in the form of various economic entities, types of activity, projects, and funding initiatives. Their merger and coordination for the success of the business require the creation of a special type of cluster initiative that corresponds with the megacity's conditions – the urban supercluster.

> The urban supercluster brings together many participants of various forms, sizes, and types of activities, ranging from sole proprietors to cluster initiatives localized within the megacity's borders or beyond, which are not bogged down by hierarchy or contractual obligations and receive funding or public goods to lower the transaction costs of implementing innovation and joint projects directly from their cluster management organization.

The urban supercluster does not renounce the conventional format of cluster initiatives; quite the opposite, it adds value to them. Let us look at the features of a supercluster.

1. A monumental initiative that brings entire industries under one umbrella

The number of participants in a conventional cluster initiative does not usually exceed a hundred, and their communication takes place mostly within the borders of the cluster. As a result, the megacity has a plethora of dispersed specialized cluster initiatives. The format of an urban supercluster with a low barrier to entry facilitates bringing an unlimited number of participants under one umbrella, thus providing targeted funding to entire sectors.

2. A cross-sectoral initiative that promotes the emergence of new types of economic activity

Quite often, the rationale behind developing conventional clusters is specialization. Superclusters, on the other hand, bet on diversification that brings together many urban economy participants and promotes cross-sectoral convergences. The diversification in the urban supercluster may be achieved by being open to companies of any type of activity, or the inclusion of more highly specialized, sectoral cluster initiatives.

3. An interactive initiative aimed at minimizing transaction costs

Usually, the growth in the number of cluster participants is tied to increased transaction costs that stand in the way of knowledge dissemination and make the initiative less flexible. Cluster management organizations improve trust within the cluster by addressing various types of proximity – social, organizational, or cognitive, which help minimize transaction costs. It is easier for like-minded people to agree on the rules of interaction, which brings more certainty into their joint activity. Within a scope of an urban supercluster, a digital platform will work as the sole way to reinforce

non-locational proximity with practically no alternatives, because the ICT dissemination lowers many transaction costs and supports the organizations' readiness to open their innovation processes for the influx and deflux of knowledge.

4. An open initiative that benefits from external relations

The conventional approach to clusters underlines the importance of local ties. However, it has been proven that innovations appear as a result of both close and remote interactions. The urban supercluster with its many diverse participants who represent the megacity's economy may stimulate their cooperation with outside partners around the country and abroad. Such cooperation is no less advantageous for the city and local businesses than supporting internal relations.

5. An initiative that gives its participants a new public good

Cluster initiatives are generally associated with providing their participants with a public good on account of trust-based relations, sharable access to know-how, and infrastructure. Public goods within the cluster are characterized by non-exclusion and non-rivalry, as its members cannot be taken outside the circle of those who receive free-of-charge services of the cluster management organization, and the appearance of every new member does not make such services less affordable or accessible for others.

MIC: a Megacity-Sized Cluster Initiative

The size and diversity of the Moscow's economy inspired the city authorities to create in 2018–2019 a Moscow Innovation Cluster (MIC) that was intended to provide the conditions for innovation development and implement new projects based on intersectoral cooperation. Organizing cluster members' cooperation within Moscow and between the city and its partners from other Russian regions is facilitated by i.moscow, a digital platform where one can seek funding opportunities or non-financial support.[1]

> The MIC is the first urban supercluster in Russia, a cluster initiative that brings together economy agents on a single digital platform with access to various tools that promote cooperation regardless of their sectoral and territorial affiliations, size, and forms of incorporation.

[1] More about the Moscow Innovation Cluster can be found on its official website (only in Russian): https://i.moscow/ (Assessed: 29.08.2024).

The MIC has the main qualities of an urban supercluster.

1. The MIC has many participants

The MIC has over 40,000 members and partners: ca. 27,000 from Moscow and more than 13,000 from Russian regions.

To boost up agglomeration effects, the new urban supercluster had set minimal requirements for its participants. Potential members from Moscow and partners from other Russian regions need to get their legal entity or sole proprietor status approved, provide documentation that their enterprise is not in the process of winding down, has not filed for bankruptcy, or suspended its activity. The procedure of joining the MIC was also honed and now requires registration on the i.moscow website with an e-signature and filling out participation forms.

2. The MIC supports cross-sectoral cooperation

The MIC has around 90 industries – from high tech to creative industries – and includes 15 cross-sectoral clusters containing over 1,100 companies and implementing over 140 projects.

The MIC was initially thought of as a tech-based cluster initiative that would work primarily with ICT companies, of which Moscow has over 43,000. However, the tech specialization would soon become polysectoral, and today the cluster includes members and partners of different types of activities that represent the high tech and creative sectors of the Russian capital's economy. Together with enterprises and sole proprietors, the MIC contains entire cluster initiatives, i.e., cross-sectoral clusters where companies combine their efforts to expedite and launch innovative products. Among them are Green Moscow, the innovative cross-sectoral cluster, "MEDTECH CLUSTER", the cross-sectoral cluster of bio pharmacology and medical technology, and SportTech, the Moscow innovative cross-sectoral cluster in the sports industry, and a beauty industry cluster.

A cross-sectoral cluster has to be initiated by a MIC member, include at least 30 Moscow companies, out of which at least two have to have implemented at least one innovation project.

3. The MIC helps keep transaction costs at minimum

Many close and remote economy agents of various incorporation types, sizes, and specializations may develop effective and trust-based relations within the supercluster initiative through the i.moscow platform.

The i.moscow platform helps minimize many transaction costs related to the search for and the verification of information. MIC members and partners know that participation in the supercluster is provided to those enterprises and sole proprietors that have proven their goodwill. This measure, together with the ongoing monitoring of information about supercluster participants by a special management organization – MIC Foundation, reduces the possibility of opportunism and reinforces trust-based relations. Apart from that, the i.moscow platform aggregates

the data about new projects, events, and competitions. It also integrates an electronic database of patents, a marketplace for selling products and services, and a contract manufacturing exchange. The latter provides companies with an opportunity to find a reliable, certified contractor/manufacturer. The search and selection of orders, the discussion of payments and contract conditions are undertaken directly on the platform. Another platform service is the "Innovative solutions" catalogue that records open queries of companies that are looking for partners to grow. Among the services' functions are also an intelligent partner search: the user can describe what his or her project needs and the system will offer a list of potential contractors.

4. The MIC is open for companies and entrepreneurs all around the country

The MIC has over 13,000 partners from Russian regions, which is over 32% of the total number of supercluster's participants.

The MIC is a cluster initiative based in the capital city, which can be joined by partnering enterprises and sole proprietors from other Russian regions. The urban supercluster's openness is aimed at the fortification of ties between R&D organizations, high tech corporations, and universities concentrated in Moscow, and industrial platforms located outside of that region. Both Moscow members and regional partners have access to the i.moscow platform services.

5. The MIC supports its members with financial and non-financial tools, as well as public goods

Over 7,300 supercluster members have already used available resources, and the total sum of approved grants amounted to 15.2 billion rubles (ca. 163.9 million USD).

With the help of a government funding navigator on i.moscow, supercluster members and partners may find the necessary tools to launch products and enter new markets, lower the tax burden, take out a loan, conduct R&D, train personnel, increase manufacturing capacity, and raise additional capital. To receive a grant, a supercluster member needs to file a (paperless) request online; after that, application tracking and downloading of additional documents happen within the member account.

Some Like It Disruptive

The sharpest uptick in the HSE GCII was demonstrated by cities that appeared in the top 50 for the first time ever in the 2024 ranking results

After analyzing the changes in the top 200 HSE GCII cities in relation to the 2023 ranking, it became obvious that 52 centers of innovation were able to radically improve their results by going up 10 positions or more. The biggest leap was managed by Daejeon, which moved from 198th to 102nd place. At the same time, 26 cities, despite disruptive changes in their rankings, remained within the second hundred. Another 13 centers were able to improve their three-figure position to a two-figure but did not rise above 51st place. Only ten cities that demonstrated a more vigorous increase in the level of innovation attractiveness managed to end up in the top 50 of the HSE GCII ranking or solidify their positions (Table 1).

Table 1. Movement in the Ranks for the Selected HSE GCII 2024 Cities by the Overall Index and Subindices vs. HSE GCII 2023

HSE GCII 2024 rank	City*	Movement in the ranks compared to HSE GCII 2023			
		HSE GCII rank	Technological Development Subindex	Creative Industries Subindex	Urban Environment Subindex
18	Istanbul	+17	+5	+19	+19
21	Taipei	+16	+2	+26	+9
22	Hangzhou	+12	0	+30	+49
32	Dubai	+26	+16	+38	+8
40	Prague	+10	+15	-17	+2
44	**Wuhan**	+15	+2	+27	+54
45	**Mumbai**	+17	-8	+9	+77
48	**Hamburg**	+19	+35	-8	+78
49	**Nagoya**	+54	+8	+55	+114
50	**Bangkok**	+25	+42	+16	+16

* Highlighted in orange are the cities appearing in the top 50 of the overall HSE GCII ranking for the first time in 2024.
Source: HSE ISSEK.

These cities' sharp increase in the overall ranking was achieved through the strengthening of their positions in one or several indicators. For example, Nagoya has eight designers and design firms that won the international A' Design Award, iF Design Award, and Red Dot Design Award, which allowed the city to place 40th in the corresponding indicator and move from 177th to 122nd position in the Creative Industries Subindex. Among them is a UK designer, Simon Humphries, who has been working at Toyota Motor Corporation since 1994 and who today serves as a member of the Board of Directors, Chief Branding Officer, Senior General Manager of Design, and Head of Design.[1] Apart from that Nagoya became the leading HSE GCII 2024 city in safety. Dubai ranked 23rd in the Film and animation section due to its appearance in the top 10 by the number of video streaming services – participants of the FlixPatrol ranking. A four-fold growth in the number of startups – from 1,108 to 4,360 – provided the city with a result that exceeds Austin's results (1,393 start-ups in the HSE GCII 2023 ranking vs. 3,095 in the current issue) and Mumbai (1,388 vs. 3,857, respectively), which allowed it to take its place in the first ten world centers by the value of this indicator.

[1] Toyota. Simon Humphries. Available at: https://global.toyota/en/company/profile/executives/simon_humphries.html (Accessed: 08.07.2024).

Even Spread: Only One Among Leadership Factors

Every second city in the top 10 of the HSE GCII 2024 has evenly developed all components of innovation attractiveness, however three out of the ten world centers of high tech and creativity have scored over 20 times lower in the level of urban environment development than in the overall attractiveness for talent

Cities' placement in the overall HSE GCII 2024 were benchmarked with their positions in the sub-rankings – Technological Development, Creative Industries, and Urban Environment. In most cases, high values in one subindex go hand in hand with low values in other subindices or there are other deviations from the overall HSE GCII by one or several subindices. Even[1] development is endemic only for seven cities in the top 200, and they are spread over Europe, the Americas, and Asia (Table 2).

The main centers of innovation, apart from highly developed technological and creative sectors, offer their visitors a wide variety of cultural pastimes (Paris, London, Tokyo, Shanghai, and Moscow are all in the top 10 most appealing cities for tourists) and great mobility – like a plethora of airline routes (352 in London) or EV charging stations (453 in Tokyo). Some of these agglomerations are especially attractive for innovators with their preferential conditions for doing business (Moscow is in the top three cities with the lowest tax burden on entrepreneurs[2]) and advanced digital services (Shanghai is ranked 5th by the speed of mobile Internet and 8th by the level of digital public and municipal services).

Nevertheless, it would be wrong to think that the even development of all components of innovation attractiveness is exclusively tied to having top positions in the ranking. Some cities that took top positions in the overall HSE GCII 2024 ranking have high values in the Technological Development and Creative Industries Subindices and a low value in the Urban Environment Subindex. As a result, the ranks of every fifth innovation center from the top 50 HSE GCII 2024 in the corresponding subindex are behind the overall index by 50 or more positions (Table 3).

[1] The level of innovation attractiveness was considered even if the deviation of the ranks for all HSE GCII subindex values was less than ten positions in either direction. Otherwise, it was found that the thematic block, as reflected by the corresponding subindex, is a strength or a weakness in the innovation attractiveness of the city.

[2] The data for "Estimated tax" refer to 2023.

Table 2. Ranks of the HSE GCII 2024 Cities with the Even Development of Innovation Attractiveness Components

City	HSE GCII 2024 rank	Subindices' ranks		
		Technological Development	Creative Industries	Urban Environment
London	1	5	1	3
Tokyo	3	4	3	9
Paris	6	8	5	10
Shanghai	7	6	7	5
Moscow	9	7	15	6
Toronto	23	27	24	28
Rio de Janeiro	65	59	69	74

1–10 11–50 51–100 101–150 151–200

Source: HSE ISSEK.

Even though the majority of them are the same attractive cities like the most "well-balanced" innovation centers (New York, Los Angeles, São Paulo, San Francisco, and Milan are in the top 20 by the number of cultural and sports venues), and are creating the same favorable conditions for mobility (one can fly out from New York to 228 destinations, ranked 6th; or Boston and Milan, for example, have no problems with EV charging stations – 450 and 442 stations, ranked 3rd and 4th by their number, respectively), or reining in the tax burden on businesses, like São Paulo does so with one of the lowest tax rates in the world (ranked 5th), however, by many other parameters of the urban environment, they have significant drawbacks. These cities, save for São Paulo, – are among the most expensive on the planet (the average cost of renting a flat there is 2,553.4 USD per month), they have an issue with traffic congestion (commuting takes about 47 minutes), they are moderately unsafe (the crime rate in all agglomerations, save for Sydney, places them in the second hundred of HSE GCII 2024) and São Paulo, Milan, Los Angeles, New York, San Francisco, Chicago, and Washington, D.C. have a high environmental pollution index (ranked from 180th to 110th by the corresponding indicator).

In general, it is namely the Urban Environment Subindex values that typically demonstrate the greatest divergence from other aspects of the overall HSE GCII, and for 45.5% of the top 200 cities the level of comfort and infrastructure development was most often called the main driver of innovation attractiveness – be it Singapore, the leader of this subindex (ranked 14th in the overall HSE GCII 2024) or Rochester (197th).

Table 3. Ranks of the HSE GCII 2024
Cities with Low Values in the Urban Development Subindex

City	HSE GCII 2024 rank	Subindices' ranks		
		Technological Development	Creative Industries	Urban Environment
New York	2	3	2	65
San Francisco	5	1	8	177
Los Angeles	8	14	4	151
Boston	16	9	43	176
Milan	20	28	11	97
Sydney	26	26	16	86
Washington, D.C.	31	13	47	181
São Paulo	34	40	22	87
Melbourne	35	32	21	116
Chicago	42	19	48	167

1–10 11–50 51–100 101–150 151–200

Source: HSE ISSEK.

> Postindustrial economy leaders are attracted to cities combining high tech, creativity, and advanced infrastructure. Nevertheless, renovated urban spaces alone, even if coupled with breakthrough digital services or various ways to culturally educate oneself, continue to be more on the basic side of mass scale attraction: their absence can push people away, but their presence is unlikely to cause an uptick in relocatees.

Creative Polarization

The level of development of creative industries remains the main distinction between cities leading in innovation attractiveness

To evaluate the range of variation in the parameters of cities' innovation attractiveness, the overall HSE GCII 2024 ranking and subindex values for the leaders of these rankings were benchmarked against cities that are bringing up the rear of the corresponding top 100.[1]

As happened a year before, global centers of the first hundred cities turned out to be insignificantly differentiated in the overall index (the difference is 4.3 times). The equalization of the HSE GCII value happens on account of combining high scores in one factor of innovation attractiveness and low scores in others. The differences between cities in the Technological Development Subindex were more significant (17 times). Over 25% of Nobel Prize laureates and Fields Medal winners, 30% of companies with the highest R&D expenditures, and 50% of unicorns are in the top 10 HSE GCII cities. However, the biggest gap, as before, is found in the Creative Industries Subindex – 30 times. In the first ten cities, there

1.4 times
is the differentiation by the Urban Environment Subindex

17 times
is the differentiation by the Technological Development Subindex

4.3 times
is the differentiation by the overall HSE GCII

30 times
is the differentiation by the Creative Industries Subindex

[1] Comparison for the whole sample was not conducted in order to exclude bias on account of cities with values approaching zero that occupy the last places in the ranking.

are at least 45% of the largest PR agencies, recognized fashion brands, and video games developers, 68% of companies producing the highest rated films, 45% of architects who are Pritzker Architecture Awards laureates, 55% of internationally recognized artists, 57% of the most-streamed singers, and 70% of artists leading in auction revenue. The cities are least different by the state of the urban environment by 1.4 times.

> Competition for attracting the brightest minds and the greatest amount of capital to the city is based on the presence of global leaders in technological innovation and the most influential representatives of the art world. The global creative sector is distributed less evenly than the technological sector and represents "room for improvement" for most cities when it comes to innovation attractiveness.

The Geography of Innovation Efficiency

Out of 50 cities with the greatest number of innovation economy leaders per capita, 46 are located in European countries and the United States

The key feature of the HSE GCII ranking lies in finding the global centers of innovation attractiveness by identifying locations where high tech and creative industries leaders chose to live, work, or do business. These places are the concentration of high tech corporations, unicorns, venture capital investors, leading universities, exceptional researchers, and prominent personalities in the worlds of fashion, architecture, art, and literature. Most of innovation economy leaders are drawn to large agglomerations – New York (1,353 enterprises and individuals), London (1,342), San Francisco (1,118), Paris (902), and Beijing (901). Apart from centers that accumulate the largest number of prominent representatives in the technological sector and creative industries, there are small but efficient cities in the ranking with a noticeably greater density of globally important personalities and organizations, i.e., the ratio of their number to the total population (Table 4).

Table 4. Top 50 HSE GCII 2024 Cities by the Density of Innovation Economy Leaders (Individuals and Enterprises)

No.	City	Country	HSE GCII 2024 rank	HSE GCII 2023 rank	Population	Number of innovation economy leaders (individuals and enterprises)
1	Ithaca	United States	140	118	100,018	45
2	Cambridge	United Kingdom	98	76	376,139	115
3	Durham	United States	188	108	326,126	90
4	Leuven	Belgium	130	157	124,666	33
5	Oxford	United Kingdom	138	127	553,098	104
6	Ede	Netherlands	171	–	157,018	28
7	Munich	Germany	19	23	1,561,094	262
8	Rochester	United States	197	191	227,151	37
9	Copenhagen	Denmark	33	29	1,308,983	211

(continued)

No.	City	Country	HSE GCII 2024 rank	HSE GCII 2023 rank	Population	Number of innovation economy leaders (individuals and enterprises)
10	Boston	United States	16	11	4,450,569	693
11	Geneva	Switzerland	92	68	606,748	94
12	Ghent	Belgium	94	173	377,978	55
13	San Francisco	United States	5	6	7,753,000	1,118
14	Florence	Italy	191	188	367,150	52
15	Heidelberg	Germany	131	138	355,470	48
16	Boulder	United States	135	133	329,543	41
17	Lausanne	Switzerland	174	179	433,676	52
18	London	United Kingdom	1	1	12,451,423	1,342
19	Tsukuba	Japan	151	189	207,314	22
20	Aarhus	Denmark	115	146	340,421	36
21	Ann Arbor	United States	173	162	369,390	36
22	Leiden	Netherlands	155	155	355,634	32
23	Nashville	United States	195	131	366,735	32
24	Zürich	Switzerland	58	40	1,560,992	129
25	Nijmegen	Netherlands	105	106	330,359	26
26	Milan	Italy	20	24	4,956,521	388
27	Stockholm	Sweden	24	16	2,415,139	189
28	Canberra	Australia	166	148	453,558	34
29	Paris	France	6	5	12,405,426	902
30	Grenoble	France	192	190	450,000	32
31	Utrecht	Netherlands	95	165	914,955	65
32	Edinburgh	United Kingdom	82	66	912,490	64
33	Amsterdam	Netherlands	27	32	2,903,122	202
34	Santa Barbara	United States	185	163	446,475	31
35	Basel	Switzerland	133	126	555,526	38
36	New York	United States	2	2	20,452,987	1,353
37	Montpellier	France	190	–	473,092	31
38	Daejeon	Republic of Korea	102	198	544,465	34
39	Bologna	Italy	159	175	786,741	48

(continued)

No.	City	Country	HSE GCII 2024 rank	HSE GCII 2023 rank	Population	Number of innovation economy leaders (individuals and enterprises)
40	Oslo	Norway	39	48	1,558,457	95
41	Helsinki	Finland	46	46	1,200,000	72
42	Exeter	United Kingdom	146	153	499,742	28
43	Bern	Switzerland	165	166	505,102	28
44	Mainz	Germany	124	–	438,514	24
45	Brussels	Belgium	60	45	1,831,742	98
46	Warsaw	Poland	38	43	2,131,032	110
47	Sidney	Australia	26	20	5,259,764	263
48	San Diego	United States	85	55	3,286,069	163
49	Strasbourg	France	145	–	486,746	24
50	Padua	Italy	175	196	535,203	26

Source: HSE ISSEK.

Among all HSE GCII 2024 leaders, the most effective are San Francisco (ranked 13th in the corresponding indicator), London (18th), Paris (29th), and New York (36th). At the same time, six of the top ten innovatively efficient centers are located in the second hundred of the overall ranking, occupying 130th to 197th positions.

The top 50 cities with the highest density of innovation leaders are distinguished by a relatively low population – a little over 2 million persons on average (here, the densest are New York, London, and Paris, but two-thirds of the listed cities account on average for almost 430 thousand persons). All 50 centers are located in high-income countries, 35 cities – in Europe (the Netherlands, Switzerland, and United Kingdom, – five cities each; France and Italy– four cities; Belgium and Germany – three; Denmark – two; Finland, Norway, Poland, and Sweden – one), 11 centers – in the United States. Other global macro regions still cannot compete with Europe and North America in this regard: Australia has two cities with the great concentration of the best representatives of high tech and creative industries; the leading Asian economies – the Republic of Korea and Japan have one city each.

The ranking of the main innovatively efficient cities was yet again topped by Ithaca, despite the decline in the overall HSE GCII ranking by 22 positions. Ede in the Netherlands appeared in the top 200 HSE GCII for the first time ever (ranked 171st) and immediately became one of the most effective (ranked 6th) due to 25 highly cited researchers living in the city, among whom is Girard Heuvelink, a professor of the Netherlands'

largest Wageningen University & Research (WUR). His scientific contributions to the development and application of mathematical and statistical methods of soil spatial and temporal variability analysis and modelling was recognized by some professional awards: The Richard Webster Medal of the Pedometrics Commission of the International Union of Soil Sciences (2014) and The Peter Burrough Medal of the International Spatial Accuracy Research Organisation (2019).[1]

The new entrants into the top 50 efficient cities in HSE GCII 2024 are Montpellier, Strasbourg, and Mainz, which have world-class R&D organizations (13, 11, and 3, respectively). For example, these organizations include Mainz's Max Planck Institutes for Polymer Research and Chemistry under the Max Plank Society, as well as The Helmholtz Institute Mainz that specializes on studying the strong interaction.

The main centers of innovation efficiency could be rightfully regarded as "star cities": they account for over a third of most awarded representatives of high tech and creative industries on the planet in terms of nominations that mark the greatest in the industry.

The cities with the highest density of innovation leaders can be distinguished first and foremost by a strong education and science sector. In each of the top 50 cities, there is at least one highly cited researcher (Boston has the most of them – 432), which gives 35% of the world total; at least one university from the QS, THE, and ARWU international rankings; and one leading higher education institution in arts (save for Rochester and Montpellier). There are leading research centers in 38 cities from the shortlisted assembly above.

> Twenty-eight of the top 50 HSE GCII 2024 cities by innovation efficiency have 50% of living Nobel Prize laureates and Fields Medal winners. Among them is Ferenc Krausz from the Max Planck Institute of Quantum Optics in Munich, as well as researchers from Boston – Moungi Bawendi, representing MIT and Harvard professor Claudia Goldin, who were awarded The Nobel Prize in 2023 in physics, chemistry, and economics, respectively.

[1] WUR. Prof.dr.ir. GBM (Gerard) Heuvelink. Available at: https://www.wur.nl/en/persons/gerard-heuvelink.htm (Accessed: 08.07.2024).

Share of talented representatives of high tech and creative industries concentrated in the top 50 HSE GCII cities by the density of the innovation economy leaders (individuals and enterprises) in the world total number

35%
highly cited researchers

41%
unicorns

50%
Nobel Prize laureates and Fields Medal winners

31%
winners of World Architecture Festival Awards

34%
film production companies that won international film festival awards

38%
Pritzker Architecture Prize laureates

40%
largest fashion companies

43%
top artists by auction revenue

44%
best-selling authors

52%
best opera performers

53%
fashion brands

55%
largest PR agencies

Source: HSE ISSEK, based on Clarivate, Crunchbase, CB Insights, websites of the Nobel Prize and International Mathematical Union, World Architecture Festival Awards, FIAPF, The Pritzker Architecture Prize, Fashion United, Artprice, Wikipedia (The Books Portal), The International Opera Awards, FARFETCH, NET-A-PORTER, Luisa Via Roma, Mytheresa, and PRovoke Media.

Achievements of cities with the highest density of innovation economy leaders is not limited to groundbreaking research studies and academic activity at the international level. Thirty-eight of them have a company with the largest R&D expenditures, and 27 – unicorns. Such is Boston that is ranked 4th among the top 200 HSE GCII 2024 cities by the number of high tech corporations from the R&D Scoreboard and 7th – by the number of unicorns (104 and 42, respectively). The headquarters of companies with the highest R&D expenditures and unicorns are based in San Diego (38 and 10, respectively), Stockholm (20 and 9), Munich (16 and 7), Amsterdam (15 and 8) and other centers.[1] Cambridge in the UK hosts a legendary university town with a population under 400,000 people and is home to pharmaceutical giants like AstraZeneca, Bicycle Therapeutics, and Abcam, as well as a unicorn company CMR Surgical that produces the Versius surgical robot, which experienced 50% sales growth in 2023 in comparison to 2022.[2]

Cities of innovation efficiency have also distinguished themselves in creative industries. Thirty-seven of them have companies that are taking part in the most visited gaming trade shows (27 in Warsaw, 26 in Munich); 35 – have internationally recognized designers and design firms (25 in Munich, 19 in Milan); 33 – have fashion brands represented on the websites of online retailers (250 in Milan, 67 in Copenhagen, 53 in Sydney). Copenhagen (ranked 9th among cities by the density of innovation economy leaders) distinguished itself by many indicators of the creative block. Here, there are offices of 67 fashion brands represented on FARFETCH, NET-A-PORTER, Luisa Via Roma, and Mytheresa (among them is minimalist Samsøe & Samsøe, eclectic Wood Wood, picturesque Stine Goya); each has ten companies that are participating in gaming trade shows and winners of the prestigious World Architecture Festival Award; each – seven leading advertising agencies and film production studios that won international film festival awards (among them is Zentropa Entertainments with "Druk" highlighted at the San Sebastián International Film Festival in 2020[3]).

Ithaca with a population of slightly over 100,000 people has leaders of industrial design and auction revenue: Yen-Lin Wu, a Cornell University professor specializing in biomaterials, 3D printing, and tissue engineering;[4] Josh Sperling, an ultramodern artist, whose works combine bright paintings and minimalistic sculpture were showcased on respectable art platforms, such as the Perrotin gallery in New York.[5] Vladimir Nabokov also lived and worked in Ithaca from 1948 till 1959: here, he taught a course on Russian and world literature at Cornell University and finished writing Lolita (1953).

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[1] Here and below, examples are given excluding the data on the top 10 overall HSE GCII 2024 cities.

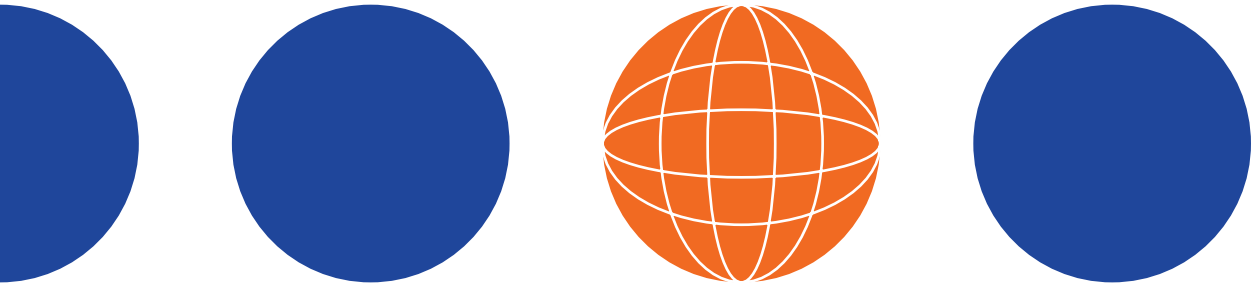
[2] MassDevice. CMR leaders on the 'massive advantages" of Versius and growing robotic surgery penetration. Available at: https://www.massdevice.com/cmr-surgical-versius-robotic-surgery-market-penetration-growth/ (Accessed: 08.07.2024).

[3] San Sebastián International Film Festival / 2020. Available at: https://www.imdb.com/event/ev0000588/2020/1/ (Accessed: 17.07.2024).

[4] Yen-Lin Wu. Available at: https://www.researchgate.net/profile/Yen-Lin-Wu (Accessed: 17.07.2024).

[5] Josh SPERLING. Available at: https://www.perrotin.com/artists/Josh_Sperling/335#images (Accessed: 17.07.2024).

> What defines the city' attractiveness for the main technological and creative leaders hinges not only upon its size. The real magnet for talent is the opportunity to work with the best in innovation in an environment that predisposes one to reproduce and spread knowledge, ideas, competences, and inspiring experiences for new individual breakthroughs.



University Towns

Small and medium-sized cities of the West are demonstrating consistent development of innovations due to strong universities

Two thirds of the top 20 cities with a highest concentration of leaders of the innovation economy fall under the category of small and medium-sized cities[1], their median population being 372,000 persons. At the same time, out of 20 small but efficient cities, 18 ended up in the second hundred of the overall HSE GCII, and only two – Ghent and Cambridge – made it into the top 100, occupying 94th and 98th positions, respectively (Figure 9). The average rank of the top 20 of small and medium-sized cities is 154th, over half of them are located in European countries.

Smaller cities with the highest concentration of innovation economy leaders are distinguished by the presence in each of those cities of at least one leading world university. Thus, Ithaca has Cornell University, an Ivy League school and a cradle of exceptional talent, among whom is Eric Betzig, who received a Noble Prize in Chemistry in 2014 for the creation of a super-resolved microscopy.[2] Cambridge in the UK is famous for its oldest university that is ranked fifth in the global QS and THE rankings; it is the *alma mater* and work place of 121 Nobel Prize laureates.[3] The Durham in North Carolina in the US is represented by the Duke University, a member of the Research Triangle so named after the park located at the center of three research universities.[4] Belgium's Leuven with a population of over 125,000 people is famous for the Catholic University included among the top 50 world universities according to the THE ranking. Ede hosts Wageningen University & Research specializing in natural sciences and has been ranked the best Dutch university for 17 years.[5]

Small and medium-sized cities with a high concentration of innovation leaders, for which the nucleus is comprised of recognized global universities, attract notable student flows: their average share in the population of the "efficient twenty" is higher than the same indicator for all other HSE GCII 2024 cities by a factor of 3.5. For example, in Leuven students comprise over 40% of the city's population, in Ithaca – 25%, in Durham – 16%, and in Cambridge – 15%. In addition, cities from the "efficient" top 20 work as gravitation

[1] According to the classification of Functional Urban Areas used by OECD.

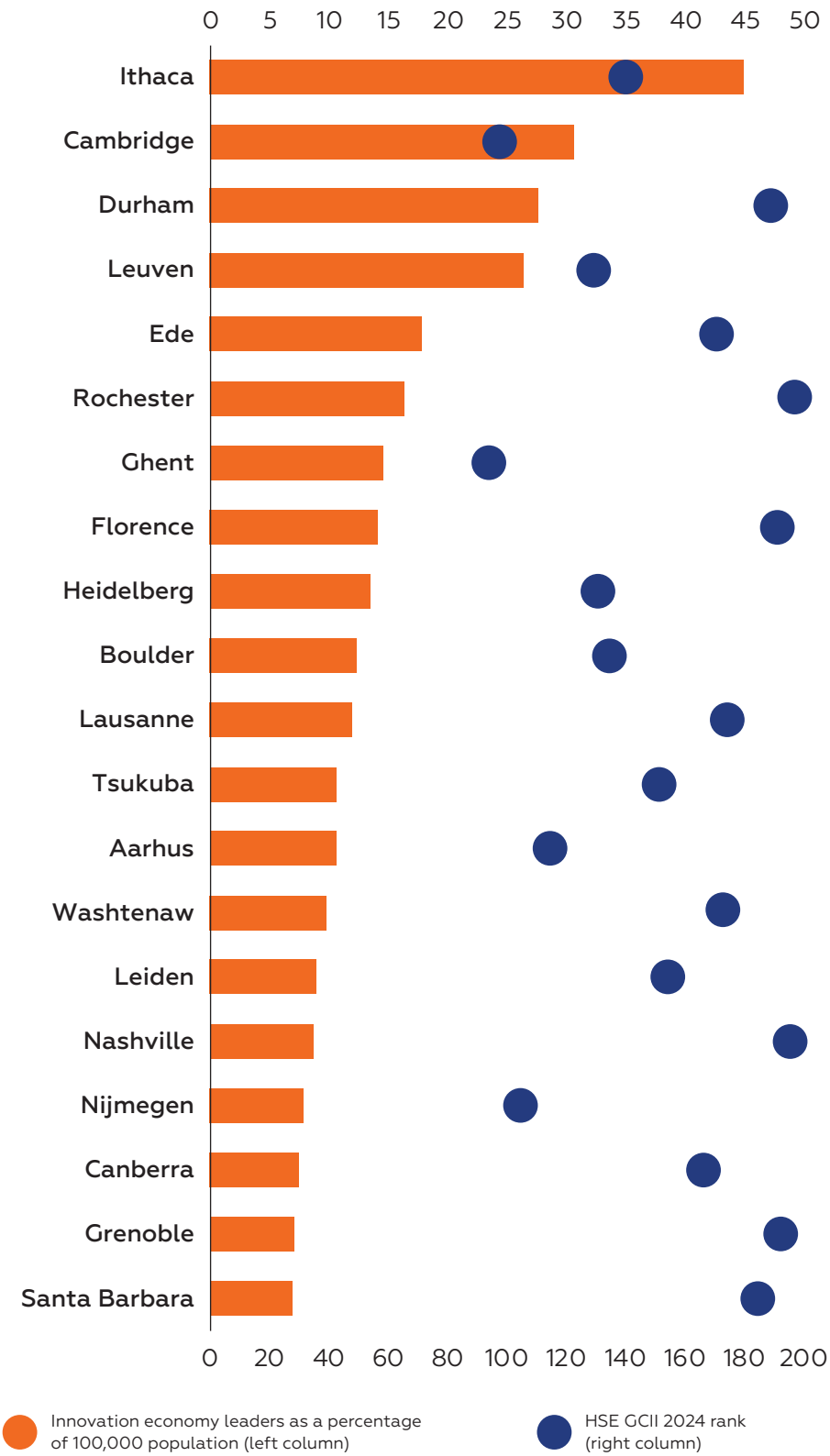
[2] The Nobel Prize. Available at: https://www.nobelprize.org/prizes/chemistry/2014/betzig/facts/ (Accessed: 16.06.2024).

[3] University of Cambridge. Nobel Prize. Available at: https://www.cam.ac.uk/research/research-at-cambridge/nobel-prize (Accessed: 16.06.2024).

[4] Research Triangle. Available at: https://www.researchtriangle.org (Accessed: 16.06.2024).

[5] Wageningen University & Research. Available at: https://www.topuniversities.com/universities/wageningen-university-research (Accessed: 16.06.2024).

Figure 9. Top 20 HSE GCII 2024 Small and Medium-Sized Cities by the Concentration of Innovation Economy Leaders (Individuals and Enterprises)



Source: HSE ISSEK.

points for international students: their share in the total number of university students is 1.3 times higher than the average indicator for the rest of the innovation attractiveness centers. Leaders by this indicator are Lausanne (46%), Rochester (34%), and Canberra (31%), and in five cities the share of international students exceeds 20%.

> Cities from the top 20 of innovation attractiveness centers exceed other participants of HSE GCII 2024 by the average share of students in the population in 3.5 times; these cities exceed other participants in the ranking by the average share of international students in the total number of university students – by 1.3 times.

Cities with a high concentration of students also attract high tech businesses, billion-dollar startups, and outstanding researchers. A total of 60% of cities in the "efficient twenty" have companies that lead by R&D expenditures, and their largest number has gathered in Heidelberg (four). Nine cities are home to the headquarters of unicorns, three billion-dollar startups are active in Boulder and Santa Barbara. Each city from the top 20 has highly cited researchers, their average number is 27 persons, their highest number has been found in Cambridge (78, ranked 18th among all HSE GCII 2024 cities). Half of the cities turned out to be attractive for Nobel Prize laureates and Fields Medal winners. Most of them (nine) also reside in Cambridge, which helped the city to place 8th by this indicator among all global centers of innovation attractiveness; Durham, Boulder, and Santa Barbara each

40%

share of students in Leuven's population

46%

share of international students in the total number of Lausanne's university students

have four recipients of prestigious awards, two – in Ithaca, Heidelberg, Lausanne, and Tsukuba, one – in Ghent and Canberra.

The high level of inventive activity is another important aspect of small and medium-sized innovative cities. Invention is most developed in Leuven (194 patent applications per 10,000 population), Cambridge (153), and Florence (141), which corresponds to the 10th, 18th, and 19th places by this indicator among the top 200 HSE GCII 2024 cities.

University towns are known for their high cost of living. Thus, visitors to the top 20 small innovation cities will pay for hotel accommodation that is on average 1.5 times more than visitors to cities in the top 20 of the overall HSE GCII 2024 ranking; the cost of living for an expat is 10% more expensive; a commute pass – 20%; taxi – 40%; mobile and Internet costs will turn out to be 40% and 60% more expensive, respectively. The high cost of living in these cities is the downside of high living standards for residents which is reflected in the level of average income (higher than the average in the global top 20 by 10%); level of digitalization (speed of fixed bandwidth on average is faster by 4 Mbit/s); a higher level of safety and improved quality of healthcare services (corresponding indices are 1.1 times higher than the overall top 20 cities' average); and ecology (the pollution level is 1.8 times lower).

The university town format so typical for small and medium-sized cities facilitates the creation of a productive multi-cultural environment where advanced ideas are taking root and innovation solutions are being promoted [Kutsenko et al., 2024].

Several best practices from the most effective cities to scale up the universities' activities, build modern campuses, open branches of leading universities, and develop academic mobility programs can be valuable for smaller cities that have chosen the pursuit of innovation as a path for development. For example, Leiden and Leuven have experience launching student centers and special business infrastructure in cooperation with universities. Leiden Bio Science Park[1] together with Leiden University, the Netherlands Organization of Applied Research, Naturalis Center for Biodiversity, Trade Chamber, Leiden Municipality, and the Southern Holland region are implementing research and educational programs, as well as combining startups and science to launch new breakthrough projects in high tech. Another case of the successful cooperation between a university and businesses is the Technology Transfer Center at KU Leuven Research and Development[2] that was created over 40 years ago by the Catholic University in Leuven and gives birth to at least 20 startups per year.

The practice of the effective spatial development of innovation is demonstrated by Durham, Raleigh,

[1] Leiden Bio Science Park. Available at: https://leidenbiosciencepark.nl (Accessed: 20.06.2024).

[2] KU Leuven Research & Development - Tech Transfer Office. Available at: https://lrd.kuleuven.be/en (Accessed: 20.06.2024).

and Chapel Hill, for which cross-municipal cooperation is aimed at the creation of joint R&D infrastructure and R&D funding programs. Three key universities – Durham's Duke University, Raleigh's North Carolina State University, and Chapel Hill's University of North Carolina – are attracting almost 3 billion USD per year of federal R&D funding, creating hundreds of new startups, and introducing thousands of highly qualified personnel onto the market. The innovation territory they share has all the prerequisite conditions to develop science-intensive businesses in the spheres of biotechnology, IT, and electronics, which includes modern infrastructure, tax incentives, and special grants. Thus, in 2022, local companies received 2 billion USD of investments from 150 deals that comprised 90% of the total volume of investments and 77% of all deals in the state.[1] Higher city attractiveness for living and doing business greatly depends upon the favorable position at the crossroads of railway and vehicle corridors, as well as the presence of the Raleigh-Durham International Airport that connects to the largest airports of the United States and Europe.

> Maintaining the central role of universities in small and medium-sized cities works to the advantage of attracting a constant flow of talent, who in turn, bring new ideas, create a highly productive environment, implement breakthrough projects, make scientific discoveries, and become founders of high tech companies, whilst maintaining the sustainability of cities' innovation systems.

[1] Research Triangle Regional Partnership. Available at: https://www.researchtriangle.org/investment/ (Accessed: 20.06.2024).

2

Technological Development

Cities' Ranking by the Technological Development Subindex: 2024

(continued)

	Technological Development Subindex Rank	Sections' Ranks				
		Technology Companies	Startups and Venture Capital	Universities and R&D Organizations	Productivity of the Innovative Class	Innovation Infrastructure
Mexico City	41	149–200	51	14	103	57
Dallas	42	30	24	62	57	49
San Diego	43	13	33	58	53	90
Tehran	44	149–200	149	15	33	89
Cairo	45	149–200	64	10	65	147–152
Stockholm	46	29	31	90	63	47
Dublin	47	35	52	65	80	26
Houston	48	46	35	78	37	46
Rome	49	77	87	39	25	65–66
Chengdu	50	59	89	47	14	162–165
Chongqing	51	71	137	93	15	119–120
Buenos Aires	52	147	92	29	160	44
Brussels	53	60	72	49	97	34
Kuala Lumpur	54	144	69	30	62	73
Cambridge	55	51	97	40	60	51
Tel Aviv	56	28	20	116	81	86
Mumbai	57	41	12	168	78	75
Nagoya	58	24	169	80	41	76
Rio de Janeiro	59	138	100	60	94	23
Copenhagen	60	33	49	71	69	70–72
Montreal	61	63	44	55	56	61
Budapest	62	133	111	69	128	18
Qingdao	63	74	168	84	16	170–175
Bangkok	64	149–200	88	50	76	36
Atlanta	65	58	32	96	54	69
Zürich	66	56	42	76	67	56
Sofia	67	149–200	110	113	184	14
Bogotá	68	149–200	74	51	172	38
Phoenix	69	40	43	82	86	64
Bengaluru	70	117	22	155	61	68
Denver	71	84	34	160	70	50
Lisbon	72	134	95	83	101	32
Vienna	73	123	61	43	64	80–81
Hsinchu	74	16	180	184	93	58
Marseille	75	149–200	150	124	167	16
Santiago	76	149–200	82	23	116	141–142
Dubai	77	149–200	25	118	181	59–60
Changsha	78	50	131	63	29	146
Vancouver	79	90	37	92	77	77
Islamabad	80	149–200	138	42	105	67

▼▲ — Rank Change

1–10 11–50 51–100 101–150 151–200

	Technological Development Subindex Rank	Sections' Ranks				
		Technology Companies	Startups and Venture Capital	Universities and R&D Organizations	Productivity of the Innovative Class	Innovation Infrastructure
Miami	81	73	16	132	84	133
Ankara	82	116	158	54	83	62–63
Gothenburg	83	91	136	162	136	30
Riyadh	84	149–200	76	66	72	70–72
Helsinki	85	37	47	153	87	74
Warsaw	86	140	75	45	74	92
Kyiv	87	149–200	102	74	130	53
Jinan	88	67	166	88	32	128–131
Oslo	89	79	55	134	111	59–60
Luxembourg	90	95	68	195	199	31
Geneva	91	48	77	52	88	126–127
Ningbo	92	52	132	194	26	123–124
Lyon	93	101	108	53	124	87–88
Prague	94	129	80	46	85	116
Manila	95	149–200	90	120	194	45
Porto	96	149–200	143	169	120	40–41
Saint Petersburg	97	149–200	N/A	48	55	180–191
Xiamen	98	55	128	144	24	180–191
Toulouse	99	149–200	147	44	131	104
Hamburg	100	75	57	138	98	78
Hefei	101	47	129	167	27	192–200
Edinburgh	102	125	101	61	107	101
Detroit	103	32	71	179	92	121
Harbin	104	124	190	77	30	192–200
València	105	149–200	120	129	125	65–66
Essen-Dortmund	106	69	139	79	90	112–113
Durham	107	81	86	72	123	114
Minneapolis	108	39	53	123	91	141–142
Stuttgart	109	31	123	165	126	125
Lima	110	149–200	148	59	182	97
Oxford	111	82	112	56	66	180–191
Athens	112	149–200	118	75	115	100
Dalian	113	118	196	98	31	180–191
Frankfurt am Main	114	53	121	159	151	80–81
Brisbane	115	143	78	57	82	147–152
Daejeon	116	136	160	122	71	85
Turin	117	104	144	117	109	82
Manchester	118	141	63	67	99	138–140
Malmö	119	108	126	173	197	55
Taichung-Changhua	120	87	193	73	100	119–120

▼▲ — Rank Change 1–10 11–50 51–100 101–150 151–200

(continued)

	Technological Development Subindex Rank	Sections' Ranks				
		Technology Companies	Startups and Venture Capital	Universities and R&D Organizations	Productivity of the Innovative Class	Innovation Infrastructure
Ottawa	121	97	93	101	102	110–111
New Haven	122	38	73	119	89	158–161
Portland	123	98	54	193	133	79
Kraków	124	149–200	151	112	118	83
Pittsburgh	125	72	67	135	75	132
Utrecht	126	122	116	125	106	91
Basel	127	25	130	186	144	147–152
Bucharest	128	149–200	99	115	149	87–88
Jakarta	129	130	45	126	114	122
Belgrade	130	149–200	152	161	176	70–72
Birmingham	131	78	113	94	113	135–136
Ho Chi Minh City	132	149–200	81	97	156	105
Nijmegen	133	149–200	177	183	166	62–63
Glasgow	134	148	125	86	129	117
Fuzhou	135	64	186	111	51	180–191
Heidelberg	136	57	159	131	108	123–124
Boulder	137	146	66	128	150	108–109
Eindhoven	138	61	127	198	137	84
Bologna	139	109	164	150	121	95–96
Düsseldorf	140	85	122	140	191	98–99
Salt Lake City	141	65	60	187	147	115
Perth	142	149–200	106	70	135	158–161
Changchun	143	113	189	121	42	192–200
St. Louis	144	93	84	106	104	158–161
Dresden	145	149–200	167	152	139	93–94
Ann Arbor	146	137	119	157	73	128–131
Brno	147	149–200	173	110	173	106–107
Lausanne	148	88	109	100	127	162–165
Nottingham	149	149–200	162	114	170	110–111
Grenoble	150	149–200	157	95	141	143
Cologne	151	49	105	180	159	144–145
Auckland	152	120	91	137	153	138–140
Nuremberg	153	83	183	185	142	108–109
Exeter	154	149–200	185	170	186	93–94
Tsukuba	155	149–200	191	142	122	118
Cleveland	156	44	98	171	110	180–191
Vilnius	157	149–200	96	172	196	103
Bristol	158	135	104	108	154	153–157
Adelaide	159	149–200	140	104	145	147–152
Kitchener	160	100	135	163	162	128–131

▼▲ — Rank Change 1–10 11–50 51–100 101–150 151–200

(continued)

	Technological Development Subindex Rank	Sections' Ranks				
		Technology Companies	Startups and Venture Capital	Universities and R&D Organizations	Productivity of the Innovative Class	Innovation Infrastructure
Leeds	161	149–200	124	99	148	162–165
Novosibirsk	162	149–200	N/A	103	138	180–191
Calgary	163	149–200	59	176	158	138–140
Liverpool	164	149–200	145	102	117	166–167
Aarhus	165	112	133	189	171	106–107
Rotterdam	166	105	94	177	165	135–136
Beirut	167	149–200	142	81	195	168–169
Columbus	168	114	83	158	96	170–175
Cape Town	169	149–200	85	174	183	126–127
Canberra	170	149–200	156	136	178	137
Montpellier	171	149–200	161	91	155	180–191
Braunschweig-Salzgitter-Wolfsburg	172	36	197	182	190	192–200
Raleigh	173	89	58	190	163	166–167
Ghent	174	127	146	143	152	153–157
Lille	175	145	134	133	185	153–157
Nashville	176	142	65	191	146	147–152
The Hague	177	119	117	178	143	147–152
Mainz	178	62	181	141	180	192–200
Bordeaux	179	149–200	141	130	179	158–161
Bern	180	96	172	197	168	128–131
Madison	181	128	114	164	112	170–175
Strasbourg	182	149–200	182	105	189	170–175
Leuven	183	132	174	146	95	180–191
Cork	184	131	154	192	198	112–113
Kaohsiung	185	86	194	149	164	176–179
Padua	186	149–200	187	127	134	176–179
Leipzig	187	149–200	163	147	174	153–157
Leiden	188	99	176	151	157	180–191
Santa Barbara	189	103	103	154	187	176–179
Bonn	190	126	171	148	169	168–169
Jeddah	191	149–200	153	145	140	170–175
Kansas City	192	111	79	200	193	144–145
Hanover	193	102	170	175	177	170–175
Antwerp	194	139	178	196	192	134
Groningen	195	149–200	165	156	161	176–179
Florence	196	149–200	184	166	119	180–191
Ithaca	197	149–200	179	139	175	192–200
Rochester	198	149–200	188	188	132	192–200
Ede	199	149–200	192	181	188	192–200
Venice	200	149–200	195	199	200	192–200

— Rank Change 1–10 11–50 51–100 101–150 151–200

Asian cities are occupying an increasingly noticeable place on the updated technological map of the world. Not only did they attain a numerical advantage among the top 20 technological leaders, they also solidified their positions in science, innovation, and attraction of outstanding researchers. The West has made its own mark by relying upon venture capital – unicorn companies and influential investors. The leading cities, San Francisco and Beijing, each achieve their excellence in the world of high tech by following two different strategies. With the clear advantage of megacities in attracting high tech corporations, billion-dollar startups, and scientists, smaller cities are also putting their best foot forward – through the dense concentration of the best innovators in the economy. They placed their bet on strong universities to attract talent from all over the world and create a breeding ground for stimulating the propulsion of breakthrough ideas.

To measure the city's overall potential in science, education, and innovative entrepreneurship, a corresponding subindex was calculated, which includes 18 indicators grouped into five sections:

- Technology companies (2 indicators)
- Startups and venture capital (5)
- Universities and R&D organizations (6)
- Productivity of the innovative class (2)
- Innovation infrastructure (3).

A city's technological profile is made of large companies with some of the highest R&D expenditures; promising startups and unicorns, whose development is actively supported by venture capital investors and innovation support funds; world famous universities, research institutes, and exceptional researchers; and advanced infrastructure that links the participants in the innovation process and provides them with conditions to implement complex knowledge-intensive solutions. Productivity indicators of a city's innovators are their publication and patent activities that contribute to the creation of the technologies of the future.

One's placement in the Technological Development Subindex reflects the level of a city's technological prowess in comparison with other centers of high tech and its position in the corresponding section allows one to see which factors influence its development.

From Technological Parity to Technological Advantage

Asian cities are settling down at the forefront of technological development

For the first time in the history of HSE GCII observations, Asian cities dominated the top 20 positions of the Technological Development Subindex (Beijing is ranked 2nd, Tokyo – 4th, Shanghai – 6th, Seoul – 10th, Shenzhen – 11th, Guangzhou – 12th, Suzhou – 15th, Nanjing – 16th, Hangzhou – 17th, Osaka – 18th, Singapore – 20th), overtaking from Greater Europe and North America in sheer quantity of representatives (San Francisco – 1st, New York – 3rd, London – 5th, Moscow – 7th, Paris – 8th, Boston – 9th, Washington, D.C. – 13th, Los Angeles – 14th, Chicago – 19th). The final score is 11:9, in Asia's favor.

Cities around the world differ not only historically or culturally, but also in how they establish their technological leadership. Asian centers from the top 20 of the Technological Development Subindex have ramped up their productivity even more: eight of them are in the top 10 cities leading by the growth in patent and publication activity. The prolific activity of representatives of the innovative class is prompting another trend: a higher concentration of intellectual property. If HSE GCII 2023 cities in China, Japan, Republic of Korea, and Singapore in the top 20 of the Technological Development Subindex accounted for 47% of patent applications in the overall ranking's pool, HSE GCII 2024 cities accounted for 59%; in publication activity, their share increased from 17% to 21%. Meanwhile, European and American cities retain the status of the main attractors of venture capital: five of them were in the top 10 by the growth rate in the total volume of venture capital investment, six were in the top 10 by the growth in the number of unicorn companies and innovation support funds, eight – by the growth in the number of business angels.

The balance of power on the technological map of the world has significantly shifted toward the Northern Hemisphere, where all the cities from the top 20 and 93% of the cities from the top 200 HSE GCII 2024 are located. Among representatives of the Global South, the top 50 of the Technological Development Subindex included Sydney, Melbourne, São Paulo, Cairo (ranked 26th, 32nd, 40th and 45th, respectively); in the top 100 – Buenos Aires, Rio de Janeiro, Bogotá, Santiago (52nd, 59th, 68th, 76th); in the top 200 – Lima, Brisbane, Perth, Auckland, Adelaide, Cape Town, Canberra (110th, 115th, 142nd, 152nd, 159th, 169th, 170th).

> Asian cities from the overall top 20 account for 59% of patent applications and 21% of scientific publications in the overall HSE GCII 2024 pool.

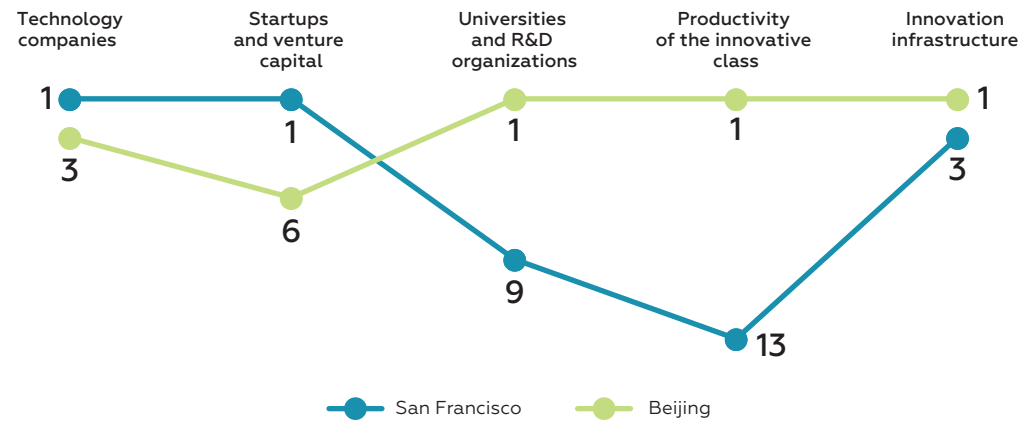
Flagships of Technological Development

San Francisco and Beijing are cities that each have chosen a unique but equally effective strategy for achieving technological superiority

San Francisco has become the absolute leader of the Technological Development Subindex, the permanent record holder in venture capital, and the most attractive city for tech entrepreneurs (Figure 10). It is home to the largest number of corporations from the R&D Scoreboard – 212, which is 1.4 times higher than its runner-up, Tokyo. The gap between them and nearest competitors in terms of the number of unicorn companies is even more prominent: there are 325 unicorns in San Francisco, which constitutes 2.3 times more than the number of unicorns in New York, which holds second place. This difference could be primarily explained by the presence of influential investors and the size of the venture capital market – San Francisco is top of the world by the number of business angels and the volume of venture capital investment.

Beijing is a leader in three sections of Technological Development at once: the number of universities and R&D organizations, the productivity of the innovative class, and innovation infrastructure. This city is most distinguished by the high publication activity, which has allowed it to increase the gap between itself and Washington, D.C., the closest Western competitor in terms of the number of published scientific papers, from 2.5 to 3.3 times.

Figure 10. Rankings of San Francisco and Beijing in Technological Development Sections: 2024



Source: HSE ISSEK.

Changes for the Better

What contributed to the growth in the ranking of the main centers of innovation attractiveness

Eight cities from the top 20 HSE GCII 2023 cities in the Technological Development Subindex improved their positions in the new issue: San Francisco topped it (+1), New York rose to 3rd place (+1), Paris to 8th (+1), Seoul to 10th (+1), Shenzhen – 11th (+1), Guangzhou – 12th (+1), and Barcelona and Sydney, who dropped out of the top twenty, were replaced by two new cities: Osaka – 18th place (+4) and Chicago – 19th (+9) (Figure 11).

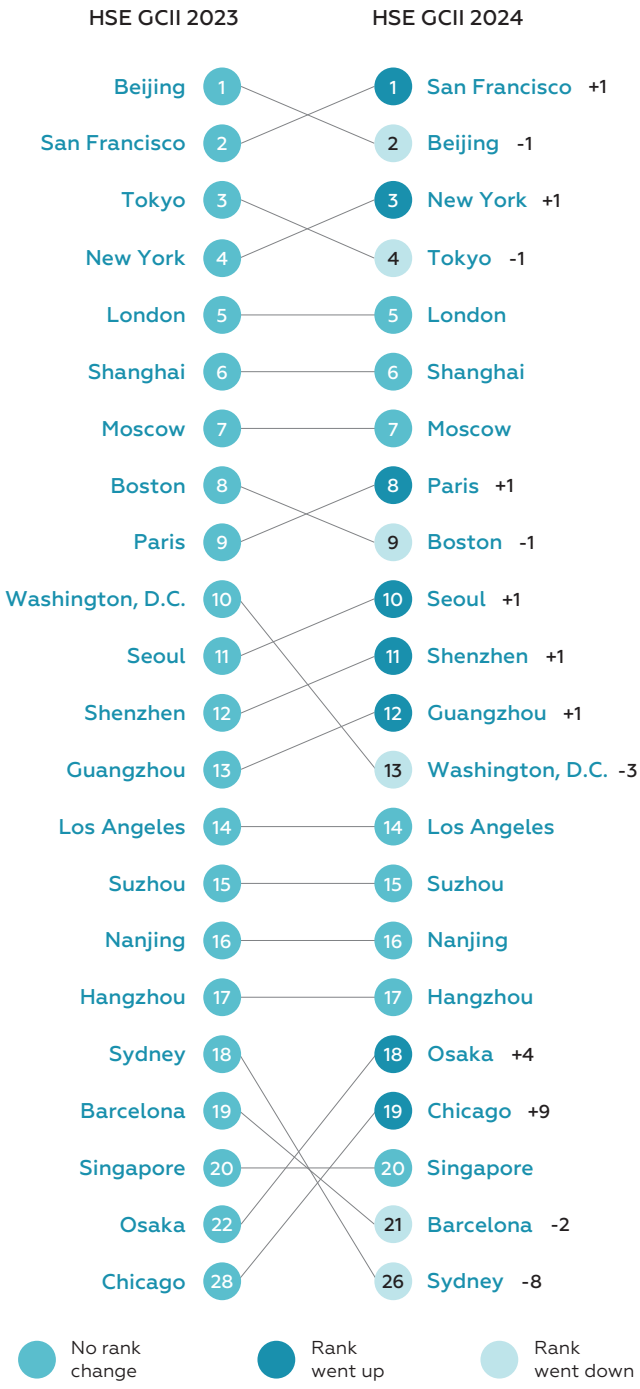
San Francisco's growth within the subindex turned out to be the most versatile. The increase in the number of high tech corporations here (+18) is the largest among all HSE GCII 2024 cities. Due to the increase in the number of innovative companies, their total investment in R&D has increased significantly (+84.5 billion USD) – San Francisco is leading by the growth rate of this indicator among global innovative megacities. In addition, it confidently occupies the position of the most attractive city for unicorns, of which there are 46 more. The high tech sector's synergy was enhanced by the growth of the venture capital market: the number of business angels increased by 3,300 people (ranked 1st in terms of their growth among all cities in the ranking), the total volume of venture capital investment – by 41.3 billion USD, and the number of innovation support funds – by 709 organizations (ranked 2nd). The technological ranking of the city was also influenced by the gain in the number of elite, highly cited researchers (+30 people), as well as Nobel Prize laureates and Fields Medal winners (+2).

> There are 46 more unicorns in San Francisco.

New York progressed in the ranking primarily due to venture capital: the city now has 767 new innovation support funds (ranked 1st in terms of their growth among all HSE GCII 2024 cities), 32 new unicorns (2nd), the number of business angels increased by 2,900 people (2nd), and the volume of venture capital investment – by 14.1 billion USD (4th).

Paris entered the top 10 most rapidly growing cities by three parameters of the venture capital market, ranking 5th in terms of the growth in the number of business angels (+847 people), 7th – in terms of the increase in venture capital investment (+7.5 billion USD), and 8th – in the number of innovation support funds (+238 organizations). Meanwhile, the number of unicorns in the city increased slightly – by only three companies (ranked 19th).

Figure 11. Top 20 HSE GCII Cities' Ranks in the Technological Development Subindex: 2023, 2024



Source: HSE ISSEK.

The growth of Seoul's positions in venture capital turned out to be more uniform. The capital of the Republic of Korea ranked 3rd in terms of increasing the volume of investment (+14.2 billion USD), 4th – in terms of the growth in the number of innovation support funds (+409 organizations), and 6th – in terms of the increasing number of unicorns (+11 companies).

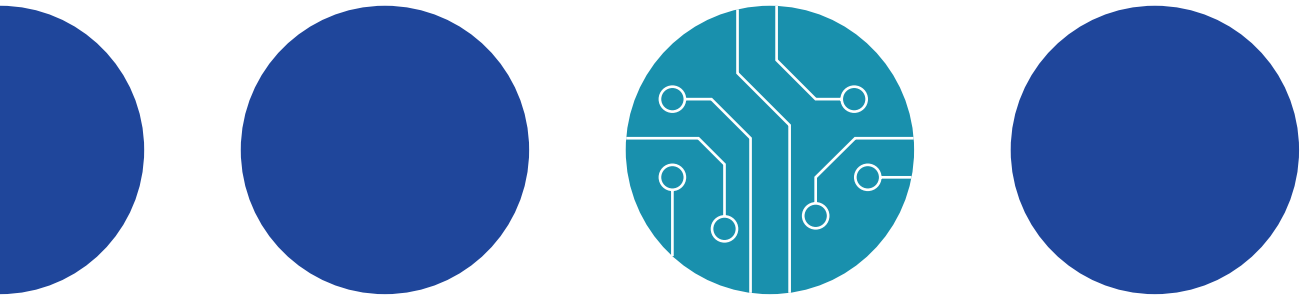
Chinese cities have a different configuration of factors that have determined their positions in the Technological Development Subindex. Shenzhen and Guangzhou have moved up due to an increase in the number of unicorns (+6 and +10, respectively) and the number of highly cited researchers (+21 and +20 people). At the same time, if the former was noticeably more successful in accelerating innovation activity (+156,000 patent applications), ranked 2nd in terms of growth among 200 HSE GCII 2024 cities, the latter city significantly increased its advantage in the number of scientific publications (+107,000) and ranked 3rd.

Osaka was the leader by the growth in the number of supercomputers (+3 units) and entered the top 20 world cities in terms of increasing the number of students (+40,000 persons). The growth of positions in other indicators turned out to be less notable but still covered seven of the 18 sections of Technological Development Subindex.

Chicago burst its way into the top 20 major high tech centers, climbing nine positions due to an increase in the number of business angels (+407 people), the number of innovation support funds (+156 organizations), startups

(+1,600 companies) and super-computers (+2 units).

Singapore turned out to be the most stable HSE GCII 2024 city in the Technological Development Subindex, improving its results on 14 indicators, maintaining the same level of three indicators (the number of leading universities, clusters and science parks, Nobel Prize laureates and Fields Medal winners) and not lowering the bar on any other. Meanwhile, Singapore's overall rank remained unchanged – it again brings up the rear of the top 20 of the Technological Development Subindex.



The Cities in the Background

The top 20 strongest cities by the level of technological development are dominated by non-capital cities

The top 20 in the Technological Development Subindex is dominated by the largest agglomerations, with a median population exceeding 16 million people. The majority (60%) of them are not capitals (San Francisco ranked 1st, New York – 3rd, Shanghai – 6th, Boston – 9th, Shenzhen – 11th, Guangzhou – 12th, Los Angeles – 14th, Suzhou – 15th, Nanjing – 16th, Hangzhou –17th, Osaka –18th, Chicago – 19th). There are even more non-capital cities among the top 20 world centers by the number of unicorns and innovation support funds (65% each), the number of corporations with the highest R&D expenditures, and the number of Nobel Prize laureates and Fields Medal winners (70% each).

World-renowned researchers prefer less densely populated agglomerations. The median population of 79 cities with at least one Nobel Prize laureate or Fields Prize winner is 2.6 million people, which is six times smaller than the median population of the cities leading in the Technological Development Subindex. Among the top 20 cities in terms of the number of prestigious awards winners, there are medium-sized cities – Cambridge in the United Kingdom (ranked 9th) and Boulder (18th) and Santa Barbara (19th) in the United States.

Innovation Relocation

How Texas megacities became the global leader in attracting the headquarters of innovative companies

At the end of 2023, the European Commission published the new R&D Scoreboard reporting on the activities of 2,500 public companies with the highest R&D expenditures [European Union, 2023]. One of its main conclusions is that the level of total R&D expenditures at the leading firms of the Scoreboard has increased. If in 2021, their total sum was estimated at 908.9 billion euros [European Union, 2022], in 2022, it surpassed 1.2 trillion euros. The profit of innovation companies has doubled – from 1.5 trillion euros in 2021 to 3.1 trillion euros in 2022, and their total market capitalization went up from 33.9 to 39.5 trillion euros. At the industry level, as in previous years, the largest R&D expenditures are generally found in companies specializing in biotech and pharmaceuticals, software, electrical components, and equipment.

Business Attraction Centers

In addition to the growth in capitalization and R&D expenditures, innovation is undergoing geographical changes. Thus, in the United States and China, which were leading in 2021, the number of high tech corporations experienced even faster growth, and in terms of the growth rates China significantly overshadows its competitor (+82 companies in two years vs. +48 in the United States). Japan, on the other hand, lost its position in this indicator (-64 companies vs. same indicator in 2021). Such a dynamic reflects the trend of a decline in patent activity in previous years [Nishimura et al., 2022] and a drop in the overall productivity of business [Nakamura et al., 2018]. A decrease of companies on the R&D Scoreboard, albeit not as dramatic, is observed in the Republic of Korea and several European countries.

The cities that host the headquarters of companies with largest investments in R&D are also changing. Leading cities by their number are still San Francisco (212), Tokyo (151), and Beijing (129). In terms of gaining new such companies, the ranking is as follows: San Francisco (+18), Shanghai (+17), Beijing (+12), and Boston (+10). Tokyo, on the contrary, "lost" 49 such firms in comparison to 2021. Despite the traditional locations of high tech headquarters – San Francisco, Beijing, Shanghai, Boston, and Shenzhen – there are new centers that attract corporate investments in research and development. Thus, Texas's ranking (United States) in relation to the number of companies from the R&D Scoreboard 2023 has been strengthened by three cities at once – Dallas (19 firms, adding five

more to the previous 2021 list), Austin (19, +2), and Houston (9, +1).

The growth in the number of innovative businesses with the highest GERD in Texas cities is supported by the trend discovered by the American commercial real estate agency CBRE.[1] From 2018 to 2023, Texas saw the largest relocation of the headquarters of public American companies: 66 corporations – to Austin, 32 – to Dallas, and 25 – to Houston. CBRE mentions that many large companies moved to Texas after the pandemic. Business owners were attracted by lower lease costs for commercial property and lower payrolls, and salary workers were drawn by a generally inexpensive cost of living in comparison to San Francisco, Los Angeles, or New York.

Austin: the Alternative to Silicon Valley

Table 5 shows companies from R&D Scoreboard 2023 that moved to Austin, Texas but were founded in different cities.

The relocation of these innovators to Austin over the last few years has turned the cluster of tech companies into something of a Silicon Valley by the concentration of high tech headquarters, for which its metropolitan area was also dubbed "Silicon Hills." The city is ranked 17th in the world by its level of startup ecosystem development.[2]

What moved the needle for large innovation firms to relocate to Austin were tax incentives: in all of Texas, firms are not being taxed on income at all. Apart from that, companies engaging in R&D can be exempt from paying sales tax for the acquisition of particular materials, software, and R&D equipment or use an R&D tax credit to lower the franchise tax payable by Texas-based companies for doing business.[3] In the latter case, the tax credit rate will be 5% of the difference between R&D expenditures in the reporting period and 50% of the average sum of such expenditures for the last three years. The rate will increase up to 6.25%, if the company has entered a contract with public or private universities to conduct R&D.[4] At the same time, the tax credit limit is 50% of the amount of tax payable.

In February 2024, the Texas government announced the launch of the Jobs, Energy, Technology, and Innovation program (JETI), a comprehensive program aimed at job creation and the promotion of investments in the state's key industries: energy, technologies, and innovation, on account of decreasing the real estate tax rate

[1] CBRE. The Shifting Landscape of Headquarters Relocations: Trends and Outlook. Available at: https://www.cbre.com/insights/viewpoints/the-shifting-landscape-of-headquarters-relocations-trends-and-outlook (Accessed: 02.04.2024).

[2] StartupBlink. The Global Startup Ecosystem Index Report 2024. Available at: https://lp.startupblink.com/report/ (Accessed: 02.04.2024).

[3] Texas Comptroller. Sales Tax Exemption or Franchise Tax Credit for Qualified Research. Available at: https://www.comptroller.texas.gov/taxes/qualified-research/ (Accessed: 02.04.2024).

[4] What You Need to Know About Texas' R&D Tax Credit. Available at: https://gusto.com/resources/articles/taxes/texas-r&d-tax-credit (Accessed: 04.07.2024).

Table 5. R&D Scoreboard Companies that Relocated their Headquarters to Austin, Texas

Company	Founded	Industry	Headquarters relocated	GERD: 2022, million euros
Oracle	Santa Clara, California	Software & computer services	2020	8,085
Tesla	San Carlos, California	Automotive	2021	2,883
Cirrus Logic	Salt Lake City, Utah	Technology hardware & equipment	1999	438
SolarWinds	Tulsa, Oklahoma	Software & computer services	2006	87
BigCommerce	Sydney, Australia	Software & computer services	2009	82
Cassava Sciences	San Francisco, California	Pharmaceuticals & biotechnology	2017	64

Source: HSE ISSEK, based on [European Commission, 2023].

for companies moving to Texas.[1] For instance, at the time of relocation of the business operations to a district with a population of 750,000 people or more, the company has to create at least 75 workplaces and invest at least 200 million USD into fixed assets in order for the option to decrease taxable equity value by half within ten years.[2]

Austin also has a municipal incentive program to support relocating businesses, which are eligible for reimbursement of up to 3% of the payroll fund per year (maximum of 1,800 USD per employee) and up to 50% of real estate tax if it created at least 75 jobs over 10 years paying at least the living wage.[3]

Austin is also a place where a lot of high tech professionals are gathered and every second resident has a university degree. It is home to state's largest university, University of Texas at Austin (ranked 43rd in ARWU), that attracts thousands of students every year. According to the Brookings Institution, the city ranked 9th in the United States by the share of high tech employees – 16.3%, meanwhile the average for the United States is 9%.

Austin has a relatively cheap cost of living. According to Best Places portal, the corresponding index is 129.1 points, which is higher than average for the United States (100 points), but lower than in other tech hubs of the country – San Francisco (245.5 points), New York (172.5), and Boston (150.8).[4]

[1] The Texas Tribune. Texas launches new property tax incentive program to lure new businesses. Available at: https://www.texastribune.org/2024/02/22/texas-economic-incentives-chapter-313-replacement/ (Accessed: 02.04.2024).

[2] Texas Jobs, Energy, Technology and Innovation (JETI). Available at: https://gov.texas.gov/business/page/texas-jobs-energy-technology-and-innovation-jeti (Accessed: 04.07.2024).

[3] AustinTexas.gov. Business Expansion Incentive Program. Available at: https://www.austintexas.gov/department/business-incentives-district-development (Accessed: 02.04.2024).

[4] BestPlaces. Boston, MA Cost of Living. Available at: https://www.bestplaces.net/cost_of_living/city/massachusetts/boston (Accessed: 02.04.2024).

Dallas: an Innovation Hub in the Middle of USA

If Austin is preferred by companies that are mostly producing software, Dallas attracts industrial companies (Table 6).

Table 6. R&D Scoreboard Companies that Relocated their Headquarters to Dallas, Texas

Company	Founded	Industry	Headquarters relocated	GERD: 2022, million euros
Boeing Global Services	Seattle, Washington	Aerospace & defense	2017	2,470
Caterpillar	Peoria, Illinois	Automobile	2022	1,701
AT&T	Bedminster, New Jersey	Telecommunications services	2008	1,159
Kimberly-Clark	Neenah, Wisconsin	Personal goods	1985	274
Celanese	New York City, New York	Chemicals	2005	105
McKesson	New York City, New York	Healthcare equipment & services	2021	83
Lennox International	Marshalltown, Iowa	Construction & materials	2016	75

Source: HSE ISSEK, based on [European Commission, 2023].

From a tax standpoint, Dallas provides the same kind of benefits as Austin does – no corporate tax, tax incentives on R&D, and the JETI program. Adding to that, the city administration, together with The Dallas Innovation Alliance (DIA), is implementing a Smart Dallas project, within which a Dallas Innovation District will be built in the central city area.[1] In order to test innovative solutions in the designed urban space with direct user participation, a Smart Cities Living Lab has been launched that encompasses three dimensions – infrastructure, travel modes, and connected living.[2]

The Living Lab is equipped with CCTV, environmental sensors, meter boxes, smart street light systems, free public Wi-Fi hotspots, all-digital smart kiosks, dashboards, and parking sensors. The testing of tech novelties will help evaluate the citizens' attitudes toward the changing quality of the environment, including:

- lower crime rates due better street lighting;
- lower water discharge and better energy efficiency due to the use of water meters and LED light bulbs;
- better parking accommodation due to early updates on space availability;

[1] Dallas Innovation Alliance. Smart Cities Living Lab. Available at: https://www.dallasinnovationalliance.com/living-lab (Accessed: 02.04.2024).

[2] This concept described a world where work, home, and urban spaces are interconnected via multiple smart devices that integrate voice, video, and data services and provide omnipresent and continuous access for the user.

- health improvements due to the expansion of green spaces and the timely response of municipal services to air pollution alerts;
- raising awareness about the local initiatives and opportunities offered by the municipality as a result of sharing information in a more accessible format.

The DIA is following a concept, according to which the smart city combines the community, big data, and high technologies to achieve accelerated sustainability, efficient resource conservation, and improved quality of life. The projects like Smart Dallas are capable of attracting new technological companies that want to test their innovative ideas in a living lab format or equip them for future testing.

Dallas, like Austin, represents a city with a high concentration of skilled personnel: 36.5% of city residents over 25 have a higher education.[1] It also has a large university – The University of Texas in Dallas (351–400th position in the Times Higher Education ranking), with the share of international students reaching 17.3% (for comparison, in University of Texas at Austin – 9.2%). At the same time, by being located in the central part of the United States, the city provides additional perks for companies that wish to have a convenient connectivity with other parts of the country.

The cost of living in Dallas is even lower than in Austin: the corresponding index value is 100.2 points, which is almost the country's average.[2]

Houston: the History of the Largest Oil Production Cluster

ouston, the largest city in Texas, is considered the unofficial capital of the global oil industry [HSE University, 2022]. For a long time, it has not only been the location hosting the head offices and regional branches of the majority of the largest oil corporations in the world, but an intellectual center at a global level, generating technological innovations for all segments of the oil and gas industry and, in recent years, innovations for other sectors in the industrial production and the services industry. The city hosts over 600 oil producers, around 1,100 oilfield service firms, and over 180 oil and oil-product distribution companies; it employs over a third of all those employed in the United States oil and gas industry and more technicians and engineers specializing in the energy sector than in any other part of the country.[3] That is why many innovative companies moving to Houston do so because they are primarily connected to the oil and gas industry (Table 7).

[1] Census.gov. U.S. Census Bureau QuickFacts: Dallas city, Texas. Available at: https://www.census.gov/quickfacts/fact/table/dallascitytexas/LND110210 (Accessed: 02.04.2024).

[2] BestPlaces. Dallas, TX Cost of Living. Available at: https://www.bestplaces.net/cost_of_living/city/texas/dallas (Accessed: 02.04.2024).

[3] Greater Houston Partnership. Available at: https://www.houston.org/ (Accessed: 02.04.2024).

Table 7. R&D Scoreboard Companies that Relocated their Headquarters to Houston, Texas

Company	Founded	Industry	Headquarters relocated	GERD: 2022, million euros
Hewlett Packard Enterprise	Palo Alto, California	Technology hardware & equipment	2021	1,917
Exxon Mobil	Newark, New Jersey and New York City, New York	Oil & gas producers	2021	773
Halliburton	Duncan, Oklahoma	Oil equipment, services & distribution	2003	323
Weatherford International	Weatherford, Texas	Oil equipment, services & distribution	2009	84
ConocoPhillips	Ogden, Utah	Oil & gas producers	2002	67
Aravive	Stanford, California	Pharmaceuticals & biotechnology	2016	57

Source: HSE ISSEK, based on [European Commission, 2023].

Houston is one of the leading centers of higher education in the United States. There are five prestigious colleges and graduate schools that rank quite high in the global rankings; especially prominent are the University of Houston and William March Rice University. A good part of these colleges' alumni find jobs in the city and stay, also securing a steady inflow of young talent. According to expert estimates, around 350,000 highly skilled undergrads categorized as millennials (born in or after the 1980s who absorbed digital culture) are working in Houston. Around 240,000 people are engaged in science and technology, including engineering.[1]

Such a dense concentration of intellectual potential provided the "energy capital" of the world with favorable conditions for becoming a leading global S&T center in oil & gas, as well as in several other sectors. By 2020, the city had 67 technology companies, over 20 research centers, and over 30 incubators, accelerators, and co-working centers specializing in various aspects of the fuel and power sector.

The most important factor behind Houston's accelerated innovation development is the proactive city policy in shaping the innovation ecosystem. In 2017, based on an analysis of a special Mayor's office working group focused on innovation, a non-profit organization was founded called Houston Exponential (HX), whose main task was to support the development of an innovation ecosystem in the city. Within four years, HX played a significant role in establishing the necessary links and coordinating the work of municipal

[1] Greater Houston Partnership. Available at: https://www.houston.org/ (Accessed: 02.04.2024).

departments, local universities, and the corporate sector to attract talent and capital for the sake of innovative development. Through its active work, Houston expanded the whole network of organizations supporting the creation of innovation startups and founded a special VC fund – HX Venture Fund with equity of 50 million USD. At the end of 2020, HX launched a database on HTXTechList.com that significantly simplifies the search for business partners for innovators. As a result of these measures, the VC volume, according to local experts, increased almost by 250%, overcoming the threshold of 753 million USD in 2020.[1] It does not come as a surprise that in recent years Houston and Texas, as a whole, have become regular winners of many competitions for the best US territorial entity in which to do business from the standpoint of the business environment and innovative entrepreneurship.[2]

* * *

Despite the fact that San Francisco, New York, and Boston remain megacities with the largest number of companies from the R&D Scoreboard, the United States is experiencing a trend of the relocation of such companies to Texas. This could be largely explained by a significant increase in the cost of living in areas that have traditionally been the headquarters of large innovative firms. It has ceased to be lucrative to live or work there: whether it be the workers who have to overpay for housing, products, and services, or the companies themselves that are forced to increase salaries, pay higher taxes, and office rent. Amid all these factors, Austin, Dallas, and Houston offer tax incentives, access to a highly skilled workforce, and affordable cost of living and thus become attractive territories for relocating the headquarters of high tech firms.

[1] Greater Houston Partnership. Available at: https://www.houston.org/ (Accessed: 02.04.2024).

[2] Casselberry C. Will Innovation Transform Texas? Available at: https://texasceomagazine.com/will-innovation-transform-texas/ (Accessed: 02.04.2024).

Reaching for the Stars

Cities that have made gains in the technological ranking more than others started from rather low positions

The high concentration of technology companies, venture capital, leading universities, people at the frontier of science, and innovative infrastructure facilities in the main centers of innovation attractiveness leads to insignificant changes in their ranking positions within the top 20. To grab the medal of Technological Development, cities need to boast outstanding results in attracting leaders of the innovation economy.

For example, Seoul has moved from 17th to 12th position by the number of unicorns due to the emergence of 11 new companies. Only five global innovative cities were able to surpass this result: San Francisco (+46 companies), New York (+32), Beijing (+13), Boston (+13), and London (+12). Among Seoul's billion-dollar startups are Lionheart, a developer of mobile and online games with the highest estimated value; Tridge, an online platform that brings together buyers and sellers of agricultural products from around the world (3 billion USD each); and Megazone Cloud, a company specializing in cloud computing services, whose clients include Samsung, LG, Hyundai, and other large South Korean companies (2 billion USD).

Suzhou has managed to improve its position in the Technology Development Subindex, rising from 32nd to 18th place by the number of innovative corporations on the R&D Scoreboard due to the emergence of eight new companies. Of these, most active investors in R&D were the chemical manufacturer Jiangsu Eastern Shenghong (230 million USD), the developer of renewable energy projects Hongyuan Green Energy (137 million USD), and the manufacturer of lithium-ion batteries Calb (95 million USD).

The rankings of cities outside the top 20 in terms of Technological Development turned out to be more sensitive to changes in its various components (Table 8). Thus, Raleigh moved up 44 positions by the number of high tech corporations due to the emergence of four companies: the developer of network solutions Extreme Networks, the creator of software Prometheus, the communication platform Bandwidth, and the biopharmaceutical company TG Therapeutics.

Innovative enterprises' increase in R&D expenditures pushed Birmingham from 106th to 52nd place, and the largest contribution to the total expenditures was made by the HSBC UK Bank and the luxury car manufacturer Aston Martin Lagonda Global Holdings. Rome has advanced the most in terms of the number of startups: it has risen by 59 positions to 56th place thanks to the appearance of 672 companies. When it comes to the growth in the number of unicorns, Hefei, Portland, and Cairo stood out the most by acquiring two new billion-dollar startups each and moving to 71st position in the ranking.

Daejeon rose by 27 positions in the number of innovation support funds (+10 organizations) and ended up being ranked 155th. Seoul demonstrated the sharpest increase in the ranking in two

Hefei, Portland, and Cairo

+2 unicorn companies

+36 ranking positions

areas at once – the number of business angels (+152 people) and the number of clusters and science parks (+3 facilities), taking 45th and 12th places, respectively. Increasing venture capital investment by almost 4 billion USD allowed Aarhus to soar 67 positions up – to 53rd place by the total volume of venture capital investment. The leading universities have brought Bengaluru to the 78th place by their number (67 positions higher than in HSE GCII 2023) due to the entry of three universities into global rankings. Chongqing has moved up from 152nd to 94th place by the number of highly cited researchers (+10 people). In Columbus, Malmö, St. Louis, and Leipzig, the number of the rarest group of leaders in the innovation economy – Nobel Prize laureates and Fields Medal winners – increased by one representative, providing these cities with an increase in rank by 38 positions and entry into the top 50 by the number of holders of these prestigious prizes. London and Nuremberg have strengthened their innovative infrastructure by introducing two new supercomputers, which has brought them to 21st place in the corresponding indicator.

Table 8. Cities' Placement by the Largest Increase in the Ranking of Technological Development Indicators: 2024

Indicator name	Agglomeration	Rank by indicator 2023		Rank by indicator 2024	Changes in rank	Changes in indicator value
Leading companies by R&D expenditure	Raleigh	118	→	74	+44	+4
R&D expenditure of largest innovation companies, billion USD	Birmingham	106	→	52	+54	+2.8
Startups	Rome	115	→	56	+59	+672
Unicorns	Cairo	107	→	71	+36	+2
	Portland	107	→	71	+36	+2
	Hefei	107	→	71	+36	+2

(continued)

Indicator name	Agglomeration	Rank by indicator 2023		Rank by indicator 2024	Changes in rank	Changes in indicator value
Innovation support funds	Daejeon	182	→	155	+27	+10
Business angels	Seoul	104	→	45	+59	+152
Venture capital investment, billion USD	Aarhus	120	→	53	+67	+4
Leading universities	Bengaluru	145	→	78	+67	+3
Highly cited researchers	Chongqing	152	→	94	+58	+10
Nobel Prize laureates and Fields Medal winners	Columbus	79	→	41	+38	+1
	Leipzig	79	→	41	+38	+1
	Malmö	79	→	41	+38	+1
	St. Louis	79	→	41	+38	+1
Clusters and science parks	Seoul	88	→	12	+76	+3
Supercomputers	London	64	→	21	+43	+2
	Nuremberg	64	→	21	+43	+2

Source: HSE ISSEK, based on R&D Scoreboard 2023, Crunchbase, StartupBlink, CB Insights, QS, THE, ARWU, Clarivate, official websites of the Nobel Prize and International Mathematical Union, TCI Network, International Association of Science Parks, and TOP500.

Tech Minimum

Every leader of the innovation economy has a leading university

Some factors determining the level of the city's technological development remain the abode of a small number of global centers of innovative attractiveness, while others are inherent in most of them. When unicorns are present in only 57% of HSE GCII 2024 cities, and Nobel Prize laureates and Fields Medal winners live in about 40% of them, every single city in the top 200 has at least one leading university.

Tokyo (44), Seoul (27), Moscow (26), Beijing (26), and London (25) occupy the first five positions by the number of leading universities. Of the ten cities with the largest number of universities, seven have capital status, and three more – Istanbul, Osaka, and New York – in different historical periods had the capital status and still remain key business centers in their countries (Figure 12). Two new cities entered the top 10 in terms of the number of leading universities – Santiago (+7 universities recognized by world rankings) and Kuala Lumpur (+4).

China has the largest representation in the "university top 20": in addition to its capital, three cities are in the lead in terms of the number of the world's best universities; 16 in Shanghai, 14 in Nanjing, and 12 in Guangzhou.

It is almost expected from larger cities to have many leading universities, but if a smaller city obtains at least one university with international status, it may become the main factor for attracting talent from all around the world and create a favorable environment for developing and implementing innovation.

40%

of HSE GCII 2024 cities were chosen by Nobel Prize laureates and Fields Medal winners

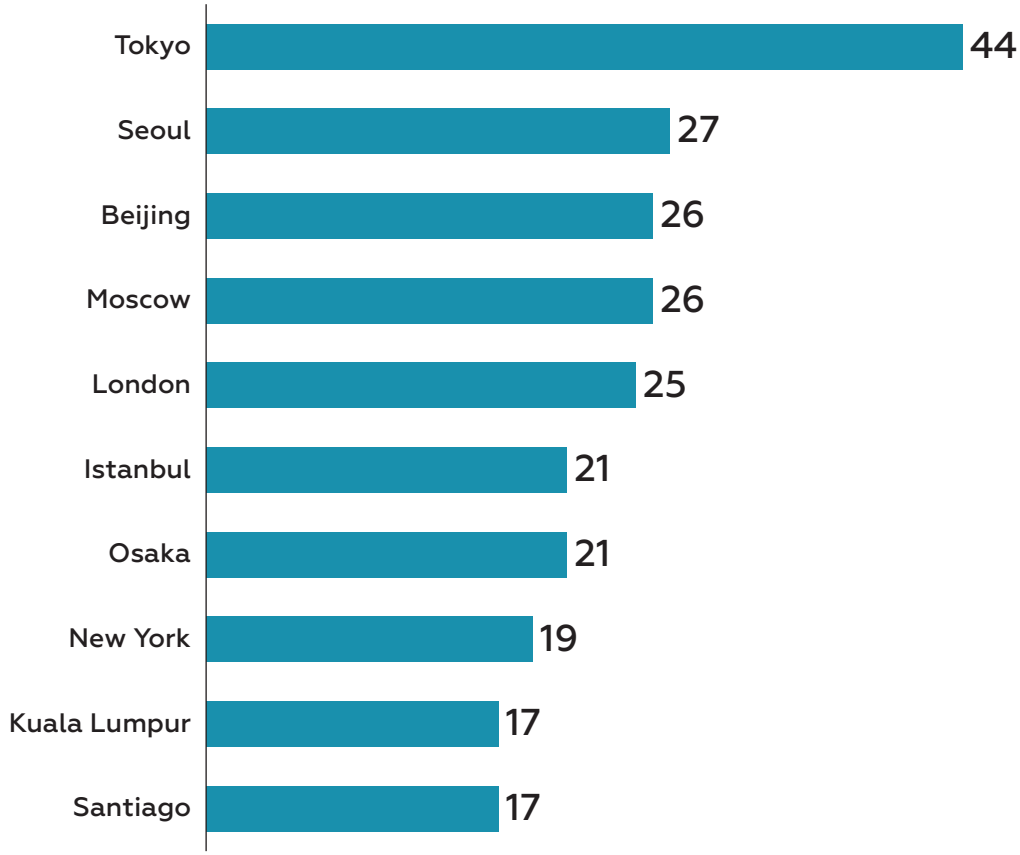
57%

of HSE GCII 2024 cities have unicorn companies

100%

of HSE GCII 2024 cities have leading universities

Figure 12. Top 10 HSE GCII Cities by the Number of Leading Universities: 2023



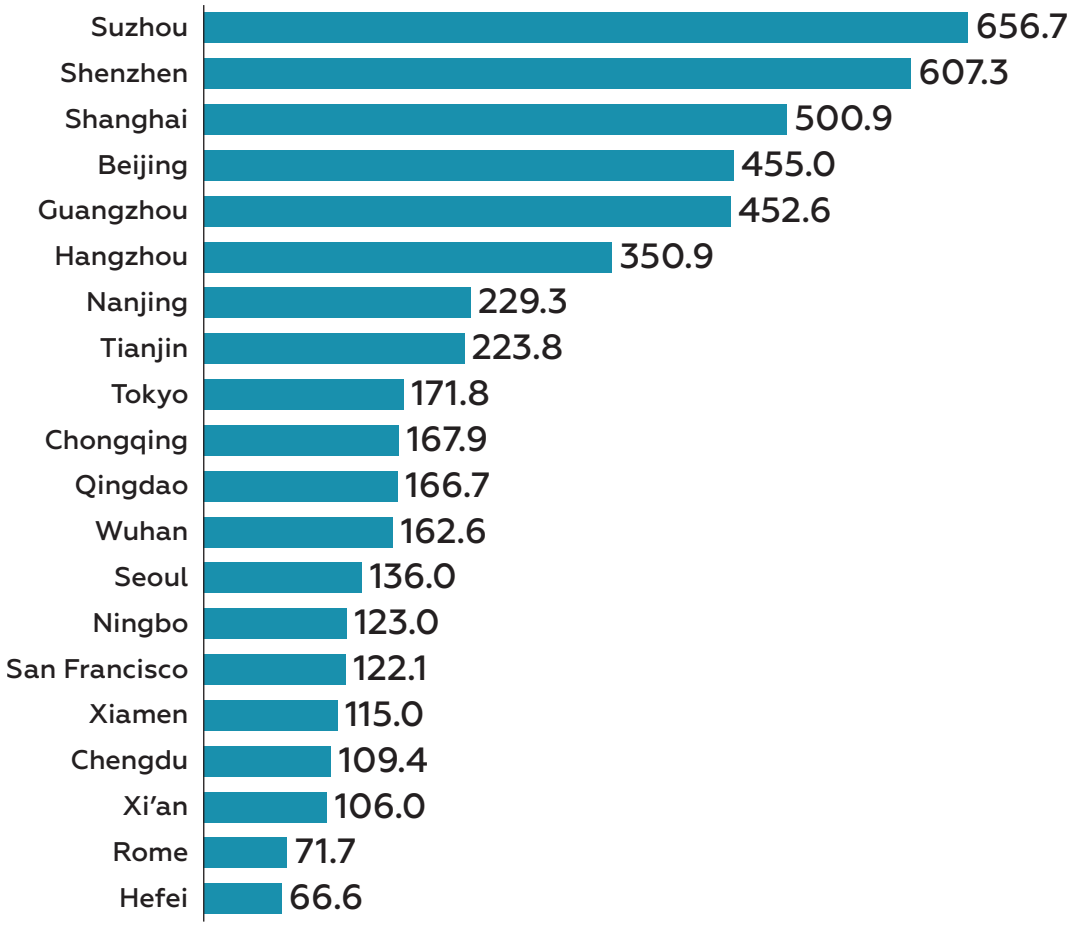
Source: HSE ISSEK, based on QS, THE, and ARWU.

The Most Productive in Science and Technology

Nine out of 10 leaders by the number of patents and articles are Chinese cities

The technological development performed by the Celestial Empire's cities is distinguished from others by how massive their scientific and innovative activity is. Nine Chinese cities (Beijing, Shanghai, Guangzhou, Hangzhou, Nanjing, Wuhan, Tianjin, Xi'an, and Chengdu) waltzed into the top 20 by the sheer scale of their publication and patent activities. Outside of China, such success was only attainable by Tokyo, Seoul, and San Francisco (Figures 13 and 14).

Figure 13. Top 20 HSE GCII 2024 Cities by the Number of Patent Applications: 2019–2021, thousands



Source: HSE ISSEK, based on PATSTAT Global.

Figure 14. Top 20 HSE GCII 2024 Cities by the Number of Scientific Publications: 2019–2023, thousands

Source: HSE ISSEK, based on Scopus.

In total, there are 23 cities of Mainland China that made their appearance in the top 200 HSE GCII 2024 and they account for 76.7% of patent applications and 30.6% of scientific publications.

In the previous issue, these shares were 72.4% and 24.3%, respectively, which points toward the growing role that Chinese innovation centers play in the world of science and innovation.

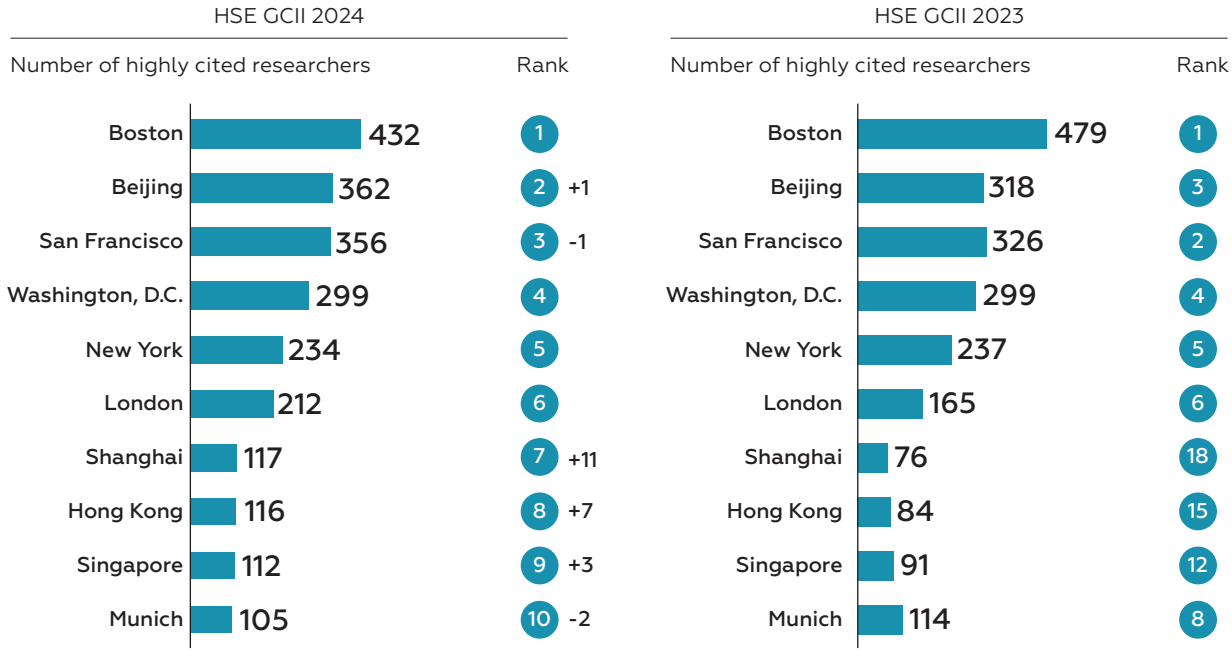
Transforming Quantity into Quality

Three Chinese cities made it into the top 10 innovation centers by the number of highly cited researchers

With the continuing trend toward increasing patent and publication activity, representatives of elite science from China are gaining more and more weight within the global science community. As such, if only Beijing was in the top 10 cities by the number of highly cited researchers in HSE GCII 2023, in the new ranking, Beijing (ranked 2nd) is joined by Shanghai (7th), which improved its rank by 11 positions, and Hong Kong (8th), which entered the top 10 after moving up 7 positions (Figure 15). The number of highly cited researchers from Beijing increased by 44 people, which allowed the city to outpace San Francisco by this indicator.

There are still no Chinese cities in the top 10 by the number of Nobel Prize laureates and Fields Medal winners. The absolute majority of outstanding scientists (93% of the total) prefer to live in Western cities.

Figure 15. Top 10 HSE GCII Cities by the Number of Highly Cited Researchers: 2023, 2024



Note: data on the number of highly cited researchers: HSE GCII 2024, for 2023; HSE GCII 2023, for 2021.
Source: HSE ISSEK, based on Clarivate.

Opening the Doors to Talent

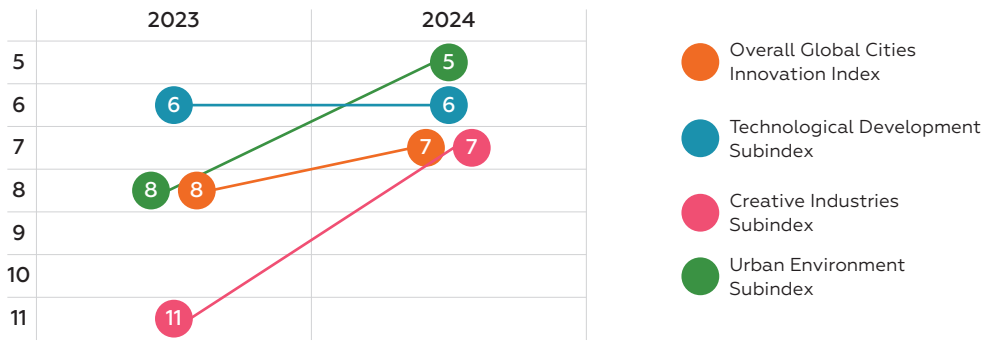
Shanghai's recipe for attracting innovators

Having a centuries old history of being the main seaport in China, Shanghai continued to develop its trade and cultural ties with the world. In recent years, the city is working on strategies to use its rich heritage to strengthen its status as a leading business center, a key innovation hub, and a Mecca for talent.

The efficiency of the implemented policy is reflected in Shanghai's growth in the HSE GCII 2024 ranking positions (Figure 16). It entered the top 10 global cities in three sections at once, progressing in the Creative Industries Subindex (+4, ranked 7th), Urban Environment Subindex (+3, 5th), and the overall HSE GCII (+1, 7th). In comparison to last year's results, the city increased the number of high tech corporations (+17), unicorns (+6), innovation support funds (+136), and the number of business angels (+124 people). In 2023, the total number of companies with international investment in Shanghai reached 70,000, and the total volume of such investment rose beyond 330 billion USD, which accounts for a fourth of the gross metropolitan product (GMP), a third of tax revenue, and almost two thirds of the total volume of foreign trade turnover.[1]

Despite being in the pack of high tech and creative leaders and being home to a lot of foreign capital, Shanghai

Figure 16. Shanghai's Rankings in the Overall HSE GCII and the Technological Development, Creative Industries, and Urban Environment Subindices: 2023, 2024



Source: HSE ISSEK.

[1] Shanghai continues to improve the "gold content" of economic development. (In Chinese). Available at: https://www.gov.cn/lianbo/difang/202305/content_6857411.htm (Accessed: 18.07.2024).

does not rest on its laurels and continues to strengthen its positions among global cities on account of honing its foreign talent attraction policy, implementing special programs, and providing access to public and municipal services.

The Celestial Empire has a talent classification system for attracting foreign labor from abroad[1]: highly skilled professionals (Class A); foreign professional talent (Class B); and other foreign personnel (Class C), whose entry into the country is regulated by national guidelines. Applications in each category must meet a specific set of criteria using a score-based system: level of education, qualification and professional specialization, intellectual property rights, annual wage, work experience, including at Fortune 500 companies, and proficiency in Chinese.

Only the applicants who received job offers may become Shanghai residents. That being said, the work permit can be provided to both candidates and companies that filed a request to hire international specialists. There are over 10,000 companies in the city that are presently certified as employers entitled to hire highly skilled scholars and technicians from abroad.[2]

To optimize the stream of specialists coming to Shanghai, the city is monitoring the local companies' demand for international personnel. According to the last survey of the Shanghai Diplomatic Service, in which 126 companies took part, foreign experts are mostly in-demand in research and development (27%), information technology (19%), marketing (17%), and sales (16%).[3]

To make sure that the attracted international workforce meets the needs of the internal market and the national development goals, the city authorities developed a Talent Attraction Plan, standardized the identification of outstanding talent, and compiled a list of "urgently required foreign talent" that includes essential professions in 62 areas, as well as requirements for their professional skills and qualifications.[4] For example, talent in researching and developing systems for lithographic presses need to know the principles of its operation, have deep knowledge of Fourier optics, and be able to use AutoCAD and ProE. The work on testing these standards began in 2023 and will go on for two years.

The city authorities are trying not only to up the brain gain from abroad but create conditions to retain international workers in the country. Foreigners can apply for permanent residency after three years of continuous employment in Shanghai if they have

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[1] Notice on Transferring International Work Management System and the Information System in Foreign Experts Project Management in China. (In Chinese). Available at: https://fuwu.most.gov.cn/lhgzweb/attached/file/20220402/a78c3a78-2ea4-46a1-87b3-dd1791970546.pdf (Accessed: 18.07.2024).

[2] New policy trends in post-covid attraction of foreign talent. (In Chinese). Available at: https://kpmg.com/cn/zh/home/insights/2021/03/china-tax-alert-09.html (Accessed: 18.07.2024).

[3] Shanghai diplomatic service publishes report on researching foreign talent demand and business administration practices. (In Chinese). Available at: https://www.fsg.com.cn/repository/portal-local/ngc202204150002/cms/file/88e66313-0028-4c11-801e-56af1a243b14.pdf (Accessed: 18.07.2024).

[4] Shanghai standards for identifying international "high performance" talent. (In Chinese). Available at: https://www.sh-hitech.com/qtfc/7457.html (Accessed: 18.07.2024).

a "talent" residency and reference letters from the employer.[1]

One of Shanghai's largest municipal projects is "The Pujiang Plan" aimed at attracting exceptional foreign students, developing innovation and the business environment in high tech.[2] The Plan is being implemented in the following areas: research and development (Category A); technological entrepreneurship (Category B); social sciences (Category C); and talent requiring expedited processing (Category D). As of 2022, around 3,000 people who fall under Categories A and B received financing for a total of 635 million yuan (around 86.8 million USD). Two candidates in these categories were selected by the Chinese Academy of Sciences.

International tech entrepreneurs in Shanghai have special preferences, including a one-time relocation package, a tax incentive for software companies, and free land plots and office facilities. The Shanghai Industrial Policy Service Center helps register the company for free and obtains information from the city on how to receive business development grants.

Sixteen innovation infrastructure facilities were launched within the "Tech Parks for 1,000 Talents" project, among which are entrepreneurship parks in Shanghai's Zhanjiang, Jiading, and Xinmin districts. They have been provided for people who have at least a Bachelor's degree from a foreign university; visiting foreign specialists with a Bachelor's degree or higher awarded in China, or those certified in vocational fields of at least a secondary level; or people who spent at least a year in foreign universities or R&D organizations.[3] Infrastructure facilities built there provide a special range of services that includes housing benefits, tax preferences, patent fee reimbursement and are giving out grants to its members. For example, the Zhanjiang park specializing in information and bio technology, gives out a one-time payment in the amount of 500,000 to 1 million yuan (from around 68,300 to 136,600 USD); in the Jiading park specializing in automobile manufacturing, new sources of energy and materials, the funding volume varies from 200,000 to 500,000 yuan (from around 27,500 to 68,700 USD); R&D organizations in the Xinmin park can claim payments amounting to 30,000 to 200,000 yuan (from around 4,100 to 27,500 USD).

Programs for attracting personnel are implemented in certain parts of Shanghai. Most proactive in this area is Pudong, one of the largest international trade, economic, financial, and technological centers in China. It worked out an all-round support package for individual talent or separate teams, projects, and companies[4] (Table 9). By 2025, the Pudong New

[1] High level international talent claim permanent residence. (In Chinese). Available at: https://zwdt.sh.gov.cn/group1/M00/61/84/rBJ9Jl9xpm-ADTUcAALnwnUDN4k696.pdf (Accessed: 18.07.2024).

[2] Opinions on Proposal No. 0321 of the CPPCC 14th National Committee's First Session. (In Chinese). Available at: https://www.shanghai.gov.cn/cmsres/15/15fc21d30efd483da95cd22f04e9ff89/3923da3e1a4f8b5aea7463da61c3b0f6.pdf (Accessed: 18.07.2024).

[3] Innovation and Entrepreneurship Parks in China. (In Chinese). Available at: https://rsj.sh.gov.cn/entrepreneur-park.html (Accessed: 18.07.2024).

[4] Shanghai's Pudong Promotes "1+1+N" HR Policy Focusing on Stimuli for Foreign Talent Attraction. (In Chinese). Available at: http://www.chisa.edu.cn/exclusive/202301/t20230130_2110995619.html (Accessed: 18.07.2024).

Table 9. Talent Attraction Programs in the Pudong New Area (Shanghai)

Area	Program	About
Funding programs for individuals and teams	One-time grants	• "Pearl Talent"– 2 million yuan (around 274,900 USD) • "Leading Pearl Talent" – 1 million yuan (137,500 USD) • "Elite Pearl Talent" – 500,000 yuan (68,700 USD) • "Pearl Engineer" – 200,000 yuan (27,500 USD)
	Contribution rewards	Candidates in the "Pearl Talent" category receive a yearly reward in the amount of up to 5 million yuan (around 687,300 USD); "Leading Pearl Talent" – up to 3 million yuan (412,400 USD); "Elite Pearl Talent" – up to 2 million yuan (274,900 USD)
Funding programs for large projects	Projects grants	Grants are provided to large innovative and industrial projects led by "Pearl Talents" in the amount of up to 100 million yuan (around 13.7 million USD) based on 50% of actual expenses incurred implementing the project
	Institutional grants	• a grant in the amount of up to 50% of the total investment amount in construction. Maximum investment volume per project – 50 million yuan (around 6.9 million USD) • a grant in the amount of up to 50% of the total investment amount during construction, not exceeding 5 million yuan (around 687,000 USD) per year, for three years after completion – newly established R&D organizations. Maximum investment volume per project – 20 million yuan (2.7 million USD) • a grant up to 10 million yuan (1.4 million USD) – large corporate innovation centers licensed by the Pudong New Area
Entrepreneurship development grants	Infrastructure	Entrepreneurs in the "Leading Pearl Talent" category receive preferences during the allocation of industrial land plots and office facilities, a yearly rental grant in the amount of up to 500,000 yuan (around 68,700 USD) for three years Entrepreneurs in the "Elite Pearl Talent" category receive rental grants in the amount of up to 300,000 yuan (41,200 USD) per year for three years
	Support of tech companies and R&D projects	• newly established R&D organizations of national and municipal levels – one-time grant in the amount of 500,000 to 5 million yuan (from around 68,700 to 687,000 USD) • "small giants" of national and municipal levels – one-time grant in the amount of up to 1 million yuan (137,500 USD) and 250,000 yuan (34,400 USD), respectively • newly established high tech companies – one-time grant in the amount of 250,000 yuan (34,400 USD) • small and micro enterprises in science and technology – grant of up to 1 million yuan (137,500 USD) • enterprises implementing critical technologies and equipment – grant of up to 1 million yuan (137,500 USD), not exceeding 20% of the investment amount in the project • startups working with universities, R&D organizations, and mining and manufacturing enterprises – a grant not exceeding 30% of the total investment amount in the project and no more than 2 million yuan (274,900 USD)

(continued)

Area	Program	About
	Funding intellectual property	Maximum yearly grant in the amount of 500,000 yuan (68,700 USD) for intellectual property protection; maximum yearly grant in the amount of 1 million yuan (137,500 USD) – for intellectual property protection abroad
Other	Housing	• "Pearl Talent" – a 300 m² apartment or a rental grant in the amount of up to 30,000 yuan (4,100 USD) per month • "Leading Pearl Talent" – a rental grant in the amount of 6,000 yuan (824.8 USD) per month for up to five years • "Elite Pearl Talent", "Pearl Engineer" – a rental grant in the amount of 3,000 yuan (412.4 USD) per month for up to three years

Source: HSE ISSEK, based on the Pudong International Talent Center.

Area plans to support over 10 "Pearl Talents" (heads of large innovative projects), over 300 "Leading Pearl Talents" (winners of international awards), over 600 "Elite Pearl Talents" (outstanding young entrepreneurs or scientists with high growth potential), and over 1,000 "Pearl Engineers" (with five-year experience working in strategically important industries in the Pudong New Area).[1]

Shanghai's efforts to attract talent came to fruition – the city is ranked first in the country by the number of foreign highly skilled specialists (Class A). In 2022, over 370,000 work permits to foreigners have been issued, a fifth of whom hold the highest qualification level.[2]

The city's policy for attracting and retaining talent is distinguishable by its wide coverage – everyone from ambitious foreign students and highly experienced professionals to exceptional scientists, engineers, and tech entrepreneurs, – as well as the abundance of tools for direct and infrastructure support that helps people with recognized achievements ease into becoming part of the local community of innovators.

> Shanghai is first in the country by the number of highly qualified talent attracted from abroad.

[1] Concentrate on Presenting on Presenting High Level Foreign Talent! The "Pearl" Plan for the Shanghai's New Pudong Area officially published. (In Chinese). Available at: https://www.sdxz2050.com/28228.html (Accessed: 18.07.2024).

[2] Opinions on Proposal No. 0321 of the CPPCC 14th National Committee's First Session. (In Chinese). Available at: https://www.shanghai.gov.cn/cmsres/15/15fc21d30efd483da95cd22f04e9ff89/3923da3e1a4f8b5aea7463da61c3b0f6.pdf (Accessed: 18.07.2024).

Where Science Begets Technology

The scientific publications of the US cities are cited in patents most frequently

The transformation of scientific knowledge into a commercial product is one of the most important and complex tasks in developing innovations. One can conclude whether an approach to solve that problem is successful or not based on the citation count of a scientific publication in a patent. This indicator demonstrates the applied significance and quality of the study conducted in the city in terms of its further use in the development of new products and the improvement of technological processes. However, not all research areas are equally sought-after as a source of practical knowledge. If a significant weight in a research profile is allocated to general sciences or the humanities, it may lead to the city's decline according to this indicator.

The leaders in commercializing scientific knowledge were mostly US cities: San Francisco (3.53% of city publications are cited in patents), Boston (3.21%), New York (2.49%), Washington, D.C. (2.28%), Los Angeles (2.26%), and Chicago (2.14%) (Table 10).

Table 10. Citation Rates of Scientific Publications in Patents of the Top 50 HSE GCII 2024 Cities: 2019–2023

City*	Publications cited in patents as a percentage of the total number of city publications	Number of city publications cited in patents
San Francisco	3.53	7,680
Boston	3.21	8,721
Singapore	2.50	3,006
New York	2.49	6,279
Washington, D.C.	2.28	6,620
Los Angeles	2.26	4,067
Munich	2.16	2,047
Seoul	2.14	5,782
Chicago	2.14	2,606
Stockholm	1.99	1,413
Tokyo	1.95	4,847
Amsterdam	1.93	1,387
Copenhagen	1.92	1,306
London	1.90	4,988

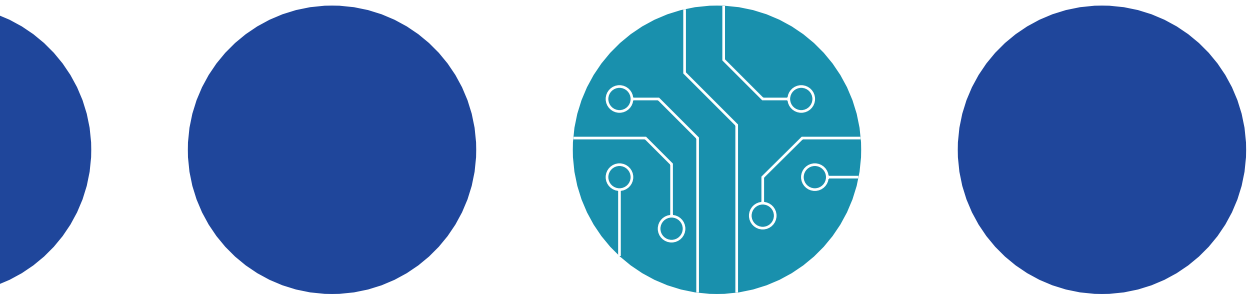
(continued)

City*	Publications cited in patents as a percentage of the total number of city publications	Number of city publications cited in patents
Paris	1.90	3,718
Barcelona	1.89	1,942
Osaka	1.89	2,270
Vancouver	1.89	1,120
Toronto	1.87	2,126
Helsinki	1.85	864
Berlin	1.84	2,103
Montreal	1.80	1,545
Hamburg	1.69	807
Hong Kong	1.67	2,298
Vienna	1.65	1,278
Milan	1.63	1,816
Melbourne	1.58	1,754
Shenzhen	1.57	2,512
Nagoya	1.50	751
Madrid	1.49	2,040
Sidney	1.44	1,610
Oslo	1.42	634
Taipei	1.33	1,236
Suzhou	1.30	1,577
Shanghai	1.24	5,382
Guangzhou	1.14	3,380
Budapest	1.14	465
Hangzhou	1.12	2,400
Prague	1.07	624
Warsaw	1.06	697
Beijing	1.02	9,697
Wuhan	0.99	2,754
Nanjing	0.92	3,147
Chengdu	0.87	1,924
Bangkok	0.80	507
São Paulo	0.78	671
Mumbai	0.74	430
Istanbul	0.69	577
Dubai	0.66	169
Moscow	0.48	1,200

* Cities are ranked in descending order by the shares of publications cited in patents in the total number of city publications.

Source: HSE ISSEK, based on Scopus.

Despite the low relative indicators of Chinese megacities in the top 50 according to the number of their scientific publications, it is namely Beijing that is leading in the world by the absolute number of articles cited in patents (9,697); Shanghai (5,382, ranked 7th), Guangzhou (3,380, 12th), and Nanjing (3,147, 13th) are not too far behind. Such results could in part explain the success of the United States and China in developing deep tech unicorns – companies at the intersection of basic science and commercial products that can prove the market value of their ideas to investors.



Deep Tech Is Changing the World

When fundamental science becomes innovation

Deep tech, or deep technologies, are companies that create knowledge- and capital-intensive innovations based on fundamental research and development to solve global economic and societal problems. Deep tech companies are often working in advanced manufacturing fields, such as AI, nanotechnology, biotechnology, quantum computing, and other areas [European Institute of Innovation & Technology, 2023] that are connected to high complexity, take long time to enter the market, and have high stakes.

Deep technologies brought about revolutionary changes in various sectors of the economy and in the lives of people in general. For example, high-performance quantum computers with high computing speeds help solve otherwise insolvable tasks. Deep tech projects in biotechnology help create a basis for new ways to treat diseases and increase agricultural productivity.

In the long term, AI applications will probably automate and optimize business processes in different industries.

It is difficult for deep tech companies to commercialize their products, which is often attributed to a high level of uncertainty and long periods of product development and market launches, which are unacceptable for investors, who expect a fast return on investment. For many companies, the associated expenses could turn out to be unwarranted, especially for those that only embarked on the path of being a tech business. Meanwhile, some deep tech companies even grow to become unicorns, i.e., startups with valuation of over 1 billion USD. Among them is SpaceX, whose innovative rocket technologies revolutionized the space industry, or Moderna, a company that created a COVID-19 vaccine based on mRNA technology (Table 11).

Table 11. Top 10 Deep Tech Unicorns by Valuation: 2024

Name	City	Country	Valuation, billion USD	Field of activity
SpaceX	Los Angeles, California	United States	150	Production of reusable launch vehicles, spacecraft, and rocket engines
OpenAI	San Francisco, California	United States	80	Development of text (ChatGPT) and image (DALL-E) generation models
Databricks	San Francisco, California	United States	43	Provision of a cloud- and AI-based big data analytics platform

(continued)

Name	City	Country	Valuation, billion USD	Field of activity
Cruise	San Francisco, California	United States	30	Autonomous cars manufacturing
Waymo	San Francisco, California	United States	30	Autonomous cars manufacturing
CoreWeave	New York City, New York	United States	19	Provision of cloud-based services for large workloads
Anthropic	San Francisco, California	United States	16	Development of AI systems and language models (Claude)
Bitmain	Beijing	China	15	Production of mining servers for cryptocurrencies
DJI	Shenzhen	China	15	Production of unmanned aerial vehicles (UAV)
Ripple	San Francisco, California	United States	15	Development of blockchain technology based on decentralized digital ledger reducing transaction time through XRP cryptocurrency

Source: HSE ISSEK, based on Crunchbase and CB Insights.

Smart People Found Smart Companies

Majoring in engineering sciences is a foothold for creating high tech startups. According to XB100, the founders of 50% of deep tech companies have a PhD.[1] Among them is one of the founders of Moderna, Noubar Afeyan, who earned his PhD in biochemical engineering at MIT in 1987. Academic degrees in computer science were awarded to the founder of Pony.ai – James Peng (Stanford) and the founder of Ava Labs – Emin Gün Sirer (University of Washington); the Nuro's Dave Ferguson received a degree in robotics.

Some founders of deep tech start-ups receive not only knowledge out of their postgraduate education but also the ability to commercialize it. For example, Sebastian Thrun, a computer science professor at Stanford, combines in-depth competences in his professional field with business acumen, which helped him to co-found two deep tech unicorns. Sebastian Thrun's partners were his former students who worked at the Stanford Artificial Intelligence Laboratory, headed by him in 2004–2007, and those that participated in developing a self-driving car project at Google. Among them was S. Zayd Enam, the co-founder of Cresta (valuation – 2 billion USD) that develops autonomous vehicles. Another student of Sebastian Thrun was Dmitri Dolgov, who later became Waymo's co-founder (valuation – 30 billion USD). In 2016, the size of the project

[1] State of Deep Tech. Available at: https://www.bvp.com/atlas/state-of-deep-tech#Introducing-The-XB100 (Accessed: 27.02.2024).

allowed in to be spun out of the Google structure and became a subsidiary of the entire Alphabet Inc. tech holding. The combination of fundamental education and the practical experience of working on the market helps students become founders of deep tech startups.

Deep Tech in the Service of the City

Today, most deep tech projects are undergoing experimental adoption and, if successful, may lead to significant positive changes in how a city operates. For example, in June 2021, Pony.ai headquartered in the Fremont in the United States test-launched robotaxis in Guangzhou, where one of its Chinese offices is located. In 2022, the company became the first in China to be licensed as an autonomous taxi and, therefore, have an opportunity to commercialize its services. Pony.ai also obtained permission to test the car in Beijing. As of April 2023, its driverless cars covered over 21 million km and performed around 200,000 robotaxi orders.[1] In 2024, the company entered the European market: in March, it signed an MoU with the Government of Luxembourg in order to provide autonomous vehicles for the country.[2] The further development of driverless transport technology will help optimize taxi routes, lower the time spent waiting for public transportation, and lower the overall number of cars on the roads. Furthermore, as the autonomous taxi's vision gets better, these vehicles will lower the number of road traffic incidents.

Another deep tech field capable of radically changing life in the city is telemedicine. For example, China's unicorn Ping An Healthcare Management serves medical organizations and provides residents with online healthcare services. As of 2022, the companies' projects helped conduct 1.3 billion consultations and connect over 55,000 clinics in 180 cities of the country to its system.[3] On the one hand, Ping An Healthcare Management performs administrative functions to manage patient data with the help of BigData or organize the procurement of pharmaceutical products. On the other hand, the company provides instant telehealth services, and on top of that, doctor's consultations are supplemented with AI recommendations. The further scaling of deep tech services will help improve the accuracy of diagnosis, make medical help, including obtaining a second opinion, more affordable to patients, and lower the administrative burden on medical organizations.

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[1] Pony.ai is First to Receive Permit to Provide Public-Facing, Fully Driverless Robotax Service in Guangzhou. Available at: https://www.businesswire.com/news/home/20230425006213/en/Pony.ai-is-First-to-Receive-Permit-to-Provide-Public-Facing-Fully-Driverless-Robotaxi-Service-in-Guangzhou (Accessed: 15.07.2024).

[2] Luxembourg and Pony.ai Sign MoU to Advance Autonomous Mobility in the Country. Available at: https://www.businesswire.com/news/home/20240306928526/en/Luxembourg-and-Pony.ai-Sign-MoU-to-Advance-Autonomous-Mobility-in-the-Country (Accessed: 15.07.2024).

[3] Ping An Health acquires Ping An Smart healthcare. Available at: https://www.prnewswire.com/news-releases/ping-an-health-acquires-ping-an-smart-healthcare-301657078.html (Accessed: 27.02.2024).

Governments and Cities are Helping Deep Tech Startups

In some countries deep tech startups are supported at the government level. For example, the EU has a program of the European Innovation Council (EIC) – EIC Scale Up 100 aimed at the identification and support of 100 promising startups in deep tech.[1] Within this program, the companies will receive support to implement their corporate strategies, establish contacts with strategic investors and partners, and expand their businesses abroad. It is expected that by the end of the two-year support period, the program participants will be demonstrating annual growth in valuation, investments, and job creation by 40%, and companies from the top 20 of most successful – by 50%.

The European initiative involved the creation of a professional EIC Scaling Club consisting of at least 400 participants, among which are:

- The 100 most active investors, including VC and government funds;
- The 100 most influential corporations with departments specializing in innovation and VC investment;
- 100 agencies, clusters, and the media that promote large-scale projects in the EU;
- 100 independent mentors who have experience and connections at the level of large companies' Boards of Directors.

Japan launched a four-year program in 2022 to support deep tech start-ups on the basis of the New Energy and Industrial Technology Development Organization (NEDO).[2] The initiative funds joint international R&D and encourages companies' entry onto foreign markets. Program partners are Canada, Czech Republic, France, Spain, United Kingdom, Singapore, and Netherlands.
The maximum grant sum amounts to 100 million yen (around 632,000 USD) per project. The total volume of program funding – 2 billion yen (12.6 million USD).

Beijing has a city program that supports deep tech startups in attracting talent and assists with marketing, innovative developments, raising funds, and expedited IPOs.[3] Apart from that, the program provides an opportunity to fund deep tech start-ups implementing projects of national strategic importance within the borders of the city with up to 100 million yuan (around 13.6 million USD) per company.

Within the Barcelona Deep Tech Node[4] that was launched in 2021,

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[1] Scaling up with the European Innovation Council: launch of the new initiative to support Europe's future deep tech champions. Available at: https://eic.ec.europa.eu/news/scaling-european-innovation-council-launch-new-initiative-support-europes-future-deep-tech-champions-2023-06-01_en (Accessed: 27.02.2024).

[2] Deep-Tech Startups Support Fund/International Joint Research and Development. Available at: https://www.nedo.go.jp/english/activities/activities_ZZJP_100262.html (Accessed: 27.02.2024).

[3] Beijing city authorities take steps to support tech unicorns, including fast-tracking IPO approvals. Available at: https://finance.yahoo.com/news/beijing-city-authorities-steps-support-093000329.html (Accessed: 27.02.2024).

[4] Barcelona Deep Tech Node. Available at: https://ajuntament.barcelona.cat/digital/en/technological-entrepreneurship-and-digital-talent/impetus-technological-entrepreneurship/barcelona-deep-tech-node (Accessed: 15.07.2024).

it is expected to invest around 10 million euros in the city's high tech companies using Deep Tech Barcelona funds. It also offers six-month mentoring assistance for startups' general directors and aid in networking between companies looking for new technological solutions through the work of the professional Open Innovation Deep Tech Club. The program budget – 840,000 euros, including 470,000 euros from Barcelona City Council funds, 300,000 euros from universities, and 70,000 euros from private investors.[1]

Since 2021, Helsinki has had Urban Tech Helsinki, a business incubator for deep tech startups supported by the city authorities.[2] It is actively cooperating with leading universities – University of Helsinki, Metropolia University of Applied Sciences, and Aalto University – and two startup hubs – Maria 01 and Aalto Startup Center. The business incubator's residents can test their products on a special platform, get consultations from experts in the search for project financing, and develop connections with Urban Tech Helsinki partners.

[1] Barcelona launches the Deep Tech Node initiative to become a benchmark for technology start-ups. Available at: https://www.barcelonacatalonia.eu/en/barcelona-launches-the-deep-tech-node-initiative-to-become-a-benchmark-for-technology-start-ups/ (Accessed: 15.07.2024).

[2] Urban Tech Helsinki. Available at: https://urbantechhelsinki.fi/ (Accessed: 15.07.2024).

Centers for Healthy Living

Researchers from cities that are leading in innovation attractiveness are making their main contribution to the global development of life sciences, but their chief specialization is medicine

Cities from the top 50 in the HSE GCII 2024 ranking secured 36.6% of the world total of articles published in 2019–2023, and in selected research areas their contribution ended up being even more significant. Health sciences are somewhat of a mix: if medicine (42.5%) entered the top three along with some life sciences, veterinary (23.1%) and dentistry (30.9%) turned out to be the outsiders in this aspect. The innovation centers' lowest contribution was to the humanities and arts (18.4%) and social sciences (24.2%), as well as in business, management and accounting (26.8%) (Figure 17).

The biggest share in the top 50 cities' research profile (Table 12) falls under publications in medicine (32.1%), then, with a big gap, follow engineering (17.8%), physics and astronomy (13.4%), computer science (13.0%), and biochemistry, genetics and molecular biology (13.0%). Most HSE GCII 2024 centers are specialized[1] in biochemistry, genetics and molecular biology (44 cities), immunology and microbiology (40), and neuroscience (38).

> For example, the main global innovation centers accounted for around a half of the publications in three out of five research areas in life sciences – neuroscience (47.8%), biochemistry, genetics and molecular biology (44.7%), and immunology and microbiology (42.2%).

[1] The cities' technological or scientific specialization was assessed using the commonly applied indicator, the Specialization Index (SI). The Scientific Specialization Index (SSI) and Technological Specialization Index (TSI) are calculated by comparing the thematic structure of a city's publication or patent portfolio with those worldwide. This allows one to identify research fields and technological areas being examined in the city at a faster rate than the world average. A research field or a technological area are considered to be the city's specialization if the value of the corresponding index exceeds 1.

Figure 17. Top 50 HSE GCII 2024
Cities' Contribution to the World Total of Scientific Publications by Research Field: 2019–2023, %

Source: HSE ISSEK, based on Scopus.

Table 12. Key Indicators in the Subject Structure of the Top 50 HSE GCII 2024 Cities' Scientific Publications: 2019–2023

Research fields	Share of the research field in the total number of publications in cities*	Number of cities with a specialization in the research field	Top five cities by the Scientific Specialization Index value
Medicine	32.1	34	Amsterdam (2.17), New York (2.12), Toronto (2.10), Boston (2.08), Chicago (1.96)
Engineering	17.8	14	Nanjing (1.53), Shenzhen (1.49), Chengdu (1.44), Wuhan (1.41), Beijing (1.37), Shanghai, (1.37)
Physics and astronomy	13.4	27	Moscow (1.83), Mumbai (1.79), Munich (1.77), Warsaw (1.74), Nagoya (1.67)
Biochemistry, genetics, and molecular biology	13.0	44	Osaka (1.66), Copenhagen (1.65), Nagoya (1.59), Boston (1.55), Suzhou (1.55)
Computer science	13.0	11	Dubai (1.61), Shenzhen (1.51), Singapore (1.44), Hong Kong (1.42), Nanjing (1.17)
Material science	10.3	20	Suzhou (2.05), Shenzhen (1.85), Shanghai (1.62), Seoul (1.55), Chengdu (1.54)
Chemistry	8.6	21	Suzhou (2.08), Shenzhen (1.60), Hangzhou (1.59), Shanghai (1.53), Mumbai (1.51)
Environmental science	7.2	19	Nanjing (1.57), Wuhan (1.45), Beijing (1.45), Helsinki (1.39), Guangzhou (1.34)
Social sciences	7.2	6	Hong Kong (1.30), Oslo (1.28), Melbourne (1.13), Budapest (1.06), Helsinki (1.05)
Mathematics	7.1	15	Budapest (1.32), Paris (1.26), Shenzhen (1.22), Dubai (1.19), Nanjing (1.19)
Agricultural and biological sciences	6.3	17	Bangkok (1.54), Prague (1.49), São Paulo (1.47), Helsinki (1.35), Copenhagen (1.27)

(continued)

Research fields	Share of the research field in the total number of publications in cities*	Number of cities with a specialization in the research field	Top five cities by the Scientific Specialization Index value
Earth and planetary sciences	5.8	26	Beijing (2.12), Wuhan (2.01), Los Angeles (1.93), Moscow (1.91), Chengdu (1.76)
Chemical engineering	5.2	18	Suzhou (2.11), Seoul (1.61). Hangzhou (1.60), Shanghai (1.55), Shenzhen (1.45)
Energy	4.4	14	Dubai (1.73), Wuhan (1.67), Chengdu (1.67), Beijing (1.62), Nanjing (1.40)
Immunology and microbiology	3.6	40	Copenhagen (2.03), Bangkok (1.94), Washington, D.C. (1.81), São Paulo (1.77), Suzhou (1.66)
Neuroscience	3.5	38	Montreal (2.67), Amsterdam (2.64), Toronto (2.63), New York (2.48), Boston (2.45)
Pharmacology, toxicology and pharmaceutics	3.0	20	Dubai (1.59), Guangzhou (1.53), Bangkok (1.48), Hangzhou (1.41), Shanghai (1.23)
Psychology	2.5	26	Amsterdam (2.26), Oslo (2.20), Montreal (1.98), Melbourne (1.90), Los Angeles (1.88)
Business, management and accounting	2.3	9	Dubai (3.53), Hong Kong (1.87), Melbourne (1.30), Sydney (1.21), Bangkok (1.20), Helsinki (1.20)
Arts and humanities	2.3	4	Moscow (1.48), Prague (1.10), Vienna (1.04), Budapest (1.02), Warsaw (0.98)
Nursing	1.9	26	Melbourne (2.29), Oslo (1.98), São Paulo (1.97), Sydney (1.95), Washington, D.C. (1.83)
Decision sciences	1.9	10	Dubai (2.73), Mumbai (1.99), Bangkok (1.37), Budapest (1.31), Hong Kong (1.19)
Health professions	1.5	21	Oslo (2.21), Melbourne (2.15), Sydney (1.96), São Paulo (1.86), Vancouver (1.76)

(continued)

Research fields	Share of the research field in the total number of publications in cities*	Number of cities with a specialization in the research field	Top five cities by the Scientific Specialization Index value
Economics, econometrics and finance	1.5	13	Dubai (2.18), Moscow (1.42), Hong Kong (1.38), Vienna (1.37), Budapest (1.23), Prague (1.23)
Dentistry	0.6	18	Dubai (4.65), São Paulo (4.44), Istanbul (2.60), Bangkok (2.34), Mumbai (1.90)
Veterinary	0.6	7	Bangkok (2.49), São Paulo (2.48), Budapest (2.14), Vienna (2.07), Copenhagen (1.45)

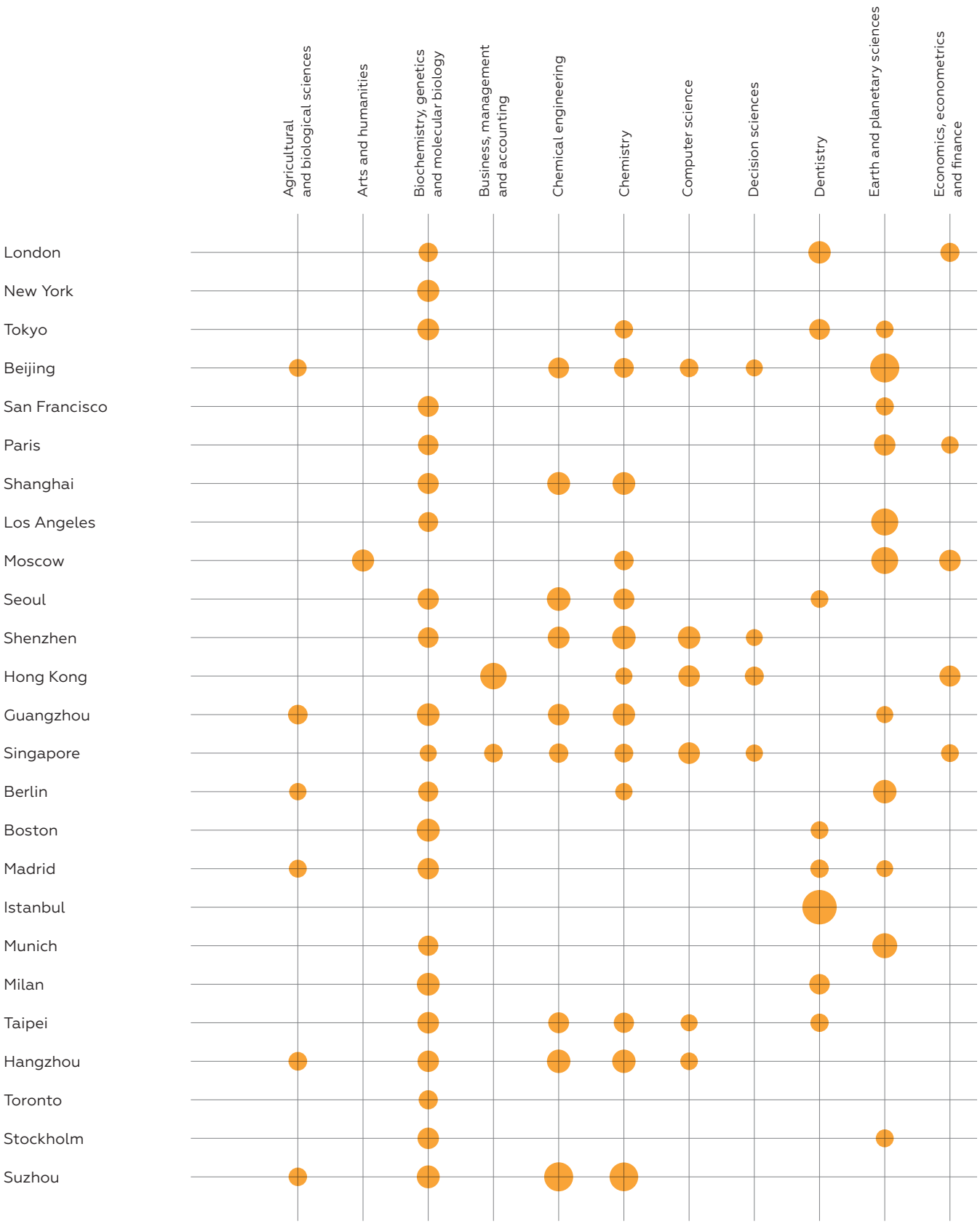
* The sum of specific weights in all research areas does not add up to 100%, because one publication may belong to several research fields.

Source: HSE ISSEK, based on Scopus.

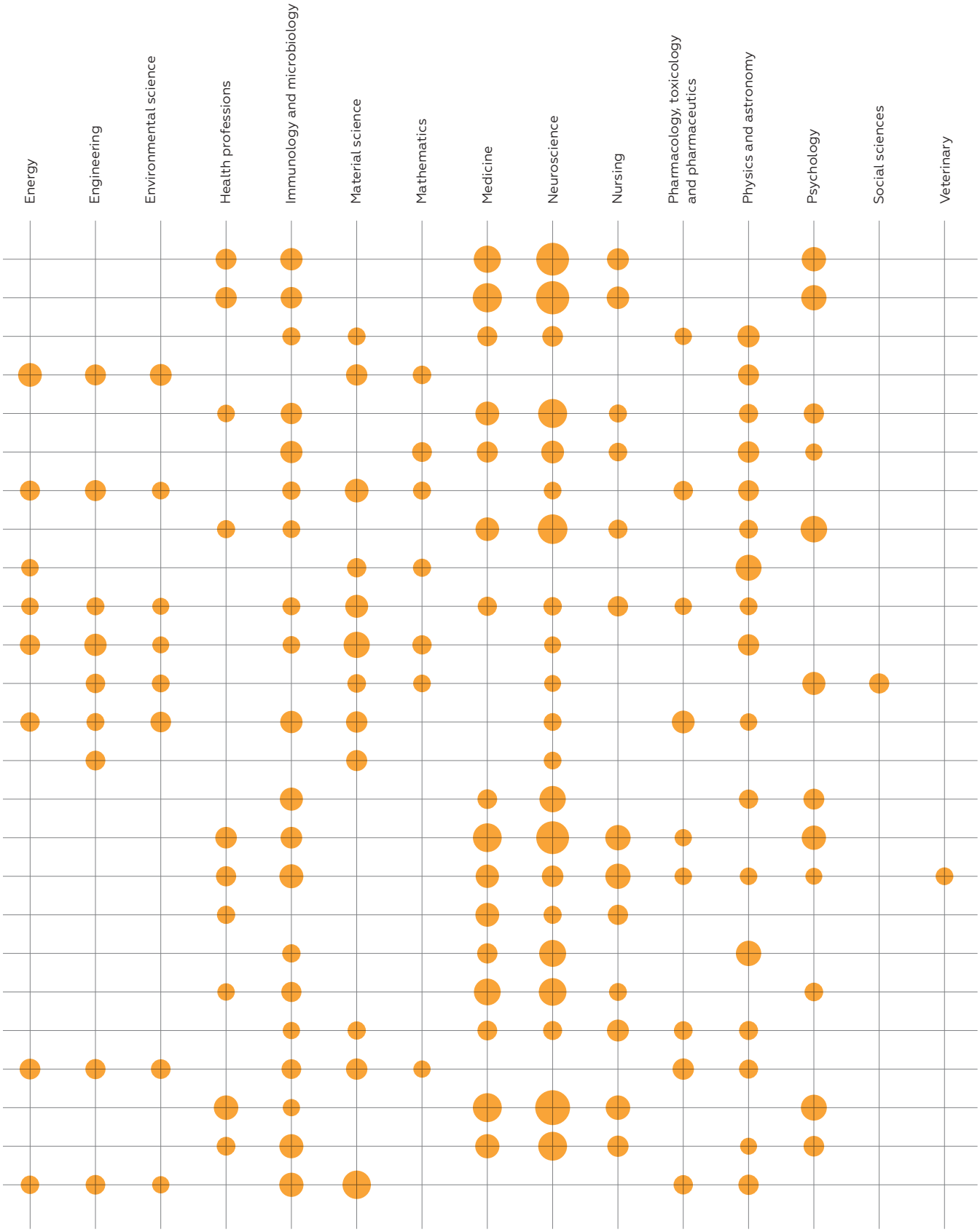
The cities of Europe, Australia, Canada, and the United States are primarily specializing in medical, health, and life sciences, and as for the cities of Mainland China, they typically specialize in physical sciences over others (Figure 18).

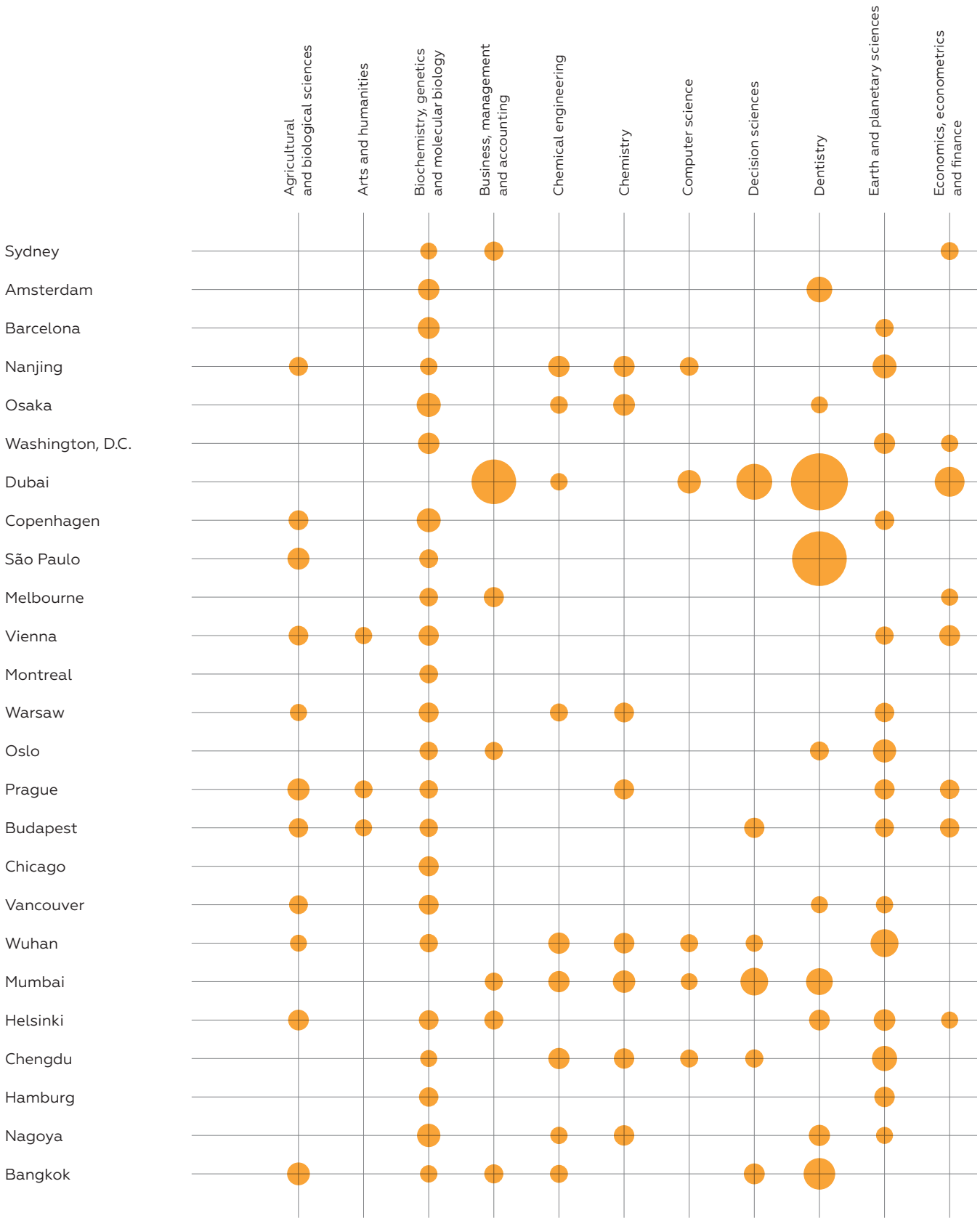
> For example, the research portfolio of Amsterdam, New York, and Toronto has almost a two-fold prevalence of medical publications – 51.9%, 50.6%, and 50.0%, respectively. Chinese cities substitute medical sciences with physical sciences in their specialization: their maximum input in the total flow of the city publications is in Nanjing (33.6%), Shenzhen (32.8%), and Chengdu (31.6%).

Figure 18. Top 50 HSE GCII 2024 Cities' Areas of Scientific Specialization: 2019–2023*

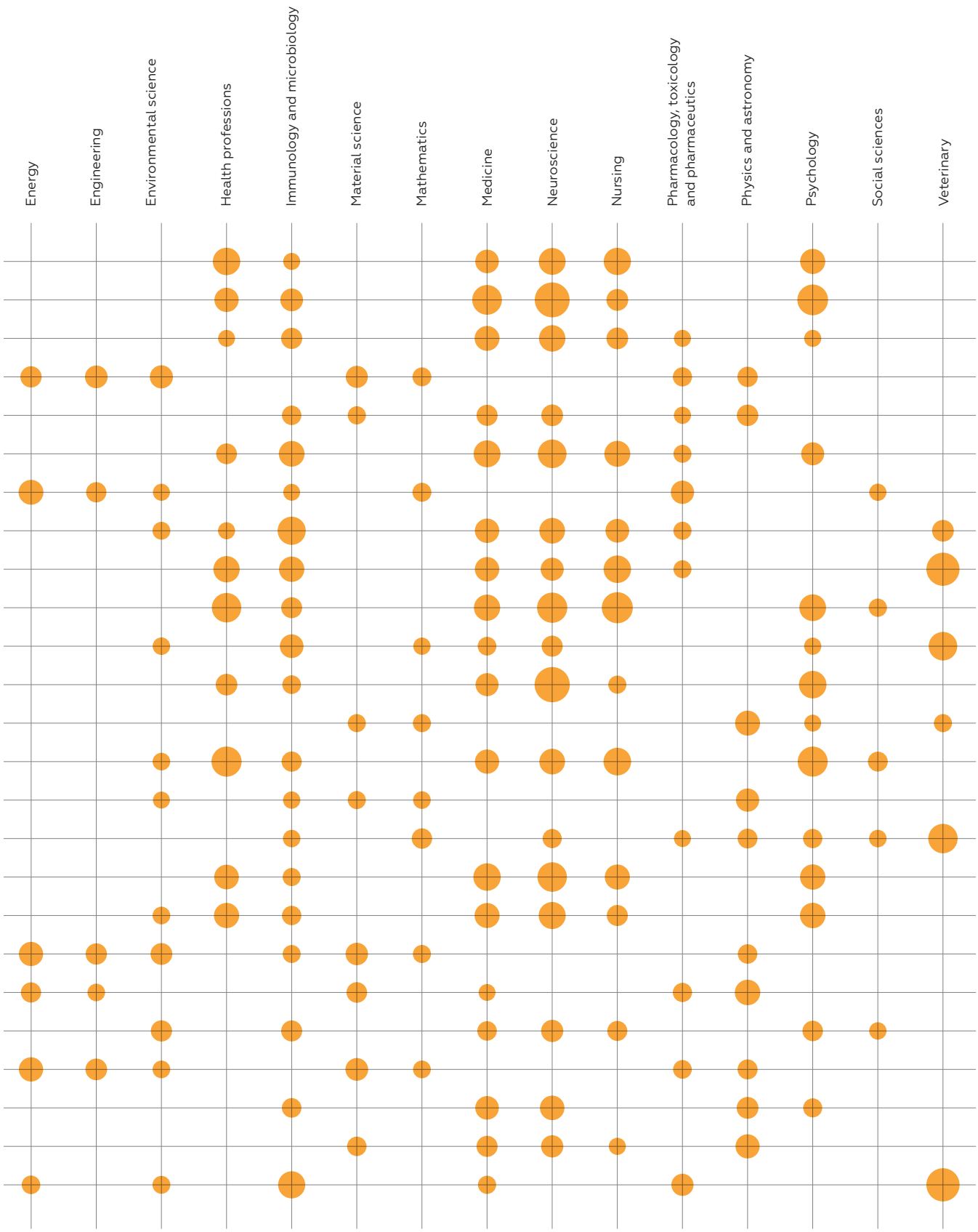


* For each city, the illustration marks areas with SSI not lower than 1, signifying the city's scientific specializations. The size of the bubble correlates with the SSI value.


Energy
Engineering
Environmental science
Health professions
Immunology and microbiology
Material science
Mathematics
Medicine
Neuroscience
Nursing
Pharmacology, toxicology and pharmaceutics
Physics and astronomy
Psychology
Social sciences
Veterinary


Agricultural and biological sciences
Arts and humanities
Biochemistry, genetics and molecular biology
Business, management and accounting
Chemical engineering
Chemistry
Computer science
Decision sciences
Dentistry
Earth and planetary sciences
Economics, econometrics and finance
Sydney
Amsterdam
Barcelona
Nanjing
Osaka
Washington, D.C.
Dubai
Copenhagen
São Paulo
Melbourne
Vienna
Montreal
Warsaw
Oslo
Prague
Budapest
Chicago
Vancouver
Wuhan
Mumbai
Helsinki
Chengdu
Hamburg
Nagoya
Bangkok

(continued)



Source: HSE ISSEK, based on PATSTAT Global.

Creators of New Technologies

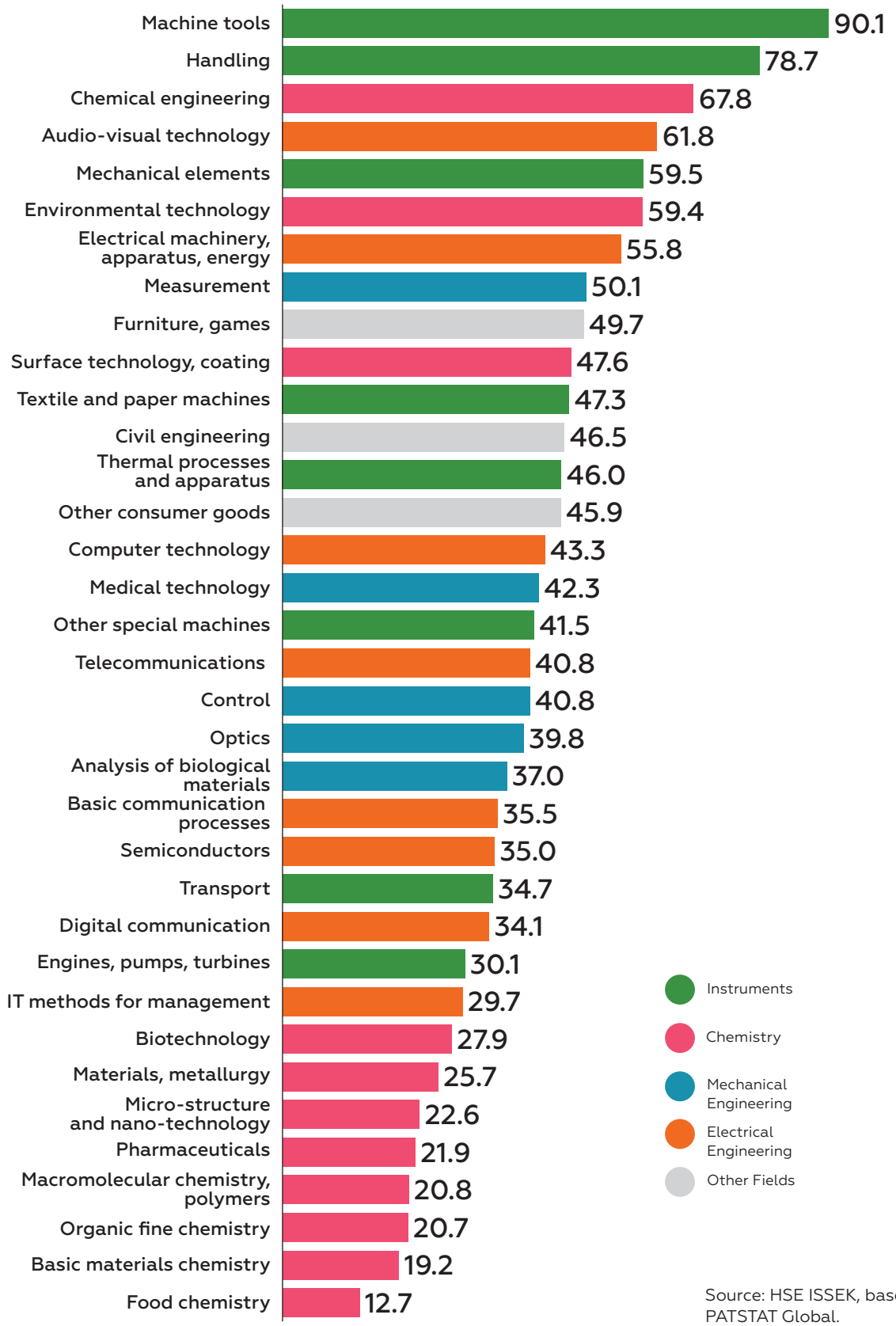
Global innovation centers are making the greatest contributions to the creation of new digital and industrial technologies, but the majority of them are specializing in health technologies

The top 50 HSE GCII 2024 cities create 38.1% of the world's total flow of patent applications, which is slightly higher than the same indicator for scientific publications – 36.6%.
At the same time, the concentration of technologies in these highly innovative cities turned out to be significantly higher than of science. For example, they have the majority of world patents in such technological areas as machine tools (90.1%), handling (78.7%), chemical engineering (67.8%), audio-visual technology (61.8%), and mechanical elements (59.5%) (Figure 19), whereas in neuroscience their share comprises 47.8%.
In many aspects, such technological domination of megacities is provided by the Chinese cities that are superleaders in the number of patents – Suzhou, Shenzhen, Shanghai, Beijing, and Guangzhou.

Global innovation centers contribute the least in 8 out of 11 technological areas related to chemistry (for example, food chemistry – 12.7%, basic materials chemistry – 19.2%, organic fine chemistry – 20.7%), which is quite possibly related to limitations in the practical application of these technologies in highly urbanized territories.

The technological portfolio of the top 50 HSE GCII 2024 cities is more diversified than the scientific portfolio. The share of the largest technological areas – computer science; electrical machinery, apparatus, energy; and machine tools – account for 9.9%, 8.2%, and 6.8%, respectively, in the total number of patent applications of the cities under consideration (Table 13), which cumulatively account for 24.9% of the total flow of the cities. For patents, the share of scientific publications in medicine alone exceeded 30%.

Figure 19. Top 50 HSE GCII 2024
Cities' Contribution to the Total Number of Patent Applications Filed Worldwide by Technological Area: 2019–2021, %



Source: HSE ISSEK, based on PATSTAT Global.

Table 13. Key Indicators in the Subject Structure of the Top 50 HSE GCII 2024 Cities' Patent Applications: 2019–2021

Technological area	Share of the technological area in the city's total number of patent applications	Number of cities with a specialization in the technological area	Top five cities by the Technological Specialization Index value
Computer technology	9.9	21	New York (3.18), San Francisco (2.92), Dubai (2.22), Beijing (2.11), Toronto (1.92)
Electrical machinery, apparatus, energy	8.2	15	Nagoya (2.82), Osaka (2.09), Shenzhen (1.81), Taipei (1.79), Munich (1.75)
Machine tools	6.8	13	Suzhou (4.51), Guangzhou (2.78), Hangzhou (2.70), Chengdu (2.43), Wuhan (2.30)
Measurement	6.5	15	Oslo (2.03), Wuhan (1.70), Nanjing (1.63), Munich (1.60), Moscow (1.52)
Handling	5.5	17	Suzhou (2.95), Guangzhou (2.55), Hangzhou (2.26), Shanghai (2.13), Hamburg (1.98)
Medical technology	4.8	31	Warsaw (9.21), Copenhagen (3.43), Boston (3.31), Los Angeles (2.77), Moscow (2.56)
Chemical engineering	4.8	17	Mumbai (2.54), Hangzhou (2.35), Suzhou (2.31), Nanjing (2.13), Chengdu (1.95)
Audio-visual technology	4.0	19	Bangkok (3.27), Copenhagen (2.98), Shenzhen (2.72), Taipei (2.50), Singapore (2.30)
Civil engineering	4.0	16	Dubai (1.84), Shanghai (1.66), Chengdu (1.55), Wuhan (1.52), Budapest (1.46)
Digital communication	3.9	20	Stockholm (11.26), Helsinki (6.85), Singapore (2.65), San Francisco (2.57), Hong Kong (2.39)
Other special machines	3.6	16	Mumbai (1.86), Sydney (1.60), Hamburg (1.53), Moscow (1.52), Vienna (1.47)
Transport	3.4	15	Nagoya (5.50), Hamburg (3.54), Berlin (2.76), Chicago (2.35), Madrid (1.85)
Mechanical elements	3.2	17	Suzhou (2.00), Nagoya (1.87), Hangzhou (1.87), Shanghai (1.72), Chicago (1.52)
Furniture, games	2.7	15	Istanbul (2.82), Hangzhou (2.34), Los Angeles (2.33), Guangzhou (2.24), Hong Kong (1.60)

(continued)

Technological area	Share of the technological area in the city's total number of patent applications	Number of cities with a specialization in the technological area	Top five cities by the Technological Specialization Index value
Environmental technology	2.6	11	Nanjing (2.36), Prague (2.22), Shanghai (1.82), Suzhou (1.75), Wuhan (1.73)
Semiconductors	2.3	12	Seoul (3.46), Taipei (2.80), Tokyo (2.75), Singapore (2.04), New York (1.86)
Control	2.2	10	Sydney (4.44), Nagoya (2.31), Munich (2.11), Berlin (1.38), Chicago (1.29)
Optics	2.0	13	Bangkok (12.44), Tokyo (3.22), Singapore (3.10), Osaka (2.17), Budapest (1.74)
Other consumer goods	1.9	21	London (4.82), Istanbul (4.66), Hamburg (1.97), Hong Kong (1.90), Shenzhen (1.90)
Thermal processes and apparatus	1.7	11	Istanbul (3.20), Guangzhou (1.64), Hangzhou (1.33), Munich (1.30), Osaka (1.27)
IT methods for management	1.7	15	Toronto (2.97), New York (2.89), Washington, D.C. (2.40), Chicago (2.19), Dubai (1.85)
Surface technology, coating	1.6	22	Amsterdam (4.88), Dubai (3.22), São Paulo (1.90), Suzhou (1.78), Tokyo (1.76)
Telecommunications	1.6	22	Stockholm (4.97), Helsinki (4.30), Singapore (1.83), Taipei (1.71), Bangkok (1.70)
Textile and paper machines	1.5	13	São Paulo (5.27), Helsinki (3.12), Hangzhou (2.21), Tokyo (1.95), Suzhou (1.67)
Pharmaceuticals	1.5	33	Melbourne (6.07), Budapest (6.02), Madrid (4.83), Barcelona (4.81), Copenhagen (4.43)
Biotechnology	1.4	29	Copenhagen (7.21), Budapest (5.09), Boston (4.53), Washington, D.C. (4.15), Barcelona (3.84)
Materials, metallurgy	1.3	8	Oslo (2.34), Amsterdam (1.77), São Paulo (1.43), Moscow (1.41), Madrid (1.33)
Engines, pumps, turbines	1.3	12	London (4.64), Nagoya (3.29), Hamburg (3.27), Barcelona (3.11), Warsaw (3.01)
Basic materials chemistry	1.0	12	Mumbai (2.02), São Paulo (1.98), Copenhagen (1.95), Hamburg (1.91), Amsterdam (1.71)

(continued)

Technological area	Share of the technological area in the city's total number of patent applications	Number of cities with a specialization in the technological area	Top five cities by the Technological Specialization Index value
Organic fine chemistry	0.9	24	Budapest (3.92), São Paulo (3.23), Prague (3.16), Paris (2.72), Hamburg (2.63)
Macromolecular chemistry, polymers	0.7	10	Vienna (9.11), Bangkok (7.22), Mumbai (5.30), São Paulo (2.91), Milan (2.62)
Analysis of biological materials	0.5	27	Barcelona (4.54), Madrid (4.23), Melbourne (3.34), Moscow (3.25), Washington, D.C. (2.80)
Basic communication processes	0.4	18	Munich (3.55), Osaka (3.10), Los Angeles (2.54), Singapore (2.48), Stockholm (2.31)
Food chemistry	0.4	10	Prague (4.55), Copenhagen (3.04), Sydney (2.88), Moscow (1.76), Amsterdam (1.68)
Micro-structure and nano-technology	0.1	14	São Paulo (4.32), Moscow (3.00), Madrid (2.36), Munich (2.33), Singapore (2.08)

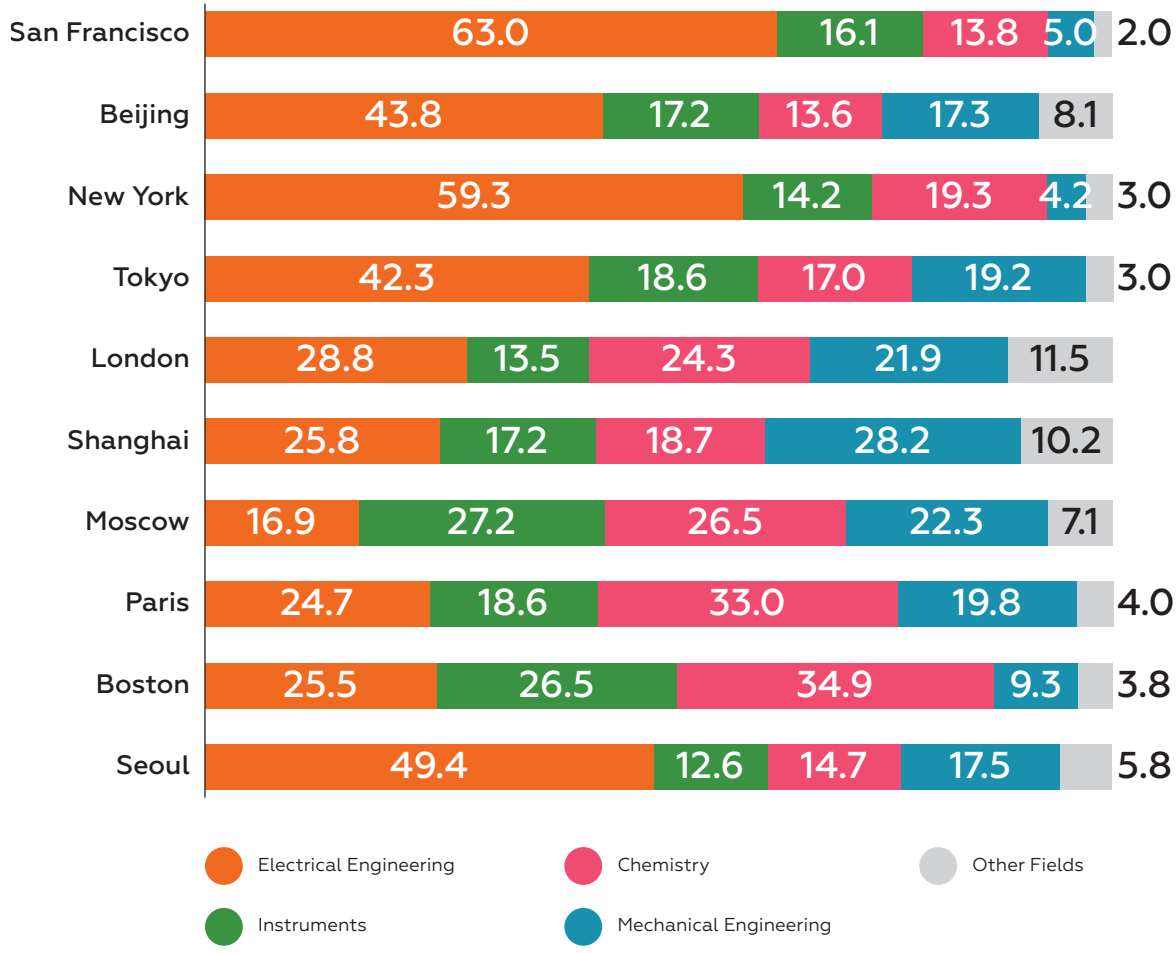
Source: HSE ISSEK, based on PATSTAT Global.

The significant weight of electrical engineering areas (in particular, computer technology; electrical machinery, apparatus, energy; audio-visual technology, etc.) in the total technological profile of HSE GCII 2024 cities can be explained by the fact that these are the specialization areas of leading innovation centers represented by the largest city agglomerations with an average population of 19 million people (Figure 20).

For example, computer technology holds almost a third of the patent applications in New York (32.2%) and San Francisco (29.5%), the largest share of this technological area is also in Beijing (21.3%). Such megacities like Shenzhen, Taipei, and Seoul are specializing on the area of electrical machinery, apparatus, and energy (11.8% of the total number of city patent applications, 11.6%, and 10.4%, respectively).

Despite the significant contribution of megacities to ICT, the most widespread specialization among the cities under consideration, similarly to the scientific publications, were areas related to human health – pharmaceuticals (33 cities out of 50), medical technology (31), biotechnology (29), and the analysis of biological materials (27) (Figure 21). For instance, a significant share of pharmaceutical technologies is typical for such cities as Melbourne (18.3%), Budapest (18.2%), Madrid (14.6%), Barcelona (14.6%), and Copenhagen (13.4%); medical technology prevails in Warsaw (46.4%), Copenhagen (17.3%), and Boston (16.7%). Unlike the ICT leaders, these cities are smaller: the scale is 4 million people per one medical technology center on average.

Figure 20. Subject Structure of Patent Applications in the Top 10 HSE GCII 2024 Cities by the Technological Development Subindex: 2019–2021, %

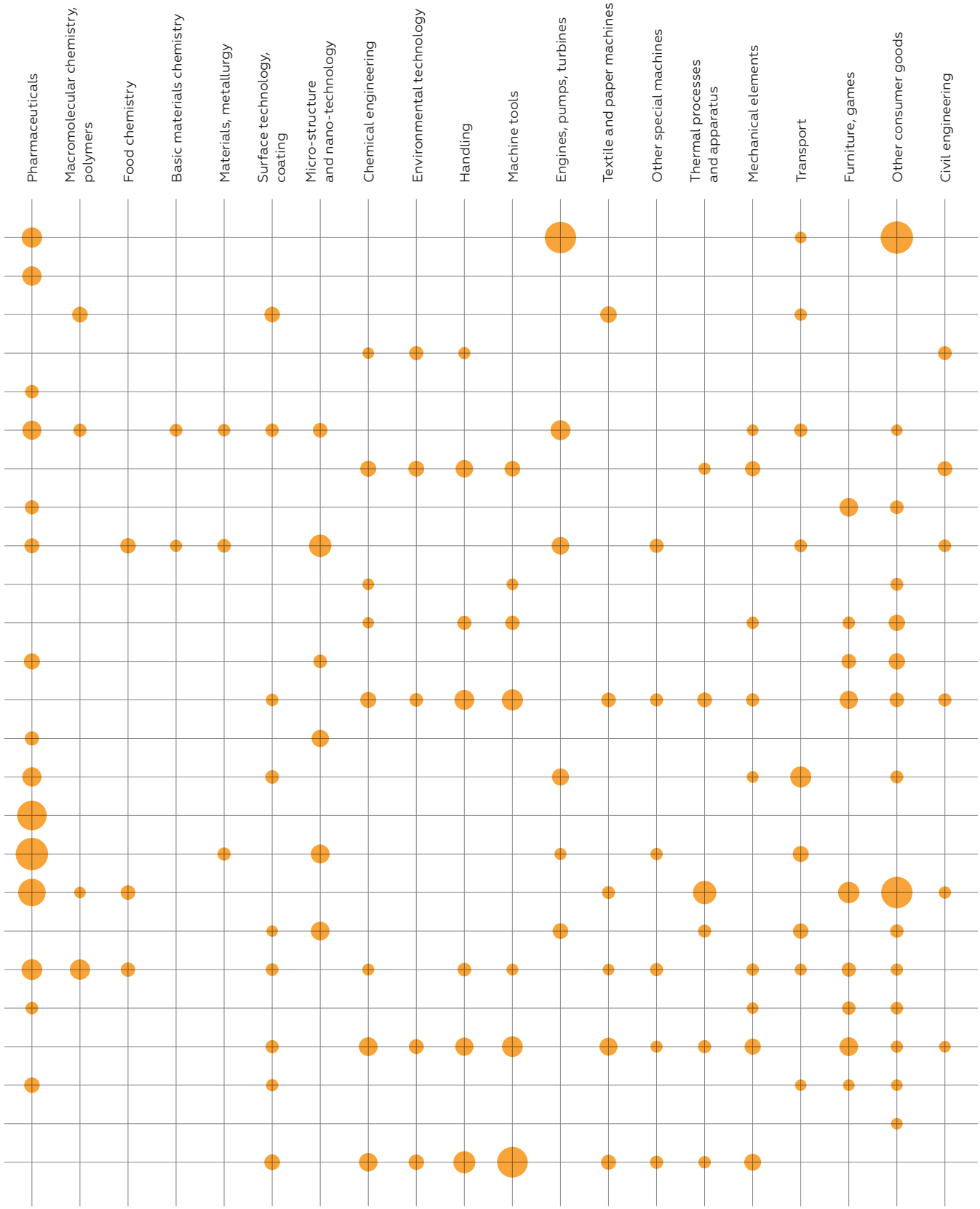


Source: HSE ISSEK, based on PATSTAT Global.

For several technological areas, as well as for research areas, it is possible to identify clear macro-regional priorities. Thus, chemical engineering prevails in the sector-specific portfolios of Asian cities – Mumbai (7.9%), Hangzhou (7.3%), Suzhou (7.2%), Nanjing (6.6%), and Chengdu (6.1%). The lowest share of this area, on the contrary, was noted in European and US cities – Stockholm (0.2%), San Francisco (0.9%), Budapest (1.0%), Munich (1.2%), and Los Angeles (1.5%). Such a pattern reveals itself in machine tools as well: the leaders are Suzhou (15.0%), Guangzhou (9.3%), Hangzhou (9.0%), Chengdu (8.1%), and Wuhan (7.7%), whereas, the underdogs are Sydney (0.2%), New York (0.3%), San Francisco (0.4%), Copenhagen, and Helsinki (0.5% each). The reverse situation is observed in biotechnology. Their largest weight is documented in Copenhagen (16.3%), Budapest (11.5%), Boston (10.3%), Washington, D.C. (9.4%), and Barcelona (8.7%), the lowest was observed in Nagoya (0.4%), Shenzhen (0.6%), Suzhou (0.6%), Hangzhou, and Guangzhou (0.7% each).

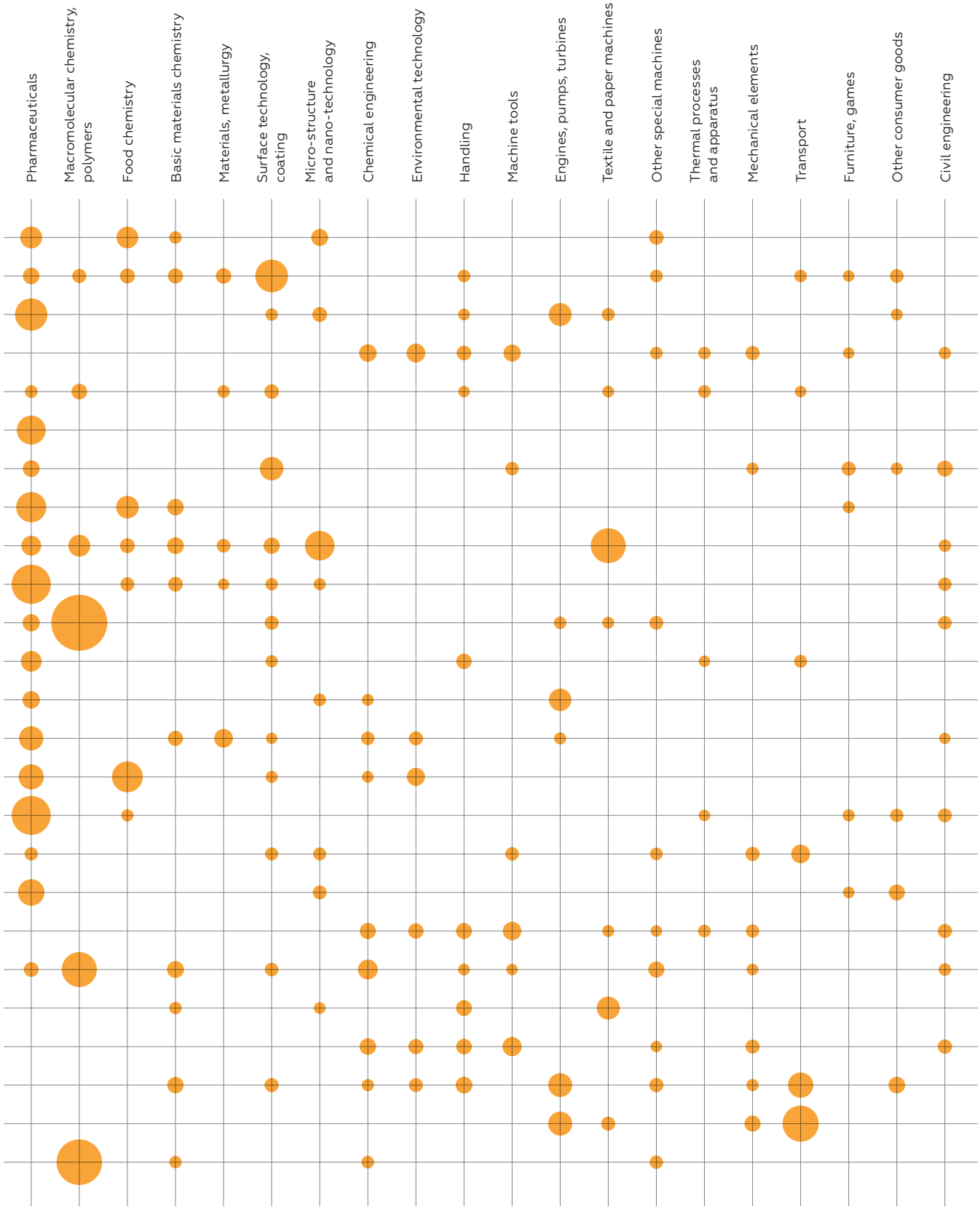
Figure 21. Top 50 HSE GCII 2024 Cities' Areas of Technological Specialization: 2019–2021*

* For each city, the illustration marks areas with TSI not lower than 1, signifying the city's scientific specializations. The size of the bubble correlates with the TSI value.


Pharmaceuticals
Macromolecular chemistry, polymers
Food chemistry
Basic materials chemistry
Materials, metallurgy
Surface technology, coating
Micro-structure and nano-technology
Chemical engineering
Environmental technology
Handling
Machine tools
Engines, pumps, turbines
Textile and paper machines
Other special machines
Thermal processes and apparatus
Mechanical elements
Transport
Furniture, games
Other consumer goods
Civil engineering

Electrical machinery, apparatus, energy
Audio-visual technology
Telecommunications
Digital communication
Basic communication processes
Computer technology
IT methods for management
Semiconductors
Optics
Measurement
Analysis of biological materials
Control
Medical technology
Organic fine chemistry
Biotechnology
Sydney
Amsterdam
Barcelona
Nanjing
Osaka
Washington, D.C.
Dubai
Copenhagen
São Paulo
Melbourne
Vienna
Montreal
Warsaw
Oslo
Prague
Budapest
Chicago
Vancouver
Wuhan
Mumbai
Helsinki
Chengdu
Hamburg
Nagoya
Bangkok

(continued)



Source: HSE ISSEK, based on PATSTAT Global.

Built on Microchips

What helps Beijing expand its influence on the global market of semiconductors

Integrated circuits[1] are paramount for modern manufacturing. Microchips hidden from the naked eye of the ordinary user are indispensable elements of various devices and mechanisms – from electronics and household appliances to cars and spaceships. Semiconductors have strategic importance for plenty of other sectors of the economy, are deeply integrated into global production chains, and are listed by most developed countries as a critical technology.

The global model of semiconductor industry has led to asymmetric and interdependent relations, with China as the central link in semiconductor production and countries like the United States, Japan, Republic of Korea, and Netherlands as the ones controlling key factors for their production. During this industry's initial stages, China relied on the international division of labor and acted as the "world factory" for leading companies of the sector. Consequently, China became significantly import dependent on underlying technologies, key components, and specific equipment to produce high performance microchips. When affected by geopolitical factors, the country risked losing its technological independence if it continued following this development pattern and the industry itself could be jeopardized by uncertainty.

China began making microchips in the middle of the 20th century, but it took a while before the government started providing coordinated funding for the semiconductor industry. Only after 2014 did it develop a holistic set of policy measures to localize the entire production chain in Mainland China, outlined milestones for the industry's development up to 2025 and 2035, and "appointed" a flagship city for the entire industry – Beijing.

Beijing's integrated circuits industry, as does its entire high tech sector, advances according to five-year development plans containing special mechanisms, programs, and strategies to be implemented on Beijing's territory. Thus, the 14th Five-Year Plan Period listed the integrated circuits industry as the Celestial Empire's main specialization.[2] Until 2035, Beijing is supposed to take the leading role in implementing the new nationwide industrialization and informatization policy, upgrade the industrial control system, use smart and green production methods, and create a new industrial cooperation model in the Beijing-Tianjin-Hebei region. As suggested by the outlined

[1] Here and below, the terms "integrated circuit designs" and "microchips" are used interchangeably.

[2] Notice of the Beijing Municipal People's Government on Issuing the "Beijing High-tech Industry Development Plan for the 14th Five-Year Plan Period." (In Chinese). Available: https://www.gov.cn/xinwen/2021-08/18/content_5631916.htm (Accessed: 12.07.2024).

goals, the high tech sectors' share in the value added of Beijing's GRP must exceed 30%, and by 2035 – surpass the mark of 40%; the planned number of industrial clusters with a total output of over 1 trillion yuan (around 136 billion USD) must grow to four or five by 2025 and eight or ten by 2035; the share of R&D expenditures in the high technology companies' revenue – to 8.5% and 10%, respectively.

In 2021, an additional strategy was developed for Beijing's high tech industry – "2441." Every figure in the name has symbolic meaning: two leading industries, upon whose development the city is betting; four key sectors of high tech manufacturing, including microchips; four sectors of disruptive intellectual services; and one goal – Beijing as the leading global high tech center[1] (Table 14).

Table 14. Beijing's High Tech Manufacturing Development Strategy – "2441"

Two leading economy sectors	Four sectors of "Beijing's high tech manufacturing"
1 New generation information technology	1 Integral circuits
2 Biotechnology	2 Connected smart cars
	3 Intelligent production and equipment
	4 Green energy and energy-saving technology

Four sectors of "Beijing's intellectual services"	One goal
1 Blockchain and advanced computing	Beijing's status as the leading global high tech center
2 Technological services	
3 Smart city	
4 Information consumption	

Source: HSE ISSEK, based on the official website of the State Council of China.

Along with overall planned indicators and sectoral milestones, key priorities in the development of Beijing's semiconductor industry were determined. For example, by 2025, corporate revenue from developing and manufacturing integrated circuits must reach 300 billion yuan (around 41.5 billion USD).[2] Key areas of the microchip industry development include:

[1] 2024 Beijing Future Industry Panorama (with industrial development status, spatial layout, development direction, etc.). (In Chinese). Available at: https://m.askci.com/news/chanye/20240222/175658270859560866237844.shtml (Accessed: 12.07.2024).

[2] Panorama of Beijing's integrated circuit industry chain in 2023 (with industrial policy, chain status map, resource spatial layout, chain development plan). (In Chinese). Available at: https://www.qianzhan.com/analyst/detail/220/230119-ea83af86.html (Accessed: 12.07.2024).

- establishing the national innovation platform and combining the industry's leading enterprises and R&D organizations;
- engineering microchips with different architectures;
- building specialized production chains, developing microelectromechanical systems and compound semiconductor technology;
- constructing the Beijing Industrial Park with the best-in-the-country hardware testing site;
- introducing a system for appointing chief experts in the sector, training highly skilled personnel in the key fields (Table 15).

Table 15. Beijing's Priorities for Developing the Semiconductor Industry

General development program	Creating the two zones of Beijing's economic and technological development – the Haidian and Shunyi Districts – an industrial cluster that is commercially competitive on the global market, which encompasses design, material preparation, integrated circuits, and equipment
Innovative integrated circuit platform	Creating in Beijing a nationwide innovative platform with the industry's leading enterprises and R&D organizations for the purpose of supporting R&D, testing basic advanced technologies, new storage devices, processors, and high-performance image sensors
Designing integrated circuits	Conducting R&D in Haidian on high performance processors, FPGAs (field-programmable gate arrays), DSPs (digital signal processors), and other general-purpose circuits, as well as EDA (electronic design automation). Developing microchips for household and automobile electronics, Industrial Internet, ultra-HD video, and other areas. Funding leading tech developer companies that create industrial innovation centers
Producing integrated circuits	Developing integrated circuit manufacturing within the cluster. Funding Beijing's economic and technological development zones and the Shunyi District in building production chains for advanced technologies and developing microelectromechanical systems and compound semiconductor production technology
Equipment for producing integrated circuits	Constructing the Beijing Industrial Park specializing in integrated circuits design. Creating the best-in-the-country hardware testing site in the Park; arranging the manufacturing of plant and equipment platforms for lithographic presses, the optimization of the production chain
Attracting and training personnel	Introducing a system for appointing chief experts in key sectors, including integrated circuit manufacturing; implementing pilot projects on the cooperation of industrial sector enterprises and educational institutions; training personnel in the key fields

Source: HSE ISSEK, based on the official website of the State Council of China.

Since 2014, Beijing has been gradually developing a holistic set of government funding programs for manufacturing integrated circuits. During this time, the municipal government published a notice on "Beijing's Selected Measures to Further Promote the Software and Integrated Circuit Industry Development." The document outlines measures to build an industry-specific cluster, construct the Integrated Circuit Desing Park in

the innovative supercluster Zhongguancun, an industrial park in the southern part of the Hi-Tech Industrial Belt (Daxing District), to attract venture capital, including foreign, to promote the cooperation of companies in designing and producing integrated circuits.[1]

To focus the government funding on the industry's leading participants, an accreditation system was developed. Companies fulfilling the following criteria will be awarded special status: the revenue stream from the sales of integrated circuits and goods and services associated with their production – at least 60% of the company's total revenue; R&D expenditure – at least 6% of the total volume of operating earnings; R&D expenditure on China's territory – at least 60% of the total R&D expenditure; have rights to intellectual property assets; have a management system controlling product quality, production and operating sites, software and hardware to design integrated circuits, and support tools.

Microelectronics were developed in Beijing largely on the grants of the High Tech Industry Fund. In 2022, the Manual on the Usage of the Fund's Grants was published, listing funding programs that were supposed to help with first stage of import phase-out and substitute the equipment and tools to design integrated circuits. In particular, the following advantages were available for companies: tax holidays; preferential loans for key investment projects; bonuses for developing equipment and tools to design integrated circuits; rewards within the "100 New Smart Manufacturing Sites" project; grants for the partial reimbursement of costs associated with paying insurance premiums (automotive chips); grants for the financial leasing of advanced manufacturing enterprises; incentives to rebuild and use old factory buildings; grants for purchasing EDA by enterprises producing integrated circuits; and rewards for modernizing enterprises[2] (Table 16).

For the purpose of making high tech companies sustainable, the Celestial Empire's capital created favorable conditions for attracting investments from various public and private sources. For example, the municipal platform Beijing Industrial Developing Investment Management, which is designed to develop Beijing's advanced manufacturing sectors, coordinates the work of private investment funds.

In 2014, a fund to develop the semiconductor industry in Beijing was founded – Beijing Integrated Circuit Industry Development Equity Investment Fund for a total volume of 30 billion yuan (around 4.1 billion USD). Its shareholders became Zhongguancun Development Group, a government-controlled fund, and the Beijing Shengshi Hongming Investment Fund Management, a private investment fund.[3]

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[1] The Study on the Development of the Beijing Microchip Industry. (In Chinese). Available at: https://www.changfeng.org.cn/data/admin/enclosure/2022-04-29/626ba6d4e58f5.pdf (Accessed: 12.07.2024).

[2] Instructions for application for first-round tape-out awards for integrated circuit design products. (In Chinese). Available at: https://www.ncsti.gov.cn/zcfg/zcwj/202303/t20230301_109723.html (Accessed: 12.07.2024).

[3] Beijing Integrated Circuit Industry Development Equity Investment Fund. (In Chinese). Available at: https://www.qcc.com/firm/d96f8034aba575f4b7e9749317bd87a2.html (Accessed: 12.07.2024).

Table 16. Selected Government Funding Programs for Beijing's Enterprises Specializing in Designing and Producing Integrated Circuits and Associated Equipment

Funding program	About
Tax holidays[1]	Enterprises engaged in integrated circuit design are exempt from paying corporate tax for the first two years of operation. In years 3 to 6 they pay a corporate tax at a reduced rate, the discounted amount dependent upon the type of integrated circuit produced by the enterprise
Preferential loans for key investment projects[2]	Enterprises in key industry sectors that invested over 5 million yuan (around 682 thousand USD) in fixed assets and received investment loans from banks, R&D investment loans, or other medium- and long-term loans, obtain a discounted interest rate not exceeding 2% Enterprises leading in the sectoral supply chain that received working capital loans from banks obtain a discounted interest rate not exceeding 1% The maximum yearly discount amount per enterprise in monetary terms shall not exceed 10 million yuan (around 1.4 million USD)
Grants for the partial reimbursement of insurance premium costs[3]	Grants are given to companies producing innovative products. The maximum grant amount shall not exceed 10 million yuan and 50% of the actual yearly insurance premium. The grant term shall not exceed a three-year period
Grants for financial leasing[4]	Priority support is given to advanced manufacturing enterprises to pay for the leasing of equipment and production lines used in research, development, construction, and production. Each enterprise that documents in a financial leasing agreement a payment for a sum of at least 10 million yuan, obtains yearly grants in the amount not exceeding 5% of the contract price and no more than 10 million yuan over a three-year period
Rewards within the "100 New Smart Manufacturing Sites" project (2021–2025)[5]	Projects with a construction period of under three years and investment in fixed assets of over 5 million yuan obtain multi-tier financial premiums: ● projects of intellectual transformation of technologies that satisfy Beijing's performance requirements – up to 20% of the sum of investment in fixed assets

[1] Announcement on the corporate income tax policy to promote the high-quality development of the integrated circuit industry and the software industry. (In Chinese). Available at: https://www.gov.cn/zhengce/zhengceku/2020-12/17/content_5570401.htm (Accessed: 12.07.2024).

[2] Notice of the Beijing Municipal Bureau of Economy and Information Technology and the Beijing Municipal Bureau of Finance on organizing and carrying out the application for funds for the development of high-tech industries in Beijing in 2024. (In Chinese). Available at: https://www.beijing.gov.cn/zhengce/zhengcefagui/202401/t20240122_3542235.html (Accessed: 12.07.2024).

[3] It is an integrated circuit enterprise that supports high-tech Zhongguancun innovative enterprises to carry out research and development. (In Chinese). Available at: https://www.beijing.gov.cn/fuwu/lqfw/ztzl/zsyzzcfwb/xydxxjscy/sj/zczc/202305/t20230518_3106496.html (Accessed: 12.07.2024).

[4] Beijing Municipal Peoples' Government. (In Chinese). Available at: https://www.beijing.gov.cn/ (Accessed: 12.07.2024).

[5] Beijing's "New Intelligent Manufacturing 100" Project Implementation Plan (2021-2025). (In Chinese), Available at: https://www.autothinker.net/editor/attached/file/20210901/20210901181223_11182.pdf (Accessed: 12.07.2024).

(continued)

Funding program	About
	• projects of construction or design update that satisfy Beijing' standards for "Digital Workshops" and "Smart Factories" – up to 25% • projects of construction or technological redesign that are certified by the World Economic Forum as a Lighthouse Factory and satisfy standards of Benchmark Intelligent Manufacturers – up to 30% Reward amount shall not exceed 30 million yuan a year per enterprise[1]
Budget appropriations	Companies specializing in integrated circuits that support the R&D of innovative products in Zhongguancun and acquire EDA software, including costs on software updates, may claim the partial reimbursement of procurement costs. The maximum reimbursement amount shall not exceed to 5 million yuan Some projects may obtain grants in the maximum amount of 50 million yuan (around 6.8 million USD)

Source: HSE ISSEK, based on the official website of the State Council of China.

The activities of the Beijing Yizhuang International Investment Development are aimed at servicing the Beijing Economic-Technological Development Area (BETDA). As of the end of 2023, is manages 199 investment projects for a total funding amount exceeding 89.5 billion yuan (around 12.2 billion USD).

CDB Capital owned by China Development Bank specializes in funding innovation in high performance equipment, new generation IT, smart manufacturing, biomedicine, and other sectors through the China Integrated Circuit Industry Investment Fund, CDB Science and Technology Fund, and the CDIC Kaiyuan Fund. As of the end of 2021, the total investment volume of the company was over 290 billion yuan (around 39.6 billion USD).

Today, Beijing has completed building the entire production chain for making integrated circuits on its territory by determining the specialization of three major centers: Haidian District, as known as the Chinese Silicon Valley, is responsible for design; Daxing District, which is part of BETDA, is focused on production; the Shunyi District makes third generation semiconductors.

> The three districts of the Chinese capital – Haidian, Daxing, and Shunyi – deliver the full production cycle for integrated circuits.

[1] Support Policy Package for the Intelligent Manufacturing and Equipment Industry. (In Chinese). Available at: https://english.beijing.gov.cn/latest/specials/policypackages/ime/202305/t20230524_3112095.html (Accessed: 12.07.2024).

Most of Beijing companies that develop integrated circuits are based in Haidian. Among them are: Semiconductor Manufacturing International Corporation, Datang Microelectronics, Sugon, Loongson Zhongke, Beidazhi, Ingenic, Vimicro, and Shengbang Microelectronics. The main landmark of the district is the Zhongguancun Integrated Circuit Desing Park that implements dozens of key projects.[1]

BETDA completes the full chain of producing integrated circuits, including design, fabrication of wafers, equipment, components and materials, packaging, and testing. It allied the leading companies in the industry, such as SMIC, Unisoc, and Northern Huachuang. Here the first production line for making 12-inch integrated circuit wafers was built in the country. Shunyi is striving to create an open international public platform for research and development and technological innovation. This district has a special center on an area of 71,000 square meters and a fund to finance third generation semiconductors in the amount of 10 billion yuan (around 1.4 billion USD).

The number of Beijing companies that are associated with the integrated circuit industry now constitute only 1% of their total number in the whole of China, which is significantly lower than in Guangdong, Fujian, Jiangsu, and other provinces. At the same time, the average cost of making microchips in the capital is relatively low: Beijing's share in the total country-wide production volume of is 10%.[2] The city's targeted policy to localize the manufacturing of integrated circuits, lower import dependence, and support leading participants in the industry turned out to rather effective. Today, Beijing's companies are successfully competing with global players in the segment of high-performance integrated circuits used in critically important sectors, such as aerospace, defense, and medicine.

> Beijing accounts for 10% of China's semiconductor industry.

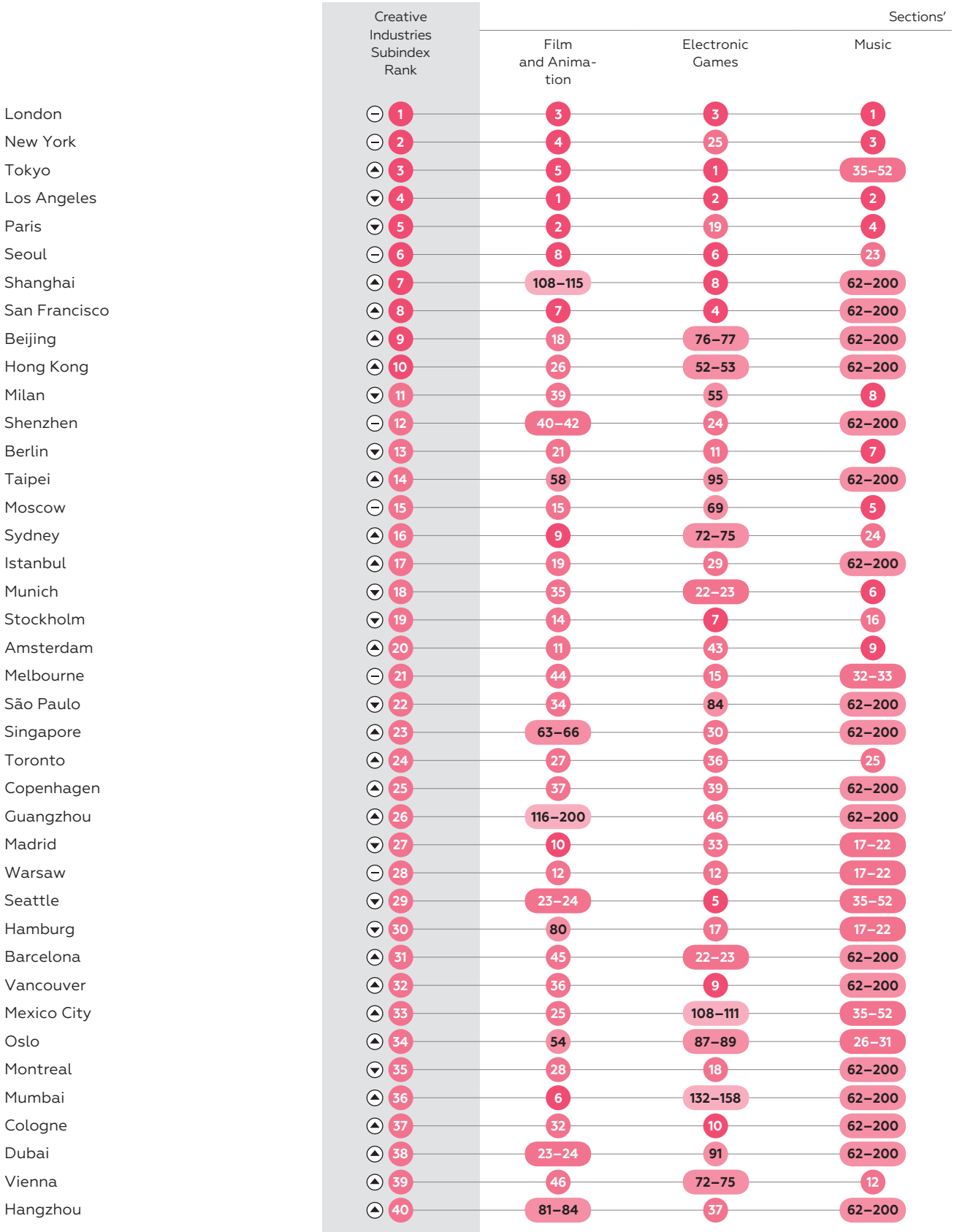
[1] The Study on the Development of the Beijing Microchip Industry. (In Chinese). https://www.changfeng.org.cn/data/admin/enclosure/2022-04-29/626ba6d4e58f5.pdf (Accessed: 12.07.2024).

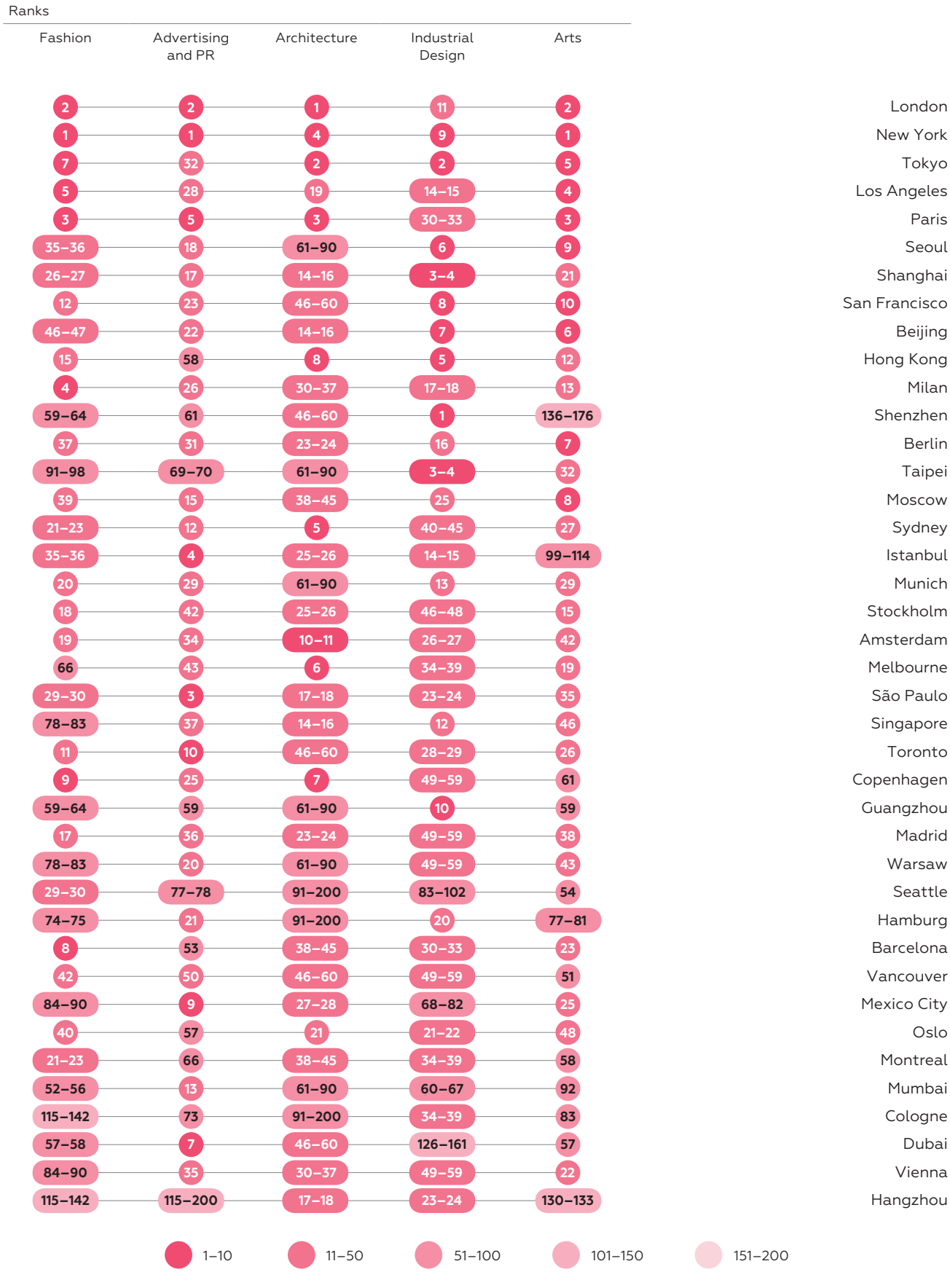
[2] Focus on Chinese industries: Panoramic analysis of the integrated circuit industry in Beijing's featured industries in 2022 (with industry spatial layout, development status and goals, and competitiveness analysis). (In Chinese). Available at: https://www.qianzhan.com/analyst/detail/220/211124-9bbbce6f.html (Accessed: 12.07.2024).

3

Creative Industries

Cities' Ranking by the Creative Industries Subindex: 2024




Ranks
Fashion
Advertising and PR
Architecture
Industrial Design
Arts
2 2 1 11 2 London
1 1 4 9 1 New York
7 32 2 2 5 Tokyo
5 28 19 14–15 4 Los Angeles
3 5 3 30–33 3 Paris
35–36 18 61–90 6 9 Seoul
26–27 17 14–16 3–4 21 Shanghai
12 23 46–60 8 10 San Francisco
46–47 22 14–16 7 6 Beijing
15 58 8 5 12 Hong Kong
4 26 30–37 17–18 13 Milan
59–64 61 46–60 1 136–176 Shenzhen
37 31 23–24 16 7 Berlin
91–98 69–70 61–90 3–4 32 Taipei
39 15 38–45 25 8 Moscow
21–23 12 5 40–45 27 Sydney
35–36 4 25–26 14–15 99–114 Istanbul
20 29 61–90 13 29 Munich
18 42 25–26 46–48 15 Stockholm
19 34 10–11 26–27 42 Amsterdam
66 43 6 34–39 19 Melbourne
29–30 3 17–18 23–24 35 São Paulo
78–83 37 14–16 12 46 Singapore
11 10 46–60 28–29 26 Toronto
9 25 7 49–59 61 Copenhagen
59–64 59 61–90 10 59 Guangzhou
17 36 23–24 49–59 38 Madrid
78–83 20 61–90 49–59 43 Warsaw
29–30 77–78 91–200 83–102 54 Seattle
74–75 21 91–200 20 77–81 Hamburg
8 53 38–45 30–33 23 Barcelona
42 50 46–60 49–59 51 Vancouver
84–90 9 27–28 68–82 25 Mexico City
40 57 21 21–22 48 Oslo
21–23 66 38–45 34–39 58 Montreal
52–56 13 61–90 60–67 92 Mumbai
115–142 73 91–200 34–39 83 Cologne
57–58 7 46–60 126–161 57 Dubai
84–90 35 30–37 49–59 22 Vienna
115–142 115–200 17–18 23–24 130–133 Hangzhou
1–10
11–50
51–100
101–150
151–200

Creative Industries Subindex Rank
Sections'
Film and Animation
Electronic Games
Music
Budapest 41 29 63 62–200
Stuttgart 42 60–62 51 62–200
Boston 43 90 60 62–200
Zürich 44 55–56 28 26–31
Auckland 45 86–89 52–53 62–200
Frankfurt am Main 46 81–84 13 13–14
Washington, D.C. 47 22 40 35–52
Chicago 48 108–115 57 32–33
Dublin 49 71 96–104 62–200
Atlanta 50 49 35 11
Geneva 51 43 93 26–31
Bogotá 52 63–66 132–158 62–200
Brussels 53 16 112–117 10
Kyiv 54 13 70–71 62–200
Osaka 55 81–84 32 62–200
Dallas 56 116–200 14 62–200
Helsinki 57 63–66 49 62–200
Düsseldorf 58 86–89 27 62–200
Bucharest 59 31 34 62–200
Santiago 60 91–107 87–89 53–61
Prague 61 33 20 62–200
Buenos Aires 62 38 159–200 34
Rome 63 17 72–75 53–61
Suzhou 64 76–79 21 62–200
Lima 65 91–107 130–131 62–200
Athens 66 63–66 96–104 35–52
Bangkok 67 72–75 68 62–200
Miami 68 91–107 108–111 15
Rio de Janeiro 69 20 107 53–61
Porto 70 81–84 159–200 62–200
Tehran 71 52 159–200 62–200
Taichung-Changhua 72 116–200 159–200 62–200
Ankara 73 91–107 31 62–200
Essen-Dortmund 74 116–200 44 35–52
Birmingham 75 116–200 26 17–22
Antwerp 76 116–200 108–111 26–31
Lisbon 77 68–70 132–158 62–200
Kuala Lumpur 78 40–42 76–77 62–200
Cape Town 79 76–79 120–129 13–14
Aarhus 80 116–200 59 62–200
Rank Change
1–10
11–50
51–100
101–150
151–200

(continued)

Ranks

Fashion	Advertising and PR	Architecture	Industrial Design	Arts	
99–114	40–41	91–200	19	69–73	Budapest
91–98	105–114	27–28	17–18	136–176	Stuttgart
24	38	46–60	40–45	11	Boston
38	44	91–200	34–39	30	Zürich
78–83	14	10–11	126–161	77–81	Auckland
78–83	62–63	30–37	60–67	136–176	Frankfurt am Main
52–56	33	91–200	68–82	14	Washington, D.C.
78–83	27	46–60	46–48	16	Chicago
31–34	71–72	12–13	49–59	20	Dublin
31–34	82–85	91–200	83–102	45	Atlanta
6	115–200	61–90	68–82	52	Geneva
99–114	6	91–200	126–161	41	Bogotá
76	51	61–90	103–125	63	Brussels
73	24	91–200	68–82	136–176	Kyiv
41	105–114	30–37	49–59	50	Osaka
13–14	92–104	46–60	103–125	136–176	Dallas
91–98	30	38–45	60–67	69–73	Helsinki
28	67	61–90	46–48	177	Düsseldorf
68	19	91–200	126–161	136–176	Bucharest
115–142	16	30–37	126–161	31	Santiago
115–142	46–47	91–200	83–102	39–40	Prague
143–200	11	91–200	83–102	85–87	Buenos Aires
67	82–85	91–200	68–82	18	Rome
143–200	115–200	91–200	30–33	136–176	Suzhou
115–142	8	91–200	162–200	136–176	Lima
72	49	91–200	28–29	136–176	Athens
99–114	60	29	49–59	69–73	Bangkok
57–58	39	61–90	83–102	60	Miami
74–75	68	30–37	103–125	66	Rio de Janeiro
84–90	115–200	9	68–82	136–176	Porto
143–200	115–200	20	49–59	134	Tehran
143–200	115–200	61–90	21–22	178	Taichung-Changhua
115–142	115–200	46–60	60–67	99–114	Ankara
143–200	92–104	91–200	34–39	136–176	Essen-Dortmund
84–90	92–104	91–200	103–125	77–81	Birmingham
48–51	69–70	61–90	49–59	84	Antwerp
84–90	52	91–200	34–39	68	Lisbon
143–200	48	61–90	126–161	24	Kuala Lumpur
115–142	71–72	38–45	103–125	115	Cape Town
77	115–200	38–45	60–67	99–114	Aarhus

1–10 11–50 51–100 101–150 151–200

	Creative Industries Subindex Rank	Sections'		
		Film and Animation	Electronic Games	Music
Basel	81	91–107	132–158	62–200
Tel Aviv	82	50	120–129	35–52
Riyadh	83	116–200	16	62–200
Philadelphia	84	108–115	85–86	62–200
Lyon	85	51	47	17–22
Rotterdam	86	91–107	87–89	62–200
Manchester	87	116–200	94	62–200
Chengdu	88	116–200	41	62–200
Columbus	89	116–200	67	62–200
Brisbane	90	108–115	80–82	35–52
Kaohsiung	91	116–200	132–158	62–200
Saint Petersburg	92	60–62	108–111	35–52
Nuremberg	93	116–200	96–104	62–200
Gothenburg	94	72–75	120–129	26–31
Ho Chi Minh City	95	116–200	48	62–200
Ghent	96	60–62	42	26–31
Eindhoven	97	116–200	132–158	62–200
Nanjing	98	91–107	90	62–200
Vilnius	99	91–107	96–104	17–22
Cairo	100	40–42	78–79	62–200
Beirut	101	67	159–200	62–200
Manila	102	47	58	62–200
Delhi	103	86–89	132–158	62–200
Edinburgh	104	91–107	38	35–52
Pittsburgh	105	116–200	159–200	62–200
Houston	106	116–200	132–158	53–61
Xiamen	107	116–200	132–158	62–200
Hanover	108	116–200	61	35–52
Bologna	109	91–107	96–104	62–200
Xi'an	110	91–107	45	62–200
San Diego	111	116–200	56	62–200
Bristol	112	30	96–104	62–200
Austin	113	86–89	64	62–200
Brno	114	116–200	62	35–52
Florence	115	116–200	132–158	62–200
Dresden	116	116–200	159–200	62–200
Portland	117	48	132–158	62–200
Belgrade	118	116–200	54	62–200
Kraków	119	68–70	65	35–52
Turin	120	116–200	112–117	62–200

▼▲ — Rank Change

1–10 11–50 51–100 101–150 151–200

(continued)

Ranks

Fashion	Advertising and PR	Architecture	Industrial Design	Arts	
99–114	115–200	12–13	126–161	64	Basel
91–98	40–41	61–90	68–82	98	Tel Aviv
143–200	54–56	91–200	162–200	136–176	Riyadh
45	92–104	30–37	126–161	33	Philadelphia
52–56	115–200	91–200	126–161	99–114	Lyon
99–114	115–200	22	103–125	126–128	Rotterdam
25	86–88	61–90	126–161	28	Manchester
143–200	115–200	46–60	68–82	124–125	Chengdu
10	92–104	91–200	126–161	136–176	Columbus
143–200	92–104	46–60	68–82	69–73	Brisbane
143–200	115–200	91–200	26–27	179–200	Kaohsiung
59–64	74–76	61–90	103–125	39–40	Saint Petersburg
31–34	92–104	91–200	49–59	136–176	Nuremberg
43–44	105–114	46–60	103–125	99–114	Gothenburg
143–200	89–91	38–45	83–102	179–200	Ho Chi Minh City
115–142	105–114	61–90	126–161	130–133	Ghent
115–142	115–200	91–200	30–33	99–114	Eindhoven
143–200	115–200	91–200	40–45	89–90	Nanjing
115–142	115–200	91–200	60–67	99–114	Vilnius
143–200	45	91–200	103–125	99–114	Cairo
71	54–56	46–60	103–125	53	Beirut
115–142	89–91	46–60	126–161	82	Manila
91–98	46–47	61–90	83–102	55	Delhi
99–114	105–114	91–200	162–200	44	Edinburgh
16	89–91	61–90	126–161	77–81	Pittsburgh
31–34	65	91–200	103–125	94–97	Houston
115–142	115–200	61–90	40–45	179–200	Xiamen
48–51	115–200	61–90	126–161	136–176	Hanover
13–14	115–200	61–90	162–200	136–176	Bologna
143–200	115–200	91–200	68–82	179–200	Xi'an
78–83	115–200	91–200	103–125	47	San Diego
99–114	115–200	91–200	83–102	93	Bristol
84–90	86–88	91–200	83–102	88	Austin
143–200	115–200	91–200	83–102	89–90	Brno
21–23	115–200	91–200	103–125	67	Florence
99–114	115–200	91–200	40–45	126–128	Dresden
26–27	79–81	91–200	126–161	91	Portland
115–142	115–200	91–200	60–67	179–200	Belgrade
143–200	74–76	91–200	103–125	126–128	Kraków
69	105–114	91–200	83–102	37	Turin

1–10 11–50 51–100 101–150 151–200

	Creative Industries Subindex Rank	Sections'		
		Film and Anima-tion	Electronic Games	Music
Utrecht	121	59	96–104	62–200
Nagoya	122	116–200	159–200	62–200
New Haven	123	76–79	159–200	62–200
Perth	124	116–200	132–158	62–200
Bern	125	116–200	159–200	35–52
Jakarta	126	91–107	70–71	62–200
Chongqing	127	116–200	83	62–200
Sofia	128	55–56	159–200	62–200
Ottawa	129	57	66	35–52
Santa Barbara	130	116–200	132–158	62–200
Oxford	131	116–200	159–200	53–61
Raleigh	132	116–200	50	62–200
València	133	91–107	120–129	62–200
The Hague	134	91–107	120–129	62–200
Wuhan	135	116–200	105	62–200
Lausanne	136	91–107	112–117	35–52
Nashville	137	116–200	159–200	53–61
Leipzig	138	72–75	92	62–200
Detroit	139	116–200	159–200	53–61
Daejeon	140	116–200	159–200	62–200
Lille	141	68–70	72–75	62–200
Adelaide	142	116–200	80–82	62–200
Minneapolis	143	108–115	130–131	53–61
Malmö	144	116–200	96–104	62–200
Phoenix	145	116–200	132–158	62–200
Liverpool	146	116–200	112–117	35–52
Denver	147	108–115	120–129	62–200
Changsha	148	116–200	118	62–200
Kansas City	149	76–79	159–200	62–200
Calgary	150	116–200	78–79	62–200
Cambridge	151	116–200	80–82	62–200
Bengaluru	152	116–200	132–158	62–200
Montpellier	153	116–200	85–86	62–200
St. Louis	154	116–200	159–200	62–200
Padua	155	116–200	159–200	62–200
Tianjin	156	116–200	159–200	62–200
Hsinchu	157	116–200	159–200	62–200
Strasbourg	158	53	120–129	62–200
Leeds	159	116–200	112–117	62–200
Mainz	160	85	132–158	62–200

▼▲ — Rank Change

1–10 11–50 51–100 101–150 151–200

(continued)

Ranks

Fashion	Advertising and PR	Architecture	Industrial Design	Arts	
59–64	92–104	91–200	83–102	85–87	Utrecht
143–200	115–200	91–200	40–45	136–176	Nagoya
143–200	115–200	30–37	162–200	36	New Haven
99–114	92–104	38–45	103–125	76	Perth
43–44	92–104	91–200	83–102	129	Bern
115–142	115–200	46–60	126–161	118	Jakarta
115–142	115–200	91–200	68–82	124–125	Chongqing
91–98	54–56	91–200	68–82	179–200	Sofia
99–114	115–200	91–200	126–161	136–176	Ottawa
46–47	92–104	91–200	83–102	94–97	Santa Barbara
115–142	115–200	91–200	162–200	17	Oxford
143–200	82–85	91–200	126–161	119–123	Raleigh
91–98	105–114	91–200	68–82	99–114	València
115–142	115–200	61–90	83–102	99–114	The Hague
143–200	115–200	91–200	68–82	99–114	Wuhan
115–142	115–200	91–200	103–125	69–73	Lausanne
52–56	82–85	91–200	103–125	136–176	Nashville
143–200	115–200	61–90	126–161	99–114	Leipzig
115–142	79–81	91–200	103–125	62	Detroit
143–200	115–200	91–200	60–67	136–176	Daejeon
48–51	115–200	91–200	162–200	179–200	Lille
99–114	105–114	61–90	162–200	99–114	Adelaide
115–142	62–63	91–200	162–200	65	Minneapolis
99–114	105–114	91–200	103–125	99–114	Malmö
143–200	115–200	61–90	162–200	34	Phoenix
99–114	115–200	91–200	126–161	85–87	Liverpool
59–64	92–104	91–200	103–125	179–200	Denver
143–200	115–200	91–200	68–82	179–200	Changsha
99–114	64	61–90	126–161	179–200	Kansas City
143–200	115–200	61–90	162–200	136–176	Calgary
115–142	115–200	91–200	162–200	74	Cambridge
115–142	79–81	91–200	83–102	179–200	Bengaluru
143–200	115–200	91–200	103–125	179–200	Montpellier
52–56	77–78	91–200	162–200	116–117	St. Louis
70	115–200	91–200	103–125	136–176	Padua
143–200	115–200	91–200	83–102	130–133	Tianjin
143–200	115–200	91–200	83–102	136–176	Hsinchu
143–200	115–200	91–200	126–161	136–176	Strasbourg
115–142	115–200	91–200	162–200	56	Leeds
143–200	115–200	91–200	103–125	136–176	Mainz

1–10 11–50 51–100 101–150 151–200

	Creative Industries Subindex Rank	Sections'		
		Film and Animation	Electronic Games	Music
Jeddah	▼ 161	116–200	119	62–200
Nottingham	▲ 162	116–200	132–158	62–200
Braunschweig-Salzgitter-Wolfsburg	▼ 163	116–200	132–158	62–200
Canberra	▲ 164	116–200	106	62–200
Bordeaux	▲ 165	116–200	96–104	35–52
Ningbo	▲ 166–167	116–200	159–200	62–200
Qingdao	▼ 166–167	116–200	159–200	62–200
Grenoble	▲ 168	116–200	132–158	62–200
Venice	▼ 169	116–200	159–200	62–200
Glasgow	▼ 170	108–115	159–200	62–200
Salt Lake City	▼ 171	116–200	159–200	53–61
Madison	▲ 172	116–200	159–200	62–200
Cork	▲ 173	116–200	132–158	62–200
Ithaca	▲ 174	108–115	159–200	62–200
Luxembourg	▲ 175	72–75	120–129	62–200
Kitchener	▲ 176	116–200	132–158	62–200
Ann Arbor	– 177	116–200	159–200	62–200
Bonn	▼ 178	116–200	112–117	62–200
Dalian	▼ 179–181	116–200	159–200	62–200
Harbin	▼ 179–181	116–200	159–200	62–200
Hefei	▲ 179–181	116–200	159–200	62–200
Groningen	▼ 182	116–200	120–129	62–200
Boulder	▼ 183	116–200	159–200	62–200
Marseille	▼ 184	91–107	132–158	62–200
Leuven	▼ 185	116–200	120–129	62–200
Islamabad	▲ 186	116–200	132–158	62–200
Toulouse	▼ 187	91–107	159–200	62–200
Cleveland	▼ 188	116–200	159–200	62–200
Durham	▼ 189	116–200	159–200	62–200
Fuzhou	▲ 190–191	116–200	159–200	62–200
Changchun	▲ 190–191	116–200	159–200	62–200
Heidelberg	▼ 192–195	116–200	132–158	62–200
Leiden	▼ 192–195	116–200	132–158	62–200
Nijmegen	▼ 192–195	116–200	132–158	62–200
Exeter	▼ 192–195	116–200	132–158	62–200
Novosibirsk	▲ 196–198	116–200	159–200	62–200
Tsukuba	▼ 196–198	116–200	159–200	62–200
Ede	▲ 196–198	116–200	159–200	62–200
Rochester	▼ 199–200	116–200	159–200	62–200
Jinan	▼ 199–200	116–200	159–200	62–200

▼▲ — Rank Change 1–10 11–50 51–100 101–150 151–200

(continued)

Ranks

Fashion	Advertising and PR	Architecture	Industrial Design	Arts	
115–142	86–88	61–90	162–200	136–176	Jeddah
91–98	115–200	91–200	126–161	77–81	Nottingham
59–64	115–200	91–200	126–161	179–200	Braunschweig-Salzgitter-Wolfsburg
143–200	115–200	91–200	126–161	119–123	Canberra
84–90	115–200	91–200	162–200	179–200	Bordeaux
143–200	115–200	91–200	83–102	179–200	Ningbo
143–200	115–200	91–200	83–102	179–200	Qingdao
48–51	115–200	91–200	162–200	136–176	Grenoble
65	115–200	91–200	162–200	99–114	Venice
143–200	115–200	91–200	162–200	49	Glasgow
143–200	92–104	91–200	162–200	75	Salt Lake City
143–200	115–200	61–90	162–200	94–97	Madison
143–200	115–200	91–200	126–161	119–123	Cork
143–200	115–200	91–200	126–161	116–117	Ithaca
115–142	115–200	91–200	162–200	130–133	Luxembourg
115–142	115–200	91–200	126–161	136–176	Kitchener
143–200	115–200	91–200	126–161	119–123	Ann Arbor
143–200	115–200	91–200	162–200	136–176	Bonn
143–200	115–200	91–200	126–161	136–176	Dalian
143–200	115–200	91–200	126–161	136–176	Harbin
143–200	115–200	91–200	126–161	136–176	Hefei
115–142	115–200	91–200	162–200	136–176	Groningen
99–114	105–114	91–200	162–200	119–123	Boulder
99–114	115–200	91–200	162–200	135	Marseille
143–200	115–200	91–200	162–200	136–176	Leuven
143–200	74–76	91–200	162–200	179–200	Islamabad
115–142	115–200	91–200	126–161	179–200	Toulouse
143–200	115–200	91–200	162–200	94–97	Cleveland
143–200	115–200	91–200	162–200	99–114	Durham
143–200	115–200	91–200	126–161	179–200	Fuzhou
143–200	115–200	91–200	126–161	179–200	Changchun
143–200	115–200	91–200	162–200	136–176	Heidelberg
143–200	115–200	91–200	162–200	136–176	Leiden
143–200	115–200	91–200	162–200	136–176	Nijmegen
143–200	115–200	91–200	162–200	136–176	Exeter
143–200	115–200	91–200	162–200	136–176	Novosibirsk
143–200	115–200	91–200	162–200	136–176	Tsukuba
143–200	115–200	91–200	162–200	136–176	Ede
143–200	115–200	91–200	162–200	179–200	Rochester
143–200	115–200	91–200	162–200	179–200	Jinan

1–10 11–50 51–100 101–150 151–200

London, New York, and Tokyo swept the podium of the Creative Industries Subindex – the top three of HSE GCII 2024. Leadership positions are still held by several super-creative centers, where traditional art and modern technology are flourishing together. The ability to combine historical traditions and new trends is what is keeping competitors at a safe distance. In addition to the leaders, the centers of one or two hyper successful creative industries, like East and Southeast Asian cities, as well as modern Eurasian centers influenced by the Ottoman Empire and the Arab world in the past, were able to push their own positions forward in the Creative Industries Subindex.

Creative industries not only make significant contributions to the cities' economy, but also create vivid and memorable impressions on works of literature, art, architecture, and luxury products designed for both a wide audience and sophisticated customers. It is no coincidence that these types of activities turned out to be deeply connected with other sectors of the economy. For example, art is intertwined with venture capital while films and architecture are entangled with tourism.

To measure the level of creative industries, this study uses an appropriate subindex that includes 26 indicators grouped into eight sections:

- Film and animation (5 indicators)
- Electronic games (4)
- Music (2)
- Fashion (2)
- Advertising and PR (4)
- Architecture (2)
- Industrial design (1)
- Arts (6).

The rank of the city in the Creative Industries Subindex shows the level of creative industries' development in comparison to other centers of innovation.

Mega-Creativity: in Earnest and for the Long Haul

For the first time, the top three cities of the Creative Industries Subindex coincided in composition and order with the top three cities of the overall HSE GCII 2024 ranking

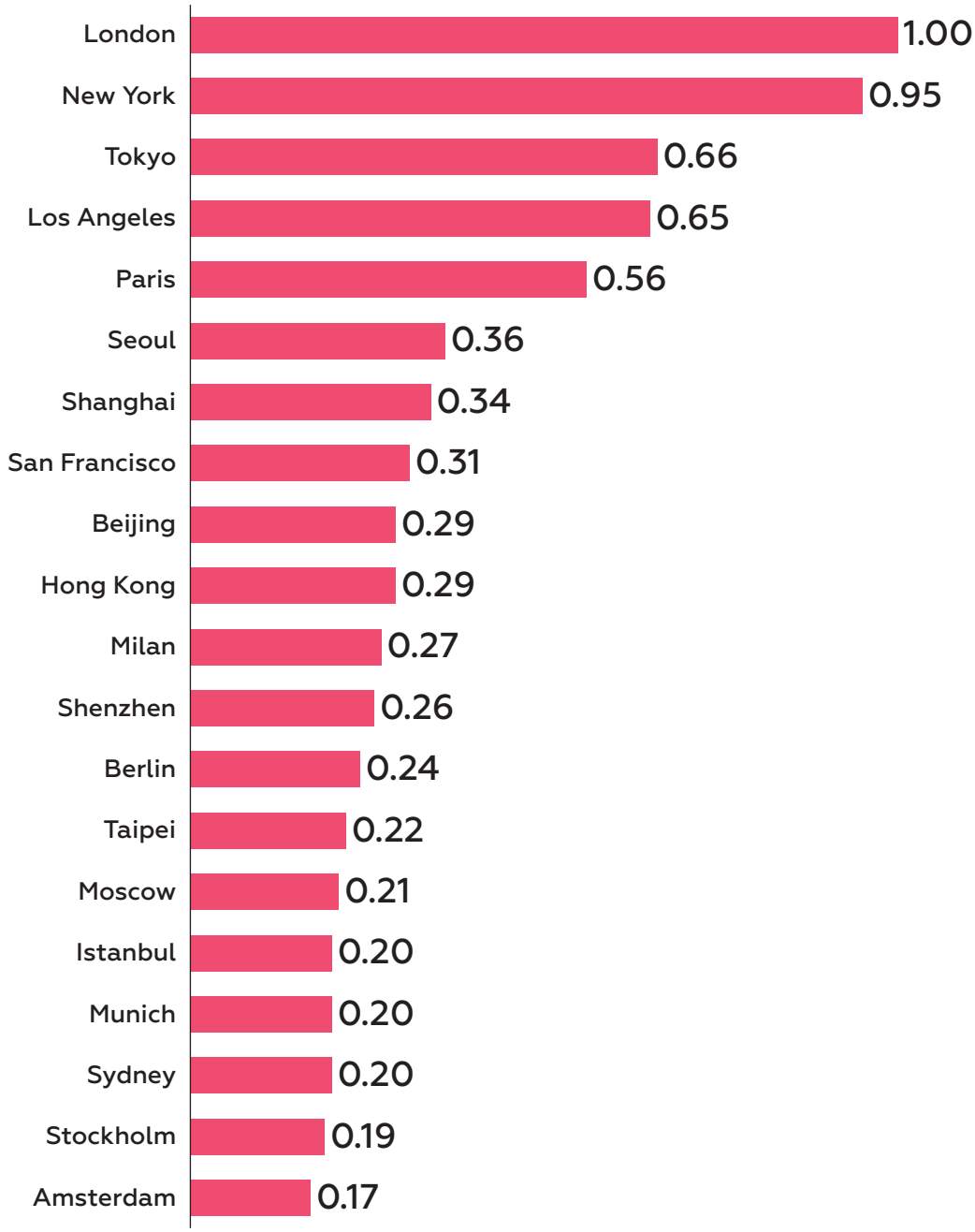
The five global centers that led HSE GCII 2024 – London, New York, Tokyo, Los Angeles, and Paris – significantly surpassed the rest by the level of creative industries development (Figure 22). The composition of the top five cities in the Creative Industries Subindex has not changed since last year, but their order is now different: Tokyo has risen from 5th rank to 3rd, stealing away the "bronze" from Los Angeles. The capital of Japan has also reduced a two-fold gap with London, which is the all-time leader, to 30%.

Games and arts have become a catalyst for the growth of Tokyo's creative sector. The city rose from 5th to 1st place in the Electronic Games section, largely due to the fact that from 2022 to 2024 the developers living in the city released five new diverse computer games that were among the most popular on Steam. These are "Palworld" from Pocket Pair, "Elden Ring" (FromSoftware), "Granblue Fantasy: Relink" (Cygames), "Yu-Gi-Oh! Master Duel" (Konami), and "Tekken 8" (Bandai Namco Studio). Well-known products, such as "Final Fantasy XIV Online" from Square Enix, also retained top positions.

In Arts, Tokyo moved from 7th to 5th place due to the appearance of seven new young artists who took their place among leaders of auction sales. Among them is Tatsuhiro Ide, also known as TIDE, who uses a generalized mean cat image from cartoons and memes in his works.

The rest of the mega-creative cities do not rest on their laurels either. The number of fashion brands represented by global online retailers increased by 5.2% in New York, by 14% in London, by 15.6% in Paris, and by 17.6% in Los Angeles; the number of performers of the most streamed tracks on Spotify increased by 46.7% in Los Angeles and in New York – by 75%.

Figure 22. Top 20 HSE GCII Cities by the Number of Creative Leaders (Individuals and Enterprises): 2024 (Normalized Estimates)



Source: HSE ISSEK, based on IMDb, FIAPF, Annecy International Animation Film Festival, Animation Career Review, FlixPatrol, British Academy Games Awards, Czech Game of the Year Awards, D.I.C.E. Awards, Famitsu Awards, Game Awards, Game Developers Choice Awards, Golden Joystick Awards, Japan Game Awards, New York Game Awards, SXSW Gaming Award, Spike Video Game Awards, VSDA Awards, Wikipedia, Esports Earnings, Steam, Capcom Showcase Livestream, Devolver Direct, Future Games Show Summer Showcase, Gamescom, OTK Games Expo, PC Gaming Show, Summer Game Fest, Ubisoft Forward, Wholesome Direct, Xbox Games Extended Showcase, Xbox Games Showcase & Starfield Direct, Spotify, The International Opera Awards, Fashion United, FARFETCH, NET-A-PORTER, Luisa Via Roma, Mytheresa, Effie Awards, PRovoke Media, Cannes Lions International Festival of Creativity, D&AD, The Pritzker Architecture Prize, World Architecture Festival Awards, A' Design Award, iF Design Award, Red Dot Design Award, Japanese Art Association, Artprice, ArtReview, QS, THE, and Goodreads.

Salieri from Skynet

How generative AI develops technologies and arts, disrupting the world of music

It would probably only be in their wildest dreams that Adele fans could see her singing together with Freddie Mercury. Queen's frontman participating in Andrew Lloyd Webber's "Phantom of the Opera" also did not become a reality, though it had been discussed.[1] However, both events were organized virtually with the help of AI tools.

Today AI gives every art lover almost unlimited power over an artist's image and the opportunity to take on a role of a producer. As expected, A-list celebrities are especially popular in such "exercises": for 16 Spotify singers, there are at least 180 AI-generated remixes. The full list of AI covers with Jung Kook's voice model on YouTube in June 2024 had 13 video clips. The AI cover of Coolio's 1995 song "Gangsta's Paradise" generated for "Minecraft" with closing doors instead of the singer's voice was uploaded on 23 August 2023 on the Ai Cover YouTube channel (ca. 11,700 subscribers) and garnered more than 1.7 million views and over 3,800 comments over 11 months. In this manner, AI not only creates an opportunity to breach copyright laws, but also tends to amplify the "super-star effect", an explosive growth in popularity of already famous singers to the detriment of local singers and musicians or novices.

For example, a user with a name Ghostwriter977 created a song "Heart on My Sleeve" with the use of voice models of Drake and The Weeknd without their permission, which disqualified both artists from being considered for a Grammy nomination. Using neural networks like that prompted a legal question about the distribution of awards between living artists and their voice models, and as for the latter case, it is uncertain to whom the remuneration is going – the prompt engineer or the company that produces the generative neural network.

Neural networks generating music are used not only by fans, but also by professional musicians and producers. The most famous virtual singer is the Vocaloid's Hatsune Miku created in 2007 in Sapporo by Crypton Future Media.[2] At the end of November 2023, an entirely new virtual singer appeared on streaming platforms – Anna Indiana that performs her "own" generated music. Over the course of eight months, her debut video aggregat-

[1] Freddie Mercury in Phantom of the Opera? Martin Scala. QueenZone discussion #1046830. Available at: https://www.queenconcerts.com/queenzone/1046830.html (Accessed: 11.07.2024).

[2] Who is Hatsune Miku? Available at: https://ec.crypton.co.jp/pages/prod/virtualsinger/cv01_us (Accessed: 11.07.2024).

ed over 33,900 views and 200 comments, and the digital production of music by the AI artist attest to the risks of emerging competition between real and virtual singers.

At the same time, there are legal ways to generate vocal profiles that are not infringing upon artists' intellectual property. One of the best examples of the mutually beneficial business model fostering cooperation between the music's neural network and artists is the Kits.AI generator of vocal profiles. Its developers state that this service can legally use AI and even tell vocalists how they can earn extra money after adding their voice to the Kits Verified Voice library on the related Kits Earn platform: the remuneration per minute of used audio is 0.085 USD. The artists can also decide that if they want to share their voice with the public or make it exclusive to be used in selected projects.

Today, there are over 40 projects[1] in the music sphere to develop AI-based software that help composers perform four key functions and implement the most complex artistic concepts.

1. The generation of soundtracks and soundscapes based on textual prompts or music, video, photo, and other multimedia references for other creative products and projects similar in narratives, spirit, and style without searching for finished music and acquiring copyrights to use it. Thus, the Suno neural network, made in Cambridge and funded in May 2024 with a total of 125 million USD in investments,[2] helps create popular singles and even their covers based on textual descriptions. The Endel service creates soundtracks to suit the mood of listeners and help them focus, relax, or fall asleep. The "compositions" of AIVA classical music generator were performed by the Avignon Symphonic Orchestra, which brought recognition from the entire musical community to the virtual composer.

2. Production and mastering. For example, the Max/MSP and PureData tools are used in AI-generated sound and rhythm design engineering, including in the music industry. The unique experience of creating music at one's fingertips can be felt through the Mi.Mu gloves, developed by a team led by British singer and musician Imogen Heap.

3. Marketing. The function that helps create playlists most suitable for a particular user is already being implemented by Spotify, Amazon, YouTube, Apple Music, and Yandex, helping its singers to find their audiences. Thus, the Singaporean startup Musiio AI, bought by SoundCloud in 2022, helps pick the background music suitable for the project based on specific data. The Downtown music label is effectively using an AI marketing technology SymphonyOS for its artists Hunter Hayes, Mehro, and Ryan

[1] The following rankings were used when compiling the top-most famous musical AI-services: FlexOS's "Generative AI Top 150" (Van Rossum, D. (n.d.). [Report] Generative AI Top 150: The world's most used AI tools. Available at: https://www.flexos.work/learn/generative-ai-top-150 (Accessed: 11.07.2024)); Tracklib's "The Best AI Music Production Tools" (The best AI music Production Tools: A complete & expert guide. Available at: https://www.tracklib.com/blog/ai-music-production-tools (Accessed: 11.07.2024)); Bobby Owsinski Handbook (Owsinski, B. Music cheat sheet. A list of popular music AI apps and plugins (And tips on how to use them). Available at: https://bobbyowsinski.com/ (Accessed: 11.07.2024)); and Top 10 Startups developing AI for Music. Available at: https://www.ai-startups.org/top/music/ (Accessed: 11.07.2024).

[2] Stuart Dredge. Suno raises $125m: what does that mean for the music industry? Musically. News. May 22, 2024. Available at: https://musically.com/2024/05/22/suno-raises-125m-what-does-that-mean-for-the-music-industry/ (Accessed: 11.07.2024).

Nealon, who practically doubled their audience while releasing their new singles.

4. Higher legal literacy of artists. In June 2024, it became known that the Grammy winner and owner of Alpha Pup Records – Daddy Kev (birth name Kevin Moo) launched Musiclawyer.ai that helps artists wrap their head around legal issues having to do with sound recording labels and music distributors. Users can upload music contracts to analyze them for errors or red flags. As the founder states, the app is not meant to replace a lawyer, but rather to receive and clarify information.

The demand for the described projects is confirmed by the commercial success of their developers: Epidemic Sound, Stability AI, and Synthesia – all became unicorns.[1]

The wide spectrum of AI-enabled functions in music stands in contrast with its restricted geography. Only 21 cities host the headquarters of companies that create generative AI software for the music industry. Meanwhile, 22 out of 40 of the mentioned projects have been launched in five centers – mega-creative San Francisco, London, New York, Tokyo, as well as Stockholm, which has developed a music industry with a rich history (ranked 8th in HSE GCII 2024 by the number of most-streamed artists on Spotify).

San Francisco's leadership, where eight of the companies developing generative AI out of the 40 most public projects are located, results from the city's attractiveness for global IT corporations – Microsoft, Alphabet, Apple, and so on. Apart from these giants, the city hosts every third AI unicorn, of which the four most valuable are – OpenAI (80 billion USD), Databrics (43 billion USD), Cruise (30 billion USD), and xAI (24 billion USD). Apart from that, generative AI projects in music may appear to be based on a more generic design called artificial general intelligence (AGI). For example, the Jukebox neural network can create user-generated music in various genres by using OpenAI's ChatGPT tools. The Magenta project that researchers AI's potential in the arts was launched by Google, which is developing AGI called Bard.

Music neural networks are mostly created in mega-creative cities under the influence of the unique profile of their founders' competences. Thus, Daigo Kusunoki, the Tokyo-based[2] founder of one of the most affordable projects to create soundtracks – Soundraw, is also famous as a dancer and a music technology specialist.[3] Voice-Swap, a vocal re-singing project registered in London, was created in collaboration with Dan Stein (stage name – DJ Fresh) and a skilled frontend developer Nico Pellerin.[4]

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[1] According to Crunchbase and Pitchbook.

[2] Soundraw, AI music composer from Japan, secures $1.4M to boost global expansion effort. Available at: https://thebridge.jp/en/2022/07/soundraw-jpy180m-round-funding (Accessed: 11.07.2024).

[3] Soundraw Raises $3M for its AI Music Generator. Record of the Day. March 13, 2024. Available at: https://www.recordoftheday.com/on-the-move/news-press/soundraw-raises-3m-for-its-ai-music-generator (Accessed: 11.07.2024).

[4] Voice-Swap AI. Available at: https://www.voice-swap.ai/team (Accessed: 11.07.2024).

Zeroing in on AI creation in the music industry has a lot to do with path dependence. In 1980, David Cope from the University of California at Santa Cruz developed EMI software that allows one to perform experiments in music intelligence.[1] In London, where five music AI projects are based (Synthesia, Stability AI, DreamStudio, Voice-Swap, Aflorithmic), the studio of Brian Eno is located, a pioneer of generative music. In 1996, he and SSEYO launched a record titled "Generative Music 1", created with the help of generative software, which may be considered an early form of music AI. Russian developers made their own contribution: LALAL.AI was founded by Dmitry Orlov,[2] Mubert – by Alexey Kotchetkov,[3] and a Soviet mathematician Rudolf Zaripov invented algorithms for composing music on the computer "Ural-1" already in the 1960s.[4]

However talented and popular "Salieri from Skynet" could be, the matter of deciding who its compositions belong to has not yet been resolved, as only a human can be a copyright holder. At the same time, this does not mean that generative music AI cannot earn money off the associated copyright for reproducing tracks. Several instruments for music generation, apart from the free demo version, enable their users to create a paid subscription and regularly create music for one's own business projects (for example, Magenta). Music AI not recognized by artists constantly fall under the risk of being accused of plagiarism, if it illegally uses finished compositions for learning; the corresponding resolutions have already been ruled by a court for Udio and Suno. The technological solution for this challenge has been provided by Soundful,[5] which enables users to make do without finished materials when generating music.

All in all, music AI today is already proving its popularity and ability to overcome legal and technological limitations, creating favorable prospects for their stakeholders and helping composers and other creators of artistic products.

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[1] Chris Garcia. Algorithmic music – David Cope and EMI. Computer History Museum. Curatorial insights. April 29, 2015. Available at: https://computerhistory.org/blog/algorithmic-music-david-cope-and-emi/ (Accessed: 11.07.2024).

[2] LALAL.AI. Clever AI Tools. Available at: https://cleveraitools.ai/category/ai-voice/ai-audio-enhancer/lalalai (Accessed: 11.07.2024).

[3] Lionbridge: CEO of AI Music Generator Mubert Wants to "Create a Musical DNA" December 3, 2019. Available at: https://mubert.com/blog/lionbridge-ceo-of-ai-music-generator-mubert-wants-to-create-a-musical-dna (Accessed: 11.07.2024).

[4] Generative AI in Audio: How is it made, and how can you detect it? Antispoofing. October 31, 2023. Available at: https://antispoofing.org/generative-ai-in-audio-speech-music-and-its-detection/ (Accessed: 11.07.2024); Ianina Prudenko. Soviet Cybernetics in Stories and Pictures. The Forgotten Soviet Art of Cybernetics. (In Russian). Available at: https://arzamas.academy/materials/2254 (Accessed: 11.07.2024).

[5] A guide to music copyright with generative AI. Soundful, 2024. News. Available at: https://soundful.com/music-copyright-with-generative-ai/ (Accessed: 11.07.2024).

The East Wind

Tokyo is not the only Asian city that has demonstrated booming creative industries over the past two years

If in the past the top ten most creative cities included only three Far Eastern centers – Tokyo, Beijing, and Seoul, now Hong Kong and Shanghai have joined these ranks. Impressive growth rates were also demonstrated by cities in East and Southeast Asia outside the creative top 10: Taipei rose by 16 positions – from 40th to 14th place, and Singapore and Guangzhou – by 33 positions, ranking 23rd and 26th, respectively (Figure 23).

The new creative leaders have a common growth factor – the development of advertising and PR: Shanghai moved up in the ranks of the corresponding section from 22nd to 17th place, Hong Kong – from 79th to 58th. The success of these cities is associated with the activities of international companies, whose representative offices are in the city – Dentsu (headquartered in Tokyo), MSL, and TBWA (headquartered in New York). For example, the TBWA division – Media Arts Lab is based in Shanghai, which has been providing marketing support to Apple since 2006. In a similar manner, the rapid development of advertising and PR in Hong Kong happened after divisions of foreign companies started to actively participate in international professional competitions (companies like Cheil, Ogilvy, Sandpiper, MSL).

Architecture has played an important role in the development of Shanghai's creative sector, namely the firms, which are young in the industry's common practice and have been operating for about 10–20 years (for example, Atelier tao+c and AIM Architecture, which received several prestigious awards in 2022, including the World Architecture Festival Award). The rise of Hong Kong in the Creative Industries Subindex was facilitated by the gaming industry: the appearance of a new developer Orienjoy International Company Limited, which released the successful free game "Hero's Land" on Steam, securing the city's 16th place in the "Developers of popular computer games" indicator.[1] The project combines playful graphics with modern gaming technologies: multi-player mode, open world, and a chance to win NFT tokens.

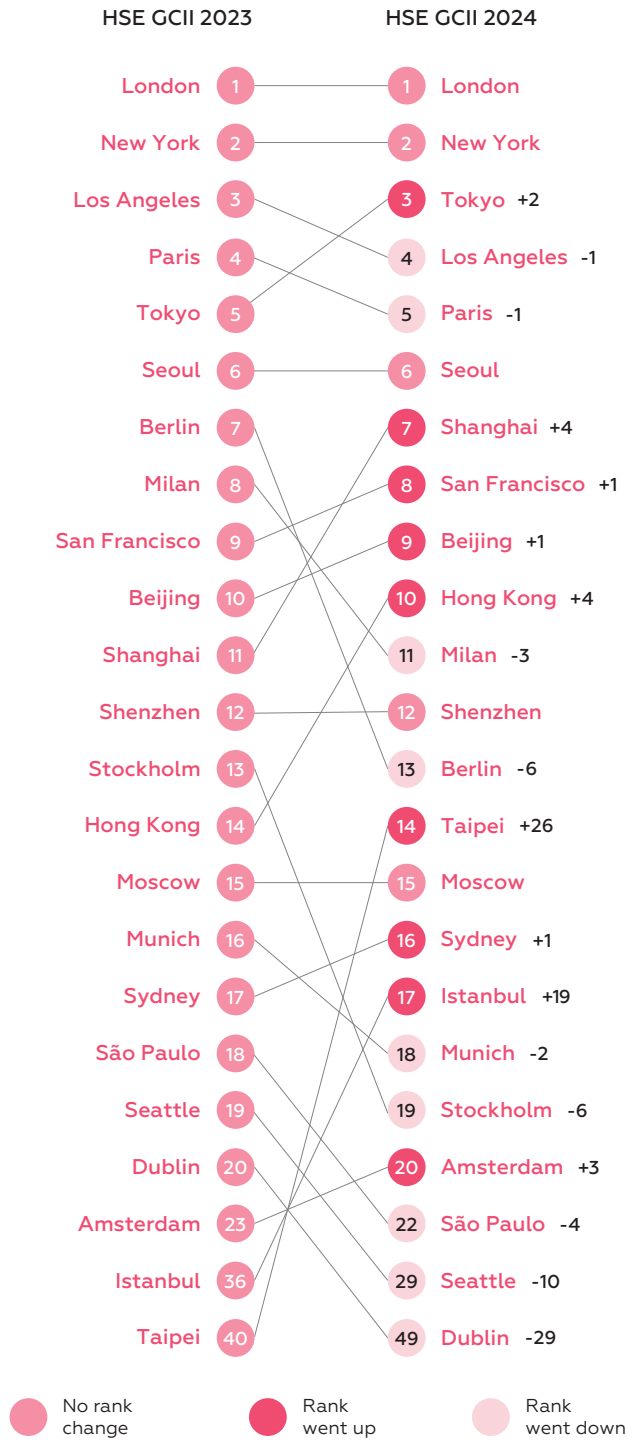
The creative growth of Taipei and Singapore is mainly related to the industrial design industry: according to HSE GCII estimates, one in fifteen internationally recognized designers or design firms is located in these cities. The emergence of young creators basing their artwork on historical traditions in the field of communication, interior, and fashion design allowed Taipei to rise from 4th to 3rd place in the Industrial design

[1] Hero's Land. Available at: https://store.steampowered.com/app/2349820/Heros_Land/? (Accessed: 01.07.2024).

ranking. For example, the famous Ccilu shoe brand, which endorses the trend of conscious consumption through the use of recycled materials, was founded by a designer from Taipei Wilson Hsu.[1] Singapore rose in the same section from 78th to 12th place mainly due to new talents in the field of industrial design of high tech products. Among them is RITKIT, which received the Red Dot Award for the innovative music stand – Musician KIT.

Guangzhou's achievements in the gaming industry – an increase from two to five in the number of e-sports tournaments held in the city and the debuts of local developers at international gaming exhibitions (eight events) – were likely the result of adopting an action plan for the development of the local video game industry in 2019. In the Arts ranking, the city rose from 86th to 59th place due to the appearance on Artprice of a new artist named Yushin Huang, whose painting sold in 2023 for 138,700 USD.

Figure 23. Top 20 HSE GCII Cities' Ranks in the Creative Industries Subindex: 2023, 2024



Source: HSE ISSEK.

[1] Ccilu's Goals for Green Sustainability. Available at: https://www.yii00.com/en-us/life.php?act=view&no=421 (Accessed: 01.07.2024).

When Emotions Mix with Technologies

South Korean TV shows are gaining momentum on the international market not only by using emotive images, but also by the virtue of innovations

The cinema industry of the Republic of Korea is on the rise today: Seoul has been scoring in the top 10 positions of the Film and Animation section of the HSE GCII Creative Industries Subindex for two years in a row, by being ranked 8th in the number of top-rated film production companies and 12th – in the number of film production companies that won international film festival awards.

Apart from the highest-grossing and independent films, the country is actively developing the series production industry. In July 2024, Disney+ announced another South Korean show – a spy thriller "The Tyrant" about the search for biological weapon that had been stolen by terrorists.[1] Although "The Tyrant" does not really fit well with Disney's product policy as a family-friendly company and Disney+ as a "family-friendly streaming platform," it is not the first South Korean show aired on this channel. In recent years, Disney+ launched several big South Korean series at once: a crime-action thriller "Casino", the drama "Moving" about special agents protecting children with supernatural abilities, and a detective film "The Worst of All." In June 2024, a history drama, "Red Swan," premiered.

The procurement of South Korean series – K-dramas – occurred when Disney was trying to optimize its expenditures on its own new releases – the so-called "originals." For example, Disney+, despite the exuberance of announcements about the upcoming South Korean shows, launched only one show of its own in the last several months – a Star Wars prequel called "The Acolyte."

The streaming giant Netflix is in a similar spot: when looking for original content to offer its viewers, more often than not it "turns to the East." In April 2023, Netflix announced a 2.5 billion USD investment in Korean film production companies.[2]

A variety of genres and styles makes Seoul and Korean cinema extremely popular in general.[3] K-dramas have a wide spectrum of themes and

[1] Korean Vengeance Miniseries "The Tyrant" Launching on Disney+. Available at: https://variety.com/2024/tv/news/korea-miniseries-tyrant-disney-1236064530/ (Accessed: 11.07.2024).

[2] Netflix launched South Korea's entertainment industry to superstardom. But is the "Netflix Effect" really paying off? Available at: https://www.scmp.com/news/asia/east-asia/article/3224704/netflix-launched-south-koreas-entertainment-industry-superstardom-netflix-effect-really-paying (Accessed: 11.07.2024).

[3] Tatiana Bogatyryova. Asian Cinema: China, Japan and South Korea. Moscow : Bombora, 2024.

genres – from romantic soap operas to period dramas and fantasy. For example, the three series that were hugely successful on Netflix belong to different genres – a zombi horror "Kingdom" that takes place in a fictional, alternative historical period, a legal drama "Extraordinary Attorney Woo" about an autistic lawyer, and an action thriller "Squid Games" with a dash of "battle royale."

The second important factor in the blossoming of K-drama series is the artistic exaggeration of feelings and emotions. It is customary to hide your feelings in Korean culture (and the same goes for the Japanese and the Chinese), and in film and TV they allow themselves more emotional freedom, causing, thereby, a deeper psychological impact in comparison to Western shows, when the audience reciprocates more profoundly. At the same time, the source of their inner turmoil is often not rooted in realistic things, for example, love at first sight, finding destiny, or meeting with one's significant other in a previous or the next life.

K-dramas achieve their success not only due to emotionally stirring and visually appealing content, but also due to innovations in audiovisual technologies, as well as talent and film production management. Screenwriters in South Korea are as popular as actors, and their remunerations take up a considerable portion of the film budget.[1] The highest-paid screenwriter is Kim Eun-Sook: for every episode of "The Glory" she received over 100 million won (around 81,000 USD).[2] The pay of novice writers is roughly 400,000 won per episode (around 325 USD), which is, considering the average volume of work, gives around 1.6 million won (1,300 USD) per month.[3] Such high wages of screenwriters are justified, since the K-dramas' forte are stories beyond generic tropes.

The most popular shows are those that attempt an original take on cut-and-dry plot twists ("Weightlifting Fairy Kim Bok-Joo", "Age of Youth", and "Because This Is My First Life"). South Korean content is not usually a straight-up comedy, a romance, or an action film – elements of all genres are intertwined in a single plot: mystery can go together with realism, characters from myths and legends can live in a contemporary urban set-up ("Tale of the Nine-Tailed", "Guardian: The Lonely and Great God", etc.).

The interest of the audience in dramas is sparked by the participation of K-pop idols in the filming. For example, Rowoon (a stage name of Kim Seok-Woo), a former SF9 boy band member acted out a leading role in a romcom "Destined with You", and the leading actress in the period drama "Snowdrop" was Blackpink's Kim Jisoo.

Unlike series in Japan or China which are produced predominantly for the domestic market and rarely gain

[1] S. Korea's investment in its screenwriters results in a K-content global sensation. Available at: https://world.thaipbs.or.th/detail/s-koreas-investment-in-its-screenwriters-results-in-a-kcontent-global-sensation/49755 (Accessed: 11.07.2024).

[2] How much does "The Glory" writer Kim Eun Sook get paid per episode? Available at: https://www.allkpop.com/article/2023/01/how-much-does-the-glory-writer-kim-eun-sook-get-paid-per-episode (Accessed: 11.07.2024).

[3] Behind The Scenes of K-dramas: The Life of Broadcasting Producers and Screenwriters. Available at: https://creatrip.com/en/blog/11262 (Accessed: 11.07.2024).

traction abroad, K-dramas are made with export in mind. An untrained European eye sometimes finds it difficult to distinguish Asian actors, so film producers think about foreigners' perception of their shows even before pre-production. For instance, every character is supposed to have their own color palette, dress in specific costumes, and wear particular hairdos, since it helps to anchor the viewers who are trying to untangle the plot twists.[1]

It is customary in South Korea to shoot films within a short time frame to obtain faster feedback from the audience and have an opportunity to adjust the script to improve the film and save money in renting film sets or other production costs. K-dramas usually broadcast new episodes two times per week[2] and limit one season to 16 or 32 episodes, which avoids boring the viewers and minimizes investments into projects with waning popularity.

Unlike India and the United States, it is unusual for the Republic of Korea to build film cities outside agglomerations. The main filming center, Studio Cube, was opened in 2017 in Daejeon,[3] located within an hour's ride from Seoul and hosting over 1.5 million people. The country regards it as beneficial to rent film studios closer to the offices of broadcasting companies[4], which is motivated by the continuing popularity of cable TV.

It is not unheard of today to use neural networks when producing K-dramas. For example, the AI-powered TooToon tool that was initially designed to be used for creating digital comics is applied when doing storyboarding.[5] When shooting "Queen of Tears," AI was applied to generate falling snow.[6] Neural networks are often used in post-production to process the characters' voices.[7] The popularity of AI and neural networks in South Korean filmmaking is reflected in the fact that Bucheon International Fantastic Film Festival (BiFan) holds a separate nomination for films created with the help of generative tools.

The scale and the tapestry of technologies used in South Korean filmmaking raises a question about the further source of inspiration and ways to optimize business processes for K-drama producers. A wider scale of co-production is possible with the involvement of the largest streaming

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[1] CSTB discussed cinema of India, Türkiye, China, and South Korea. (In Russian). Available at: https://www.intermedia.ru/news/377346 (Accessed: 11.07.2024).

[2] K-Drama: A Whole New World of TV-Shows. Available at: https://overseas.mofa.go.kr/no-en/brd/m_21237/view.do?seq=41 (Accessed: 11.07.2024).

[3] S. Korea's largest film studio opens doors to support Hallyu. Available at: https://www.koreaherald.com/view.php?ud=20170926000864 (Accessed: 11.07.2024).

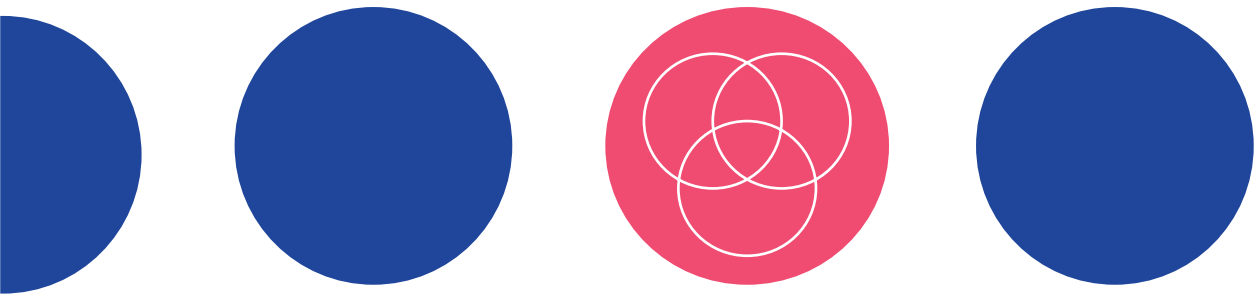
[4] The K-wave calls for production studios in Korea. Available at: https://www.jll.com.mo/en/trends-and-insights/research/the-k-wave-calls-for-production-studios-in-korea (Accessed: 11.07.2024).

[5] AI technology finds its way into South Korean comics, dramas. Available at: https://asia.nikkei.com/Business/Media-Entertainment/AI-technology-finds-its-way-into-South-Korean-comics-dramas (Accessed: 11.07.2024).

[6] How AI helped South Korean hit drama "Queen of Tears". Available at: https://news.abs-cbn.com/entertainment/2024/5/9/how-ai-helped-south-korean-hit-drama-queen-of-tears-1102 (Accessed: 11.07.2024).

[7] Artificial Intelligence and Its Pitfalls Are at the Core of Bucheon Film Festival Revamp: "Author-Generated Cinema May Become Local and Niche". Available at: https://variety.com/2024/film/global/artificial-intelligence-bucheon-film-festival-revamp-1236067098/ (Accessed: 11.07.2024).

companies or famous Hollywood majors. One also cannot exclude the possibility of TV shows going totally digital (in 2022, South Korean MBN cable TV channel launched a TV show in a metaverse[1]). However, much as in traditional K-dramas, it is only possible for us to know whether our forecasts will come true in the next episode.



[1] MBN to air first metaverse-based music survival show "Avatar Singer". Available at: https://www.koreaherald.com/view.php?ud=20220825000734 (Accessed: 11.07.2024).

One's Own Track

Agglomerations with a mature creative sector are showing organic growth in sectors of their historical specialization

The Old World cities – Copenhagen, Oslo, and Amsterdam – demonstrated moderate growth of their creative sector (+5, +4 and +3 positions in the sub-ranking, respectively) due to reinforcing positions in industries where they are traditionally strong. Copenhagen's success is linked to the fashion industry: the city managed to enter the top 10 fashion centers of HSE GCII 2024 thanks to 67 brands represented on global online retailers (an increase of 19 companies and a move in the Fashion ranking from 21st to 9th place). The presentation of the prestigious World Architecture Festival Award to seven bureaus from Amsterdam specializing in social areas – Scandinavian style and green architecture – contributed to the rise of the Dutch capital from 16th to 10th place in the Architecture ranking.

The driver of Oslo's creative growth is industrial design: the city rose by 13 positions and is ranked 21st in the corresponding ranking due to the growth in the number of designers and design firms – from two to 15 – that have been awarded the international A' Design Award, iF Design Award, or Red Dot Design Award.

The trend of moderate growth, due to successes in certain creative specializations, is also observed among individual cities of the New World. For example, the rise of Toronto and Sydney in the Creative Industries Subindex (+11 and +1 positions, respectively) is mainly associated with progress in advertising and filmmaking. The number of leading advertising agencies in Toronto has grown from three to 17, and in Sydney from two to 18.

The Wonderful Architects of Oz

Contemporary Australian architecture is based on the diversity and harmonious co-existence of cultures and the unity of humanity and nature

Sydney and Melbourne, the two largest Australian cities, share the "silver" medal for the number of architects and architecture bureaus recognized by the HSE GCII 2024 ranking (17 each), occupying 5th and 6th places, respectively, by the progressiveness of architecture industry. Every tenth laureate of the World Architecture Festival Award for the period from 2015 to 2023 worked in Australia, and after the 2002 Pritzker Architecture Prize was given to Australian architect Glenn Murcutt, it was confirmed that the country deserves to take its rightful place among the cream of the crop in the architectural elite.

At a first glance, Australia's achievement can be attributed to the strong influence of British culture that seeped into the continent during the time of its colonization. However, most of the cities in former British colonies demonstrated limited success in the HSE GCII 2024 ranking. For instance, New Zealand's Auckland is ranked 10th by the level of architecture development, followed by Cape Town and Montreal – 38th, Vancouver and Toronto – 46th, which may signify the presence of less important success factors of this industry in Australia.

The first factor is a multicultural society that was formed in Australia after several waves of skilled migration. During World War II, Ludwig Hirschfeld Mack and Gerard Herbst, the two famous Bauhaus architects, moved to Australia and developed a design course for the Royal Melbourne Institute of Technology.[1] Later, in 1973, the White Australia policy limiting the influx of migrants had been abolished, which led to the flow of skilled workers and students from Viet Nam, China, India, and other countries. Among them is one of the most famous Sydney architects, Koichi Takada, who received a 2024 ArchDaily Award for designing a shopping gallery that reminds one of an architectural forest,[2] where he was born in Tokyo.

The multiculturalism that is flourishing in the country today reinforced the trend for international integration. Now, Australia implements the New Colombo Plan,[3] a governmental funding program

[1] Bauhaus In Australia: A Migrant Story. Available at: https://www.goethe.de/ins/au/en/kul/arc/bau/21688803.html (Accessed: 10.07.2024).

[2] The 15 Winners of the 2024 ArchDaily Building of the Year Awards. Available at: https://www.archdaily.com/1013650/the-15-winners-of-the-2024-archdaily-building-of-the-year-awards (Accessed: 10.07.2024).

[3] New Colombo Plan. Available at: https://www.dfat.gov.au/people-to-people/new-colombo-plan (Accessed: 10.07.2024).

that finances the internships of Australian bachelor degree students, including those studying "Architecture" and "Design" programs in countries of the Indo-Pacific region. Apart from that, in 2023, for specialists from Canada, Japan, Singapore, United States, and United Kingdom, the obligatory multistep accreditation procedure (including the confirmation of professional skills and practical experience) has been abolished so such specialists can receive permits to perform architectural activities.[1]

The second success factor is turning back to the original culture of the continent. Gregory Burgess, an architect from Melbourne, who interned at the leading firms of Copenhagen and London during his studies, started an independent firm before he even finished his undergraduate studies and today is notable for the buildings he designed for indigenous communities. One of Burgess's flagship projects, the Brambuk Aboriginal Cultural Centre, was designed together with the Koori Aboriginals. Another interesting case of collaborative artistry was the Uluru-Kata Tjuta Cultural Centre. The Uluru community with whom Burgess was working believed in a special type of connection between people, nature, and memory: tales of the past are passed down in the form of a dance with particular movements. Together with the Uluru people and the Australian Nature Conservation Agency (ANCA), the architect spent a month creating blueprints for the center, whose shape brings to mind the ancient narratives and ancestor stories.[2]

Australia's architecture is quite often related not merely to the Aboriginal culture, but to their peculiar living conditions. In 1992, a landmark court decision was passed following the Mabo case involving Eddie Mabo, an Australian rights activist who initiated court proceeding for recognition of the pre-colonial land interests of Indigenous Australians. After redressing historical injustices, the Aboriginals had a need for housing facilities, which were designed by the future Pritzker Architecture Prize laureate – architect Glenn Murcutt. As a prototype, he created a house for the local activist Maramburra Marika and her husband Mark Alderton.[3] The building design was influenced by the landscape and climate conditions of where they lived, as well as cultural family traditions. In 2021, Glenn Murcutt became the first Australian who received the Japanese Praemium Imperiale. He also designed an education center near Sydney and an Islamic center in Melbourne.[4]

Apart from keeping traditions, Australia implements systemic initiatives in green architecture. The Green Building Council of Australia trains participants on the construction market on the relevant technologies and standards, develops and substantiates incentives, and implements the world famous system of green

[1] What Does an Architect Do? Available at: https://site.co-architecture.com/articles/what-is-an-architect-unlocking-the-secrets-of-the-profession-in-australia-2023/ (Accessed: 10.07.2024).

[2] Seeking Resonance: The life-architecture of Gregory Burgess. Available at: https://www.archdaily.com/988802/seeking-resonance-the-life-architecture-of-gregory-burgess (Accessed: 10.07.2024).

[3] Marika-Alderton House (Glenn Murcutt). Available at: https://orthoslogos.fr/architecture/marika-alderton-house/ (Accessed: 10.07.2024).

[4] Glenn Murcutt wins 2021 Praemium Imperiale for architecture. Available at: https://www.dezeen.com/2021/09/14/glenn-murcutt-praemium-imperiale-architecture/ (Accessed: 10.07.2024).

building certification – Green Star.[1] New Zealand borrowed this system for its own construction industry, and South Africa and United Arab Emirates used it as the foundation to create their own national standards.[2] Australia's architecture bureaus are actively supporting the ecological agenda: every fourth internationally recognized firm declares on its website's front page its social and environmental responsibility and implements the corresponding projects. For example, Melbourne's Aspect Studios created a linear park consisting of public spaces under the railroad connecting several parts of the city in 2015–2018.[3]

Since its inception in 1966, the non-governmental Australian Institute of Landscape Architects (AILA) has been calling for the conservation of endangered nature landscapes. The institute certifies landscape architects and relevant educational programs at the largest universities.[4]

A network of professional governmental development institutes conserve and accrue competences in architecture by way of formulating national architectural and city planning agendas and implementing joint projects. Thus, the leading national organization – the Planning Institute of Australia (PIA)[5] that unites 5,000 architects and city planners in the country and abroad, is providing funding to the professional community members, sets industry development trends, and conducts various events.

The Australian Institute of Architects, officially The Royal Australian Institute of Architects (RAIA)[6], was founded by the government to develop and implement the national policy in urban studies and architecture. The organization is funded through the federal budget that helps it to function within public programs and initiatives, and in particular deals with issues of climate change and the revision of construction regulations.

The Australian Housing and Urban Research Institute (AHURI),[7] a non-profit organization funded by Australia's federal government, regional authorities, and private companies, is doing research to rationalize city planning and housing policies focused on creating affordable residences (including for homeless people and social renting), as well as the rational use of land.

[1] Green Building Council of Australia. Available at: https://new.gbca.org.au/ (Accessed: 10.07.2024)

[2] International Comparison of Sustainable Rating Tools. Available at: https://www.tandfonline.com/doi/abs/10.1080/10835547.2009.12091787 (Accessed: 10.07.2024).

[3] Caulfield to Dandenong Railway & Linear Park. Available at: https://www.aspect-studios.com/projects/caulfield-to-dandenong-railway-linear-park (Accessed: 10.07.2024).

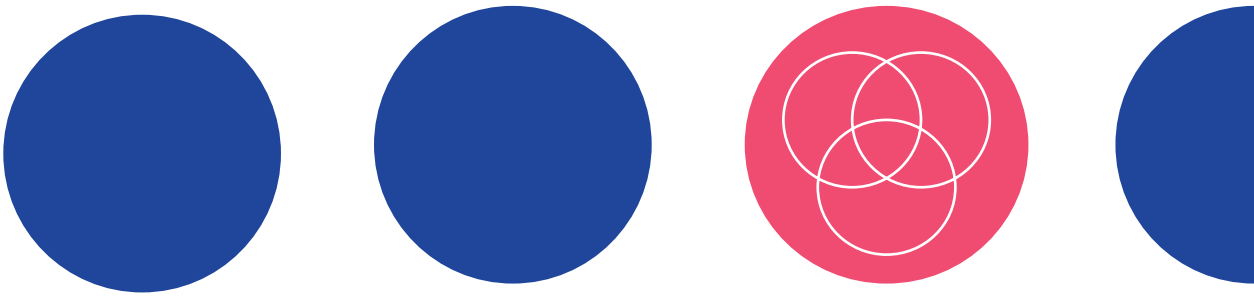
[4] Australian Institute of Landscape Architects. Available at: https://www.architecture.com.au/ (Accessed: 10.07.2024).

[5] Planning Institute of Australia. Available at: https://www.planning.org.au (Accessed: 10.07.2024).

[6] Australian Institute of Architects. Available at: https://www.architecture.com.au/ (Accessed: 10.07.2024).

[7] Australian Housing and Urban Research Institute. Available at: https://www.ahuri.edu.au/ (Accessed: 10.07.2024).

Australia's success in developing the architecture industry was achieved through an environmentally conscious attitude reflected in the acceptance of history and the conservation of culture, as well as the creation of an institutional system that develops and spreads contemporary environmental standards and compliance control.



Playing in a Sandbox: Factors that Modeled Videogaming in Sweden

The successes of Swedish companies promoted the development of a large-scale, diverse, and independent gaming industry

Sweden became one of the global leaders in the development of video games, which regularly end up on the most popular lists on Steam. Every eighth person living on planet Earth played the games made in this country,[1] among which are the world's bestselling game of all time – "Minecraft" (over 300 million copies sold since its launch[2]), created in a sandbox genre by the Swedish programmer Markus Persson and launched by the Mojang AB studio. In 2009, Persson published an original demo of the game, and at the end of 2011 he launched a stable, i.e., ready for mass use, version. In September 2014, Mojang AB was bought by Microsoft for 2.5 billion USD and became a subsidiary of Xbox Game Studios.

Another Swedish company, Arrowhead Game Studios, launched a humor game "Magika" in 2011, of which an earlier version was awarded the game of the year on Swedish Game Awards 2008. In 2015, another Arrowhead Game Studios game called "Helldivers" was nominated for the D.I.C.E. Award for Game of the Year. In 2024, the studio welcomed its sequel – a multiplayer shooter "Helldivers 2", which became a leader by the number of sales and players in Steam.

Sweden is also a birthplace of "Battlefield", one of the biggest series of first-person tactical shooters. In 2002, with the launch of the first part of the game "Battlefield 1942", its developer, DICE, was founded by four friends.[3] After the game and the studio were bought in 2006 by Electronic Arts, the franchise has come to list dozens of games and DLCs.

Swedish indie developer Avalanche Studios Group specializes in open-world shooters: since 2006, have been launched four parts "Just Cause", "Mad Max", "Rage 2", and "Generation Zero." Avalanche Studios Group was able to keep a somewhat independent approach from its parent company Nordisk, and, despite contradictory

[1] Swedish Games Industry 2023: Game Developer Index. Available at: https://dataspelsbranschen.se/game-developer-index (Accessed: 11.07.2024).

[2] Minecraft Just Surpassed 300 Million Sales – Here's The Only Video Game Still Beating It. Available at: https://www.forbes.com/sites/britneynguyen/2023/10/16/minecraft-just-surpassed-300-million-sales-heres-the-only-video-game-still-beating-it/ (Accessed:11.07.2024).

[3] The story of DICE – the Swedish game company – as told by the founder. Available at: https://internetmuseum.se/tidslinjen/berattelsen-om-svenska-spelundret-dice-med-grundarens-egna-ord/ (Accessed: 11.07.2024).

evaluations of the latest projects from critics and users, its games are still retaining a competitive edge[1] over the most popular shooters from gaming majors – largely due to the familiar atmosphere and unusual gameplay mechanisms.[2]

In 2021, Iron Gate, a small team of developers from Sweden were inspired by Scandinavian mythology and developed an open-world game "Valheim", whose action takes place in a procedurally generated world. It received great popularity due to the elaborated cooperative multi-user gameplay and deep techniques of designing in-game items.

There are more Swedish games with features for expanded creativity, other than sandbox games. These include "Geometry Dash" by Robert Topala, also known under his nickname as RobTop. Initially launched for mobile devices in 2013, in 2018 the game entered the top 10 on two charts of the top paid App Store apps – for iPad and for iPhone, ranking 2nd and 7th, respectively.[3] In 2019, the game's ranking positions had improved: while keeping its position on the first chart, it placed 5th on the second.[4] The games helps its users create their own levels and upload soundtracks to finish them.

Strategic games of the company Paradox Development Studio (a division of Paradox Interactive) – historical "Europa Universalis", "Hearts of Iron", "Crusader Kings", "Victoria", and sci-fi "Stellaris" – are distinguished by high complexity and intricate plots.

An independent company, Hazelight Studios, is famous for its games "A Way Out" and "It Takes Two," which emphasize the storyline.

There are many other world renowned games that originated in Sweden, for example, the most downloaded match 3 puzzle game – "Candy Crush Saga"[5] which is actively using game features to attract users from social networks, and a team-based shooter – "The Finals."

One of the factors that laid the groundwork for the creation of a successful and authentic gaming industry in Sweden was the harsh climate conditions, which are commonly known to increase the demand for functionality (among the devices invented in this country at various points in time – an adjustable spanner, a pacemaker, a zipper, and a three-point seat belt). Applied inventive activity left an impact on other spheres of life: in the 1990s, the Swedish government subsidized the expenses of large companies to buy home computers for their employees, which increased the level of computerization among the population. The corresponding Home PC

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[1] Nordisk Games acquires Flashbulb Games. Available at: https://www.nordiskgames.com/journal/nordisk-games-acquires-flashbulb-games (Accessed: 11.07.2024).

[2] How Nordisk Film's data strategy drives box office success. Available at: https://techinformed.com/how-an-entertainment-companys-data-strategy-keeps-them-in-the-charts/ (Accessed: 11.07.2024).

[3] The Highest Rated iOS Apps and Games of All Time, According to App Store Users. Available at: https://sensortower.com/blog/highest-rated-apps (Accessed: 11.07.2024).

[4] These are the best apps and games of 2019, according to Apple. Available at: https://www.fastcompany.com/90438371/these-are-the-best-apps-and-games-of-2019-according-to-apple (Accessed: 11.07.2024).

[5] Data Confirms "Candy Crush Saga" As Most Downloaded Game of All Time On iOS. Available at: https://variety.com/2018/gaming/news/candy-crush-saga-ios-most-downloaded-1202967553/ (Accessed: 11.07.2024).

Reform[1] launched in 1998 was initially directed at providing social benefits, improving the population's digital and computer literacy, and, ultimately, their competitiveness on the labor market due to acquired skills. The funding program was based on the provision of tax benefits to companies that were allowed to buy computers and rent them out to their employees at a low rate and significantly decrease the expenditures for introducing new technologies. As a result of implementing the Home PC Reform, one million Swedes received their first home computer (a total of 850,000 devices were disseminated), and 71% of program participants reported their digital skills improving. Already a year after the program launch, Sweden introduced broadband Internet available to anybody at a relatively low price. All of this led to the overall growth of the IT industry in the country [Rahm, 2021].

Sweden became the third European country in rankings (after the United Kingdom and France) by volume of investments in technology over the last decade.[2] The country has a public research institute, RISE[3], which supports the creation of "simple", i.e., entertaining games, and "serious" gamification initiatives in businesses and the public sector (for example, VR modeling, making digital twins to visualize complex environments and develop skills as well as to increase efficiency in manufacturing). Thus, British-Swedish biopharmaceutical company AstraZeneca uses digital solutions to simplify clinical trials and gamify personnel training.

Sweden is known for its high-quality education. Among national companies, whose games are among the top-ranking games on the Steam platform, Iron Gate with an office in remote Skövde, 150 km north of Gothenburg, particularly stands out. The local university implements 12 programs associated with education in gaming, including four in master's degree. Its candidates are taught not only practical skills in game development, but also the theoretical basics of designing games. Graduates of the master's degree program have an opportunity to receive a PhD in video game development.

The University of Skövde is one among the Sweden Game Arena (SGA) cluster that supports startups within its funding program – the Sweden Game Startup. Within SGA there is a yearly Sweden Game Conference, to which professionals from all around the world fly to participate.

Sweden combines innovation and cultural traditions in the gaming industry and leads the charge in storytelling by designing popular games based on Scandinavia mythology (for example, "Valheim"). This excellent storytelling has further disseminated into the plots of foreign-made games ("God of War: Ragnarök", "Assassin's Creed Valhalla", and "Hellblade: Senua's Sacrifice").

Between 2006 and 2012, under the auspices of the Nordic Council of Ministers, Sweden conducted the Nordic Game Program that supported creating good games for the youth of

[1] Home PC reform gives one million Swedes their first computer. Available at: https://internetmuseum.se/english/home-pc-reform-gives-one-million-swedes-their-first-computer/ (Accessed: 11.07.2024).

[2] Sweden Tech Ecosystem: Report 2021. Available at: https://si.se/app/uploads/2022/02/dealroom-sweden-tech-report-feb-2022.pdf (Accessed: 11.07.2024).

[3] RISE in short. Available at: https://www.ri.se/en/about-rise/rise-in-short (Accessed: 11.07.2024).

Sweden, Finland, Norway, Denmark, and Iceland. The program showed special support for the developers of products that reflect the cultural and historic traits of Nordic countries and contributed to the commercial success of games made in the region by providing grants for their development. This helped small studios start their own projects, among which is DICE that later came into global fame.

Implementing funding programs at the cross-national level nurtured wholesome competition between gaming companies in the Northern Europe: by being on a relatively small domestic market, developers get to compete not with each other so much as with global players, thus increasing the quality of products and evolving independently.

Despite the good prospects for the gaming industry, Sweden today does not have specific measures for the direct funding of developer companies. However, they may use funding programs aimed at the R&D development through tax incentives and grants to invent new technologies (for example, Vinnova).[1]

Despite the high quality of professional educational programs, the gaming industry is experiencing a deficit of skilled personnel, which is compensated for by opening foreign offices and the acquisition of companies in other countries.

> The Swedish gaming industry demonstrates how to successfully survive on a highly competitive market, whose underlying motivation is to create a favorable technological and educational environment that invigorates independent developers with an open outlook on computer games.

[1] Vinnova is Sweden's innovation agency. Available at: https://www.vinnova.se/en/ (Accessed: 11.07.2024).

The Magnificent Century

A positive trend in the development of the creative sector was demonstrated by the Eurasian cities that were once part of the Ottoman Empire and the Arab world or were influenced by them

Istanbul, Athens, Tehran, and Riyadh have strengthened their positions in the Creative Industries Subindex in different ways.

Istanbul has risen from 36th to 17th place due to the development of gaming, fashion, and industrial design. In 2022–2023, two major e-sports tournaments for "PUBG Mobile" and "Valorant" were held here, and in 2023, 19 companies in the city became participants in international gaming industry exhibitions. Among them is Core Engage, which presented its own urban planning simulator "New Cycle" at the Future Games Show.

In Athens, designers and design firms began to actively win international competitions, which secured the city a position in the top 30 by the number of industrial design leaders (ranked 28th, with over 50 positions) and, in general, an increase in Creative Industries Subindex from 118th to 66th place.

Architecture and industrial design became the catalysts of growth for Tehran, which moved from 108th to 71st place. Seven architecture firms in the city have achieved international recognition (only four had done so a year earlier). Among them is Next Office, a six-time winner of the World Architecture Festival Awards and one of the most influential bureaus in Iran, whose project in 2014 entered the top 20 most popular according to the international ArchDaily platform.[1] Six more designers and design firms were awarded the A' Design Award (there were none a year before). Among the winners of prestigious awards is Mortazavi Design Academy, which creates jewelry with an Oriental touch.

Riyadh has risen from 149th to 83rd place thanks to its achievements in the gaming industry. Since 2019, the city has hosted 23 major e-sports tournaments for fans of the most popular games of various genres. These include sports simulators "FIFA 23", "Rocket League", and "Rennsport", fighting games "Street Fighter 6" and "Tekken 7", cooperative shooters "Fortnite", "Rainbow Six Siege", "Counter-Strike: Global Offensive", "PUBG", as well as MOBA games – "Dota 2" and "League of Legends".

[1] The Most Popular Projects of 2014. Available at: https://www.archdaily.com/582695/the-most-popular-projects-of-2014 (Accessed: 07/01/2024).

Premium Luxury

Dubai, following Hong Kong, proves that the luxury industry can act as a full-fledged driver of the creative sector's development

Dubai has become one of the cities in the Middle East that has achieved impressive success in the creative sector, as is confirmed by its climb up the sub-ranking from 76th to 38th place. The main catalysts for growth there were arts, architecture, and especially luxury fashion produced by relatively young brands, which were founded in other cities, but relocated to Dubai due to the high concentration of the target audience and favorable conditions for doing business. Thus, on the territory of the Dubai Design District creative cluster, where premium brands, like Lama Jouni, Saiid Kobeisy, and Salama Khalfan, are localized with an Oriental style, there is a zero rate on personal and corporate income taxes.[1] In addition to fashion, Dubai is developing its architecture industry: international companies, such as Zaha Hadid Architects, headquartered in London, open their offices here and attract aspiring architects.

It could be assumed that Dubai is taking a page out of the Hong Kong's book, which has gone from a luxury brand shopping center to a new focal point of independent designers. In HSE GCII 2024, Hong Kong again showed an increase in the indicators of the Fashion and Industrial Design sectors. For example, the number of fashion brands represented by global online retailers has increased from 16 to 24, and the number of internationally recognized designers and design firms has increased six-fold – from 10 to 64. At the same time, half of the brands belong to premium segments, every second of them (for example, ACUPUNCTURE 1993 and Chocolate) specializes in sports and casual clothing.

[1] Business Setup in Dubai Design District/D3. Available at: https://www.nrdoshi.ae/dubai-design-district-business-setup-in-d3 / (Accessed: 07.01.2024)

Supernova Explosions and Dissipations

Astounding achievements of HSE GCII cities in creative industries do not always become a steady trend

The results of last year's ranking revealed the "supernova" cities from countries with young market economies, which clearly manifested themselves in the creative community due to outstanding achievements in one or two industries. Among them are Mexico City, Santiago, and Mumbai, which continued their string of successes in the current edition of HSE GCII. Four new international award-winning architecture and interior designers have appeared in Mexico City. Santiago rode the wave of reggaeton popularity and improved its position in the music industry thanks to a Chilean artist Cris MJ, whose dance track "Una Noche en Medellín" became one of the most-streamed compositions on Spotify.

Mumbai took 36th place in the Creative Industries Subindex, establishing itself as one of the leaders of the global film industry. In Film and Animation section, the city rose from 7th to 6th place, due to achievements in the production of independent films. For example, the Indian company Reliance Entertainment (part of the Reliance Group conglomerate) co-produced Steven Spielberg's "The Fabelmans", which won the People's Choice Award at the Toronto International Film Festival in 2022.

However, not all "supernovae" were able to keep up with their own pace. Thus, São Paulo and Rio de Janeiro demonstrated a slowdown in architecture (São Paulo moved from 15th to 17th place relative to HSE GCII 2023, Rio de Janeiro – from 27th to 30th), music (from 43rd to 62nd and from the 18th to the 53rd, respectively), and design (from the 16th to the 23rd and from the 48th to the 103rd).

Digital Reggaeton

How Latin American performers were able to find their way in the digital space

Since streaming content became available in 2005, artists' incomes from streaming their music have been steadily growing. An especially proactive gain in the digital royalties of world famous singers – 2% per year – has been reported by the International Federation of the Phonographic Industry (IFPI)[1] since 2015. One of the trends of the contemporary music industry was the growth in popularity of Latin American performers.

The musical style and dancing of reggaeton that originated from Puerto Rico and spread among Hispanic people living in the United States via the Caribbean is today known due to songs like "Gasolina" by Daddy Yankee and "Amor Con la Ropa" by Sir Speedy. This genre found its modern sound in the 1990s under the influence of catchy repeatable bass rhythmic riddims from the traditional Jamaican dance music. The first reggaeton performers to appear in the United States top charts were singers from Jamaica – Sean Paul with songs "Infitrate," "Excite me," and "Hot Gal Today" and Sean Kingston with songs "Beautiful Girls" and "Me Love." Reggaeton is a new synthetic genre of Latin American music that stems from chants of the indigenous population of Panama during the time of separation from Columbia (1903), combining reggae, hip hop, and "tropical sounds." Its popularity in streaming in the beginning of 2020s is due to how easy it is to get into the groove of the dance moves.

An analysis of Apple Music top charts IFPI yearly reports for 2020–2023 showed an upsurge of listeners' interest in Latin American music for the last four years amid the oversaturation with less positive hip hop, which peaked in the 2000s and 2010s (Tables 17 and 18).

For the first nine months of 2023, the number of streams of Latin American music via streaming services increased compared to the same period in the previous year by 22.2%, surpassing all genres in terms of growth (13.3%).[2] The number of streams of Mexican music on Spotify from 2020 to 2023 almost tripled.[3] Reggaeton king Daddy Yankee, the Columbian pop and trap artist Manuel Turizo, and the pop singer Shakira are among the top five best artists on Spotify.

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[1] IFPI Global Music Report 2021. State of the Industry. IFPI. Available at: https://www.ifpi.org/wp-content/uploads/2020/03/GMR2021_STATE_OF_THE_INDUSTRY.pdf (Accessed: 15.07.2024).

[2] How the Global Streaming Boom Helped Local Music Consumption Surge in Latin America. Billboard. Available at: https://www.billboard.com/business/streaming/global-streaming-growth-local-music-boom-latin-america-1235634924/ (Accessed: 15.07.2024).

[3] Streams Of Música Mexicana Soared By 440% In Five Years on Spotify, Platform Says. Music Business Worldwide. Available at: https://www.musicbusinessworldwide.com/streams-of-musica-mexicana-soared-by-440-in-five-years-spotify-says/ (Accessed: 15.07.2024).

Table 17. Top 10 IFPI Tracks: 2020–2023

IFPI Rank	2020		2021		2022		2023	
	Artist	Single	Artist	Single	Artist	Single	Artist	Single
1	The Weeknd	Blinding Lights	The Weeknd	Save Your Tears	Harry Styles	As It Was	Miley Cyrus	Flowers
2	Tones and I	Dance Monkey	The Kid Laroi, Justin Bieber	Stay	Glass Animals	Heat Waves	Rema, Selena Gomez	Calm Down
3	Roddy Ricch	The Box	Dua Lipa	Levitating	The Kid Laroi, Justin Bieber	Stay	SZA	Kill Bill
4	SAINt JHN	Roses	BTS	Butter	Elton John & Dua Lipa	Cold Heart (Pnau Remix)	The Weeknd, Ariana Grande	Die For You
5	Dua Lipa	Don't Start Now	Olivia Rodrigo	Driver's License	The Weeknd	Save Your Tears	Harry Styles	As It Was
6	Future (feat. Drake)	Life Is Good	Justin Bieber (feat. Daniel Caesar, Giveon)	Peaches	Imagine Dragons & J.I.D.	Enemy	Yng Lvcas, Peso Pluma	La Bebe
7	Xiao Zhan	Made To Love	The Weeknd	Blinding Lights	Ed Sheeran	Shivers	Taylor Swift	Cruel Summer
8	DaBaby (feat. Roddy Ricch)	ROCK-STAR	Olivia Rodrigo	good 4 u	Gayle	ABCDEFU	Morgan Wallen	Last Night
9	Billie Eilish	bad guy	Lil Nas X	MONTERO (Call Me by Your Name)	Bad Bunny & Chencho Corleone	Me Porto Bonito	Taylor Swift	Anti-Hero
10	BTS	Dynamite	Ed Sheeran	Bad Habits	Ed Sheeran	Bad Habits	Jung Kook feat. Latto	SEVEN

Source: HSE ISSEK, based on IFPI.

At a first glance, such popularity is caused by the rhythm of the music, bursting emotions, and catchiness of Latin American songs. Their melody and airiness lower the language barrier – listeners automatically join the singer in performing the song, without thinking about the lyrics, which resulted in many remixes being produced based on the same Latino song in various languages. For example, the Luis Fonsi's song "Despacito" has been performed in 70 languages[1] and entered the rankings of the most successful remixes, according to Billboard.[2] However, one would need

[1] Despacito – 70 Different Languages. PixeleQ. Available at: https://www.youtube.com/watch?v=fzTN9iyJ8gs (Accessed: 15.07.2024).

[2] The Power of Remixes in Popularizing Tracks: A Historical Exploration from 'Despacito' to 'Die For You.' How Music Charts. Available at: https://hmc.chartmetric.com/do-remixes-outperform-original-tracks/ (Accessed: 15.07.2024).

Table 18. Share of Various Genres in the Top 10 Tracks: 2020–2023, %

Place	Genre	2020	2021	2022	2023
1	Reggaeton	0	10	10	20
2	Disco Pop	50	50	–	–
3	Hip Hop	30	10	20	20
4	Indie Rock	–	–	10	–
5	K-Pop	20	10	–	10
6	Pop Rock	–	20	–	–
7	Pop, including Hyperpop	–	–	60	50

Source: HSE ISSEK, based on IFPI.

to tap its strength from other, less obvious sources to hold ground with no less memorable Korean hits. According to the Independent Music Publishing Forum (IMPF) for Q1 2024,[1] Mexico is among the world's top leaders by the share of royalties from streaming services in artistic revenues, which brought this country's musicians 111 million euros, which is barely behind the revenues of hugely successful Korean pop stars (117 million euros) (Table 19).

In Chile, in March 2021, the streaming platform market issued PortaDisk, a local streaming music service specializing in national melodies. The platform has over 130,000 soundtracks, over 7,000 independent Chilean artists, and 300 national record labels. According to tunedGlobal's managing director, Con Raso, such positioning allows local services to effectively communicate with fans and support the local music industry and performers.[2] A platform of the same kind – Riivi – was also created in Chile, and then spread to Peru and Columbia. Apart from commercial projects, there are government-funded streaming services – Ondamedia in Chile and Retina Latina in Peru.[3]

Amid the domination of global streams in Latin American countries (Table 20), a significant share of their

[1] IMPF. Global Market View Independent Music Publishing. Fourth Edition. Available at: https://www.impforum.org/wp-content/uploads/2024/04/IMPF-Global-Market-View-Independent-Music-Publishing-4th-Edition-April-2024.pdf (Accessed: 15.07.2024).

[2] PortalDisc & Tuned Global Launch 1st Chilean Music Streaming App. Tuned Global. News. Available at: https://blog.tunedglobal.com/news/portaldisc-tuned-global-launch-chilean-niche-music-streaming-app (Accessed: 15.07.2024).

[3] Rodrigo Munizaga. Meet Riivi, the Streaming Platform Based Solely on Latin American Content. July 26, 2022. CONTXTO. Latinamerican VC, Startup and Tech News. Available at: https://contxto.com/en/news/meet-riivi-the-streaming-platform-based-exclusively-on-latinamerican-content/ (Accessed: 15.07.2024).

Table 19. Countries Leading by the Share of Royalties Earned from Streaming Services in the Total Artist Income: 2024

Country	Royalties earned from streaming services, million euros	Total royalties' volume, million euros	Share of royalties earned from streaming services in the total artist income
Mexico	111	157	70.4
India	45	67	67.1
Australia	223	345	64.5
Sweden	103	167	61.9
Canada	180	337	53.4
United Kingdom	192	1,011	48.7
Republic of Korea	117	247	47.7
TOTAL	**10,832**	**2,331**	

Source: CISAC.[1]

Table 20. Revenues of Key Streaming Platforms in Mexico: 2018–2022, billion USD

Streaming company	2018	2019	2020	2021	2022
Alphabet	136.8	161.9	182.5	257.6	282.8
Amazon.com	232.9	280.5	386.1	469.8	514
Apple	265.6	260.2	274.5	365.8	394.3
Deezer	–	0.43	0.43	0.47	0.5
Reliance Industries	89.41	93.09	72.65	101.5	119.7
Sirius XM Holdings	5.77	7.79	8.04	8.7	9
SoundCloud Limited	0.13	0.17	0.14	0.14	0.16
Spotify Technology	6.21	7.57	8.99	11.44	13.12

Source: Statista.[2]

musical market – around 70% – does not fall under local singers.[3]

The domination of local performers is partially driven by the snowball effect, when the most popular tracks are automatically rising in search queries and lists generated by the streaming service. The snowball is created by the so-called Latin American super-

[1] CISAC Global Collections Report 2023 (for 2022 data). Available at: https://gcr2023.cisac.org/EN/ (Accessed: 15.07.2024).

[2] Music Streaming – Mexico. Statista, 2024. Available at: https://www.statista.com/outlook/dmo/digital-media/digital-music/music-streaming/mexico (Accessed: 15.07.2024)

[3] How the Global Streaming Boom Helped Local Music Consumption Surge in Latin America. Billboard. Available at: https://www.billboard.com/business/streaming/global-streaming-growth-local-music-boom-latin-america-1235634924/ (Accessed: 15.07.2024)

fans – avid lovers of music, actively reporting and commenting on the tracks of their favorite artists in fandom communities. This also motivates the organizers of sports events to use Latin American music, which, on the one hand, increases the rate of the tracks being tagged in social media, and on the other – increases the popularity of this music genre. Concurrently, Latin American superfans are spending 30% more on their hobby than their peers who enjoy other genres,[1] which also increases the attractiveness of performers from the countries of South America for international streaming services.

The development of streaming technology not only prompted the growth of global popularity for already famous Latin American performers, but also opens unusual and authentic genres. For example, the Corridos Tumbados genre, combining hip hop and reggaeton, became famous due to Mexican performer Peso Plum climbing the music charts.[2]

Contributions to the popularity of local music genres are made not only by audio, but also video streaming services. For many singers, participation in the soundtracks of high-ranking series became a real boost. Just look at Tito & Tarantula, whose success is related to their appearance in Robert Rodriguez's films (for example, in the films "Desperado" and "From Dusk till Dawn").

Despite the expansion to Latin American markets of American media giants Netflix, Amazon, and Paramount, Brazil placed among the top 20 countries by the number of video streaming services with the largest number of subscriptions (the headquarters of the Globoplay and Claro TV media corporations are located in Rio de Janeiro). The mentioned top list of streaming services also contains Mexico's Blim TV, specializing in local content.[3] In Argentina, the Instituto Nacional de Cine y Artes Audiovisuales (INCAA) had already been founded in 2015 and funded by the government online cinema CINE. AR Play – "the Creole Netflix"[4] to screen the national films. The Mexican initiative to set a minimal share of local content for subscription-based foreign video and audio streaming services, albeit not implemented, pushed Netflix to open an office in Mexico City.[5]

The cultural exchange that is so important for Latin American music is constrained by the limitations placed on international media giants attempting to operate in the countries of Latin America.

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[1] Latin Music Super Fans Key to Driving Double-Digit Growth, Says Luminate. Billboard. Business News. Available at: https://www.billboard.com/business/business-news/luminate-latin-music-growth-numbers-streaming-super-fans-whatsapp-1235430663/ (Accessed: 15.07.2024)

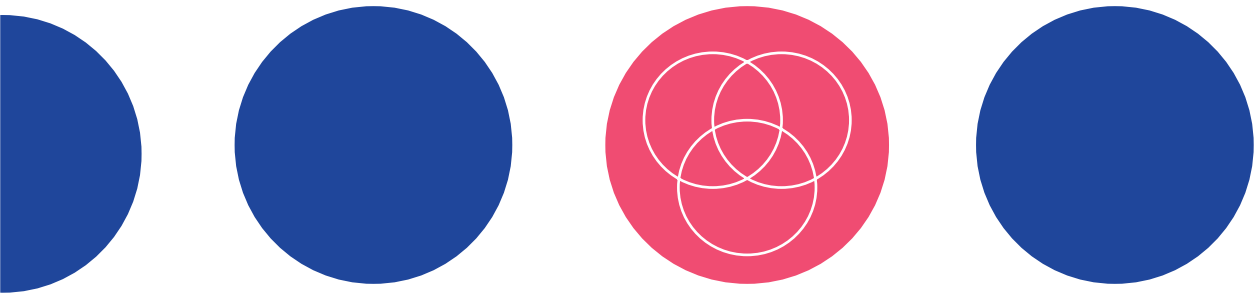
[2] The World Loves Corridos Tumbados. In Mexico, It's Complicated. The New York Times. Available at: https://www.nytimes.com/2023/12/05/arts/music/corridos-tumbados-peso-pluma-mexico.html (Accessed: 15.07.2024)

[3] Blim TV: Niche platforms and local content like ours will remain relevant. Produ 35. Available at: https://www.produ.com/english/noticias/blim-tv-niche-platforms-and-local-content-like-ours-will-remain-relevant/ (Accessed: 15.07.2024)

[4] Odeón, "the Creole Netflix" that offers 700 hours of movies and series for free. La Nación. (In Spanish). Available at: https://www.lanacion.com.ar/espectaculos/odeon-el-netflix-criollo-que-ofrece-gratis-700-horas-de-peliculas-y-series-nid1849074/ (Accessed: 15.07.2024)

[5] Supporting Local Content Investment: International Policy Approaches to VOD Services. Oliver & Ohlbaum Ltd. Available at: https://www.infrastructure.gov.au/sites/default/files/documents/mrgp-abc-attachment-b-oliver-and-ohlbaum.pdf (Accessed: 15.07.2024)

> The accelerated development and many capacities of streaming technology, especially those providing local content, made the development of the Latin American music industry self-propagating. Finding favorable currents in streaming popularity is possible not only for performers, living in points of high concentration of the global show business, but local talent as well.



The Gold Rush

Access to venture capital determines the geography of the most expensive creative industries, including cinema and contemporary art

The composition of the top 20 HSE GCII 2024 cities in terms of the development of venture capital investments, arts, cinema, and animation is two-thirds similar, and in each of these rankings the five mega-creative centers are fully represented (Table 21).

Table 21. Top 20 HSE GCII 2024 Cities in Venture Capital Investment, Film and Animation, and Arts*

Venture capital investment	Film and animation	Arts
1. San Francisco	1. Los Angeles	1. New York
2. New York	2. Paris	2. London
3. London	3. London	3. Paris
4. Los Angeles	4. New York	4. Los Angeles
5. Boston	5. Tokyo	5. Tokyo
6. Beijing	6. Mumbai	6. Beijing
7. Delhi	7. San Francisco	7. Berlin
8. Paris	8. Seoul	8. Moscow
9. Singapore	9. Sydney	9. Seoul
10. Shanghai	10. Madrid	10. San Francisco
11. Washington, D.C.	11. Amsterdam	11. Boston
12. Mumbai	12. Warsaw	12. Hong Kong
13. Toronto	13. Kyiv	13. Milan
14. Tokyo	14. Stockholm	14. Washington, D.C.
15. Chicago	15. Moscow	15. Stockholm
16. Miami	16. Brussels	16. Chicago
17. Berlin	17. Rome	17. Oxford
18. Seoul	18. Beijing	18. Rome
19. Austin	19. Istanbul	19. Melbourne
20. Tel Aviv	20. Rio de Janeiro	20. Dublin

* Highlighted in gray are cities that are included in both the top 20 in Startups and venture capital and Film and animation or Arts.

Source: HSE ISSEK.

Film production is considered the most capital-intensive of all creative industries: the budgets of the highest-grossing films reach 200–300 million USD. Arts, especially contemporary art, evolve in where there are collectors who invest not only in private collections, but also in premium cultural spaces. Thus, the Naoshima Museum Island in the Inland Sea of Japan was revived by tycoon Soichiro Fukutake, who invested 240 million USD of his own funds in this project.[1]

The creative industries' thirst for capital leads to the emergence of special financing mechanisms in mega-creative cities, for example, the securitization of intellectual property or the use of NFTs. The former is issued in the form derivatives secured by intellectual property rights, and thus allows one to attract financial resources. The mechanism was developed by David Pullman, an investment banker from Los Angeles, who in 1997 offered David Bowie to issue bonds that gave investors a share in the singer's royalties over the next decade. Bowie Bonds were bought by the American insurance giant Prudential, and the artist used some of the money raised to buy the rights to his songs from his former manager.[2] An NFT is a digital blockchain-powered certificate that assigns the owner the rights to an object. Among the auction revenue leaders living in the HSE GCII 2024 mega-creative cities, Damien Hirst (London), Takashi Murakami (Tokyo), and Jenny Holzer (New York) produced their own NFTs.

[1] Treasure Islands: Inside A Japanese Billionaire's Art Archipelago. Available at: https://www.forbes.com/sites/susanadams/2015/07/29/naoshima-island-inside-japanese-billionaire-soichiro-fukutakes-art-archipelago/ (Accessed: 01.07.2024).

[2] Sotheby's to use Picasso, Warhol and Rembrandt paintings to back $500m bond. Available at: https://www.pullmanbonds.com/_files/ugd/0a4161_bc768066874e40fdb4d25feb87a813ed.pdf (Accessed: 04.07.2024).

Palma de Masala

In 2024, a film by a young Indian director Payal Kapadia "All We Imagine as Light" received a Grand Prix Award at the Cannes Film Festival

On the one hand, this achievement is impressive in and of itself since independent filmmaking is still more developed and popular in Western cities (the leaders in the "Film production companies that won international film festival awards" indicator are Paris, Los Angeles, Berlin, and London). This is not totally a result one would expect to see, because Indian films are rarely showcased at the Cannes (the last Indian picture to be included in the program was "Swaham" (or "My Own") by Shaji N. Karun in 1994), although in terms of the total number of produced pictures, Indian cinema has been holding onto the palm branch for quite some time. In 1990, for example, Indian cinema was even included in The Guinness Book of Records for the total number of released films (948). Now, 30 years later, India is still a record-holder: by the end of 2023, it released over 1,700 films.[1] In 2022, the national box office reached almost 1.3 billion USD[2] with an average ticket price of 1.4 USD (or 119 rupees)[3] (for comparison, in the United States – almost 7.4 billion USD[4] with the average ticket price of 9.5 USD).[5]

Previously, only one of the largest centers of Indian cinema making was well-known – Bollywood, which received its name by combining two toponyms: Bombay (since 1995, Mumbai) which has been the cradle of most Indian films for a long time and American Hollywood. However, Indian films are not only being produced in Bollywood: there are at least two flourishing "star factories" in the country – Kollywood, in the Southern state of Tamil Nadu, and Tollywood, in the other Southern state, Andhra-Pradesh.

One of the reasons why cinema in India had received such a stimulus for development in various regions is the absence of linguistic consistency: at present, there are 22 languages with national status: Hindi[6] and its dialects are the most disseminated, followed by Bengali, Marathi, Telugu,

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[1] The number of new film releases in India from 2017 to 2023. Available at: https://www.statista.com/statistics/1346845/india-number-of-film-releases/ (Accessed: 07.06.2024).

[2] India Recorded Second-Biggest Box Office Year Ever In 2022 With $1.28B, but Admissions Still Down on Pre-Pandemic Levels. Available at: https://deadline.com/2023/02/india-box-office-second-biggest-year-kgf-chapter-2-rrr-avatar-1235261274/ (Accessed: 07.06.2024).

[3] Average cost of movie tickets in India from 2015 to 2022. Available at: https://www.statista.com/statistics/1346978/india-average-movie-ticket-price/ (Accessed: 07.06.2024).

[4] Box Office Mojo by IMDbPro. Domestic Yearly Box Office. Available at: https://www.boxofficemojo.com/year/ (Accessed: 07.06.2024).

[5] Finally, the NATO Report Tells Us the Average Price of a Movie Theater Ticket. Available at: https://www.imdb.com/news/ni63988272/ (Accessed: 07.06.2024).

[6] The Eighth Schedule to the Constitution of India. Available at: https://www.mha.gov.in/sites/default/files/EighthSchedule_19052017.pdf (Accessed: 07.06.2024).

and Tamil, which leads to each state wanting to create their own films in their own language: Bollywood – in Hindi, Kollywood – in Tamil, and Tollywood – in Telugu.

Due to these language barriers, it is unlikely for films produced in one of the states to be adapted and translated for other regions of the country. As a result, Indian cinema adopted another business model, where they do remakes using the original scripts of successful films. As such, Bollywood films, for example, will be released within a year as an adaptation of Tamil or Telugu versions, and vice versa.

In the 1970s, these regions collectively created and spread the "masala" genre. It was coined using the name of a national blend of spices, reminding how such films harmoniously combine romance, action, comedy, and musical.

For many years the three centers of cinema have been passing the palm of victory from one to another with varying degrees of success. Bollywood still proves to be the national cinema center; but was already outdone by Kollywood and Tollywood in terms of the number of produced pictures: in 2022, 194 films were produced in Hindi, 228 – in Tamil, and 278 – in Telugu.[1] However, by box office sales Bollywood films are still in the lead: in 2022, they took 33% of the total Indian box office, whereas films produced in Kollywood accounted for 20%, and in Tollywood – 16%.[2] Western companies collaborate mostly with film production companies located in Mumbai, because strongest media corporations have been historically formed in this city. Examples of that are Zee Entertainment Enterprises, an Indian partner of Sony Pictures; and Disney Company, which launched an online theatre, Disney+ Hotstar, together with an Indian studio Reliance Entertainment. Today, there are six large film production companies in Andhra-Pradesh and over twenty – in Kollywood.

West Bengal is a unique state that is practically solely responsible for producing arthouse Indian cinema – so unlike the typical Indian "masala" but familiar to European audiences. This is no surprise, given that its founder, Satyajit Ray, draws inspiration from Italian neorealism.
What is causing such active production of cinema in India?

1. Evolving Financial Instruments

Mass produced Indian cinema that emerged in the 1950s often followed a very similar process to manufacturing. Even today, the producer can also be the leading actor, director, screenwriter, and perform miscellaneous tasks on the film set; and many modern film production studios –

[1] The number of new film releases in India from 2019 to 2023, by language. Available at: https://www.statista.com/statistics/1263342/india-number-of-film-releases-by-language/ (Accessed: 07.06.2024).

[2] Distribution of the Indian box office sales in 2022, by language. Available at: https://www.statista.com/statistics/948615/india-box-office-share-by-language/ (Accessed: 07.06.2024).

Anurag Kashyap Films, Aamir Khan Productions, Bombay Talkies, and RK Films – grew from family enterprises.

Industries with "family ties" tend to primarily fund their projects through their own money. For example, the main investors in Indian cinema in the predigital era were "filmlabs"[1], companies that printed positive films using the original negatives, i.e., they made and disseminated physical copies. Their concentration and market influence were especially significant in Mumbai. Apart from sticking to internal financing, there were no other ways to raise funds, such as taking loans from a bank, which naturally stifled the industry's development. The situation changed in 2003 with the launch of a campaign to prevent "underground" funding of the economy, within which legal constraints that previously prevented the bank from giving loans to film production companies were lifted.[2] It happened at the same time the Ministry of Finance of India developed several criteria for which fulfilment is necessary to receive loans: the producer must have the status of a legal entity, film production insurance, and music rights. As a result, during the last 20 years the largest banks of the country – Yes Bank, IDBI Bank, ICICI Bank, Dena Bank, and Canara Bank – became active investors in the cinema industry by way of offering lower-than-average interest rates to film producers (the average rate being around 9.5%–10%) and issuing loans on the security of intellectual property.[3]

2. Modern Infrastructure

In 1996, Tollywood built the largest film production site, Ramoji Film City, using the money of the media tycoon and film producer Ramoji Rao (1936–2024), whose empire includes, among other things, another film production company Usha Kiran Movies, an eight-channel television company ETV Network, a daily newspaper Eenadu, and a country-wide chain of hotels and trade centers.[4]

Ramoji's total area exceeds any studio in Hollywood[5] (1,666 acres, or 6.74 km^2) and looks like a large "cinemapolis" with developed infrastructure that includes 50 stages[6], 47 sound rooms, and 500 rural and urban filming locations decorated

[1] The era of film processing labs. Available at: https://www.business-standard.com/article/news-ians/the-era-of-film-processing-labs-comment-b-town-119032400106_1.html (Accessed: 07.06.2024).

[2] Indian banks find confidence to fund films. Available at: https://www.screendaily.com/indian-banks-find-confidence-to-fund-films/408677.article (Accessed: 07.06.2024).

[3] IP-Backed Financing: Using Intellectual Property as Collateral. Available at: https://ciiipr.in/pdf/CII-Duff-&-Phelps-Report-on-Using-IP-as-Collateral-2019.pdf (Accessed: 07.06.2024).

[4] Who was Ramoji Rao? Here's all about Eenadu and Ramoji Film City founder who passed away in Hyderabad. Available at: https://economictimes.indiatimes.com/news/india/who-was-ramoji-rao-heres-all-about-eenadu-and-ramoji-film-city-founder-who-passed-away-in-hyderabad/articleshow/110812766.cms (Accessed: 07.06.2024).

[5] Here on Planet Tollywood. Available at: https://www.vanityfair.com/hollywood/2012/03/tollywood-201203 (Accessed: 07.06.2024).

[6] Film Facilitation Office. FILM CITY, HYDERABAD. Available at: https://ffo.gov.in/index.php/production-directory/film-cities/ramoji-film-city-hyderabad (Accessed: 07.06.2024).

with gardens and streets[1], production and postproduction centers, food halls, and hotels for personnel, actors, and tourists (every year the studio accommodates over 1.5 million visitors[2]). Ramoji's facilities have the capacity to shoot about 20 films simultaneously, engage around 6,000 extras, conduct film festivals and carnivals, and take people backstage for excursions.[3] There is an entertainment park adjacent to the filming grounds that has an amphitheater for special stage performances and shows and theme parks, where visitors can create their own films.

Apart from Ramoji, there are nine other large film cities in different Indian regions.[4] Since 1977, Mumbai Film City has occupied an area of 520 acres, or 2.1 km^2, where 42 outdoor and 16 indoor movie sets are located. Mumbai Film City provides around 800 jobs on a yearly basis, but, unlike other Indian film cities, does not have special designated area for accommodating and entertaining visitors (only film sets are appropriated for excursions[5]).

Another large film city is Noida Film City in the Delhi agglomeration founded by Sandeep Marwah, an Indian film producer, owner of Marwah Films & Video Studios, and founder of the Asian Academy of Film and Television, all of which are located on the premises of the film city.[6] The whole complex occupies an area of 100 acres (around 400,000 m^2) and includes 16 film studios and the offices of 350 TV channels. Noida Film City provides over 150,000 jobs, including 17,000 in the media. The film city has trade centers, restaurants, and medical institutions, as well as a smooth and fast connection to Delhi. Noida Film City is less focused on accepting visitors than other film cities, and its specialization is mainly the production of shows and TV programs, rather than full-feature films.

3. The Power of the Media

Indian television and video streaming services are actively participating in making movies – there are around 900 TV channels in the country[7] and 57 steaming platforms.[8] According to Ormax Media, the size of the audience

[1] Ramoji Film City. Studio Floors. Available at: https://filmmaker.ramojifilmcity.com/studio-floors (Accessed: 07.06.2024).

[2] India's City of Dreams – Ramoji Film City continues its expansion. Available at: https://blooloop.com/play/in-depth/ramoji-film-city-india-expansion/ (Accessed: 07.06.2024).

[3] Film Facilitation Office. FILM CITY, HYDERABAD. Available at: https://ffo.gov.in/index.php/production-directory/film-cities/ramoji-film-city-hyderabad (Accessed: 07.06.2024).

[4] List of Top Film Cities in India. Available at: https://www.jagranjosh.com/general-knowledge/film-cities-in-india-1607004253-1 (Accessed: 07.06.2024).

[5] Film Facilitation Office. FILM CITY, MUMBAI. Available at: https://ffo.gov.in/production-directory/film-cities/film-city-mumbai (Accessed: 07.06.2024).

[6] Film Facilitation Office. FILM CITY, NOIDA. Available at: https://ffo.gov.in/production-directory/film-cities/noida-film-city (Accessed: 07.06.2024).

[7] The number of television channels across India in 2021, by language. Available at: https://www.statista.com/statistics/1314548/india-television-channels-by-language/ (Accessed: 07.06.2024)

[8] The Ministry of Information and Broadcasting. List of OTT Platforms. Available at: https://mib.gov.in/sites/default/files/List%20of%20OTT%20Platforms_0.pdf (Accessed: 07.06.2024).

watching videos online comprises 481 million users, of whom 101.8 million pay for subscriptions.[1] In 2020, by Forrester estimates, foreign video services – Netflix, Amazon Prime Video, and Disney+ Hotstar – spent almost 520 million USD buying Indian content, which is 30% higher than the same expenses in 2019. Nevertheless, local online theaters are decent competitors of US companies. For example, JioCinema which holds exclusive rights to streaming cricket matches (enormously popular in India), is leading by the number of views.[2] Other video streaming services prefer to work with Western partners. Thus, Hotstar was leading by the number of subscriptions in India after it joined forces with Disney Star.

In what ways could Indian cinema further develop?

Today, due to the Ministry for Information and Broadcasting curating the cinema industry[3], foreigners coming to shoot movies in India are handled using a single-window approach. The film "All We Imagine as Light" which won an award at Cannes had been shot by two Indian film production companies Chalk and Cheese Films and Another Birth in cooperation with a Dutch company, BALDR Film, and French companies, Petit Chaos and Arte France Cinéma.

The Ministry tries to encourage international film production in India via rebates – reimbursements of up to 30% of expenses incurred in India when working on international projects for local video streaming services. Apart from that, the reimbursed amount may be increased to 35%, if over 15% of the labor force engaged in the project's production are Indian citizens. The limit on reimbursements is 300 million rupees (around 3.6 million USD). Similar support measures have been introduced for postproduction or visual effects companies providing services for co-production films, a status awarded by the Ministry of Information and Broadcasting of India to films with international collaboration.

The Ministry is also coordinating the work of universities and cinema schools and promoting energetic young filmmakers via specialized institutions. For example, in 1975, the National Film Development Corporation of India was founded, which provides full funding, as well as educational programs, for amateur film directors, curates the Indian International Film Festival, and promotes Indian films in other countries. Over 300 films have been produced in the language of ethnic Indian minorities under the label "Cinema of India."

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[1] From Netflix to Amazon Prime: Which OTT Platform Has The Most Subscribers In India? Available at: https://www.indiatimes.com/worth/news/from-netflix-to-amazon-prime-which-ott-platform-has-the-most-subscribers-in-india-634423.html (Accessed: 07.06.2024).

[2] Disney and Mukesh Ambani's Reliance Industries Edge Closer to Massive India TV Deal, Say Reports. Available at: https://variety.com/2024/tv/news/disney-mukesh-ambani-reliance-industries-india-tv-1235861283/ (Accessed: 07.06.2024); India-Pakistan cricket match helps Disney's Hotstar set global streaming record. Available at: https://techcrunch.com/2023/10/14/india-pakistan-cricket-match-helps-disneys-hotstar-set-global-streaming-record/ (Accessed: 07.06.2024).

[3] The Ministry of Information and Broadcasting. About Films Wing. Available at: https://mib.gov.in/about-film-wing/films-wing (Accessed: 07.06.2024).

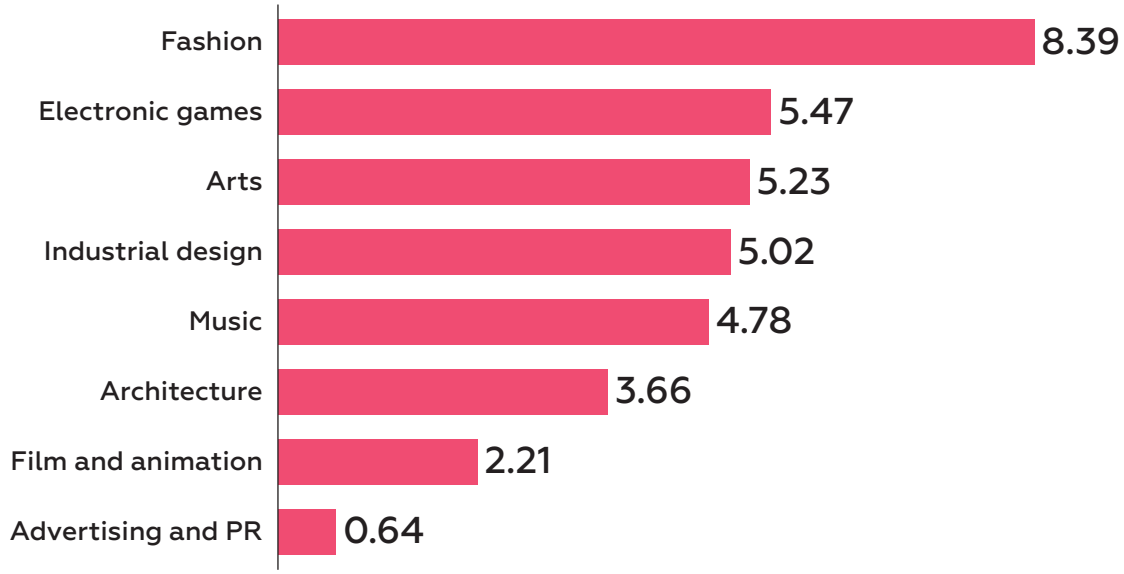
> In a lot of ways Indian cinema reminds us of the masala spice mix: it effortlessly blends large businesses, international corporations, family cooperatives, and independent creators without allowing any component to overwhelm the "flavors" of others. Their coexistence with a conservative country-wide caste system and a significant role of ethnic minorities in different states makes the local cinema industry uniquely authentic, attractive, and sustainable in the face of global competition.

Provincial Provenance

Despite the stable concentration of creative leaders in the largest agglomerations, there are a few industries that are concentrated in small towns

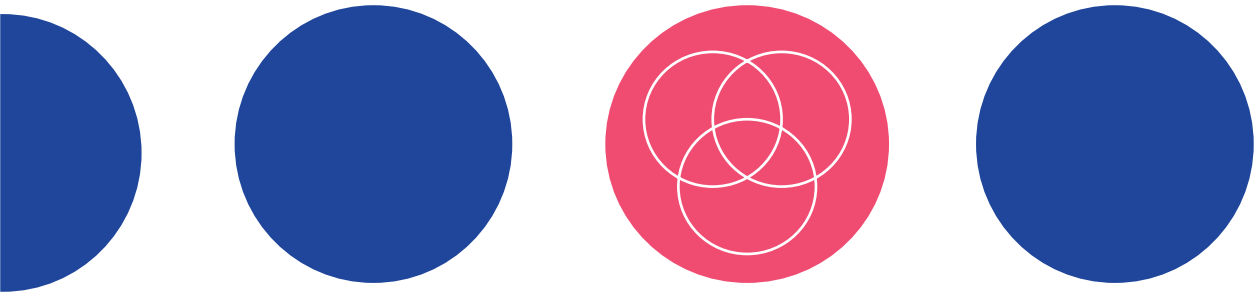
The leaders of design and arts are more inclined to work in small towns than the representatives of the world of music, architecture, cinema, and especially advertising and PR. At the same time, the fashion industry, art, and industrial design sectors also have the widest geography that is measured by the number of cities in which at least one outstanding representative of these specializations is located (Figure 24).

Figure 24. Creative Leaders of HSE GCII 2024 Located in Cities with Population of under 250,000, %



Source: HSE ISSEK, based on Fashion United, FARFETCH, NET-A-PORTER, Luisa Via Roma, British Academy Games Awards, Czech Game of the Year Awards, D.I.C.E. Awards, Famitsu Awards, Game Awards, Game Developers Choice Awards, Golden Joystick Awards, Japan Game Awards, New York Game Awards, SXSW Gaming Award, Spike Video Game Awards, VSDA Awards, Wikipedia, Esports Earnings, Steam, Capcom Showcase Livestream, Devolver Direct, Future Games Show Summer Showcase, Gamescom, OTK Games Expo, PC Gaming Show, Summer Game Fest, Ubisoft Forward, Wholesome Direct, Xbox Games Extended Showcase, Xbox Games Showcase & Starfield Direct, Japanese Art Association, Artprice, ArtReview, QS, THE, Goodreads, A' Design Award, iF Design Award, Red Dot Design Award, Spotify, The International Opera Awards, The Pritzker Architecture Prize, World Architecture Festival Awards, IMDb, FIAPF, Annecy International Animation Film Festival, Animation Career Review, FlixPatrol, Effie Awards, PRovoke Media, Cannes Lions International Festival of Creativity, and D&AD.

This pattern is explained by the attractiveness of the quiet lifestyle of small towns for artists and writers, the low capital intensity of industrial design and its relative independence from the financial institutions of large centers, as well as the connection of fashion with its industrial base, which historically is often located at a distance from modern megacities (for example, the production facilities of the Italian brand Brunello Cucinelli are located in the village of Solomeo in Umbria region).



Ariadne's Thread

Many Italian fashion brands made it to the top by maintaining ties with previous generations and one's birthplace

Italy is a recognized leader in the fashion industry: according to HSE ISSEK, the share of world famous Italian brands represented on FARFETCH is 14.8%, and many of those brands label their products with "Made in Italy." The emergence of FARFETCH in the 1980s was inspired by the need to protect the products of four main sectors of the national economy from counterfeits. These sectors are known as 4A: Automobili (cars and equipment), Agroalimentare (food and beverages), Abbigliamento (apparel), and Arredamento (furniture and home decor). The country lists 4.4 million small and medium-sized enterprises (SMEs), comprising 99.9% of all currently operating companies. SMEs create 80% of jobs and 70% of value added in the country. Their share in national exports reaches 53%, which exceeds the average value for the EU (40%).[1] According to HSE ISSEK, almost 40% of Italian fashion brands, including the Benetton Group, Max Mara, Liu Jo, and Calzedonia, are located in cities with a population of fewer than 250,000 people. For example, Arezzo (97,000 people, as of 2022[2]) and Grosseto (81,600 residents, as of 2023), where successful brands, such as Frenzlauer, Prosperine, RRD, and Vivetta, are registered, 78% and 90% of companies, respectively, have at least 10 employees on their payroll. Such companies account for 26% and 45% of the total employment in manufacturing.[3]

In small Italian cities, as in the whole Italian economy, it is quite common to keep the business in the hands of one family, which adds to the enterprise's rich history, spanning several generations [European Commission, 2019]. Many of them made their way up from home-based artisans to world famous maisons de couture. Mariella Ferrari, the founder of the children's apparel brand of the same name from Pignola (Province of Potenza), began creating costumes for her daughters, Alberta and Giulia, at the end of the 1970s. The first ones to buy dresses from high-quality embroidered fabrics in traditional Tuscany style were the seamstress's neighbors. Today Mariella Ferrari[4] garments are displayed in boutiques in many countries, and Alberta and Giulia regularly present new collections of children's apparel together with their mother.

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[1] Italy – SME Fact Sheet 2021. Available at: https://ec.europa.eu/docsroom/documents/46080/attachments/1/translations/en/renditions/native (Accessed: 11.07.2024).

[2] Arezzo. (In Italian). Available at: https://www.tuttitalia.it/toscana/96-arezzo/ (Accessed: 11.07.2024).

[3] Rural development. Available at: https://www.oecd.org/regional/rural-development/future-of-rural-manufacturing-case-study-italy.pdf (Accessed: 11.07.2024).

[4] Mariella Ferrari – Brand History. Available at: https://www.mariellaferrari.com/en/brand/ (Accessed: 11.07.2024).

In 1956, Alberto Xoccato from San Vito di Leguzzano (Province of Vicenza) began sewing mens shirts in a small workshop in the attic of his own house. They gained popularity in Italy really quickly due to specific stylistic finishings. In the 1970s, the sons of the founder brought their firm "Xacus" to the international arena, and today the brand has over 50 retail outlets.[1] Among Xacus admirers are the economist Jeffrey Sachs and former UK Prime Minister Tony Blair.[2]

Over 40 years ago, Silvano Volpato created in Sant'Angelo di Piove di Sacco (Province of Padua) a brand of hand-sewn footwear – Via Roma 15.[3] The sons of the entrepreneur inherited the business and turned it into a modern mass production company of premium brand shoes. Via Roma 15 products are presented in fashion boutiques around the world.

For some brands, family ties stretch outside the blood line and form a close bond with the land. Their founders take inspiration from nature and city landscapes and treasure the places of their origin. Brunello Cucinelli grew from a family business to make it into the top 100 of the largest Fashion United companies today and significantly contributed to the development of its home, Solomeo (Province of Perugia). The Brunello and Federica Cucinelli Foundation, established by its founders, restored the local castle, opened a theatre and a library, thus completing the cultural ensemble.

In 1910, Ermenegildo Zegna[4] founded a wool mill in Trivero (Province of Biella). The merchant wanted to increase the quality of life in his hometown and in 1930–1940s built a swimming pool, a school, a hospital and a road, later dubbed Panoramica Zegna. Today, Ermenegildo Zegna, being the manufacturer of luxury suits for men and one of the Fashion United's top 100, pays special attention to environmental protection. It has overseen a large reforestation project: in 1993, it founded a nature reserve in the Biellese Alps called Oasi Zegna.

However, passing the business from one generation to the next is not simple. The second generation inherits only half of the firms, and the third – only 10%.[5] To work out this situation, one of the largest Italian banks – Intesa Sanpaolo[6] launched a special consulting program to support businesses undergoing generational change.

The authorities also help companies. For example, the Province of Grosseto administration started to develop

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[1] Modula Warehouse Automation for Textile: Xacus. Available at: https://www.modula.eu/case-history/textile-clothing-accessories/xacus/ (Accessed: 11.07.2024).

[2] Brand Xacus' celebrities – Kamiceria's Blog. Available at: https://blog.kamiceria.com/2014/04/brand-xacus-celebrities/ (Accessed: 11.07.2024).

[3] The story of the brand Via Roma 15. (In Italian). Available at: https://www.viaroma15.com/it/chi-siamo (Accessed: 11.07.2024).

[4] History of the Group – Ermenegildo Zegna Group. Available at: https://www.zegnagroup.com/en/overview/history (Accessed: 11.07.2024).

[5] CERIF. Family Company Research. Cit. ex.: Supporting family businesses in the challenge of generational transition. Available at: https://group.intesasanpaolo.com/en/newsroom/all-news/news/2023/family-businesses-future-italian-industry (Accessed: 11.07.2024).

[6] Supporting family businesses in the challenge of generational transition. Available at: https://group.intesasanpaolo.com/en/newsroom/all-news/news/2023/family-businesses-future-italian-industry (Accessed: 11.07.2024).

plans to attract skilled representatives of intellectual or creative companies to cities with a moderate number of people already in 2019. The target audience of the program were freelancers who could work from any part of the world (COVID-19 lockdowns demonstrated the necessity of such political decisions). The gathering place that was selected to attract talent became the village of Santa Fiora with a population of under 2,500 people.

The good ecology and developed bandwidth system made this settlement a perfect base for reurbanization. In 2020, municipal authorities founded a grant to purchase or rent housing to those who wish to relocate to the smart village[1] for at least one month. The benefit covered around 50% of the rental sum.
In addition to that, leisure programs for various ages were developed to attract workers with families: kindergartens, camps, youth centers, and so on, but only those workers who have a job are allowed to use these benefits when relocating.
This experiment resonated with people and received a thousand applications from around the country and abroad. In 2022, Santa Fiora received financing in the amount of 1.6 million euros to finish constructing infrastructure facilities – places to accommodate startups, co-working spaces, and other necessary facilities.

Universities in Arezzo and Grosseto are collaborating with private and public partners, as well as universities in other provinces to satisfy business requests of a particular territory.
For example, the University of Arezzo has a professional development course on computer engineering from the Polytechnic University of Milan.[2]

In 2022, in Tuscany, a New Jobs Pact[3] was adopted that included measures to support supply on the labor market. Among them are grants of up to 10,000 euros to open a business on the region's territory, individual vouchers to pay for professional retraining for the most disadvantaged groups of society, infant care services, and compensation for transport expenses when undergoing professional development courses in another city. The amount of funds allocated from the regional budget was 53.8 million euros.

There is a whole array of cause-and-effect relations that are associated with the development of fashion brands in small Italian cities – threads that connect various generations with their environment or birthplace. Institutional players – the authorities, banks, and large companies – help keep these relations (often quite subtle) strong, revitalize labor markets in small cities, and help maintain family businesses and aid in their modernization.

[1] These beautiful Italian towns will pay you to work remotely. Available at: https://edition.cnn.com/travel/article/italy-towns-pay-remote-working-cmd/index.html (Accessed: 11.07.2024).

[2] Computer Engineering at the Polytechnic University of Milan. (In Italian). Available at: https://www.polouniversitarioaretino.it/corsi-di-laurea/ (Accessed: 11.07.2024).

[3] Tuscany Launches the "New Pact for Work" for 53.8 million euros. (In Italian). Available at: https://www.toscana-notizie.it/-/la-toscana-vara-il-nuovo-patto-per-il-lavoro-da-53-8-milioni-di-euro (Accessed: 11.07.2024).

Global Creative Warming

North Africa, West Asia, Latin America, and the Caribbean are increasing their share in the total number of leaders in the world of individual creativity, following the internationally recognized creative macro-regions of Europe, North America, and East Asia

The creative specializations of the cities of the Global South differ (Figure 25). The Latin American and Caribbean centers make the greatest contribution to the development of the global media industries – music, film, and animation. Thus, Mexico City and Buenos Aires are among the top 20 by the number of film production companies that won international film festival awards, and the music of Latin American performers consistently occupies high positions on streaming services: Santiago ranks 11th in terms of the number of downloads of tracks on Spotify, São Paulo – 25th.

North Africa and West Asia are the leaders among the macro-regions of the Global South in architecture, industrial design, and fashion – industries with a predominant role played by graphics. For example, the offices of 13 fashion brands of evening fashion wear and jewelry represented by global online retailers are located in Beirut (ranked 31st).

> Every tenth performer of the leading music tracks by the number of downloads from Spotify represents Latin American cities.

150

fashion brands represented on global online retaliers' websites, internationally recognized architecture bureaus and architects, as well as designers and design firms, are located in North Africa and West Asia

Figure 25. Creative Specializations of Macro-Regions Where HSE GCII 2024 Cities are Located, %

Macro-region	Creative industries	Film and animation	Electronic games	Music	Fashion	Advertis-ing and PR	Architec-ture	Industrial design	Arts
America and the Caribbean	2.11	4.92	1.54	3.28	1.65	0.77	3.14	2.48	2.54
Central and Southeast Asia	1.01	3.04	0.32	0.00	0.23	0.64	3.66	1.39	1.45
Europe	54.42	49.47	53.93	57.91	62.22	72.24	40.84	36.12	41.82
North Africa and West Asia	2.76	2.79	4.78	0.30	2.59	2.19	4.71	3.21	1.40
North America	20.17	27.09	18.05	33.13	23.91	23.91	11.26	11.98	33.28
Southeast Asia, East Asia, and Oceania	19.14	12.39	21.18	3.58	9.27	16.24	34.55	44.71	18.43
Sub-Saharan Africa (South Africa)	0.39	0.33	0.21	1.79	0.13	0.09	1.83	0.12	1.09
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

The macro-region's input into the number of industry leaders exceeds its average input into the number of leaders in all industries collectively. The macro-region is ranked lower than 4th by input into the industry among other macro-regions

The macro-region's input into the number of industry leaders exceeds its average input into the number of leaders in all industries collectively. The macro-region is ranked 4th by input into the industry among other macro-regions

Source: HSE ISSEK.

There and Back Again

The biographies of successful contemporary artists from developing countries read like a folktale

Despite almost three quarters of creative leaders being concentrated in Europe and North America, the West's dominion over contemporary art somewhat weakened: during the 2021–2023 period, the share of representatives from developed countries in the Power 100 list of the most influential people in contemporary art decreased from 66% to 60%. Meanwhile, the countries of South America and Africa that went through colonialism and today represent the Global South, account for 10.8% in the "mighty hundred" (15 people out of 139) and only 3.4% of the total number of creative leaders (405 individuals and enterprises from 11,738). In 2023, the Power 100 ranking was supplemented with four new representatives outside the G7 – Reem Fadda, a curator from Abu Dhabi; Marwan Zakhem, a gallerist from Ghana; and Sandra Benites and Rafael Fonseca, Brazil curators. Apart from that, among top artists by auction revenue in the Artprice 2022–2023 ranking are masters from Ghana, Zimbabwe, South Africa, Indonesia, and the Philippines. The perceived trend is supported by statistical data: from 2018 to 2022, the exports in cultural, recreational, and heritage services[1] of developing countries grew by 68%, and in developed countries they fell by 6.8%.[2]

There are several reasons for changes in the global creative landscape. Firstly, they manifest in the Maslow's pyramid effect that causes humans' consistent gravitation toward satisfying the needs at an elevated level, such as companionship, respect, and self-expression, inasmuch as their basic needs are quenched – physiological and safety. Thus, for the last 20 years the growth rate of real GDP in developing countries reached 5.5%.[3]

Secondly, the reason lies in the diversified system of grants in the countries of the Middle East, Africa, and Latin America. The NALAC Fund for the Arts (NFA) supports Latin American artists, creative managers, collectives, and cultural organizations. Since 2007, in Lebanon The Arab Fund for Arts and Culture (AFAC) has operated and financed

[1] This category includes industries from SK23 EBOPS 2010: the conservation of heritage assets, visual arts, performance arts, the organization of recreational activities, sports activities, and so on. Source: Creative Economy Outlook 2022. Available at: https://unctad.org/publication/creative-economy-outlook-2022 (Accessed: 11.07.2024).

[2] Creative services exports of selected groups of economies (experimental). Available at: https://unctadstat.unctad.org/datacentre/dataviewer/US.CreativeServ_Group_E (Accessed: 11.07.2024).

[3] World Economic Outlook, April 2024: Steady but Slow: Resilience amid Divergence. Available at: https://www.imf.org/en/Publications/WEO/Issues/2024/04/16/world-economic-outlook-april-2024#Gdp (Accessed: 11.07.2024).

projects in the visual arts and other creative industries.[1] Especially diverse are the art funding programs that support African countries. For example, The African Arts Trust[2] helps organizations working in contemporary art – creative spaces, galleries, residencies, curators, competition organizers, and so on. The Art Moves Africa (AMA) program supports the cultural exchange between countries in Africa and other continents by funding mobility programs for art professionals.[3] Girl Child Art Foundation encourage the self-realization of artistic potential among girls[4] and African Youth Mentorship Network – among boys.[5]

Many artistic workers from developing countries are demonstrating a particular type of social responsibility. The biographies of the most successful painters resemble stories from folktales as described by Vladimir Propp: experiencing the coming-of-age, facing personal creative ambitions or true callings, traveling to an "alien world" and passing the trials to achieve the creative victory and, finally, coming back to their "own world" with a well-deserved reward [Propp, 2015]. Having received recognition, the masters of the Global South strive to help others make their own contributions to maintaining and developing the national creative tradition.

Among the leaders in the contemporary art is Theaster Gates (ranked 4th on the Power 100 list for 2021), who was born in Chicago, but went on to study religion and art as part of a master's degree program at the University of Cape Town in Africa, the birthplace of his predecessors. Gates gained fame as the creator of a special type of ceramics that utilizes the gastronomic traditions of the African population and as a founder of the Rebuild Foundation, that promotes artistic practices among the dwellers of peripheral districts of Chicago.

Ibrahim Mahama, one among the most popular African artists in Europe and the Unites States, who collaborated with Gates in ceramics, stayed to live in his hometown of Tamala in Ghana and opened a public Savannah Centre for Contemporary Art.[6]

Achille Mbebe[7] (ranked 39th in Power 100), a political philosopher re-thinking the colonial past and post-colonial future of African countries, was born in Cameroon, but received his education in Paris at the Sorbonne University. After

[1] The Arab Fund for Arts and Culture. Available at: https://www.arabculturefund.org/About (Accessed: 11.07.2024).

[2] Funding for Developing Arts in Africa. Available at: https://www.theafricanartstrust.org/funding-developing-arts-africa.php (Accessed: 11.07.2024).

[3] About AMA – Art Moves Africa. Available at: https://artmovesafrica.org/en/about-ama-2/ (Accessed: 11.07.2024).

[4] Girl Child Art Foundation. Available at: https://www.girlchildart.org/our-mission/ (Accessed: 11.07.2024).

[5] African Youth Mentorship Network – Preparing Africa's Future Leaders. Available at: https://aymnetwork.org/ (Accessed: 11.07.2024).

[6] Ibrahim Mahama. White Cube. Available at: https://www.whitecube.com/artists/ibrahim-mahama (Accessed: 11.07.2024).

[7] Achille Mbembe – ArtReview. Available at: https://artreview.com/artist/achille-mbembe/ (Accessed: 11.07.2024).

working at various universities in the United States, he came back to his home country and is now a researcher for the University of the Witwatersrand, Johannesburg (South Africa). The central topic of Mbebe's philosophical work is connecting Africa to the world and integrating it with the global political, economic, and cultural agenda.

Five years ago, a fashion brand "Made For A Woman" emerged in Madagascar's capital, Antananarivo.[1] Its founder, Eileen Akbaraly, was born on the island, but later moved to Italy, where she founded a small factory to preserve the traditional weaving craft from raffia, a symbolical material of Malagasy culture. Most of the factory workers belong to vulnerable social groups (single mothers, people with limited health capacities, etc.). Made For A Woman is in fact demonstrating their commitment to protect the nature: the factory uses eco-friendly ways to collect raffia and zero-waste techniques to produce accessories, furnishing, and packaging.

Rajeeb Samdani, a self-made businessman, who built start-up capital as a stock exchange broker in Singapore,[2] is today promoting contemporary art at his home in Bangladesh together with his wife. The Samdani Art Foundation, co-funded by the couple, is conducting a biannual Dhaka Art Summit, one of the most visited exhibitions in the world: in 2020, the event was attended by over 500,000 people.[3]

> The talent of the Global South are making headway in the intricate world of contemporary art. They are honing their craft to a world-class level, becoming embedded into global institutions, but continue to work on topics related to national identity and helping local communities.

[1] About Us – Made For A Woman. Available at: https://madeforawoman.shop/about-us/ (Accessed: 11.07.2024).

[2] Rajeeb Samdani: Entrepreneurship in Bangladesh, from the Pandemic to the Future. The Lakshmi Mittal and Family South Asia Institute. Available at: https://mittalsouthasiainstitute.harvard.edu/2020/06/rajeeb-samdani-entrepreneurship-in-bangladesh-from-the-pandemic-to-the-future/ (Accessed: 11.07.2024).

[3] Dhaka Art Summit. Available at: https://www.samdani.com.bd/dhaka-art-summit (Accessed: 11.07.2024).

Literary Environment

Developed cultural industries – arts, architecture, film, and animation – make global cities interesting for tourists

The cities included in the top 20 HSE GCII 2024 by tourist appeal are 50% the same in composition as the top 20 in Arts and Film and Animation and 45% – as the top 20 in Architecture (Table 22).

Table 22. Top 20 HSE GCII 2024 Cities in Tourist Appeal, Architecture, Arts, and Film and Animation*

Tourist appeal	Architecture	Arts	Film and animation
1. Paris	1. London	1. New York	1. Los Angeles
2. London	2. Tokyo	2. London	2. Paris
3. Tokyo	3. Paris	3. Paris	3. London
4. New York	4. New York	4. Los Angeles	4. New York
5. Bangkok	5. Sydney	5. Tokyo	5. Tokyo
6. Shanghai	6. Melbourne	6. Beijing	6. Mumbai
7. Dubai	7. Copenhagen	7. Berlin	7. San Francisco
8. Hong Kong	8. Hong Kong	8. Moscow	8. Seoul
9. Moscow	9. Porto	9. Seoul	9. Sydney
10. Beijing	10. Amsterdam	10. San Francisco	10. Madrid
11. Singapore	11. Auckland	11. Boston	11. Amsterdam
12. Jackson	12. Dublin	12. Hong Kong	12. Warsaw
13. Istanbul	13. Basel	13. Milan	13. Kyiv
14. Shenzhen	14. Shanghai	14. Washington, D.C.	14. Stockholm
15. Osaka	15. Beijing	15. Stockholm	15. Moscow
16. Los Angeles	16. Singapore	16. Chicago	16. Brussels
17. Rome	17. São Paulo	17. Oxford	17. Rome
18. Guangzhou	18. Hangzhou	18. Rome	18. Beijing
19. Berlin	19. Los Angeles	19. Melbourne	19. Istanbul
20. Madrid	20. Tehran	20. Dublin	20. Rio de Janeiro

* Highlighted in gray are the cities included in the top 20 both in Tourist Appeal and Architecture, Arts, or Film and Animation.

Source: HSE ISSEK.

> The shortlisted most popular books "Doctor Zhivago" by Boris Pasternak and "The Master and Margarita" by Mikhail Bulgakov conjure up vivid images of Moscow, "Norwegian Forest" by Haruki Murakami – of Tokyo, "Les Miserables" by Victor Hugo – Paris, "The Great Gatsby" by F. Scott Fitzgerald – New York.

The relationship between tourist appeal and literature is particularly interesting. Paris, London, Tokyo, New York, Moscow, Hong Kong, and Beijing are in the top 10 the "Best-selling authors" and "Most popular authors" indicators.

In addition, nine of the 20 global centers of industrial design leaders are among the 20 megacities offering their residents the most convenient means of mobility (Table 23). Thus, freelancing designers who do not have a stationary workplace may be attracted by an opportunity to plan their business trips more flexibly and move more comfortably around the city.

Table 23. Top 20 HSE GCII 2024 Cities in Mobility and Industrial Design*

Industrial design	Mobility
1. Shenzhen	1. London
2. Tokyo	2. Nijmegen
3. Shanghai	3. Tokyo
4. Taipei	4. New York
5. Hong Kong	5. Paris
6. Seoul	6. Frankfurt am Main
7. Beijing	7. Stockholm
8. San Francisco	8. West Midlands
9. New York	9. Ruhr
10. Guangzhou	10. Vienna
11. London	11. Hong Kong
12. Singapore	12. Munich
13. Munich	13. Prague
14. Istanbul	14. Singapore
15. Los Angeles	15. Nagoya
16. Berlin	16. Shanghai
17. Milan	17. Milan
18. Stuttgart	18. Moscow
19. Budapest	19. Shenzhen
20. Hamburg	20. Leiden

* Highlighted in gray are the cities included in the top 20 both in Industrial Design and Mobility.
Source: HSE ISSEK.

Elite Externalities

Cities with advanced elite segments of creative industries are also making progress on the mass market

Creative leaders usually develop segments related to the creation of both elite and mass-produced art. For example, Paris, Los Angeles, Rome, London, Berlin, and Tokyo are simultaneously among the top 10 cities by the number of film production companies that won international film festival awards and top-rated production companies. Tokyo, London, Paris, New York, Sydney, Copenhagen, and São Paulo are among the top 20 in terms of both the number of Pritzker Architecture Prize laureates (an analogue of the Nobel Prize, but for architects, awarded for achievements affecting the development of the industry on a global scale), and the number of architecture firms and architects who won World Architecture Festival Awards, the largest architectural award by the number of countries participating.

The rationale behind the combination of elite and mass production of creativity can be based on the transfer of knowledge from masters to young authors, artists, directors, architects, or other creators not only in the academic environment, but also directly in the course of their practical activities.

4

Urban Environment

Cities' Ranking by the Urban Environment Subindex: 2024

(continued)

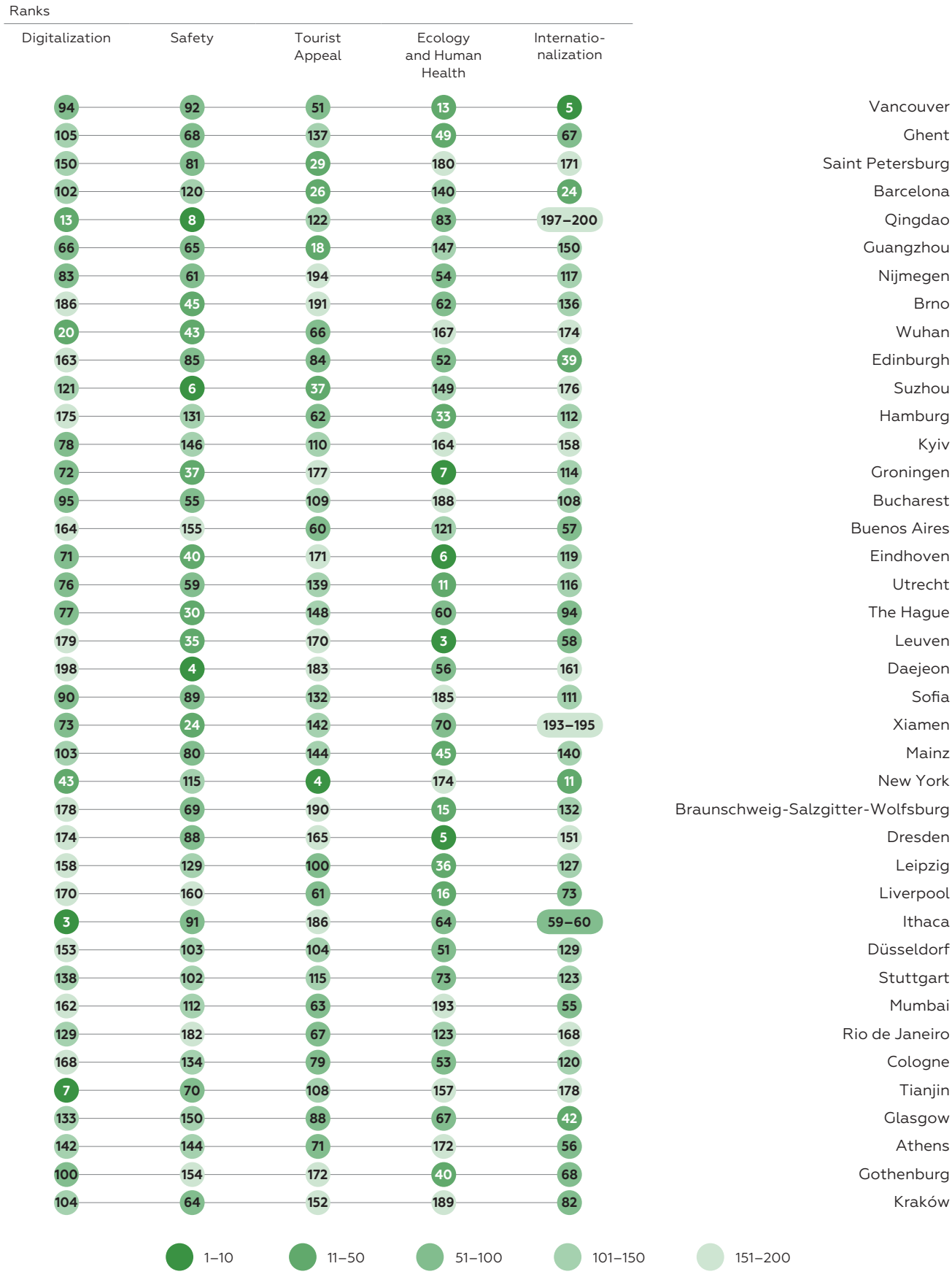
Ranks

Digitalization	Safety	Tourist Appeal	Ecology and Human Health	Internatio-nalization	
54	31	11	68	12	Singapore
27	38	20	78	14	Madrid
87	137	2	143	3	London
4	5	7	150	13	Dubai
8	60	6	159	64	Shanghai
49	71	9	173	141	Moscow
144	54	38	2	17	Vienna
56	44	178	23	105	Vilnius
39	77	3	120	98	Tokyo
30	135	1	134	27	Paris
111	22	22	117	49	Prague
47	114	13	137	18	Istanbul
109	33	8	182	23	Hong Kong
1	3	188	48	192	Hsinchu
21	1	91	12	183	Nagoya
40	26	98	32	71	Helsinki
146	16	44	21	88	Munich
22	52	10	156	91	Beijing
50	47	59	75	25	Lisbon
124	57	85	41	8	Montreal
12	41	94	17	52	Copenhagen
45	105	106	31	79	Stockholm
52	62	87	1	63	Oslo
81	74	23	18	34	Amsterdam
16	28	34	155	172	Chengdu
106	56	14	141	153	Shenzhen
69	96	5	169	164	Bangkok
33	98	47	92	2	Toronto
60	82	102	30	74	Porto
14	14	113	128	166	Nanjing
15	7	143	107	181	Dalian
9	156	192	27	142	Essen-Dortmund
80	42	42	132	134	Seoul
108	72	49	162	110	Budapest
59	99	19	142	29	Berlin
177	9	45	111	169	Taipei
75	36	89	184	62	Warsaw
127	84	15	74	148	Osaka
32	10	58	126	159	Hangzhou
155	107	77	59	97	Frankfurt am Main

1–10 11–50 51–100 101–150 151–200

Urban Environment Subindex Rank
Sections'
Cost of Doing Business
Cost of Living
Mobility
Vancouver 41 139 177 117
Ghent 42 124 86 45
Saint Petersburg 43 4 12 112
Barcelona 44 81 124 39
Qingdao 45 43 17 167
Guangzhou 46 64 40 121
Nijmegen 47 143 144 2
Brno 48 29 52 59
Wuhan 49 46 42 62
Edinburgh 50 79 135 68
Suzhou 51 63 60 41
Hamburg 52 66 95 24
Kyiv 53 1 3 103
Groningen 54 142 104 79
Bucharest 55 13 24 96
Buenos Aires 56 20 14 109
Eindhoven 57 173 118 58
Utrecht 58 148 130 55
The Hague 59 154 127 49
Leuven 60 111 103 153
Daejeon 61 11 66 107
Sofia 62 6 36 101
Xiamen 63 34 38 133
Mainz 64 69 87 82
New York 65 187 200 4
Braunschweig-Salzgitter-Wolfsburg 66 68 73 104
Dresden 67 85 93 38
Leipzig 68 65 94 37
Liverpool 69 114 76 77
Ithaca 70 141 143 159
Düsseldorf 71 94 114 26
Stuttgart 72 88 117 30
Mumbai 73 47 9 94
Rio de Janeiro 74 2 39 89
Cologne 75 91 100 29
Tianjin 76 58 23 151
Glasgow 77 76 115 102
Athens 78 19 59 67
Gothenburg 79 126 77 60
Kraków 80 26 53 83
Rank Change
1–10
11–50
51–100
101–150
151–200

(continued)


Ranks
Digitalization
Safety
Tourist Appeal
Ecology and Human Health
Internatio-nalization
94 92 51 13 5 Vancouver
105 68 137 49 67 Ghent
150 81 29 180 171 Saint Petersburg
102 120 26 140 24 Barcelona
13 8 122 83 197–200 Qingdao
66 65 18 147 150 Guangzhou
83 61 194 54 117 Nijmegen
186 45 191 62 136 Brno
20 43 66 167 174 Wuhan
163 85 84 52 39 Edinburgh
121 6 37 149 176 Suzhou
175 131 62 33 112 Hamburg
78 146 110 164 158 Kyiv
72 37 177 7 114 Groningen
95 55 109 188 108 Bucharest
164 155 60 121 57 Buenos Aires
71 40 171 6 119 Eindhoven
76 59 139 11 116 Utrecht
77 30 148 60 94 The Hague
179 35 170 3 58 Leuven
198 4 183 56 161 Daejeon
90 89 132 185 111 Sofia
73 24 142 70 193–195 Xiamen
103 80 144 45 140 Mainz
43 115 4 174 11 New York
178 69 190 15 132 Braunschweig-Salzgitter-Wolfsburg
174 88 165 5 151 Dresden
158 129 100 36 127 Leipzig
170 160 61 16 73 Liverpool
3 91 186 64 59–60 Ithaca
153 103 104 51 129 Düsseldorf
138 102 115 73 123 Stuttgart
162 112 63 193 55 Mumbai
129 182 67 123 168 Rio de Janeiro
168 134 79 53 120 Cologne
7 70 108 157 178 Tianjin
133 150 88 67 42 Glasgow
142 144 71 172 56 Athens
100 154 172 40 68 Gothenburg
104 64 152 189 82 Kraków
1–10
11–50
51–100
101–150
151–200

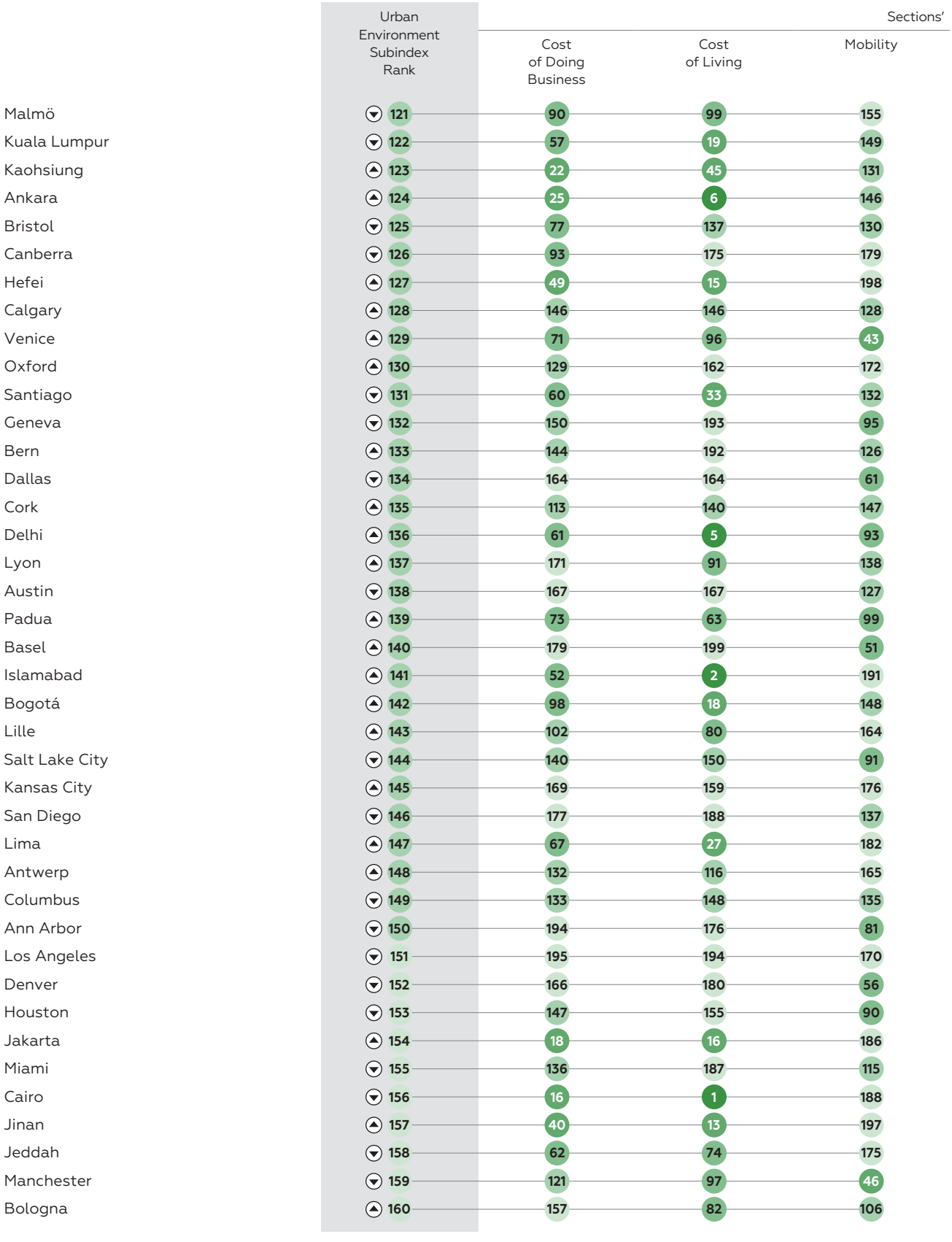
Urban Environment Subindex Rank
Sections'
Cost of Doing Business
Cost of Living
Mobility
Xi'an 81 53 11 178
Heidelberg 82 83 126 80
Luxembourg 83 192 156 57
Brisbane 84 112 133 168
Auckland 85 165 132 143
Sydney 86 125 154 111
São Paulo 87 3 41 105
Rome 88 160 113 47
Chongqing 89 39 31 174
Birmingham 90 78 102 8
Hanover 91 45 90 27
Leiden 92 156 149 20
Brussels 93 151 128 32
Zürich 94 190 190 21
Bonn 95 32 89 44
Strasbourg 96 100 83 87
Milan 97 162 108 17
Boulder 98 178 189 40
Aarhus 99 161 131 97
Changsha 100 41 30 173
València 101 92 67 134
Exeter 102 109 125 166
Leeds 103 135 129 76
Bordeaux 104 105 75 116
Rotterdam 105 170 121 85
Tsukuba 106 123 64 156
Ottawa 107 137 151 88
Toulouse 108 122 72 144
Dublin 109 118 169 36
Tel Aviv 110 116 134 69
Nuremberg 111 56 101 125
Fuzhou 112 44 20 196
Belgrade 113 8 48 114
Taichung-Changhua 114 24 47 74
Ede 115 97 106 73
Melbourne 116 185 142 108
Riyadh 117 80 98 185
Adelaide 118 95 152 163
Cambridge 119 103 141 187
Nottingham 120 75 111 63
— Rank Change
1–10
11–50
51–100
101–150
151–200

(continued)

Ranks

Digitalization	Safety	Tourist Appeal	Ecology and Human Health	Internatio-nalization	
35	27	35	178	182	Xi'an
159	49	146	69	121	Heidelberg
64	46	189	4	102	Luxembourg
180	108	30	58	41	Brisbane
65	117	118	55	22	Auckland
173	73	64	109	15	Sydney
136	198	28	118	149	São Paulo
93	116	17	122	104	Rome
42	25	54	165	180	Chongqing
166	190	69	89	66	Birmingham
141	149	193	57	139	Hanover
79	17	197	8	184	Leiden
122	130	76	112	32	Brussels
98	18	125	35	87	Zürich
132	122	138	24	185	Bonn
28	121	175	66	157	Strasbourg
123	124	32	130	92	Milan
25	53	114	65	81	Boulder
11	34	158	47	179	Aarhus
63	20	96	114	196	Changsha
125	67	128	104	128	València
152	100	187	9	59–60	Exeter
55	145	124	88	50	Leeds
23	159	123	29	163	Bordeaux
119	83	168	72	72	Rotterdam
6	75	195	63	188–189	Tsukuba
113	87	116	94	47	Ottawa
36	164	86	28	143	Toulouse
157	133	75	136	10	Dublin
145	58	126	85	124	Tel Aviv
147	111	150	81	122	Nuremberg
46	50	103	82	191	Fuzhou
135	95	149	181	146	Belgrade
151	13	154	166	187	Taichung-Changhua
101	86	141	14	197–200	Ede
183	140	41	93	9	Melbourne
24	21	72	146	167	Riyadh
184	90	129	61	43	Adelaide
181	76	161	44	35	Cambridge
140	167	81	106	85	Nottingham

1–10 11–50 51–100 101–150 151–200


Urban Environment Subindex Rank
Sections'
Cost of Doing Business
Cost of Living
Mobility
Malmö 121 90 99 155
Kuala Lumpur 122 57 19 149
Kaohsiung 123 22 45 131
Ankara 124 25 6 146
Bristol 125 77 137 130
Canberra 126 93 175 179
Hefei 127 49 15 198
Calgary 128 146 146 128
Venice 129 71 96 43
Oxford 130 129 162 172
Santiago 131 60 33 132
Geneva 132 150 193 95
Bern 133 144 192 126
Dallas 134 164 164 61
Cork 135 113 140 147
Delhi 136 61 5 93
Lyon 137 171 91 138
Austin 138 167 167 127
Padua 139 73 63 99
Basel 140 179 199 51
Islamabad 141 52 2 191
Bogotá 142 98 18 148
Lille 143 102 80 164
Salt Lake City 144 140 150 91
Kansas City 145 169 159 176
San Diego 146 177 188 137
Lima 147 67 27 182
Antwerp 148 132 116 165
Columbus 149 133 148 135
Ann Arbor 150 194 176 81
Los Angeles 151 195 194 170
Denver 152 166 180 56
Houston 153 147 155 90
Jakarta 154 18 16 186
Miami 155 136 187 115
Cairo 156 16 1 188
Jinan 157 40 13 197
Jeddah 158 62 74 175
Manchester 159 121 97 46
Bologna 160 157 82 106
— Rank Change
1–10
11–50
51–100
101–150
151–200

(continued)

Ranks

Digitalization	Safety	Tourist Appeal	Ecology and Human Health	Internatio-nalization	
48	178	147	43	101	Malmö
84	185	27	179	107	Kuala Lumpur
171	29	131	148	190	Kaohsiung
193	113	145	124	165	Ankara
120	138	136	90	80	Bristol
191	66	173	22	46	Canberra
44	2	99	168	188–189	Hefei
88	118	92	110	44	Calgary
167	94	68	183	130	Venice
182	101	151	34	31	Oxford
139	173	82	138	118	Santiago
117	51	135	42	103	Geneva
57	23	155	20	155	Bern
149	168	48	100	19	Dallas
161	104	198	91	37	Cork
131	184	43	187	144	Delhi
41	171	40	86	125	Lyon
74	132	50	116	33	Austin
165	142	164	131	115	Padua
97	48	162	10	113	Basel
196	79	200	96	160	Islamabad
156	170	130	101	126	Bogotá
29	158	156	80	162	Lille
86	93	134	127	93	Salt Lake City
34	186	12	71	89	Kansas City
70	125	36	108	28	San Diego
126	175	121	171	61	Lima
114	123	160	87	106	Antwerp
31	166	70	125	77	Columbus
200	39	181	19	75	Ann Arbor
89	127	16	152	4	Los Angeles
160	153	55	113	26	Denver
110	191	24	133	20	Houston
53	147	57	197	152	Jakarta
197	126	21	158	6	Miami
137	110	101	199	145	Cairo
10	15	182	196	197–200	Jinan
85	19	117	163	186	Jeddah
185	177	111	135	69	Manchester
169	152	140	98	99	Bologna

1–10 11–50 51–100 101–150 151–200

Urban Environment Subindex Rank
Sections'
Cost of Doing Business
Cost of Living
Mobility
Ningbo 161 36 34 194
Novosibirsk 162 15 7 177
Minneapolis 163 163 173 72
Ho Chi Minh City 164 14 10 180
Bengaluru 165 72 4 183
Harbin 166 33 21 193
Chicago 167 180 179 120
Rochester 168 196 139 195
Lausanne 169 149 191 71
New Haven 170 184 165 139
Marseille 171 96 84 145
Santa Barbara 172 198 196 142
Montpellier 173 106 110 181
St. Louis 174 176 145 119
Changchun 175 50 22 200
Boston 176 189 198 110
San Francisco 177 199 197 136
Perth 178 181 183 158
Florence 179 153 105 161
Portland 180 191 185 113
Washington, D.C. 181 200 184 86
Madison 182 182 160 169
Cleveland 183 107 161 152
Mexico City 184 87 56 160
Grenoble 185 159 81 157
Beirut 186 7 62 190
Nashville 187 145 182 150
Seattle 188 193 195 92
Durham 189 172 168 171
Turin 190 158 70 124
Kitchener 191 197 158 162
Tehran 192 23 8 189
Manila 193 30 46 184
Philadelphia 194 138 178 123
Pittsburgh 195 188 171 154
Cape Town 196 89 50 192
Atlanta 197 186 170 84
Detroit 198 130 166 141
Phoenix 199 183 172 122
Raleigh 200 84 181 199
— Rank Change
1–10
11–50
51–100
101–150
151–200

(continued)

Ranks

Digitalization	Safety	Tourist Appeal	Ecology and Human Health	Internatio-nalization	
19	11	166	191	193–195	Ningbo
134	148	174	175	173	Novosibirsk
118	181	56	103	30	Minneapolis
107	162	97	194	154	Ho Chi Minh City
154	165	167	176	96	Bengaluru
5	32	159	198	197–200	Harbin
128	163	31	170	7	Chicago
2	143	196	79	95	Rochester
130	63	169	26	177	Lausanne
17	188	119	46	76	New Haven
68	193	83	102	137	Marseille
67	12	176	76	70	Santa Barbara
37	187	157	25	170	Montpellier
91	197	46	37	100	St. Louis
38	78	185	160	193–195	Changchun
82	97	73	119	36	Boston
115	151	33	84	16	San Francisco
176	136	95	77	38	Perth
188	119	78	115	138	Florence
61	180	53	105	45	Portland
116	189	25	161	1	Washington, D.C.
199	106	105	38	90	Madison
187	192	120	39	78	Cleveland
143	169	90	186	131	Mexico City
62	183	179	95	135	Grenoble
190	109	180	192	156	Beirut
96	157	39	139	86	Nashville
172	172	65	50	48	Seattle
18	179	133	97	83	Durham
148	161	127	144	147	Turin
92	139	199	99	54	Kitchener
189	141	184	195	175	Tehran
99	196	163	190	109	Manila
58	195	112	151	40	Philadelphia
112	128	80	154	84	Pittsburgh
192	176	153	129	133	Cape Town
194	194	93	145	21	Atlanta
51	199	74	177	65	Detroit
195	174	52	153	51	Phoenix
26	N/A	107	N/A	53	Raleigh

1–10 11–50 51–100 101–150 151–200

Focal points of postindustrial economy leaders are likelier to emerge in the cities providing a comfortable and esthetically pleasing modern environment for their residents. The winning formula for becoming attractive to innovators lies in keeping a balance between a high level of available infrastructure and affordable basic goods for happy living, creating, and doing business. Global centers with the most prominent technological and creative potential diversify the areas in which they develop the urban environment. Moscow, Istanbul, and Vilnius place their bets on the low cost of doing business and long-term living. London, Paris, and Singapore aim at providing the utmost mobility and openness. Dubai and Shanghai outpace their competitors in terms of advanced digital services; Copenhagen and Munich invest in green energy and sustainability projects; and Riyadh and Auckland focus on testing new tools for integrating expats.

The high level of development and comfort of urban spaces for living and doing business, coupled with a diverse variety of ways to entertain oneself, are the best ways for cities to obtain a competitive edge in the global battle for talent and innovation excellence. The Urban Environment Subindex includes 46 indicators grouped into eight sections:

- Cost of doing business (5 indicators)
- Cost of living (13)
- Mobility (5)
- Digitalization (5)
- Safety (3)
- Tourist appeal (8)
- Ecology and human health (3)
- Internationalization (4).

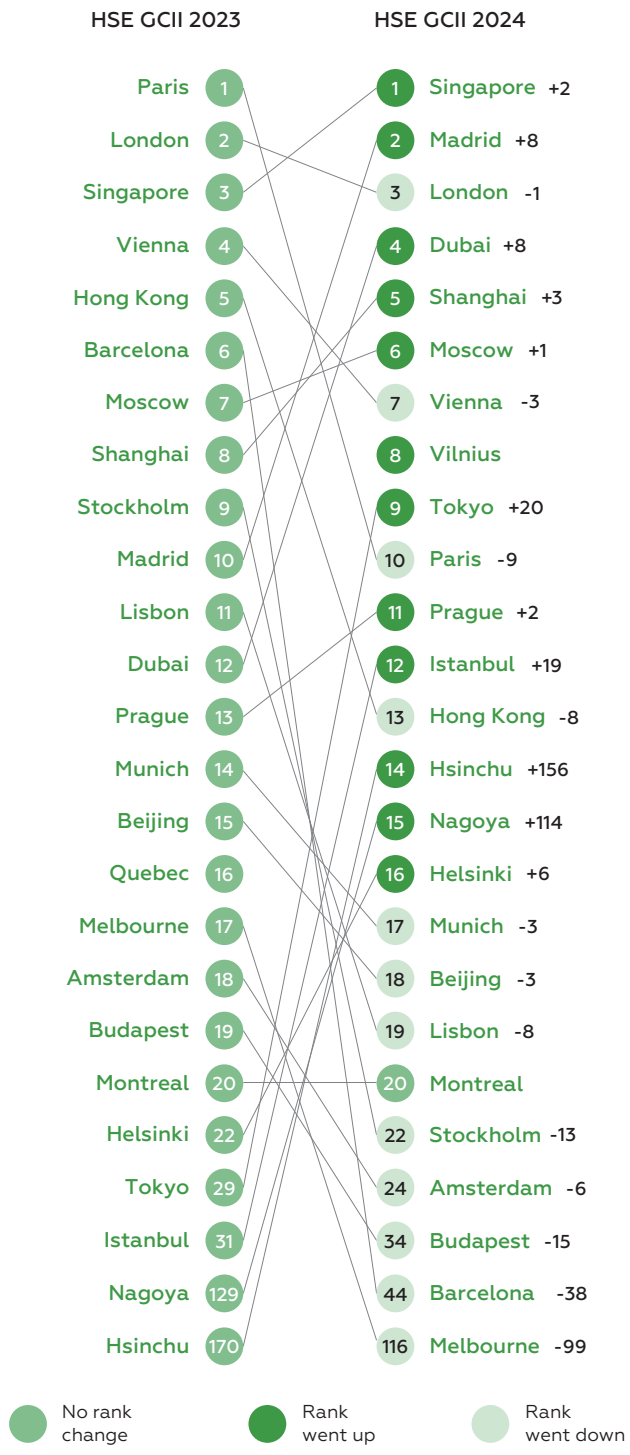
The city's rank in the corresponding sub-ranking revealed how the cities' urban setting reflects their attractiveness in the eyes of innovators.

Faster, Higher, Stronger!

European and Asian agglomerations are competing for the title of a global innovation attractiveness center with the best urban environment

The HSE GCII 2024 Urban Environment Subindex was topped by Singapore, previously a "bronze" medal holder in the 2023 sub-ranking. The numeric leg-up in the bid for the best infrastructure for innovators was achieved by European agglomerations, which occupy half of the top 20 sub-ranking (Madrid ranked 2nd, London – 3rd, Moscow – 6th, Vienna – 7th, Vilnius – 8th, Paris – 10th, Prague – 11th, Helsinki – 16th, Munich – 17th, Lisbon – 19th). The other nine top positions were distributed among Asian cities (Singapore – 1st, Dubai – 4th, Shanghai – 5th, Tokyo – 9th, Istanbul – 12th, Hong Kong – 13th, Hsinchu – 14th, Nagoya – 15th, Beijing – 18th). The biggest movement in the ranking compared to the previous subindex was demonstrated by Tokyo, Istanbul, Hsinchu, and Nagoya, which improved their ranks by 20, 19, 156, and 114 positions, respectively (Figure 26). As it happened, the short-list of cities with the most comfortable living conditions for innovators was supplemented primarily by Asian cities; new European focal points for advanced urban environment were Vilnius and Helsinki.

Figure 26. Top 20 HSE GCII Cities' Ranks in the Urban Environment Subindex: 2023, 2024



Source: HSE ISSEK.

The Allure of Capitals

Eight cities from the top 10 by the level of the urban infrastructure development have capital status

The number of national administrative centers in the top 10 of the Urban Environment Subindex has gone up from seven to eight in comparison to the results from HSE GCII 2023. It is Singapore (ranked 1st), Madrid (2nd), London (3rd), Moscow (6th), Vienna (7th), Vilnius (8th), Tokyo (9th), and Paris (10th). What is interesting though, is that Shanghai, which also had capital status in the past, was ranked 5th in this sub-ranking.

These global capitals are attracting innovation economy leaders through their advanced transport and tourist infrastructure, an abundance of cultural leisure activities, and a high level of internationalization – outperforming even the largest non-capital megacities by several factors.

However, capital cities do not always claim high positions due to having the competitive advantages listed above. An alternative path to success was taken by Copenhagen: it achieved high scores for several digitalization indicators (ranked 2nd and 3rd by "Mobile Internet speed" and "Digital public and municipal services", respectively) and was ranked 11th by the "Green energy" indicator. The top positions of the Danish capital in the mentioned areas are largely achieved due to maintaining a consistent energy and climate policies.

Back to the Nature Through Technology

How Copenhagen became the global leader in green energy

Denmark is rightly regarded as the pioneer of energy transition: its consecutive energy and climate policy, which began forming over 50 years ago in a response to the 1973 oil crisis, today serves as a model for many countries. A government agency that is responsible for nudging the country toward a low-carbon economy is the Danish Ministry of Climate, Energy and Utilities, which has five dedicated agencies,[1] as well as associated independent organizations: Danish Utility Regulator, Energinet, and The Climate Council. The creation of such a wide system of governance is aimed at achieving climate neutrality[2] by 2050, as stipulated in the corresponding 2020 law.[3]

A by no means less ambitious goal to turn the Denmark's administrative center into the world's first zero-carbon capital by 2025[4] has been set by the Copenhagen City Council, by adopting its 2025 Climate Plan – already in 2012. In 2013, the city obtained a Climate Leadership Award, and later, in 2014 – won the European Green Capital Award, thus receiving international recognition for its leadership in the green transition.[5] The Danish capital is one of the C40 Cities, a global network of 96 cities that aim to confront the climate crisis. On top of that, Copenhagen serves as a model for many world cities that strive to achieve the goals of sustainable urban development. The key aspects of this concept, apart from the growing share of renewables in the energy mix, are waste processing, water saving, green infrastructure, and sustainable transport.

Wind turbines became Copenhagen's trademark, such as the Middelgrunden wind farm that provides for 3% of the city's electricity.[6] The city hosts the headquarters of Copenhagen Infrastructure Partners (CIP), one of the world's largest investors in energy infrastructure, first and foremost,

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[1] Danish Geodata Agency, Danish Energy Agency, Agency for Data Supply and Infrastructure, Danish Meteorological Institute, Geological Survey of Denmark and Greenland.

[2] Climate neutrality means a situation when the volume of harmful atmospheric discharge does not exceed nature's capacity to sequester it.

[3] The 2020 Danish Climate Act. Available at: https://climate-laws.org/document/the-climate-act_dae7 (Accessed: 03.07.2024).

[4] The CPH 2025 Climate Plan. Available at: https://urbandevelopmentcph.kk.dk/climate (Accessed: 03.07.2024).

[5] Environment: Copenhagen European Green Capital 2014. Available at: https://ec.europa.eu/commission/presscorner/detail/en/IP_12_718 (Accessed: 03.07.2024); LSE Cities. Available at: https://lsecities.net/publications/reports/copenhagen/ (Accessed: 03.07.2024).

[6] Copenhagen, Europe's Greenest Capital City. Available at: https://www.planete-energies.com/en/media/article/copenhagen-europes-greenest-capital-city#:~:text=Form%20of%20energy%20resulting%20from,80%25%20its%20CO2%20emissions (Accessed: 03.07.2024).

in offshore and onshore wind power plants.

The first strategic document of Copenhagen on the climate policy "CO2 Plan for Copenhagen 1990–2010" was focused on conducting campaigns to mitigate climate change and the role of regional cooperation was underlined.[1] Thus, the Danish capital initiated "Dogme 2000", an intermunicipal cooperation initiative between Albertslund, Ballerup, Fredericia, and Herning. A general model for a sustainable city has been developed and environmental quality targets have been set. The local population widely supports the green transition and are empathic to both environment and, hence, climate change. Its citizens are actively decreasing carbon dioxide emissions, for example, by changing their transportation habits, sorting household waste, or participating in the environmental actions. Consecutive efforts of the Copenhagen Administration and its residents aimed at achieving sustainable urban development have brought impressive results – lowering carbon dioxide emissions by 73% from 2005 to 2021.[2]

The city deliberately invests in green technology, such as the installation of wind turbines and solar panels, conducts green procurement, erects low-energy structures, and introduces energy management systems. Copenhagen's green growth is achieved through the collaboration of municipal authorities with businesses, R&D organizations, and local communities. Thus, in 2016 the city administration together with Cisco, TDC, Citelum, and the Copenhagen Solutions Lab incubator launched a living Street Lab, to test innovative solutions for atmospheric monitoring, the effective use of parking places, and the optimization of the waste collection process.

The goal of reaching a full transition to the use of alternative energy sources was outlined in the Copenhagen Energy Vision 2050. The Copenhagen's transformation into a "climate company"[3] demonstrates the special role municipal authorities play in reducing the carbon footprint. Today, according to CDP, the share of alternative energy sources in the city's energy consumption is 81%. Meanwhile, 42% of the total energy consumption falls exclusively under wind energy, which pushed the Danish capital into 1st place among megacities by the share of wind energy. However, it is worth mentioning other renewables: the share of bioenergy in the Copenhagen's total consumption is 19%, hydro energy – 12%, energy generated from solar power, as well as waste, or other sources – 4% each, which makes the whole mix rather impressive.

[1] Urban climate governance and co-creation – in Cape Town, Copenhagen, Gothenburg and Oslo. Available at: https://oda.oslomet.no/oda-xmlui/handle/20.500.12199/3126 (Accessed: 03.07.2024).

[2] Technical and Environmental Administration, City of Copenhagen. Available at: https://urbandevelopmentcph.kk.dk/climate (Accessed: 03.07.2024).

[3] Climate Plan 2025: CO_2 neutral capital. (In Danish). Available at: https://www.kk.dk/politik/politikker-og-indsatser/klima-og-miljoe/klimaplan-co2-neutral-hovedstad (Accessed: 03.07.2024).

~81%

the share of alternative energy sources in the Copenhagen's total energy consumption

11th

Copenhagen's rank by the share of alternative energy sources in the total energy consumption

~42%

the share of wind energy in the Copenhagen's total energy consumption

> CopenHill, a unique waste-to-energy plant that provides over 150,000 houses with electricity and heating[1], at the same time works as a recreation area for residents of the Danish capital. The roof of the huge building operates as a year-round ski slope with a height of 85 m and length of 450 m, spiraling down to ground level.[2] CopenHill has observation decks and the world's highest climbing wall – also 85 m.

[1] CopenHill. Available at: https://www.copenhill.dk/en (Accessed: 03.07.2024).

[2] The length of CopenHill roof without its zigzag shape is 200 m.

Being Open is Worth the Effort

Talented foreigners can count on decent returns for their work in the most expensive cities in the world

Internationalized centers for innovation attractiveness can offer expats the most competitive salaries in the world despite the high cost of living. Cities from the top 10 HSE GCII 2024 by the share of foreign born population in the total population can be found in high income countries (UAE, Canada, Luxembourg, New Zealand, Switzerland, United States, United Kingdom, Israel, and Australia). The average employee salary in these cities is 4,299 USD per month, whereas long-term living costs reach around 3,150 USD per month (Table 24).

Table 24. Selected Indicators for Top 10 HSE GCII 2024 Cities by the Share of City Residents Born Outside the Country

City	Share of city residents born outside the country: 2015*	Cost of long-term residence in the city for an employed foreign citizen who rents housing in the city center and eats out: 2023, USD per month	Average employee salary: 2023, USD per month
Dubai	83.0	2,873	4,035
Toronto	47.9	2,936	3,496
Luxembourg	47.4	2,920	5,196
Auckland	43.1	2,169	3,429
Vancouver	42.7	3,227	3,083
Geneva	38.7	3,837	6,671
Miami	38.3	3,600	4,349
London	36.6	4,129	4,044
Tel Aviv	36.0	2,881	3,107
Perth	34.6	2,924	5,583

* Or the latest available period.
Source: HSE ISSEK, based on the Columbian College of Arts & Sciences, Nomad List, and Numbeo.

The gap between the cities from the top 10 with the highest and the lowest share of foreign born population by the level of salary is 2.6 times, and by the average cost of long-term residence for an expat – 4 times.

A taxi fare will cost up to 3.3 USD per km for residents of Dubai, Luxembourg, and Geneva. Renting an apartment in Miami, London, Perth, Geneva, and Dubai will cost over 2,100 USD per month, and the highest price is found in Florida's Magic City (2,840 USD per month).

Global cities with the highest share of city residents born outside the country attract innovators by their openness and multicultural environment. The top 10 in the Internationalization section include Toronto (ranked 2nd), London (3rd), Vancouver (5th), and Miami (6th). For example, Toronto has 58 international schools, which places it at the 6th position among all world cities by the corresponding indicator.

2.6 times

is the salary gap between the top 10 cities with the highest and lowest shares of foreign born population

4 times

is the cost gap for the expat's long-term residence between the top 10 cities with the highest and lowest shares of foreigners

But still, not all global cities that accept innovation economy leaders from different countries offer a high salary. Additional advantages in attracting talent include novel integration being implemented both on the corporate, and municipal levels.

Making Expats Feel at Home

Masterclasses from Aukland, Riyadh, and Dongguan with a personal touch

Every year global centers of innovation attractiveness become the new home for leaders of high tech and creative industries, who choose the best places to make the most out of their potential. Innovative cities are distinguished by their ability to adopt expats from all walks of life and make them their own. Auckland and Riyadh have their own unique way to "adopt talent," being ranked 4th and 12th, respectively, in the HSE GCII 2024 by the share of foreign born population in the total city population, as well as China's Dongguan[1], located between two of the world's largest innovation centers – Shenzhen (ranked 11th in the overall HSE GCII 2024) and Guangzhou (13th).

Unity in diversity: Aukland continues to be the home for people who relocate from anywhere and promotes ideas of interculturalism

Picturesque New Zealand, "The Home of the Middle Earth",[2] located far away from most countries, has the city of Aukland and 43.1% of its residents were born outside the country (Figure 27).

Historically, New Zealand has been a haven for settlers from mainland Europe. At the end of 1980s, the national migration policy was radically changed: all those who wish to come to the country were accepted regardless of their nationality or ethnic origin.[3] After becoming a magnet attracting immigrants from almost all corners of the globe, New Zealand developed a unique cultural policy that takes into account the interests of the indigenous population, the Māori, as well as of immigrants. As a result of that, Aukland has become the largest city in the country (with a third of the country's entire population), inhabited by representatives of over 120 nationalities with 33% of its residents speaking languages that do not have the official status.

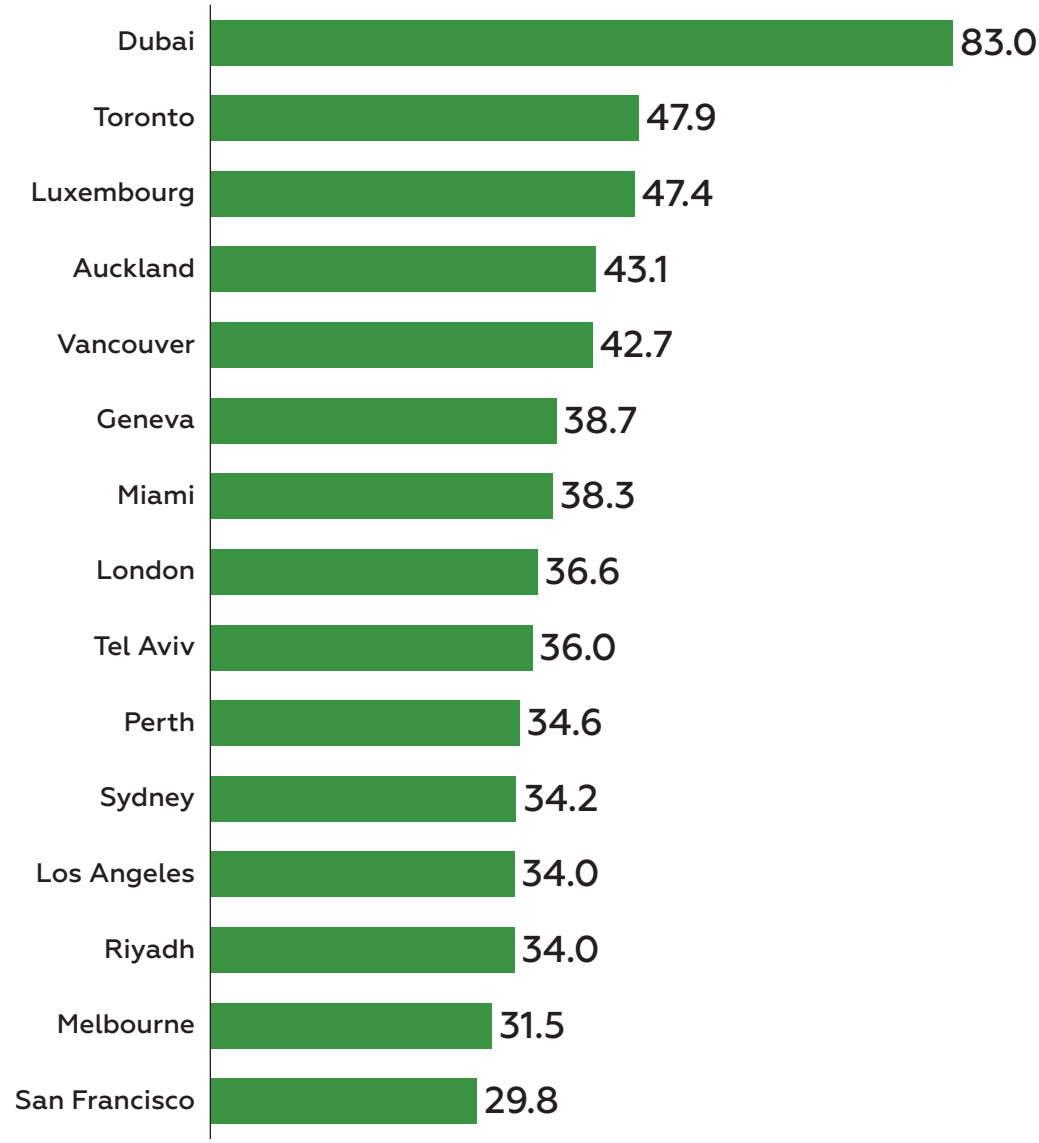
The fundamental Auckland development program, Auckland Plan 2050, underscores interculturalism that promotes diversity and cross-national dialogue as the foundation upon which the citizens' wellbeing is built. This type of integration that they

[1] According to the HSE GCII 2024 methodology, Dongguan is listed under the administration of Guangzhou agglomeration. For details, see the chapter on "Methodology and statistical audit."

[2] The famous "Lord of the Rings" trilogy was shot in New Zealand (directed by Peter Jackson).

[3] Immigration regulation. 1986–2003: selection on merit. Available at: https://teara.govt.nz/en/immigration-regulation/page-5 (Accessed: 07.06.2024).

Figure 27. Top 15 HSE GCII 2024 Cities by the Share of Foreign Born Population in the Total City Population: 2015*



* Or the latest available period.
Source: Columbian College of Arts & Sciences.

chose is dedicated to strengthening the sense of belonging to the local community among representatives of various nationalities through their involvement in the social life of the city.[1] Another program, Auckland Inclusive Framework under the moto "Diversity is our Strength. Together we are Auckland,"[2] has also been implementing an interculturalism policy. This document outlines four key areas of the Auckland Council's

[1] Auckland Plan 2050. Available at: https://www.aucklandcouncil.govt.nz/plans-projects-policies-reports-bylaws/our-plans-strategies/auckland-plan/Pages/default.aspx (Accessed: 05.06.2024).
[2] The Inclusive Auckland Framework. Available at: https://www.coe.int/en/web/interculturalcities/-/the-inclusive-auckland-framework (Accessed: 05.06.2024).

~120

nationalities among Aukland's residents[1]

~33%

Aukland's residents speak languages that do not have the official status[2]

activities: creating a diverse talented workforce; policymaking to respond to the needs of all Aucklanders; the fostering of national social inclusion by strategic leadership; and supporting diverse and inclusive governance.

Oases behind the brick wall: compounds in Riyadh – not simply a cushy way to accommodate an expat long-term, but a way of living to which one is accustomed

In 2016, the Crown Prince of Saudi Arabia Mohammed bin Salman Al Saud presented a visionary program – Saudi Arabia's Vision 2030, which became a starting point to lower the country's dependence on oil exports.[3] Three years later, in 2019, the Kingdom turned into an attractive tourist destination by opening its doors to a wider circle of people who wish to visit the country, it was previously accessible to most tourists with exclusively non-tourist visas. As a result, according to Nomad List, Riyadh is now ranked 29th among HSE GCII cities by the total number of international tourists and is preparing to host the World Expo 2030, for which it won the bidding in 2023, surpassing Busan and Rome.[4]

Today foreigners comprise over a third (34%) of Riyadh's population, which grants it 12th place among the megacities in terms of the corresponding indicator (Figure 27).

Saudi Arabia previously had a sponsorship system, according to which foreign workers were unable to change their employer (sponsor) for the duration of their stay in the country. However, after the system was reformed in 2021, most categories of workers received this opportunity along with the right to exit the country without the employer's permission.[5]

When looking for a place to settle in Riyadh, some expats arriving from countries with social, cultural, or religious customs that are different from those practiced in the Kingdom, choose to live in compounds: closed-off apartment complexes with a vari-

[1] Ethnic Communities Data Dashboard. Available at: https://www.ethniccommunities.govt.nz/our-communities/ (Accessed: 07.06.2024).

[2] The Ministry for Ethnic Communities. Available at: https://www.ethniccommunities.govt.nz/resources/our-languages-o-tatou-reo/languages-spoken-by-region/ (Accessed: 07.06.2024).

[3] Saudi Vision 2030. Available at: https://www.vision2030.gov.sa/en (Accessed: 05.06.2024).

[4] Riyadh Expo 2030. Available at: https://riyadhexpo2030.sa/ (Accessed: 05.06.2024).

[5] Saudi-Arabia: Reform of the Kafala System comes into force. Available at: https://www.roedl.com/insights/saudi-arabia-reform-of-kafala-system-comes-into-force (Accessed: 05.06.2024).

ety of infrastructure that help them be a part of multicultural, highly qualified community. Compounds are owned by private companies that provide foreign citizens and their family members with a wide spectrum of services – from school buses to leisure activities. Despite the amenities' diversity, access to them is strictly protected: compounds' borders are guarded 24 hours a day and are under constant surveillance.[1] Tight security measures go hand in hand with increased privacy for its residents. For example, they are allowed to invite guests to come into the compounds.

Some "oases behind the brick wall" have international schools located on the premises. For example, in the northern parts of Riyadh is Al-Bustan Village with two international schools – The American International School Riyadh (AIS-R) and the German one – Deutsche Internationale Schule Riad (DISR). Both educational institutions have multinational faculty and the management itself decides what programs and languages of instruction to have and what foreign languages to teach.

The area of 728,400 m^2 has over 1,000 apartments and villas.[2] "A city within a city" is how they describe themselves: a residential area with many facilities, such as football fields, a sports arena, a recreational center with indoor and outdoor swimming pools, a beauty salon, supermarkets and shops, restaurants, a bowling center, a movie theatre, a gym, and a spa center. Residents of Al-Bustan Village have daily transportation to trade centers and city landmarks. On top of the listed amenities, they can take a walk in large, well-groomed parks and gardens or have barbecues in a special zone within the housing complex.

Expats find compounds in Riyadh attractive due to the basic set of amenities and services that provide elevated comfort, as well as opportunities to have ordinary lives, albeit within the confines of the complex. This model of integrating foreigners responds to their wish to localize in a multicultural environment. Cultural "enclaves" in Riyadh are an example of a harmonious co-existence of contrasting ways of life within a common urban habitat.

Huawei recreated Europe... in Dongguan: the telecommunications giant reproduced the Old World's architectural heritage on a corporate R&D campus

Huawei is ranked 5th in the world by R&D expenditures, which in 2022 reached 20.9 billion USD [European Commission, 2023]. The company is the global leader in the production of telecommunications equipment,

[1] Al Nakheel Village Compound Riyadh: A Comprehensive Guide. Available at: https://arabmls.org/al-nakheel-village-compound-riyadh (Accessed: 05.06.2024).

[2] Al-Bustan Village. The Story. Available at: https://albustanvillage.com/story.aspx (Accessed: 05.06.2024).

headquartered in Shenzhen, and has subsidiaries in 170 countries, while its total number of employees exceeds 200,000.[1]

Huawei is vibrant and attracts the world's best minds: in 2008, the company launched a yearly global program to support talented students in IT – Seeds for the Future.[2]

The telecommunications giant's outperforming development predetermined the decision to build another corporate R&D campus in Dongguan, Ox Horn, for 25,000 workers with a value of 10 billion yuan (around 1.48 billion USD).[3] The campus with an area of 1.4 km^2 is composed of 12 districts that are radically different in their design from the famous similar projects of other companies.[4] The famous European architecture was reconstructed on its territory: here one can find replicas of Paris, Verona, Bologna, Granada, Bruges, Tallinn, Freiburg, and other colorful European localities, and one of the R&D departments on Songshan Lake looks like a Heidelberg Castle. The campus's districts are connected by a 7.8-km-long railroad, built for new "city dwellers". One can reach any European city by this train that was designed using blueprints of rolling stock by a Swiss company – Stadler Rail;[5] it will not take more than 22 minutes.

The company's decision to build not only an entire city but a "small Europe" for its employees immediately drew the attention of the global community. The construction of Ox Horn began in 2014, and already in 2018 it could accept its first residents.

As ambitious as it was, Ox Horn reflected Huawei's wish to create for its residents a unique urban habitat: it took the company a mere 45 months to recreate from scratch the Old World's architectural heritage by building the first ever corporate cosmopolitan city.

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[1] Corporate Fact Sheet. Huawei Technologies Co., Ltd. Available at: https://www.huawei.com/en/media-center/company-facts (Accessed: 07.06.2024).

[2] Inspiring Global Talent to Shape the Future. Available at: https://www.huawei.com/minisite/seeds-for-the-future/index.html (Accessed: 09.06.2024).

[3] Huawei OX Horn Campus – Creating New Corporate Values. Huawei Has Built a New One-of-a-kind Research Center in Shenzhen. Available at: https://huaweiarmenia.am/gb/blog-post/61 (Accessed: 09.06.2024).

[4] Huawei's new China campus is divided into 12 European-style towns connected by a train. Available at: https://www.businessinsider.com/huawei-ox-horn-campus-china-design-europe-cities-2019-4 (Accessed: 09.06.2024).

[5] Inside Huawei's New, Giant Faux-European Campus. Available at: https://www.bloomberg.com/news/photo-essays/2019-01-16/inside-huawei-s-new-giant-faux-european-campus (Accessed: 09.06.2024).

Innovators Are the Same Kind of Tourists

Most talented innovation economy leaders continue to prefer cities with sophisticated architecture that are popular among tourists

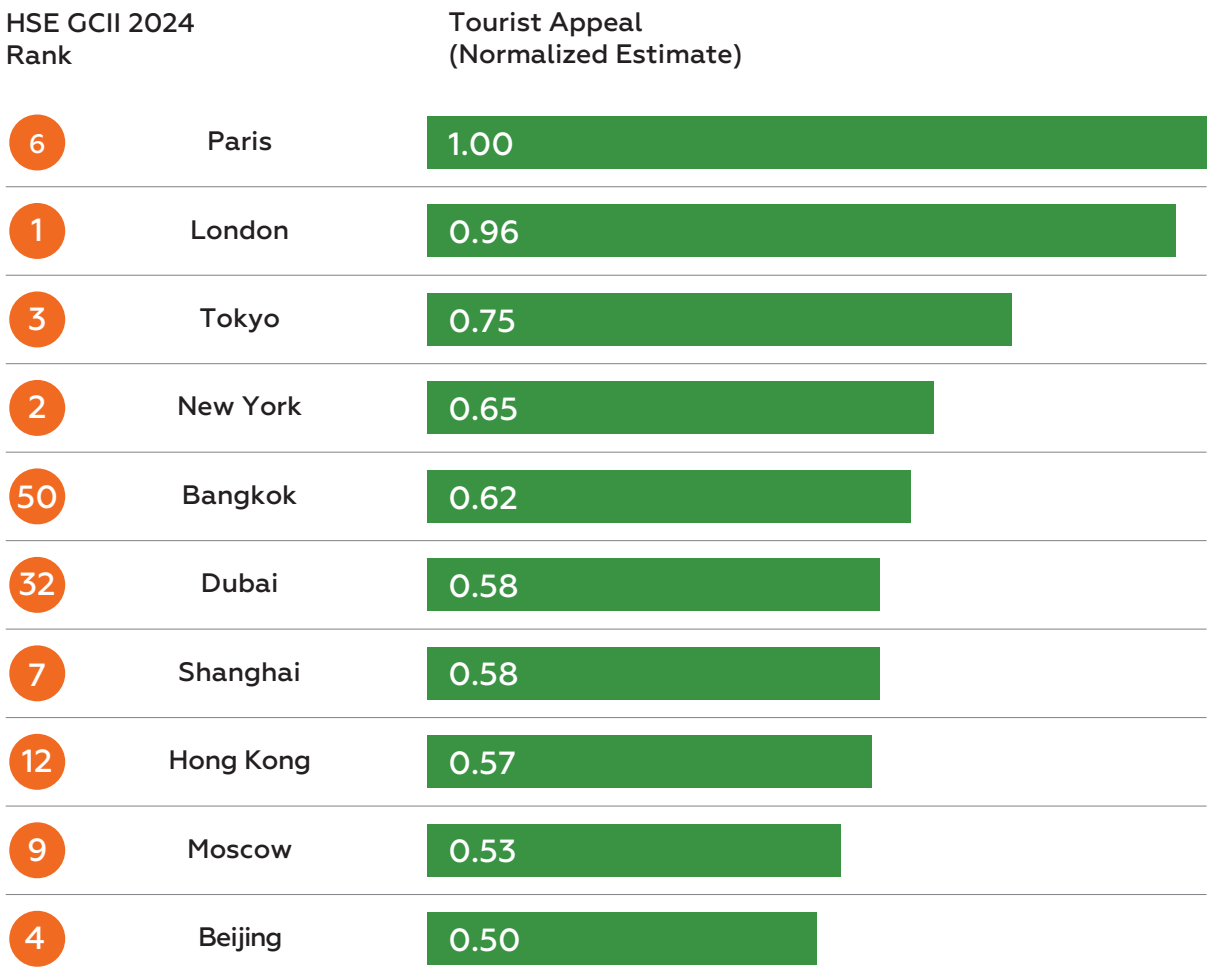
Seven cities out of the top 10 global centers by tourist appeal are at the pinnacle of the overall HSE GCII 2024 ranking (Figure 28). Among them Paris, London, and Tokyo are completely stealing the show – they are the leading world centers of high tech and creative industries and make up the top three of the Tourist appeal section. These capitals have a particularly prominent "architecture profile" that is naturally confirmed by their place on the pedestal of the corresponding section.

> Collectively, Paris, London, and Tokyo host almost 20% of leaders from the world of architecture in the ranking's sample, i.e., 60 of the 326 prominent individuals and enterprises.

London has six living Pritzker Architecture Prize laureates and 29 winners of the World Architecture Festival Awards. Then, with a tangible gap, follow Tokyo and Paris (15 and 10 exceptional architects, respectively). Architects recognized at the international level are active creators of the image of their respective cities. For example, Tokyo's Kenzō Tange, a Pritzker Architecture Prize laureate of 1987, is the mind behind the city's most iconic buildings, including the Tokyo Metropolitan Government Building. These skyscrapers with aseismic structures astonish not only tourists, but young architects who are coming to Tokyo every year.

The talent that arrives to London from all around the world finds itself immersed in its architectural diversity – from Belgravia's fashionable mansions to the City's progressive office buildings. One of the most recognized sports venues is the London Aquatics Centre designed in 2011 by Zaha Hadid Architects, a multiple time winner of the World Architecture Festival Awards, which amazes us with an unusual wave-like roof. Mansard roofs, historical masterpieces of the Gothic and Art Nouveau styles, against the background of postmodern buildings, are attracting millions of tourists to Paris, as well as leaders of high tech and creative industries. The French capital's appearance is impossible to imagine

Figure 28. Top 10 HSE GCII 2024 Cities in Tourist Appeal (Normalized Estimate) and Their Overall HSE GCII Ranks



Source: HSE ISSEK.

without the National Center of Art and Culture – The Centre Pompidou, a high tech masterpiece built in 1998 with participation of the Pritzker Architecture Prize laureate Renzo Piano who later redesigned the GES-2 House of Culture in Moscow.

However, a unique architectural profile may play a cruel trick on cities if droves of tourists are coming to see and connect with the history through the stones. Mass tourism negatively affects urbanized spaces, but the use of new technologies is able to, if not turn back time, then to lay the groundwork for minimizing the risk of irreversible changes. Venice became one of the HSE GCII cities that depend upon innovation for the sake of preserving history.

Cloudy in Venice, with a Definite Chance of Tourism

City authorities aim to solve overtourism with a smart control station

Venice is a UNESCO World Heritage city with a population of over 250,000 people that sits on 118 islands in a scenic lagoon. Every season, its streets are packed with tourists from various countries who come to enjoy the scenery of this "open-air museum."

The likelihood of including this unique port city on the UNESCO World Heritage in Danger list has been discussed numerous times at the international level. The environmental and human-made changes may lead to the loss of the city's distinctive appearance: buildings are getting flooded by abnormally high tides (every year Venice sinks by 4–5 mm) and historical landmarks are damaged from an overflow of tourists.[1]
The swift transformation of the Adriatic's gem into an "amusement park" is causing unrest among its residents and alarms the municipal administration.

In order to survive, the authorities have set new rules, which, as expected, will soon again make Venice into a comfortable city for both long-term and short-term stays.[2]
In 2017, declared by the 70th UN General Assembly the International Year of Sustainable Tourism for Development, the #EnjoyRespectVenezia campaign was launched to raise awareness among guests arriving to Venice and the city residents of the negative consequences of mass tourism and ways to contribute to the city's sustainable development.[3]

One of the overtourism's consequences for Venice is a considerable decline in the number of residents in its historical center: in 1960–2022, it fell from 145,000 to 52,000 people.[4] Venetians were forced to relocate to the outskirts or leave the city for good, because the center was now more oriented toward the needs of its guests rather than

[1] UNESCO recommends putting Venice on heritage danger list. Available at: https://www.theguardian.com/world/2023/jul/31/unesco-recommends-putting-venice-on-heritage-danger-list (Accessed: 10.06.2024).

[2] Venice to make tourists pre-book and charge day trippers an entry fee, as well as track their movements around the city, to reduce the strain on resources and residents. Available at: https://www.scmp.com/lifestyle/travel-leisure/article/3147812/venice-make-tourists-pre-book-and-charge-day-trippers (Accessed: 10.06.2024).

[3] #EnjoyRespectVenezia. Available at: https://www.comune.venezia.it/en/content/enjoyrespectvenezia (Accessed: 10.06.2024).

[4] Integrated Action Plan. Enhancing sustainable tourism in Venice. Available at: https://urbact.eu/sites/default/files/2023-01/TFC_IAP%20Venice.pdf (Accessed: 10.06.2024).

~52,000
people live in the historic center of Venice

~3 million euros
is the cost of the Smart Control Room system

~5.27 million
international tourists visited Venice in 2023[1]

468
digital devices are integrated into the Smart Control Room system

the locals.[2] According to Nomad List, Venice is placed 9th among cities with the highest hotel accommodation costs. The authorities are especially concerned with the negative effects of the so-called day trippers, who do not spend the night in the city and overcrowd its historical areas. As the Venezia Autentica's website mentions, "Venice cannot provide picnic or resting areas because of its small size and its morphology, resulting in visitors sitting down for resting and eating on bridges, narrow alleys, house doors and shop windows blocking even further the already jammed city."[3] Since April 2024, a five-euro entry fee was introduced as an experiment, to be charged from 8:30 am to 4:00 pm from this largest category of tourists.[4]

Apart from economic policies, the city authorities use innovative means of solving this issue. For example, The Venice Sustainability Foundation presented a roadmap in 2022 for adopting sustainable tourism that was developed together with non-profit, tech, and consulting companies – Comune di Venezia, Fondazione di Venezia, TIM, BCG, etc., Ca' Foscari University of Venice, and the administration of Ports of Venice and Chioggia.

In September 2020, the Venice administration in cooperation with TIM, an Italian telecommunication company, launched a unique state-of-the-art system – Smart Control Room for a price of 3 million euros[5], which analyzes tourist flows and

[1] As of 2023, according to Nomad List. Available at: https://nomads.com/digital-nomad-guide/venice (Accessed: 10.06.2024).

[2] Venice: A Future for a Dying City. Available at: https://www.oxfordurbanists.com/magazine/2021/12/22/venice-a-future-for-a-dying-city (Accessed: 10.06.2024).

[3] Venezia Autentica. Available at: https://veneziaautentica.com/impact-tourism-venice/ (Accessed: 10.06.2024).

[4] Venice entry fees: How much does it cost and how does it work? Available at: https://www.independent.co.uk/travel/news-and-advice/venice-entry-fee-cost-date-rulesexemptions-b2534528.html (Accessed: 10.06.2024).

[5] Venice opens state-of-the-art control room that tracks which country EVERY tourist is from and tracks their every step around the city. Available at: https://www.dailymail.co.uk/news/article-9146719/Venice-opens-control-room-tracks-tourist-visit.html (Accessed: 10.06.2024).

solves the related tasks of mobility and safety.[1] The system encompasses 468 CCTV cameras, optical sensors, and real-time mobile-phone tracers;[2] it uses advanced digital technologies – Internet of Things, 5G, AI, and a cloud-based software platform. The project was launched in 2018 and funded through the city budget and the EU's 2014–2020 National Operational Programme on Metropolitan Cities.[3]

Monitoring devices that were installed throughout the city within the Smart Control Room transfer data every 15 minutes to special screens containing the information on the congestion of every Venice's district and canal, tidal height, tourist flow and speed, and travel routes. The system can even predict pedestrians' behavior based on mobile phone data and distinguish local residents from guests, while maintaining the privacy of personal data and limiting access to local administration, police, and fire service only.

Smart Control Room has been tailor-made specifically for Venice and is a unique tool to control tourist flows that provides a good example for cities looking for innovative solutions for smart mobility.

[1] Venice, an example of Smart City. The city of the future is safe, livable and sustainable. (In Italian). Available at: https://www.gruppotim.it/it/sostenibilita/news/Venezia-smart-control-room.html (Accessed: 10.06.2024).

[2] Venice to make tourists pre-book and charge day trippers an entry fee, as well as track their movements around the city, to reduce the strain on resources and residents. Available at: https://www.scmp.com/lifestyle/travel-leisure/article/3147812/venice-make-tourists-pre-book-and-charge-day-trippers (Accessed: 10.06.2024).

[3] Smart control room, "eyes" on the whole city for security and tourism management. (In Italian). Available at: https://www.veneziatoday.it/attualita/presentata-smart-control-room.html (Accessed: 10.06.2024).

Spinning the World Wide Web

Cities leading by the Internet speed claim more and more territory in the East and West

The top 20 HSE GCII 2024 cities by mobile and fixed broadband Internet is composed almost exclusively by cities in China, the United States, and Europe (Table 25). The leaders' geography in terms of their mobile Internet speed is more diverse: they are located in seven countries (cities from the first top 20 by fixed broadband Internet speed – in three). The top 10 by these indicators now have new locations on the Arabian Peninsula and in Western Europe.

Table 25. Top 20 HSE GCII 2024 Cities by Mobile and Fixed Broadband Internet Speed: 2023

Mobile Internet speed			Fixed broadband Internet speed		
City	Country	Median download speed: 2023, Mbit/s	City	Country	Median download speed: 2023, Mbit/s
1 Dubai	UAE	332.54	1 Tianjin	China	334.85
2 Copenhagen	Denmark	279.13	2 Durham	United States	314.64
3 Riyadh	Saudi Arabia	267.39	3 Dalian	China	313.99
4 Oslo	Norway	260.55	4 Austin	United States	304.85
5 Shanghai	China	256.56	5 Beijing	China	299.90
6 Beijing	China	256.36	6 Wake	United States	299.44
7 Aarhus	Denmark	248.69	7 Qingdao	China	297.32
8 Porto	Portugal	245.39	8 Jinan	China	295.99
9 Detroit	United States	237.13	9 Strasbourg	France	294.19
10 Jinan	China	231.87	10 Shanghai	China	291.92
11 Portland	United States	221.53	11 Kansas City	United States	286.92

(continued)

Mobile Internet speed			Fixed broadband Internet speed		
City	Country	Median download speed: 2023, Mbit/s	City	Country	Median download speed: 2023, Mbit/s
12 Tianjin	China	220.95	12 Nanjing	China	286.45
13 Nanjing	China	218.12	13 Columbus	United States	282.72
14 Hangzhou	China	211.19	14 Xi'an	China	282.68
15 Qingdao	China	210.51	15 Bordeaux	France	282.39
16 Stockholm	Sweden	210.06	16 St. Louis	United States	279.94
17 Harbin	China	203.32	17 Toulouse	France	279.11
18 Ningbo	China	201.26	18 Lyon	France	278.66
19 Wuhan	China	192.15	19 Nashville	United States	278.41
20 Dalian	China	190.93	20 Wuhan	China	276.63

Source: HSE ISSEK.

Chinese megacities still prevail in the ranking by their score in the "Fixed broadband Internet speed" indicator, however, they take up only six out of ten top positions (compared to eight in the previous issue). Cities on the Arabian Peninsula – Dubai and Riyadh – have entered the top 10 in terms of the mobile Internet speed; Porto in Portugal and Strasbourg in France took root in the top 10 by both indicators.

Dubai secured its leadership through the achievements of the national telecommunications giant E& (etisalat and), one of the largest mobile carriers in the world, with over 160 million customers.[1] The company became the fastest 5G carrier on the planet and successfully launched a 5G-Advanced test project with support from the UAE Telecommunications and Digital Government Regulatory Authority (TDRA)[2] under the national initiatives launched within "The Year of Sustainability" in 2023.

[1] Annual report 2022. Available at: https://www.eand.com/en/investors/annual-reports.html (Accessed: 23.06.2024).

[2] TDRA ANNOUNCES Successful completion of Phase II of advanced 5G trials (Project 5G-Advanced) in the 6 GHz band. Available at: https://tdra.gov.ae/en/media/press-release/2023/tdra-announces-successful-completion-of-phase-ii-of-advanced-5g-trials (Accessed: 23.06.2024).

The concept of sustainable development inspired world cities to search for innovative ways to enhance its spaces. The driving force behind achieving lower environmental impact lies in developing and implementing new tech solutions that are crucial for the corresponding changes. Therefore, being able to adapt to those changes using investments and institutional support from public authorities comes to the forefront, since cities are becoming increasingly concerned about the sustainable urban future. Local initiatives to achieve SDGs cover various aspects of the urban environment and are inevitably based on innovations.

Your Personal Route Has Been Constructed

Munich is trailblazing sustainable urban mobility with technological innovation

Munich, one of the largest logistic nodes and among Germany's leading centers in automobile industry, is actively introducing new tech solutions into its transportation system to lower the number of trips by privately owned cars and the level of carbon dioxide emissions into the atmosphere. The transition to an alternative model of city mobility is focused on solving issues of growing passenger traffic, long-distance traffic jams, and the associated noise pollution.[1]

Munichers spent the most time in traffic jams in Germany. According to the INRIX analytics company, they wasted 4,440 minutes in traffic jams, whereas in Berlin that figure was – 4,260 minutes, and in Hamburg – 3,360 minutes.[2]

The Bavarian capital was ranked 64th among the HSE GCII 2024 cities by commute time: according to Numbeo, in 2023, its residents used 31 minutes to get to their office, and a year before – 33 minutes.

> Munich hosts the BMW Headquarters, which ranked 25th in 2022 on the R&D Scoreboard by the volume of R&D investment – around 7.8 billion USD, and the Flixbus intercity bus service, a unicorn with a valuation of 3 billion USD.

Munich is following the principles of sustainable urban mobility: including when it comes to the city's sustainable development – "flexible mobility without the need to own a car – safe, available at any moment, and meeting the demand."[3]

The largest public transport agency – Münchner Verkehrsgesellschaft (MVG) – is guided by this principle: the company's 2020 report says that lowering the use of privately owned vehicles will help in fighting air pollution and climate change.[4]

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1 CIVITAS, Cities. Available at: https://civitas.eu/cities/munich (Accessed: 07.07.2024).

2 2022 INRIX Global Traffic Scoreboard. Available at: https://lesvoitures.fr/wp-content/uploads/2023/01/2022_INRIX_Traffic_Scorecard_Report.pdf (Accessed: 07.07.2024).

3 Stadtwerke München. Sustainability Report 2022. (In German). Available at: https://www.swm.de/dam/doc/swm/swm-nachhaltigkeitsbericht.pdf (Accessed: 07.07.2024).

4 Sustainability | MVG. (In German). Available at: https://www.mvg.de/ueber/engagement/nachhaltigkeit.html (Accessed: 07.07.2024).

~36%

the share of public transport trips as part of the total number of commute trips in Munich[1]

And still, the share of Munich's commute trips using public transport is 36%, which is, however, lower than the same indicator for Prague (55%), Stockholm (54%), London (51%), Paris (46%), or Moscow (43%).

The report acknowledges that the key factor in achieving sustainable mobility goals is by introducing Mobility as a Service (MaaS), capable of transforming the transportation habits of city dwellers.[2] Within this concept mobility is viewed as a single transportation, information, and payment service integrating various types of transport and operators. It is remarkable that its implementation does not lead to competition between new types of mobility and large-scale public transport, on the contrary, it increases the efficiency of the latter.

At the first stage of introducing MaaS (in 2018), Munich set up an MVG multimodal e-mobility station, which incorporated various travel modes on a single territory. At these stations passengers could rent a regular or electric bicycle or an electric car, charge the preferred electronic vehicle,[3] and use the interactive touch screen to access the rental information.

In 2020, MVG organized a seminar to promote the launch of MVGO, a Munich-based app providing its users with a variety of routes, travel modes, and sharing services. The project enveloped key transport operators – Sixt, SHARE NOW, AND Mobility; car-sharing services – STATTAUTO München; a minibus service – CleverShuttle; taxi services – Taxi München eG, TaxiZentrale, Isar Funk, mtz (münchner taxizentrum), Dot; rental services for micromobility devices (e-scooters, e-mopeds, and e-bikes) – Bird, Circ, emmy, TIER Mobility, and VOI.[4]

MVGO was launched and open for downloading in 2021. The key feature of the app is the combination of the municipal public transportation and private operators' services on a single platform,[5] making it multimodal. MVGO contains a virtual map of the city, integrates carsharing and bikes, e-scooters, and e-bikes rental services, provides information about transfers and failures in the public transit system, projected arrival time, the map of EV charging stations, the status of metro's

[1] As of 2023, according to Numbeo. Available at: https://www.numbeo.com/cost-of-living/in/Munich?displayCurrency=USD (Accessed: 07.07.2024).

[2] MaaS Readiness Level Indicators for local authorities, 2017. Available at: https://civitas.eu/sites/default/files/maas_readiness_level_indicators_for_local_authorities_web.pdf (Accessed: 07.07.2024).

[3] Mobility Stations. Smarter Together. Available at: https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5c06b6a2a&appId=PPGMS (Accessed: 07.07.2024).

[4] MVG to launch Mobility-as-a-Service solution in Munich. Available at: https://www.intelligenttransport.com/transport-news/95880/mvg-to-launch-mobility-as-a-service-solution-in-munich/ (Accessed: 07.07.2024).

[5] Ibid.

escalators and lifts, and so on.[1] Thanks to this all-inclusive service, Munichers can plan day-to-day "door-to-door" trips, enjoy new ways to explore the city, book public transport passes, pay for different types of sharing services, and validate driver's licenses. The app was awarded the Deutscher Exzellenz-Preis 2024 by the German Institute for Service Quality and the DUP Unternehmer journal in the "Digital services" category.

Munich took the MaaS concept to the next level in March 2023 after launching a research project under the name of "Munich's Automated Public Transport with Ridesharing, Solo Buses, and Bus Platoons" (Münchens automatisierter Nahverkehr mit Ridepooling, Solobus und Bus-Platoons – MINGA). This initiative develops autonomous transportation systems and integrates them into the public transport network based on AI and machine learning.[2] It also plans to test automated e-buses in real life.[3] The use of MINGA unites under its auspices the University of Stuttgart, Karlsruhe Institute of Technology, Technical University of Munich (TUM), MVG, companies, such as Benz + Walter, ioki, MAN Truck & Bus, Ebusco Deutschland, and the FZI Research Center for Information Technologies. Other organizations include Munich Transport and Tariff Association, departments of mobility and construction of the Munich city administration, and four associated partners: Yunex Traffic, a software and hardware supplier, Pfennigparade, a rehabilitation facility, Verband Deutscher Verkehrsunternehmen (VDV), an association of German transportation companies, and Munich Administration. The project's funding for around 13 million euros is provided by the German Federal Ministry for Digital and Transport.

Along with the transfer to sustainable mobility, Munich is participating in the European MaaS project "GEMINI" with over 12 million euros in funding that is being implemented as part of the CIVITAS program and co-funded by EU.[4] In 2023–2026, the Bavarian capital and other participating cities – Helsinki, Porto, Turin, Ljubljana, Copenhagen, Amsterdam, and Paris – will test sustainable models for new mobile services and pilot innovative solutions in urban mobility that answer to the principles of not only MaaS, but also of a more recent concept for creating a sustainable, inclusive, and affordable transport system – MaaC (Mobility as a Commons).[5] For instance, Munich has already started to prepare for the creation of a Mobility Living Lab. This project plans to solve challenges surrounding

[1] MVGO – One App, Drive Everything. (In German). Available at: https://www.mvg.de/services/mobile-services/mvgo.html (Accessed: 07.07.2024).

[2] Fördervorhaben MINGA. Available at: https://muenchenunterwegs.de/angebote/minga (Accessed: 07.07.2024).

[3] MINGA research project: Automated MAN electric bus in regular service. Available at: https://press.mantruckandbus.com/corporate/minga-research-project-automated-man-electric-bus-in-regular-service/ (Accessed: 07.07.2024).

[4] GEMINI. Available at: https://civitas.eu/projects/gemini (Accessed: 07.07.2024).

[5] Discovering GEMINI'S mobility living lab in Amsterdam. Available at: https://www.geminiproject.eu/discovering-geminis-mobility-living-lab-amsterdam-mobility-as-a-commons-maac/ (Accessed: 07.07.2024).

effective road traffic and mobility for fans who come to see football matches on the Allianz Arena. Additional attention will be paid to providing convenient and affordable parking places and developing sharing services. The living lab will be coordinated by the Volkswagen Data:Lab Munich from the Volkswagen Group that is engaged in developing AI-based innovation for its divisions.[1]

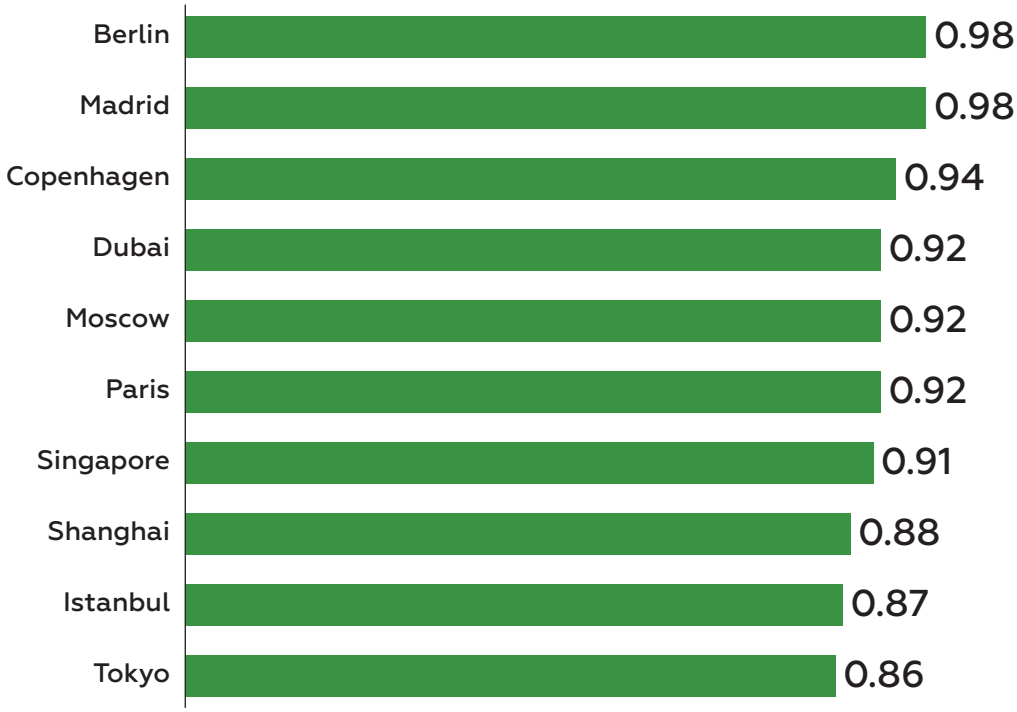
[1] Gemini MLL3 Munich. Available at: https://www.geminiproject.eu/gemini-mll3-munich-allianz-arena-living-lab-workshop-march-5-6/ (Accessed: 07.07.2024).

At Your Service

Capital cities in Europe and Asia can boast the highest quality of public and municipal services provided in a digital form

The leadership position in the development of digital public and municipal services is shared by Berlin and Madrid. Cities from the top 10 by this indicator are split in half between Europe (Berlin, Madrid, Copenhagen, Moscow, and Paris) and Asia (Dubai, Singapore, Shanghai, Istanbul, Tokyo) (Figure 29). Seven of them are modern-day capitals, Shanghai and Istanbul used to be capitals, and Dubai is an administrative center of one of the most important emirates in the country in terms of economics. The leading positions of Dubai and Shanghai in the city ranking by most advanced public and municipal services provided online can be attributed to the high level of digitalization in general (ranked 4th and 8th in the corresponding section, respectively).

Figure 29. Top 10 HSE GCII 2024 Cities in Digital Public and Municipal Services: 2023



Source: United Nations E-Government Knowledgebase.

Intelligent Manager

How artificial intelligence transforms management systems in innovative cities

The rapid development and widespread dissemination of AI may lead to radical changes in the economy and society. Integrating AI into decision-making processes will increase the efficiency of management in the public and private sectors due to its ability to analyze large quantities of data. This leads to the creation of new products and services and, therefore, the growth of consumer demand and the diversification of a company's income sources due to the emergence of new markets and sectors.

According to Goldman Sachs[1] estimates, AI may increase global GDP by 7 p.p. over the course of seven years, and labor productivity growth rates – by 1.5 p.p. The Bank of America analysts predict[2] that global revenue related to the sales of software, equipment, and AI services will continue to grow by 19 p.p. per year and by 2026 will reach 900 billion USD (in 2020 – 318 billion USD). According to other estimates, AI's contribution to the global economy will reach 15.7 trillion USD by 2030.[3]

AI, however, may also have a destructive effect on the economy and society. For example, it may create superfirms with the most accumulated technologies and capital, widen the gap between developed and developing countries, and cause disparities on the labor market due to a spike in demand on personnel with particular skills. This last trend may have long-lasting effects and lead to inequality, salary cuts, and a lower tax base.

As mentioned in the Goldman Sachs report, generative AI may be able to automate around two thirds of existing jobs in the United States and Europe; globally this number may reach up to 300 million jobs.[4] According to World Economic Forum experts, by 2025, the dissemination of AI will create 69 million new jobs, while eliminating 83 million existing jobs.[5]

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[1] Goldman Sachs (2023) Generative AI could raise global GDP by 7%. Available at: https://www.goldmansachs.com/insights/articles/generative-ai-could-raise-global-gdp-by-7-percent.html (Accessed: 20.02.2024).

[2] BofA Securities (2023) Artificial Intelligence... Is Intelligent! Available at: https://business.bofa.com/en-us/content/ai-trends-impact-report.html (Accessed: 20.02.2024).

[3] PwC (2020) Sizing the prize. Available at: https://www.pwc.com/gx/en/issues/analytics/assets/pwc-ai-analysis-sizing-the-prize-report.pdf (Accessed: 20.02.2024).

[4] Goldman Sachs (2023) The Potentially Large Effects of Artificial Intelligence on Economic Growth. Available at: https://www.gspublishing.com/content/research/en/reports/2023/03/27/d64e052b-0f6e-45d7-967b-d7be35fabd16.html (Accessed: 20.02.2024).

[5] World Economic Forum (2023) Future of Jobs Report 2023. Available at: https://www3.weforum.org/docs/WEF_Future_of_Jobs_2023.pdf (Accessed: 20.02.2024).

It is possible to apply AI in almost any sector of the economy – industries or services. Cities seem particularly attractive for this idea: they have quite a high concentration of technologically advanced infrastructure needed for complex AI systems and a high population density that creates demand on new technologies and secures the corresponding return on investment. As noted in the analytical reports of the European Parliament,[1] AI can help fully implement the smart city model and increase its usability by the local government, as well as in healthcare, social services provision, safety & security, transport services, and mobility.

Boston: Generative AI for Processing Residents' Appeals

Boston became one of the first cities in the United States where city officials used generative AI to interact with residents. In May 2023, the head of the Department of Innovation and Technology in the Boston, Massachusetts administration, Santiago Garces, sent recommendations[2] on the use of AI for working with documents and correspondence to all city officials; the new technology is supposed to help "translate" the information about municipal services from bureaucratic jargon into a language accessible to everyone. The document says that municipal officials can ask AI to write texts in a manner most suitable for their target audience. Moreover, it recommends using an AI-powered model to translate materials published or posted by the administration into other languages – to make them available for the non-English-speaking population of Boston. It also proposes to use generative AI for summarizing long texts and recordings into simple English to ease communication.

In 2023, Boston started an experiment involving the use[3] of generative AI for processing residents' appeals on the city's 311 hotline.[4] The city administration requested that the OpenAI chatbot provide them with different analytics based on the 311 calls data. The chatbot suggested a method for municipal services application analysis and streamlined the analysis itself, thus providing officials with more time for application response. OpenAI tools help officials with building charts, mapping, and other visualizations. As a result, they may propose and check more theories when processing residents' appeals, and, in the end, adopt more effective solutions.

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[1] European Parliament (2021) Artificial Intelligence and Urban Development. Available at: https://www.europarl.europa.eu/RegData/etudes/ATAG/2021/690895/IPOL_ATA(2021)690895_EN.pdf (Accessed: 20.02.2024).

[2] City of Boston Interim Guidelines for Using Generative AI. Available at: https://www.boston.gov/sites/default/files/file/2023/05/Guidelines-for-Using-Generative-AI-2023.pdf (Accessed: 20.02.2024).

[3] Fast Company (2023) Boston experimented with using generative AI for governing. It went surprisingly well. Available at: https://www.fastcompany.com/90983427/chatgpt-generative-aigovernment-reform-biden-garces-boston-goldsmith-harvard (Accessed: 20.02.2024).

[4] This phone number is used for non-emergency calls to municipal administrations.

Nevertheless, Garces highlights the need for a critical approach to using AI and the personal responsibility of officials for the results of using AI tools. In particular, he recommends checking all materials prepared with the use of generative AI so as to avoid mistakes in the published or posted information.

Shenzhen: AI as the Nucleus of a Smart City

In 2022, Shenzhen became the first city in China that developed regulations for the promotion of the Artificial Intelligence industry.[1] The document says that for the purpose of promoting AI, the city administration personnel should become the first users of the technology and apply it in their work, and that the promotion of AI must be included in the plans for social and economic growth of municipal authorities.

The use of AI in Shenzhen led to the better processing of citizens' applications and the provision of services by city organizations, due to the more rapid response time. In April 2022, Futian – one of Shenzhen's regions – launched an AI-powered digital platform for public services based on Huawei's CityCore.[2] The platform's services cover various areas of the city's life, including governance. According to its developers, city officials used to do their operations manually, which led to the poor efficiency. Now, the AI platform seamlessly analyzes the app data from various departments and helps quickly adapt to changes in public opinion. With the help of this new platform, it is also possible to automatically distribute most service provision applications among executors: instead of previous four minutes, it now requires just 50 seconds to do the work, and the precision of distributing the application to the correct department reaches 90%.

Dublin: AI for Public Opinion Analysis

Dublin, Ireland authorities started to use AI to monitor public opinion back in 2019, although regulating documents governing the use of this technology by municipalities still have not been approved. The admin-

[1] Center for Security and Emerging Technology (2022) Regulations for the Promotion of the Artificial Intelligence Industry in Shenzhen Special Economic Zone. Available at: https://cset.georgetown.edu/publication/regulations-for-the-promotion-of-the-artificial-intelligence-industry-in-shenzhen-special-economic-zone/ (Accessed: 20.02.2024).

[2] Huawei Cloud (2023) Shenzhen's Futian District Becomes a Smart City Benchmark in China. Available at: https://www.huaweicloud.com/intl/en-us/about/blogs/20230310.html (Accessed: 20.02.2024).

istration of the Irish capital uses Citibeats[1], an AI platform and a speech analytics software, which utilizes speech recognition and machine learning to organize non-structured data – public opinions expressed on social networks – in an anonymous and aggregated form and applies AI models to categorize and decipher them. The data are laid out as visual dashboards and later analyzed and used to make better decisions on improving the city life. A monthly report, Dublin Beat, is published using the dashboard information with public opinion analysis about issues of environment, culture, and city development. At the same time, the Dublin administration notes[2] that they use other methods of analyzing public opinion along with Citibeats to obtain the most unbiased sociological picture.

Amsterdam: AI for Tax Collection

Innovative cities are actively implementing AI in their management systems, enhancing them with such features as: public opinion monitoring, distribution of residents' applications into departments, hotline call processing, compilation of official documents, and the preparation of text and visual materials. Amsterdam has been delving even deeper into applying the "intelligent manager" practice: the Dutch capital has developed an AI ethics code – Algorithmic Transparency Standard, together with eight other European cities.[3] The AI agenda[4] published on the website of the city administration includes various projects, among which is the use of AI in a rather sensitive area – taxes. In 2019, the tax department of Amsterdam with support from Dataiku, launched a tax collection automation project. With the help of AI, they were able to shorten operating hours of the tax department: the evaluation of real estate units and updating information about residents' and local proprietors' debts are conducted in real time.[5]

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[1] Bable (2020) The Dublin Beat Understanding Citizen Sentiment. Available at: https://www.bable-smartcities.eu/explore/use-cases/use-case/the-dublin-beat-understanding-citizen-sentiment.html (Accessed: 20.02.2024).

[2] AI-X (2021) The Dublin Beat – Citizen opinion analysis. Available at: https://ai-watch.github.io/AI-watch-T6-X/service/90059.html (Accessed: 20.02.2024).

[3] I Amsterdam (2023) Amsterdam helps set the standard for ethical use of AI. Available at: https://www.iamsterdam.com/en/business/key-sectors-for-business/artificial-intelligence/amsterdam-helps-set-the-standard-for-ethical-use-of-ai (Accessed: 20.02.2024).

[4] Towards eXplainable Artificial Intelligence (XAI) in Taxation: The Future of Good Tax Governance. Available at: https://actl.uva.nl/content/events/2023/03/towards-explainable-artificial-intelligence-xai-in-taxation-cpt-conference.html?cb (Accessed: 20.02.2024).

[5] EGG on Air (2019) How to Improve and Innovate Tax Collection by Municipalities. Available at: https://egg.dataiku.com/how-to-improve-and-innovate-tax-collection-by-municipalities/ (Accessed: 20.02.2024).

And Yet It Extends!

How metaverses bring urban spaces and services to virtual life

One of the major trends of the past few years in communications is a massive "Zoomification" of contacts on various levels. Humanity had to resort to virtual communications during the COVID-19 pandemic, but today remote communication has become an ordinary practice for governmental agencies, businesses, and regular users. Amid the dissemination of this comfortable digital alternative to offline business contacts, there are new technologies that combine physical and virtual realities to simulate live meetings and the feeling of being present in real time and space. Such innovations have become the rationale behind the metaverse concept, in which projects are dedicated not only to revolutionizing communications, but also to reforming urban services.

The idea of human's coexistence in a metaverse was first suggested at the dawn of the 1990s by the fiction writer Neal Stephenson [Stephenson, 1992]. His futuristic notions, however, were only implemented in real life three decades later, and the pioneers of the metaverse became world famous corporations like Microsoft, Epic Games, Huawei, NetEase, Tencent, Baidu, ByteDance, Alibaba, Siemens, and Nvidia. Following the global virtualization trend, some global cities announced the launch of their own metaverse projects aimed at the integration of new technologies into the urban environment and the enhancement of urban services using them as a base [Kutsenko, Ostashchenko, Boos, 2024].

Today, there are two major types of urban metaverses that differ from one another in their purpose:

1) platforms that combine the landscape of a real city with various services for residents;
2) digital twins of cities that represent real-time high precision models of physical objects used by the local administration for planning the city landscape and testing city planning solutions.

The boundaries between these types are rather blurry given that the digital copy of a city is generally a starting point for the launch of a full-scale metaverse platform.

Among the metaverses of the first type one particularly stands out. Metaverse Dubai was one of the first virtual megacities in which media space allows its users to participate in large events and develop communities and business projects. Metaverse Dubai helps users with buying and selling virtual real estate through NFTs – non-exchangeable tokens – that secure unique ownership rights on the acquired digital asset. Visually, the metaverse

replicates the map of the most prestigious Dubai districts by recreating their esthetics and topography. The city authorities' goal to turn Metaverse Dubai into a global virtual hub has been outlined in the Dubai Metaverse Strategy. Among its priorities are the development of mixed extended virtual and augmented realities, Web3, and digital twins, which ensure the digital ecosystem of the city is functioning properly.

Seoul first began its creation of the metaverse in 2023 with a budget of 3.8 billion USD.[1] Creating the metacity was among the development priorities of the South Korean capital within the framework of a visionary Seoul Vision 2030 project prepared with the participation of Seoul Government members, business representatives, public organizations, and researchers from the Seoul National University, experts, and other stakeholders. The platform was intended to provide public services, open digital tourism, develop education technologies, and scale out communications. Currently, the metaverse already has a functioning Seoul Laboratory of Financial Technologies aimed at the development of the fintech cluster and the presentation of online consultation services for businesses; the virtual representative office of the Invest Seoul Center supports the development of foreign startups in Seoul; there is also a university campus with free-of-charge access to educational programs. In addition, the metaverse has sightseeing excursions you can take from any part of the world to digitally travel through Gwanghwamun Square, Deoksugung Palace, and Namdaemun Market.

The Shanghai metaverse combines the features of a classic digital twin and a platform for developing digital tourism. The project of a digital copy of the city was commissioned by the local administration and developed by 51World – the largest global supplier of technologies in this area.[2] The creation of this digital city was achieved based on the information received from satellites, drones, and special sensors. Its current capabilities include landscape planning, transport flow regulation, and the demonstration of future city infrastructure to residents. The virtual city spans over 3,800 km^2 and allows one to visit over 20 landmarks, including the West Pearl Tower and one of the highest buildings in the world – Shanghai Tower.

In 2023, Moscow started testing the Meta Moscow platform, commissioned by the Department of Information Technologies.[3] It is supported by Unreal Engine by Epic Games, which is usually used in video game development. In the future, it will be substituted with a Russian-produced

[1] Metabus Seoul. (In Korean). Available at: https://mediahub.seoul.go.kr/archives/2003118 (Accessed: 14.05.2024).

[2] 51World creates digital twin of the entire city of Shanghai. Available at: https://www.unrealengine.com/en-US/spotlights/51world-creates-digital-twin-of-the-entire-city-of-shanghai (Accessed: 14.05.2024).

[3] The use of digital twins and metaverses in smart cities was discussed at the Moscow Urban Forum. (In Russian). Available at: https://mosurbanforum.ru/news/na-moskovskom-urbanisticheskom-forume-obsudili-primenenie-tsifrovykh-dvoynikov-i-metavselennykh-v-um/ (Accessed: 14.05.2024).

engine.[1] The metaverse is filled with photorealistic, accurate models of tourist attractions in the city. In particular, a 3D VDNKh space created with a use of gamification enables residents and guests of the city to go on a virtual excursion, research digital items on display, or attend special events.[2] Apart from that, metaverse users can travel on a cable car to digital twins of significant places in Moscow, among which are Vorontsovsky Park, Luzhniki Stadium, Zaryadye Park, and Bauman University.

The technological base of the Moscow metaverse is composed of a digital copy of a city that has been operational since 2019 with an area of over 2,500 km^2. It is used as a tool to manage the city, to plan the construction of residential, industrial, and social objects, and to optimize transport flows based on real-time data.[3]

Another example of a metaverse of the second type is Singapore's digital twin. The authorities use it to develop infrastructure, optimize energy consumption processes and building design, develop landscape planning scenarios, and alert the population of oncoming natural disasters.[4] Using digital twins made it possible to find the best position for solar photoelectric systems and provide the maximum output. After implementing this technology, Singapore was able to decrease expenses on round-the-clock topographic imaging by 82.8% and save 29 million Singapore dollars (around 21.4 million USD) of budget resources.[5]

The MetaCenter of Orlando, Florida was built by the mayor's office together with Unity Technologies, a video games developer. This is an accurate 3D digital model of the city of over 2,000 km^2 with an extended set of features.[6] The metaverse helps city authorities, local companies, non-governmental organizations, and other stakeholders model projects with the use of holographic technologies: it monitors climate changes, plans infrastructure, finds investment projects, controls talent migration, and creates an attractive image of the city.

The currently operating metaverse projects are aimed, first and foremost, at gaining practical advantages as reflected in the optimization of planning the urban territory and of key investment projects; increasing the cost impact of decision-making due to accurate modeling; and sophisticating the city services. City metaverses as platforms for business cooperation will stimulate the development of

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[1] Architect and the metaverse. (In Russian). Available at: https://mosbuild.com/ru/media/news/2023/april/06/arhitektor-i-metavselennaya/ (Accessed: 17.05.2024).

[2] "Meta VDNKh", virtual trips and gadgets from the past: new exhibitions in the Smart City hall (In Russian). Available at: https://www.mos.ru/news/item/139197073/ (Accessed: 02.07.2024).

[3] Moscow's digital twin (In Russian). Available at: https://ict.moscow/projects/smartcitymoscow/case/tsifrovoi-dvoinik-goroda-moskvy/ (Accessed: 14.05.2024).

[4] Singapore's First Country-Scale Digital Twin and The Future of Digital Open Data. Available at: https://www.structuresinsider.com/post/singapore-s-first-country-scale-digital-twin-and-the-future-of-digital-open-data (Accessed: 14.05.2024).

[5] How Singapore created the first country-scale digital twin. Available at: https://venturebeat.com/business/how-singapore-created-the-first-country-scale-digital-twin/ (Accessed: 14.05.2024).

[6] Orlando Regional Digital Twin. Available at: https://business.orlando.org/l/orlando-regional-digital-twin/ (Accessed: 14.05.2024).

virtual business clusters in the digital world, significantly enlarge the geography of its participants, and implement more cross-sectoral initiatives.

In several projects, the feature set goes beyond simple utilitarian tasks. Meta-cities have virtually unlimited capabilities for building a reality with unusual qualities that is both entertaining and educating. Today, metaverses already operate as platforms for hosting concerts and theater performances, exhibitions of digital art with virtual value, and 3D reenactments of cultural heritage.

The majority of city metaverse projects today are used as pilot projects due to the novelty and high cost of their technology or other limitations such as patent rights protection, cybersecurity, and needs to attract highly professional specialists and have sufficient capacity and Internet speed. In the future, we should expect a deeper integration of functionality and interactivity of digital twins to engage with city residents and create an attractive VR environment. At the same time, the popularity and the number of visitors coming to virtual cities will hinge upon a unique user experience offered to digital residents.

METHODOLOGY AND STATISTICAL AUDIT

Methodology

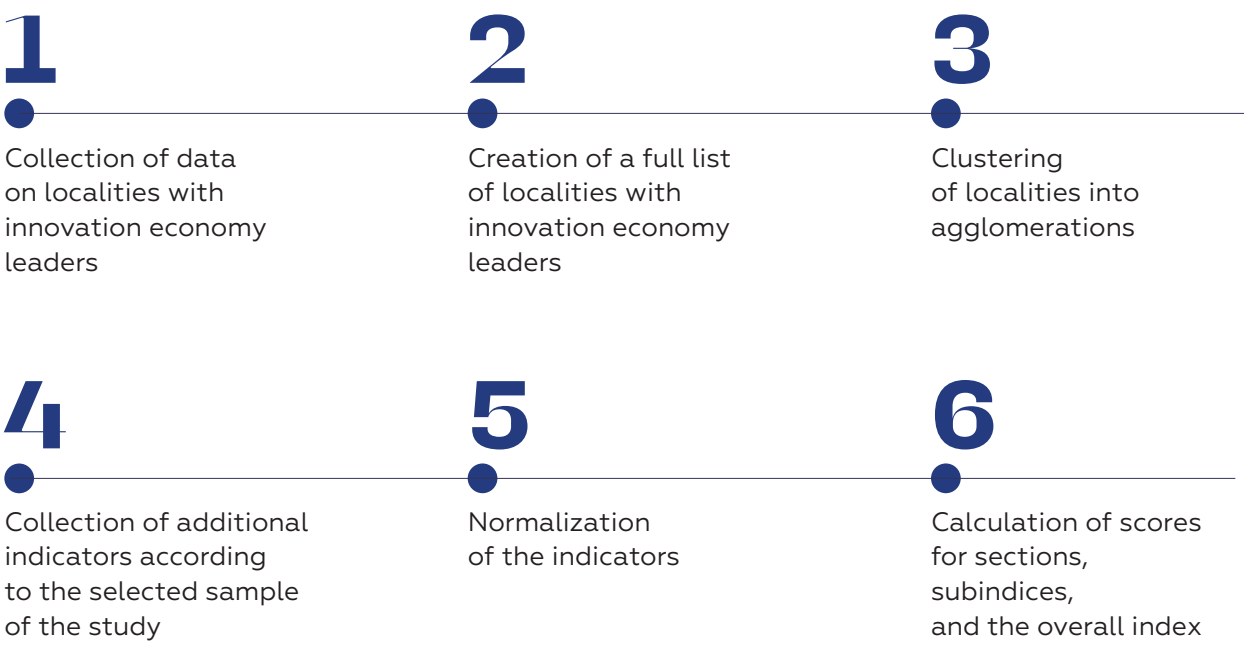
This ranking was created due to the need to have an objective comprehensive measurement of cities' innovation development on a global scale. The research methodology is based on the following principles:

- the equal representation of two key aspects of innovation – technology and creativity, as well as considering the characteristics of the urban environment
- the use of reliable data sources on global science leaders, technological entrepreneurs, and creatives: international platforms, aggregators, and rankings that comply with the requirements of transparency, verifiability, and wide coverage
- data collection for agglomerations.

Creation of the Database and Sample for HSE GCII 2024

In order to calculate the ranking and the associated indicators, a bulk of the data was collected and subjected to a qualitative evaluation in terms of the factors attracting leading participants of global innovation to the cities in question (Figure 30).

Figure 30. Algorithm for Calculating HSE GCII 2024



Source: HSE ISSEK.

In order to include all possible centers of innovation activity, the first stage involved creating a database of 3,536 unique locations from 144 countries with at least one innovation economy leader (an individual or an enterprise). This database included the indicators calculated with the help of various ratings and databases containing information on a limited number of exceptional representatives of the high tech and creative industries (Table 26).

Table 26. Indicators Forming a List of Localities of HSE GCII 2024

No.	Indicators reflecting the presence of innovation economy leaders	Number of innovation economy leaders	Number of localities with innovation economy leaders	Number of countries with innovation economy leaders
1	Leading companies by R&D expenditure	2,500	825	46
2	Unicorns	1,619	328	52
3	Leading universities	2,477	1,439	115
4	Leading R&D organizations	1,545	574	73
5	Highly cited researchers	6,835	785	70
6	Nobel Prize laureates and Fields Medal winners	399	156	46
7	Clusters and science parks	386	304	81
8	Supercomputers	274	128	32
9	Top-rated film production companies (audience)	344	82	29
10	Film production companies that won international film festival awards	540	168	70
11	Animation film production companies that won international festival awards	172	69	29
12	Most influential animation film production companies	99	38	13
13	Top-rated streaming services	82	48	32
14	Developers of the best video games	80	45	11
15	Largest e-sports tournaments	450	107	34
16	Developers of the most popular computer games	92	65	23
17	Companies participating in electronic games trade shows	1,331	532	62
18	Most-streamed artists	127	50	17
19	Best opera performers	214	73	26
20	Largest fashion companies	187	126	21
21	Fashion brands	3,070	684	69

(continued)

No.	Indicators reflecting the presence of innovation economy leaders	Number of innovation economy leaders	Number of localities with innovation economy leaders	Number of countries with innovation economy leaders
22	Most effective advertising agencies	329	79	51
23	Largest PR agencies	299	92	31
24	Creative production agencies	65	33	25
25	Top advertising agencies	557	117	53
26	Pritzker Architecture Prize laureates	53	30	19
27	Internationally recognized architects and architecture firms	335	135	50
28	Internationally recognized designers and design firms	1,712	511	71
29	Internationally recognized artists	173	55	29
30	Top artists by auction revenue	264	69	30
31	Most influential people in contemporary art	143	54	28
32	Leading higher education institutions in the arts	608	377	59
33	Best-selling authors	254	134	25
34	Most popular authors	310	167	24
TOTAL		**27,925**	**3,536**	**144**

Source: HSE ISSEK.

It became obvious that innovations were not limited to administrative borders. As a way to capture innovation attractiveness more accurately, global cities were clustered into agglomerations, for which purpose the following approaches were used (Table 27):

- the inclusion of Functional Urban Areas (FUAs) for OECD countries
- the use of national approaches to define agglomerations
- an independent definition of agglomerations based on additional auxiliary data sources.

Table 27. Agglomeration Approaches in Different Countries*

No.	Agglomeration approach	Countries where this agglomeration approach was applied to cities	Number of localities with innovation economy leaders	Number of localities as agglomerations
1	Inclusion of Functional Urban Areas (FUAs)	Australia, Austria, Belgium, Canada, Chile, Colombia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Lithuania, Luxembourg, Mexico, Netherlands, Norway, Poland, Portugal, Republic of Korea, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom, United States of America	2,537	1,368 (of which 662 FUAs)
2	Use of national approaches to define agglomerations	Brazil, India, South Africa	168	141 (of which 58 agglomerations)
3	Independent definition of agglomerations	Albania, Algeria, Angola, Andorra, Argentina, Armenia, Azerbaijan, Bahrain, Bangladesh, Barbados, Belarus, Bolivia, Bosnia and Herzegovina, Botswana, Brunei Darussalam, Bulgaria, Burkina Faso, Cabo Verde, Cambodia, China, Congo, Costa Rica, Croatia, Cuba, Cyprus, Democratic People's Republic of Korea, Dominican Republic, Ecuador, Egypt, El Salvador, Eswatini, Ethiopia, Fiji, Gambia, Georgia, Ghana, Guatemala, Guyana, Honduras, Indonesia, Iran, Iraq, Israel, Jamaica, Jordan, Kazakhstan, Kenya, Kosovo, Kuwait, Kyrgyzstan, Lebanon, Liberia, Liechtenstein, Madagascar, Malaysia, Malta, Mauritius, Montenegro, Morocco, Mozambique, Monaco, Mongolia, Myanmar, Namibia, Nepal, New Zealand, Nigeria, Oman, Pakistan, Panama, Paraguay, Peru, Philippines, Puerto Rico, Qatar, Republic of Moldova, Republic of North Macedonia, Romania, Russian Federation, San Marino, Saudi Arabia, Senegal, Serbia, Seychelles, Singapore, Sri Lanka, State of Palestine, Sudan, Syrian Arab Republic, Thailand, Timor-Leste, Trinidad and Tobago, Tunisia, Turkmenistan, Türkiye, Uganda, Ukraine, United Arab Emirates, United Republic of Tanzania, Uruguay, Uzbekistan, Vatican City, Venezuela, Viet Nam, Yemen, Zambia, Zimbabwe	831	658 (of which 95 agglomerations)
TOTAL			**3,536**	**2,167**

* The data for functional urban areas are taken from the corresponding OECD classification (https://www.oecd.org/regional/regional-statistics/functional-urban-areas.htm). Some OECD countries' (Türkiye, Israel, New Zealand, and Costa Rica) information on FUAs was not available, leading to authors' clustering of agglomerations independently. National approaches to singling out agglomerations in Brazil (https://www.ibge.gov.br/), South Africa (https://www.statssa.gov.za/), and India (https://www.census2011.co.in/) are based on the data taken from the official websites of responsible organizations undertaking statistical audits with a breakdown into these territories. The independent definition approach was performed based on the open source data concerning global agglomerations (http://www.citypopulation.de/).

Source: HSE ISSEK.

Functional Urban Areas

This approach that creates functional urban areas was developed by the OECD together with Eurostat and helps one answer the question of where densely populated urban zones end and where less dense areas not yet integrated into the city's economy begin.

Functional urban areas were created after analyzing census-based information of where residents live and work, including how much they commute day-to-day from less urbanized zones to more urbanized zones (the nucleus). If the area has a specific level of connectivity, established according to individual specifications of each locality, the administrative districts are clustered into one functional urban area characterized by a shared economic space.

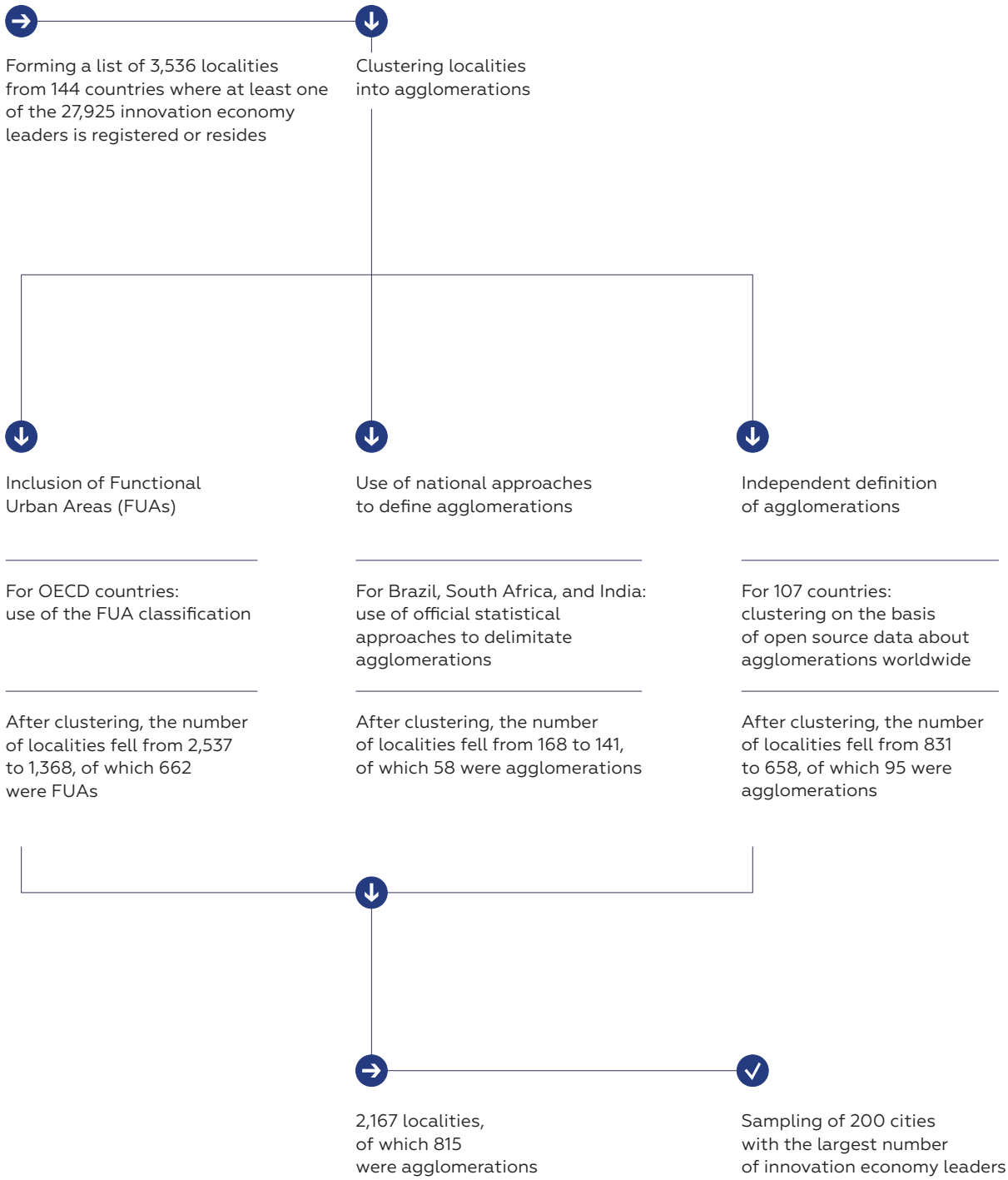
Since this approach is used in OECD countries, it allows us to conduct international comparisons of agglomerations – economic zones identified when one and the same methodology was applied. The obtained OECD classification contains information about 1,197 functional urban areas.

Source: Definition of Functional Urban Areas (FUAs) for the OECD metropolitan database. Available at: https://www.oecd.org/cfe/regionaldevelopment/Definition-of-Functional-Urban-Areas-for-the-OECD-metropolitan-database.pdf (Accessed: 24.06.2024).

After this procedure was applied, the database shrunk to 2,167 areas – agglomerations and localities that do not form any kind of large urban entities and are not part of any of them. From this list, we selected 200 locations with the largest number of innovation economy leaders for the subsequent calculations and ranking within HSE GCII 2024 (Figure 31, Table 28).

For these cities we collected additional indicators, reflecting the quality of the urban environment, as well as a number of indicators in the Technological Development Subindex ("Startups", "Innovation support funds", "Patent activity", "Publication activity", "Co-working spaces", etc.).

Figure 31. City Sampling Algorithm of HSE GCII 2024



Source: HSE ISSEK.

Table 28. Agglomerations and Localities in the Final Sample of HSE GCII 2024

Agglomeration	Localities within agglomeration
1 **London** (United Kingdom)	Amersham, Basildon, Borehamwood, Brentford, Edgware, Harpenden, Harrow, Hatfield, Hertfordshire, Kings Langley, Kingston upon Thames, London, Reigate, Richmond upon Thames, Romford, Saffron Walden, South Kensington, Sutton Coldfield, Teddington, Tooting, Uxbridge, Wandsworth, Watford, Weybridge, Woking
2 **New York, NY** (United States)	Armonk, Berkeley Heights, Bridgewater Township, Brighton, Chatham, Cranbury, East Hampton, Edison, Englewood Cliffs, Florham Park, Fort Lee, Franklin Lakes, Hackensack, Hampton, Hauppauge, Hempstead, Hoboken, Holmdel, Hudson, Huntington, Irvington, Islandia, Jericho, Jersey City, Kenilworth, Laurel Hollow, Madison, Mahwah, Mamaroneck, Maplewood, Melville, Morristown, New Brunswick, New Hyde Park, New York, Newark, North Bergen, Parsippany-Troy-Hills, Pawling, Piscataway, Purchase, Rahway, Red Bank, Roseland, Rye Brook, Saddle Brook, Secaucus, Short Hills, Somerset, South Plainfield, Stony Brook, Suffolk, Tarrytown, Tinton Falls, Union, Upton, West Bay Shore, White Plains
3 **Tokyo** (Japan)	Akishima, Akita, Asaka, Atsugi, Bunkyō, Chiba, Chigasaki, Chōfu, Chūō, Fuchū, Hachiōji, Hayama, Honjō, Ichikawa, Isehara, Kawasaki, Kazo, Kokubunji, Kunitachi, Mitaka, Musashino, Narashino, Narita, Niiza, Nishitokyo, Noda, Ōiso, Ōme, Ōta, Saitama, Shibuya, Tokyo, Wakō, Yokohama
4 **Beijing** (China)	Beijing, Langfang, Sanhe, Zhuozhou
5 **San Francisco, CA** (United States)	Alameda, Belmont, Berkeley, Brisbane, Burlingame, Concord, Cupertino, Danville, Dublin, Emeryville, Foster City, Fremont, Hayward, Hercules, Livermore, Los Altos, Los Gatos, Marin, Menlo Park, Milpitas, Mountain View, Newark, Nicasio, Novato, Oakland, Palo Alto, Pleasanton, Portola Valley, Redwood City, San Carlos, San Francisco, San José, San Mateo, San Rafael, San Ramon, Santa Clara, Sausalito, South San Francisco, Stanford, Sunnyvale, Union City, Walnut Creek
6 **Paris** (France)	Aubervilliers, Bagneux, Bezons, Boulogne-Billancourt, Bruyères-le-Châtel, Bures-sur-Yvette, Bussy-Saint-Martin, Cergy-Pontoise, Champs-sur-Marne, Charenton-le-Pont, Chatillon, Clamart, Clichy, Colombes, Courbevoie, Créteil, Dreux, Éragny, Évry, Fontainebleau, Gentilly, Gif-sur-Yvette, Goussainville, Guyancourt, Herblay-sur-Seine, Issy-les-Moulineaux, Jouy en Josas, Le Chesnay, Le Kremlin-Bicêtre, Le Plessis-Robinson, Lieusaint, Marne-la-Vallee, Massy, Meudon, Moissy-Cramayel, Montreuil, Montrouge, Nanterre, Neuilly-sur-Seine, Orsay, Palaiseau, Pantin, Paris, Persan, Poissy, Puteaux, Rocquencourt, Rueil-Malmaison, Saclay, Saint-Aubin, Saint-Denis, Saint-Mandé, Saint-Maur-des-Fossés, Saint-Ouen-sur-Seine, Sèvres, Suresnes, Thiais, Tremblay-en-France, Vélizy-Villacoublay, Versailles, Villeblevin, Villebon-sur-Yvette, Villejuif, Villepinte, Villetaneuse

Rank in HSE GCII 2024

(continued)

	Agglomeration	Localities within agglomeration
7	**Shanghai** (China)	Shanghai, Taicang, Xinqiao
8	**Los Angeles, CA** (United States)	Aliso Viejo, Altadena, Anaheim, Beverly Hills, Big Bear Lake, Brea, Burbank, Cerritos, Chino, Commerce, Compton, Costa Mesa, Covina, Culver City, Duarte, El Segundo, Fontana, Fullerton, Gardena, Glendale, Glendora, Hawthorne, Huntington Beach, Huntington Park, Irvine, Laguna Beach, Laguna Hills, Lake Forest, Lakewood, Long Beach, Los Angeles, Malibu, Manhattan Beach, Marina Del Rey, Monrovia, Newport Beach, Orange, Pasadena, Rancho Cucamonga, Riverside, San Clemente, Santa Ana, Santa Clarita, Santa Fe Springs, Santa Monica, Stanton, Temecula, Torrance, Tustin, Universal City, Vernon, Walnut, West Hollywood, Westlake Village
9	**Moscow** (Russia)	Dolgoprudny, Moscow
10	**Seoul** (South Korea)	Ansan, Anyang, Bucheon, Gangseo, Goyang, Gwacheon, Incheon, Seongdong, Seongnam, Seoul, Suwon, Uiwang, Yongin
11	**Shenzhen** (China)	Shenzhen
12	**Hong Kong** (China)	Hong Kong
13	**Guangzhou** (China)	Dongguan, Foshan, Guangzhou
14	**Singapore** (Singapore)	Singapore
15	**Berlin** (Germany)	Berlin, Dallgow-Döberitz, Fürstenberg, Großbeeren, Kleinmachnow, Müncheberg, Nuthetal, Potsdam, Schönfeld
16	**Boston, MA** (United States)	Acton, Andover, Bedford, Beverly, Billerica, Boston, Braintree, Bridgewater, Brookline, Cambridge, Chelmsford, Chestnut Hill, Danvers, Framingham, Lowell, Marlborough, Maynard, Medford, Natick, Newburyport, Newton, North Reading, Sharon, Somerville, Walpole, Waltham, Watertown, Wellesley, Westford, Wilmington, Woburn
17	**Madrid** (Spain)	Alcalá de Henares, Alcobendas, Colmenar Viejo, Getafe, Las Rozas de Madrid, Leganés, Madrid, Móstoles, San Isidro, Tres Cantosм
18	**Istanbul** (Türkiye)	Istanbul, Maslak, Sarıyer, Şişli
19	**Munich** (Germany)	Eching, Garching, Gilching, Grasbrunn, Ismaning, Landsberg am Lech, Maisach, Martinsried, Munich, Neubiberg, Oberhaching, Oberschleißheim, Olching, Planegg, Sauerlach, Seeshaupt, Stockdorf, Taufkirchen, Unterföhring, Unterschleißheim
20	**Milan** (Italy)	Basiano, Bresso, Busto Arsizio, Cardano al Campo, Caronno Pertusella, Cernusco sul Naviglio, Concorezzo, Cusano Milanino, Ferno, Giussano, Inverigo, Legnano, Lomazzo, Meda, Milan, Monza, Morimondo, Noviglio, Pieve Emanuele, Rozzano, San Donato Milanese, Sovico, Villanterio

(continued)

Agglomeration	Localities within agglomeration
21 **Taipei** (China)	Keelung, New Taipei City, Taipei
22 **Hangzhou** (China)	Hangzhou, Jiande, Shaoxing
23 **Toronto** (Canada)	Aurora, Brampton, Burlington, Markham, Mississauga, Oshawa, Toronto, Vaughan
24 **Stockholm** (Sweden)	Danderyd, Nacka, Solna, Stockholm, Täby, Tumba
25 **Suzhou** (China)	Changzhou, Jiangyin, Kunshan, Suzhou, Wuxi, Yixing
26 **Sydney** (Australia)	Bellevue Hill, Cremorne, Haymarket, Hebersham, Kensington, Liverpool, Lucas Heights, Macquarie Park, Manly, Milperra, Mosman, North Manly, Ourimbah, Paddington, Padstow, Penrith, Surry Hills, Sydney, Wollstonecraft
27 **Amsterdam** (Netherlands)	Abcoude, Almere, Amsterdam, Badhoevedorp, Bloemendaal, Enkhuizen, Haarlem, Hilversum, Hoofddorp, Lijnden, Uitgeest, Uithoorn, Weesp, Zaandam
28 **Barcelona** (Spain)	Badalona, Barcelona, Castelldefels, Cerdanyola del Vallès, Collbató, Esplugues de Llobregat, Martorell, Mataró, Mediona, Palau-solità i Plegamans, Sabadell, Sant Boi de Llobregat, Sant Cugat del Vallès, Sant Feliu de Llobregat, Sant Just Desvern, Terrassa
29 **Nanjing** (China)	Nanjing, Xiaolingwei
30 **Osaka** (Japan)	Akashi, Ashiya, Daitō, Higashiōsaka, Ibaraki, Ikoma, Itami, Kadoma, Kashihara, Kobe, Kyoto, Moriguchi, Nagaokakyō, Nara, Neyagawa, Nishinomiya, Osaka, Ōsakasayama, Ōtsu, Sakai, Settsu, Suita, Takatsuki
31 **Washington, D.C.** (United States)	Adelphi, Alexandria, Annapolis, Ashburn, Bailey's Crossroads, Baltimore, Beltsville, Bethesda, Bowie, Chantilly, Chevy Chase, College Park, Columbia, Fairfax, Falls Church, Fredericksburg, Front Royal, Gaithersburg, Germantown, Greenbelt, Herndon, Hunt Valley, Langley, McLean, Morningside, North Bethesda, Reston, Rockville, Silver Spring, Tysons, Vienna, Washington, DC
32 **Dubai** (United Arab Emirates)	Ajman, Dubai, Sharjah
33 **Copenhagen** (Denmark)	Albertslund, Bagsværd, Ballerup, Brøndby, Charlottenlund, Copenhagen, Frederiksberg, Gentofte, Hedehusene, Hellerup, Helsingør, Herlev, Hørsholm, Humlebæk, Kongens Lyngby, Lynge, Nivå, Roskilde, Smørumnedre, Tikøb, Valby
34 **São Paulo** (Brazil)	Osasco, Santo André, São Paulo
35 **Melbourne** (Australia)	Abbotsford, Burwood, City of Yarra, Heidelberg, Malvern, Melbourne, Parkville, Reservoir, Richmond
36 **Vienna** (Austria)	Gumpoldskirchen, Klosterneuburg, Laxenburg, Seibersdorf, Vienna

(continued)

	Agglomeration	Localities within agglomeration
37	**Montreal** (Canada)	Beaconsfield, Dorval, Laval, Longueuil, Montreal, Saint-Jean-sur-Richelieu, Verdun, Westmount
38	**Warsaw** (Poland)	Falenty, Jabłonowo, Jastrzębiec, Otwock, Warsaw
39	**Oslo** (Norway)	Asker, Bekkestua, Fornebu, Hakadal, Kjeller, Lysaker, Nittedal, Oslo, Ås
40	**Prague** (Czech Republic)	Husinec, Ondřejov, Prague, Průhonice, Všestudy
41	**Budapest** (Hungary)	Budapest, Dunakeszi, Gödöllő
42	**Chicago, IL** (United States)	Batavia, Berwyn, Chicago, Cicero, Crystal Lake, DeKalb, Downers Grove, Evanston, Glenview, Hammond, Hoffman Estates, Itasca, Kenosha, Lake Bluff, Lemont, Lincolnshire, Lisle, Malta, Mettawa, Roselle, Schaumburg
43	**Vancouver** (Canada)	Burnaby, New Westminster, North Vancouver, Richmond, Surrey, Vancouver
44	**Wuhan** (China)	Wuhan
45	**Mumbai** (India)	Karjat, Mumbai, Thane
46	**Helsinki** (Finland)	Espoo, Helsinki, Vantaa
47	**Chengdu** (China)	Chengdu
48	**Hamburg** (Germany)	Bad Oldesloe, Borstel, Geesthacht, Glinde, Großhansdorf, Hamburg, Norderstedt, Rellingen, Tostedt
49	**Nagoya** (Japan)	Anjō, Chiryū, Gifu, Kariya, Kasugai, Kiyosu, Nagakute, Nagoya, Ōbu, Ōgaki, Ōguchi, Okazaki, Seto, Toyoake, Toyota
50	**Bangkok** (Thailand)	Bangkok, Khlong Luang, Khlong Nueng, Nakhon Pathom, Pathum Thani, Samut Prakan
51	**Lisbon** (Portugal)	Almada, Amadora, Cascais, Charneca de Caparica, Lisbon, Odivelas, Oeiras
52	**Buenos Aires** (Argentina)	Bernal, Buenos Aires, Parque San Martín, Pilar
53	**Dublin** (Ireland)	Dublin, Dún Laoghaire–Rathdown, Maynooth, Swords, Wicklow
54	**Seattle, WA** (United States)	Bellevue, Bothell, Everett, Kirkland, Pierce, Redmond, Renton, Sammamish, Seattle, Tacoma, Woodinville
55	**Hsinchu** (China)	Hsinchu, Hukou, Zhubei
56	**Rome** (Italy)	Formello, Frascati, Rome
57	**Vilnius** (Lithuania)	Vilnius

(continued)

	Agglomeration	Localities within agglomeration
58	**Zurich** (Switzerland)	Birmensdorf, Dübendorf, Hinwil, Kloten, Männedorf, Niederweningen, Oberengstringen, Opfikon, Pfäffikon, Rümlang, Schlieren, Stäfa, Thalwil, Volketswil, Wollerau, Zürich
59	**Frankfurt am Main** (Germany)	Bad Homburg vor der Höhe, Bad Vilbel, Dietzenbach, Dreieich, Eschborn, Frankfurt am Main, Gelnhausen, Hammersbach, Hanau, Langen, Nauheim, Neu-Isenburg, Offenbach am Mein, Rüsselsheim am Mein, Schwalbach am Taunus, Seligenstadt
60	**Brussels** (Belgium)	Aalst, Brussels, Gembloux, Grand-Rosière, Halle, Hélécine, Keerbergen, La Hulpe, Lasne, Louvain-la-Neuve, Ottignies-Louvain-la-Neuve, Schaerbeek, Wavre
61	**Xi'an** (China)	Xi'an, Xianyang, Yangling
62	**Kyiv** (Ukraine)	Kyiv
63	**Porto** (Portugal)	Espinho, Gondomar, Maia, Matosinhos, Paredes, Porto
64	**Dallas, TX** (United States)	Addison, Allen, Arlington, Dallas, Denton, Fort Worth, Frisco, Glen Rose, Irving, Plano, Richardson
65	**Rio de Janeiro** (Brazil)	Niterói, Petrópolis, Rio de Janeiro
66	**Tianjin** (China)	Tianjin
67	**Mexico City** (Mexico)	Chapingo, Mexico City, Naucalpan de Juárez
68	**Stuttgart** (Germany)	Aalen, Bietigheim-Bissingen, Böblingen, Ditzingen, Esslingen am Neckar, Gerlingen, Göppingen, Kirchheim unter Teck, Leinfelden-Echterdingen, Leonberg, Ludwigsburg, Nürtingen, Schwäbisch Gmünd, Sindelfingen, Stuttgart, Waiblingen, Wendlingen am Neckar, Winnenden
69	**Essen-Dortmund** (Germany)	Bochum, Bönen, Dortmund, Duisburg, Essen, Gelsenkirchen, Mülheim an der Ruhr, Neukirchen-Vluyn, Oberhausen, Wesel, Wetter
70	**Delhi** (India)	Delhi, Faridabad, Gurgaon, New Delhi, Noida, Sonipat
71	**Qingdao** (China)	Qingdao
72	**Bucharest** (Romania)	Bucharest, Buftea, Măgurele, Tunari
73	**Saint Petersburg** (Russia)	Gatchina, Saint Petersburg
74	**Sofia** (Bulgaria)	Sofia
75	**Cologne** (Germany)	Bedburg, Cologne, Hürth, Kerpen, Leichlingen, Leverkusen
76	**Chongqing** (China)	Chongqing

(continued)

	Agglomeration	Localities within agglomeration
77	**Austin, TX** (United States)	Austin, Cedar Park, Pflugerville, Round Rock, San Marcos
78	**Tel Aviv** (Israel)	Beit-Dagan, Bnei Brak, Givatayim, Glil-Yam, Herzliya, Hod Hasharon, Holon, Kfar Saba, Kfar Yona, Lod, Mazkeret Batya, Ness Ziona, Or Yehuda, Petah Tikva, Ra'anana, Ramat Gan, Ramat HaSharon, Rehovot, Tel Aviv, Yehud
79	**Auckland** (New Zealand)	Auckland, Northcote
80	**Kuala Lumpur** (Malaysia)	Bandar Baru Bangi, Bangi, Bukit Jalil, Cyberjaya, Gombak, Kajang, Kuala Lumpur, Nilai, Petaling Jaya, Sepang, Serdang, Seri Kembangan, Shah Alam, Subang Jaya
81	**Bogotá D.C.** (Colombia)	Bogotá, Chía
82	**Edinburgh** (United Kingdom)	Bathgate, Edinburgh, Musselburgh
83	**Philadelphia, PA** (United States)	Ambler, Audubon, Bryn Mawr, Camden, Chester, Collegeville, Conshohocken, Ewing Township, Exton, Glassboro, Glen Mills, Haverford, King of Prussia, Langhorne, Malvern, New Castle, Oaks, Pennsauken Township, Philadelphia, Plymouth Meeting, Pottsgrove, Princeton, Radnor Township, Solebury Township, Swarthmore, Wayne, Wilmington, Wynnewood, Yardley
84	**Gothenburg** (Sweden)	Gothenburg, Kungsbacka, Mölndal, Mölnlycke
85	**San Diego, CA** (United States)	Carlsbad, Coronado, Encinitas, Poway, San Diego, Solana Beach, Vista
86	**Düsseldorf** (Germany)	Dormagen, Düsseldorf, Erkrath, Langenfeld, Mettmann, Ratingen, Velbert
87	**Athens** (Greece)	Agia Paraskevi, Athens, Kallithea, Kifissia
88	**Xiamen** (China)	Quanzhou, Xiamen
89	**Santiago** (Chile)	El Monte, Santiago
90	**Dalian** (China)	Dalian
91	**Cairo** (Egypt)	Al Khankah, Al Shorouk, Cairo, Giza, Helwan, Inshas, New Cairo, Sheikh Zayed City
92	**Geneva** (Switzerland)	Bellevue, Carouge, Coppet, Eysins, Geneva, Genthod, L'Abbaye, Meyrin, Montreux, Nyon, Plan-les-Ouates, Rolle, Thônex, Vernier, Vevey
93	**Eindhoven** (Netherlands)	Deurne, Eindhoven, Helmond, Veldhoven
94	**Ghent** (Belgium)	Aalter, Ghent, Merelbeke, Wetteren
95	**Utrecht** (Netherlands)	Bilthoven, Bunnik, De Bilt, Houten, Leerdam, Nieuwegein, Stichtse Vecht, Utrecht
96	**Houston, TX** (United States)	Friendswood, Galveston, Houston, Katy, Magnolia, Missouri City, Spring, The Woodlands, Webster

(continued)

	Agglomeration	Localities within agglomeration
97	**Brno** (Czech Republic)	Brno
98	**Cambridge** (United Kingdom)	Cambridge, Hinxton
99	**Riyadh** (Saudi Arabia)	Riyadh
100	**Ankara** (Türkiye)	Ankara, Kahramankazan
101	**Changsha** (China)	Changsha
102	**Daejeon** (South Korea)	Daejeon
103	**Birmingham** (United Kingdom)	Birmingham, Bromsgrove, Gaydon, Royal Leamington Spa, Rugeley, Solihull, Stratford-upon-Avon, Walsall, Wolverhampton
104	**Brisbane** (Australia)	Brisbane, Carina Heights, Nathan
105	**Nijmegen** (Netherlands)	Nijmegen
106	**Tehran** (Iran)	Karaj, Pardis, Tajrish, Tehran
107	**Taichung-Changhua** (China)	Changhua, Dacun, Taichung
108	**Dresden** (Germany)	Dresden, Glashütte, Schönfeld
109	**Miami, FL** (United States)	Boca Raton, Coral Gables, Davie, Fort Lauderdale, Glen Ridge, Hialeah, Hollywood, Miami, Miami Beach, Palm Beach, Palm Beach Gardens, Pembroke Pines, Plantation, Pompano Beach, Tamarac, West Palm Beach
110	**Kraków** (Poland)	Kraków
111	**Luxembourg** (Luxembourg)	Bertrange, Bissen, Esch-sur-Alzette, Luxembourg, Troisvierges
112	**València** (Spain)	Benaguasil, Chiva, Paterna, Riba-roja de Túria, València
113	**Lyon** (France)	Écully, Limonest, Lyon, Saint-Chamond, Ternay, Vaulx-en-Velin, Villeurbanne
114	**The Hague** (Netherlands)	De Lier, Delft, Rijswijk, The Hague, Zoetermeer
115	**Aarhus** (Denmark)	Aabyhøj, Aarhus, Ebeltoft, Viby
116	**Glasgow** (United Kingdom)	Glasgow, Hamilton, Paisley
117	**Ottawa** (Canada)	Gatineau, Ottawa, Smiths Falls
118	**Liverpool** (United Kingdom)	Lancaster, Liverpool, Ormskirk
119	**Belgrade** (Serbia)	Belgrade

(continued)

	Agglomeration	Localities within agglomeration
120	**Rotterdam** (Netherlands)	Capelle aan den IJssel, Dordrecht, Maassluis, Rotterdam, Rozenburg
121	**Lima** (Peru)	Lima
122	**Toulouse** (France)	Toulouse
123	**Denver, CO** (United States)	Aurora, Broomfield, Denver, Edgewater, Englewood, Fort Lupton, Golden, Greenwood Village, Westminster
124	**Mainz** (Germany)	Ingelheim am Rhein, Mainz
125	**Atlanta, GA** (United States)	Alpharetta, Atlanta, Duluth, Norcross
126	**Nuremberg** (Germany)	Erlangen, Fürth, Herzogenaurach, Nuremberg, Obermichelbach, Stein
127	**Groningen** (Netherlands)	Groningen, Westerbroek
128	**Leipzig** (Germany)	Leipzig
129	**Braunschweig-Salzgitter-Wolfsburg** (Germany)	Braunschweig, Salzgitter, Wolfsburg
130	**Leuven** (Belgium)	Leuven
131	**Heidelberg** (Germany)	Heidelberg, Walldorf, Weinheim
132	**Bengaluru** (India)	Bengaluru
133	**Basel** (Switzerland)	Allschwil, Basel, Birsfelden, Hölstein, Muttenz, Reinach
134	**Islamabad** (Pakistan)	Islamabad, Rawalpindi, Taxila
135	**Boulder, CO** (United States)	Boulder
136	**Hanover** (Germany)	Bad Münder am Deister, Hanover, Isernhagen
137	**Malmö** (Sweden)	Lund, Malmö, Svedala, Trelleborg, Vellinge
138	**Oxford** (United Kingdom)	Abingdon-on-Thames, Didcot, Oxford
139	**Hefei** (China)	Chaohu, Hefei
140	**Ithaca, NY** (United States)	Ithaca
141	**Manchester** (United Kingdom)	Altrincham, Bolton, Bury, Crewe, Manchester, Oldham, Salford
142	**Leeds** (United Kingdom)	Bradford, Huddersfield, Leeds, Ossett, Wakefield
143	**Fuzhou** (China)	Fuzhou
144	**Kaohsiung** (China)	Kaohsiung

(continued)

Agglomeration	Localities within agglomeration
145 **Strasbourg** (France)	Hurtigheim, Illkirch-Graffenstaden, Schiltigheim, Strasbourg
146 **Exeter** (United Kingdom)	Exeter
147 **Bristol** (United Kingdom)	Bristol, Chilcompton
148 **Marseille** (France)	Gémenos, Marseille
149 **Adelaide** (Australia)	Adelaide, Salisbury, Unley
150 **Bordeaux** (France)	Bordeaux, Gradignan, Pessac, Talence
151 **Tsukuba** (Japan)	Tsukuba
152 **Ningbo** (China)	Ningbo, Yuyao
153 **Nottingham** (United Kingdom)	Long Eaton, Nottingham
154 **Bonn** (Germany)	Bonn, Sankt Augustin, Siegburg, Wachtberg
155 **Leiden** (Netherlands)	Leiden, Noordwijk, Noordwijkerhout
156 **Ho Chi Minh City** (Viet Nam)	Ho Chi Minh City
157 **Jinan** (China)	Jinan
158 **Jakarta** (Indonesia)	Bogor, Depok, Jakarta, Tangerang, West Jakarta
159 **Bologna** (Italy)	Anzola dell'Emilia, Bentivoglio, Bologna, Castenaso, Granarolo dell'Emilia, Imola, Ozzano dell'Emilia, San Lazzaro di Savena
160 **Minneapolis, MN** (United States)	Blaine, Eagan, Eden Prairie, Golden Valley, Medina, Minneapolis, Prior Lake, Red Wing, Saint Paul
161 **Columbus, OH** (United States)	Columbus, Dublin, New Albany, Reynoldsburg, Westerville
162 **Calgary** (Canada)	Calgary
163 **Antwerp** (Belgium)	Antwerpen, Beveren, Brasschaat, Hove, Kontich, Mortsel, Niel
164 **New Haven, CT** (United States)	Bethany, Branford, Danbury, Fairfield, Greenwich, Milford, New Canaan, New Haven, Norwalk, Sandy Hook, Shelton, Stamford, Wallingford, Waterbury
165 **Bern** (Switzerland)	Bern, Biel, Boll, Burgdorf, Ittigen, Nods, Oberwangen, Saint-Imier, Wünnewil-Flamatt
166 **Canberra** (Australia)	Bruce, Canberra

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	Agglomeration	Localities within agglomeration
167	**Salt Lake, UT** (United States)	Draper, Salt Lake City, South Jordan
168	**Harbin** (China)	Harbin
169	**Portland, OR** (United States)	Beaverton, Camas, Gresham, Hillsboro, Portland, Tualatin, Vancouver, Wilsonville
170	**Lille** (France)	Croix, Fretin, Lille, Roubaix, Tourcoing, Villeneuve d'Ascq
171	**Ede** (Netherlands)	Wageningen
172	**Manila** (Philippines)	Los Baños, Makati, Mandaluyong, Manila, Muntinlupa, Pasig, Quezon City, San Pedro, Santa Maria, Taguig
173	**Ann Arbor, MI** (United States)	Ann Arbor
174	**Lausanne** (Switzerland)	Bussigny, Écublens, Épalinges, Lausanne, Mex, Paudex, Prilly, Saint-Prex
175	**Padua** (Italy)	Legnaro, Limena, Noventa Padovana, Padua, Sant'Angelo di Piove di Sacco, Vigonovo, Vigonza
176	**Cork** (Ireland)	Cork
177	**Kansas City, MO** (United States)	Independence, Kansas City, Leawood, Merriam, North Kansas City, Olathe, Overland Park
178	**Phoenix, AZ** (United States)	Cave Creek, Chandler, Paradise Valley, Phoenix, Scottsdale, Surprise, Tempe
179	**Perth** (Australia)	Fremantle, Joondalup, Perth, Swan Valley
180	**Turin** (Italy)	Leini, Pino Torinese, Rivalta di Torino, Turin
181	**St. Louis, MO** (United States)	Chesterfield, Olivette, St. Louis
182	**Venice** (Italy)	Mira, Murano, Noale, Venice
183	**Novosibirsk** (Russia)	Novosibirsk
184	**Jeddah** (Saudi Arabia)	Jeddah
185	**Santa Barbara, CA** (United States)	Carpinteria, Goleta, Montecito, Santa Barbara
186	**Beirut** (Lebanon)	Aintoura, Baabda, Beirut, Jounieh, Kaslik, Zouk Mikael
187	**Pittsburgh, PA** (United States)	Canonsburg, Coraopolis, Monroeville, Pittsburgh, Warrendale
188	**Durham, NC** (United States)	Chapel Hill, Durham
189	**Changchun** (China)	Changchun
190	**Montpellier** (France)	Montpellier, Sète

(continued)

	Agglomeration	Localities within agglomeration
191	**Florence** (Italy)	Bagno a Ripoli, Calenzano, Fiesole, Florence, Le Sieci, Montelupo Fiorentino, Sesto Fiorentino, Signa
192	**Grenoble** (France)	Grenoble, Izeaux, La Tronche, Saint-Jean-de-Moirans, Saint-Martin-d'Hères, Sassenage
193	**Detroit, MI** (United States)	Auburn Hills, Bloomfield Hills, Clinton Township, Dearborn, Detroit, Northville, Novi, Rochester, Southfield, Troy, Van Buren Township
194	**Cape Town** (South Africa)	Bellville, Cape Town
195	**Nashville, TN** (United States)	La Vergne, Nashville
196	**Cleveland, OH** (United States)	Avon Lake, Cleveland, Medina, Mentor, Westlake, Wickliffe
197	**Rochester, MN** (United States)	Rochester
198	**Madison, WI** (United States)	Dunn, Madison, Middleton
199	**Kitchener** (Canada)	Waterloo
200	**Raleigh, NC** (United States)	Cary, Morrisville, Raleigh

Structure and Indicator System of HSE GCII 2024

HSE GCII 2024 is based on ranking the cities in descending order by the values of the overall index that consists of three subindices:

- Technological Development (18 indicators, grouped into five sections)
- Creative Industries (26 indicators, grouped into eight sections)
- Urban Environment (46 indicators, grouped into eight sections).

The cities were ranked by each of these subindices and the corresponding sub-rankings were compiled.

The Technological Development Subindex measures the city's accumulated educational, research, and entrepreneurial potential, expressed as the number of technology and venture capital companies, universities and R&D organizations, innovation infrastructure facilities, and the number of publications and patents filed by the city residents.

The Creative Industries Subindex measures the development level of different activities that make up the creative sector of the economy: film and animation, electronic games, music, fashion, advertising and PR, architecture, industrial design, and arts.

The Urban Environment Subindex gives a general evaluation of the level of comfort and infrastructure development of urban areas. It covers such aspects as the costs of doing business and living, mobility, digitalization, safety, tourist appeal, ecology and human health, and internationalization.

A number of indicators (e.g., costs of doing business and of living in the city, etc.) are composite, i.e., they are composed of lower-level indicators. A total of 90 indicators were used in the ranking (Table 29).

Table 29. Indicator System of HSE GCII 2024

No.	Indicator name	Description	Data source	Period
1.	**Technological Development**			
1.1	**Technology companies**			
1.1.1	Leading companies by R&D expenditure	Number of headquarters of companies included on the R&D Scoreboard	R&D Scoreboard	2022
1.1.2	R&D expenditure of largest innovation companies	Total R&D expenditure of largest innovation companies, billion USD	HSE University, based on R&D Scoreboard	2022
1.2	**Startups and venture capital**			
1.2.1	Startups	Number of startups no more than seven years old and represented in international databases	Crunchbase, StartupBlink	2023
1.2.2	Unicorns	Number of young, rapidly growing companies (unicorns) Note: "unicorns" mean those satisfying the following criteria: 1) no more than 10 years old; 2) valuation of over 1 billion USD; 3) not traded publicly and over 25% owned by the founders.	Crunchbase, CB Insights	2023
1.2.3	Innovation support funds	Innovation support funds Number of organizations providing financial support for the innovation activities of companies Note: Business angels, investment partners, pension funds, syndicates, and co-working spaces are not included	Crunchbase (Investors)	2023
1.2.4	Business angels	Number of business angels	Crunchbase (Investors)	2023
1.2.5	Venture capital investment	Volume of venture deals with city resident organizations, million USD Note: The following types of deals are included: Pre-Seed, Seed, Series A-J, Ventures – Series Unknown, Angel, Convertible Notes, Corporate Round, Equity Crowdfunding, and Private Equity	Crunchbase	2019–2023
1.3	**Universities and R&D organizations**			
1.3.1	Leading universities	Number of higher education institutions included in international rankings	QS, THE, ARWU	2023
1.3.2	Leading R&D organizations	Number of R&D organizations included in SCImago Institutions Rankings Note: Only public R&D organizations ("Government") are included. Public authorities and "umbrella" organizations are excluded	SCImago	2023
1.3.3	Highly cited researchers	Number of highly cited researchers affiliated with city organizations	Clarivate	2023
1.3.4	Nobel Prize laureates and Fields Medal winners	Number of living Nobel Prize laureates and Fields Medal winners affiliated with city organizations	HSE University, based on the official websites of the Nobel Prize and International Mathematical Union	2023

(continued)

No.	Indicator name	Description	Data source	Period
1.3.5	Students	Number of international students in higher education institutions included in QS, THE, or ARWU rankings, thousand persons	HSE University, based on open source data	2023
1.3.6	International students	Number of international students in higher education institutions included in QS, THE, or ARWU rankings, thousand persons	HSE University, based on open source data	2023
1.4	**Productivity of the innovative class**			
1.4.1	Patent activity	Number of patent applications filed by city residents	PATSTAT Global	2019–2021
1.4.2	Publication activity	Number of publications by authors residing in the city in scientific journals indexed in Scopus	Scopus	2019–2023
1.5	**Innovation infrastructure**			
1.5.1	Clusters and science parks	Number of cluster initiatives and organizations included in the TCI Network, and technology and science parks included in the International Association of Science Parks Note: Organizations included in the TCI Network and the International Association of Science Parks during the last three years and whose operational activity is ongoing	TCI Network, International Association of Science Parks	2023
1.5.2	Co-working spaces	Number of co-working spaces included in StartupBlink	StartupBlink	2023
1.5.3	Supercomputers	Number of supercomputers included in TOP500	TOP500	2023
2.	**Creative Industries**			
2.1	**Film and animation**			
2.1.1	Top-rated film production companies (audience)	Number of film production companies that have films included in IMDb Top 250 (overall)	IMDb	2023
2.1.2	Film production companies that won international film festival awards	Number of film production companies that won top prizes at international film festivals Note: Fifteen film festivals have been accredited and classified as "Competitive Feature Film Festivals" (as of 2024) by the International Federation of Film Producers Associations (FIAPF)	FIAPF, official websites of film festivals	2010–2023
2.1.3	Animation film production companies that won international festival awards	Number of animation film production companies that won top prizes in the Annecy International Animation Film Festival	Annecy International Animation Film Festival	1960–2023
2.1.4	Most influential animation film production companies	Number of animation film production companies included in Top 100 Most Influential Animation Studios of All-Time	Animation Career Review	2023
2.1.5	Top-rated streaming services	Number of video streaming services listed on FlixPatrol	FlixPatrol	2023

(continued)

No.	Indicator name	Description	Data source	Period
2.2	**Electronic games**			
2.2.1	Developers of the best video games	Number of development companies that won the Game of the Year award (GotY) Note: The following awards are included: British Academy Games Awards, Czech Game of the Year Awards, D.I.C.E. Awards, Famitsu Awards, Game Awards, Game Developers Choice Awards, Golden Joystick Awards, Japan Game Awards, New York Game Awards, SXSW Gaming Award, Spike Video Game Awards, VSDA Awards	Official websites of awards and Wikipedia	1997–2022
2.2.2	Largest e-sports tournaments	Number of e-sports tournament finals held in the city with largest prizes	Esports Earnings	2005–2023
2.2.3	Developers of the most popular computer games	Number of development companies whose games are in the top 100 by the number of Steam players	Steam	2023
2.2.4	Companies participating in electronic games trade shows	Number of companies participating in the most visited electronic games trade shows Note: The following trade shows are included: Capcom Showcase Livestream, Devolver Direct, Future Games Show Summer Showcase, Gamescom, OTK Games Expo, PC Gaming Show, Summer Game Fest, Ubisoft Forward, Wholesome Direct, Xbox Games Extended Showcase, Xbox Games Showcase & Starfield Direct	Official websites of trade shows	2023
2.3	**Music**			
2.3.1	Most-streamed artists	Number of most-streamed artists on Spotify	Spotify	2023
2.3.2	Best opera performers	Number of individuals and enterprises that won The International Opera Awards	The International Opera Awards	2014–2023
2.4	**Fashion**			
2.4.1	Largest fashion companies	Number of fashion companies included in Fashion United's "Top 200 Fashion Companies in the World – Public and Private"	Fashion United	2023
2.4.2	Fashion brands	Number of fashion brands represented on the websites of global online retailers	FARFETCH, NET-A-PORTER, Luisa Via Roma Mytheresa	2023
2.5	**Advertising and PR**			
2.5.1	Most effective advertising agencies	Number of advertising agencies included in the top 100 with at least one nomination for the Global Effie Awards Note: Nomination in categories: Individual Agency Offices, Independent Agency Offices, Agency Holding Groups	Effie Awards	2020–2023
2.5.2	Largest PR agencies	Number of companies included in the Top 250 of PRovoke Media	PRovoke Media	2021–2023

(continued)

No.	Indicator name	Description	Data source	Period
2.5.3	Creative production agencies	Number of companies that were awarded at the Cannes Lions International Festival of Creativity Note: Nomination in categories: Agencies, Independent Agencies	Cannes Lions International Festival of Creativity	2022–2023
2.5.4.	Top advertising agencies	Number of companies included in D&AD advertising agency rankings	D&AD	2022–2023
2.6	**Architecture**			
2.6.1	Pritzker Architecture Prize laureates	Number of Pritzker Architecture Prize laureates who reside or resided in the city	The Pritzker Architecture Prize	1979–2023
2.6.2	Internationally recognized architects and architecture firms	Number of individuals and enterprises that won World Architecture Festival Awards	World Architecture Festival Awards	2015–2023
2.7	**Industrial design**			
2.7.1	Internationally recognized designers and design firms	Number of individuals and enterprises included in international design awards and ratings	A' Design Award, iF Design Award, Red Dot Design Award	2020–2023
2.8	**Arts**			
2.8.1	Internationally recognized artists	Number of Praemium Imperiale laureates who reside or resided in the city	Official website of the Japan Art Association	1989–2023
2.8.2	Top artists by auction revenue	Number of Artprice artists by auction revenue who reside or resided in the city	Artprice	2022–2023
2.8.3	Most influential people in contemporary art	Number of the most influential people in contemporary art included in the Power 100 ranking (artists, curators, gallery dealers, managers and founders of cultural institutions and others)	ArtReview	2022–2023
2.8.4	Leading higher education institutions in the arts	Number of higher education institutions that participated in international rankings in categories of Art, Design, and Performing Arts	QS, THE	2023
2.8.5	Best-selling authors	Number of authors who reside or resided in the city and are included on The Books Portal list of best-selling authors ever	Wikipedia (The Books Portal)	2023
2.8.6	Most popular authors	Number of authors included in the Best Books Ever list on Goodreads	Goodreads	2023
3.	**Urban Environment**			
3.1	**Cost of doing business**			
3.1.1	Estimated tax			
3.1.1.1	Estimated tax on a 50,000 USD income	Estimated tax on a 50,000 USD income, USD	Nomad List	2023
3.1.1.2	Estimated tax on a 100,000 USD income	Estimated tax on a 100,000 USD income, USD	Nomad List	2023
3.1.1.3	Estimated tax on a 250,000 USD income	Estimated tax on a 250,000 USD income, USD	Nomad List	2023
3.1.1.4	Corporate income tax	Total income tax rate applied to large businesses	PwC	2023
3.1.2	Salary	Average employee salary, USD per month	Numbeo	2023

(continued)

No.	Indicator name	Description	Data source	Period
3.2	**Cost of living**			
3.2.1	Food prices			
3.2.1.1	European food basket	Total cost of foods required for a balanced diet with European food types per person, USD per month	Numbeo	2023
3.2.1.2	Asian food basket	Total cost of foods required for a balanced diet with Asian food types per person, USD per month	Numbeo	2023
3.2.1.3	Cup of coffee	Average cost of a cup of coffee in public places, USD	Nomad List	2023
3.2.1.4	Restaurant meal	Average cost of a meal at a restaurant, USD	Nomad List	2023
3.2.2	Apartment rental cost	Average cost of renting a one-bedroom apartment in the city center, USD per month	Numbeo	2023
3.2.3	Hotel accommodation	Average cost of renting a hotel room, USD per month	Nomad List	2023
3.2.4	Cost of living for an expat	Cost of long-term residence in the city for an employed foreign citizen who rents housing in the city center and eats out, USD per month	Nomad List	2023
3.2.5	Cost of living for a local resident	Cost of long-term residence in the city for a local resident who rents housing outside the city center and eats at home, USD per month	Nomad List	2023
3.2.6	Travel pass	Cost of a monthly public transport pass, USD	Numbeo	2023
3.2.7	Taxi fare	Average cost of a 1 km taxi ride, USD	Numbeo	2023
3.2.8	Cellular telephone subscription	Average cost of a monthly cellular telephone subscription, USD	Numbeo	2023
3.2.9	Internet access	Average cost of Internet provider services, USD per month	Numbeo	2023
3.2.10	Tuition at an international school	Average tuition at an international school, USD per year	Nomad List	2023
3.3	**Mobility**			
3.3.1	Air traffic	Number of direct airline routes from airports located within 50 km of the city	HSE University, based on OpenFlights	2023
3.3.2	Commute time	Average time spent by city residents to go to work using ground transportation, min.	Numbeo	2023
3.3.3	Public transport	Public transport trips as a percentage of all city residents' commute trips	Numbeo	2023
3.3.4	Metro	Metro trips as a percentage of all city residents' commute trips	Numbeo	2023
3.3.5	EV charging stations	Number of charging stations for electric vehicles	PlugShare	2023
3.4	**Digitalization**			
3.4.1	Mobile Internet speed	Median download speed for mobile devices, Mbits/s	Speedtest	2023
3.4.2	Fixed broadband Internet speed	Median download speed for fixed broadband service, Mbits/s	Speedtest	2023

(continued)

No.	Indicator name	Description	Data source	Period
3.4.3	Wireless Internet	Number of Wi-Fi hotspots in the city	WiFi Map	2023
3.4.4	Remote employment	Share of city residents working from home	Numbeo	2023
3.4.5	Digital public and municipal services	E-Government Development Index that includes the evaluation of such parameters as technical specifications of online portals (functionality, affordability, safety, etc.), city residents' engagement, and content provision	United Nations E-Government Knowledgebase	2023
3.5	**Safety**			
3.5.1	Safety rate	City Safety Index reflecting the overall perceived safety in the city, perception of property crimes, violent crimes, and discrimination	Numbeo	2023
3.5.2	Crime rate	Crime Index reflecting the overall level of crime in the city	Numbeo	2023
3.5.3	Natural disaster risk	Natural disaster risk index based on data from the past 20 years	STC Database	2023
3.6	**Tourist appeal**			
3.6.1	International hotels	Number of hotels belonging to the largest international hotel chains	HSE University, based on Brand Finance	2023
3.6.2	International tourists	Number of international tourists who visited the city in one year	Nomad List	2023
3.6.3	Culture, entertainment, and sports			
3.6.3.1	Unique places	Number of unique places in the city listed by Tripadvisor as "Points of Interest & Landmarks" and "Mysterious Sites"	Tripadvisor	2023
3.6.3.2	Tourist attractions	Number of monuments and statues, historical sites, and observation decks in the city listed by Tripadvisor as "Monuments & Statues"	Tripadvisor	2023
3.6.3.3	Recreational areas	Number of fountains, piers, scenic walking areas, and viewpoints listed by Tripadvisor as "Bridges, Observation Decks & Towers", "Historic Walking Areas", and "Piers & Boardwalks"	Tripadvisor	2023
3.6.3.4	Museums and art galleries	Number of museums and art galleries in the city listed by Tripadvisor as "Museums"	Tripadvisor	2023
3.6.3.5	Theatres	Number of theaters in the city listed in Tripadvisor as "Theaters"	Tripadvisor	2023
3.6.3.6	Stadiums	Number of stadiums in the city with a capacity of over 10,000 spectators	World Stadiums	2023
3.7	**Ecology and human health**			
3.7.1	Environmental pollution level	City Pollution Index, which measures the level of air pollution, quality and availability of drinking water, cleanness and tidiness, and other environmental factors	Numbeo	2023
3.7.2	Green energy	Share of alternative sources of energy in the energy mix	CDP	2023

(continued)

No.	Indicator name	Description	Data source	Period
3.7.3	Quality of healthcare services provision	Healthcare Index, which measures the overall competence and coverage of medical personnel, speed of initial medical examination, quality of medical equipment, speed of medical services provision, services quality at health facilities	Numbeo	2023
3.8	**Internationalization**			
3.8.1	Foreign born population	Share of city residents born outside the country	Columbian College of Arts & Sciences	2015 or the last available period
3.8.2	International schools	Number of organizations implementing international programs of primary general, basic general, and secondary general education Note: International schools accredited by the International Baccalaureate Organization	International Baccalaureate Organization	2023
3.8.3	English proficiency	EF English Proficiency Index	Education First	2023
3.8.4	International business events	Number of international business events	International Congress and Convention Association	2023

Calculation of HSE GCII 2024

To achieve consistency and comparability of HSE GCII 2024 indicators, their absolute values were normalized. Each indicator's absolute value was normalized using formula (1) or (2), depending on the indicator's effect on the overall HSE GCII score.

Indicators, whose scores increase innovation attractiveness of a city, were normalized according to the following formula:

$$x_{i,j}^{\text{norm}} = \frac{x_{i,j} - x_j^{min}}{x_j^{max} - x_j^{min}}\ , \tag{1}$$

where x – is the city's indicator score;

x^{max} – is the highest indicator score for all cities in the sample;

x^{min} – is the lowest indicator score for all cities in the sample;

i – is the number of the city;

j – is the number of the indicator.

The normalized indicator scores range from 0 (for cities with the lowest indicator score) to 1 (for cities with the highest indicator score). Such indicators are "Leading companies by R&D expenditure", "Unicorns", "Leading universities", "Developers of the best video games", "Largest fashion companies", "Most effective advertising agencies", etc.

Indicators, whose scores decrease innovation attractiveness of a city, were normalized according to the following formula:

$$x_{i,j}^{\text{norm}} = \frac{x_j^{max} - x_{i,j}}{x_j^{max} - x_j^{min}}\ , \tag{2}$$

where x – is the city's indicator score;

x^{max} – is the highest indicator score for all cities in the sample;

x^{min} – is the lowest indicator score for all cities in the sample;

i – is the number of the city;

j – is the number of the indicator.

The normalized indicator scores range from 0 (for cities with the highest score) to 1 (for cities with the lowest score). Such indicators are: "Estimated tax", "Salary", "Food prices", "Apartment rental cost", "Hotel accommodation", "Cost of living for an expat", "Cost of living for a local resident", "Travel pass", "Taxi fare", "Cellular telephone subscription", "Tuition at an international school", "Commute time", "Crime rate", "Natural disaster risk", and "Environmental pollution level". The normalized indicators were used to calculate the sections, subindices, and the overall HSE GCII 2024 score for each city.

The section score is the arithmetic mean of all normalized indicators in the section:

$$y_{i,k} = \frac{\sum_1^n x_{i,j}^{\text{norm}}}{n}\ , \tag{3}$$

where x^{norm} – is the section score normalized using formula (1) or (2);

i – is the number of the city;

j – is the number of the indicator;

k – is the number of the section;

n – is the number of indicators in the section.

The subindex score is the arithmetic mean of all normalized indicators in the subindex:

$$Z_{i,l} = \frac{\sum_1^m y_{i,k}^{\text{norm}}}{m}\ , \tag{4}$$

where y^{norm} – is the section score normalized using formula (1);

i – is the number of the city;

j – is the number of the section;

k – is the number of the subindex;

m – is the number of sections in the subindex.

The overall HSE GCII 2024 score is the weighted value of all three subindices:

$$\text{HSE GCII 2024} = 0.4 \times \mathrm{Z}_i^{\text{Technological Development}} + 0.4 \times \mathrm{Z}_i^{\text{Creative Industries}} + 0.2 \times \mathrm{Z}_i^{\text{Urban Environment}}\ , \tag{5}$$

where $\mathrm{Z}^{\text{Technological Development}}$ – is the Technological Development Subindex score calculated using formula (4);

$\mathrm{Z}^{\text{Creative Industries}}$ – is the Creative Industries Subindex score calculated using formula (4);

$\mathrm{Z}^{\text{Urban Environment}}$ – is the Urban Environment Subindex score calculated using formula (4).

When calculating HSE GCII 2024, different weights were used to balance the subindices, as they have a different number of indicators and sections. Bigger weights are used for Technological Development and Creative Industries Subindices because they have a direct impact on the key object of assessment – innovation attractiveness, which, among other things, is confirmed by the statistical audit.

In case of an absence of data, the indicator was not calculated for the city and was not included when establishing the corresponding section value. Imputation of missing scores in the ranking was not performed.

Patent analysis

Another important element in calculating the Technological Development Subindex was the assessment of agglomerations' patent activity using the key indicator – the number of patent application filed by the city residents. PATSTAT Global was used as the data source, an aggregator of patent documents from most global patent agencies, including the largest – the United States Patent and Trademark Office (USPTO), European Patent Office (EPO), and Japan Patent Office (JPO). The search and screening of patent applications for each agglomeration was performed using the data about patentees and their postal addresses.

In order to measure the level of development for various technologies in agglomerations, we used Technological Specialization Index (TSI) to prepare technological profiles that highlighted faster developing areas in the sampled cities (from the patent activity point of view) than in the world on average.

Patents were analyzed for a three-year period: from 2019 to 2021, inclusively. In doing so, we could, on the one hand, evaluate the current situation (2021 was the latest year, for which complete data were published at the time of this study's calculations), and, on the other hand, avoid bias cause by random fluctuations in selected years.

Publication analysis

Another aspect we considered when calculating the Technological Development Subindex was the number of publications done by authors (researchers) from the studied agglomerations. For this task, the data was taken from scientific journals listed in the Scopus database. The calculations were conducted for the following types of documents: articles, reviews, and conference papers. Patents were analyzed for a five-year period: from 2019 to 2023, inclusive.

The publication was added to a specific agglomeration, if its author or one of the co-authors were affiliated with the city within that agglomeration and that city was automatically recognized by the Scopus's city naming system. The list of publications for each agglomeration was compiled by way of a "city" search query that included all cities which were parts of that agglomeration. Hong Kong and Singapore agglomerations were viewed as separate territories according to their representation in Scopus.

Statistical Audit

As part of the statistical audit of the Global Cities Innovation Index, we assessed the quality of the resulting database and the general consistency of the indicator system

After conducting the audit, it can be affirmed that HSE GCII 2024 is a reliable tool for the measurement and comparison of the innovation attractiveness of global cities.

Quality Assessment of the Database and Indicators of HSE GCII 2024

During this statistical audit, the database of the Global Cities Innovation Index underwent a quality assessment. Out of all 90 indicators, 88 (97.7%) contain the latest data as of 2022–2023. For two indicators, the data refer to earlier periods. The latter are "Patent activity" (2019–2021), which is related, among other things, to how much time it takes to update data sources, and "Foreign born population" (2015), where the data for the last available period were used.

There are several HSE GCII indicators with no data for some cities. All indicators with missing scores fall under the Urban Environment Subindex (Table 30).

Table 30. HSE GCII 2024 Indicators with Missing Scores

No.	Indicator	Number of agglomerations/ cities with missing scores in the final sample of the ranking	Share of agglomerations/cities with missing scores in the final sample of the ranking
1	Startups	3	1.5
2	Unicorns	3	1.5
3	Innovation support funds	3	1.5
4	Business angels	3	1.5
5	Venture capital investment	3	1.5
6	Most-streamed artists	3	1.5

(continued)

No.	Indicator	Number of agglomerations/ cities with missing scores in the final sample of the ranking	Share of agglomerations/cities with missing scores in the final sample of the ranking
7	Estimated tax on a 50,000 USD income (included in the "Estimated Tax" composite indicator)	112	56
8	Estimated tax on a 100,000 USD income (included in the "Estimated Tax" composite indicator)	112	56
9	Estimated tax on a 250,000 USD income (included in the "Estimated Tax" composite indicator)	112	56
10	Cup of coffee (included in the "Food Prices" composite indicator)	18	9
11	Restaurant meal (included in the "Food Prices" composite indicator)	17	8.5
12	Apartment rental cost	3	1.5
13	Hotel accommodation	15	7.5
14	Cost of living for an expat	17	8.5
15	Cost of living for a local resident	17	8.5
16	Travel pass	9	4.5
17	Taxi fare	4	2
18	Cellular telephone subscription	1	0.5
19	Tuition at an international school	35	17.5
20	Commute time	10	5
21	Public transport	19	9.5
22	Metro	116	58
23	EV charging stations	1	0.5
24	Mobile Internet speed	46	23
25	Fixed broadband Internet speed	16	8
26	Wireless Internet	9	4.5
27	Remote employment	53	26.5
28	Digital public and municipal services	160	80
29	Safety rate	1	0.5
30	Crime rate	2	1
31	Natural disaster risk	125	62.5
32	International hotels	116	58
33	International tourists	1	0.5
34	Green energy	105	52.5
35	Quality of healthcare services provision	4	2
36	Foreign born population	84	42
37	English proficiency	19	9.5
38	International business events	1	0.5

Source: HSE ISSEK.

As it happens, 52 indicators (57.7% of the total) do not have missing scores. Indicators for 16 cities (8%) do not have a single missing score, and the average number of missing scores per city is seven. Out of 18,000 entries in the database (90 indicators for 200 cities), 1,378 have missing scores (7.6%).

To evaluate this irregular distribution of innovation economy leaders among global cities, we calculated kurtosis and skewness coefficients. All Creative Industries Subindex indicators and 16 out of 18 Technological Development Subindex indicators (save for the number students at leading universities and co-working spaces) have high values for the kurtosis coefficient (over 10). Similarly, there are high values for the skewness coefficient (over 3) recorded for these indicators (save for the number of leading universities and the number of companies participating in electronic games trade shows). Therefore, this means that there is a significant irregular distribution of indicators' values for these subindices among cities, further, a handful of them has the highest concentration of such leaders. A total of 41 out of 46 Urban Environment Subindex indicators have low scores for the aforementioned coefficients, meaning they are more equally distributed among global innovation centers. Exceptions are "Taxi fare", "Wireless Internet", "Natural disaster risk", "International hotels" (by kurtosis coefficient), and the "Culture, entertainment, and sports" indicator (by skewness coefficient) – which proves that the cities indeed differ significantly by these indicators and, as with two indicators from the Tourist appeal section, could point to their high correlation with a number of cultural entertainment and sports facilities (theaters, museums, tourist attractions, etc.).

Despite the fact that the majority of indicators had high values for kurtosis and skewness coefficients, the authors refrained from using data-smoothing methods. In doing so, we wanted to highlight objective irregularities and the extreme concentration of the intellectual elite, apart from simply ranging the cities. Unsmoothed data provided a more precise evaluation of gaps between cities and painted a fairer picture, reflecting both strengths and weaknesses.

This irregularity statement is also confirmed by the fact that 200 agglomerations and cities of the final HSE GCII 2024 sample have 80.7% of all identified innovation economy leaders (Table 31).

Table 31. Distribution of Innovation Economy Leaders by the Top 200 Cities of HSE GCII 2024

No.	Indicators reflecting the presence of innovation economy leaders	Number of innovation economy leaders	Number of innovation economy leaders in the final sample of the ranking	Share of innovation economy leaders in the final sample of the ranking
1	Leading companies by R&D expenditure	2,500	2,057	82.3
2	Unicorns	1,619	1,501	92.7
3	Leading universities	2,477	1,024	41.3
4	Leading R&D organizations	1,545	1,012	65.5
5	Highly cited researchers	6,835	6,430	94.1
6	Nobel Prize laureates and Fields Medal winners	399	340	85.2
7	Clusters and science parks	386	183	47.4
8	Supercomputers	274	182	66.4
9	Top-rated film production companies (audience)	344	325	94.5
10	Film production companies that won international film festival awards	540	457	84.6
11	Animation film production companies that won international festival awards	172	157	91.3
12	Most influential animation film production companies	99	94	94.9
13	Top-rated streaming services	82	68	85.0
14	Developers of the best video games	80	402	89.3
15	Largest e-sports tournaments	450	78	84.8
16	Developers of the most popular computer games	92	957	71.9
17	Companies participating in electronic games trade shows	1,331	103	81.1
18	Most-streamed artists	127	179	83.6
19	Best opera performers	214	71	86.6
20	Largest fashion companies	187	142	75.9
21	Fashion brands	3,070	2,514	81.9

(continued)

No.	Indicators reflecting the presence of innovation economy leaders	Number of innovation economy leaders	Number of innovation economy leaders in the final sample of the ranking	Share of innovation economy leaders in the final sample of the ranking
22	Most effective advertising agencies	329	289	87.8
23	Largest PR agencies	299	284	95.0
24	Creative production agencies	65	62	95.4
25	Top advertising agencies	557	535	96.1
26	Pritzker Architecture Prize laureates	53	47	88.7
27	Internationally recognized architects and architecture firms	335	279	83.3
28	Internationally recognized designers and design firms	1,712	1,394	81.4
29	Internationally recognized artists	173	157	90.8
30	Top artists by auction revenue	264	242	91.7
31	Most influential people in contemporary art	143	120	83.9
32	Leading higher education institutions in the arts	608	440	72.4
33	Best-selling authors	254	194	76.4
34	Most popular authors	310	220	71.0
TOTAL		**27,925**	**22,539**	**80.7**

Source: HSE ISSEK.

Consistency Assessment of the Indicator System of HSE GCIl 2024

At the various stages of preparing this Global Cities Innovation Index, a consistency assessment was applied to the indicator system. For this purpose, the correlations between different elements of the ranking were calculated (indicators, sections, subindices, or the overall HSE GCII score).

It was necessary to calculate the correlation between indicators to exclude duplicating indicators that increase some cities' positions in the ranking. For example, indicator "Leading business schools" was eliminated, which had a high correlation level (over 0.9) with the "Leading universities" indicator. At the same time, we did not exclude indicators with a high level of correlation that reflected related, but not similar, things (for example, "Startups" and "Venture capital investment", "Unicorns" and "Business angels").

The calculation of correlation coefficients between indicators, sections, subindices, or the overall HSE GCII 2024 demonstrated that all indicators have the strongest correlation with elements within their own category. However, there are a few indicators, which have an insignificant negative correlation (under -0.3) with the overall HSE GCIl score. These are the indicators from the Cost of doing business, Cost of living, and Ecology and human health sections.

The same could be said about the sections. They correlate the most with their respective subindices and only three (Cost of doing business, Cost of living, and Ecology and human health) have a negative correlation with the overall HSE GCII 2024 (Table 32).

Table 32. Correlation between Sections and Subindices and the Overall HSE GCII 2024

Section	Subindices			Overall HSE GCII 2024
	Technological Development	Creative Industries	Urban Environment	
Technology companies	0.86	0.54	0.13	0.71
Startups and venture capital	0.80	0.70	0.08	0.76
Universities and R&D organizations	0.85	0.69	0.28	0.81
Productivity of the innovative class	0.71	0.36	0.29	0.59
Innovation infrastructure	0.86	0.70	0.39	0.84
Film and animation	0.55	0.84	0.25	0.73
Electronic games	0.55	0.70	0.29	0.67
Music	0.43	0.80	0.22	0.64
Fashion	0.49	0.84	0.19	0.69
Advertising and PR	0.51	0.76	0.28	0.67
Architecture	0.52	0.81	0.34	0.72
Industrial design	0.70	0.69	0.44	0.77
Arts	0.63	0.89	0.21	0.78
Cost of doing business	-0.09	-0.10	0.33	-0.04
Cost of living	-0.12	-0.21	0.21	-0.12
Mobility	0.31	0.46	0.64	0.50
Digitalization	0.14	0.07	0.32	0.16
Safety	0.06	0.03	0.57	0.15
Tourist appeal	0.66	0.74	0.45	0.77
Ecology and human health	-0.23	-0.16	0.22	-0.15
Internationalization	0.26	0.38	0.11	0.33

Source: HSE ISSEK.

The overall HSE GCII 2024 has the highest correlation with the Technological Development and Creative Industries subindices. The lowest correlation between other subindices and the overall HSE GCII is observed in the Urban Environment Subindex (Table 33), which proves the validity of using different weights when calculating the overall index.

Table 33. Correlation between Subindices and the Overall HSE GCII 2024

Subindices	Subindices			Overall HSE GCII 2024
	Technological Development	Creative Industries	Urban Environment	
Technological Development		0.73	0.30	0.91
Creative Industries	0.73		0.38	0.92
Urban Environment	0.30	0.38		0.52

Source: HSE ISSEK.

Therefore, it is reasonable to conclude that the indicator system of HSE GCII 2024 is structurally consistent and unambiguous.

CITY PROFILES

London

1.000

Rank 1

Technological Development

0.574

Rank 5

Technology companies	10
Leading companies by R&D expenditure	8
R&D expenditure of largest innovation companies	17
Startups and venture capital	3
Startups	1
Unicorns	5
Innovation support funds	3
Business angels	3
Venture capital investment	5
Universities and R&D organizations	3
Leading universities	5
Leading R&D organizations	32–37
Highly cited researchers	6
Nobel Prize laureates and Fields Medal winners	11–12
Students	18
International students	1
Productivity of the innovative class	20
Patent activity	47
Publication activity	10
Innovation infrastructure	5
Clusters and science parks	12–24
Co-working spaces	1
Supercomputers	21–39

Creative Industries

1.000

Rank 1

Film and animation	3
Top-rated film production companies (audience)	4
Film production companies that won international film festival awards	3–4
Animation film production companies that won international festival awards	2
Most influential animation film production companies	3–4
Top-rated streaming services	4
Electronic games	3
Developers of the best video games	6–13
Largest e-sports tournaments	7–9
Developers of the most popular computer games	8–15
Companies participating in electronic games trade shows	1
Music	1
Most-streamed artists	3
Best opera performers	1
Fashion	2
Largest fashion companies	2
Fashion brands	1
Advertising and PR	2
Most effective advertising agencies	28–32
Largest PR agencies	2
Creative production agencies	5–6
Top advertising agencies	1
Architecture	1
Pritzker Architecture Prize laureates	2
Internationally recognized architects and architecture firms	1
Industrial design	11
Internationally recognized designers and design firms	11
Arts	2
Internationally recognized artists	3
Top artists by auction revenue	3
Most influential people in contemporary art	2
Leading higher education institutions in the arts	1
Best-selling authors	2
Most popular authors	2

Urban Environment

0.967

Rank 3

Cost of doing business	108
Estimated tax	31–37
Salary	161
Cost of living	186
Food prices	158
Apartment rental cost	191
Hotel accommodation	145
Cost of living for an expat	181
Cost of living for a local resident	181
Travel pass	191
Taxi fare	159
Cellular telephone subscription	75
Internet access	103
Tuition at an international school	142
Mobility	1
Air traffic	1
Commute time	159
Public transport	8
Metro	4
EV charging stations	15
Digitalization	87
Mobile Internet speed	107
Fixed broadband Internet speed	131
Wireless Internet	21
Remote employment	40
Digital public and municipal services	25–26
Safety	137
Safety rate	162
Crime rate	168
Natural disaster risk	28
Tourist appeal	2
International hotels	6
International tourists	3
Culture, entertainment, and sports	3
Ecology and human health	143
Environmental pollution level	134
Green energy	55
Quality of healthcare services provision	107
Internationalization	3
Foreign born population	8
International schools	28–29
English proficiency	1–62
International business events	10

Benchmarking against the leading city

0.XXX — Index value

— Rank change

London

Number of patent applications, 2019–2021 **13,193**

Number of patent applications of the city leading in this technological area

Rank **47**

New York, NY

0.938

− 2

Technological Development

0.621

Rank − 3

Technology companies	5
Leading companies by R&D expenditure	6
R&D expenditure of largest innovation companies	4
Startups and venture capital	2
Startups	3
Unicorns	2
Innovation support funds	1
Business angels	2
Venture capital investment	2
Universities and R&D organizations	5
Leading universities	8
Leading R&D organizations	49–58
Highly cited researchers	5
Nobel Prize laureates and Fields Medal winners	4
Students	13
International students	4
Productivity of the innovative class	19
Patent activity	24
Publication activity	11
Innovation infrastructure	8
Clusters and science parks	91–200
Co-working spaces	3
Supercomputers	13–20

Creative Industries

0.951

Rank − 2

Film and animation	4
Top-rated film production companies (audience)	2
Film production companies that won international film festival awards	12–20
Animation film production companies that won international festival awards	6–8
Most influential animation film production companies	5
Top-rated streaming services	1
Electronic games	25
Developers of the best video games	26–200
Largest e-sports tournaments	14
Developers of the most popular computer games	16–36
Companies participating in electronic games trade shows	37–46
Music	3
Most-streamed artists	2
Best opera performers	2
Fashion	1
Largest fashion companies	1
Fashion brands	2
Advertising and PR	1
Most effective advertising agencies	6–7
Largest PR agencies	1
Creative production agencies	1
Top advertising agencies	2
Architecture	4
Pritzker Architecture Prize laureates	4
Internationally recognized architects and architecture firms	4–6
Industrial design	9
Internationally recognized designers and design firms	9
Arts	1
Internationally recognized artists	1
Top artists by auction revenue	1
Most influential people in contemporary art	1
Leading higher education institutions in the arts	5
Best-selling authors	1
Most popular authors	1

Urban Environment

0.527

Rank ▼ 65

Cost of doing business	187
Estimated tax	60–61
Salary	191
Cost of living	200
Food prices	196
Apartment rental cost	197
Hotel accommodation	132
Cost of living for an expat	183
Cost of living for a local resident	182
Travel pass	185
Taxi fare	148–150
Cellular telephone subscription	189
Internet access	181
Tuition at an international school	N/A
Mobility	4
Air traffic	6
Commute time	153
Public transport	14
Metro	3
EV charging stations	31
Digitalization	43
Mobile Internet speed	N/A
Fixed broadband Internet speed	32
Wireless Internet	20
Remote employment	39
Digital public and municipal services	N/A
Safety	115
Safety rate	145
Crime rate	147
Natural disaster risk	32–37
Tourist appeal	4
International hotels	9
International tourists	7
Culture, entertainment, and sports	7
Ecology and human health	174
Environmental pollution level	136
Green energy	72
Quality of healthcare services provision	171
Internationalization	11
Foreign born population	19
International schools	13
English proficiency	1–62
International business events	70–72

Benchmarking against the leading city

0.XXX — Index value

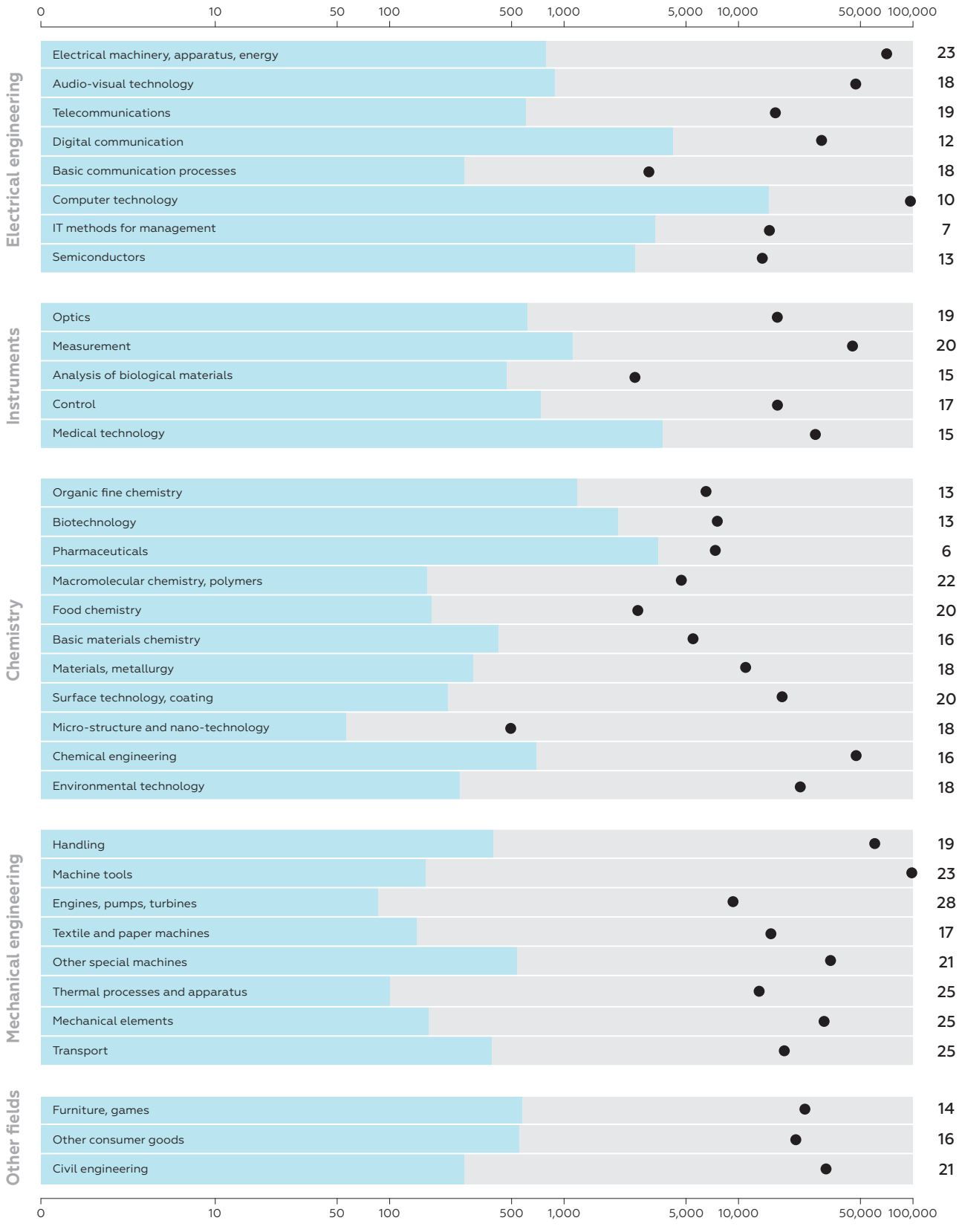
▼▲ — Rank change

New York, NY

Number of patent applications, 2019–2021 **49,069**

Number of patent applications of the city leading in this technological area

Rank **24**



Tokyo

0.802

Rank ▲ 3

Technological Development

0.576

Rank ▲ 4

Technology companies	2
Leading companies by R&D expenditure	2
R&D expenditure of largest innovation companies	2
Startups and venture capital	14
Startups	11
Unicorns	25–29
Innovation support funds	15
Business angels	11–12
Venture capital investment	26
Universities and R&D organizations	8
Leading universities	1
Leading R&D organizations	38–43
Highly cited researchers	29–32
Nobel Prize laureates and Fields Medal winners	14–23
Students	5
International students	15
Productivity of the innovative class	9
★ Patent activity	9
Publication activity	12
Innovation infrastructure	4
Clusters and science parks	91–200
Co-working spaces	2
Supercomputers	4

Creative Industries

0.660

Rank ▲ 3

Film and animation	5
Top-rated film production companies (audience)	5
Film production companies that won international film festival awards	5–6
Animation film production companies that won international festival awards	6–8
Most influential animation film production companies	2
Top-rated streaming services	5–8
Electronic games	1
Developers of the best video games	1
Largest e-sports tournaments	10–13
Developers of the most popular computer games	1–2
Companies participating in electronic games trade shows	9
Music	35–52
Most-streamed artists	25–200
Best opera performers	28–48
Fashion	7
Largest fashion companies	13–28
Fashion brands	6
Advertising and PR	32
Most effective advertising agencies	41–57
Largest PR agencies	11–14
Creative production agencies	30–200
Top advertising agencies	8–10
Architecture	2
Pritzker Architecture Prize laureates	1
Internationally recognized architects and architecture firms	12–13
Industrial design	2
Internationally recognized designers and design firms	2
Arts	5
Internationally recognized artists	4
Top artists by auction revenue	5
Most influential people in contemporary art	9–16
Leading higher education institutions in the arts	6–8
Best-selling authors	3
Most popular authors	31–69

Urban Environment

0.900

Rank ▼ 9

Cost of doing business	155
Estimated tax	184–187
Salary	100
Cost of living	79
Food prices	91
Apartment rental cost	81
Hotel accommodation	71
Cost of living for an expat	84
Cost of living for a local resident	84
Travel pass	78
Taxi fare	180–181
Cellular telephone subscription	119
Internet access	82
Tuition at an international school	102
Mobility	3
Air traffic	29
Commute time	141
Public transport	4
Metro	1
EV charging stations	2
Digitalization	39
Mobile Internet speed	N/A
Fixed broadband Internet speed	84
Wireless Internet	53
Remote employment	75
Digital public and municipal services	10
Safety	77
Safety rate	34
Crime rate	38
Natural disaster risk	74
Tourist appeal	3
International hotels	66–67
International tourists	11
Culture, entertainment, and sports	1
Ecology and human health	120
Environmental pollution level	93
Green energy	82–83
Quality of healthcare services provision	35
Internationalization	98
Foreign born population	103
International schools	14–18
English proficiency	161–162
International business events	26–28

Benchmarking against the leading city

0.XXX — Index value

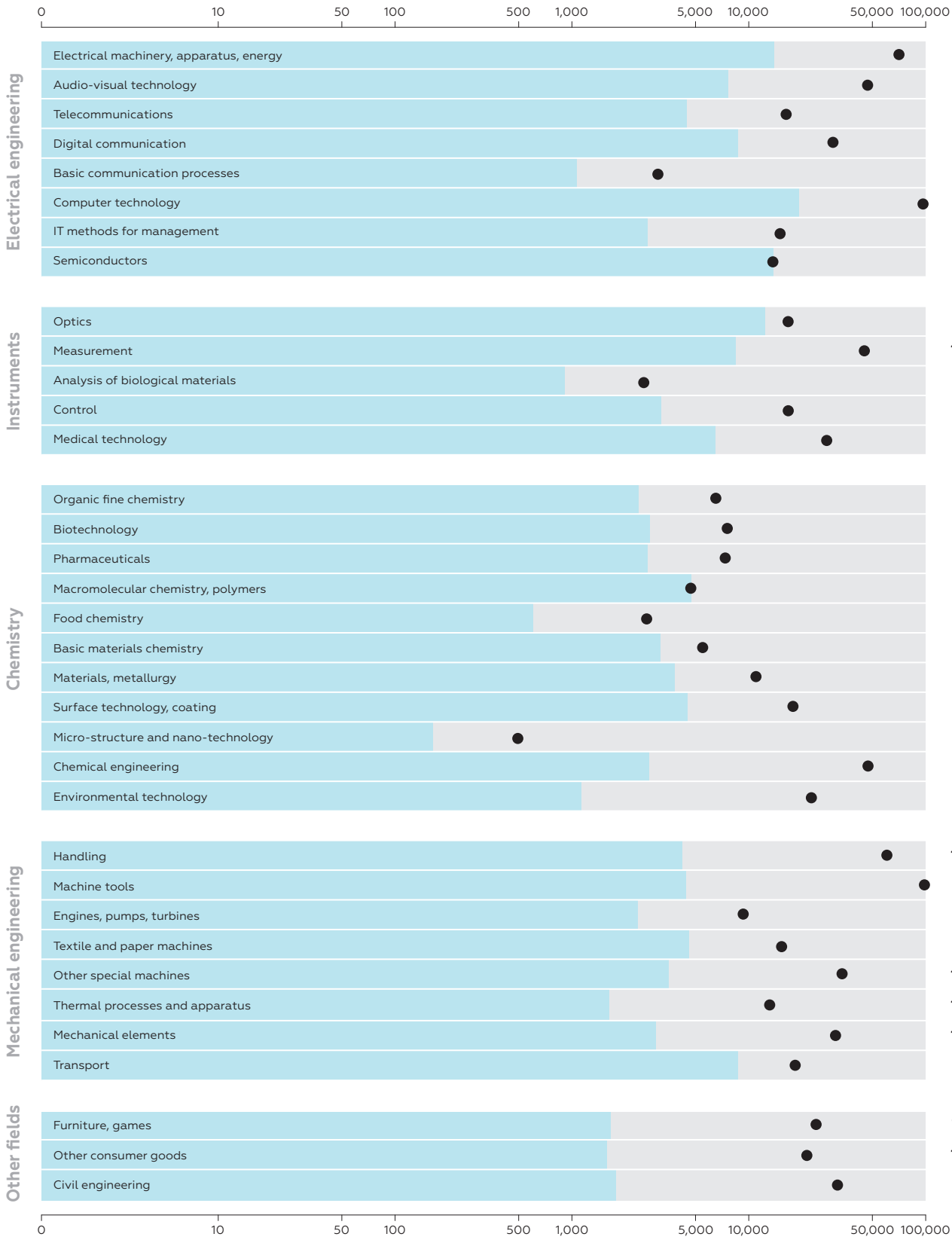
▼ ▲ — Rank change

Tokyo

Number of patent applications, 2019–2021 **171,845**

Number of patent applications of the city leading in this technological area

Rank **9**



Beijing

0.780

4

Technological Development

0.928

Rank 2

Technology companies	3
Leading companies by R&D expenditure	3
R&D expenditure of largest innovation companies	3
Startups and venture capital	6
Startups	37
Unicorns	3
Innovation support funds	5
Business angels	37
Venture capital investment	4
Universities and R&D organizations	1
Leading universities	3–4
Leading R&D organizations	2
Highly cited researchers	2
Nobel Prize laureates and Fields Medal winners	27–40
Students	4
International students	16
Productivity of the innovative class	1
Patent activity	4
Publication activity	1
Innovation infrastructure	1
Clusters and science parks	1
Co-working spaces	30
Supercomputers	1

Creative Industries

0.293

Rank 9

Film and animation	18
Top-rated film production companies (audience)	24–50
Film production companies that won international film festival awards	12–20
Animation film production companies that won international festival awards	50–200
Most influential animation film production companies	22–200
Top-rated streaming services	9–21
Electronic games	76–77
Developers of the best video games	26–200
Largest e-sports tournaments	23–31
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	87–110
Music	62–200
Most-streamed artists	25–200
Best opera performers	49–200
Fashion	46–47
Largest fashion companies	29–59
Fashion brands	69–78
Advertising and PR	22
Most effective advertising agencies	17–20
Largest PR agencies	15–17
Creative production agencies	30–200
Top advertising agencies	27–33
Architecture	14–16
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	9–11
Industrial design	7
Internationally recognized designers and design firms	7
Arts	6
Internationally recognized artists	41–200
Top artists by auction revenue	2
Most influential people in contemporary art	9–16
Leading higher education institutions in the arts	6–8
Best-selling authors	10–13
Most popular authors	70–200

Urban Environment

0.764

Rank 18

Cost of doing business	82
Estimated tax	106–148
Salary	61
Cost of living	58
Food prices	53
Apartment rental cost	80
Hotel accommodation	49
Cost of living for an expat	68
Cost of living for a local resident	70
Travel pass	49
Taxi fare	22–26
Cellular telephone subscription	20
Internet access	29
Tuition at an international school	149
Mobility	66
Air traffic	10
Commute time	152
Public transport	49
Metro	24
EV charging stations	144
Digitalization	22
Mobile Internet speed	6
Fixed broadband Internet speed	5
Wireless Internet	65
Remote employment	77
Digital public and municipal services	N/A
Safety	52
Safety rate	51–52
Crime rate	42
Natural disaster risk	54–65
Tourist appeal	10
International hotels	3
International tourists	36
Culture, entertainment, and sports	28
Ecology and human health	156
Environmental pollution level	177
Green energy	N/A
Quality of healthcare services provision	112
Internationalization	91
Foreign born population	N/A
International schools	14–18
English proficiency	155
International business events	83–87

Benchmarking against the leading city

0.XXX — Index value

— Rank change

Beijing

Number of patent applications, 2019–2021 **455,000**

Number of patent applications of the city leading in this technological area

Rank **4**

San Francisco, CA

0.751

⊖ 5

Technological Development

1.000 — Rank 1

Technology companies	1
Leading companies by R&D expenditure	1
R&D expenditure of largest innovation companies	1
Startups and venture capital	1
Startups	2
Unicorns	1
Innovation support funds	2
Business angels	1
Venture capital investment	1
Universities and R&D organizations	9
Leading universities	57–77
Leading R&D organizations	49–58
Highly cited researchers	3
Nobel Prize laureates and Fields Medal winners	2
Students	80
International students	51
Productivity of the innovative class	13
Patent activity	15
Publication activity	15
Innovation infrastructure	3
Clusters and science parks	44–90
Co-working spaces	6
Supercomputers	2

Creative Industries

0.315 — Rank 8

Film and animation	7
Top-rated film production companies (audience)	11–12
Film production companies that won international film festival awards	46–57
Animation film production companies that won international festival awards	16–25
Most influential animation film production companies	3–4
Top-rated streaming services	5–8
Electronic games	4
Developers of the best video games	3
Largest e-sports tournaments	16–20
Developers of the most popular computer games	7
Companies participating in electronic games trade shows	11–12
Music	62–200
Most-streamed artists	25–200
Best opera performers	49–200
Fashion	12
Largest fashion companies	9–12
Fashion brands	46–49
Advertising and PR	23
Most effective advertising agencies	58–200
Largest PR agencies	4
Creative production agencies	11–29
Top advertising agencies	8–10
Architecture	46–60
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	30–47
Industrial design	8
Internationally recognized designers and design firms	8
Arts	10
Internationally recognized artists	16–40
Top artists by auction revenue	23–47
Most influential people in contemporary art	9–16
Leading higher education institutions in the arts	36–54
Best-selling authors	6–8
Most popular authors	4

Urban Environment

0.177 — Rank 177

Cost of doing business	199
Estimated tax	78–80
Salary	200
Cost of living	197
Food prices	192
Apartment rental cost	196
Hotel accommodation	142
Cost of living for an expat	182
Cost of living for a local resident	183
Travel pass	170
Taxi fare	148–150
Cellular telephone subscription	164
Internet access	173
Tuition at an international school	158
Mobility	136
Air traffic	47–48
Commute time	182
Public transport	112
Metro	59
EV charging stations	63–65
Digitalization	115
Mobile Internet speed	N/A
Fixed broadband Internet speed	60
Wireless Internet	34
Remote employment	132
Digital public and municipal services	N/A
Safety	151
Safety rate	180
Crime rate	177
Natural disaster risk	32–37
Tourist appeal	33
International hotels	31
International tourists	39
Culture, entertainment, and sports	19
Ecology and human health	84
Environmental pollution level	123
Green energy	7
Quality of healthcare services provision	167
Internationalization	16
Foreign born population	15
International schools	23
English proficiency	1–62
International business events	83–87

Benchmarking against the leading city

0.XXX — Index value

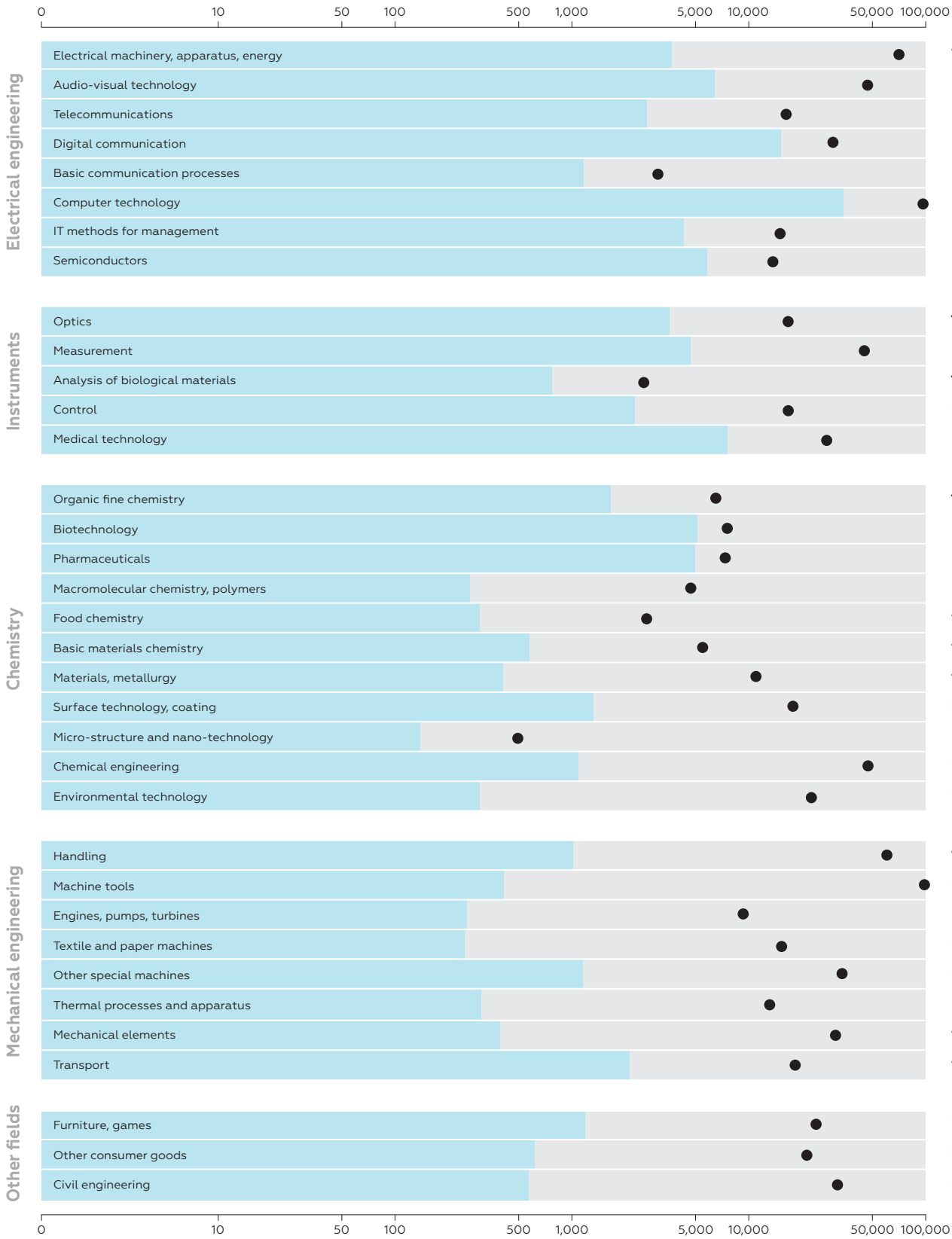
⊖ ⊕ — Rank change

San Francisco, CA

Number of patent applications, 2019–2021 **122,059**

Number of patent applications of the city leading in this technological area

Rank **15**



Paris

0.667

Rank 6

Technological Development

0.441 — Rank 8

Technology companies	8
Leading companies by R&D expenditure	11
R&D expenditure of largest innovation companies	9
Startups and venture capital	8
Startups	7
Unicorns	11
Innovation support funds	10
Business angels	6
Venture capital investment	9
Universities and R&D organizations	2
Leading universities	11–13
Leading R&D organizations	1
Highly cited researchers	12
Nobel Prize laureates and Fields Medal winners	6
Students	16
International students	5
Productivity of the innovative class	22
Patent activity	35
Publication activity	17
Innovation infrastructure	6
Clusters and science parks	25–43
Co-working spaces	8–9
Supercomputers	3

Creative Industries

0.560 — Rank 5

Film and animation	2
Top-rated film production companies (audience)	3
Film production companies that won international film festival awards	1
Animation film production companies that won international festival awards	1
Most influential animation film production companies	22–200
Top-rated streaming services	9–21
Electronic games	19
Developers of the best video games	26–200
Largest e-sports tournaments	21–22
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	10
Music	4
Most-streamed artists	7
Best opera performers	3
Fashion	3
Largest fashion companies	3
Fashion brands	3
Advertising and PR	5
Most effective advertising agencies	17–20
Largest PR agencies	6
Creative production agencies	2–3
Top advertising agencies	3
Architecture	3
Pritzker Architecture Prize laureates	3
Internationally recognized architects and architecture firms	15–17
Industrial design	30–33
Internationally recognized designers and design firms	30–33
Arts	3
Internationally recognized artists	2
Top artists by auction revenue	6–8
Most influential people in contemporary art	7
Leading higher education institutions in the arts	2–3
Best-selling authors	4
Most popular authors	7

Urban Environment

0.891 — Rank 10

Cost of doing business	175
Estimated tax	191–193
Salary	118
Cost of living	138
Food prices	163
Apartment rental cost	140
Hotel accommodation	167
Cost of living for an expat	137
Cost of living for a local resident	120
Travel pass	156
Taxi fare	132–134
Cellular telephone subscription	80
Internet access	84
Tuition at an international school	114
Mobility	5
Air traffic	2
Commute time	139
Public transport	15
Metro	7
EV charging stations	87–88
Digitalization	30
Mobile Internet speed	43
Fixed broadband Internet speed	77
Wireless Internet	25
Remote employment	72
Digital public and municipal services	4–6
Safety	135
Safety rate	173
Crime rate	165
Natural disaster risk	12
Tourist appeal	1
International hotels	1
International tourists	6
Culture, entertainment, and sports	6
Ecology and human health	134
Environmental pollution level	150
Green energy	53
Quality of healthcare services provision	50
Internationalization	27
Foreign born population	42
International schools	57–60
English proficiency	119
International business events	3

Benchmarking against the leading city

0.XXX — Index value

— Rank change

Paris

Number of patent applications, 2019–2021 **26,736**

Number of patent applications of the city leading in this technological area

Rank **35**

Shanghai

0.584

Rank 7

Technological Development

0.501

Rank 6

Technology companies	7
Leading companies by R&D expenditure	5
R&D expenditure of largest innovation companies	11
Startups and venture capital	10
Startups	52
Unicorns	4
Innovation support funds	9
Business angels	46
Venture capital investment	7
Universities and R&D organizations	13
Leading universities	11–13
Leading R&D organizations	12–15
Highly cited researchers	7
Nobel Prize laureates and Fields Medal winners	41–79
Students	14
International students	23
Productivity of the innovative class	2
Patent activity	3
Publication activity	2
Innovation infrastructure	10
Clusters and science parks	5–11
Co-working spaces	11
Supercomputers	13–20

Creative Industries

0.337

Rank 7

Film and animation	108–115
Top-rated film production companies (audience)	24–50
Film production companies that won international film festival awards	87–200
Animation film production companies that won international festival awards	50–200
Most influential animation film production companies	22–200
Top-rated streaming services	34–200
Electronic games	8
Developers of the best video games	26–200
Largest e-sports tournaments	1
Developers of the most popular computer games	16–36
Companies participating in electronic games trade shows	145–200
Music	62–200
Most-streamed artists	25–200
Best opera performers	49–200
Fashion	26–27
Largest fashion companies	13–28
Fashion brands	46–49
Advertising and PR	17
Most effective advertising agencies	14–15
Largest PR agencies	72–200
Creative production agencies	30–200
Top advertising agencies	20–22
Architecture	14–16
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	9–11
Industrial design	3–4
Internationally recognized designers and design firms	3–4
Arts	21
Internationally recognized artists	41–200
Top artists by auction revenue	6–8
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	11–16
Best-selling authors	56–200
Most popular authors	70–200

Urban Environment

0.943

Rank 5

Cost of doing business	70
Estimated tax	106–148
Salary	53
Cost of living	54
Food prices	59
Apartment rental cost	88
Hotel accommodation	28
Cost of living for an expat	45
Cost of living for a local resident	65
Travel pass	48
Taxi fare	28–31
Cellular telephone subscription	41
Internet access	43
Tuition at an international school	140
Mobility	16
Air traffic	16–17
Commute time	169
Public transport	21
Metro	11
EV charging stations	77
Digitalization	8
Mobile Internet speed	5
Fixed broadband Internet speed	10
Wireless Internet	64
Remote employment	49–50
Digital public and municipal services	8
Safety	60
Safety rate	66
Crime rate	55
Natural disaster risk	54–65
Tourist appeal	6
International hotels	2
International tourists	21
Culture, entertainment, and sports	27
Ecology and human health	159
Environmental pollution level	169
Green energy	N/A
Quality of healthcare services provision	160
Internationalization	64
Foreign born population	N/A
International schools	7
English proficiency	157
International business events	95–96

Benchmarking against the leading city

0.XXX — Index value

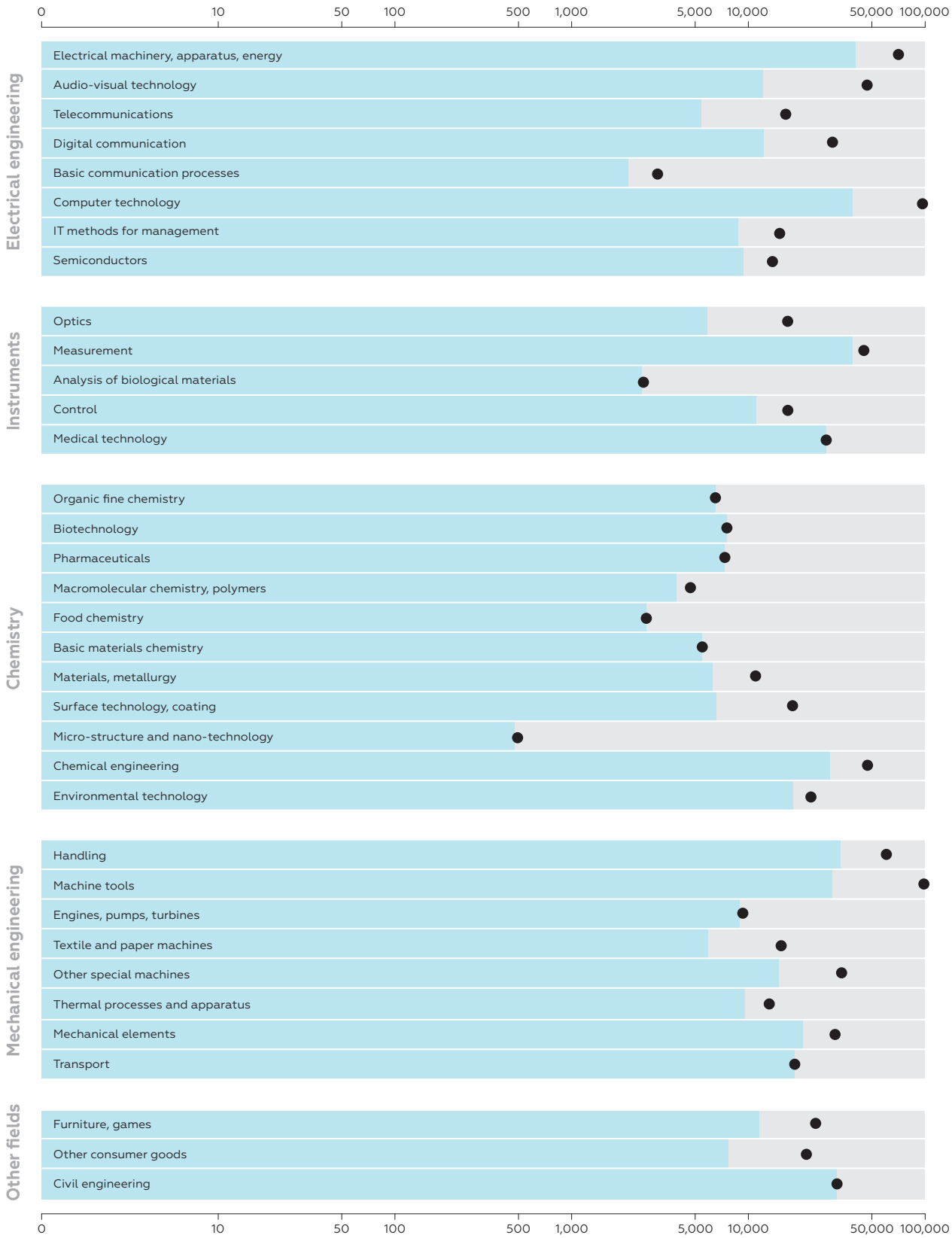
— Rank change

Shanghai

Number of patent applications, 2019–2021 **500,894**

Number of patent applications of the city leading in this technological area

Rank **3**



Los Angeles, CA

0.542

⊖ 8

Technological Development

0.286

Rank ⌄ 14

Technology companies ⊖	18
Leading companies by R&D expenditure	15–17
R&D expenditure of largest innovation companies	28
Startups and venture capital ⌄	4
Startups	4
Unicorns	6
Innovation support funds	4
Business angels	4
Venture capital investment	6
Universities and R&D organizations ⌄	22
Leading universities	34–42
Leading R&D organizations	87–110
Highly cited researchers	11
Nobel Prize laureates and Fields Medal winners	8–9
Students	30
International students	20
Productivity of the innovative class ⌄	23
Patent activity	28
Publication activity	18
Innovation infrastructure ⌄	21
Clusters and science parks	91–200
Co-working spaces	7
Supercomputers	63–200

Creative Industries

0.651

Rank ⌃ 4

Film and animation ⌄	1
Top-rated film production companies (audience)	1
Film production companies that won international film festival awards	2
Animation film production companies that won international festival awards	4–5
Most influential animation film production companies	1
Top-rated streaming services	2–3
Electronic games ⌃	2
Developers of the best video games	2
Largest e-sports tournaments	2
Developers of the most popular computer games	6
Companies participating in electronic games trade shows	6–8
Music ⌄	2
Most-streamed artists	1
Best opera performers	49–200
Fashion ⌄	5
Largest fashion companies	5–6
Fashion brands	5
Advertising and PR ⌄	28
Most effective advertising agencies	58–200
Largest PR agencies	18–23
Creative production agencies	11–29
Top advertising agencies	5
Architecture ⊖	19
Pritzker Architecture Prize laureates	5–8
Internationally recognized architects and architecture firms	82–200
Industrial design ⊖	14–15
Internationally recognized designers and design firms	14–15
Arts ⌃	4
Internationally recognized artists	41–200
Top artists by auction revenue	4
Most influential people in contemporary art	3
Leading higher education institutions in the arts	11–16
Best-selling authors	5
Most popular authors	3

Urban Environment

0.267

Rank ⌃ 151

Cost of doing business ⌃	195
Estimated tax	78–80
Salary	194
Cost of living ⌃	194
Food prices	190
Apartment rental cost	186
Hotel accommodation	149
Cost of living for an expat	162
Cost of living for a local resident	173
Travel pass	144
Taxi fare	106
Cellular telephone subscription	199
Internet access	194
Tuition at an international school	135
Mobility ⌃	170
Air traffic	26–28
Commute time	189
Public transport	175
Metro	84
EV charging stations	49
Digitalization ⌃	89
Mobile Internet speed	N/A
Fixed broadband Internet speed	61
Wireless Internet	18
Remote employment	99
Digital public and municipal services	N/A
Safety ⌃	127
Safety rate	157
Crime rate	162
Natural disaster risk	32–37
Tourist appeal ⌄	16
International hotels	29
International tourists	N/A
Culture, entertainment, and sports	9
Ecology and human health ⌄	152
Environmental pollution level	155
Green energy	33
Quality of healthcare services provision	174
Internationalization ⌄	4
Foreign born population	12–13
International schools	5
English proficiency	1–62
International business events	68–69

Benchmarking against the leading city

0.XXX — Index value

⌄⌃ — Rank change

Los Angeles, CA

Number of patent applications, 2019–2021 **33,859**

Number of patent applications of the city leading in this technological area

Rank **28**

Moscow

0.486

▲ 9

Technological Development

0.461 — Rank 7

Technology companies	110
Leading companies by R&D expenditure	106–122
R&D expenditure of largest innovation companies	84
Startups and venture capital	N/A
Startups	N/A
Unicorns	N/A
Innovation support funds	N/A
Business angels	N/A
Venture capital investment	N/A
Universities and R&D organizations	6
Leading universities	3–4
Leading R&D organizations	3
Highly cited researchers	145–148
Nobel Prize laureates and Fields Medal winners	13
Students	12
International students	6
Productivity of the innovative class	21
Patent activity	45
Publication activity	13
Innovation infrastructure	2
Clusters and science parks	2
Co-working spaces	5
Supercomputers	9–12

Creative Industries

0.206 — Rank 15

Film and animation	15
Top-rated film production companies (audience)	24–50
Film production companies that won international film festival awards	36–45
Animation film production companies that won international festival awards	9–10
Most influential animation film production companies	12–21
Top-rated streaming services	9–21
Electronic games	69
Developers of the best video games	26–200
Largest e-sports tournaments	23–31
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	76–86
Music	5
Most-streamed artists	N/A
Best opera performers	5–6
Fashion	39
Largest fashion companies	29–59
Fashion brands	35
Advertising and PR	15
Most effective advertising agencies	8–10
Largest PR agencies	24–35
Creative production agencies	30–200
Top advertising agencies	63–86
Architecture	38–45
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	21–29
Industrial design	25
Internationally recognized designers and design firms	25
Arts	8
Internationally recognized artists	6–7
Top artists by auction revenue	48–200
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	4
Best-selling authors	10–13
Most popular authors	14–20

Urban Environment

0.928 — Rank 6

Cost of doing business	5
Estimated tax	3–4
Salary	47
Cost of living	28
Food prices	28
Apartment rental cost	68
Hotel accommodation	23
Cost of living for an expat	57
Cost of living for a local resident	55
Travel pass	38
Taxi fare	33
Cellular telephone subscription	9
Internet access	2
Tuition at an international school	55
Mobility	18
Air traffic	14–15
Commute time	174
Public transport	23
Metro	9
EV charging stations	71
Digitalization	49
Mobile Internet speed	143
Fixed broadband Internet speed	146
Wireless Internet	6
Remote employment	37
Digital public and municipal services	4–6
Safety	71
Safety rate	96
Crime rate	88
Natural disaster risk	30–31
Tourist appeal	9
International hotels	43
International tourists	34
Culture, entertainment, and sports	2
Ecology and human health	173
Environmental pollution level	126
Green energy	90
Quality of healthcare services provision	134
Internationalization	141
Foreign born population	79
International schools	34–35
English proficiency	144
International business events	149–200

Benchmarking against the leading city

0.XXX — Index value

▼▲ — Rank change

Moscow

Number of patent applications, 2019–2021 **15,504**

Number of patent applications of the city leading in this technological area

Rank **45**

Seoul

0.486

Rank 10

Technological Development

0.381 — Rank 10

Technology companies	9
Leading companies by R&D expenditure	12–13
R&D expenditure of largest innovation companies	6
Startups and venture capital	18
Startups	19
Unicorns	12
Innovation support funds	14
Business angels	45
Venture capital investment	10
Universities and R&D organizations	11
Leading universities	2
Leading R&D organizations	32–37
Highly cited researchers	39–41
Nobel Prize laureates and Fields Medal winners	80–200
Students	8
International students	7
Productivity of the innovative class	11
Patent activity	13
Publication activity	8
Innovation infrastructure	7
Clusters and science parks	12–24
Co-working spaces	4
Supercomputers	21–39

Creative Industries

0.360 — Rank 6

Film and animation	8
Top-rated film production companies (audience)	8
Film production companies that won international film festival awards	12–20
Animation film production companies that won international festival awards	16–25
Most influential animation film production companies	7–11
Top-rated streaming services	9–21
Electronic games	6
Developers of the best video games	26–200
Largest e-sports tournaments	5–6
Developers of the most popular computer games	3–5
Companies participating in electronic games trade shows	16
Music	23
Most-streamed artists	6
Best opera performers	49–200
Fashion	35–36
Largest fashion companies	60–200
Fashion brands	9
Advertising and PR	18
Most effective advertising agencies	24–27
Largest PR agencies	11–14
Creative production agencies	7–10
Top advertising agencies	23–26
Architecture	61–90
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	48–81
Industrial design	6
Internationally recognized designers and design firms	6
Arts	9
Internationally recognized artists	41–200
Top artists by auction revenue	12–22
Most influential people in contemporary art	9–16
Leading higher education institutions in the arts	2–3
Best-selling authors	56–200
Most popular authors	70–200

Urban Environment

0.644 — Rank 33

Cost of doing business	21
Estimated tax	11–12
Salary	116
Cost of living	107
Food prices	170
Apartment rental cost	71
Hotel accommodation	109
Cost of living for an expat	55
Cost of living for a local resident	72
Travel pass	75
Taxi fare	40–42
Cellular telephone subscription	157
Internet access	55
Tuition at an international school	115
Mobility	23
Air traffic	34–35
Commute time	147
Public transport	7
Metro	5
EV charging stations	141
Digitalization	80
Mobile Internet speed	N/A
Fixed broadband Internet speed	N/A
Wireless Internet	16
Remote employment	105
Digital public and municipal services	18–20
Safety	42
Safety rate	36
Crime rate	47
Natural disaster risk	44
Tourist appeal	42
International hotels	127–129
International tourists	19
Culture, entertainment, and sports	29
Ecology and human health	132
Environmental pollution level	135
Green energy	79
Quality of healthcare services provision	15
Internationalization	134
Foreign born population	108
International schools	178–200
English proficiency	128
International business events	17

Benchmarking against the leading city

0.XXX — Index value

— Rank change

Seoul

Number of patent applications, 2019–2021 **135,959**

Number of patent applications of the city leading in this technological area

Rank **13**

Shenzhen

0.426

▲ 11

Technological Development

0.359

Rank ▲ 11

Technology companies	6
Leading companies by R&D expenditure	7
R&D expenditure of largest innovation companies	5
Startups and venture capital	26
Startups	53–54
Unicorns	9
Innovation support funds	16
Business angels	79–80
Venture capital investment	15
Universities and R&D organizations	107
Leading universities	78–95
Leading R&D organizations	87–110
Highly cited researchers	35–38
Nobel Prize laureates and Fields Medal winners	80–200
Students	110
International students	197
Productivity of the innovative class	4
★ Patent activity	2
Publication activity	21
Innovation infrastructure	17
Clusters and science parks	44–90
Co-working spaces	83–88
Supercomputers	5

Creative Industries

0.265

Rank ▼ 12

Film and animation	40–42
Top-rated film production companies (audience)	51–200
Film production companies that won international film festival awards	87–200
Animation film production companies that won international festival awards	50–200
Most influential animation film production companies	22–200
Top-rated streaming services	22–33
Electronic games	24
Developers of the best video games	26–200
Largest e-sports tournaments	10–13
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	21–23
Music	62–200
Most-streamed artists	25–200
Best opera performers	49–200
Fashion	59–64
Largest fashion companies	29–59
Fashion brands	136–200
Advertising and PR	61
Most effective advertising agencies	41–57
Largest PR agencies	36–71
Creative production agencies	30–200
Top advertising agencies	50–62
Architecture	46–60
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	30–47
Industrial design	1
Internationally recognized designers and design firms	1
Arts	136–176
Internationally recognized artists	41–200
Top artists by auction revenue	48–200
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	94–173
Best-selling authors	56–200
Most popular authors	70–200

Urban Environment

0.683

Rank ▲ 26

Cost of doing business	74
Estimated tax	106–148
Salary	57
Cost of living	49
Food prices	58
Apartment rental cost	55
Hotel accommodation	30–31
Cost of living for an expat	46
Cost of living for a local resident	52
Travel pass	33
Taxi fare	22–26
Cellular telephone subscription	28
Internet access	31
Tuition at an international school	146
Mobility	19
Air traffic	41
Commute time	98
Public transport	29
Metro	19
EV charging stations	37
Digitalization	106
Mobile Internet speed	34
Fixed broadband Internet speed	108
Wireless Internet	83
Remote employment	46
Digital public and municipal services	N/A
Safety	56
Safety rate	51–52
Crime rate	44
Natural disaster risk	N/A
Tourist appeal	14
International hotels	20
International tourists	8
Culture, entertainment, and sports	79
Ecology and human health	141
Environmental pollution level	132
Green energy	N/A
Quality of healthcare services provision	175
Internationalization	153
Foreign born population	N/A
International schools	49
English proficiency	166
International business events	113–121

Benchmarking against the leading city

0.XXX — Index value

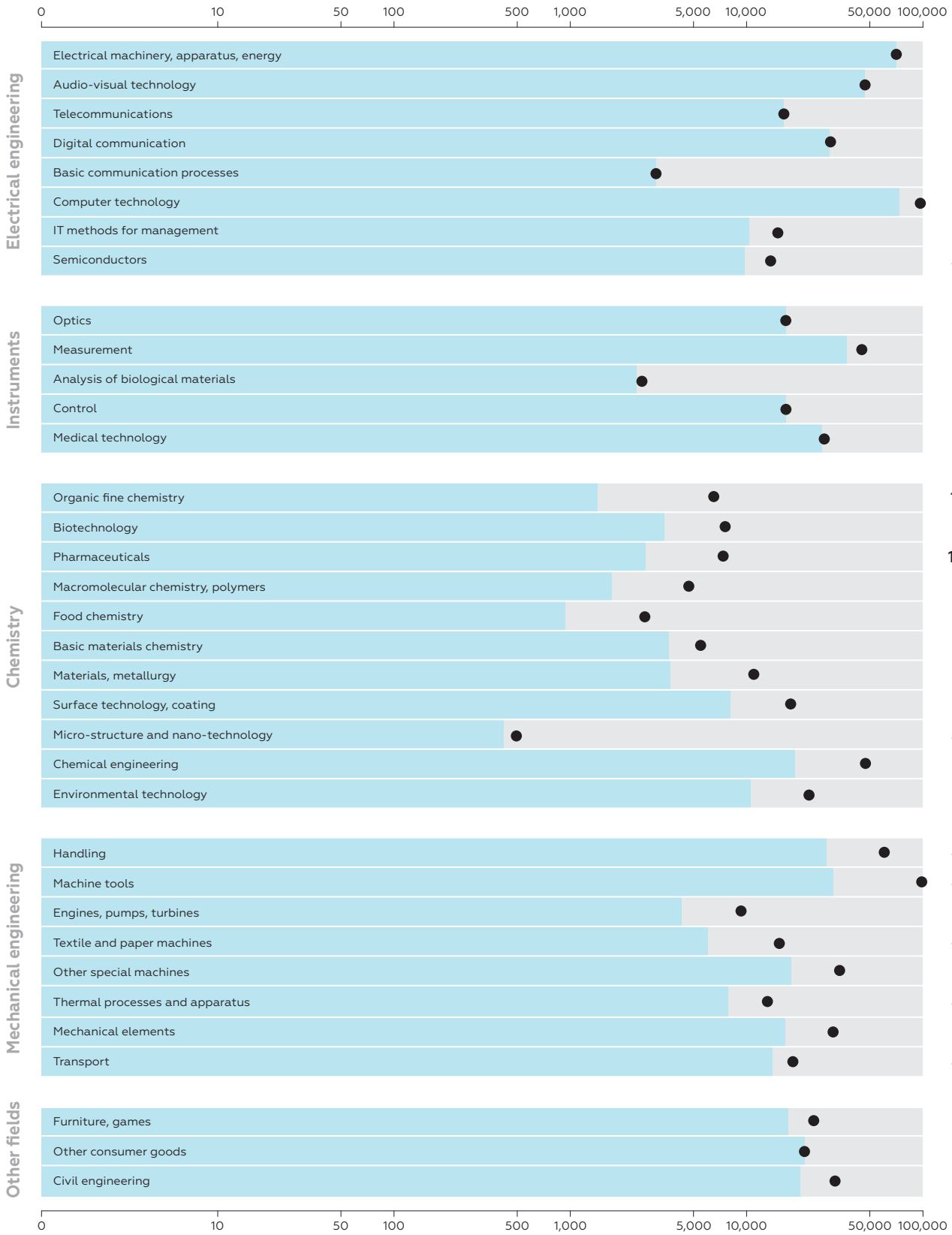
▼▲ — Rank change

Shenzhen

Number of patent applications, 2019–2021 **607,291**

Number of patent applications of the city leading in this technological area

Rank **2**



Hong Kong

0.352

▼ 12

Technological Development

0.166

Rank ▲ 25

Technology companies	19
Leading companies by R&D expenditure	19
R&D expenditure of largest innovation companies	27
Startups and venture capital	29
Startups	43
Unicorns	31–34
Innovation support funds	13
Business angels	21
Venture capital investment	36
Universities and R&D organizations	34
Leading universities	34–42
Leading R&D organizations	111–141
Highly cited researchers	8
Nobel Prize laureates and Fields Medal winners	80–200
Students	76
International students	18
Productivity of the innovative class	36
Patent activity	51
Publication activity	23
Innovation infrastructure	37
Clusters and science parks	25–43
Co-working spaces	27
Supercomputers	63–200

Creative Industries

0.292

Rank – 10

Film and animation	26
Top-rated film production companies (audience)	24–50
Film production companies that won international film festival awards	25–30
Animation film production companies that won international festival awards	26–49
Most influential animation film production companies	12–21
Top-rated streaming services	22–33
Electronic games	52–53
Developers of the best video games	26–200
Largest e-sports tournaments	70–200
Developers of the most popular computer games	16–36
Companies participating in electronic games trade shows	60–75
Music	62–200
Most-streamed artists	25–200
Best opera performers	49–200
Fashion	15
Largest fashion companies	13–28
Fashion brands	15–16
Advertising and PR	58
Most effective advertising agencies	41–57
Largest PR agencies	24–35
Creative production agencies	30–200
Top advertising agencies	50–62
Architecture	8
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	4–6
Industrial design	5
Internationally recognized designers and design firms	5
Arts	12
Internationally recognized artists	41–200
Top artists by auction revenue	9–11
Most influential people in contemporary art	5–6
Leading higher education institutions in the arts	6–8
Best-selling authors	56–200
Most popular authors	70–200

Urban Environment

0.840

Rank 13

Cost of doing business	42
Estimated tax	8
Salary	162
Cost of living	120
Food prices	160
Apartment rental cost	181
Hotel accommodation	42
Cost of living for an expat	114
Cost of living for a local resident	169
Travel pass	112
Taxi fare	71
Cellular telephone subscription	72
Internet access	50
Tuition at an international school	85
Mobility	11
Air traffic	36–37
Commute time	144
Public transport	1
Metro	14
EV charging stations	92
Digitalization	109
Mobile Internet speed	130
Fixed broadband Internet speed	24
Wireless Internet	60
Remote employment	104
Digital public and municipal services	N/A
Safety	33
Safety rate	26
Crime rate	27
Natural disaster risk	N/A
Tourist appeal	8
International hotels	146–151
International tourists	1
Culture, entertainment, and sports	59
Ecology and human health	182
Environmental pollution level	154
Green energy	88
Quality of healthcare services provision	146
Internationalization	23
Foreign born population	N/A
International schools	2
English proficiency	129–130
International business events	97–99

Benchmarking against the leading city

0.XXX — Index value

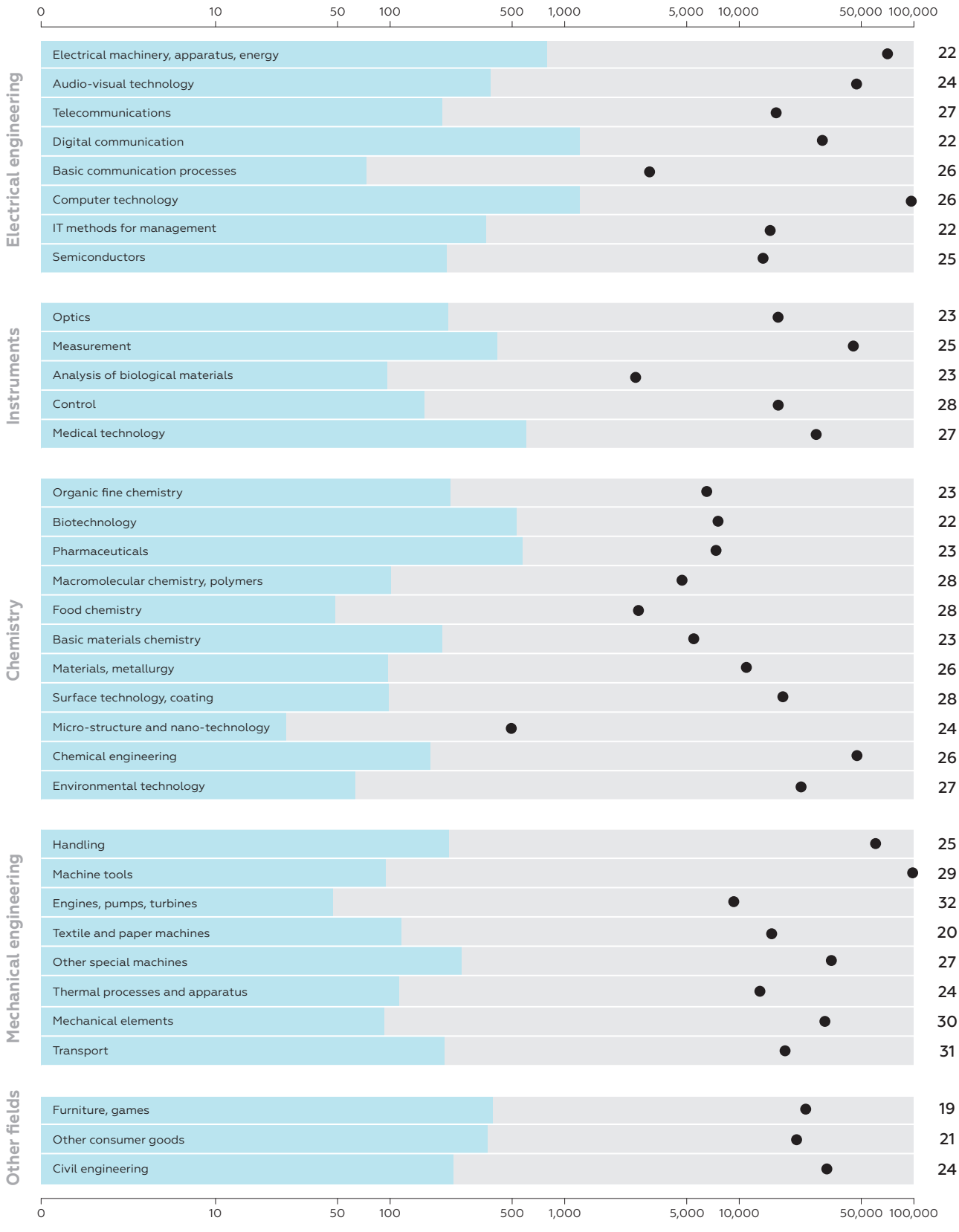
▼▲ — Rank change

Hong Kong

Number of patent applications, 2019–2021 **12,213**

Number of patent applications of the city leading in this technological area

Rank **51**



Guangzhou

0.322

▲ 13

Technological Development

0.317

Rank ▼ 12

Technology companies	20 ▼
Leading companies by R&D expenditure	18
R&D expenditure of largest innovation companies	34
Startups and venture capital	48 ▲
Startups	109
Unicorns	21–22
Innovation support funds	52
Business angels	148–151
Venture capital investment	27
Universities and R&D organizations	18 ▼
Leading universities	19–22
Leading R&D organizations	28–31
Highly cited researchers	24
Nobel Prize laureates and Fields Medal winners	80–200
Students	11
International students	19
Productivity of the innovative class	5 –
Patent activity	5
Publication activity	4
Innovation infrastructure	33 ▼
Clusters and science parks	12–24
Co-working spaces	99–101
Supercomputers	21–39

Creative Industries

0.143

Rank ▲ 26

Film and animation	116–200 ▼
Top-rated film production companies (audience)	51–200
Film production companies that won international film festival awards	87–200
Animation film production companies that won international festival awards	50–200
Most influential animation film production companies	22–200
Top-rated streaming services	34–200
Electronic games	46 ▲
Developers of the best video games	26–200
Largest e-sports tournaments	23–31
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	32–36
Music	62–200 –
Most-streamed artists	25–200
Best opera performers	49–200
Fashion	59–64 ▼
Largest fashion companies	29–59
Fashion brands	136–200
Advertising and PR	59 ▲
Most effective advertising agencies	33–40
Largest PR agencies	72–200
Creative production agencies	30–200
Top advertising agencies	87–200
Architecture	61–90 ▲
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	48–81
Industrial design	10 ▲
Internationally recognized designers and design firms	10
Arts	59 ▼
Internationally recognized artists	41–200
Top artists by auction revenue	12–22
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	36–54
Best-selling authors	56–200
Most popular authors	70–200

Urban Environment

0.596

Rank ▼ 46

Cost of doing business	64 ▼
Estimated tax	106–148
Salary	45
Cost of living	40 ▲
Food prices	39
Apartment rental cost	22
Hotel accommodation	45
Cost of living for an expat	25
Cost of living for a local resident	34
Travel pass	14
Taxi fare	22–26
Cellular telephone subscription	38
Internet access	25
Tuition at an international school	131
Mobility	121 ▲
Air traffic	26–28
Commute time	115
Public transport	52
Metro	63–65
EV charging stations	153–154
Digitalization	66 ▼
Mobile Internet speed	32
Fixed broadband Internet speed	92
Wireless Internet	52
Remote employment	N/A
Digital public and municipal services	N/A
Safety	65 ▼
Safety rate	70
Crime rate	63
Natural disaster risk	54–65
Tourist appeal	18 ▲
International hotels	27–28
International tourists	14
Culture, entertainment, and sports	30
Ecology and human health	147 ▼
Environmental pollution level	165
Green energy	N/A
Quality of healthcare services provision	135
Internationalization	150 ▼
Foreign born population	N/A
International schools	32–33
English proficiency	172
International business events	149–200

Benchmarking against the leading city

0.XXX — Index value

▼▲ — Rank change

Guangzhou

Number of patent applications, 2019–2021 **452,580**

Number of patent applications of the city leading in this technological area

Rank **5**

Singapore

0.311

▼ 14

Technological Development

0.188

Rank ▼ 20

Technology companies	43
Leading companies by R&D expenditure	39–42
R&D expenditure of largest innovation companies	56
Startups and venture capital	9
Startups	6
Unicorns	13
Innovation support funds	6
Business angels	25
Venture capital investment	8
Universities and R&D organizations	37
Leading universities	57–77
Leading R&D organizations	17–22
Highly cited researchers	9
Nobel Prize laureates and Fields Medal winners	80–200
Students	100
International students	40
Productivity of the innovative class	34
Patent activity	33
Publication activity	33
Innovation infrastructure	19
Clusters and science parks	44–90
Co-working spaces	22
Supercomputers	13–20

Creative Industries

0.156

Rank ▼ 23

Film and animation	63–66
Top-rated film production companies (audience)	51–200
Film production companies that won international film festival awards	31–35
Animation film production companies that won international festival awards	50–200
Most influential animation film production companies	22–200
Top-rated streaming services	34–200
Electronic games	30
Developers of the best video games	26–200
Largest e-sports tournaments	16–20
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	19–20
Music	62–200
Most-streamed artists	25–200
Best opera performers	49–200
Fashion	78–83
Largest fashion companies	60–200
Fashion brands	50–59
Advertising and PR	37
Most effective advertising agencies	41–57
Largest PR agencies	36–71
Creative production agencies	11–29
Top advertising agencies	15–17
Architecture	14–16
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	9–11
Industrial design	12
Internationally recognized designers and design firms	12
Arts	46
Internationally recognized artists	41–200
Top artists by auction revenue	48–200
Most influential people in contemporary art	17–34
Leading higher education institutions in the arts	26–35
Best-selling authors	56–200
Most popular authors	70–200

Urban Environment

1.000

Rank ▼ 1

Cost of doing business	59
Estimated tax	7
Salary	173
Cost of living	153
Food prices	151
Apartment rental cost	192
Hotel accommodation	79
Cost of living for an expat	172
Cost of living for a local resident	176
Travel pass	159
Taxi fare	40–42
Cellular telephone subscription	63–64
Internet access	89
Tuition at an international school	150
Mobility	14
Air traffic	42
Commute time	137
Public transport	2
Metro	13
EV charging stations	107
Digitalization	54
Mobile Internet speed	N/A
Fixed broadband Internet speed	N/A
Wireless Internet	28
Remote employment	107
Digital public and municipal services	7
Safety	31
Safety rate	45
Crime rate	50
Natural disaster risk	7
Tourist appeal	11
International hotels	46–48
International tourists	4
Culture, entertainment, and sports	38
Ecology and human health	68
Environmental pollution level	65
Green energy	N/A
Quality of healthcare services provision	99
Internationalization	12
Foreign born population	27
International schools	10
English proficiency	81
International business events	13

Benchmarking against the leading city

0.XXX — Index value

▼▲ — Rank change

Singapore

Number of patent applications, 2019–2021 **28,481**

Number of patent applications of the city leading in this technological area

Rank **33**

Berlin

0.302

15

Technological Development

0.179

Rank 23

Technology companies	94
Leading companies by R&D expenditure	83–92
R&D expenditure of largest innovation companies	94
Startups and venture capital	17
Startups	15
Unicorns	15
Innovation support funds	22
Business angels	10
Venture capital investment	11
Universities and R&D organizations	28
Leading universities	48–56
Leading R&D organizations	5
Highly cited researchers	33
Nobel Prize laureates and Fields Medal winners	24–26
Students	53
International students	31
Productivity of the innovative class	45
Patent activity	65
Publication activity	36
Innovation infrastructure	13
Clusters and science parks	12–24
Co-working spaces	21
Supercomputers	40–62

Creative Industries

0.237

Rank 13

Film and animation	21
Top-rated film production companies (audience)	10
Film production companies that won international film festival awards	3–4
Animation film production companies that won international festival awards	26–49
Most influential animation film production companies	22–200
Top-rated streaming services	34–200
Electronic games	11
Developers of the best video games	26–200
Largest e-sports tournaments	16–20
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	3
Music	7
Most-streamed artists	25–200
Best opera performers	5–6
Fashion	37
Largest fashion companies	29–59
Fashion brands	25–26
Advertising and PR	31
Most effective advertising agencies	41–57
Largest PR agencies	8–10
Creative production agencies	30–200
Top advertising agencies	11
Architecture	23–24
Pritzker Architecture Prize laureates	9–25
Internationally recognized architects and architecture firms	30–47
Industrial design	16
Internationally recognized designers and design firms	16
Arts	7
Internationally recognized artists	5
Top artists by auction revenue	6–8
Most influential people in contemporary art	4
Leading higher education institutions in the arts	11–16
Best-selling authors	27–55
Most popular authors	31–69

Urban Environment

0.643

Rank 35

Cost of doing business	99
Estimated tax	46–51
Salary	138
Cost of living	109
Food prices	115
Apartment rental cost	123
Hotel accommodation	113
Cost of living for an expat	112–113
Cost of living for a local resident	129
Travel pass	93–95
Taxi fare	160–161
Cellular telephone subscription	87
Internet access	120
Tuition at an international school	29
Mobility	53
Air traffic	172–176
Commute time	87
Public transport	42
Metro	18
EV charging stations	46
Digitalization	59
Mobile Internet speed	97
Fixed broadband Internet speed	147
Wireless Internet	40
Remote employment	42
Digital public and municipal services	1–2
Safety	99
Safety rate	124
Crime rate	125
Natural disaster risk	15–17
Tourist appeal	19
International hotels	21–22
International tourists	26
Culture, entertainment, and sports	12
Ecology and human health	142
Environmental pollution level	83
Green energy	85
Quality of healthcare services provision	124
Internationalization	29
Foreign born population	66
International schools	61–70
English proficiency	85
International business events	7

Benchmarking against the leading city

0.XXX — Index value

— Rank change

Berlin

Number of patent applications, 2019–2021 **5,540**

Number of patent applications of the city leading in this technological area

Rank **65**

Boston, MA

0.291

▲ 16

Technological Development

0.416

Rank ▲ 9

Technology companies	4 ▼
Leading companies by R&D expenditure	4
R&D expenditure of largest innovation companies	7
Startups and venture capital	5 ▲
Startups	13
Unicorns	7
Innovation support funds	7
Business angels	5
Venture capital investment	3
Universities and R&D organizations	4 ▼
Leading universities	29–33
Leading R&D organizations	87–110
Highly cited researchers	1
Nobel Prize laureates and Fields Medal winners	1
Students	46
International students	12
Productivity of the innovative class	17 ▼
Patent activity	25
Publication activity	7
Innovation infrastructure	52 ▲
Clusters and science parks	91–200
Co-working spaces	31–32
Supercomputers	21–39

Creative Industries

0.091

Rank ▼ 43

Film and animation	90 ▲
Top-rated film production companies (audience)	16–23
Film production companies that won international film festival awards	87–200
Animation film production companies that won international festival awards	50–200
Most influential animation film production companies	22–200
Top-rated streaming services	34–200
Electronic games	60 ▲
Developers of the best video games	14–25
Largest e-sports tournaments	32–37
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	87–110
Music	62–200 ▲
Most-streamed artists	25–200
Best opera performers	49–200
Fashion	24 ▲
Largest fashion companies	13–28
Fashion brands	36–37
Advertising and PR	38 ▲
Most effective advertising agencies	41–57
Largest PR agencies	5
Creative production agencies	30–200
Top advertising agencies	37–49
Architecture	46–60 ▼
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	30–47
Industrial design	40–45 ▼
Internationally recognized designers and design firms	40–45
Arts	11 ▲
Internationally recognized artists	16–40
Top artists by auction revenue	48–200
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	17–25
Best-selling authors	14–17
Most popular authors	5

Urban Environment

0.179

Rank ▼ 176

Cost of doing business	189 ▼
Estimated tax	75
Salary	192
Cost of living	198 ▼
Food prices	194
Apartment rental cost	195
Hotel accommodation	183
Cost of living for an expat	176
Cost of living for a local resident	178
Travel pass	154–155
Taxi fare	114–115
Cellular telephone subscription	182
Internet access	179
Tuition at an international school	157
Mobility	110 ▼
Air traffic	50–51
Commute time	164
Public transport	131
Metro	66–67
EV charging stations	3
Digitalization	82 ▼
Mobile Internet speed	N/A
Fixed broadband Internet speed	49
Wireless Internet	58
Remote employment	52
Digital public and municipal services	N/A
Safety	97 ▲
Safety rate	113
Crime rate	122
Natural disaster risk	32–37
Tourist appeal	73 ▼
International hotels	41–42
International tourists	64–65
Culture, entertainment, and sports	62
Ecology and human health	119 ▲
Environmental pollution level	76
Green energy	59–60
Quality of healthcare services provision	118
Internationalization	36 ▲
Foreign born population	45
International schools	61–70
English proficiency	1–62
International business events	50–51

Benchmarking against the leading city

0.XXX — Index value

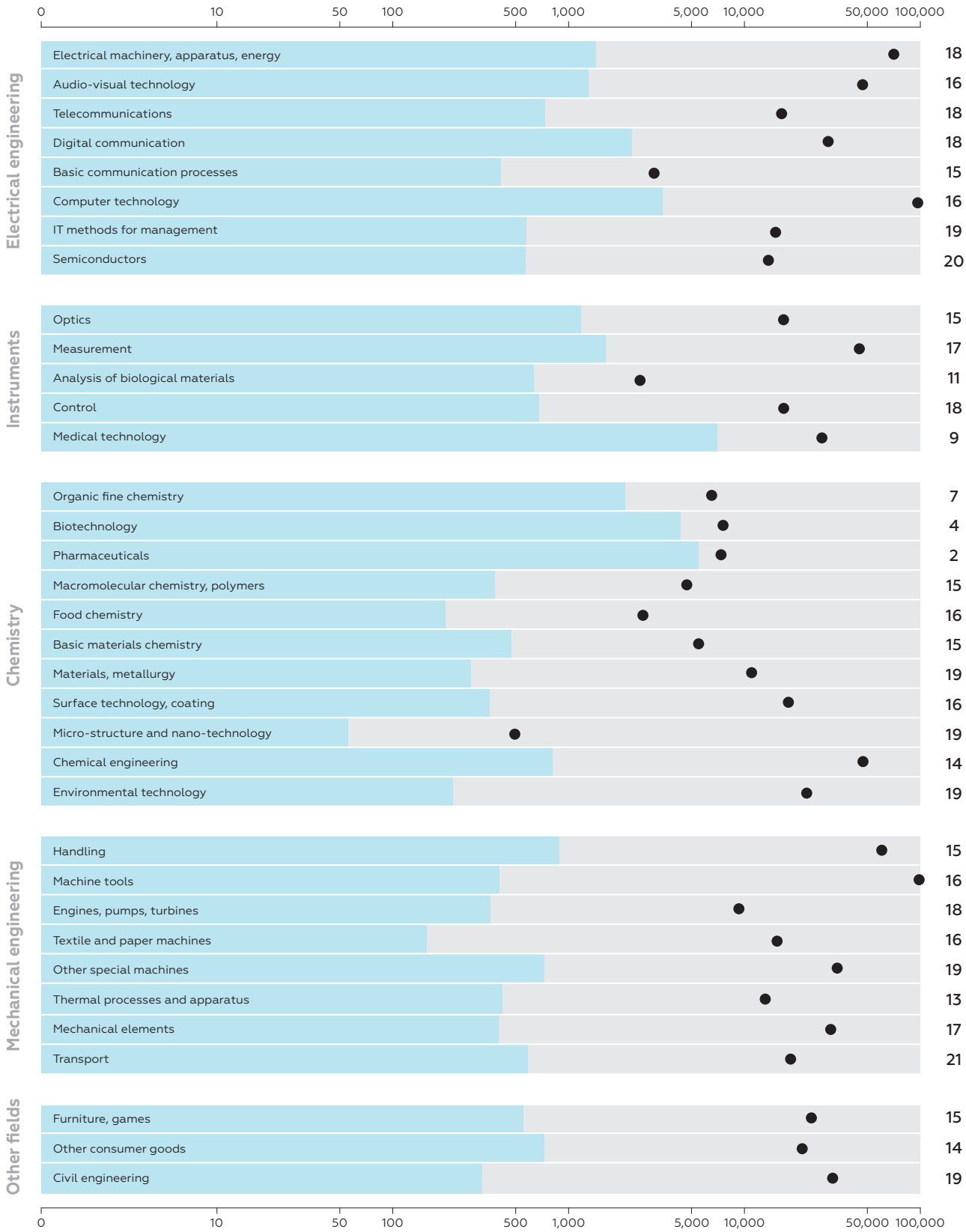
▼ ▲ — Rank change

Boston, MA

Number of patent applications, 2019–2021 **44,761**

Number of patent applications of the city leading in this technological area

Rank **25**



Madrid

0.292

▲ 17

Technological Development

0.181

Rank ▲ 22

Technology companies	45
Leading companies by R&D expenditure	46–52
R&D expenditure of largest innovation companies	45
Startups and venture capital	38
Startups	30
Unicorns	57–70
Innovation support funds	33
Business angels	28
Venture capital investment	69
Universities and R&D organizations	12
Leading universities	19–22
Leading R&D organizations	4
Highly cited researchers	47–48
Nobel Prize laureates and Fields Medal winners	41–79
Students	6
International students	11
Productivity of the innovative class	39
Patent activity	104
Publication activity	24
Innovation infrastructure	39
Clusters and science parks	44–90
Co-working spaces	17
Supercomputers	63–200

Creative Industries

0.130

Rank ▼ 27

Film and animation	10
Top-rated film production companies (audience)	6
Film production companies that won international film festival awards	12–20
Animation film production companies that won international festival awards	26–49
Most influential animation film production companies	22–200
Top-rated streaming services	9–21
Electronic games	33
Developers of the best video games	26–200
Largest e-sports tournaments	51–69
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	14–15
Music	17–22
Most-streamed artists	25–200
Best opera performers	13–18
Fashion	17
Largest fashion companies	13–28
Fashion brands	23–24
Advertising and PR	36
Most effective advertising agencies	58–200
Largest PR agencies	18–23
Creative production agencies	11–29
Top advertising agencies	12–13
Architecture	23–24
Pritzker Architecture Prize laureates	9–25
Internationally recognized architects and architecture firms	30–47
Industrial design	49–59
Internationally recognized designers and design firms	49–59
Arts	38
Internationally recognized artists	16–40
Top artists by auction revenue	12–22
Most influential people in contemporary art	17–34
Leading higher education institutions in the arts	36–54
Best-selling authors	56–200
Most popular authors	31–69

Urban Environment

0.991

Rank ▲ 2

Cost of doing business	86
Estimated tax	92–93
Salary	82
Cost of living	69
Food prices	46
Apartment rental cost	119
Hotel accommodation	87
Cost of living for an expat	82
Cost of living for a local resident	93–94
Travel pass	70–72
Taxi fare	72–75
Cellular telephone subscription	60
Internet access	78
Tuition at an international school	47
Mobility	48
Air traffic	22
Commute time	30
Public transport	96
Metro	52–53
EV charging stations	74
Digitalization	27
Mobile Internet speed	79
Fixed broadband Internet speed	40
Wireless Internet	31
Remote employment	74
Digital public and municipal services	1–2
Safety	38
Safety rate	49–50
Crime rate	49
Natural disaster risk	21–22
Tourist appeal	20
International hotels	25
International tourists	27
Culture, entertainment, and sports	14
Ecology and human health	78
Environmental pollution level	72
Green energy	28
Quality of healthcare services provision	26
Internationalization	14
Foreign born population	47
International schools	8
English proficiency	129–130
International business events	6

Benchmarking against the leading city

0.XXX — Index value

▼▲ — Rank change

Madrid

Number of patent applications, 2019–2021 **2,217**

Number of patent applications of the city leading in this technological area

Rank **104**

Istanbul

0.293

▲ 18

Technological Development

0.147 — Rank ⊖ 31

Technology companies	106 ▲
Leading companies by R&D expenditure	93–105
R&D expenditure of largest innovation companies	117
Startups and venture capital	50 ▲
Startups	42
Unicorns	71–84
Innovation support funds	53–54
Business angels	41
Venture capital investment	84
Universities and R&D organizations	16 ▼
Leading universities	6–7
Leading R&D organizations	142–200
Highly cited researchers	149–158
Nobel Prize laureates and Fields Medal winners	80–200
Students	9
International students	10
Productivity of the innovative class	59 ▼
★ Patent activity	110
Publication activity	50
Innovation infrastructure	28 ▲
Clusters and science parks	5–11
Co-working spaces	67
Supercomputers	63–200

Creative Industries

0.199 — Rank ▲ 17

Film and animation	19 ▼
Top-rated film production companies (audience)	24–50
Film production companies that won international film festival awards	25–30
Animation film production companies that won international festival awards	50–200
Most influential animation film production companies	22–200
Top-rated streaming services	9–21
Electronic games	29 ▲
Developers of the best video games	26–200
Largest e-sports tournaments	41–50
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	13
Music	62–200 ⊖
Most-streamed artists	25–200
Best opera performers	49–200
Fashion	35–36 ▼
Largest fashion companies	29–59
Fashion brands	21–22
Advertising and PR	4 ▲
Most effective advertising agencies	1
Largest PR agencies	72–200
Creative production agencies	11–29
Top advertising agencies	37–49
Architecture	25–26 ▼
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	15–17
Industrial design	14–15 ▲
Internationally recognized designers and design firms	14–15
Arts	99–114 ▼
Internationally recognized artists	41–200
Top artists by auction revenue	48–200
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	55–93
Best-selling authors	56–200
Most popular authors	70–200

Urban Environment

0.863 — Rank ▲ 12

Cost of doing business	28 ▼
Estimated tax	96–98
Salary	22
Cost of living	25 ▲
Food prices	16
Apartment rental cost	57
Hotel accommodation	98
Cost of living for an expat	21
Cost of living for a local resident	17
Travel pass	54
Taxi fare	35
Cellular telephone subscription	14
Internet access	16
Tuition at an international school	11
Mobility	64 ▲
Air traffic	7
Commute time	179
Public transport	56
Metro	68
EV charging stations	54–55
Digitalization	47 ▼
Mobile Internet speed	141
Fixed broadband Internet speed	177
Wireless Internet	3
Remote employment	43
Digital public and municipal services	9
Safety	114 ▼
Safety rate	139
Crime rate	135–136
Natural disaster risk	48
Tourist appeal	13 ▲
International hotels	15–16
International tourists	16
Culture, entertainment, and sports	15
Ecology and human health	137 ⊖
Environmental pollution level	160
Green energy	34
Quality of healthcare services provision	108
Internationalization	18 ▼
Foreign born population	N/A
International schools	3
English proficiency	164–165
International business events	23

Benchmarking against the leading city

0.XXX — Index value

▼ ▲ — Rank change

Istanbul

Number of patent applications, 2019–2021 **1,939**

Number of patent applications of the city leading in this technological area

Rank **110**

Munich

0.283

19

Technological Development

0.155

Rank 30

Technology companies	26
Leading companies by R&D expenditure	30–31
R&D expenditure of largest innovation companies	15
Startups and venture capital	39
Startups	46
Unicorns	37–39
Innovation support funds	41
Business angels	20
Venture capital investment	34
Universities and R&D organizations	38
Leading universities	110–147
Leading R&D organizations	26–27
Highly cited researchers	10
Nobel Prize laureates and Fields Medal winners	24–26
Students	103
International students	37
Productivity of the innovative class	44
Patent activity	38
Publication activity	44
Innovation infrastructure	20
Clusters and science parks	91–200
Co-working spaces	33–34
Supercomputers	6–7

Creative Industries

0.196

Rank 18

Film and animation	35
Top-rated film production companies (audience)	11–12
Film production companies that won international film festival awards	58–86
Animation film production companies that won international festival awards	50–200
Most influential animation film production companies	22–200
Top-rated streaming services	22–33
Electronic games	22–23
Developers of the best video games	26–200
Largest e-sports tournaments	70–200
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	6–8
Music	6
Most-streamed artists	25–200
Best opera performers	4
Fashion	20
Largest fashion companies	13–28
Fashion brands	28–29
Advertising and PR	29
Most effective advertising agencies	33–40
Largest PR agencies	8–10
Creative production agencies	11–29
Top advertising agencies	27–33
Architecture	61–90
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	48–81
Industrial design	13
Internationally recognized designers and design firms	13
Arts	29
Internationally recognized artists	16–40
Top artists by auction revenue	23–47
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	26–35
Best-selling authors	18–26
Most popular authors	31–69

Urban Environment

0.773

Rank 17

Cost of doing business	115
Estimated tax	46–51
Salary	150
Cost of living	123
Food prices	121
Apartment rental cost	143
Hotel accommodation	86
Cost of living for an expat	145
Cost of living for a local resident	118
Travel pass	93–95
Taxi fare	160–161
Cellular telephone subscription	94
Internet access	112
Tuition at an international school	113
Mobility	12
Air traffic	13
Commute time	64
Public transport	41
Metro	17
EV charging stations	41–42
Digitalization	146
Mobile Internet speed	50
Fixed broadband Internet speed	142
Wireless Internet	86
Remote employment	81–83
Digital public and municipal services	N/A
Safety	16
Safety rate	21
Crime rate	21
Natural disaster risk	15–17
Tourist appeal	44
International hotels	23
International tourists	41
Culture, entertainment, and sports	60
Ecology and human health	21
Environmental pollution level	32
Green energy	N/A
Quality of healthcare services provision	53
Internationalization	88
Foreign born population	29
International schools	118–130
English proficiency	73
International business events	48–49

Benchmarking against the leading city

0.XXX — Index value

— Rank change

Munich

Number of patent applications, 2019–2021 **19,697**

Number of patent applications of the city leading in this technological area

Rank **38**

Milan

0.279

Rank 20

Technological Development

0.158 — Rank 28

Technology companies	70
Leading companies by R&D expenditure	58–66
R&D expenditure of largest innovation companies	75
Startups and venture capital	46
Startups	38
Unicorns	71–84
Innovation support funds	48
Business angels	43
Venture capital investment	73
Universities and R&D organizations	41
Leading universities	43–47
Leading R&D organizations	49–58
Highly cited researchers	52–53
Nobel Prize laureates and Fields Medal winners	80–200
Students	38
International students	28
Productivity of the innovative class	46
Patent activity	69
Publication activity	39
Innovation infrastructure	11
Clusters and science parks	3–4
Co-working spaces	15–16
Supercomputers	63–200

Creative Industries

0.267 — Rank 11

Film and animation	39
Top-rated film production companies (audience)	51–200
Film production companies that won international film festival awards	58–86
Animation film production companies that won international festival awards	50–200
Most influential animation film production companies	22–200
Top-rated streaming services	22–33
Electronic games	55
Developers of the best video games	26–200
Largest e-sports tournaments	70–200
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	24–25
Music	8
Most-streamed artists	11–24
Best opera performers	7–8
Fashion	4
Largest fashion companies	4
Fashion brands	4
Advertising and PR	26
Most effective advertising agencies	33–40
Largest PR agencies	24–35
Creative production agencies	5–6
Top advertising agencies	23–26
Architecture	30–37
Pritzker Architecture Prize laureates	9–25
Internationally recognized architects and architecture firms	82–200
Industrial design	17–18
Internationally recognized designers and design firms	17–18
Arts	13
Internationally recognized artists	8
Top artists by auction revenue	48–200
Most influential people in contemporary art	17–34
Leading higher education institutions in the arts	9–10
Best-selling authors	18–26
Most popular authors	31–69

Urban Environment

0.445 — Rank 97

Cost of doing business	162
Estimated tax	195–199
Salary	71
Cost of living	108
Food prices	96
Apartment rental cost	137
Hotel accommodation	150
Cost of living for an expat	147
Cost of living for a local resident	117
Travel pass	68
Taxi fare	141–145
Cellular telephone subscription	24
Internet access	64
Tuition at an international school	109
Mobility	17
Air traffic	45
Commute time	103
Public transport	40
Metro	15
EV charging stations	4
Digitalization	123
Mobile Internet speed	116
Fixed broadband Internet speed	101
Wireless Internet	48
Remote employment	31
Digital public and municipal services	N/A
Safety	124
Safety rate	153
Crime rate	154
Natural disaster risk	41–42
Tourist appeal	32
International hotels	70
International tourists	22
Culture, entertainment, and sports	20
Ecology and human health	130
Environmental pollution level	159
Green energy	39
Quality of healthcare services provision	95
Internationalization	92
Foreign born population	38–39
International schools	105–117
English proficiency	120
International business events	19–21

Benchmarking against the leading city

0.XXX — Index value

— Rank change

Milan

Number of patent applications, 2019–2021 **5,200**

Number of patent applications of the city leading in this technological area

Rank **69**

Taipei

0.267

▲ 21

Technological Development

0.138

Rank ▲ 35

Technology companies	22
Leading companies by R&D expenditure	20–21
R&D expenditure of largest innovation companies	30
Startups and venture capital	70
Startups	64
Unicorns	85–113
Innovation support funds	53–54
Business angels	89
Venture capital investment	100
Universities and R&D organizations	31
Leading universities	15–16
Leading R&D organizations	17–22
Highly cited researchers	109–112
Nobel Prize laureates and Fields Medal winners	41–79
Students	35
International students	45
Productivity of the innovative class	49
Patent activity	46
Publication activity	45
Innovation infrastructure	43
Clusters and science parks	91–200
Co-working spaces	12–13
Supercomputers	63–200

Creative Industries

0.219

Rank ▲ 14

Film and animation	58
Top-rated film production companies (audience)	51–200
Film production companies that won international film festival awards	87–200
Animation film production companies that won international festival awards	26–49
Most influential animation film production companies	12–21
Top-rated streaming services	34–200
Electronic games	95
Developers of the best video games	26–200
Largest e-sports tournaments	41–50
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	87–110
Music	62–200
Most-streamed artists	25–200
Best opera performers	49–200
Fashion	91–98
Largest fashion companies	60–200
Fashion brands	69–78
Advertising and PR	69–70
Most effective advertising agencies	41–57
Largest PR agencies	72–200
Creative production agencies	30–200
Top advertising agencies	63–86
Architecture	61–90
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	48–81
Industrial design	3–4
Internationally recognized designers and design firms	3–4
Arts	32
Internationally recognized artists	41–200
Top artists by auction revenue	48–200
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	11–16
Best-selling authors	56–200
Most popular authors	70–200

Urban Environment

0.642

Rank ▼ 36

Cost of doing business	37
Estimated tax	62–70
Salary	63
Cost of living	55
Food prices	82
Apartment rental cost	53
Hotel accommodation	48
Cost of living for an expat	43
Cost of living for a local resident	48
Travel pass	55
Taxi fare	48
Cellular telephone subscription	82
Internet access	59
Tuition at an international school	106
Mobility	28
Air traffic	163
Commute time	95
Public transport	54
Metro	N/A
EV charging stations	1
Digitalization	177
Mobile Internet speed	115
Fixed broadband Internet speed	N/A
Wireless Internet	43
Remote employment	41
Digital public and municipal services	N/A
Safety	9
Safety rate	9
Crime rate	10
Natural disaster risk	N/A
Tourist appeal	45
International hotels	185–188
International tourists	13
Culture, entertainment, and sports	36
Ecology and human health	111
Environmental pollution level	108
Green energy	74
Quality of healthcare services provision	7
Internationalization	169
Foreign born population	110
International schools	131–144
English proficiency	N/A
International business events	25

Benchmarking against the leading city

0.XXX — Index value

▼▲ — Rank change

Taipei

Number of patent applications, 2019–2021 **14,652**

Number of patent applications of the city leading in this technological area

Rank **46**

Hangzhou

0.249

▲ 22

Technological Development

0.235 — Rank ▲ 17

Technology companies	11 ▲
Leading companies by R&D expenditure	9
R&D expenditure of largest innovation companies	18
Startups and venture capital	36 ▼
Startups	67
Unicorns	10
Innovation support funds	34
Business angels	126–128
Venture capital investment	20
Universities and R&D organizations	36 ▲
Leading universities	29–33
Leading R&D organizations	111–141
Highly cited researchers	27–28
Nobel Prize laureates and Fields Medal winners	80–200
Students	26
International students	52
Productivity of the innovative class	6 ▼
★ Patent activity	6
Publication activity	16
Innovation infrastructure	153–157 ▲
Clusters and science parks	91–200
Co-working spaces	111–119
Supercomputers	63–200

Creative Industries

0.091 — Rank ▲ 40

Film and animation	81–84 −
Top-rated film production companies (audience)	51–200
Film production companies that won international film festival awards	87–200
Animation film production companies that won international festival awards	26–49
Most influential animation film production companies	22–200
Top-rated streaming services	34–200
Electronic games	37 ▲
Developers of the best video games	26–200
Largest e-sports tournaments	16–20
Developers of the most popular computer games	16–36
Companies participating in electronic games trade shows	87–110
Music	62–200 −
Most-streamed artists	25–200
Best opera performers	49–200
Fashion	115–142 ▼
Largest fashion companies	60–200
Fashion brands	102–135
Advertising and PR	115–200 ▼
Most effective advertising agencies	58–200
Largest PR agencies	72–200
Creative production agencies	30–200
Top advertising agencies	87–200
Architecture	17–18 ▲
Pritzker Architecture Prize laureates	9–25
Internationally recognized architects and architecture firms	18–20
Industrial design	23–24 ▲
Internationally recognized designers and design firms	23–24
Arts	130–133 ▲
Internationally recognized artists	41–200
Top artists by auction revenue	23–47
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	94–173
Best-selling authors	56–200
Most popular authors	70–200

Urban Environment

0.625 — Rank ▲ 39

Cost of doing business	55 ▲
Estimated tax	106–148
Salary	38
Cost of living	35 ▲
Food prices	50
Apartment rental cost	44
Hotel accommodation	12
Cost of living for an expat	28
Cost of living for a local resident	28
Travel pass	15
Taxi fare	19–21
Cellular telephone subscription	39–40
Internet access	28
Tuition at an international school	123
Mobility	140 ▼
Air traffic	87–88
Commute time	125
Public transport	76–77
Metro	31–32
EV charging stations	158
Digitalization	32 ▼
Mobile Internet speed	14
Fixed broadband Internet speed	45
Wireless Internet	99
Remote employment	22–24
Digital public and municipal services	N/A
Safety	10 ▼
Safety rate	14
Crime rate	9
Natural disaster risk	N/A
Tourist appeal	58 ▲
International hotels	24
International tourists	79
Culture, entertainment, and sports	53
Ecology and human health	126 ▲
Environmental pollution level	153
Green energy	N/A
Quality of healthcare services provision	109
Internationalization	159 ▼
Foreign born population	N/A
International schools	57–60
English proficiency	159
International business events	122–128

Benchmarking against the leading city

0.XXX — Index value

▼ ▲ — Rank change

Hangzhou

Number of patent applications, 2019–2021 **350,883**

Number of patent applications of the city leading in this technological area

Rank **6**

Toronto

0.249

▲ 23

Technological Development

0.162 — Rank ⊖ 27

Technology companies	▲ 66
Leading companies by R&D expenditure	67–73
R&D expenditure of largest innovation companies	58
Startups and venture capital	⊖ 13
Startups	8
Unicorns	25–29
Innovation support funds	12
Business angels	11–12
Venture capital investment	29
Universities and R&D organizations	▲ 33
Leading universities	57–77
Leading R&D organizations	142–200
Highly cited researchers	27–28
Nobel Prize laureates and Fields Medal winners	41–79
Students	34
International students	9
Productivity of the innovative class	▲ 43
★ Patent activity	61
Publication activity	37
Innovation infrastructure	▼ 27
Clusters and science parks	91–200
Co-working spaces	10
Supercomputers	40–62

Creative Industries

0.153 — Rank ⊖ 24

Film and animation	▲ 27
Top-rated film production companies (audience)	51–200
Film production companies that won international film festival awards	87–200
Animation film production companies that won international festival awards	26–49
Most influential animation film production companies	6
Top-rated streaming services	22–33
Electronic games	▼ 36
Developers of the best video games	26–200
Largest e-sports tournaments	32–37
Developers of the most popular computer games	16–36
Companies participating in electronic games trade shows	47–54
Music	▲ 25
Most-streamed artists	8–10
Best opera performers	28–48
Fashion	▲ 11
Largest fashion companies	9–12
Fashion brands	43–45
Advertising and PR	▼ 10
Most effective advertising agencies	21–23
Largest PR agencies	15–17
Creative production agencies	4
Top advertising agencies	7
Architecture	▲ 46–60
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	30–47
Industrial design	▼ 28–29
Internationally recognized designers and design firms	28–29
Arts	▲ 26
Internationally recognized artists	10–15
Top artists by auction revenue	48–200
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	36–54
Best-selling authors	27–55
Most popular authors	10–13

Urban Environment

0.671 — Rank ▲ 28

Cost of doing business	⊖ 152
Estimated tax	156–158
Salary	139
Cost of living	▲ 163
Food prices	153
Apartment rental cost	169
Hotel accommodation	108
Cost of living for an expat	144
Cost of living for a local resident	159
Travel pass	179
Taxi fare	72–75
Cellular telephone subscription	161
Internet access	152
Tuition at an international school	122
Mobility	▲ 65
Air traffic	24–25
Commute time	157
Public transport	85
Metro	44
EV charging stations	47
Digitalization	▲ 33
Mobile Internet speed	51
Fixed broadband Internet speed	50
Wireless Internet	22
Remote employment	55–56
Digital public and municipal services	18–20
Safety	▼ 98
Safety rate	121
Crime rate	126
Natural disaster risk	18–20
Tourist appeal	▼ 47
International hotels	46–48
International tourists	35
Culture, entertainment, and sports	47
Ecology and human health	▼ 92
Environmental pollution level	79
Green energy	43
Quality of healthcare services provision	71
Internationalization	▼ 2
Foreign born population	2
International schools	6
English proficiency	1–62
International business events	42–46

Benchmarking against the leading city

0.XXX — Index value

▼▲ — Rank change

Toronto

Number of patent applications, 2019–2021 **6,858**

Number of patent applications of the city leading in this technological area

Rank **61**

Stockholm

0.251

▲ 24

Technological Development

0.115

Rank ▲ 46

Technology companies	29
Leading companies by R&D expenditure	24–25
R&D expenditure of largest innovation companies	29
Startups and venture capital	31
Startups	36
Unicorns	31–34
Innovation support funds	27
Business angels	15
Venture capital investment	23
Universities and R&D organizations	90
Leading universities	78–95
Leading R&D organizations	59–74
Highly cited researchers	59–63
Nobel Prize laureates and Fields Medal winners	41–79
Students	131
International students	69
Productivity of the innovative class	63
★ Patent activity	57
Publication activity	62
Innovation infrastructure	47
Clusters and science parks	25–43
Co-working spaces	45–46
Supercomputers	63–200

Creative Industries

0.194

Rank ▼ 19

Film and animation	14
Top-rated film production companies (audience)	24–50
Film production companies that won international film festival awards	12–20
Animation film production companies that won international festival awards	11–15
Most influential animation film production companies	22–200
Top-rated streaming services	9–21
Electronic games	7
Developers of the best video games	6–13
Largest e-sports tournaments	23–31
Developers of the most popular computer games	1–2
Companies participating in electronic games trade shows	26–31
Music	16
Most-streamed artists	8–10
Best opera performers	19–27
Fashion	18
Largest fashion companies	29–59
Fashion brands	10
Advertising and PR	42
Most effective advertising agencies	58–200
Largest PR agencies	8–10
Creative production agencies	30–200
Top advertising agencies	18–19
Architecture	25–26
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	15–17
Industrial design	46–48
Internationally recognized designers and design firms	46–48
Arts	15
Internationally recognized artists	16–40
Top artists by auction revenue	23–47
Most influential people in contemporary art	17–34
Leading higher education institutions in the arts	11–16
Best-selling authors	14–17
Most popular authors	14–20

Urban Environment

0.714

Rank ▲ 22

Cost of doing business	104
Estimated tax	81–82
Salary	132
Cost of living	119
Food prices	130
Apartment rental cost	139
Hotel accommodation	85
Cost of living for an expat	103
Cost of living for a local resident	144
Travel pass	165
Taxi fare	186
Cellular telephone subscription	112
Internet access	70
Tuition at an international school	37
Mobility	7
Air traffic	26–28
Commute time	94
Public transport	6
Metro	12
EV charging stations	72
Digitalization	45
Mobile Internet speed	16
Fixed broadband Internet speed	98
Wireless Internet	68
Remote employment	141
Digital public and municipal services	13–15
Safety	105
Safety rate	132
Crime rate	137
Natural disaster risk	4
Tourist appeal	106
International hotels	135–139
International tourists	53
Culture, entertainment, and sports	63
Ecology and human health	31
Environmental pollution level	7
Green energy	12
Quality of healthcare services provision	138
Internationalization	79
Foreign born population	46
International schools	162–177
English proficiency	79
International business events	19–21

Benchmarking against the leading city

0.XXX — Index value

▲▼ — Rank change

Stockholm

Number of patent applications, 2019–2021 **8,054**

Number of patent applications of the city leading in this technological area

Rank **57**

Suzhou

0.242

25

Technological Development

0.263

Rank 15

Technology companies	17
Leading companies by R&D expenditure	14
R&D expenditure of largest innovation companies	42
Startups and venture capital	56
Startups	111
Unicorns	35–36
Innovation support funds	63
Business angels	152–155
Venture capital investment	25
Universities and R&D organizations	87
Leading universities	57–77
Leading R&D organizations	87–110
Highly cited researchers	64–66
Nobel Prize laureates and Fields Medal winners	80–200
Students	54
International students	147
Productivity of the innovative class	3
Patent activity	1
Publication activity	31
Innovation infrastructure	95–96
Clusters and science parks	44–90
Co-working spaces	137–145
Supercomputers	40–62

Creative Industries

0.061

Rank 64

Film and animation	76–79
Top-rated film production companies (audience)	51–200
Film production companies that won international film festival awards	87–200
Animation film production companies that won international festival awards	50–200
Most influential animation film production companies	12–21
Top-rated streaming services	34–200
Electronic games	21
Developers of the best video games	26–200
Largest e-sports tournaments	4
Developers of the most popular computer games	16–36
Companies participating in electronic games trade shows	145–200
Music	62–200
Most-streamed artists	25–200
Best opera performers	49–200
Fashion	143–200
Largest fashion companies	60–200
Fashion brands	136–200
Advertising and PR	115–200
Most effective advertising agencies	58–200
Largest PR agencies	72–200
Creative production agencies	30–200
Top advertising agencies	87–200
Architecture	91–200
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	82–200
Industrial design	30–33
Internationally recognized designers and design firms	30–33
Arts	136–176
Internationally recognized artists	41–200
Top artists by auction revenue	48–200
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	94–173
Best-selling authors	56–200
Most popular authors	70–200

Urban Environment

0.578

Rank 51

Cost of doing business	63
Estimated tax	106–148
Salary	44
Cost of living	60
Food prices	119
Apartment rental cost	25
Hotel accommodation	11
Cost of living for an expat	49
Cost of living for a local resident	54
Travel pass	66
Taxi fare	19–21
Cellular telephone subscription	62
Internet access	21
Tuition at an international school	160
Mobility	41
Air traffic	16–17
Commute time	12
Public transport	19
Metro	60–61
EV charging stations	142–143
Digitalization	121
Mobile Internet speed	N/A
Fixed broadband Internet speed	94
Wireless Internet	72
Remote employment	N/A
Digital public and municipal services	N/A
Safety	6
Safety rate	4
Crime rate	1
Natural disaster risk	54–65
Tourist appeal	37
International hotels	18
International tourists	N/A
Culture, entertainment, and sports	72
Ecology and human health	149
Environmental pollution level	170
Green energy	N/A
Quality of healthcare services provision	139–140
Internationalization	176
Foreign born population	N/A
International schools	43–44
English proficiency	179
International business events	149–200

Benchmarking against the leading city

0.XXX — Index value

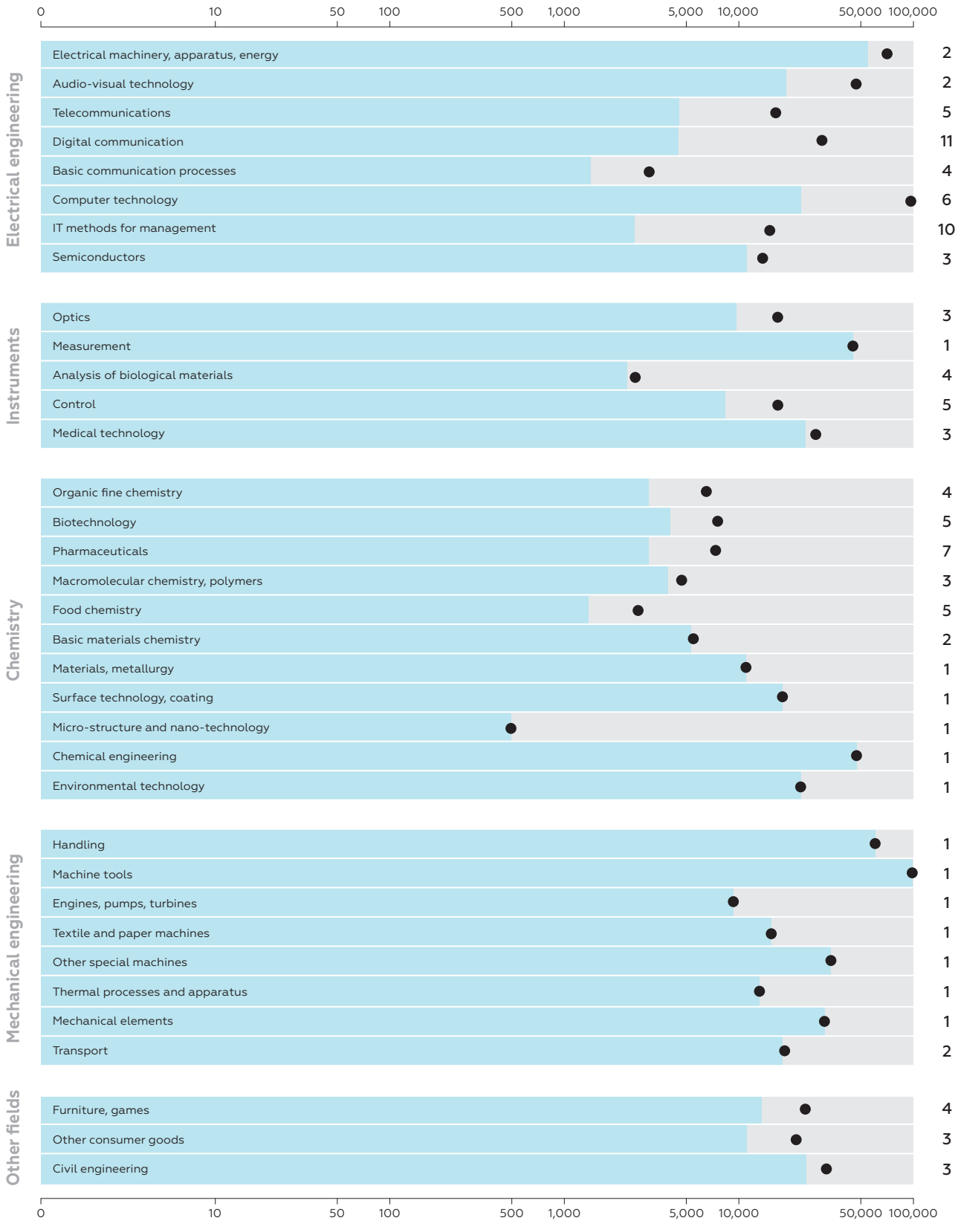
— Rank change

Suzhou

Number of patent applications, 2019–2021 **656,656**

Number of patent applications of the city leading in this technological area

Rank **1**



Sydney

0.249

▼ 26

Technological Development

0.165

Rank ▼ 26

Technology companies	80
Leading companies by R&D expenditure	83–92
R&D expenditure of largest innovation companies	55
Startups and venture capital	28
Startups	21
Unicorns	43–49
Innovation support funds	24
Business angels	18
Venture capital investment	41
Universities and R&D organizations	27
Leading universities	57–77
Leading R&D organizations	59–74
Highly cited researchers	15
Nobel Prize laureates and Fields Medal winners	80–200
Students	43
International students	3
Productivity of the innovative class	47
★ Patent activity	82
Publication activity	38
Innovation infrastructure	15
Clusters and science parks	12–24
Co-working spaces	36–37
Supercomputers	21–39

Creative Industries

0.204

Rank ▼ 16

Film and animation	9
Top-rated film production companies (audience)	24–50
Film production companies that won international film festival awards	46–57
Animation film production companies that won international festival awards	26–49
Most influential animation film production companies	7–11
Top-rated streaming services	5–8
Electronic games	72–75
Developers of the best video games	26–200
Largest e-sports tournaments	70–200
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	32–36
Music	24
Most-streamed artists	11–24
Best opera performers	19–27
Fashion	21–23
Largest fashion companies	60–200
Fashion brands	8
Advertising and PR	12
Most effective advertising agencies	17–20
Largest PR agencies	18–23
Creative production agencies	11–29
Top advertising agencies	6
Architecture	5
Pritzker Architecture Prize laureates	9–25
Internationally recognized architects and architecture firms	2–3
Industrial design	40–45
Internationally recognized designers and design firms	40–45
Arts	27
Internationally recognized artists	16–40
Top artists by auction revenue	48–200
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	26–35
Best-selling authors	27–55
Most popular authors	14–20

Urban Environment

0.460

Rank ▼ 86

Cost of doing business	125
Estimated tax	71–74
Salary	153
Cost of living	154
Food prices	90
Apartment rental cost	180
Hotel accommodation	141
Cost of living for an expat	148
Cost of living for a local resident	157
Travel pass	187
Taxi fare	182
Cellular telephone subscription	125
Internet access	153
Tuition at an international school	103
Mobility	111
Air traffic	75–77
Commute time	167
Public transport	58
Metro	48
EV charging stations	103
Digitalization	173
Mobile Internet speed	71
Fixed broadband Internet speed	169
Wireless Internet	59
Remote employment	90–92
Digital public and municipal services	N/A
Safety	73
Safety rate	92–93
Crime rate	89
Natural disaster risk	39–40
Tourist appeal	64
International hotels	54
International tourists	37
Culture, entertainment, and sports	68
Ecology and human health	109
Environmental pollution level	59
Green energy	57
Quality of healthcare services provision	94
Internationalization	15
Foreign born population	11
International schools	39
English proficiency	1–62
International business events	52–55

Benchmarking against the leading city

0.XXX — Index value

▼▲ — Rank change

Sydney

Number of patent applications, 2019–2021 **3,387**

Number of patent applications of the city leading in this technological area

Rank **82**

Amsterdam

0.242

▲ 27

Technological Development

0.129 — Rank ⊖ 39

Technology companies	34 ▲
Leading companies by R&D expenditure	32
R&D expenditure of largest innovation companies	25
Startups and venture capital	27 ▼
Startups	24
Unicorns	35–36
Innovation support funds	30–31
Business angels	19
Venture capital investment	35
Universities and R&D organizations	85 ▲
Leading universities	110–147
Leading R&D organizations	59–74
Highly cited researchers	29–32
Nobel Prize laureates and Fields Medal winners	80–200
Students	106
International students	54
Productivity of the innovative class	68 ▲
★ Patent activity	102
Publication activity	61
Innovation infrastructure	25 ▼
Clusters and science parks	91–200
Co-working spaces	15–16
Supercomputers	13–20

Creative Industries

0.170 — Rank ▲ 20

Film and animation	11 ▼
Top-rated film production companies (audience)	51–200
Film production companies that won international film festival awards	12–20
Animation film production companies that won international festival awards	9–10
Most influential animation film production companies	22–200
Top-rated streaming services	9–21
Electronic games	43 ▲
Developers of the best video games	26–200
Largest e-sports tournaments	51–69
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	19–20
Music	9 ⊖
Most-streamed artists	25–200
Best opera performers	7–8
Fashion	19 ▼
Largest fashion companies	29–59
Fashion brands	11
Advertising and PR	34 ⊖
Most effective advertising agencies	41–57
Largest PR agencies	36–71
Creative production agencies	11–29
Top advertising agencies	8–10
Architecture	10–11 ⊖
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	7–8
Industrial design	26–27 ▲
Internationally recognized designers and design firms	26–27
Arts	42 ⊖
Internationally recognized artists	41–200
Top artists by auction revenue	23–47
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	36–54
Best-selling authors	27–55
Most popular authors	21–30

Urban Environment

0.688 — Rank ▲ 24

Cost of doing business	174 ▲
Estimated tax	167–171
Salary	152
Cost of living	157 ▼
Food prices	101
Apartment rental cost	173
Hotel accommodation	178
Cost of living for an expat	180
Cost of living for a local resident	155
Travel pass	152
Taxi fare	168–169
Cellular telephone subscription	96
Internet access	130
Tuition at an international school	76
Mobility	25 ▼
Air traffic	8
Commute time	20
Public transport	119
Metro	55
EV charging stations	12
Digitalization	81 ▼
Mobile Internet speed	73
Fixed broadband Internet speed	99
Wireless Internet	38
Remote employment	87–89
Digital public and municipal services	27–29
Safety	74 ⊖
Safety rate	62
Crime rate	77
Natural disaster risk	71
Tourist appeal	23 ▼
International hotels	36–37
International tourists	23
Culture, entertainment, and sports	18
Ecology and human health	18 ▲
Environmental pollution level	30
Green energy	N/A
Quality of healthcare services provision	41
Internationalization	34 ▼
Foreign born population	18
International schools	56
English proficiency	74
International business events	16

Benchmarking against the leading city

0.XXX — Index value

▼ ▲ — Rank change

Amsterdam

Number of patent applications, 2019–2021 **2,280**

Number of patent applications of the city leading in this technological area

Rank **102**

Barcelona

0.234

Rank 28

Technological Development

0.187 — Rank 21

Technology companies	115
Leading companies by R&D expenditure	106–122
R&D expenditure of largest innovation companies	113
Startups and venture capital	40
Startups	34
Unicorns	71–84
Innovation support funds	40
Business angels	31
Venture capital investment	44
Universities and R&D organizations	24
Leading universities	34–42
Leading R&D organizations	6
Highly cited researchers	50–51
Nobel Prize laureates and Fields Medal winners	80–200
Students	23
International students	30
Productivity of the innovative class	52
Patent activity	103
Publication activity	42
Innovation infrastructure	9
Clusters and science parks	3–4
Co-working spaces	20
Supercomputers	13–20

Creative Industries

0.119 — Rank 31

Film and animation	45
Top-rated film production companies (audience)	51–200
Film production companies that won international film festival awards	12–20
Animation film production companies that won international festival awards	50–200
Most influential animation film production companies	22–200
Top-rated streaming services	34–200
Electronic games	22–23
Developers of the best video games	26–200
Largest e-sports tournaments	70–200
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	6–8
Music	62–200
Most-streamed artists	25–200
Best opera performers	49–200
Fashion	8
Largest fashion companies	7–8
Fashion brands	17
Advertising and PR	53
Most effective advertising agencies	58–200
Largest PR agencies	24–35
Creative production agencies	11–29
Top advertising agencies	50–62
Architecture	38–45
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	21–29
Industrial design	30–33
Internationally recognized designers and design firms	30–33
Arts	23
Internationally recognized artists	16–40
Top artists by auction revenue	12–22
Most influential people in contemporary art	17–34
Leading higher education institutions in the arts	17–25
Best-selling authors	27–55
Most popular authors	70–200

Urban Environment

0.601 — Rank 44

Cost of doing business	81
Estimated tax	92–93
Salary	79
Cost of living	124
Food prices	66
Apartment rental cost	122
Hotel accommodation	182
Cost of living for an expat	118
Cost of living for a local resident	125
Travel pass	31
Taxi fare	154–155
Cellular telephone subscription	73
Internet access	93
Tuition at an international school	71
Mobility	39
Air traffic	20
Commute time	60
Public transport	67
Metro	30
EV charging stations	108–109
Digitalization	102
Mobile Internet speed	84
Fixed broadband Internet speed	57
Wireless Internet	35
Remote employment	93
Digital public and municipal services	N/A
Safety	120
Safety rate	151–152
Crime rate	152
Natural disaster risk	21–22
Tourist appeal	26
International hotels	46–48
International tourists	20
Culture, entertainment, and sports	22
Ecology and human health	140
Environmental pollution level	146
Green energy	58
Quality of healthcare services provision	55
Internationalization	24
Foreign born population	56
International schools	30–31
English proficiency	137–138
International business events	4

Benchmarking against the leading city

0.XXX — Index value

— Rank change

Barcelona

Number of patent applications, 2019–2021 **2,241**

Number of patent applications of the city leading in this technological area

Rank **103**

Nanjing

0.227

▲ 29

Technological Development

0.242

Rank ▲ 16

Technology companies	▲ 42
Leading companies by R&D expenditure	34
R&D expenditure of largest innovation companies	65
Startups and venture capital	− 62
Startups	123
Unicorns	25–29
Innovation support funds	82
Business angels	163–168
Venture capital investment	33
Universities and R&D organizations	▼ 20
Leading universities	15–16
Leading R&D organizations	44–48
Highly cited researchers	16
Nobel Prize laureates and Fields Medal winners	80–200
Students	10
International students	62–63
Productivity of the innovative class	− 7
★ Patent activity	7
Publication activity	3
Innovation infrastructure	▲ 40–41
Clusters and science parks	5–11
Co-working spaces	120–129
Supercomputers	63–200

Creative Industries

0.034

Rank ▲ 98

Film and animation	▲ 91–107
Top-rated film production companies (audience)	51–200
Film production companies that won international film festival awards	58–86
Animation film production companies that won international festival awards	50–200
Most influential animation film production companies	22–200
Top-rated streaming services	34–200
Electronic games	▼ 90
Developers of the best video games	26–200
Largest e-sports tournaments	23–31
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	145–200
Music	▼ 62–200
Most-streamed artists	25–200
Best opera performers	49–200
Fashion	▲ 143–200
Largest fashion companies	60–200
Fashion brands	136–200
Advertising and PR	▲ 115–200
Most effective advertising agencies	58–200
Largest PR agencies	72–200
Creative production agencies	30–200
Top advertising agencies	87–200
Architecture	▲ 91–200
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	82–200
Industrial design	▲ 40–45
Internationally recognized designers and design firms	40–45
Arts	▲ 89–90
Internationally recognized artists	41–200
Top artists by auction revenue	23–47
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	55–93
Best-selling authors	56–200
Most popular authors	70–200

Urban Environment

0.662

Rank ▲ 30

Cost of doing business	▲ 51
Estimated tax	106–148
Salary	36
Cost of living	▼ 37
Food prices	30
Apartment rental cost	24
Hotel accommodation	27
Cost of living for an expat	18
Cost of living for a local resident	20
Travel pass	21
Taxi fare	28–31
Cellular telephone subscription	48
Internet access	26
Tuition at an international school	136
Mobility	▲ 75
Air traffic	118
Commute time	161
Public transport	17–18
Metro	2
EV charging stations	182–183
Digitalization	▲ 14
Mobile Internet speed	13
Fixed broadband Internet speed	12
Wireless Internet	147
Remote employment	N/A
Digital public and municipal services	N/A
Safety	▼ 14
Safety rate	7
Crime rate	5
Natural disaster risk	54–65
Tourist appeal	▲ 113
International hotels	88–89
International tourists	N/A
Culture, entertainment, and sports	117
Ecology and human health	▼ 128
Environmental pollution level	172
Green energy	N/A
Quality of healthcare services provision	81
Internationalization	▲ 166
Foreign born population	N/A
International schools	57–60
English proficiency	164–165
International business events	129–135

Benchmarking against the leading city

0.XXX — Index value

▼▲ — Rank change

Nanjing

Number of patent applications, 2019–2021 **229,276**

Number of patent applications of the city leading in this technological area

Rank **7**

Osaka

0.226

▲ 30

Technological Development

0.215

Rank ▲ 18

Technology companies	12
Leading companies by R&D expenditure	10
R&D expenditure of largest innovation companies	21
Startups and venture capital	107
Startups	84
Unicorns	114–200
Innovation support funds	112–114
Business angels	120–125
Venture capital investment	127
Universities and R&D organizations	21
Leading universities	6–7
Leading R&D organizations	59–74
Highly cited researchers	85–89
Nobel Prize laureates and Fields Medal winners	14–23
Students	20
International students	46
Productivity of the innovative class	28
★ Patent activity	22
Publication activity	32
Innovation infrastructure	12
Clusters and science parks	44–90
Co-working spaces	35
Supercomputers	6–7

Creative Industries

0.068

Rank ▲ 55

Film and animation	81–84
Top-rated film production companies (audience)	51–200
Film production companies that won international film festival awards	87–200
Animation film production companies that won international festival awards	26–49
Most influential animation film production companies	22–200
Top-rated streaming services	34–200
Electronic games	32
Developers of the best video games	5
Largest e-sports tournaments	70–200
Developers of the most popular computer games	16–36
Companies participating in electronic games trade shows	87–110
Music	62–200
Most-streamed artists	25–200
Best opera performers	49–200
Fashion	41
Largest fashion companies	29–59
Fashion brands	39–42
Advertising and PR	105–114
Most effective advertising agencies	58–200
Largest PR agencies	72–200
Creative production agencies	30–200
Top advertising agencies	63–86
Architecture	30–37
Pritzker Architecture Prize laureates	9–25
Internationally recognized architects and architecture firms	82–200
Industrial design	49–59
Internationally recognized designers and design firms	49–59
Arts	50
Internationally recognized artists	16–40
Top artists by auction revenue	23–47
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	55–93
Best-selling authors	14–17
Most popular authors	70–200

Urban Environment

0.632

Rank ▲ 38

Cost of doing business	131
Estimated tax	184–187
Salary	76
Cost of living	57
Food prices	67
Apartment rental cost	40
Hotel accommodation	77
Cost of living for an expat	51
Cost of living for a local resident	45
Travel pass	46
Taxi fare	192
Cellular telephone subscription	121
Internet access	72
Tuition at an international school	60
Mobility	35
Air traffic	94
Commute time	43
Public transport	46–47
Metro	22
EV charging stations	81–83
Digitalization	127
Mobile Internet speed	123
Fixed broadband Internet speed	93
Wireless Internet	97
Remote employment	27–29
Digital public and municipal services	N/A
Safety	84
Safety rate	81
Crime rate	71
Natural disaster risk	N/A
Tourist appeal	15
International hotels	90–95
International tourists	24
Culture, entertainment, and sports	4
Ecology and human health	74
Environmental pollution level	111
Green energy	N/A
Quality of healthcare services provision	34
Internationalization	148
Foreign born population	100
International schools	45
English proficiency	173
International business events	36

Benchmarking against the leading city

0.XXX — Index value

▼▲ — Rank change

Osaka

Number of patent applications, 2019–2021 **56,112**

Number of patent applications of the city leading in this technological area

Rank **22**

Washington, DC

0.220

▲ 31

Technological Development

0.302

Rank ⊖ 13

Technology companies	27 ▲
Leading companies by R&D expenditure	22
R&D expenditure of largest innovation companies	32
Startups and venture capital	11 ⊖
Startups	14
Unicorns	23–24
Innovation support funds	8
Business angels	8
Venture capital investment	19
Universities and R&D organizations	7 ▼
Leading universities	17–18
Leading R&D organizations	12–15
Highly cited researchers	4
Nobel Prize laureates and Fields Medal winners	5
Students	28
International students	26
Productivity of the innovative class	18 ⊖
★ Patent activity	32
Publication activity	5
Innovation infrastructure	24 ▲
Clusters and science parks	44–90
Co-working spaces	18–19
Supercomputers	21–39

Creative Industries

0.087

Rank ▲ 47

Film and animation	22 ▼
Top-rated film production companies (audience)	51–200
Film production companies that won international film festival awards	87–200
Animation film production companies that won international festival awards	26–49
Most influential animation film production companies	22–200
Top-rated streaming services	9–21
Electronic games	40 ▲
Developers of the best video games	14–25
Largest e-sports tournaments	41–50
Developers of the most popular computer games	16–36
Companies participating in electronic games trade shows	87–110
Music	35–52 ⊖
Most-streamed artists	25–200
Best opera performers	28–48
Fashion	52–56 ⊖
Largest fashion companies	29–59
Fashion brands	102–135
Advertising and PR	33 ⊖
Most effective advertising agencies	58–200
Largest PR agencies	3
Creative production agencies	30–200
Top advertising agencies	87–200
Architecture	91–200 ⊖
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	82–200
Industrial design	68–82 ▲
Internationally recognized designers and design firms	68–82
Arts	14 ▼
Internationally recognized artists	41–200
Top artists by auction revenue	48–200
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	17–25
Best-selling authors	9
Most popular authors	8

Urban Environment

0.153

Rank ▲ 181

Cost of doing business	200 ▲
Estimated tax	178
Salary	197
Cost of living	184 ▼
Food prices	189
Apartment rental cost	187
Hotel accommodation	104
Cost of living for an expat	165
Cost of living for a local resident	174
Travel pass	141
Taxi fare	151
Cellular telephone subscription	185
Internet access	172
Tuition at an international school	141
Mobility	86 ▲
Air traffic	21
Commute time	163
Public transport	126
Metro	56
EV charging stations	20–21
Digitalization	116 ▼
Mobile Internet speed	N/A
Fixed broadband Internet speed	65
Wireless Internet	47
Remote employment	106
Digital public and municipal services	N/A
Safety	189 ▲
Safety rate	178
Crime rate	179
Natural disaster risk	N/A
Tourist appeal	25 ▼
International hotels	26
International tourists	N/A
Culture, entertainment, and sports	26
Ecology and human health	161 ▲
Environmental pollution level	110
Green energy	84
Quality of healthcare services provision	156
Internationalization	1 ▼
Foreign born population	33
International schools	1
English proficiency	1–62
International business events	52–55

Benchmarking against the leading city

0.XXX — Index value

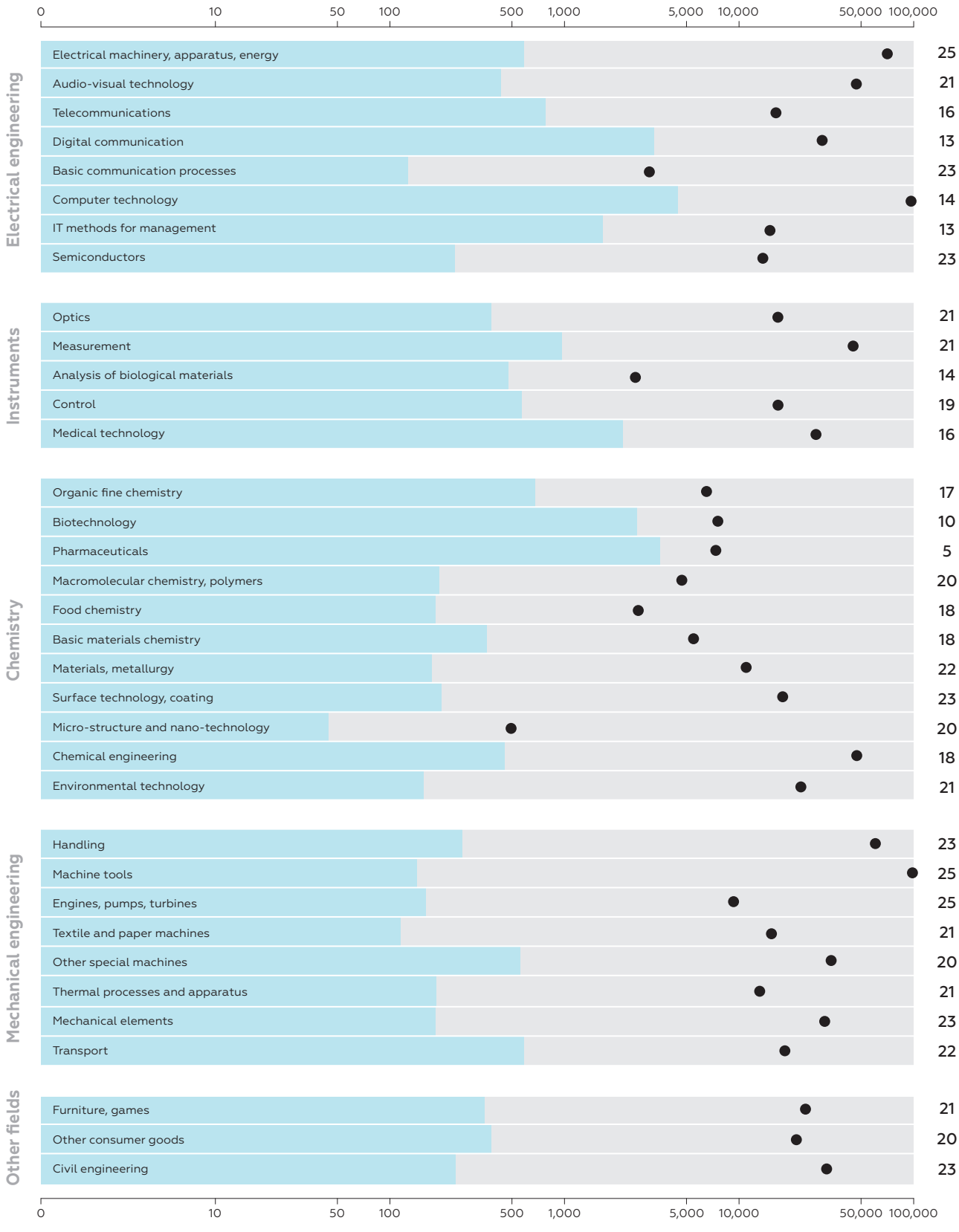
▼▲ — Rank change

Washington, DC

Number of patent applications, 2019–2021 **29,028**

Number of patent applications of the city leading in this technological area

Rank **32**



Dubai

0.206

▼ 32

Technological Development

0.074

Rank ▼ 77

Technology companies	149–200 ▲
Leading companies by R&D expenditure	149–200
R&D expenditure of largest innovation companies	149–200
Startups and venture capital	25 ▲
Startups	10
Unicorns	50–56
Innovation support funds	25
Business angels	42
Venture capital investment	46
Universities and R&D organizations	118 ▼
Leading universities	48–56
Leading R&D organizations	142–200
Highly cited researchers	178–190
Nobel Prize laureates and Fields Medal winners	80–200
Students	164
International students	48
Productivity of the innovative class	181 ▼
Patent activity	170
Publication activity	178
Innovation infrastructure	59–60 ▲
Clusters and science parks	25–43
Co-working spaces	70–72
Supercomputers	63–200

Creative Industries

0.096

Rank ▼ 38

Film and animation	23–24 ▼
Top-rated film production companies (audience)	51–200
Film production companies that won international film festival awards	87–200
Animation film production companies that won international festival awards	50–200
Most influential animation film production companies	22–200
Top-rated streaming services	9–21
Electronic games	91 ▲
Developers of the best video games	26–200
Largest e-sports tournaments	32–37
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	111–144
Music	62–200 ▼
Most-streamed artists	25–200
Best opera performers	49–200
Fashion	57–58 ▼
Largest fashion companies	60–200
Fashion brands	19–20
Advertising and PR	7 ▲
Most effective advertising agencies	3–4
Largest PR agencies	72–200
Creative production agencies	30–200
Top advertising agencies	12–13
Architecture	46–60 ▼
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	30–47
Industrial design	126–161 ▼
Internationally recognized designers and design firms	126–161
Arts	57 ▼
Internationally recognized artists	41–200
Top artists by auction revenue	48–200
Most influential people in contemporary art	17–34
Leading higher education institutions in the arts	36–54
Best-selling authors	56–200
Most popular authors	70–200

Urban Environment

0.958

Rank ▲ 4

Cost of doing business	10 ▬
Estimated tax	1
Salary	160
Cost of living	174 ▼
Food prices	118
Apartment rental cost	179
Hotel accommodation	50
Cost of living for an expat	139
Cost of living for a local resident	168
Travel pass	142
Taxi fare	191
Cellular telephone subscription	184
Internet access	200
Tuition at an international school	73
Mobility	100 ▲
Air traffic	11
Commute time	114
Public transport	143
Metro	78–79
EV charging stations	89
Digitalization	4 ▲
Mobile Internet speed	1
Fixed broadband Internet speed	64
Wireless Internet	7
Remote employment	131
Digital public and municipal services	4–6
Safety	5 ▼
Safety rate	10–11
Crime rate	16
Natural disaster risk	3
Tourist appeal	7 ▼
International hotels	8
International tourists	5
Culture, entertainment, and sports	67
Ecology and human health	150 ▲
Environmental pollution level	113
Green energy	80
Quality of healthcare services provision	114
Internationalization	13 ▼
Foreign born population	1
International schools	14–18
English proficiency	158
International business events	52–55

Benchmarking against the leading city

0.XXX — Index value

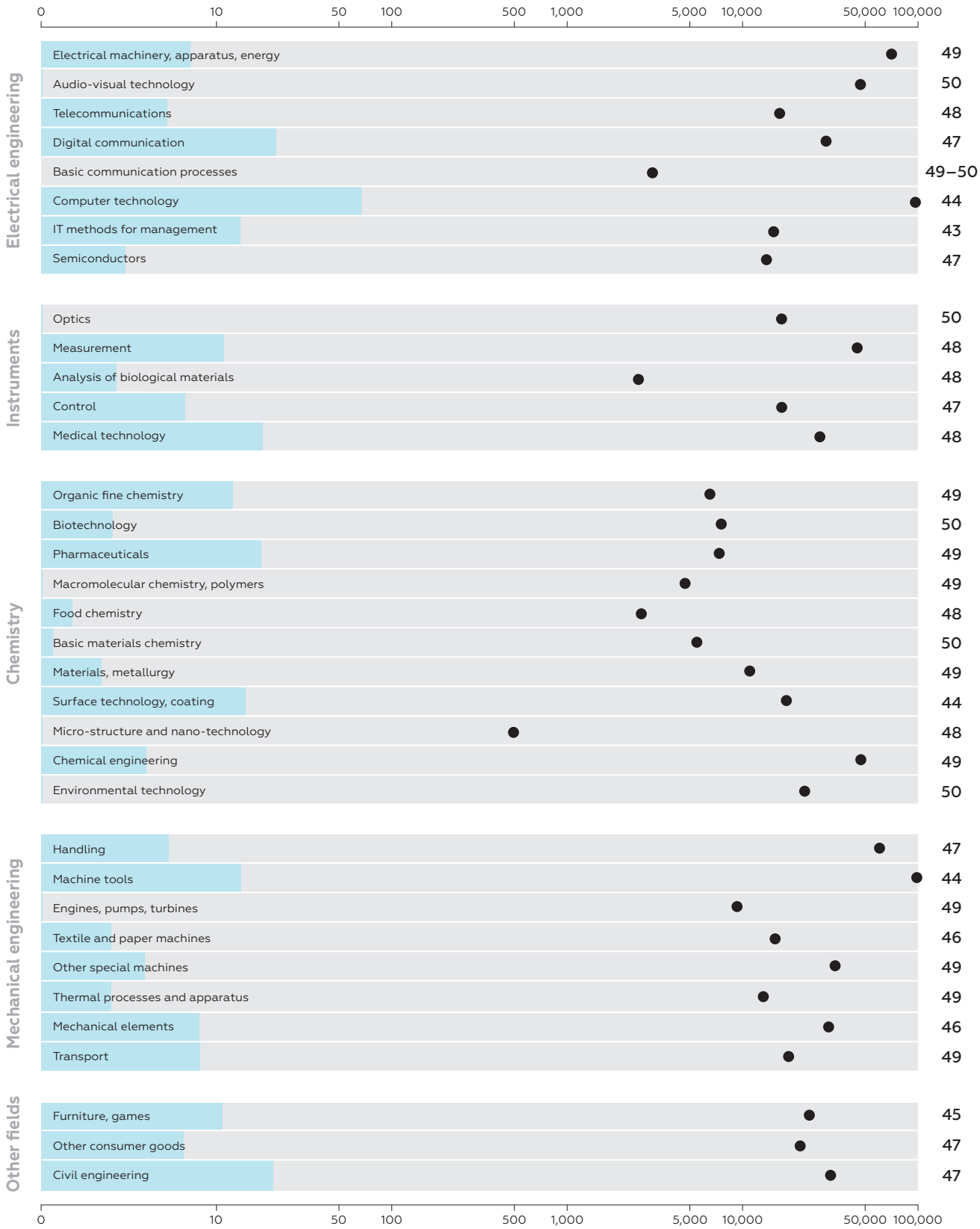
▼▲ — Rank change

Dubai

Number of patent applications, 2019–2021 **326**

Number of patent applications of the city leading in this technological area

Rank **170**



Copenhagen

0.212

▲ 33

Technological Development

0.092

Rank ▲ 60

Technology companies	33 ▼
Leading companies by R&D expenditure	24–25
R&D expenditure of largest innovation companies	35
Startups and venture capital	49 ▲
Startups	48
Unicorns	71–84
Innovation support funds	56
Business angels	33
Venture capital investment	56
Universities and R&D organizations	71 ▲
Leading universities	78–95
Leading R&D organizations	75–86
Highly cited researchers	35–38
Nobel Prize laureates and Fields Medal winners	27–40
Students	111
International students	73
Productivity of the innovative class	69 ▲
★ Patent activity	75
Publication activity	64
Innovation infrastructure	70–72 ▲
Clusters and science parks	25–43
Co-working spaces	83–88
Supercomputers	63–200

Creative Industries

0.144

Rank ▲ 25

Film and animation	37 ▲
Top-rated film production companies (audience)	16–23
Film production companies that won international film festival awards	21–23
Animation film production companies that won international festival awards	16–25
Most influential animation film production companies	22–200
Top-rated streaming services	34–200
Electronic games	39 ▲
Developers of the best video games	26–200
Largest e-sports tournaments	23–31
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	26–31
Music	62–200 ▬
Most-streamed artists	25–200
Best opera performers	49–200
Fashion	9 ▲
Largest fashion companies	29–59
Fashion brands	7
Advertising and PR	25 ▲
Most effective advertising agencies	21–23
Largest PR agencies	72–200
Creative production agencies	11–29
Top advertising agencies	20–22
Architecture	7 ▼
Pritzker Architecture Prize laureates	9–25
Internationally recognized architects and architecture firms	4–6
Industrial design	49–59 ▲
Internationally recognized designers and design firms	49–59
Arts	61 ▼
Internationally recognized artists	16–40
Top artists by auction revenue	48–200
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	36–54
Best-selling authors	56–200
Most popular authors	70–200

Urban Environment

0.736

Rank ▲ 21

Cost of doing business	168 ▼
Estimated tax	160–161
Salary	154
Cost of living	136 ▼
Food prices	185
Apartment rental cost	160
Hotel accommodation	93
Cost of living for an expat	170
Cost of living for a local resident	172
Travel pass	158
Taxi fare	157
Cellular telephone subscription	59
Internet access	96
Tuition at an international school	28
Mobility	33 ▼
Air traffic	44
Commute time	48
Public transport	76–77
Metro	39
EV charging stations	19
Digitalization	12 ▲
Mobile Internet speed	2
Fixed broadband Internet speed	53
Wireless Internet	109–110
Remote employment	139
Digital public and municipal services	3
Safety	41 ▼
Safety rate	46
Crime rate	62
Natural disaster risk	13
Tourist appeal	94 ▼
International hotels	132–134
International tourists	44
Culture, entertainment, and sports	49
Ecology and human health	17 ▲
Environmental pollution level	23
Green energy	11
Quality of healthcare services provision	59
Internationalization	52 ▲
Foreign born population	62
International schools	145–161
English proficiency	77
International business events	12

Benchmarking against the leading city

0.XXX — Index value

▼ ▲ — Rank change

Copenhagen

Number of patent applications, 2019–2021 **4,175**

Number of patent applications of the city leading in this technological area

Rank **75**

São Paulo

0.207

▼ 34

Technological Development

0.128

Rank ▲ 40

Technology companies	121
Leading companies by R&D expenditure	106–122
R&D expenditure of largest innovation companies	129
Startups and venture capital	23
Startups	18
Unicorns	21–22
Innovation support funds	32
Business angels	23
Venture capital investment	21
Universities and R&D organizations	35
Leading universities	29–33
Leading R&D organizations	87–110
Highly cited researchers	117–125
Nobel Prize laureates and Fields Medal winners	80–200
Students	15
International students	110
Productivity of the innovative class	58
★ Patent activity	156–157
Publication activity	48
Innovation infrastructure	35
Clusters and science parks	91–200
Co-working spaces	12–13
Supercomputers	40–62

Creative Industries

0.165

Rank ▼ 22

Film and animation	34
Top-rated film production companies (audience)	24–50
Film production companies that won international film festival awards	36–45
Animation film production companies that won international festival awards	6–8
Most influential animation film production companies	22–200
Top-rated streaming services	34–200
Electronic games	84
Developers of the best video games	26–200
Largest e-sports tournaments	41–50
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	60–75
Music	62–200
Most-streamed artists	25–200
Best opera performers	49–200
Fashion	29–30
Largest fashion companies	29–59
Fashion brands	15–16
Advertising and PR	3
Most effective advertising agencies	11–13
Largest PR agencies	24–35
Creative production agencies	2–3
Top advertising agencies	4
Architecture	17–18
Pritzker Architecture Prize laureates	9–25
Internationally recognized architects and architecture firms	18–20
Industrial design	23–24
Internationally recognized designers and design firms	23–24
Arts	35
Internationally recognized artists	10–15
Top artists by auction revenue	23–47
Most influential people in contemporary art	5–6
Leading higher education institutions in the arts	94–173
Best-selling authors	56–200
Most popular authors	70–200

Urban Environment

0.460

Rank ▲ 87

Cost of doing business	3
Estimated tax	5–6
Salary	10
Cost of living	41
Food prices	26
Apartment rental cost	45
Hotel accommodation	38
Cost of living for an expat	36
Cost of living for a local resident	35–36
Travel pass	81
Taxi fare	51
Cellular telephone subscription	54
Internet access	52
Tuition at an international school	69
Mobility	105
Air traffic	58
Commute time	177
Public transport	59
Metro	50
EV charging stations	81–83
Digitalization	136
Mobile Internet speed	N/A
Fixed broadband Internet speed	87
Wireless Internet	129–130
Remote employment	78–79
Digital public and municipal services	N/A
Safety	198
Safety rate	195
Crime rate	194
Natural disaster risk	N/A
Tourist appeal	28
International hotels	19
International tourists	54
Culture, entertainment, and sports	13
Ecology and human health	118
Environmental pollution level	180
Green energy	8
Quality of healthcare services provision	178
Internationalization	149
Foreign born population	111
International schools	47–48
English proficiency	154
International business events	68–69

Benchmarking against the leading city

0.XXX — Index value

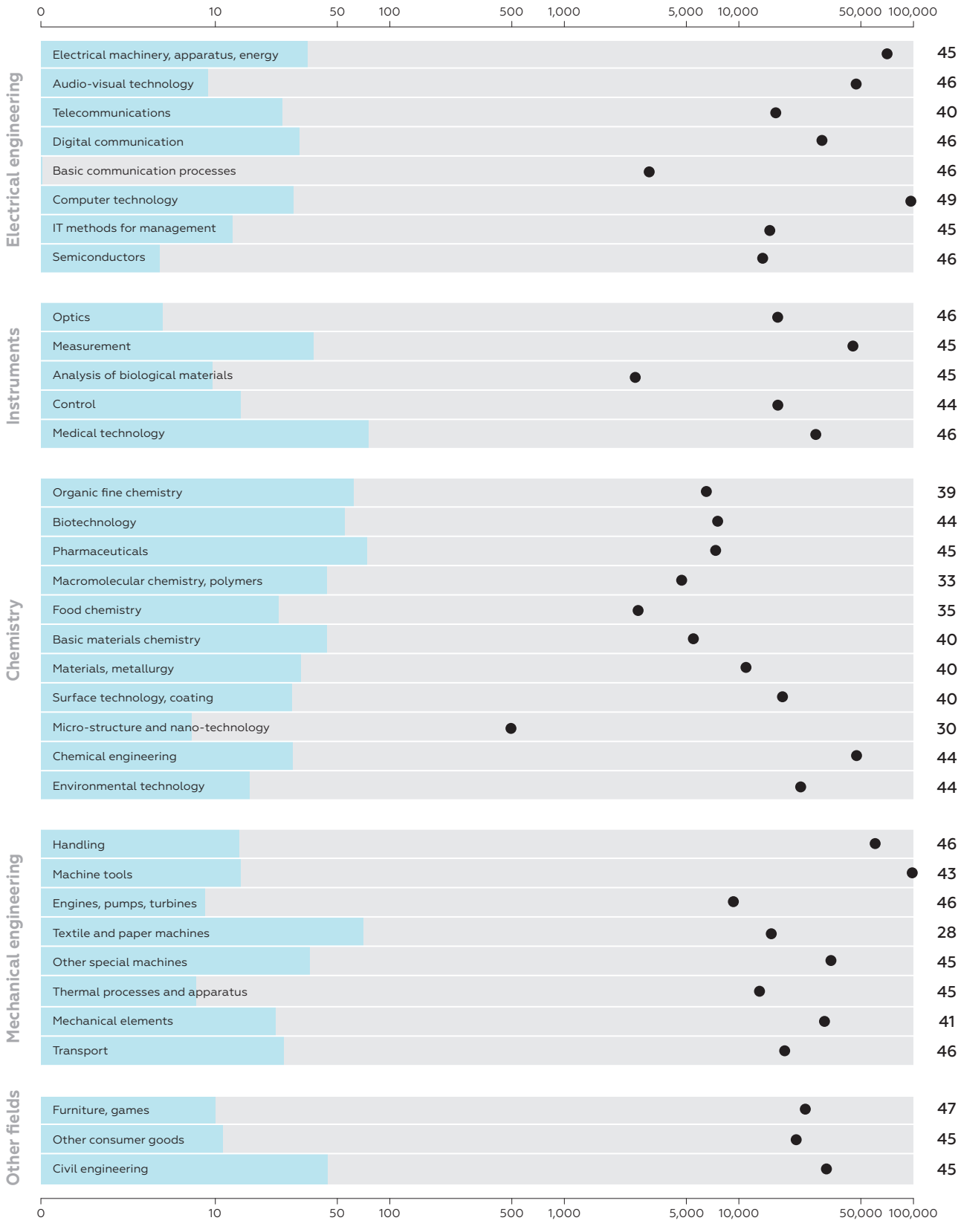
▼▲ — Rank change

São Paulo

Number of patent applications, 2019–2021 **531**

Number of patent applications of the city leading in this technological area

Rank **156–157**



Melbourne

0.209

▲ 35

Technological Development

0.147

Rank ▲ 32

Technology companies	68 ▼
Leading companies by R&D expenditure	67–73
R&D expenditure of largest innovation companies	59
Startups and venture capital	41 ▼
Startups	33
Unicorns	43–49
Innovation support funds	43
Business angels	40
Venture capital investment	61
Universities and R&D organizations	19 ▲
Leading universities	34–42
Leading R&D organizations	87–110
Highly cited researchers	13
Nobel Prize laureates and Fields Medal winners	80–200
Students	24
International students	2
Productivity of the innovative class	50 ▲
★ Patent activity	123
Publication activity	40
Innovation infrastructure	42 ▲
Clusters and science parks	25–43
Co-working spaces	38–39
Supercomputers	63–200

Creative Industries

0.166

Rank ▲ 21

Film and animation	44 –
Top-rated film production companies (audience)	24–50
Film production companies that won international film festival awards	46–57
Animation film production companies that won international festival awards	11–15
Most influential animation film production companies	22–200
Top-rated streaming services	34–200
Electronic games	15 ▼
Developers of the best video games	6–13
Largest e-sports tournaments	70–200
Developers of the most popular computer games	8–15
Companies participating in electronic games trade shows	24–25
Music	32–33 –
Most-streamed artists	11–24
Best opera performers	28–48
Fashion	66 –
Largest fashion companies	60–200
Fashion brands	23–24
Advertising and PR	43 –
Most effective advertising agencies	33–40
Largest PR agencies	36–71
Creative production agencies	30–200
Top advertising agencies	23–26
Architecture	6 –
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	2–3
Industrial design	34–39 ▲
Internationally recognized designers and design firms	34–39
Arts	19 ▼
Internationally recognized artists	41–200
Top artists by auction revenue	12–22
Most influential people in contemporary art	9–16
Leading higher education institutions in the arts	11–16
Best-selling authors	27–55
Most popular authors	31–69

Urban Environment

0.397

Rank ▲ 116

Cost of doing business	185 ▲
Estimated tax	182–183
Salary	155
Cost of living	142 ▼
Food prices	143
Apartment rental cost	145
Hotel accommodation	91
Cost of living for an expat	107
Cost of living for a local resident	122–123
Travel pass	182
Taxi fare	128
Cellular telephone subscription	130–131
Internet access	149–150
Tuition at an international school	126
Mobility	108 ▲
Air traffic	104–107
Commute time	168
Public transport	87
Metro	N/A
EV charging stations	78
Digitalization	183 ▲
Mobile Internet speed	77
Fixed broadband Internet speed	170
Wireless Internet	63
Remote employment	126
Digital public and municipal services	N/A
Safety	140 ▲
Safety rate	123
Crime rate	117
Natural disaster risk	N/A
Tourist appeal	41 ▼
International hotels	32–34
International tourists	N/A
Culture, entertainment, and sports	39
Ecology and human health	93 ▲
Environmental pollution level	57
Green energy	40
Quality of healthcare services provision	113
Internationalization	9 ▼
Foreign born population	14
International schools	14–18
English proficiency	1–62
International business events	58–59

Benchmarking against the leading city

0.XXX — Index value

▼▲ — Rank change

Melbourne

Number of patent applications, 2019–2021 **1,346**

Number of patent applications of the city leading in this technological area

Rank **123**

Vienna

0.201

▲ 36

Technological Development

0.078 — Rank ▲ 73

Technology companies	123 ▼
Leading companies by R&D expenditure	106–122
R&D expenditure of largest innovation companies	133
Startups and venture capital	61 ▲
Startups	69
Unicorns	57–70
Innovation support funds	55
Business angels	56
Venture capital investment	62
Universities and R&D organizations	43 ▲
Leading universities	48–56
Leading R&D organizations	32–37
Highly cited researchers	45–46
Nobel Prize laureates and Fields Medal winners	14–23
Students	82
International students	34
Productivity of the innovative class	64 ▼
★ Patent activity	92
Publication activity	57
Innovation infrastructure	80–81 ▲
Clusters and science parks	91–200
Co-working spaces	52–56
Supercomputers	40–62

Creative Industries

0.093 — Rank ▲ 39

Film and animation	46 ▼
Top-rated film production companies (audience)	24–50
Film production companies that won international film festival awards	21–23
Animation film production companies that won international festival awards	50–200
Most influential animation film production companies	22–200
Top-rated streaming services	34–200
Electronic games	72–75 ▼
Developers of the best video games	26–200
Largest e-sports tournaments	70–200
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	32–36
Music	12 ▲
Most-streamed artists	25–200
Best opera performers	10
Fashion	84–90 ▼
Largest fashion companies	60–200
Fashion brands	60–68
Advertising and PR	35 ▲
Most effective advertising agencies	21–23
Largest PR agencies	72–200
Creative production agencies	30–200
Top advertising agencies	34–36
Architecture	30–37 ▼
Pritzker Architecture Prize laureates	9–25
Internationally recognized architects and architecture firms	82–200
Industrial design	49–59 ▲
Internationally recognized designers and design firms	49–59
Arts	22 ▼
Internationally recognized artists	16–40
Top artists by auction revenue	9–11
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	17–25
Best-selling authors	27–55
Most popular authors	31–69

Urban Environment

0.919 — Rank ▼ 7

Cost of doing business	120 ▼
Estimated tax	104
Salary	101
Cost of living	88 ▲
Food prices	128
Apartment rental cost	99
Hotel accommodation	107
Cost of living for an expat	87–88
Cost of living for a local resident	83
Travel pass	102
Taxi fare	112–113
Cellular telephone subscription	63–64
Internet access	90
Tuition at an international school	83
Mobility	10 –
Air traffic	39–40
Commute time	15
Public transport	28
Metro	20
EV charging stations	27–28
Digitalization	144 ▼
Mobile Internet speed	88
Fixed broadband Internet speed	123
Wireless Internet	62
Remote employment	N/A
Digital public and municipal services	N/A
Safety	54 ▼
Safety rate	69
Crime rate	75
Natural disaster risk	26
Tourist appeal	38 ▲
International hotels	64–65
International tourists	25
Culture, entertainment, and sports	25
Ecology and human health	2 ▲
Environmental pollution level	4
Green energy	N/A
Quality of healthcare services provision	39
Internationalization	17 ▲
Foreign born population	48
International schools	162–177
English proficiency	76
International business events	1

Benchmarking against the leading city

0.XXX — Index value

▼▲ — Rank change

Vienna

Number of patent applications, 2019–2021 **3,029**

Number of patent applications of the city leading in this technological area

Rank **92**

Montreal

0.192

37

Technological Development

0.091

Rank 61

Technology companies	63
Leading companies by R&D expenditure	53–57
R&D expenditure of largest innovation companies	80
Startups and venture capital	44
Startups	39
Unicorns	50–56
Innovation support funds	46
Business angels	38
Venture capital investment	45
Universities and R&D organizations	55
Leading universities	78–95
Leading R&D organizations	111–141
Highly cited researchers	71–73
Nobel Prize laureates and Fields Medal winners	80–200
Students	52
International students	17
Productivity of the innovative class	56
Patent activity	90
Publication activity	49
Innovation infrastructure	61
Clusters and science parks	44–90
Co-working spaces	60
Supercomputers	40–62

Creative Industries

0.105

Rank 35

Film and animation	28
Top-rated film production companies (audience)	16–23
Film production companies that won international film festival awards	58–86
Animation film production companies that won international festival awards	4–5
Most influential animation film production companies	7–11
Top-rated streaming services	34–200
Electronic games	18
Developers of the best video games	26–200
Largest e-sports tournaments	38–40
Developers of the most popular computer games	8–15
Companies participating in electronic games trade shows	21–23
Music	62–200
Most-streamed artists	25–200
Best opera performers	49–200
Fashion	21–23
Largest fashion companies	13–28
Fashion brands	31–32
Advertising and PR	66
Most effective advertising agencies	58–200
Largest PR agencies	24–35
Creative production agencies	30–200
Top advertising agencies	37–49
Architecture	38–45
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	21–29
Industrial design	34–39
Internationally recognized designers and design firms	34–39
Arts	58
Internationally recognized artists	41–200
Top artists by auction revenue	48–200
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	36–54
Best-selling authors	56–200
Most popular authors	31–69

Urban Environment

0.744

Rank 20

Cost of doing business	128
Estimated tax	156–158
Salary	96
Cost of living	122
Food prices	138
Apartment rental cost	111
Hotel accommodation	94
Cost of living for an expat	98
Cost of living for a local resident	107–108
Travel pass	127
Taxi fare	72–75
Cellular telephone subscription	151
Internet access	119
Tuition at an international school	53
Mobility	52
Air traffic	59
Commute time	130
Public transport	48
Metro	28
EV charging stations	39–40
Digitalization	124
Mobile Internet speed	66
Fixed broadband Internet speed	118
Wireless Internet	37
Remote employment	55–56
Digital public and municipal services	N/A
Safety	57
Safety rate	80
Crime rate	78
Natural disaster risk	18–20
Tourist appeal	85
International hotels	75–77
International tourists	58–59
Culture, entertainment, and sports	57
Ecology and human health	41
Environmental pollution level	67
Green energy	2
Quality of healthcare services provision	172
Internationalization	8
Foreign born population	25
International schools	19
English proficiency	1–62
International business events	24

Benchmarking against the leading city

0.XXX — Index value

— Rank change

Montreal

Number of patent applications, 2019–2021 **3,120**

Number of patent applications of the city leading in this technological area

Rank **90**

Warsaw

0.177

▲ 38

Technological Development

0.068

Rank ⊖ 86

Technology companies	140 ▲
Leading companies by R&D expenditure	123–148
R&D expenditure of largest innovation companies	140
Startups and venture capital	75 ▲
Startups	76
Unicorns	85–113
Innovation support funds	65
Business angels	57
Venture capital investment	116
Universities and R&D organizations	45 ▼
Leading universities	48–56
Leading R&D organizations	9–10
Highly cited researchers	166–170
Nobel Prize laureates and Fields Medal winners	41–79
Students	47
International students	103
Productivity of the innovative class	74 ▲
Patent activity	169
Publication activity	66
Innovation infrastructure	92 ▲
Clusters and science parks	91–200
Co-working spaces	42–44
Supercomputers	63–200

Creative Industries

0.130

Rank ▲ 28

Film and animation	12 ▲
Top-rated film production companies (audience)	24–50
Film production companies that won international film festival awards	5–6
Animation film production companies that won international festival awards	26–49
Most influential animation film production companies	22–200
Top-rated streaming services	9–21
Electronic games	12 ▲
Developers of the best video games	14–25
Largest e-sports tournaments	70–200
Developers of the most popular computer games	16–36
Companies participating in electronic games trade shows	5
Music	17–22 ⊖
Most-streamed artists	25–200
Best opera performers	13–18
Fashion	78–83 ⊖
Largest fashion companies	60–200
Fashion brands	50–59
Advertising and PR	20 ⊖
Most effective advertising agencies	14–15
Largest PR agencies	72–200
Creative production agencies	11–29
Top advertising agencies	50–62
Architecture	61–90 ⊖
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	48–81
Industrial design	49–59 ▲
Internationally recognized designers and design firms	49–59
Arts	43 ▲
Internationally recognized artists	16–40
Top artists by auction revenue	23–47
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	26–35
Best-selling authors	56–200
Most popular authors	70–200

Urban Environment

0.638

Rank ▼ 37

Cost of doing business	27 ▼
Estimated tax	38
Salary	69
Cost of living	51 ▼
Food prices	61
Apartment rental cost	104
Hotel accommodation	58
Cost of living for an expat	67
Cost of living for a local resident	98
Travel pass	34
Taxi fare	43–46
Cellular telephone subscription	19
Internet access	32
Tuition at an international school	75
Mobility	42 ▲
Air traffic	63–64
Commute time	102
Public transport	13
Metro	43
EV charging stations	97
Digitalization	75 ▼
Mobile Internet speed	83
Fixed broadband Internet speed	90
Wireless Internet	88
Remote employment	84
Digital public and municipal services	18–20
Safety	36 ▲
Safety rate	55
Crime rate	41
Natural disaster risk	24
Tourist appeal	89 ▼
International hotels	120–126
International tourists	47
Culture, entertainment, and sports	43
Ecology and human health	184 ▲
Environmental pollution level	145
Green energy	70
Quality of healthcare services provision	187
Internationalization	62 ▼
Foreign born population	N/A
International schools	50–53
English proficiency	105–106
International business events	30–31

Benchmarking against the leading city

0.XXX — Index value

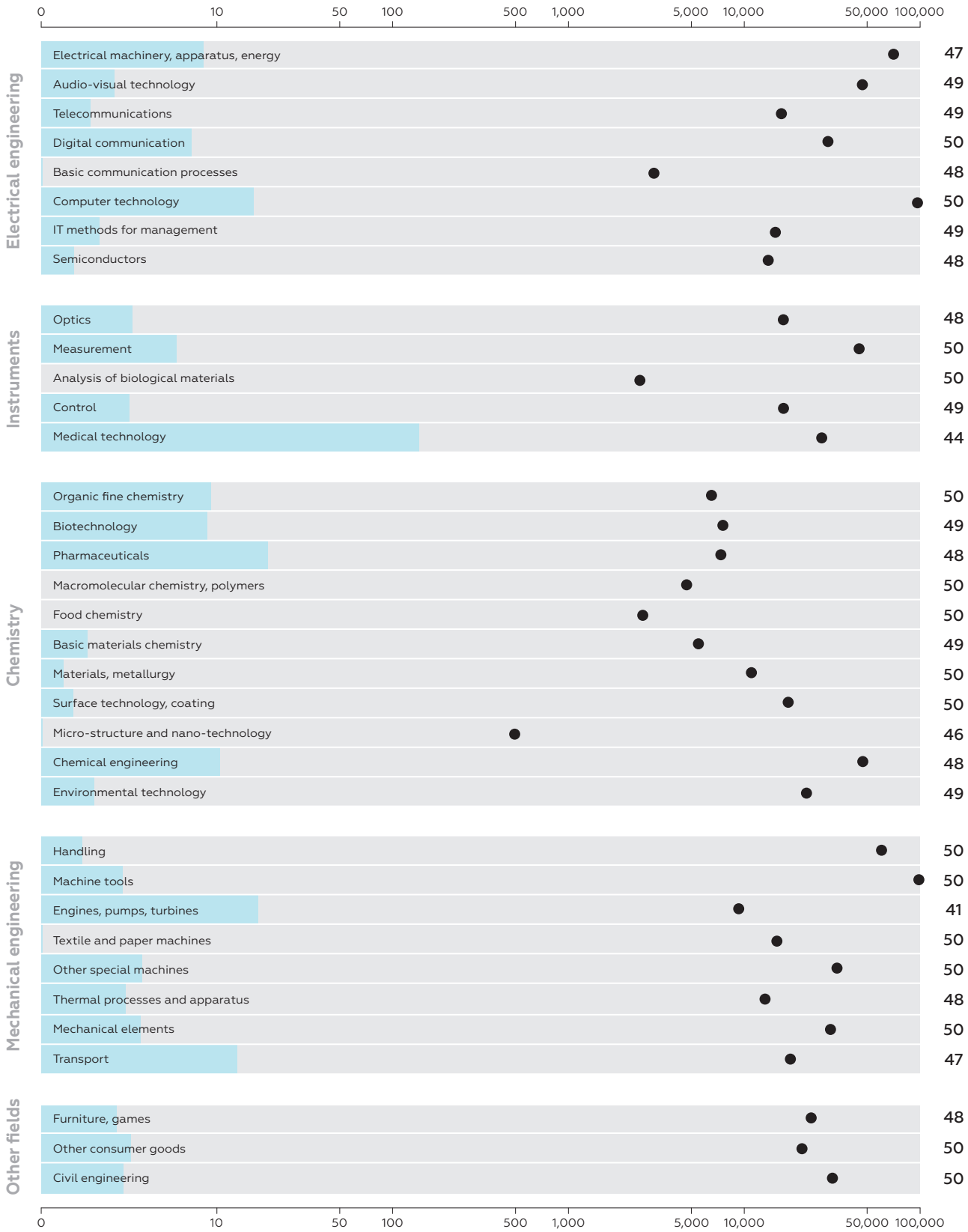
▼ ▲ — Rank change

Warsaw

Number of patent applications, 2019–2021 **328**

Number of patent applications of the city leading in this technological area

Rank **169**



Oslo

0.170

▲ 39

Technological Development

0.062

Rank ▲ 89

Technology companies	79
Leading companies by R&D expenditure	67–73
R&D expenditure of largest innovation companies	97
Startups and venture capital	55
Startups	61
Unicorns	50–56
Innovation support funds	50
Business angels	52–53
Venture capital investment	72
Universities and R&D organizations	134
Leading universities	110–147
Leading R&D organizations	28–31
Highly cited researchers	90–93
Nobel Prize laureates and Fields Medal winners	80–200
Students	179
International students	158
Productivity of the innovative class	111
Patent activity	122
Publication activity	104
Innovation infrastructure	59–60
Clusters and science parks	25–43
Co-working spaces	70–72
Supercomputers	63–200

Creative Industries

0.107

Rank ▬ 34

Film and animation	54
Top-rated film production companies (audience)	51–200
Film production companies that won international film festival awards	36–45
Animation film production companies that won international festival awards	26–49
Most influential animation film production companies	22–200
Top-rated streaming services	34–200
Electronic games	87–89
Developers of the best video games	26–200
Largest e-sports tournaments	70–200
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	47–54
Music	26–31
Most-streamed artists	25–200
Best opera performers	19–27
Fashion	40
Largest fashion companies	29–59
Fashion brands	38
Advertising and PR	57
Most effective advertising agencies	58–200
Largest PR agencies	11–14
Creative production agencies	30–200
Top advertising agencies	50–62
Architecture	21
Pritzker Architecture Prize laureates	9–25
Internationally recognized architects and architecture firms	21–29
Industrial design	21–22
Internationally recognized designers and design firms	21–22
Arts	48
Internationally recognized artists	41–200
Top artists by auction revenue	48–200
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	36–54
Best-selling authors	18–26
Most popular authors	31–69

Urban Environment

0.709

Rank ▼ 23

Cost of doing business	127
Estimated tax	90–91
Salary	140
Cost of living	147
Food prices	173
Apartment rental cost	128
Hotel accommodation	156
Cost of living for an expat	150
Cost of living for a local resident	148
Travel pass	138
Taxi fare	86
Cellular telephone subscription	146
Internet access	125
Tuition at an international school	45
Mobility	31
Air traffic	54–55
Commute time	47
Public transport	25
Metro	54
EV charging stations	58–60
Digitalization	52
Mobile Internet speed	4
Fixed broadband Internet speed	124
Wireless Internet	136
Remote employment	130
Digital public and municipal services	21–23
Safety	62
Safety rate	87
Crime rate	90
Natural disaster risk	5
Tourist appeal	87
International hotels	85–87
International tourists	N/A
Culture, entertainment, and sports	64
Ecology and human health	1
Environmental pollution level	19
Green energy	4
Quality of healthcare services provision	44
Internationalization	63
Foreign born population	32
International schools	85–104
English proficiency	82
International business events	18

Benchmarking against the leading city

0.XXX — Index value

▼▲ — Rank change

Oslo

Number of patent applications, 2019–2021 **1,369**

Number of patent applications of the city leading in this technological area

Rank **122**

Prague

0.168

▼ 40

Technological Development

0.059

Rank ▼ 94

Technology companies	129 ▲
Leading companies by R&D expenditure	123–148
R&D expenditure of largest innovation companies	119
Startups and venture capital	80 ▲
Startups	92
Unicorns	85–113
Innovation support funds	74
Business angels	48
Venture capital investment	114
Universities and R&D organizations	46 ▼
Leading universities	57–77
Leading R&D organizations	7
Highly cited researchers	149–158
Nobel Prize laureates and Fields Medal winners	80–200
Students	69
International students	33
Productivity of the innovative class	85 ▼
Patent activity	183
Publication activity	75
Innovation infrastructure	116 ▲
Clusters and science parks	91–200
Co-working spaces	68–69
Supercomputers	63–200

Creative Industries

0.065

Rank ▼ 61

Film and animation	33 ▼
Top-rated film production companies (audience)	51–200
Film production companies that won international film festival awards	12–20
Animation film production companies that won international festival awards	16–25
Most influential animation film production companies	12–21
Top-rated streaming services	34–200
Electronic games	20 ▼
Developers of the best video games	6–13
Largest e-sports tournaments	70–200
Developers of the most popular computer games	8–15
Companies participating in electronic games trade shows	47–54
Music	62–200 ▼
Most-streamed artists	25–200
Best opera performers	49–200
Fashion	115–142 ▲
Largest fashion companies	60–200
Fashion brands	102–135
Advertising and PR	46–47 ▲
Most effective advertising agencies	28–32
Largest PR agencies	36–71
Creative production agencies	30–200
Top advertising agencies	87–200
Architecture	91–200 ▼
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	82–200
Industrial design	83–102 ▲
Internationally recognized designers and design firms	83–102
Arts	39–40 ▼
Internationally recognized artists	41–200
Top artists by auction revenue	48–200
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	26–35
Best-selling authors	27–55
Most popular authors	31–69

Urban Environment

0.870

Rank ▬ 11

Cost of doing business	31 ▼
Estimated tax	43–45
Salary	65
Cost of living	71 ▼
Food prices	64
Apartment rental cost	89
Hotel accommodation	46
Cost of living for an expat	168
Cost of living for a local resident	87
Travel pass	25
Taxi fare	64–65
Cellular telephone subscription	128
Internet access	51
Tuition at an international school	87
Mobility	13 ▲
Air traffic	70–71
Commute time	74
Public transport	5
Metro	10
EV charging stations	93
Digitalization	111 ▲
Mobile Internet speed	81
Fixed broadband Internet speed	167
Wireless Internet	29
Remote employment	76
Digital public and municipal services	27–29
Safety	22 ▼
Safety rate	38
Crime rate	23
Natural disaster risk	25
Tourist appeal	22 ▼
International hotels	101–104
International tourists	17
Culture, entertainment, and sports	8
Ecology and human health	117 ▲
Environmental pollution level	66
Green energy	75
Quality of healthcare services provision	70
Internationalization	49 ▲
Foreign born population	80
International schools	118–130
English proficiency	114–115
International business events	5

Benchmarking against the leading city

0.XXX — Index value

▼▲ — Rank change

Prague

Number of patent applications, 2019–2021 **158**

Number of patent applications of the city leading in this technological area

Rank **183**

Budapest

0.169

▲ 41

Technological Development

0.091

Rank ▲ 62

Technology companies	133
Leading companies by R&D expenditure	123–148
R&D expenditure of largest innovation companies	130
Startups and venture capital	111
Startups	108
Unicorns	114–200
Innovation support funds	87–88
Business angels	120–125
Venture capital investment	143
Universities and R&D organizations	69
Leading universities	48–56
Leading R&D organizations	24–25
Highly cited researchers	166–170
Nobel Prize laureates and Fields Medal winners	80–200
Students	86
International students	70
Productivity of the innovative class	128
Patent activity	175
Publication activity	120
Innovation infrastructure	18
Clusters and science parks	5–11
Co-working spaces	42–44
Supercomputers	63–200

Creative Industries

0.091

Rank ▲ 41

Film and animation	29
Top-rated film production companies (audience)	51–200
Film production companies that won international film festival awards	8–9
Animation film production companies that won international festival awards	11–15
Most influential animation film production companies	22–200
Top-rated streaming services	34–200
Electronic games	63
Developers of the best video games	26–200
Largest e-sports tournaments	51–69
Developers of the most popular computer games	16–36
Companies participating in electronic games trade shows	111–144
Music	62–200
Most-streamed artists	25–200
Best opera performers	49–200
Fashion	99–114
Largest fashion companies	60–200
Fashion brands	79–101
Advertising and PR	40–41
Most effective advertising agencies	24–27
Largest PR agencies	72–200
Creative production agencies	30–200
Top advertising agencies	63–86
Architecture	91–200
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	82–200
Industrial design	19
Internationally recognized designers and design firms	19
Arts	69–73
Internationally recognized artists	41–200
Top artists by auction revenue	48–200
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	36–54
Best-selling authors	56–200
Most popular authors	70–200

Urban Environment

0.643

Rank ▼ 34

Cost of doing business	12
Estimated tax	28
Salary	46
Cost of living	43
Food prices	45
Apartment rental cost	49
Hotel accommodation	54
Cost of living for an expat	52
Cost of living for a local resident	43
Travel pass	30
Taxi fare	64–65
Cellular telephone subscription	103
Internet access	41
Tuition at an international school	59
Mobility	54
Air traffic	80–82
Commute time	122
Public transport	22
Metro	38
EV charging stations	81–83
Digitalization	108
Mobile Internet speed	129
Fixed broadband Internet speed	66
Wireless Internet	41
Remote employment	95
Digital public and municipal services	35
Safety	72
Safety rate	89
Crime rate	79
Natural disaster risk	49
Tourist appeal	49
International hotels	90–95
International tourists	38
Culture, entertainment, and sports	23
Ecology and human health	162
Environmental pollution level	125
Green energy	N/A
Quality of healthcare services provision	193
Internationalization	110
Foreign born population	93
International schools	118–130
English proficiency	108
International business events	22

Benchmarking against the leading city

0.XXX — Index value

▼ ▲ — Rank change

Budapest

Number of patent applications, 2019–2021 **244**

Number of patent applications of the city leading in this technological area

Rank **175**

Chicago, IL

0.167

▲ 42

Technological Development

0.191

Rank ▼ 19

Technology companies	21
Leading companies by R&D expenditure	23
R&D expenditure of largest innovation companies	24
Startups and venture capital	15
Startups	17
Unicorns	20
Innovation support funds	11
Business angels	13
Venture capital investment	24
Universities and R&D organizations	32
Leading universities	34–42
Leading R&D organizations	87–110
Highly cited researchers	21
Nobel Prize laureates and Fields Medal winners	10
Students	51
International students	57
Productivity of the innovative class	38
★ Patent activity	43
Publication activity	30
Innovation infrastructure	22
Clusters and science parks	91–200
Co-working spaces	18–19
Supercomputers	9–12

Creative Industries

0.086

Rank ▲ 48

Film and animation	108–115
Top-rated film production companies (audience)	24–50
Film production companies that won international film festival awards	87–200
Animation film production companies that won international festival awards	50–200
Most influential animation film production companies	22–200
Top-rated streaming services	34–200
Electronic games	57
Developers of the best video games	6–13
Largest e-sports tournaments	70–200
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	60–75
Music	32–33
Most-streamed artists	11–24
Best opera performers	28–48
Fashion	78–83
Largest fashion companies	60–200
Fashion brands	50–59
Advertising and PR	27
Most effective advertising agencies	41–57
Largest PR agencies	11–14
Creative production agencies	7–10
Top advertising agencies	18–19
Architecture	46–60
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	30–47
Industrial design	46–48
Internationally recognized designers and design firms	46–48
Arts	16
Internationally recognized artists	41–200
Top artists by auction revenue	12–22
Most influential people in contemporary art	9–16
Leading higher education institutions in the arts	17–25
Best-selling authors	14–17
Most popular authors	10–13

Urban Environment

0.231

Rank ▲ 167

Cost of doing business	180
Estimated tax	83
Salary	185
Cost of living	179
Food prices	191
Apartment rental cost	184
Hotel accommodation	121
Cost of living for an expat	151
Cost of living for a local resident	156
Travel pass	148–149
Taxi fare	82–85
Cellular telephone subscription	180
Internet access	159
Tuition at an international school	145
Mobility	120
Air traffic	181–184
Commute time	148
Public transport	98
Metro	46
EV charging stations	22
Digitalization	128
Mobile Internet speed	N/A
Fixed broadband Internet speed	97
Wireless Internet	56
Remote employment	44
Digital public and municipal services	N/A
Safety	163
Safety rate	191
Crime rate	191
Natural disaster risk	32–37
Tourist appeal	31
International hotels	10
International tourists	61
Culture, entertainment, and sports	24
Ecology and human health	170
Environmental pollution level	121
Green energy	82–83
Quality of healthcare services provision	161
Internationalization	7
Foreign born population	43
International schools	4
English proficiency	1–62
International business events	57

Benchmarking against the leading city

0.XXX — Index value

▼▲ — Rank change

Chicago, IL

Number of patent applications, 2019–2021 **17,547**

Number of patent applications of the city leading in this technological area

Rank **43**

Vancouver

0.168

43

Technological Development

0.073

Rank 79

Technology companies	90
Leading companies by R&D expenditure	74–82
R&D expenditure of largest innovation companies	107
Startups and venture capital	37
Startups	32
Unicorns	31–34
Innovation support funds	36
Business angels	34
Venture capital investment	42
Universities and R&D organizations	92
Leading universities	110–147
Leading R&D organizations	111–141
Highly cited researchers	59–63
Nobel Prize laureates and Fields Medal winners	80–200
Students	89
International students	32
Productivity of the innovative class	77
Patent activity	87
Publication activity	73
Innovation infrastructure	77
Clusters and science parks	91–200
Co-working spaces	63–66
Supercomputers	21–39

Creative Industries

0.113

Rank 32

Film and animation	36
Top-rated film production companies (audience)	14–15
Film production companies that won international film festival awards	46–57
Animation film production companies that won international festival awards	16–25
Most influential animation film production companies	7–11
Top-rated streaming services	34–200
Electronic games	9
Developers of the best video games	14–25
Largest e-sports tournaments	51–69
Developers of the most popular computer games	3–5
Companies participating in electronic games trade shows	37–46
Music	62–200
Most-streamed artists	25–200
Best opera performers	49–200
Fashion	42
Largest fashion companies	29–59
Fashion brands	43–45
Advertising and PR	50
Most effective advertising agencies	41–57
Largest PR agencies	72–200
Creative production agencies	11–29
Top advertising agencies	50–62
Architecture	46–60
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	30–47
Industrial design	49–59
Internationally recognized designers and design firms	49–59
Arts	51
Internationally recognized artists	41–200
Top artists by auction revenue	48–200
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	36–54
Best-selling authors	56–200
Most popular authors	21–30

Urban Environment

0.621

Rank 41

Cost of doing business	139
Estimated tax	159
Salary	123
Cost of living	177
Food prices	169
Apartment rental cost	175
Hotel accommodation	163
Cost of living for an expat	157
Cost of living for a local resident	163
Travel pass	176
Taxi fare	99
Cellular telephone subscription	168
Internet access	168
Tuition at an international school	119
Mobility	117
Air traffic	86
Commute time	119
Public transport	103–104
Metro	76
EV charging stations	35–36
Digitalization	94
Mobile Internet speed	61
Fixed broadband Internet speed	75
Wireless Internet	46
Remote employment	65–66
Digital public and municipal services	N/A
Safety	92
Safety rate	118
Crime rate	111
Natural disaster risk	18–20
Tourist appeal	51
International hotels	130–131
International tourists	48
Culture, entertainment, and sports	11
Ecology and human health	13
Environmental pollution level	43
Green energy	3
Quality of healthcare services provision	91
Internationalization	5
Foreign born population	5
International schools	25
English proficiency	1–62
International business events	33

Benchmarking against the leading city

0.XXX — Index value

— Rank change

Vancouver

Number of patent applications, 2019–2021 **3,240**

Number of patent applications of the city leading in this technological area

Rank **87**

Wuhan

0.158

▲ 44

Technological Development

0.156

Rank ▲ 29

Technology companies	54 ▲
Leading companies by R&D expenditure	46–52
R&D expenditure of largest innovation companies	63
Startups and venture capital	115 ▲
Startups	164
Unicorns	50–56
Innovation support funds	102–104
Business angels	175–186
Venture capital investment	66
Universities and R&D organizations	25 ▲
Leading universities	25–28
Leading R&D organizations	28–31
Highly cited researchers	18–19
Nobel Prize laureates and Fields Medal winners	80–200
Students	19
International students	76
Productivity of the innovative class	8 ▲
Patent activity	12
Publication activity	6
Innovation infrastructure	162–165 ▼
Clusters and science parks	91–200
Co-working spaces	130–136
Supercomputers	63–200

Creative Industries

0.019

Rank ▲ 135

Film and animation	116–200 –
Top-rated film production companies (audience)	51–200
Film production companies that won international film festival awards	87–200
Animation film production companies that won international festival awards	50–200
Most influential animation film production companies	22–200
Top-rated streaming services	34–200
Electronic games	105 ▲
Developers of the best video games	26–200
Largest e-sports tournaments	38–40
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	145–200
Music	62–200 –
Most-streamed artists	25–200
Best opera performers	49–200
Fashion	143–200 –
Largest fashion companies	60–200
Fashion brands	136–200
Advertising and PR	115–200 –
Most effective advertising agencies	58–200
Largest PR agencies	72–200
Creative production agencies	30–200
Top advertising agencies	87–200
Architecture	91–200 ▲
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	82–200
Industrial design	68–82 ▲
Internationally recognized designers and design firms	68–82
Arts	99–114 ▼
Internationally recognized artists	41–200
Top artists by auction revenue	48–200
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	55–93
Best-selling authors	56–200
Most popular authors	70–200

Urban Environment

0.588

Rank ▼ 49

Cost of doing business	46 ▼
Estimated tax	106–148
Salary	30
Cost of living	42 ▼
Food prices	34
Apartment rental cost	17
Hotel accommodation	119
Cost of living for an expat	17
Cost of living for a local resident	21
Travel pass	44
Taxi fare	3–4
Cellular telephone subscription	18
Internet access	36
Tuition at an international school	112
Mobility	62 ▼
Air traffic	99
Commute time	84
Public transport	16
Metro	6
EV charging stations	177–178
Digitalization	20 ▼
Mobile Internet speed	19
Fixed broadband Internet speed	20
Wireless Internet	135
Remote employment	N/A
Digital public and municipal services	N/A
Safety	43 ▲
Safety rate	35
Crime rate	24
Natural disaster risk	54–65
Tourist appeal	66 ▼
International hotels	49–51
International tourists	N/A
Culture, entertainment, and sports	69
Ecology and human health	167 ▲
Environmental pollution level	193
Green energy	N/A
Quality of healthcare services provision	90
Internationalization	174 ▼
Foreign born population	N/A
International schools	131–144
English proficiency	160
International business events	129–135

Benchmarking against the leading city

0.XXX — Index value

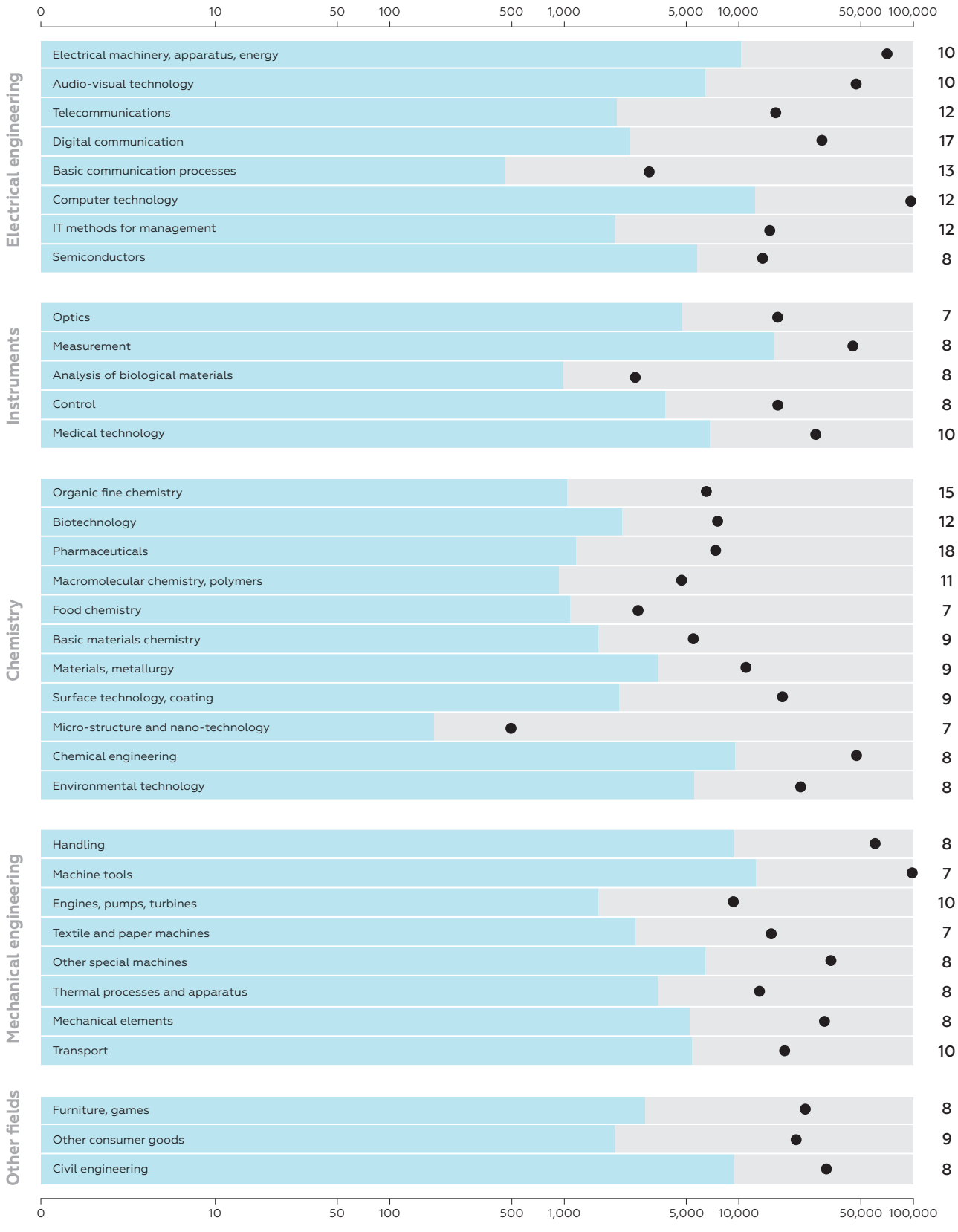
▼ ▲ — Rank change

Wuhan

Number of patent applications, 2019–2021 **162,633**

Number of patent applications of the city leading in this technological area

Rank **12**



Mumbai

0.158

▲ 45

Technological Development

0.096

Rank ▲ 57

Technology companies	41
Leading companies by R&D expenditure	35–38
R&D expenditure of largest innovation companies	48
Startups and venture capital	12
Startups	12
Unicorns	16
Innovation support funds	20
Business angels	7
Venture capital investment	14
Universities and R&D organizations	168
Leading universities	78–95
Leading R&D organizations	75–86
Highly cited researchers	178–190
Nobel Prize laureates and Fields Medal winners	80–200
Students	168
International students	198
Productivity of the innovative class	78
Patent activity	77
Publication activity	77
Innovation infrastructure	75
Clusters and science parks	91–200
Co-working spaces	28–29
Supercomputers	63–200

Creative Industries

0.102

Rank ▲ 36

Film and animation	6
Top-rated film production companies (audience)	7
Film production companies that won international film festival awards	36–45
Animation film production companies that won international festival awards	26–49
Most influential animation film production companies	22–200
Top-rated streaming services	2–3
Electronic games	132–158
Developers of the best video games	26–200
Largest e-sports tournaments	70–200
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	111–144
Music	62–200
Most-streamed artists	25–200
Best opera performers	49–200
Fashion	52–56
Largest fashion companies	29–59
Fashion brands	102–135
Advertising and PR	13
Most effective advertising agencies	11–13
Largest PR agencies	36–71
Creative production agencies	11–29
Top advertising agencies	15–17
Architecture	61–90
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	48–81
Industrial design	60–67
Internationally recognized designers and design firms	60–67
Arts	92
Internationally recognized artists	16–40
Top artists by auction revenue	48–200
Most influential people in contemporary art	17–34
Leading higher education institutions in the arts	94–173
Best-selling authors	56–200
Most popular authors	70–200

Urban Environment

0.494

Rank ▲ 73

Cost of doing business	47
Estimated tax	106–148
Salary	31
Cost of living	9
Food prices	8
Apartment rental cost	46
Hotel accommodation	47
Cost of living for an expat	29
Cost of living for a local resident	31–32
Travel pass	1
Taxi fare	22–26
Cellular telephone subscription	3
Internet access	10
Tuition at an international school	7
Mobility	94
Air traffic	72–73
Commute time	187
Public transport	65
Metro	33
EV charging stations	27–28
Digitalization	162
Mobile Internet speed	124
Fixed broadband Internet speed	172
Wireless Internet	10
Remote employment	58
Digital public and municipal services	N/A
Safety	112
Safety rate	125
Crime rate	124
Natural disaster risk	68
Tourist appeal	63
International hotels	180–182
International tourists	15
Culture, entertainment, and sports	134
Ecology and human health	193
Environmental pollution level	187
Green energy	87
Quality of healthcare services provision	153
Internationalization	55
Foreign born population	N/A
International schools	9
English proficiency	112
International business events	143–148

Benchmarking against the leading city

0.XXX — Index value

▼▲ — Rank change

Mumbai

Number of patent applications, 2019–2021 **4,074**

Number of patent applications of the city leading in this technological area

Rank **77**

Helsinki

0.161

46

Technological Development

0.068

Rank 85

Technology companies	37
Leading companies by R&D expenditure	35–38
R&D expenditure of largest innovation companies	39
Startups and venture capital	47
Startups	55
Unicorns	57–70
Innovation support funds	42
Business angels	39
Venture capital investment	52
Universities and R&D organizations	153
Leading universities	110–147
Leading R&D organizations	49–58
Highly cited researchers	104–108
Nobel Prize laureates and Fields Medal winners	80–200
Students	143
International students	146
Productivity of the innovative class	87
Patent activity	60
Publication activity	96
Innovation infrastructure	74
Clusters and science parks	44–90
Co-working spaces	52–56
Supercomputers	63–200

Creative Industries

0.066

Rank 57

Film and animation	63–66
Top-rated film production companies (audience)	51–200
Film production companies that won international film festival awards	31–35
Animation film production companies that won international festival awards	50–200
Most influential animation film production companies	22–200
Top-rated streaming services	34–200
Electronic games	49
Developers of the best video games	14–25
Largest e-sports tournaments	32–37
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	55–59
Music	62–200
Most-streamed artists	25–200
Best opera performers	49–200
Fashion	91–98
Largest fashion companies	60–200
Fashion brands	69–78
Advertising and PR	30
Most effective advertising agencies	17–20
Largest PR agencies	36–71
Creative production agencies	30–200
Top advertising agencies	63–86
Architecture	38–45
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	21–29
Industrial design	60–67
Internationally recognized designers and design firms	60–67
Arts	69–73
Internationally recognized artists	41–200
Top artists by auction revenue	48–200
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	36–54
Best-selling authors	56–200
Most popular authors	70–200

Urban Environment

0.776

Rank 16

Cost of doing business	101
Estimated tax	89
Salary	119
Cost of living	78
Food prices	144
Apartment rental cost	98
Hotel accommodation	67
Cost of living for an expat	83
Cost of living for a local resident	114
Travel pass	134
Taxi fare	76
Cellular telephone subscription	123
Internet access	47
Tuition at an international school	26
Mobility	34
Air traffic	63–64
Commute time	31–33
Public transport	37
Metro	51
EV charging stations	45
Digitalization	40
Mobile Internet speed	29
Fixed broadband Internet speed	141
Wireless Internet	111
Remote employment	N/A
Digital public and municipal services	13–15
Safety	26
Safety rate	39
Crime rate	46
Natural disaster risk	6
Tourist appeal	98
International hotels	88–89
International tourists	N/A
Culture, entertainment, and sports	91
Ecology and human health	32
Environmental pollution level	1
Green energy	27
Quality of healthcare services provision	28
Internationalization	71
Foreign born population	69–70
International schools	85–104
English proficiency	97–99
International business events	14

Benchmarking against the leading city

0.XXX — Index value

— Rank change

Helsinki

Number of patent applications, 2019–2021 **7,141**

Number of patent applications of the city leading in this technological area

Rank **60**

Chengdu

0.157

▲ 47

Technological Development

0.111

Rank ▲ 50

Technology companies	59
Leading companies by R&D expenditure	53–57
R&D expenditure of largest innovation companies	66
Startups and venture capital	89
Startups	139
Unicorns	40–42
Innovation support funds	94
Business angels	171–174
Venture capital investment	47
Universities and R&D organizations	47
Leading universities	43–47
Leading R&D organizations	59–74
Highly cited researchers	54–55
Nobel Prize laureates and Fields Medal winners	80–200
Students	25
International students	96
Productivity of the innovative class	14
Patent activity	17
Publication activity	14
Innovation infrastructure	162–165
Clusters and science parks	91–200
Co-working spaces	130–136
Supercomputers	63–200

Creative Industries

0.037

Rank ▲ 88

Film and animation	116–200
Top-rated film production companies (audience)	51–200
Film production companies that won international film festival awards	87–200
Animation film production companies that won international festival awards	50–200
Most influential animation film production companies	22–200
Top-rated streaming services	34–200
Electronic games	41
Developers of the best video games	26–200
Largest e-sports tournaments	7–9
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	111–144
Music	62–200
Most-streamed artists	25–200
Best opera performers	49–200
Fashion	143–200
Largest fashion companies	60–200
Fashion brands	136–200
Advertising and PR	115–200
Most effective advertising agencies	58–200
Largest PR agencies	72–200
Creative production agencies	30–200
Top advertising agencies	87–200
Architecture	46–60
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	30–47
Industrial design	68–82
Internationally recognized designers and design firms	68–82
Arts	124–125
Internationally recognized artists	41–200
Top artists by auction revenue	12–22
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	94–173
Best-selling authors	56–200
Most popular authors	70–200

Urban Environment

0.687

Rank ▼ 25

Cost of doing business	48
Estimated tax	106–148
Salary	33
Cost of living	29
Food prices	41
Apartment rental cost	10
Hotel accommodation	9
Cost of living for an expat	22
Cost of living for a local resident	29
Travel pass	35
Taxi fare	6–10
Cellular telephone subscription	39–40
Internet access	20
Tuition at an international school	120
Mobility	70
Air traffic	52–53
Commute time	123
Public transport	27
Metro	8
EV charging stations	170
Digitalization	16
Mobile Internet speed	38
Fixed broadband Internet speed	21
Wireless Internet	103
Remote employment	5
Digital public and municipal services	N/A
Safety	28
Safety rate	20
Crime rate	17
Natural disaster risk	54–65
Tourist appeal	34
International hotels	7
International tourists	64–65
Culture, entertainment, and sports	100
Ecology and human health	155
Environmental pollution level	173
Green energy	N/A
Quality of healthcare services provision	148
Internationalization	172
Foreign born population	N/A
International schools	47–48
English proficiency	175
International business events	122–128

Benchmarking against the leading city

0.XXX — Index value

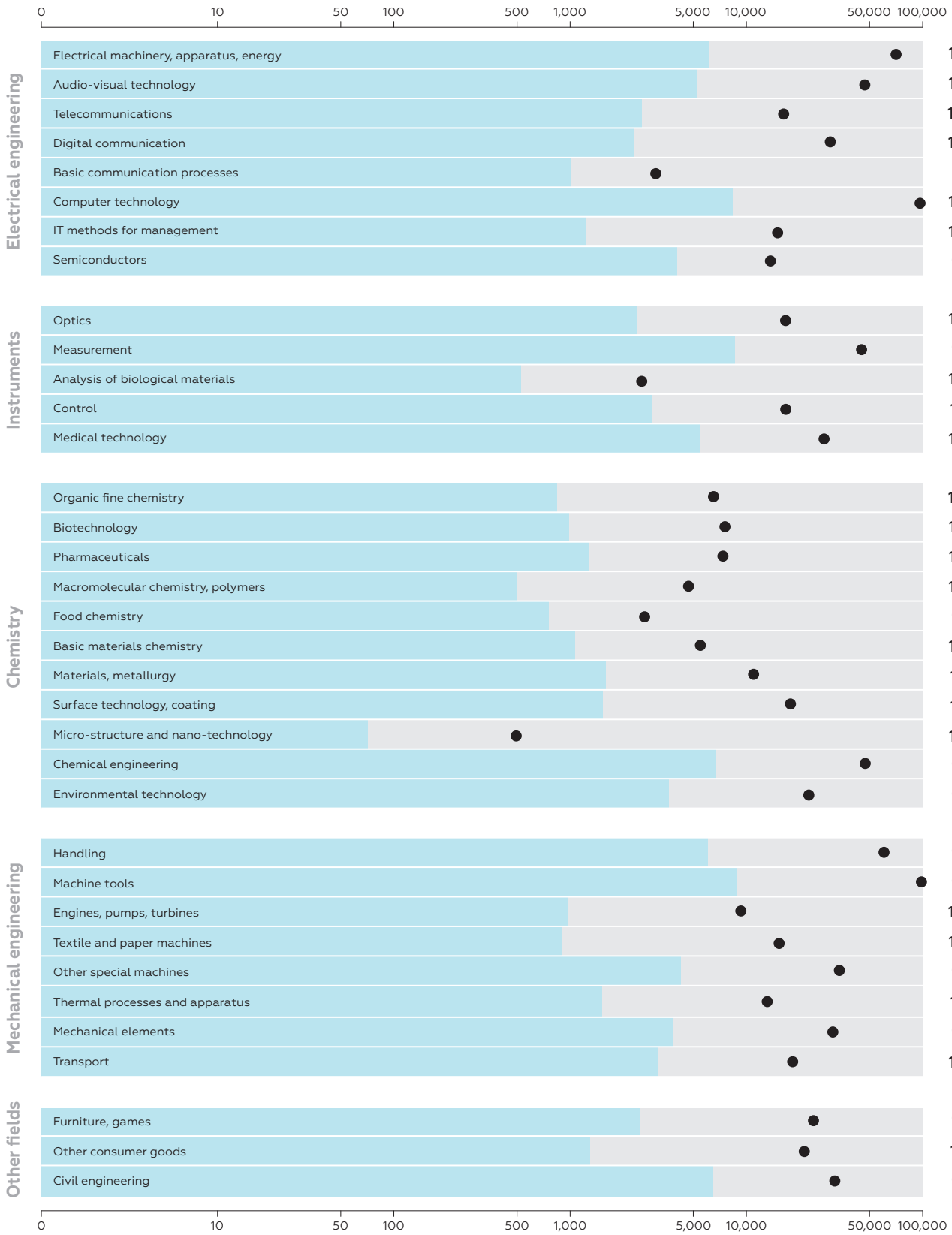
▼▲ — Rank change

Chengdu

Number of patent applications, 2019–2021 **109,366**

Number of patent applications of the city leading in this technological area

Rank **17**



Hamburg

0.157

▲ 48

Technological Development

0.055

Rank ▲ 100

Technology companies	75 ▲
Leading companies by R&D expenditure	58–66
R&D expenditure of largest innovation companies	98
Startups and venture capital	57 ▲
Startups	50
Unicorns	71–84
Innovation support funds	59–60
Business angels	59
Venture capital investment	80
Universities and R&D organizations	138 ▲
Leading universities	110–147
Leading R&D organizations	44–48
Highly cited researchers	137–144
Nobel Prize laureates and Fields Medal winners	41–79
Students	150
International students	123
Productivity of the innovative class	98 ▼
Patent activity	84
Publication activity	94
Innovation infrastructure	78 ▲
Clusters and science parks	91–200
Co-working spaces	68–69
Supercomputers	21–39

Creative Industries

0.123

Rank ▼ 30

Film and animation	80 ▼
Top-rated film production companies (audience)	24–50
Film production companies that won international film festival awards	46–57
Animation film production companies that won international festival awards	50–200
Most influential animation film production companies	22–200
Top-rated streaming services	34–200
Electronic games	17 ▼
Developers of the best video games	26–200
Largest e-sports tournaments	41–50
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	4
Music	17–22 –
Most-streamed artists	25–200
Best opera performers	13–18
Fashion	74–75 ▲
Largest fashion companies	60–200
Fashion brands	39–42
Advertising and PR	21 ▼
Most effective advertising agencies	24–27
Largest PR agencies	7
Creative production agencies	30–200
Top advertising agencies	14
Architecture	91–200 –
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	82–200
Industrial design	20 ▼
Internationally recognized designers and design firms	20
Arts	77–81 ▲
Internationally recognized artists	41–200
Top artists by auction revenue	48–200
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	55–93
Best-selling authors	56–200
Most popular authors	31–69

Urban Environment

0.578

Rank ▲ 52

Cost of doing business	66 ▼
Estimated tax	18–27
Salary	129
Cost of living	95 ▼
Food prices	124
Apartment rental cost	97
Hotel accommodation	N/A
Cost of living for an expat	N/A
Cost of living for a local resident	N/A
Travel pass	83–89
Taxi fare	177–178
Cellular telephone subscription	111
Internet access	124
Tuition at an international school	N/A
Mobility	24 ▲
Air traffic	65–67
Commute time	82
Public transport	33
Metro	21
EV charging stations	43–44
Digitalization	175 ▲
Mobile Internet speed	92
Fixed broadband Internet speed	145
Wireless Internet	78
Remote employment	94
Digital public and municipal services	N/A
Safety	131 ▲
Safety rate	119
Crime rate	108
Natural disaster risk	N/A
Tourist appeal	62 ▲
International hotels	49–51
International tourists	N/A
Culture, entertainment, and sports	61
Ecology and human health	33 ▼
Environmental pollution level	47
Green energy	N/A
Quality of healthcare services provision	62
Internationalization	112 ▲
Foreign born population	49
International schools	131–144
English proficiency	96
International business events	52–55

Benchmarking against the leading city

0.XXX — Index value

▼ ▲ — Rank change

Hamburg

Number of patent applications, 2019–2021 **3,367**

Number of patent applications of the city leading in this technological area

Rank **84**

Nagoya

0.154

▲ 49

Technological Development

0.094 — Rank ▲ 58

Technology companies	24
Leading companies by R&D expenditure	29
R&D expenditure of largest innovation companies	16
Startups and venture capital	169
Startups	154
Unicorns	114–200
Innovation support funds	155–161
Business angels	161–162
Venture capital investment	169
Universities and R&D organizations	80
Leading universities	29–33
Leading R&D organizations	87–110
Highly cited researchers	117–125
Nobel Prize laureates and Fields Medal winners	27–40
Students	105
International students	166
Productivity of the innovative class	41
Patent activity	23
Publication activity	84
Innovation infrastructure	76
Clusters and science parks	91–200
Co-working spaces	89–93
Supercomputers	13–20

Creative Industries

0.025 — Rank ▲ 122

Film and animation	116–200
Top-rated film production companies (audience)	51–200
Film production companies that won international film festival awards	87–200
Animation film production companies that won international festival awards	50–200
Most influential animation film production companies	22–200
Top-rated streaming services	34–200
Electronic games	159–200
Developers of the best video games	26–200
Largest e-sports tournaments	70–200
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	145–200
Music	62–200
Most-streamed artists	25–200
Best opera performers	49–200
Fashion	143–200
Largest fashion companies	60–200
Fashion brands	136–200
Advertising and PR	115–200
Most effective advertising agencies	58–200
Largest PR agencies	72–200
Creative production agencies	30–200
Top advertising agencies	87–200
Architecture	91–200
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	82–200
Industrial design	40–45
Internationally recognized designers and design firms	40–45
Arts	136–176
Internationally recognized artists	41–200
Top artists by auction revenue	48–200
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	94–173
Best-selling authors	56–200
Most popular authors	70–200

Urban Environment

0.786 — Rank ▲ 15

Cost of doing business	134
Estimated tax	184–187
Salary	77
Cost of living	65
Food prices	63
Apartment rental cost	59
Hotel accommodation	55
Cost of living for an expat	56
Cost of living for a local resident	59
Travel pass	122
Taxi fare	180–181
Cellular telephone subscription	122
Internet access	58
Tuition at an international school	88
Mobility	15
Air traffic	127–131
Commute time	3
Public transport	N/A
Metro	N/A
EV charging stations	39–40
Digitalization	21
Mobile Internet speed	122
Fixed broadband Internet speed	59
Wireless Internet	106
Remote employment	1–2
Digital public and municipal services	N/A
Safety	1
Safety rate	1
Crime rate	N/A
Natural disaster risk	N/A
Tourist appeal	91
International hotels	105–107
International tourists	N/A
Culture, entertainment, and sports	50
Ecology and human health	12
Environmental pollution level	61
Green energy	N/A
Quality of healthcare services provision	10
Internationalization	183
Foreign born population	106
International schools	85–104
English proficiency	178
International business events	113–121

Benchmarking against the leading city

0.XXX — Index value

▼▲ — Rank change

Nagoya

Number of patent applications, 2019–2021 **53,874**

Number of patent applications of the city leading in this technological area

Rank **23**

Bangkok

0.153

▲ 50

Technological Development

0.090

Rank ▲ 64

Technology companies	149–200 ▼
Leading companies by R&D expenditure	149–200
R&D expenditure of largest innovation companies	149–200
Startups and venture capital	88 ▼
Startups	103
Unicorns	57–70
Innovation support funds	91
Business angels	79–80
Venture capital investment	78
Universities and R&D organizations	50 ▲
Leading universities	34–42
Leading R&D organizations	49–58
Highly cited researchers	178–190
Nobel Prize laureates and Fields Medal winners	80–200
Students	22
International students	154
Productivity of the innovative class	76 ▼
Patent activity	158
Publication activity	69
Innovation infrastructure	36 ▲
Clusters and science parks	25–43
Co-working spaces	40
Supercomputers	40–62

Creative Industries

0.055

Rank ▲ 67

Film and animation	72–75 −
Top-rated film production companies (audience)	51–200
Film production companies that won international film festival awards	36–45
Animation film production companies that won international festival awards	50–200
Most influential animation film production companies	22–200
Top-rated streaming services	34–200
Electronic games	68 −
Developers of the best video games	26–200
Largest e-sports tournaments	16–20
Developers of the most popular computer games	37–200
Companies participating in electronic games trade shows	111–144
Music	62–200 −
Most-streamed artists	25–200
Best opera performers	49–200
Fashion	99–114 −
Largest fashion companies	60–200
Fashion brands	79–101
Advertising and PR	60 −
Most effective advertising agencies	58–200
Largest PR agencies	36–71
Creative production agencies	30–200
Top advertising agencies	23–26
Architecture	29 −
Pritzker Architecture Prize laureates	26–200
Internationally recognized architects and architecture firms	18–20
Industrial design	49–59 ▲
Internationally recognized designers and design firms	49–59
Arts	69–73 ▼
Internationally recognized artists	41–200
Top artists by auction revenue	48–200
Most influential people in contemporary art	35–200
Leading higher education institutions in the arts	36–54
Best-selling authors	56–200
Most popular authors	70–200

Urban Environment

0.677

Rank ▲ 27

Cost of doing business	17 ▲
Estimated tax	62–70
Salary	15
Cost of living	32 ▲
Food prices	29
Apartment rental cost	51
Hotel accommodation	4–5
Cost of living for an expat	34
Cost of living for a local resident	42
Travel pass	51
Taxi fare	61
Cellular telephone subscription	36
Internet access	35
Tuition at an international school	80
Mobility	118 ▼
Air traffic	38
Commute time	162
Public transport	130
Metro	63–65
EV charging stations	50
Digitalization	69 ▲
Mobile Internet speed	126
Fixed broadband Internet speed	41
Wireless Internet	15
Remote employment	54
Digital public and municipal services	34
Safety	96 −
Safety rate	105
Crime rate	105
Natural disaster risk	53
Tourist appeal	5 ▼
International hotels	27–28
International tourists	2
Culture, entertainment, and sports	71
Ecology and human health	169 ▲
Environmental pollution level	176
Green energy	66
Quality of healthcare services provision	56
Internationalization	164 ▼
Foreign born population	115
International schools	61–70
English proficiency	176
International business events	32

Benchmarking against the leading city

0.XXX — Index value

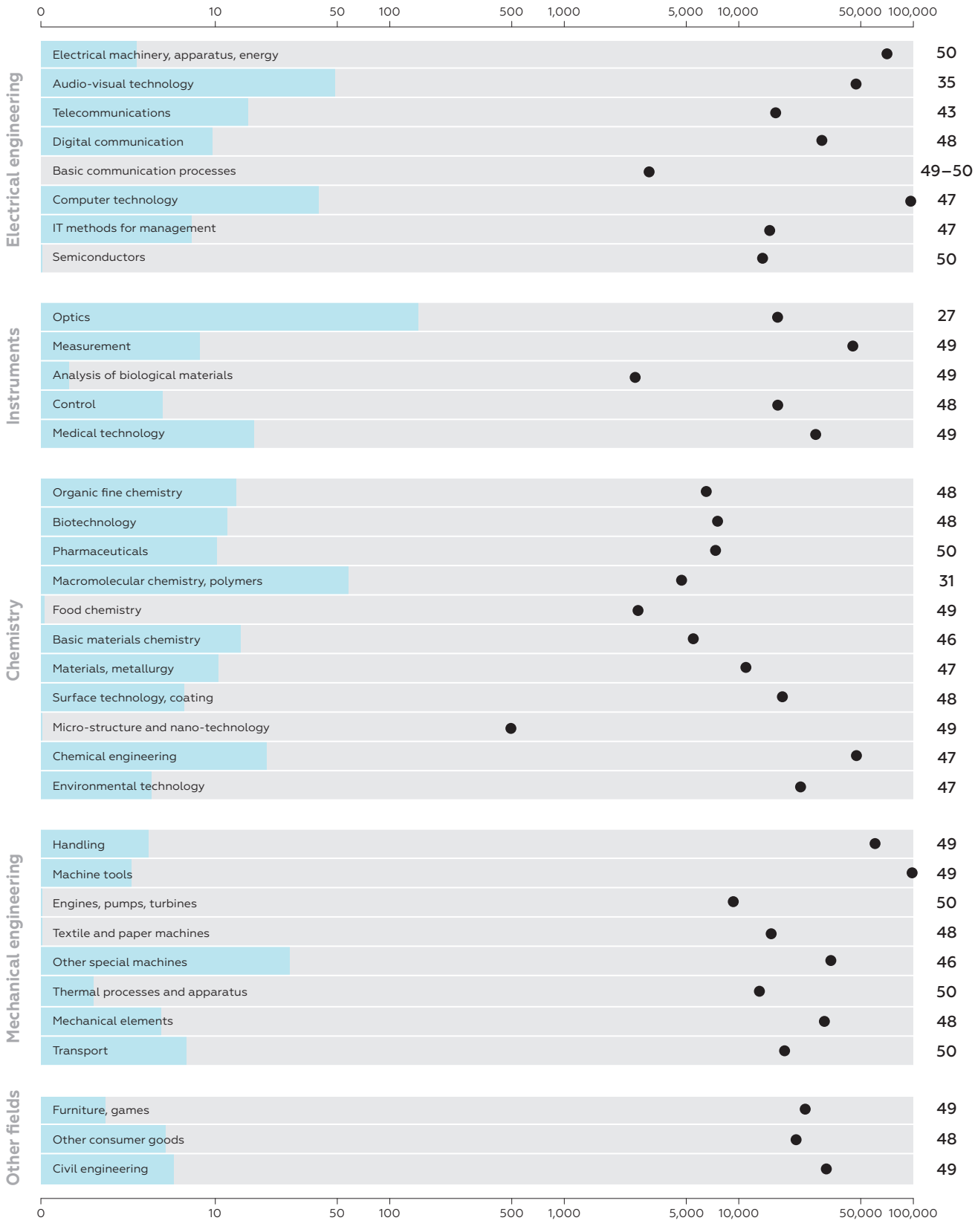
▼ ▲ — Rank change

Bangkok

Number of patent applications, 2019–2021 **526**

Number of patent applications of the city leading in this technological area

Rank **158**



Appendix

Top 1,000+ HSE GCII 2024 Centers of Innovation

HSE GCII 2024 Rank	City, country
1	London, United Kingdom
2	New York, NY, United States
3	Tokyo, Japan
4	Beijing, China
5	San Francisco, CA, United States
6	Paris, France
7	Shanghai, China
8	Los Angeles, CA, United States
9	Moscow, Russia
10	Seoul, South Korea
11	Shenzhen, China
12	Hong Kong, China
13	Guangzhou, China
14	Singapore, Singapore
15	Berlin, Germany
16	Boston, MA, United States
17	Madrid, Spain
18	Istanbul, Türkiye
19	Munich, Germany
20	Milan, Italy
21	Taipei, China
22	Hangzhou, China
23	Toronto, Canada
24	Stockholm, Sweden
25	Suzhou, China
26	Sydney, Australia
27	Amsterdam, Netherlands
28	Barcelona, Spain
29	Nanjing, China
30	Osaka, Japan
31	Washington D.C., United States
32	Dubai, UAE
33	Copenhagen, Denmark
34	São Paulo, Brazil
35	Melbourne, Australia
36	Vienna, Austria
37	Montreal, Canada
38	Warsaw, Poland
39	Oslo, Norway
40	Prague, Czech Republic
41	Budapest, Hungary
42	Chicago, IL, United States
43	Vancouver, Canada
44	Wuhan, China
45	Mumbai, India
46	Helsinki, Finland
47	Chengdu, China
48	Hamburg, Germany
49	Nagoya, Japan
50	Bangkok, Thailand

HSE GCII 2024 Rank	City, country
51	Lisbon, Portugal
52	Buenos Aires, Argentina
53	Dublin, Ireland
54	Seattle, WA, United States
55	Hsinchu, China
56	Rome, Italy
57	Vilnius, Lithuania
58	Zürich, Switzerland
59	Frankfurt am Main, Germany
60	Brussels, Belgium
61	Xi'an, China
62	Kyiv, Ukraine
63	Porto, Portugal
64	Dallas, TX, United States
65	Rio de Janeiro, Brazil
66	Tianjin, China
67	Mexico City, Mexico
68	Stuttgart, Germany
69	Essen-Dortmund, Germany
70	Delhi, India
71	Qingdao, China
72	Bucharest, Romania
73	Saint Petersburg, Russia
74	Sofia, Bulgaria
75	Cologne, Germany
76	Chongqing, China
77	Austin, TX, United States
78	Tel Aviv, Israel
79	Auckland, New Zealand
80	Kuala Lumpur, Malaysia
81	Bogotá D.C., Colombia
82	Edinburgh, United Kingdom
83	Philadelphia, DE, United States
84	Gothenburg, Sweden
85	San Diego, CA, United States
86	Düsseldorf, Germany
87	Athens, Greece
88	Xiamen, China
89	Santiago, Chile
90	Dalian, China
91	Cairo, Egypt
92	Geneva, Switzerland
93	Eindhoven, Netherlands
94	Ghent, Belgium
95	Utrecht, Netherlands
96	Houston, TX, United States
97	Brno, Czech Republic
98	Cambridge, United Kingdom
99	Riyadh, Saudi Arabia
100	Ankara, Türkiye

(continued)

HSE GCII 2024 Rank	City, country
101	Changsha, China
102	Daejeon, South Korea
103	Birmingham, United Kingdom
104	Brisbane, Australia
105	Nijmegen, Netherlands
106	Tehran, Iran
107	Taichung-Changhua, China
108	Dresden, Germany
109	Miami, FL, United States
110	Kraków, Poland
111	Luxembourg, Luxembourg
112	València, Spain
113	Lyon, France
114	The Hague, Netherlands
115	Aarhus, Denmark
116	Glasgow, United Kingdom
117	Ottawa, Canada
118	Liverpool, United Kingdom
119	Belgrade, Serbia
120	Rotterdam, Netherlands
121	Lima, Peru
122	Toulouse, France
123	Denver, CO, United States
124	Mainz, Germany
125	Atlanta, GA, United States
126	Nuremberg, Germany
127	Groningen, Netherlands
128	Leipzig, Germany
129	Braunschweig-Salzgitter-Wolfsburg, Germany
130	Leuven, Belgium
131	Heidelberg, Germany
132	Bengaluru, India
133	Basel, Switzerland
134	Islamabad, Pakistan
135	Boulder, CO, United States
136	Hanover, Germany
137	Malmö, Sweden
138	Oxford, United Kingdom
139	Hefei, China
140	Ithaca, NY, United States
141	Manchester, United Kingdom
142	Leeds, United Kingdom
143	Fuzhou, China
144	Kaohsiung, China
145	Strasbourg, France
146	Exeter, United Kingdom
147	Bristol, United Kingdom
148	Marseille, France
149	Adelaide, Australia
150	Bordeaux, France

HSE GCII 2024 Rank	City, country
151	Tsukuba, Japan
152	Ningbo, China
153	Nottingham, United Kingdom
154	Bonn, Germany
155	Leiden, Netherlands
156	Ho Chi Minh City, Viet Nam
157	Jinan, China
158	Jakarta, Indonesia
159	Bologna, Italy
160	Minneapolis, MN, United States
161	Columbus, OH, United States
162	Calgary, Canada
163	Antwerp, Belgium
164	New Haven, CT, United States
165	Bern, Switzerland
166	Canberra, Australia
167	Salt Lake City, UT, United States
168	Harbin, China
169	Portland, WA, United States
170	Lille, France
171	Ede, Netherlands
172	Manila, Philippines
173	Washtenaw, MI, United States
174	Lausanne, Switzerland
175	Padua, Italy
176	Cork, Ireland
177	Jackson, MO, United States
178	Phoenix, AZ, United States
179	Perth, Australia
180	Turin, Italy
181	St. Louis, MO, United States
182	Venice, Italy
183	Novosibirsk, Russia
184	Jeddah, Saudi Arabia
185	Santa Barbara, CA, United States
186	Beirut, Lebanon
187	Pittsburgh, PA, United States
188	Durham, NC, United States
189	Changchun, China
190	Montpellier, France
191	Florence, Italy
192	Grenoble, France
193	Detroit, MI, United States
194	Cape Town, South Africa
195	Nashville, TN, United States
196	Cuyahoga, OH, United States
197	Rochester, MN, United States
198	Dane, WI, United States
199	Kitchener, Canada
200	Raleigh, NC, United States

HSE GCII 2024 Rank	City, country
201	Naples, Italy
202	Johannesburg, South Africa
203	Hampden, MA, United States
204–205	Santa Cruz, CA, United States
204–205	Thuwal, Saudi Arabia
206–207	Dhaka, Bangladesh
206–207	Hamilton, Canada
208–216	Brighton, United Kingdom
208–216	Göttingen, Germany
208–216	Karlsruhe, Germany
208–216	Katowice, Poland
208–216	Las Vegas, NV, United States
208–216	Macau, China
208–216	Monroe, IN, United States
208–216	Shenyang, China
208–216	Taoyuan, China
217–221	Benton, WA, United States
217–221	Edmonton, Canada
217–221	Norwich, United Kingdom
217–221	Providence, RI, United States
217–221	Pune, India
222–228	Almaty, Kazakhstan
222–228	Quebec, Canada
222–228	Reykjavík, Iceland
222–228	Sacramento, CA, United States
222–228	Tübingen, Germany
222–228	Ulsan, South Korea
222–228	Uppsala, Sweden
229–240	Bergen, Norway
229–240	Freiburg im Breisgau, Germany
229–240	Guildford, United Kingdom
229–240	Leicester, United Kingdom
229–240	Ludwigshafen am Rhein, Germany
229–240	Montevideo, Uruguay
229–240	Perugia, Italy
229–240	Reading, United Kingdom
229–240	Saarbrücken, Germany
229–240	Salzburg, Austria
229–240	Southampton, United Kingdom
229–240	Zhenjiang, China
241–255	Abu Dhabi, United Arab Emirates
241–255	Belfast, United Kingdom
241–255	Chennai, India
241–255	Gdańsk, Poland
241–255	Genoa, Italy
241–255	Nancy, France
241–255	Nantes, France
241–255	Newcastle upon Tyne, United Kingdom
241–255	Porto Alegre, Brazil
241–255	Shijiazhuang, China

HSE GCII 2024 Rank	City, country
241–255	Tallinn, Estonia
241–255	Trondheim, Norway
241–255	Wellington, New Zealand
241–255	Zagreb, Croatia
241–255	Zhengzhou, China
256–263	Champaign, IL, United States
256–263	Hartford, CT, United States
256–263	Indianapolis, IN, United States
256–263	Jena, Germany
256–263	Nanchang, China
256–263	Pisa, Italy
256–263	Poznań, Poland
256–263	Wrocław, Poland
264–276	Dammam, Saudi Arabia
264–276	Doha, Qatar
264–276	Fukuoka, Japan
264–276	Hyderabad, India
264–276	Jerusalem, Israel
264–276	Kiel, Germany
264–276	Kunming, China
264–276	Lugano, Switzerland
264–276	Rennes, France
264–276	Seville, Spain
264–276	Tainan City, China
264–276	Tbilisi, Georgia
264–276	Utah, UT, United States
277–286	Aberdeen, United Kingdom
277–286	Graz, Austria
277–286	Hanoi, Viet Nam
277–286	Innsbruck, Austria
277–286	Kolkata, India
277–286	Lahore, Pakistan
277–286	Memphis, TN, United States
277–286	San Antonio, TX, United States
277–286	Sheffield, United Kingdom
277–286	Valletta, Malta
287–300	Aachen, Germany
287–300	Aalborg, Denmark
287–300	Bilbao, Spain
287–300	Centre, PA, United States
287–300	Charleston, SC, United States
287–300	Coventry, United Kingdom
287–300	Darmstadt, Germany
287–300	Haifa, Israel
287–300	Jiangmen, China
287–300	Lafayette, IN, United States
287–300	Ljubljana, Slovenia
287–300	Oak Ridge, TN, United States
287–300	St. Gallen, Switzerland
287–300	Tampa, FL, United States

(continued)

HSE GCII 2024 Rank	City, country
301–321	Amman, Jordan
301–321	Bari, Italy
301–321	Bratislava, Slovakia
301–321	Charlotte, NC, United States
301–321	Christchurch, New Zealand
301–321	Cluj-Napoca, Romania
301–321	Düren, Germany
301–321	Granada, Spain
301–321	İzmir, Türkiye
301–321	Lanzhou, China
301–321	Limassol, Cyprus
301–321	Linköping, Sweden
301–321	London, Canada
301–321	Medellín, Colombia
301–321	Milwaukee, WI, United States
301–321	Nicosia, Cyprus
301–321	Parma, Italy
301–321	Tshwane, South Africa
301–321	Wollongong, Australia
301–321	Würzburg, Germany
301–321	Xuzhou, China
322–342	Alachua, FL, United States
322–342	Albany, NY, United States
322–342	Alexandria, Egypt
322–342	Bandung, Indonesia
322–342	Bielefeld, Germany
322–342	Cardiff, United Kingdom
322–342	Charlottesville, VA, United States
322–342	Dundee, United Kingdom
322–342	Lagos, Nigeria
322–342	Liège, Belgium
322–342	Odense, Denmark
322–342	Richmond, VA, United States
322–342	Riga, Latvia
322–342	Santo Domingo, Dominican Republic
322–342	Tallahassee, FL, United States
322–342	Thessaloniki, Greece
322–342	Trieste, Italy
322–342	Tunis, Tunisia
322–342	Vicenza, Italy
322–342	Winnipeg, Canada
322–342	Zug, Switzerland
343–361	Bath, United Kingdom
343–361	Brazos, TX, United States
343–361	Erie, NY, United States
343–361	Gimhae, South Korea
343–361	Halle, Germany
343–361	Hamamatsu, Japan
343–361	Karachi, Pakistan
343–361	Kharkiv, Ukraine

HSE GCII 2024 Rank	City, country
343–361	Knox, TN, United States
343–361	Maastricht, Netherlands
343–361	Málaga, Spain
343–361	Monterrey, Mexico
343–361	Newcastle, Australia
343–361	Orange, FL, United States
343–361	Oulu, Finland
343–361	Sapporo, Japan
343–361	Tomsk, Russia
343–361	Worcester, MA, United States
343–361	Yekaterinburg, Russia
362–392	Ahmedabad, India
362–392	Baku, Azerbaijan
362–392	Bergamo, Italy
362–392	Braga, Portugal
362–392	Brasília, Brazil
362–392	Bremen, Germany
362–392	Campinas, Brazil
362–392	Caracas, Venezuela
362–392	Clermont-Ferrand, France
362–392	Fayette, KY, United States
362–392	Guadalajara, Mexico
362–392	Honolulu, HI, United States
362–392	Ingham, MI, United States
362–392	Irkutsk, Russia
362–392	Łódź, Poland
362–392	Minsk, Belarus
362–392	Murcia, Spain
362–392	New Orleans, LA, United States
362–392	Nice, France
362–392	Quito, Ecuador
362–392	San Mauro Pascoli, Italy
362–392	San Sebastián, Spain
362–392	Taiyuan, China
362–392	Townsville, Australia
362–392	Trento, Italy
362–392	Ürümqi, China
362–392	Ventura, CA, United States
362–392	Verona, Italy
362–392	Wiesbaden, Germany
362–392	Yantai, China
362–392	Yogyakarta, Indonesia
393–427	A Coruña, Spain
393–427	Accra, Ghana
393–427	Albuquerque, NM, United States
393–427	Blacksburg, VA, United States
393–427	Brescia, Italy
393–427	Brest, France
393–427	Burlington, MA, United States
393–427	Canterbury, United Kingdom

HSE GCII 2024 Rank	City, country
393–427	Catania, Italy
393–427	Durham, United Kingdom
393–427	Enschede, Netherlands
393–427	Flagstaff, AZ, United States
393–427	Fukui, Japan
393–427	Guiyang, China
393–427	Haikou, China
393–427	Jefferson, KY, United States
393–427	Jiaxing, China
393–427	Kassel, Germany
393–427	Kazan, Russia
393–427	Linz, Austria
393–427	Matsumoto, Japan
393–427	Nairobi, Kenya
393–427	Nizhny Novgorod, Russia
393–427	Oklahoma City, OK, United States
393–427	Palma, Spain
393–427	Pamplona, Spain
393–427	Pima, AZ, United States
393–427	Plymouth, United Kingdom
393–427	Pullman, WA, United States
393–427	Santa Fe, NM, United States
393–427	Sendai, Japan
393–427	Tartu, Estonia
393–427	Ulm, Germany
393–427	Victoria, Canada
393–427	Wenzhou, China
428–464	Aix-en-Provence, France
428–464	Alicante, Spain
428–464	Annecy, France
428–464	Aveiro, Portugal
428–464	Barranquilla, Colombia
428–464	Belo Horizonte, Brazil
428–464	Bolzano, Italy
428–464	Burnie, Australia
428–464	Colombo, Sri Lanka
428–464	Curitiba, Brazil
428–464	Dijon, France
428–464	Douglas, NE, United States
428–464	Galway, Ireland
428–464	Halifax, Canada
428–464	Iowa City, IA, United States
428–464	Jinzhou, China
428–464	Kingston, Canada
428–464	Krasnoyarsk, Russia
428–464	La Chaux-de-Fonds, Switzerland
428–464	Larimer, CO, United States
428–464	Lublin, Poland
428–464	Lviv, Ukraine
428–464	Madison, AL, United States

HSE GCII 2024 Rank	City, country
428–464	Maribor, Slovenia
428–464	Naha, Japan
428–464	Neuchâtel, Switzerland
428–464	Panama City, Panama
428–464	Reggio nell'Emilia, Italy
428–464	Rostock, Germany
428–464	San Jose, Costa Rica
428–464	St. Joseph, IN, United States
428–464	Swindon, United Kingdom
428–464	Taif, Saudi Arabia
428–464	Treviso, Italy
428–464	Tromsø, Norway
428–464	Washoe, NV, United States
428–464	Wuppertal, Germany
465–513	Ada, ID, United States
465–513	Algiers, Algeria
465–513	Astana, Kazakhstan
465–513	Baghdad, Iraq
465–513	Bangor, United Kingdom
465–513	Barletta, Italy
465–513	Bayreuth, Germany
465–513	Bhubaneswar, India
465–513	Chandigarh, India
465–513	Cincinnati, OH, United States
465–513	Concepción, Chile
465–513	Córdoba, Argentina
465–513	Dehradun, India
465–513	East Baton Rouge Parish, LA, United States
465–513	Fermo, Italy
465–513	Ferrara, Italy
465–513	Forsyth, NC, United States
465–513	Girona, Spain
465–513	Gold Coast, Australia
465–513	Heraklion, Greece
465–513	Jyväskylä, Finland
465–513	Kaunas, Lithuania
465–513	Kortrijk, Belgium
465–513	Kuwait City, Kuwait
465–513	Limoges, France
465–513	Lucas, OH, United States
465–513	Lucknow, India
465–513	Luoyang, China
465–513	Münster, Germany
465–513	Onondaga, NY, United States
465–513	Osnabrück, Germany
465–513	Palermo, Italy
465–513	Prato, Italy
465–513	Puebla, Mexico
465–513	Regensburg, Germany
465–513	Rouen, France

(continued)

HSE GCII 2024 Rank	City, country
465–513	Salamanca, Spain
465–513	Santiago de Compostela, Spain
465–513	Saskatoon, Canada
465–513	Stavanger, Norway
465–513	Surabaya, Indonesia
465–513	Umeå, Sweden
465–513	Valparaíso, Chile
465–513	Vigo, Spain
465–513	Weifang, China
465–513	Wuhu, China
465–513	York, United Kingdom
465–513	Zaragoza, Spain
465–513	Zhuzhou, China
514–570	Aberdeen, WA, United States
514–570	Augsburg, Germany
514–570	Baoding, China
514–570	Castellón de la Plana, Spain
514–570	Chernogolovka, Russia
514–570	Ciudad Real, Spain
514–570	Coimbatore, India
514–570	Córdoba, Spain
514–570	Corvallis, OR, United States
514–570	Dauphin, PA, United States
514–570	Durban, South Africa
514–570	Faisalabad, Pakistan
514–570	Fribourg, Switzerland
514–570	Guayaquil, Ecuador
514–570	Guelph, Canada
514–570	Gwangsan, South Korea
514–570	Hamilton, New Zealand
514–570	Hanover, NH, United States
514–570	Havana, Cuba
514–570	Huizhou, China
514–570	Huzhou, China
514–570	Iași, Romania
514–570	Jacksonville, FL, United States
514–570	Kent, MI, United States
514–570	Koblenz, Germany
514–570	Košice, Slovakia
514–570	La Plata, Argentina
514–570	Lancaster, NE, United States
514–570	Lucca, Italy
514–570	Manama, Bahrain
514–570	Manhattan, KS, United States
514–570	Marburg, Germany
514–570	Merced, CA, United States
514–570	Mérida, Mexico
514–570	Montegranaro, Italy
514–570	Okayama, Japan
514–570	Ostrava, Czech Republic

HSE GCII 2024 Rank	City, country
514–570	Pohang, South Korea
514–570	Pulaski, AR, United States
514–570	Recife, Brazil
514–570	Reutlingen, Germany
514–570	Rochester, NY, United States
514–570	San Juan, Puerto Rico
514–570	Santa Cruz de Tenerife, Spain
514–570	Sarasota, FL, United States
514–570	Schaffhausen, Switzerland
514–570	Shiraz, Iran
514–570	St Andrews, United Kingdom
514–570	Tai'an, China
514–570	Tampere, Finland
514–570	Timișoara, Romania
514–570	Tulsa, OK, United States
514–570	Turku, Finland
514–570	Vicksburg, MS, United States
514–570	Virginia Beach, VA, United States
514–570	Vladivostok, Russia
514–570	Winterthur, Switzerland
571–651	Ames, IA, United States
571–651	Ancona, Italy
571–651	Angers, France
571–651	Asunción, Paraguay
571–651	Badajoz, Spain
571–651	Besançon, France
571–651	Bhopal, India
571–651	Białystok, Poland
571–651	Bozeman, MT, United States
571–651	Bragança, Portugal
571–651	Caen, France
571–651	Cagliari, Italy
571–651	Cali, Colombia
571–651	Carlow, Ireland
571–651	Carpi, Italy
571–651	Chiang Mai, Thailand
571–651	City of Milton Keynes, United Kingdom
571–651	Como, Italy
571–651	Cumberland, NC, United States
571–651	Da Nang, Viet Nam
571–651	Dalseong, South Korea
571–651	Derby, United Kingdom
571–651	Dunedin, New Zealand
571–651	El Paso, TX, United States
571–651	Eskişehir, Türkiye
571–651	Falkirk, United Kingdom
571–651	Florianópolis, Brazil
571–651	Fortaleza, Brazil
571–651	Gebze, Türkiye
571–651	Gölcük, Türkiye

HSE GCII 2024 Rank	City, country
571–651	Greifswald, Germany
571–651	Guilford, NC, United States
571–651	Hampshire, United Kingdom
571–651	Hasselt, Belgium
571–651	Isfahan, Iran
571–651	Jeju City, South Korea
571–651	Jönköping, Sweden
571–651	Kaifeng, China
571–651	Kaiserslautern, Germany
571–651	Kitakyushu, Japan
571–651	Klagenfurt, Austria
571–651	Kochi, India
571–651	Lane, OR, United States
571–651	Las Palmas de Gran Canaria, Spain
571–651	Liaocheng, China
571–651	Limerick, Ireland
571–651	Lleida, Spain
571–651	Logan, UT, United States
571–651	Los Alamos, NM, United States
571–651	Magdeburg, Germany
571–651	Mianyang, China
571–651	Minya, Egypt
571–651	Modena, Italy
571–651	Mons, Belgium
571–651	Muscat, Oman
571–651	Nanning, China
571–651	Ourense, Spain
571–651	Patras, Greece
571–651	Pau, France
571–651	Pavia, Italy
571–651	Perm, Russia
571–651	Peshawar, Pakistan
571–651	Prayagraj, India
571–651	Pristina, Kosovo
571–651	Rabat, Morocco
571–651	Rimini, Italy
571–651	Santander, Spain
571–651	Sant'Elpidio a Mare, Italy
571–651	São José dos Campos, Brazil
571–651	Starkville, MS, United States
571–651	Stoke-on-Trent, United Kingdom
571–651	Tabriz, Iran
571–651	Talca, Chile
571–651	Thanet, United Kingdom
571–651	Tilburg, Netherlands
571–651	Toowoomba, Australia
571–651	Tours, France
571–651	Tyumen, Russia
571–651	Ufa, Russia
571–651	Valenciennes, France
571–651	Yichang, China
652–810	Abano Terme, Italy
652–810	Al Ain, UAE
652–810	Amersfoort, Netherlands
652–810	Amiens, France
652–810	Antigonish, Canada
652–810	Antofagasta, Chile
652–810	Arak, Iran
652–810	Arezzo, Italy
652–810	Baia Mare, Romania
652–810	Bandar Seri Begawan, Brunei
652–810	Basingstoke and Deane, United Kingdom
652–810	Beaufort, SC, United States
652–810	Beersheba, Israel
652–810	Belém, Brazil
652–810	Bishkek, Kyrgyz Republic
652–810	Bregenz, Austria
652–810	Bremerhaven, Germany
652–810	Burlington, VT, United States
652–810	Campi Bisenzio, Italy
652–810	Casablanca, Morocco
652–810	Cebu City, Philippines
652–810	Charleroi, Belgium
652–810	Chatham, GA, United States
652–810	Chemnitz, Germany
652–810	Chiang Rai, Thailand
652–810	Chiayi City, China
652–810	Chihuahua City, Mexico
652–810	Coimbra, Portugal
652–810	Colchester, United Kingdom
652–810	Craiova, Romania
652–810	Cuenca, Ecuador
652–810	Dakar, Senegal
652–810	Denizli, Türkiye
652–810	Dnipro, Ukraine
652–810	Dongyang, China
652–810	Douliu, China
652–810	Durham, NH, United States
652–810	Farnborough, United Kingdom
652–810	Ferrera Erbognone, Italy
652–810	Fredericton, Canada
652–810	Friedrichshafen, Germany
652–810	Gatersleben, Germany
652–810	Gelugor, Malaysia
652–810	Gibraltar, United Kingdom
652–810	Giessen, Germany
652–810	Grand Cayman, United Kingdom
652–810	Guatemala City, Guatemala
652–810	Gyeongsan, South Korea
652–810	Hamar, Norway

(continued)

HSE GCII 2024 Rank	City, country
652–810	Harrogate, United Kingdom
652–810	Heerlen, Netherlands
652–810	Hertsmere, United Kingdom
652–810	Hwaseong, South Korea
652–810	Ibadan, Nigeria
652–810	Ismailia, Egypt
652–810	Jefferson, AL, United States
652–810	Jinhua, China
652–810	Jining, China
652–810	Kajaani, Finland
652–810	Kalamazoo, MI, United States
652–810	Kanazawa, Japan
652–810	Kent, United Kingdom
652–810	Khon Kaen, Thailand
652–810	La Paz, Bolivia
652–810	Lappeenranta, Finland
652–810	L'Aquila, Italy
652–810	Le Locle, Switzerland
652–810	Lecce, Italy
652–810	Lehigh, PA, United States
652–810	Lincoln, United Kingdom
652–810	Londonderry, United Kingdom
652–810	Longyan, China
652–810	Lubbock, TX, United States
652–810	Lübeck, Germany
652–810	Lucerne, Switzerland
652–810	Lüneburg, Germany
652–810	Mahoning, OH, United States
652–810	Malang, Indonesia
652–810	Mar del Plata, Argentina
652–810	Mashhad, Iran
652–810	McLennan, TX, United States
652–810	Mendoza, Argentina
652–810	Messina, Italy
652–810	Miaoli City, China
652–810	Mobile, AL, United States
652–810	Mysuru, India
652–810	Nakhon Ratchasima, Thailand
652–810	Namur, Belgium
652–810	Nantong, China
652–810	Natal, Brazil
652–810	Nelson, New Zealand
652–810	Niigata, Japan
652–810	Northampton, United Kingdom
652–810	Novi Sad, Serbia
652–810	Nsukka, Nigeria
652–810	Oldenburg, Germany
652–810	Olot, Spain
652–810	Orangeburg, SC, United States
652–810	Örebro, Sweden

HSE GCII 2024 Rank	City, country
652–810	Orléans, France
652–810	Oudenaarde, Belgium
652–810	Oviedo, Spain
652–810	Oxford, MS, United States
652–810	Palmerston North, New Zealand
652–810	Pesaro, Italy
652–810	Phnom Penh, Cambodia
652–810	Portsmouth, United Kingdom
652–810	Preston, United Kingdom
652–810	Pushchino, Russia
652–810	Qazvin, Iran
652–810	Ravenna, Italy
652–810	Regina, Canada
652–810	Resana, Italy
652–810	Rockhampton, Australia
652–810	Rostov-on-Don, Russia
652–810	Rzeszów, Poland
652–810	Saint-Étienne, France
652–810	Salvador, Brazil
652–810	Samara, Russia
652–810	San Carlos de Bariloche, Argentina
652–810	San Cibrao das Viñas, Spain
652–810	San Luis Potosí, Mexico
652–810	Santa Maria, Brazil
652–810	São Carlos, Brazil
652–810	Sarajevo, Bosnia and Herzegovina
652–810	Senigallia, Italy
652–810	Seongsan, South Korea
652–810	Shantou, China
652–810	Sherbrooke, Canada
652–810	Shizuoka, Japan
652–810	Skövde, Sweden
652–810	Stabio, Switzerland
652–810	Stillwater, OK, United States
652–810	Sunshine Coast, Australia
652–810	Taizhou, China
652–810	Tashkent, Republic of Uzbekistan
652–810	Tegucigalpa, Republic of Honduras
652–810	Temuco, Chile
652–810	Terni, Italy
652–810	Texcoco de Mora, Mexico
652–810	Thunder Bay, Canada
652–810	Toruń, Poland
652–810	Urmia, Iran
652–810	Valenza, Italy
652–810	Växjö, Sweden
652–810	Vellore, India
652–810	Vercelli, Italy
652–810	Viana do Castelo, Portugal
652–810	Viborg, Denmark

HSE GCII 2024 Rank	City, country
652–810	Viçosa, Brazil
652–810	Villena, Spain
652–810	Visakhapatnam, India
652–810	Wexford, Ireland
652–810	Wiltshire, United Kingdom
652–810	Winnebago, IL, United States
652–810	Xining, China
652–810	Yamaguchi, Japan
652–810	Yazd, Iran
652–810	Yerevan, Armenia
811–1127	Adana, Türkiye
811–1127	Addis Ababa, Ethiopia
811–1127	Ahvaz, Iran
811–1127	Alexandria, Italy
811–1127	Algeciras, Spain
811–1127	Aligarh, India
811–1127	Alkmaar, Netherlands
811–1127	Almería, Spain
811–1127	Amritsar, India
811–1127	Ansbach, Germany
811–1127	Antalya, Türkiye
811–1127	Ardmore, OK, United States
811–1127	Arles, France
811–1127	Arnhem, Netherlands
811–1127	Ashby-de-la-Zouch, United Kingdom
811–1127	Ashland, PA, United States
811–1127	Asola, Italy
811–1127	Auburn, AL, United States
811–1127	Auerbach, Germany
811–1127	Avignon, France
811–1127	Babol, Iran
811–1127	Bahía Blanca, Argentina
811–1127	Bali, Indonesia
811–1127	Bamberg, Germany
811–1127	Bangor, ME, United States
811–1127	Banyoles, Spain
811–1127	Bar Harbor, ME, United States
811–1127	Barnaul, Russia
811–1127	Bassano del Grappa, Italy
811–1127	Bathurst, Australia
811–1127	Bennington, VT, United States
811–1127	Biella, Italy
811–1127	Billund, Denmark
811–1127	Bloemfontein, South Africa
811–1127	Bocholt, Germany
811–1127	Bolu, Türkiye
811–1127	Boundary, ID, United States
811–1127	Bovolone, Italy
811–1127	Bowling Green, KY, United States
811–1127	Bredebro, Denmark

HSE GCII 2024 Rank	City, country
811–1127	Brevard, FL, United States
811–1127	Broad Chalke, United Kingdom
811–1127	Bruges, Belgium
811–1127	Brugg, Switzerland
811–1127	Bucaramanga, Colombia
811–1127	Bursa, Türkiye
811–1127	Bydgoszcz, Poland
811–1127	Byron Bay, Australia
811–1127	Carrè, Italy
811–1127	Cartagena, Colombia
811–1127	Ceggia, Italy
811–1127	České Budějovice, Czech Republic
811–1127	Chambéry, France
811–1127	Chania, Greece
811–1127	Cheltenham, United Kingdom
811–1127	Chelyabinsk, Russia
811–1127	Cherwell, United Kingdom
811–1127	Cheshire West and Chester, United Kingdom
811–1127	Chieti, Italy
811–1127	Chișinău, Moldova
811–1127	Chuncheon, South Korea
811–1127	Civitanova Marche, Italy
811–1127	Cornwall, United Kingdom
811–1127	Coronel João Pessoa, Brazil
811–1127	Cosenza, Italy
811–1127	Cranfield, United Kingdom
811–1127	Dar es Salaam, Tanzania
811–1127	Darwin, Australia
811–1127	Davos, Switzerland
811–1127	Debrecen, Hungary
811–1127	Deerfield, MA, United States
811–1127	Deokjin, South Korea
811–1127	Detmold, Germany
811–1127	Dhanbad, India
811–1127	Dili, East Timor
811–1127	Dorset, United Kingdom
811–1127	Duluth, MN, United States
811–1127	Dundalk, Ireland
811–1127	Dwingeloo, Netherlands
811–1127	Egham, United Kingdom
811–1127	El Paso, CO, United States
811–1127	Elche, Spain
811–1127	Elda, Spain
811–1127	Empoli, Italy
811–1127	Erfurt, Germany
811–1127	Eriksmåla, Sweden
811–1127	Falmouth, United Kingdom
811–1127	Fidenza, Italy
811–1127	Forlì, Italy
811–1127	Forte dei Marmi, Italy

(continued)

HSE GCII 2024 Rank	City, country
811–1127	Fuyang, China
811–1127	Gaborone, Botswana
811–1127	Gaggio Montano, Italy
811–1127	Gandia, Spain
811–1127	Gaziantep, Türkiye
811–1127	Geelong, Australia
811–1127	Gijón, Spain
811–1127	Gongyi, China
811–1127	Green Bay, WI, United States
811–1127	Grosseto, Italy
811–1127	Guanajuato, Mexico
811–1127	Guimarães, Portugal
811–1127	Guntur, India
811–1127	Guwahati, India
811–1127	Hanover, MD, United States
811–1127	Harare, Zimbabwe
811–1127	Hartfield, United Kingdom
811–1127	Heidenheim an der Brenz, Germany
811–1127	Heilbronn, Germany
811–1127	Helsingborg, Sweden
811–1127	Hermosillo, Mexico
811–1127	Heungdeok, South Korea
811–1127	Hiroshima, Japan
811–1127	Hobart, Australia
811–1127	Hohhot, China
811–1127	Horsham, United Kingdom
811–1127	Ibiza, Spain
811–1127	Idaho Falls, ID, United States
811–1127	Ilam, Iran
811–1127	Indore, India
811–1127	Ipswich, United Kingdom
811–1127	Isesaki, Japan
811–1127	Iskandar, Malaysia
811–1127	Ispra, Italy
811–1127	Ivanovo, Russia
811–1127	Jaén, Spain
811–1127	Jaipur, India
811–1127	Jiaozuo, China
811–1127	Jingzhou, China
811–1127	Juiz de Fora, Brazil
811–1127	Kanchanaburi, Thailand
811–1127	Kanpur, India
811–1127	Karagandy, Kazakhstan
811–1127	Karaikudi, India
811–1127	Karlstad, Sweden
811–1127	Kashan, Iran
811–1127	Kent, OH, United States
811–1127	Kerman, Iran
811–1127	Kermanshah, Iran
811–1127	Kharagpur, India

HSE GCII 2024 Rank	City, country
811–1127	Khartoum, Sudan
811–1127	Khulna, Bangladesh
811–1127	Kingston, Jamaica
811–1127	Kirtipur, Nepal
811–1127	Kochi, Japan
811–1127	Kōfu, Japan
811–1127	Kolding, Denmark
811–1127	Konstanz, Germany
811–1127	Kuala Terengganu, Malaysia
811–1127	Kumasi, Ghana
811–1127	Kuopio, Finland
811–1127	La Serena, Chile
811–1127	Lajeado, Brazil
811–1127	Laramie, WY, United States
811–1127	Launceston, Australia
811–1127	Le Havre, France
811–1127	Le Mans, France
811–1127	Lecco, Italy
811–1127	Lengnau, Switzerland
811–1127	Leoben, Austria
811–1127	Lianyungang, China
811–1127	Linz am Rhein, Germany
811–1127	Liuzhou, China
811–1127	Loja, Ecuador
811–1127	Londrina, Brazil
811–1127	Longkou, China
811–1127	Luleå, Sweden
811–1127	Ma'anshan, China
811–1127	Mantua, Italy
811–1127	Maputo, Republic of Mozambique
811–1127	Maracaibo, Venezuela
811–1127	Maranello, Italy
811–1127	Mardan, Pakistan
811–1127	Marrakesh, Morocco
811–1127	Martina Franca, Italy
811–1127	Mathura, India
811–1127	Mechelen, Belgium
811–1127	Medina, Saudi Arabia
811–1127	Medway, United Kingdom
811–1127	Melegnano, Italy
811–1127	Mérida, Venezuela
811–1127	Metz, France
811–1127	Middlesbrough, United Kingdom
811–1127	Mol, Belgium
811–1127	Monaco City, Monaco
811–1127	Monte Urano, Italy
811–1127	Monterey, CA, United States
811–1127	Morgantown, WV, United States
811–1127	Moscow, ID, United States
811–1127	Muroran, Japan

HSE GCII 2024 Rank	City, country
811–1127	Mykonos, Greece
811–1127	Nagaoka, Japan
811–1127	Nagpur, India
811–1127	Naju, South Korea
811–1127	Nanyang, China
811–1127	Niš, Serbia
811–1127	Novara, Italy
811–1127	Nuneaton, United Kingdom
811–1127	Odesa, Ukraine
811–1127	Oinofyta, Greece
811–1127	Ōita, Japan
811–1127	Olomouc, Czech Republic
811–1127	Olsztyn, Poland
811–1127	Oradea, Romania
811–1127	Oran, Algeria
811–1127	Orono, ME, United States
811–1127	Paphos, Cyprus
811–1127	Passau, Germany
811–1127	Patiala, India
811–1127	Pelotas, Brazil
811–1127	Peterborough, United Kingdom
811–1127	Piacenza, Italy
811–1127	Pilani, India
811–1127	Pistoia, Italy
811–1127	Poitiers, France
811–1127	Potenza, Italy
811–1127	Prince George, Canada
811–1127	Pyeongtaek, South Korea
811–1127	Qom, Iran
811–1127	Quanzhou, China
811–1127	Querétaro, Mexico
811–1127	Ramallah, Palestine
811–1127	Rasht, Iran
811–1127	Rethymno, Greece
811–1127	Road Town, United Kingdom
811–1127	Roorkee, India
811–1127	Rosario, Argentina
811–1127	Roseto degli Abruzzi, Italy
811–1127	Saignelégier, Switzerland
811–1127	Saint-Tropez, France
811–1127	Sakakah, Saudi Arabia
811–1127	Salerno, Italy
811–1127	Saltillo, Mexico
811–1127	San Luis, Argentina
811–1127	San Miguel de Tucumán, Argentina
811–1127	Sanandaj, Iran
811–1127	Santa Clara, Cuba
811–1127	Santa Fe, Argentina
811–1127	Sant'Egidio alla Vibrata, Italy
811–1127	Saratov, Russia

HSE GCII 2024 Rank	City, country
811–1127	Sari, Iran
811–1127	Sasovo, Russia
811–1127	Sassari, Italy
811–1127	Schaan, Liechtenstein
811–1127	Schmallenberg, Germany
811–1127	Schwäbisch Hall, Germany
811–1127	Semnan, Iran
811–1127	Seri Iskandar, Malaysia
811–1127	Sfax, Tunisia
811–1127	Shahr-e Kord, Iran
811–1127	Shahrud, Iran
811–1127	Siegen, Germany
811–1127	Siena, Italy
811–1127	Sint-Amands, Belgium
811–1127	Sint-Niklaas, Belgium
811–1127	Skopje, North Macedonia
811–1127	Skudai, Malaysia
811–1127	Slough, United Kingdom
811–1127	Solan, India
811–1127	Solingen, Germany
811–1127	South Burlington, VT, United States
811–1127	Steinfurt, Germany
811–1127	Stellenbosch, South Africa
811–1127	Stevenage, United Kingdom
811–1127	Sulzbach-Rosenberg, Germany
811–1127	Sumy, Ukraine
811–1127	Sunderland, United Kingdom
811–1127	Surakarta, Indonesia
811–1127	Swansea, United Kingdom
811–1127	Szeged, Hungary
811–1127	Takasaki, Japan
811–1127	Tamale, Ghana
811–1127	Tarragona, Spain
811–1127	Telgte, Germany
811–1127	Thiruvananthapuram, India
811–1127	Tirana, Albania
811–1127	Tønsberg, Norway
811–1127	Toyama, Japan
811–1127	Trier, Germany
811–1127	Trollhättan, Sweden
811–1127	Troyes, France
811–1127	Tula, Russia
811–1127	Tuscaloosa, AL, United States
811–1127	Udine, Italy
811–1127	Udupi, India
811–1127	Ulaanbaatar, Mongolia
811–1127	Utsunomiya, Japan
811–1127	Vaasa, Finland
811–1127	Valdilana, Italy
811–1127	Valdivia, Chile

(continued)

HSE GCII 2024 Rank	City, country
811–1127	Varanasi, India
811–1127	Varaždin, Croatia
811–1127	Varna, Bulgaria
811–1127	Victoria, Republic of Seychelles
811–1127	Villars-sur-Glâne, Switzerland
811–1127	Villigen, Switzerland
811–1127	Viterbo, Italy
811–1127	Vitoria-Gasteiz, Spain
811–1127	Volgograd, Russia
811–1127	Volos, Greece
811–1127	Voronezh, Russia
811–1127	Wallingford, United Kingdom
811–1127	Weil am Rhein, Germany
811–1127	Weimar, Germany
811–1127	Whatcom, WA, United States
811–1127	Winchester, United Kingdom
811–1127	Xalapa, Mexico
811–1127	Xinxiang, China
811–1127	Xinyu, China
811–1127	Yakutsk, Russia
811–1127	Yamagata, Japan
811–1127	Yinchuan, China
811–1127	Zagazig, Egypt
811–1127	Zanjan, Iran
811–1127	Zeeland, MI, United States
811–1127	Zhangjiagang, China
811–1127	Zlín, Czech Republic

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HSE Global Cities Innovation Index: 2024

Translated by M. Rukhalenko

Editors M. Sokolova and M. Rukhalenko

Proofreading C. Montgomery

Art director O. Vasiliev

Design G. Podzolkova, A. Sevodneva, and I. Tsygankov

Illustrations T. Kasimova

Desk-top editing T. Koltsova, V. Puchkov, and N. Shabanova

Format 60×90 1/8. Print sheet 54. Pressrun 950 copies

National Research University Higher School of Economics
20 Myasnitskaya st., Moscow, 101000, Russia

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