
Skoltech

Skolkovo Institute of Science and Technology

Annual Report

19

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It is my pleasure and a privilege to present the annual report. Established in 2011 with the vision of being a world class university, Skoltech proudly marks 2019 as the year of success.

2019 was the first year in the new campus. Awarded at UNESCO headquarters with the Prix Versailles as the world's best campus in 2019, it is without doubt an architectural masterpiece. At the same time, the most important aspect of the campus is its unique atmosphere and infrastructure which inspire and enable our commitment for excellence.

The high research performance of the faculty, researchers, engineers, and students has put Skoltech into the top-100 Nature Index 2019 Young Universities. Should the Index account for the size of schools, Skoltech would be ranked among the top-10, with 10 % of papers published in the prestigious Nature Index journals per capita.

Cultivating academic and technology excellence, Skoltech carried out more than 270 projects funded by national and

international high-tech companies, research and innovation agencies, in total of 1.6 bln rubles – 45% growth compared to 2018. Over 2 bln rubles of sponsored research funding have been confirmed for 2020 and beyond. Long-term investments have been secured by Skoltech joint laboratories with Oerlikon, Gazprom Neft, Huawei, Sberbank, and Topcon. Also, Sberbank joined Skoltech as a founder. I am confident that this will bring new technological tasks and opportunities for student internships and graduates' employment.

Staffed with top-notch professionals, the Center of the Internet of Things contributes to the National Technology Initiative. The 5G Open Radio Access Network Center, established at the end of the year, will implement a large-scale project within the national Digital Economy Program. In terms of successfully completed high-caliber projects, I would mark the digital platform enabling the use of AI in medicine.

Leveraging top-class faculty, state-of-the-art infrastructure and English-speaking

President's foreword

environment, Skoltech has been advancing educational programs and receiving international accreditation. The strong academic background and interest in entrepreneurship demonstrated by the intake of 2019, 20% of which are international students, attests to the global competitiveness of Skoltech education.

The key outcome of the flagship Innovation Workshop is that, out of 50 teams, many continue working on projects, with the potential to grow into new companies. In total, Skoltech has 40 startups in the Skolkovo ecosystem, half of the companies are founded by our students and alumni. We wish them success and offer full support with their ambitious endeavors.


In time of complex and dynamic global environment, the strategic collaboration with TU Munich and the renewed partnership with the MIT will lay a strong foundation to bridge Skoltech to Europe and North America.

The speed and scale of Skoltech progress require a strong institutional framework and a solid system of shared governance.

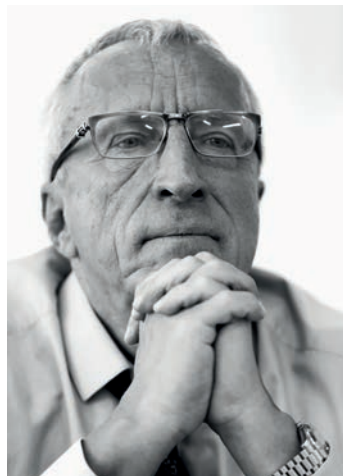
To address this, we launched and completed a formal strategic planning cycle to balance ongoing and prospective tasks, prioritize resources, and coordinate functional strategies. The Academic Council kicked off in its rotated composition of the senior faculty, administration, alumni, and invited experts. The policymaking function was re-started to ensure that the institute wide rules are developed with involvement of those, who make up the Skoltech community today.

Let me remember Ekaterina Savitskaya, a senior researcher of the Center of Life Sciences, who passed away in October. Ekaterina joined Skoltech in 2013 to conduct research on CRISPR-Cas prokaryotic immunity. She was also active in teaching, delivering courses in stem cell biology and developmental biology. Her untimely passing is an irreparable loss for our community.

I wish to thank Skoltech community and stakeholders for contribution made to advancing our Institute. Your support is key to our success.



Alexander Kuleshov
Skoltech President





Year in numbers

>1000

publications in Web
of Science, Scopus

98

papers in Nature
Index journals

97

in Nature Index 2019
Young Universities

123

research
grants

155

R&D
projects

1,6 bln RUB

sponsored research
funding

1062

MSc & PhD
students

48

students'
nationalities

652

alumni in 30+
countries

49

IP granted
to Skoltech

40

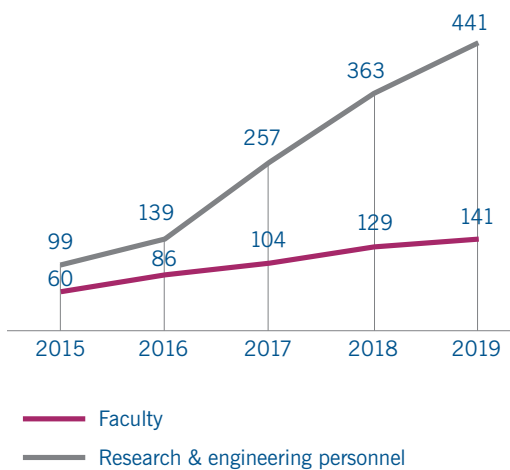
Skoltech startups
with Sk residency

48%

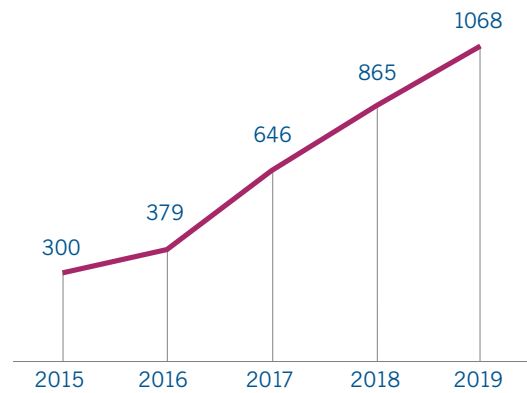
startups owned
by students &
alumni

Trends

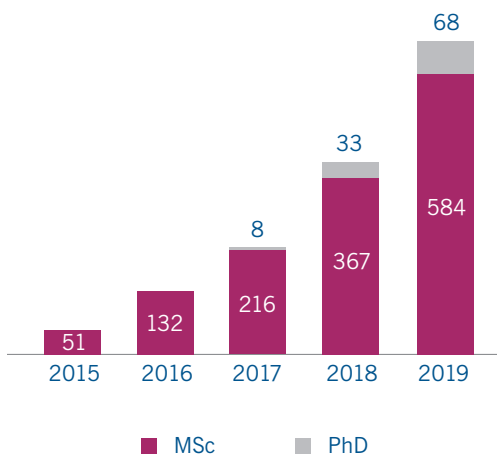
Academic & engineering personnel
(headcount)



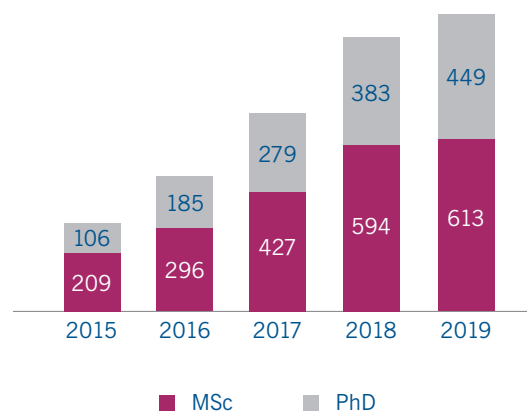
Total personnel
(headcount)



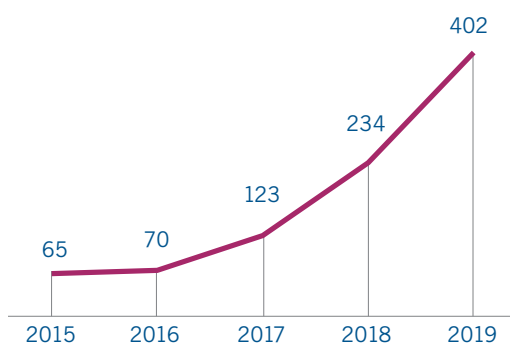
Graduates (cumulative)



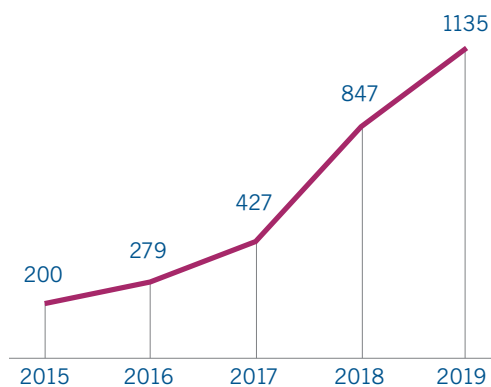
Student cohort



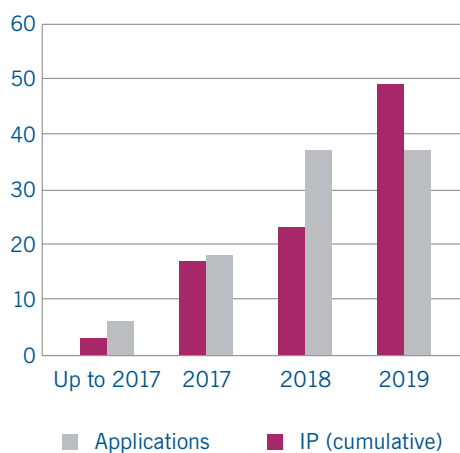
Research grants (mln RUB)



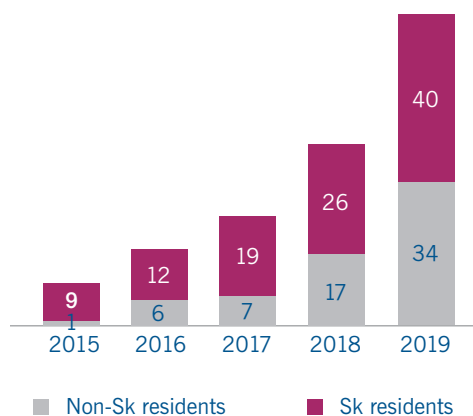
R&D projects (mln RUB)



Patent activity



Skoltech startups



Focus & Governance

/01

Human Capital

ACADEMIC & ENGINEERING PERSONNEL

Faculty

In 2019, the Skoltech community of faculty, researchers, and engineers exceeded 500 people. Several targeted appointments were made through hiring scientists with extensive international experience and expertise to build select areas of specialization at the CREIs.



Christoph Borchers was appointed as the Head of Laboratory of Omics Technologies and Big Data for Personal Medicine and Health (CDISE) sponsored by the Megagrant program of the Ministry of Science and Higher Education. Professor Borchers is a top world expert in quantitative and structural proteomics and metabolomics and big data in molecular sciences. He also holds a position at the McGill Centre for Translational Research in Cancer (Canada).



Vladimir Zakharov joined CAS as the Head of the Laboratory of Turbulence & Coherent Structures in Integral and Non-Integral Systems, supported with a RSF grant. Professor Zakharov's research covers mathematical and physical aspects of nonlinear wave theory. He is a recipient of the Dirac Medal for contributions to the theory of turbulence, and an elected Member of the Russian Academy of Sciences.



Laurent Gentzbittel was appointed as the Head of Digital Agriculture Lab. He is an expert in plant quantitative genetics and genomics, biostatistics, bioinformatics. Previously, Professor Gentzbittel held a position at the Higher School of Agronomy (Agro-Toulouse), France.



Natalia Strushkevich joined CDISE as an assistant professor. Natalia is an internationally recognized expert in pharma-relevant molecular technologies and molecular modeling. She has an extensive background in R&D, and is also a co-founder of several startups. Prior to Skoltech, she worked at the Institute of Bioorganic Chemistry (Belarus).



Alexander Panchenko joined CDISE as an assistant professor. He is an expert in natural language processing, worked on problems of semantic relatedness, sentiment analysis, gender detection, and taxonomy induction. Previously, Alexander was a senior postdoctoral researcher at the University of Hamburg (Germany).



Dmitry Dzhurinsky joined CDMM as an assistant professor. Prior to Skoltech, Dmitry held a senior R&D engineer position, servicing automotive industry needs in the Greater Detroit Area, USA. He also served at the Alcoa Open Innovation Department, working on transformational innovation technologies in the aluminum production industry.



Pavel Osinenko joined CDISE as an assistant professor. His research focuses on machine learning and its applications in engineering, control theory, autonomous driving, and data fusion. Pavel developed new approaches based on reinforcement learning with stability and safety guarantees for discrete-time systems. Prior to Skoltech, Pavel worked at the Fraunhofer Institute for Transportation and Infrastructure Systems (Germany), TU Chemnitz (Germany), and the KTO of Dresden University of Technology (Germany).



Gleb Sukhorukov was appointed as a visiting professor (CEST) to raise expertise in the area of encapsulation and microfabrication. Professor Sukhorukov is the chair at the Biopolymers at the School of Engineering and Materials Science at Queen Mary University of London.



Dmitry Ivankov was appointed as an assistant professor at CLS. Dmitry is an expert in protein physics, contributed to the theoretical description of protein folding kinetics. His current work concentrates on epistasis, an evolutionary phenomenon that has recently been found to relate to cancer, Parkinson's disease, and other diseases. Prior to Skoltech, Professor Ivankov worked at the Department of Genome-Oriented Bioinformatics of the Technical University of Munich (Germany) and the Institute of Science & Technology (Austria).

Two faculty members, Professor Geneste (Space Center) and Professor Macchiardi (CNBR), left Skoltech due to the expiry of their contracts.

Awards & promotions

Skoltech faculty were recognized nationally and internationally for academic & technology contributions, the year highlights include:

- **Professor Fedorov** – Award in the category “AI for Solving Humanity’s Greatest Challenges” at the Lenovo-Intel AI University Challenge 2019.
- **Professor Phan** – Outstanding Reviewer Award for maintaining the prestige of the IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP).
- **Professor Ouerdane** – Distinguished referee for the European Physical Journals.
- **Professor Tretiak** – Highly Cited Researcher Award from Web of Science Group.
- **Professor Oganov** – Friendship Award of the Chinese Government.
- **Professor Oseledets** – Yandex “Research Advisor” Award for contribution in training young scientists in the field of machine learning.
- **Professor Zorin** – Computer Graphics Achievement Award 2019 for fundamental contributions in the fields of geometry processing, multiresolution shape modeling, and geometric principles of physics-based simulation in graphics.
- **Professor Nasibulin** – Gold medal named after academician I.V. Petryanov for outstanding achievements in the field of physical and applied chemistry.
- **Dr. Osterman** – Moscow Government Award for developing a method to search for new antibiotics (“Ultra-high-performance screening of biodiversity in the search for new drugs” project series).

Based on international peer-review¹, the APTC made positive resolutions on faculty and researchers promotions:

- **Professor Oseledets** was promoted to full professor. His research results were published in the top journals in applied mathematics and theoretical and computational chemistry. He contributed

to curriculum design by providing core and professional education courses.

Professor Oseledets plays a leading role in a number of industrial research projects (Huawei, Gazprom Neft), also involved in startup activities.

- **Professor Troshin** was promoted to full professor. His main work is on materials chemistry, organic materials, and electronics, organic materials for advanced metal ion batteries, hybrid organic-inorganic materials for photovoltaics (solar cells). He is ranked among productive and impactful faculty at Skoltech. Professor Troshin contributed to developing the PhD program in Materials Science and Engineering and has high teaching evaluations from students. He filed several invention disclosures on organic cathodes.
- **Professor Shapeev** was promoted to associate professor. His area of expertise includes machine learning, numerical analysis, molecular modeling, models of interatomic integration. Over the last year, he published over 13 peer-review papers in prominent journals. He developed three courses, and also contributed to development of the Computational Science & Engineering program. Professor Shapeev raised grant funding and leads several industrial contracts.
- **Dr. Kostyukevich** was promoted to assistant professor. His expertise focuses on instrumentation development, numerical simulation of ion optics, omics technologies, native mass spectrometry, isotope exchange mass spectrometry, and data processing. He is a co-author of over 80 papers in the refereed journals. He has experience in winning highly competitive awards and grants.
- **Dr. Khrameeva** was promoted to assistant professor. Her research work spans a wide range of biological and methodological approaches: from genome variation to the chromatin architecture, gene expression, and metabolic evolution, from unicellular organisms to humans, and from sequencing to mass-spectrometry. She demonstrated an excellent publication

¹ Expert groups of the Appointment, Promotion and Tenure Committee of the Academic Council (APTC).

record (first-author papers in prestigious journals) and has active grants. Ekaterina teaches the Advanced Bioinformatics course at Skoltech, as well as guest lectures at MSU and HSE.

- **Dr. Nikitina** was promoted to assistant professor. Her area of expertise includes the kinetics of electron transfer in ionic and molecular solvents, the kinetics of electron transfer at modified interfaces, the molecular modeling of electron transfer and solvation, and metal-ion batteries. She is the PI of several RFBR and RSF grants, substantial experience in teaching general electrochemistry courses at MSU and Skoltech, together with Professor Stevenson.
- **Dr. Fedotov** was promoted to assistant professor. He holds a unique blend of competences in inorganic chemistry, solid-state chemistry, crystallography, and material science, with a primary focus on advanced cathode materials for the next generation of metal-ion batteries. The scientific output is exceptional for the current stage of his academic career, as reflected by the impact factors of journals in which he has published. Stanislav was a teaching assistant in the Materials Survey, Computational Chemistry, and Materials Modeling courses. Also, he designed the Materials Design and Production course.
- **Dr. Sergeichev** became assistant professor. His main publications are in the high journals and the largest international conferences (International Conference on Composite Materials, Composites and Advanced Materials Expo CAMX and the Society for the Advancement of Material and Process Engineering – SAMPE). Dr. Sergeichev spent the last two years on the development of a program Experimental and Digital Certification Platform, where he is currently the technical director. He contributed to teaching and learning by delivering a course, Structural Analysis and Design, which is evaluated highly by students. He is a founder of the Helix Tank Lab startup, which has applied for a Skolkovo residency.
- **Dr. Safonov** was promoted to assistant professor. He has an excellent publication record, involved not only in theoretical

computer science, unconventional computation, parallel computing, and artificial intelligence but also design and development of novel materials. Alexander was a presenter in more than 20 international conferences in the area of composite materials (ECCM16, ICCM20, CAMX2015, SAMPE2015, ECCM17, SAMPE2016, ICCM21, EGU2019). He led several large-scale R&D contracts with United Aircraft Corporation, AeroComposit, and other companies. Dr. Safonov has supervised students since 2016. He founded a startup company T-TECH, which is a Skolkovo resident.

Faculty assessment

The faculty assessment was organized in the form of self-evaluation, facilitated by the Provost's Office, achieving 98% of the response rate. The faculty reports, outlining the main results of the year, were assessed by scholarly output, educational load, sponsored research, contribution to innovation capacities, and professional service. It is planned to conduct faculty assessments annually. To automate data collection, Skoltech started to use the Elsevier PURE Research Information Management System.

Faculty onboarding

The onboarding program was launched by the Faculty Affairs Office (now a part of the HR Department) to support incoming faculty with seminars on teaching & mentoring, LMS usage, industry projects management, IP policy, services available in Shared Facilities, and the approach to faculty evaluation. It is planned to conduct the program in 2020.

Research and engineering personnel

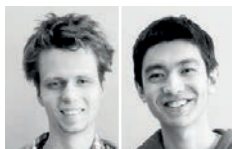
The research & engineering personnel grew by 21% compared to 2018. The majority of researchers & software engineers were hired to support R&D projects (e.g., NTI Center of Excellence Wireless Communication and Internet of Things) as well as operate state-of-the-art research infrastructure.

STUDENTS & ALUMNI

Skoltech students demonstrated a number of achievements in national and international competitions and conferences.



Ilya Fradkin
(advisor Professor Gippius) –
Yandex Prize in 3
nominations



**Ilya Vilkoviskiy, Mykola
Semenyakin**
(advisor Professor Marshakov) –
Young Russian Mathematics
2019 Fellowship



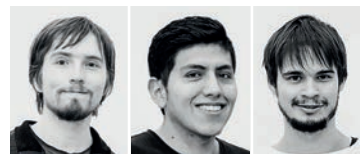
Mauro Morales
(advisor Professor Biamonte) –
Einstein Fellowship in Berlin



**Evgeny Tsykunov, Roman
Ibrahimov, Juan Heredia**
(advisor Professor Tsetserukou)
– Best Demo Award at the
International Conference
on Computer Graphics and
Interactive Technologies



**Vyacheslav Kozitsin
and Yuri Katser**
(advisor Professor
Lakontsev) – winners of
the Digital Breakthrough
Hackathon with a prototype
for a data analysis service



**Alexey Fedoseev, Juan
Heredia, Igor Usachev**
(advisors Professor
Tsetserukou, Dr. Grishaev) –
1st prize at Saudi Aramco
Upstream Solutions
Technathon 2019



Maxim Zakharkin
(advisor Professor Stevenson)
– Winner of Haldor Topsoe
Scholarship, recipient of the
ICDD Ludo Frevel Scholarship



Guillaume Debaille
(advisor Dr. Gusev) –
cash prize from Karfidov
Lab for Best Prototype at
the Ideas to Impact course



**Andrey Shevtsov and
Natalia Katorova**
(advisor Professor
Abakumov) – Winners of
LGChem Scholarship 2019

Recruitment campaign

The campaign 2019 was redesigned to maximize the admission of highly motivated and talented students. The major change was in scholarship policy, which was updated to prevent the admission of students with double affiliation (parallel studies). The other change concerned the E&I component – applicants' inclination to entrepreneurial activities were assessed by CEI faculty through the E&I Challenge and E&I slide. The changes introduced resulted in stronger commitment to E&I activities, demonstrated by the intake during Innovation Workshop 2019.

Outreach activities included events with faculty participation on campus, target universities and cities. Online marketing included targeted ads were added with online marketing – targeted ads in social networks, top aggregators of MSc programs, and context ads in Google and Yandex. The landing pages for MSc programs were updated, taking into account users' feedback and the statistics of Yandex Webvisor.

The content projects included an interactive guide on academic life at *postnauka.ru* – 24 faculty, 18 video-guides (5000-8000 views each) and 15 long-reads, which reached more than 6.8M people via social networks and brought to the project's website 350,000 visitors. The project with *vc.ru* received 1.2M ad views converted into 28,000 reads of special long-read material about 4D-printing. More than 35,000 unique views of two joint materials with *knife.media* converted into 2000 transitions to Skoltech web pages. Joint interactive material with *nplus1.ru* reached 200,000 users despite the specifics of the IoT, and resulted in 1200 leads.

3000 copies of the comics book *That's True* were distributed. Skoltech 365 movie showed a breathtaking story of a first-year student at Skoltech, receiving rhapsodic feedback from internal and external audiences.

As a part of outreach activities, undergraduate research opportunities programs were launched with MIPT (in physics) and Mendeleeev University of Chemical Technology (in chemistry).

For the first time ever, the selection days were organized on the new campus. Off-campus selection on the joint MSc programs was held at TUSUR University (Tomsk), Saint Petersburg Academic University, and Saint Petersburg State University of Aerospace Instrumentation. An international selection event was held in Bangkok, Thailand: three students received the HRH Princess Maha Chakri Sirindhorn of Thailand Scholarship to study at Skoltech.

The Olympiad track was intensified in partnership with HSE (MSc Data Science), NTI (MSc Space and Engineering Systems (Aerospace Systems track), MSc Information Science and Technology (Wireless Communication Technologies track). Fourteen winners were offered enrolment to Skoltech.

In the end, the campaign resulted in the admission of 288 MSc and 128 PhD students from 102 universities in 26 countries. About 57% are the graduates of the top-300 universities (QS, THE). For several years in a row, the majority of students have been coming from the top Russian universities (MIPT, MSU, HSE). However, due to the revision of the scholarship policy, the share of students from these universities declined to 45% compared to 2018.

In addition, 26 visiting students from the Technical University of Munich, the University of Salerno, the Shanghai Institute of Biological Science, the Swiss Federal Institute of Technology in Zurich, the Polytechnic University of Turin, IFP, and other universities, joined Skoltech during the year.

As a pilot approach, eight PhD students (CDISE) were enrolled with scholarships provided by Sberbank, Huawei, Phillips, and Samsung.



DMITRY LAKONTSEV, *Director of the NTI IoT Center of Excellence:*

"This is a well-deserved victory. Yurii Katser and Vyacheslav Kozitsin (winners of the Digital Breakthrough Hackaton) graduated from Bauman Moscow State Technical University, and they enrolled in Skoltech to take the next step in education and learn to put theoretical knowledge into practice. They are interested in processing industrial data and solving real problems in this area, and Skoltech fully helps them realize their potential and achieve their goals."



Skoltech is one of the first universities to organize the selection of MSc students using engineering team competitions.



Skoltech@NTI Olympiad student track, April 2019.

// SUCCESS STORY

OLCAY YILMAZCOBAN

*MSc graduate | Energy Science and Technology
Co-founder & CEO | FalconAI Technologies, Inc.*

**«Skoltech prepares you to life»**

I decided to join Skoltech because I wanted to learn more about technological innovation. Therefore, I enrolled to Skoltech joint program with Massachusetts Institute of Technology (MIT) and completed MSc in Innovation and Entrepreneurship. I graduated in 2015 among the first cohort of Skoltech students.

Skoltech is a great place to learn and develop an entrepreneurship mindset. In a nutshell, Skoltech prepares you to life – it is 100% correct as Edward Crawley, Skoltech Founding President, told us at the opening ceremony. I kick-started my first company LaserX, focusing on laser based space communication, while I

was still a student at Skoltech. After my first entrepreneurship experience, I decided to join a venture capital fund to learn more about start-ups and deep-tech venture investing. Right now, I'm Co-founder & CEO of FalconAI Technologies, Inc., a VC-backed startup based in Boston, USA. We are working on the one of the world's first Esports AI Platform – SenpAI. I decided to start FalconAI because I believe AI has great potential to enable us to learn faster. As a company, we are trying to demonstrate this in Esports right now. We would like to develop cutting edge AI to help millions of gamers to get better.

// SUCCESS STORY

ANNA DUBOVIK

MSc graduate / Data Science

Head of Advanced Analytics and Machine Learning at Gazprom Neft



«My experience at Skoltech was fun, unlimited, and uprising»

I received a Master of Science in Computer Science and Data Visualization degree from Skoltech in 2015. My experience at Skoltech was fun, unlimited, and uprising. I am madly in love with Skoltech people and administration team that worked hard at the very start of Skoltech (Bram Caplan and admission office is a great love of every first-year student, I think). In my days a great opportunity was to help organize Selection Weekends (back in the days it was 3 days long) – I’ve made my most long-term friendships during these activities and we stay in touch no matter how far.

My thesis at Skoltech was dedicated to professional social media analysis. I also was a member of winning teams in several

Hackathons and served as a Secretary of the Student Council. Since my graduation, I have applied the experience from Skoltech in my “Technology and Education” public speaking and workshops, as well as at my work. Currently I am the Head of the Data Science Department at Gazprom Neft, leading the advanced analytics and machine learning team. Skoltech was an amazing school for “communicating your way” with business. As first-year students, we had no borders in what we were allowed to do and that was the best part. Of course, some people were unhappy with “uncertainty”, but as it turned out when you start a real job, “nothing is certain” and Skoltech made me ready for that.

// SUCCESS STORY

ALEXANDER BEREZUTSKII*MSc graduate | Photonics & Quantum Materials**Internship at IQBit in Waterloo, Canada***«I really appreciated the flexibility of the educational and research process at Skoltech»**

I received my Bachelor's degree at MIPT, the Department of Problems of Physics and Energetics. At the end of my final year at MIPT, I learned about Skoltech and became interested because of the opportunity to build my own unique educational track, the English-speaking environment and the ability to be financially independent thanks to Skoltech's scholarship program.

Overall, I really appreciated the flexibility of the educational and research process at Skoltech, as one can take any classes he or she prefers and work with supervisors from different centers. Concerning the classes, I really enjoyed Nonlinear Optics by Professor

Shipulin and Experimental Data Processing by Professor Podladchikova.

I also participated in the academic mobility program in the last year of my studies at Skoltech. It was a very nice experience in the sense that I could unplug myself from everyday problems and responsibilities I face in Moscow, and fully devote my time to the graduate project. I would highly recommend to take such an opportunity if possible. Thanks to my co-advisor in Budapest, my visit there was my best experience of these two years in my Master program.

In this gap year I will have a year-long internship at IQBit in Waterloo, Canada.

Student support

Skoltech is committed to shape a favorable environment and high-quality services to students. The Student Department organized services on migration support, military registration, accommodation, and the design of student community-building spaces.

International students were accommodated in Tetris and other apartments and a shuttle bus to campus was launched. According to the survey, 84% are satisfied with the accommodation.

Interfaith prayer and a meditation room, a meditation room, and a special musical rehearsal room were opened on campus. An agreement was reached with the Moscow Social Register so that students can apply for a student social card. The ISIC international student card's issuing is already launched.

Student life

The Skoltech Student Council was active in organizing community-building events, including the Talent Show, International Night, and the New Year's party. Student Initiation and Science Slam – a special festival for young scientists – were held for the first time.

Student life was also enriched with multiple opportunities provided by sports clubs (football, hockey, tennis, volleyball, basketball), dance clubs, music clubs, and volunteer clubs. A number of volunteer events, such as master-classes for Open Horizons and Sheredar Foundations, Charity, and Donor Days on campus were conducted.



ANNA KOTTSOVA, *President of Skoltech Student Council:*

“This year we created several new traditions inside student body. Having started from constant dialog with Skoltech administration we managed to develop not only entertaining but also educational and socially oriented events. Sports, hobbies and all kinds of hidden talents – we help students to explore it all and share with the whole Skoltech community.”



Skoltech's Got Talent.





The New Year's party.

ADMINISTRATION

As of the end of the year, the administration comprised 376 employees, 52% of which are female.

The HR team was active in designing and launching new initiatives to support incoming employees. For example, the onboarding program was launched – each new employee is provided with a welcome “First days in Skoltech” package, which offers a guide on key administrative processes. After the probation period, HR conducts personal

interviews to receive employees’ feedback and identify areas that require attention.

The mentoring program for team assistants was held to improve the quality of administrative support – seminars on operations, and requirements for document processing were conducted on a regular basis. Training seminars on new processes (e.g., docflow in electronic systems, travel procedures) were available to all administrative staff.



Skoltech team takes part in the "Legal Run Skolkovo 2019".

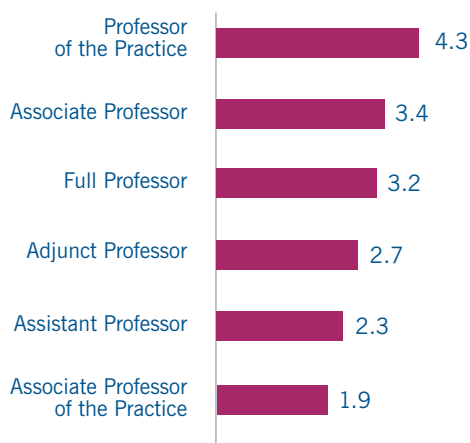


Skoltech Charity Day, May, 2019.

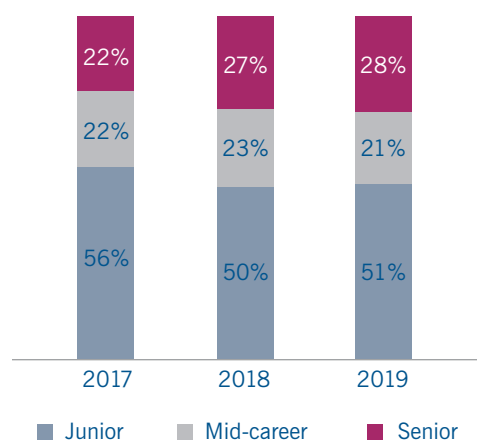
Summary Data

ACADEMIC & ENGINEERING PERSONNEL

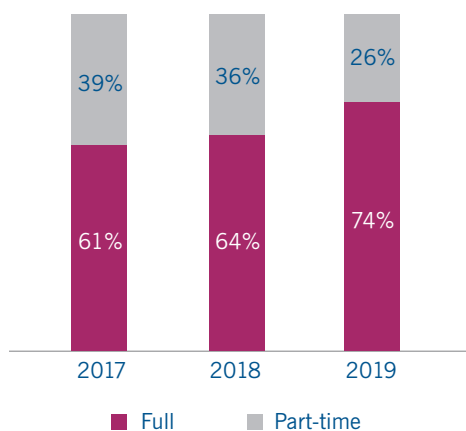
Faculty by average length of employment in Skoltech (years)



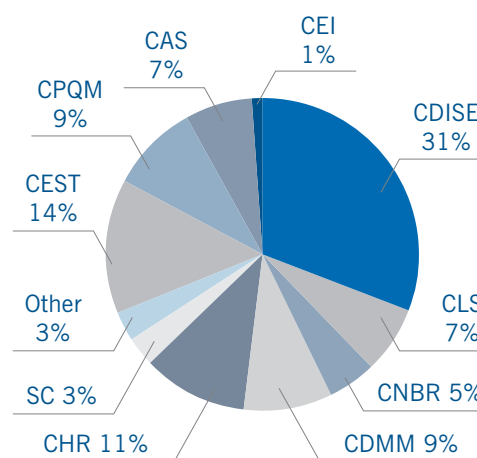
Faculty by rank



Faculty by type of employment



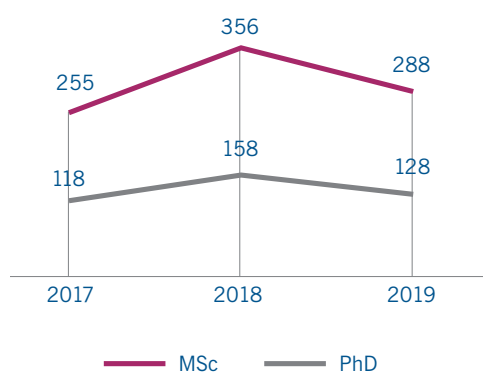
Academic & engineering personnel



Categories: faculty (excl. visiting), researchers (excl. research interns), research engineers, software engineers, technicians

STUDENT INTAKE & COHORT

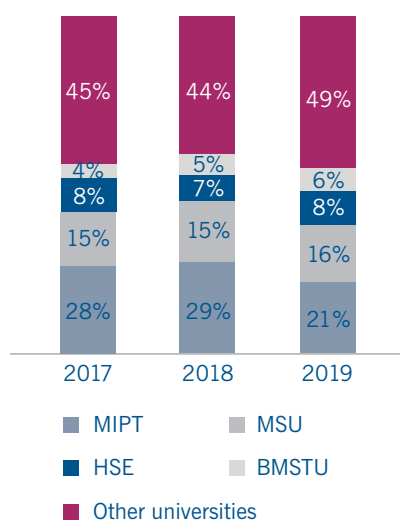
Enrollment by level of studies



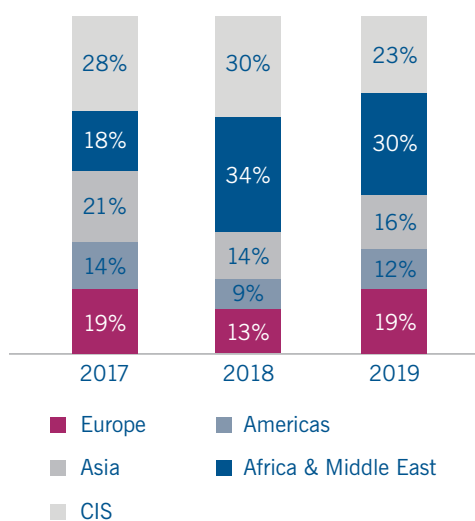
Recruitment funnel

	2017	2018	2019
Applications	11011	15641	13881
Invited to pre-selection	3642	3596	4346
Invited to selection	842	848	941
Enrolled	373	514	416
% of enrolled	3%	3%	3%

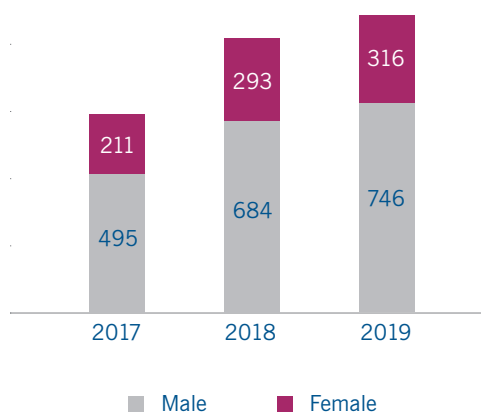
Enrollment by university of previous affiliation



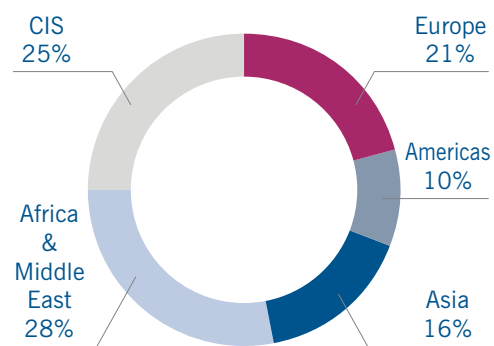
International enrollments by region



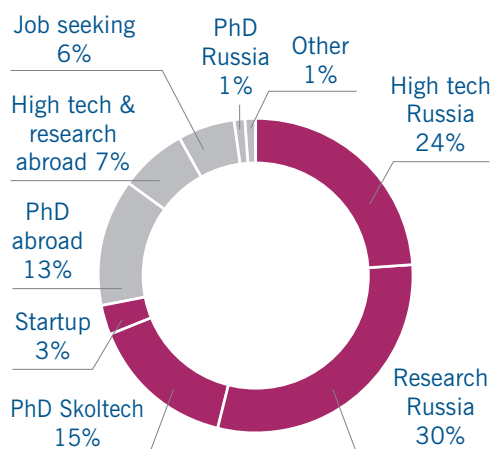
Students by gender



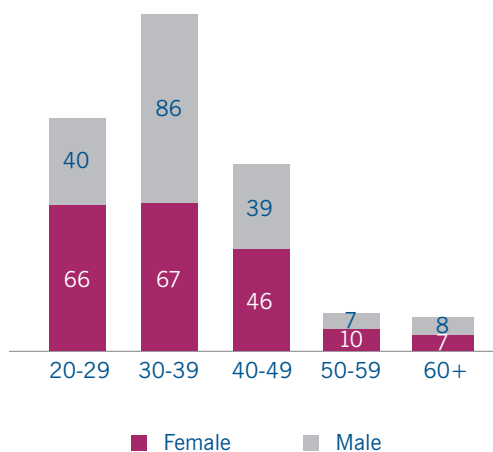
International students in cohort



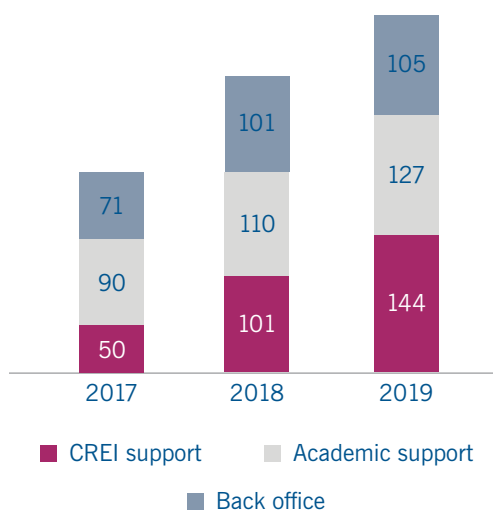
MSc & PhD graduates 2019



Administration by age



Administration by core functions



*Academic Support – personnel in functional directions
(Student Affairs, Strategic Communications, Institutional
Development, Industry Programs, KTO etc.)*

Institutional Governance & Development

The Institute's collegial governance bodies are the Founders' Assembly, the Board of Trustees, and the Academic Council.

Founders

The Founders' Assembly is the highest collegial governance body empowered to approve Skoltech charter, make decisions on the membership of the Board of Trustees, and principles to form the Academic Council.

In 2019, the Founders endorsed the rotated composition of the Academic Council, approved amendments to the charter, and unanimously supported entering of JSC Sberbank to Skoltech Founders.

In December, the founders held a remarkable meeting giving high praise to the president's report and addressing strategic issues of further development such as opening bachelor programs, graduates' career paths, and the extension of campus construction.

Board of Trustees

The Board of Trustees held four meetings, where they approved the Annual Report 2018 and interim progress reports on the execution of Strategic Action Plan. The Board also made positive resolutions on the update of the KPIs, continuation of the partnership with MIT as well as Financial Plan 2020-2022. Major recommendations were offered on intensifying activities for students' career opportunities, increasing the efficiency of R&D projects, and making greater efforts required for brand advancement. In December, the Board supported the candidacy of Simon Bradley, senior vice

president and global head of Cyber Security Protection at Siemens (Germany), to the membership of the Board.

The Board committees met on an *ad hoc* basis. The executive committee reviewed the year-closure report, providing recommendations on balancing the share of MSc & PhD students during the following years. The audit committee provided regular oversight of Skoltech financial reporting, external audit, and a system of internal control.

Academic Council

In September, the Academic Council kicked off in rotated composition presented by senior faculty, administration, alumni, and invited experts. The council held two meetings where it supported the draft of the Strategic Action Plan update, approved the results of student recruitment campaign, the admission plan 2020, and made recommendations on the undergrads research opportunity programs.

The council committees were fully operational, making decisions on faculty appointment, promotion, and contract renewal, research projects, and facilities, and the educational process. The council rotated the appointment, promotion & tenure committee, and the research & innovation committee. No consensus was reached on the composition of the educational committee; the rotation was postponed to 2020.



ALEXANDER KULESHOV, *Skoltech President:*

"Today, Sberbank is without doubt Russia's most technologically advanced company with ambitious and viable development plans. As we continue to work with and for Sberbank, it is only natural for Sberbank to join Skoltech founding members. The most valuable aspect of our partnership is that Sberbank acts as an anchor employer for a large part of our graduates who will shape the future scientific and technological elite of Russia."



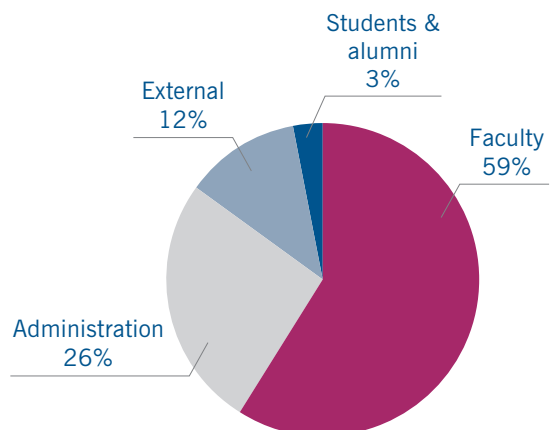
The meeting of Skoltech Founders. Skoltech, December 2019.



HERMAN GREF, *President and Chairman of the Board of Sberbank:*

“Russia’s future will be determined by the quality of its human resources capable of sustaining acute competition in the technology sector. Skoltech is one of the few educational institutions that we can count on as a source of top-notch professionals. As a technology-oriented company, Sberbank puts a high value on the cooperation with Skoltech”.

Academic Council & Committees Members

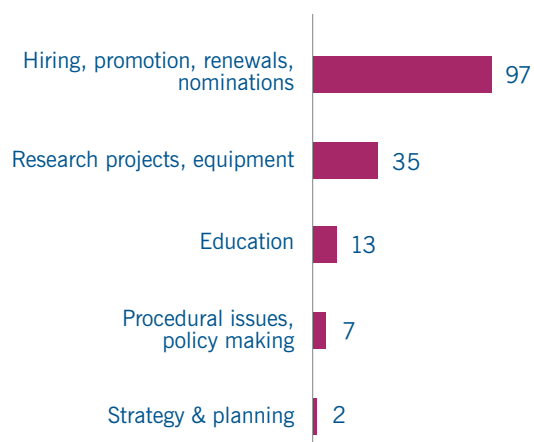


Faculty representation	
Full Professors	12
Associate Professors	6
Professors of the Practice	2

40% of Academic Council faculty serve on Committees.

Academic Council faculty are full-time, working experience in Skoltech ~ 4 years

Breakdown of resolutions



Polymaking

The Institute's polymaking was renewed with the policy on policies. The document issued by the president governs core principles and procedures for policies development (update) to ensure consistency, appropriateness, and compliance with rules adopted.

During the year, 31 policies & regulations were issued. In the main documents there was policy on planning, responsibilities between the president and the president's direct subordinates, the code of ethics, events policy, policies regulating students' admission, regulations on select administration departments. Core policies, such as the code of ethics and admission rules, were reviewed and approved by the Academic Council.

Based on employees' feedback received on policies application as well as the Institute's needs to regulate select issues, the policy making plan 2020 was developed. The focus will be on issuing policies related to Skoltech organization (CREIs, laboratories, shared facilities).

Strategic planning cycle

The formal strategic planning cycle was initiated with a goal to balance ongoing and prospective tasks, prioritize resources, and coordinate functional strategies. The cycle was led by a senior management team, which elaborated an approach on the updating of Strategic Action Plan and financial model and provided inputs on mechanisms to improve ongoing operations. The special strategic session was held to agree on priorities for 2020, including focused CREI programs, participation in large governmental initiatives & programs, efficiency of R&D projects, student career

development, and execution of the lab construction & relocation plan.

The cycle was closed with a positive resolution from the Board of Trustees on the Strategic Action Plan and Financial Plan.

Institute's senior management, organizational structure

The major changes in the senior management structure included:

- The revision of authorities of the provost, vice presidents, and the president's advisors by extending their approval & signing powers.
- The appointment of Professor Stevenson as the provost, based on the resolution of the Board.
- The appointment of Professor Abakumov as CEST director, based on the resolution of the Board.
- The appointment of Professor Kotelevtsev as CNBR interim director.
- Splitting the authorities of the vice president for real estate & facilities (resigned in July) between the vice president for finance & operations and the head of campus construction & management department.

In terms of improving the efficiency of Skoltech's organizational structure, HR function was consolidated by merging the Faculty Affairs Office with the HR Department. The Strategic Communications Department was strengthened with regards to PR, marketing & brand development functions. The Institutional Development Department was consolidated by merging the Monitoring & Report Office and the Academic Initiatives Office.

Several units were established in the CREIs:

The Laboratory of Omics Technologies and Big Data for Personalized Medicine and Health

(Professor Borchers) will conduct research under the Megagrant program of the Russian Ministry of Science and Higher Education, as well as develop a standardized targeted mass spectrometry (MS)-based assays to quantify human proteins in all human tissues and biofluids, including disease-related mutations and modifications. The assays will be validated and could be commercialized as services offered and as easy-to-use kits.

The Leading Research Center Open 5G Radio Access Networks

(Dr. Shub) will implement a new project in the framework of Russian National Program “Digital Economy”. The produced equipment will be compliant with the international open standard OpenRAN. This means that national vendors will have a unique opportunity to enter the global market with their products.

The Deep Quantum Laboratory (Professor Biamonte) will focus on the computational capacity of physical systems and processes, quantum effects for the enhancement of computational tasks such as machine learning, optimization and the simulation of physical systems, the creation of classical simulations of stochastic and open quantum systems and of quantum information processing devices/ systems.

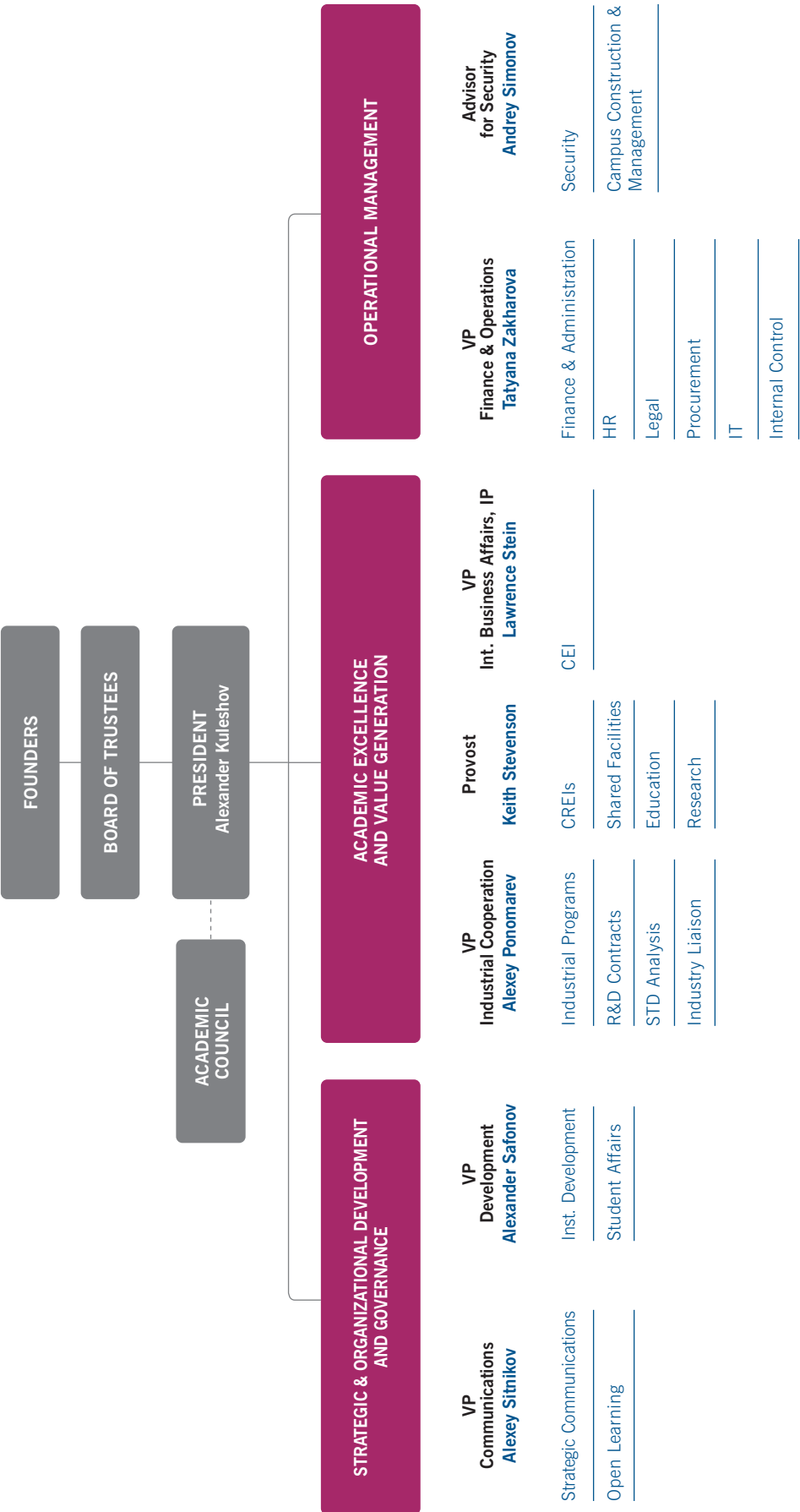
The Digital Agriculture Lab (Professor Gentzbittel) will focus on technologies important for nutrition and metabolism as a part of general health strategy, which is considerably based on the similar biological sciences, competences, and research technics in cell, molecular, gene-biologics, and computational analyses. The laboratory will have an educational program with support of global partners (Bayer, Syngenta) and regional hubs with local agro universities and research institutes.



VITALY SHUB, *Director of the Leading Research Center Open 5G Radio Access Networks:*

«For Skoltech, telecommunications have always been among the strategic targets. We have gained vast expertise and deep knowledge of the industry and put together what I believe is the strongest team of telecom experts in Russia. We work closely with operators and industrial companies operating locally and internationally. Collaborations with Russia's leading manufacturers and operators are the key to success for our LRC project».

Organizational Chart (as of December 31, 2019)



KEY INDICATORS OF DEVELOPMENT

In accordance with the Strategic Action Plan, Skoltech progress is measured through a system of key indicators reflecting the results of academic excellence & value generation. The president reports the status of execution of indicators to the Board of Trustees on a quarterly basis.

Indicator: Publications in Web of Science, Scopus

Annotation: The indicator defines a ratio of faculty publications affiliated with Skoltech, indexed in Web of Science, Scopus, to the average faculty headcount². The indicator is included in the Russian Federation State Program “Economic Development and Innovative Economy” as a measure of Skoltech academic excellence.

Result: Skoltech exceeded the target (4.1), maintaining the highest quality of publication output. Skoltech faculty published 597 papers, including 69³ in the prestigious Nature Index journals. The Institute's total output (papers of academic personnel and students) is presented with 1008 papers, 503 of which are in Q1 journals⁴.

	2015	2016	2017	2018	2019
Actual (units per average faculty)	2.5	4.4	5.6	5.8	6.3

Indicator: MSc & PhD graduates

Annotation: The indicator tracks annual graduation in MSc and PhD programs. The indicator is included in the Russian Federation State Program “Economic Development and Innovative Economy” in terms of the target to have 1000 graduates in 2020 (cumulative).

Result: Graduation for 2019 is ahead of the plan (240), which is explained by the circulation of the student cohort as well reducing the percentage of students' expulsions. The cumulative number of MSc and PhD graduates is 652.

	2015	2016	2017	2018	2019
Actual (persons)	51	81	92	176	252

Indicator: Graduates involved in innovation activities

Annotation: The indicator tracks the employability of graduates in Russian high-tech and research sectors as well as the ability of graduates to establish or join startups. The indicator is included in the Russian Federation State Program “Economic Development and Innovative Economy”.

Result: The Institute reached the target of 70% in spite of the growing graduate cohort. The majority of graduates were employed within 4 months after graduation. The year marked an increase in graduates employed in research organizations, as well as a decline in the percentage of graduates continuing for a PhD at Skoltech (15%).

	2015	2016	2017	2018	2019
Actual (%)	51	67	67	69	70

² As of Dec 31, 2019 – 94.7.

³ Out of 98 papers published in 2019 by Skoltech employees and students in total. Data as of Jan 15, 2020.

⁴ Data as of Feb 27, 2020 (SciVal).

Indicator: Attracted funding

Annotation: The indicator tracks external funds (sources, other than the SK grant) – sponsored research (grants and contracts), services of shared facilities, professional training, IP sales, licensing, attracted during the year. The actual result is calculated as committed funds under contracts.

Result: The Institute demonstrated growth in attracting funding, exceeding the target (1250 mln RUB). Funds under R&D contracts comprise 74% of the total amount of attracted funding. In 2019, Skoltech had 278 projects under grants and R&D contracts.

	2015	2016	2017	2018	2019
Actual (mln RUB)	265	348	554.7	1112	1595

Indicator: Patent applications

Measure: Counts the total number of patent applications for IP created at Skoltech to the average faculty headcount. The indicator is tracked from 2017, considering the speed of developing Skoltech capacities.

Result: The total number of patent applications is on track with the target (0.4); however, it fell short compared to 2018 (0.5). The majority of applications are for “invention” and “utility model.”

	2015	2016	2017	2018	2019
Actual (units per average faculty)	NA	NA	0.2	0.5	0.4

Indicator: startups with Skolkovo residency

Measure: This shows the cumulative number of startups, established by Skoltech faculty, researchers, students, or alumni, which received the status of Skolkovo resident. The indicator is included in the Russian Federation State Program “Economic Development and Innovative Economy” to monitor Skoltech entrepreneurial activity and contribution to developing the Skolkovo ecosystem.

Result: The cumulative number of startups is on track with the target (40). In 2019, the Skoltech portfolio of startups increased by 12 companies, established by academic personnel of CDISE, CDMM, CLS, CPQM, and alumni (SC). Several companies are the results of projects supported under the Translational Research Program.

	2015	2016	2017	2018	2019
Actual (units, cumulative)	9	12	19	26	40

Indicator: External funding

Measure: The income from grants, R&D contracts, professional training, licensing, and endowment to the Institute's total expenses (excl. capital expenditures for campus construction and investments into equipment). This is calculated as cash received.

Result: The result of the year exceeded the target (25%). Major income was received under R&D contracts (61%), grants (20%), and interest from endowment (14%). Other sources of income included professional training, services of shared facilities, and sublease.

	2015	2016	2017	2018	2019
Actual (%)	15	15	20	25	26.5

Strategic Communications

PR activity

Compared to 2018, the number of references in the media increased by more than 60% (in online media, the growth amounted to more than 5000 references). Separately, it is worth noting the twofold increase in TV reports involving the Skoltech leadership, professors, and researchers, amounting to 108 in 2019.

	2018	2019
References to Skoltech ⁵	10031	16364
Federal	6178	8220
Regional	3193	6941
Foreign	660	1203
Online media	~9000	~15000
News agencies reports	500+	800+
TV	65	108

Scientific communications

The increase in media activity from the preparation of press releases based on scientific papers by faculty and their distribution in the media amounted to more than 40% (38 scientific press releases were issued in 2018, and 55 in 2019). The total audience coverage in 2019 through the distribution of scientific news in the media amounted to more than 1,500 media references. A breakthrough in

the field of scientific communication was the access to foreign news platforms: in 2019, the number of references to Skoltech in foreign media exceeded 1200, more than 600 of which were in a foreign language. An essential role in this was played by the sustainable interaction of the Strategic Communications Department with EurekAlert!, a leading scientific news aggregator in English.

Altmetric Top 100

A visible result in online communication and social media was the paper titled “Few-Shot Adversarial Learning of Realistic Neural Talking Head Models,” authored by CDISE and Samsung AI Center researchers and students, Egor Zakharov, Aliaksandra Shisheya, Egor Burkov, and Professor Victor Lempitsky; it was listed #1 in Altmetric Top

100 best research works from all over the world. The publication became the absolute leader by the number of reposts on the Web for the 7 years of the existence of this rating. More than half of the news reports which contained a reference to Skoltech's scientific result were on CNN, Forbes, The Sun, Newsweek, FOX News Channel.



EGOR ZAKHAROV, *PhD student (CDISE)*:

“Our paper is inspired by the need to develop better telepresence solutions for augmented and virtual reality. The important component of telepresence applications is a realistic simulation of a person's appearance, which we try to perfect with the power of deep learning.”

⁵ Medialogia reports 2018-2019.

Marketing

Skoltech actively improved application of its own resources, information carriers, presentation, and branded materials. In 2019, more than 30 high-quality webpages for promoting educational programs, services, and opportunities at Skoltech were developed. The highlight is a promo video called "Skoltech 365," which immerses the audiences in Skoltech atmosphere and shows its key benefits.

Skoltech developed internal expertise in digital marketing: new online channels (targeted and contextual advertising

in social media, Google and Yandex) attracted more than 50% of the website traffic among applicants and played a key role in attracting participants to the Machine Learning Summer School (800 applications and 250 participants), Machine Learning Community Day (900 registrations and 450 participants), the SpaceUp conference (250 registrations), and other events. The marketing team started a project on the re-launch of Skoltech official website and creation of unified brand guidelines.



Featured scenes from the filming of Skoltech 365: a video that shows Skoltech through the story of a student from Italy. The filming lasted for over 23 hours non-stop and included more than 40 crew members and 30 actors. All faculty members in this movie played themselves.

Social media

In 2019, there was a rapid growth in traffic and conversion (for paid traffic from social networks) across all the Skoltech social media platforms. The increased number of followers and their deeper involvement is strengthening brand recognition and loyalty.



+185% followers
(4.0k vs 1,4k)



+17% followers
(9.5k vs 11,1k)



+12% followers
(17.3k vs 15.5k)
+66.1k views



+36% followers
(5.6k vs 4.1k)
5.5k unique visitors



+52% followers
(1.9K vs 1.25k)
+66.1k views



www.skoltech.ru
167k unique visitors
+240 Publications



On October 2, 2019, a press tour for Russian journalists took place in a new Skoltech campus for the first time. Representatives of almost two dozen socio-political and popular science media visited the Skoltech laboratories and met with the scientists.

Media projects



The Horizons of Physics

project in collaboration with Kommersant / Ogonek.

Seven interviews were published in 2019

(including interviews with Skoltech

Professor Nasibulin and Principal Research Scientist Feigelman).

All interviews (editorial choice) were recognized as the best materials of the issue.



Mathematical Walks

(Paulsen Publishing House)

A collection of interviews “Mathematical walks” (30 interviews with prominent mathematicians, including an interview with Abel Prize Laureate (2015)

Jacob Sinai, Fields Medal Laureate (2006) Andrei

Okounkov) is being prepared for re-release in preparation for the World Mathematical Congress in St. Petersburg (ICM 2022).



Sci-comic book “That’s True”⁶

The team for the project conducted a series of public discussions involving scientists, artists, and writers within the framework of major Russian sci-popular events. Among them are the book festival in Red Square, the CheapCherryBooks book fair, the Moscow Science Festival, the official opening of the Okhta Library in St. Petersburg, and others. Two thousand new books were printed and successfully distributed.



Skoltech Laboratory at the Polytechnic Museum

Six applications for participation in the project.

Opening of the Skoltech laboratory in the renovated Polytech on December 12, 2020.



How to enroll at Skoltech? (PostNauka)⁶

18 Publications, Review article, Interview, Video interview, Game test for applicants
4,550,329 views (website, YouTube, social media).



Ghost in zshell. Solving a mystery using IoT (N+1)⁶

Investigation quiz for applicants

Audience outreach: 350,000;

Participants: 25,000; Finalists: 1,235



Doing scientific business properly. Five startups established by young scientists (INC.RUSSIA)⁶

5 Longreads
101,099 views.



What is 4D printing in simple terms? (VC.RU)⁶

Review article
Audience outreach: 1,252,112;
28,503 unique users.



What should innovation education be like? (HOЖ/knife.media)⁶

Longread on Skoltech's innovative approach to STEM education – 3,500 unique readers. Test of scientific thinking – 18,000 participants.

⁶ In collaboration with Student Department;



"Ostrov 10-22". July, 2019.



In addition, the media projects team developed and issued promo materials at large Skoltech events such as Gateway to the World (4500 copies), Research Infrastructure (30 copies), Supercomputer “Zhores”⁷ (200 copies), and Instruments of Neurorehabilitation⁸ (200 copies).

Awards

Skoltech sci-comic book “That’s True” received a number of awards:

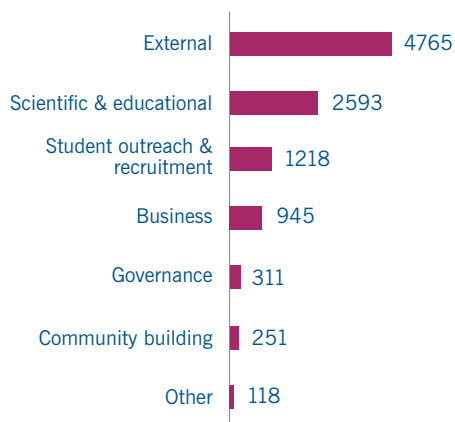
- Diploma of the 5th All-Russian Award “For Fidelity to Science” in the “Breakthrough of the Year” category (February 2019);
- “Communication Laboratory” (2nd place) for best sci-communication in Russia (June 2019);
- Long-list of Prosvetitel Award (June 2019).

Events

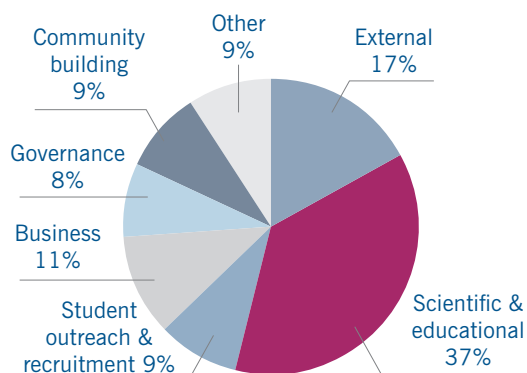
In 2019, Skoltech conducted more than 200 events. Most of them were organized at the new campus. The majority of events were scientific conferences and seminars, delegation visits, round tables with representatives of the business community and academia. Student recruitment events included Open

Doors, selection weekends, and site tours. Among key external events there was an education conference, Ostrov 10-22, seminars by the Moscow School of Management and major Russian companies (e.g. Severstal, Russian Railways). In total, 10,200 external participants visited the campus.

Campus visitors by event type



Events by type



⁷ In collaboration with CDISE

⁸ In collaboration with CNBR

Fundraising

Over the course of the year, the main goal was to create the concept of fundraising at Skoltech and establish strong cases of mutually beneficial forms of charity-based cooperation with partners. More specifically, the priorities were to extend Skoltech reach and gain support within Skoltech and the larger Skolkovo community while also attracting outside businesses, charity foundations, etc.

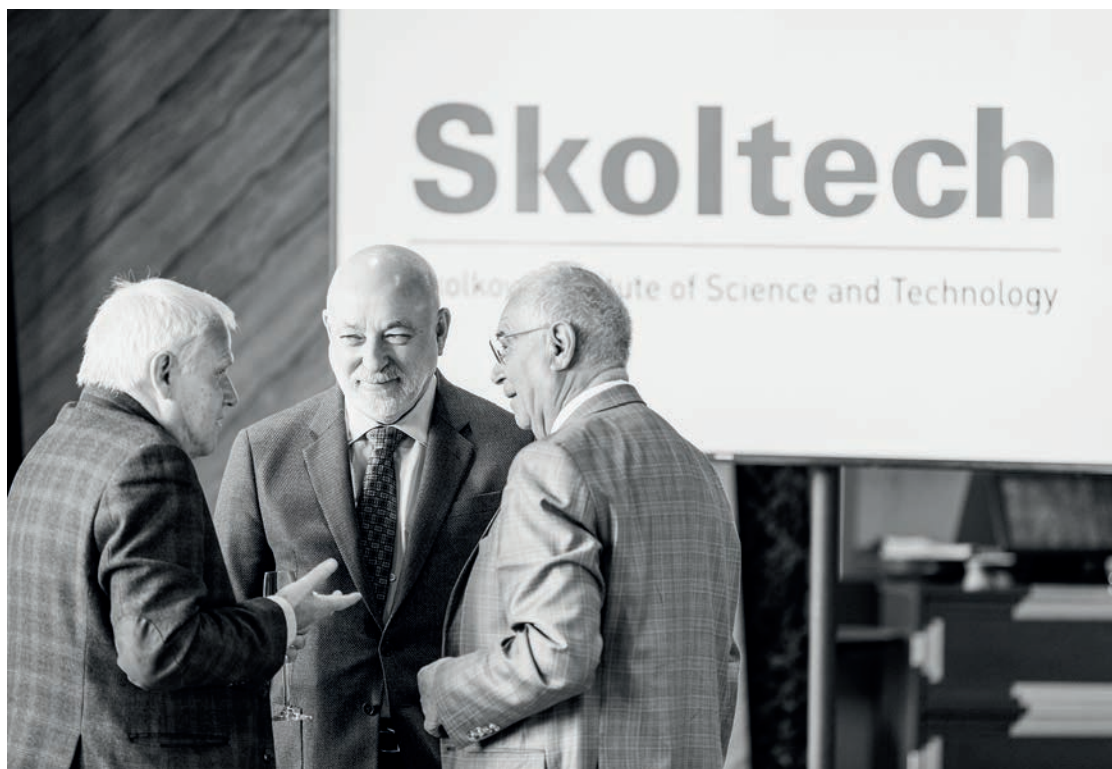
A series of special events were conducted on and off campus to engage potential donors to

the endowment, including joint events with the Andrei Melnichenko Foundation, the Gennady and Elena Timchenko Foundation, the Potanin Foundation and the Dmitry Zimin Foundation and others.

The year resulted in received commitment from a corporate donor (~ \$2 mln) in support of CNBR activities for 2020-2022; Skolkovo Ventures contributed 1 mln rubles to the Skoltech endowment, and several funding proposals are pending approval.



A fundraising event in support of the CNBR activities. April, 2019.



A fundraising event in support of the CNBR activities. April, 2019.

GLOBAL ENGAGEMENT

Partnerships

The Skoltech network of academic & industrial partners covers more than 300 organizations in most developed countries of the world. Partnerships are held in different formats – joint laboratories, research projects, faculty-to-faculty exchange, students' academic mobility, and double degree programs & cotutelle.

The year marked advancements in shaping strategic partnerships. The agreement on MIT Phase III was signed in December. Governed by a five-year agreement, Phase III will build on the most successful aspects of the previous collaboration, mainly focusing on faculty joint research projects.

A strategic collaboration agreement was signed with the Technical University of Munich (Germany). Skoltech became one of two international partners (neighboring

Imperial College of London) in the TU Munich application as a University of Excellence, which got the award in July. Both partners applied for the Erasmus+ mobility project and won the EU grant for student and faculty exchange for 2020-2022.

The bilateral program on educational, research, and innovation activities in medicine, neuroscience and big data processing was signed with TAU (Israel).

The partnership network was extended by memorandums of understanding with the Bio-Nano Electronics Research Centre (Toyo University, Japan), the RIKEN Center for Biosystems Dynamics Research (Japan), the University of Lausanne (Switzerland), the Technical University of Madrid (Spain), the Polytechnic University of Milan (Italy), and other universities.

International initiatives

Skoltech is actively integrating into international networks. In July, the first TEDx was organized by students – nine speakers gave inspiring talks on entrepreneurship, science, creative writing, and other topics to an audience of 100+ participants from Skoltech, Russian, and international universities.

The Falling Walls Lab, a unique international platform for leaders in science, business, politics, arts, and society, was held in May at Skoltech. Contestants presented ideas on social isolation, power inefficiency

and oilfield chemistry, cancer energy metabolism, and medicine inefficiency. Later in November, a Skoltech delegation attended the Falling Walls annual conference in Berlin, which brought together international community of scientists and entrepreneurs from all over the globe.

Skoltech continued to participate in the CDIO initiative as well as the Teaching and Learning Career Framework initiative of the Royal Academy of Engineering. Its presence within these networks is a key element of the future global engagement strategy.

Global Campus

To encourage international diversity, Skoltech continued to support the Global Campus program. Twenty-one students from Stanford University, MIT, Brigham Young University, the State University of New York, the University of Bristol, and the Oxford University participated in research internships,

took a Russian language course, and also had the opportunity to take select courses. Applications for the summer program 2020 have been received from students of Stanford University, Harvard University, Brigham Young University, the University of Massachusetts, and the University of Tennessee.

Global rankings

In 2019, Skoltech launched efforts to organize participation in the major rankings organizations – Times Higher Education (THE) and Quacquarelli-Symonds (QS).

The associate provost, Professor Fortin, presented two invited keynote speeches – one at the QS Conversation Summit and one at the THE Digital Transformation Forum; he will give a presentation on Skoltech at

the Innovation and Impact Summit (THE) in April 2020.

Denis Stolyarov, Head of the Student Department, gave a presentation at QS World Grad School Tour on "Things to keep in mind when choosing a Grad School," guiding the audience on how to select the university, prepare motivation letters, request reference letters, etc.



The Technical University of Munich and Skoltech sign an international cooperation agreement and a student exchange. May 2019.

Skoltech Partnership Network

North America



South America

NORTH AMERICA

CANADA
University of Calgary |
Cotutelle Agreement
**Ecole Polytechnique
Montreal** | Partnership
Agreement
TEDx

USA
**Massachusetts Institute
of Technology (MIT)** |
Strategic Partner
Schlumberger |
R&D Projects
Topcon | Joint Lab
University of Dayton |
R&D Projects

SOUTH AMERICA

CHILE
**Universidad de Santiago
de Chile** | Academic
Exchange



RICHARD LESTER, *associate provost for international activities at MIT:*

«We share many intellectual and practical interests with our Skoltech colleagues, yet collaborations like this also exist in the context of complicated and dynamic international relations. The broader US-Russia relationship was necessarily a factor in our review and planning of the MIT-Skoltech collaboration. In the rapidly changing global environment, MIT's international collaborations must remain aligned with our core mission and values. Learning about the world, helping to solve the world's greatest problems, and working with colleagues around the world who share our curiosity and commitment to rigorous scientific inquiry and free and open exchange are core values for MIT».

Asia



Australia



ASIA

CHINA

East China University of Science and Technology | Partnership Agreement
Huawei Technologies Co. | Joint Lab
Alibaba | R&D Projects

INDIA

Indian Institute of Technology Bombay | Academic Exchange

ISRAEL

Ben-Gurion University of the Negev | Joint Research
Tel Aviv University (TAU) | Strategic Partner

JAPAN

Toyohashi University of Technology (TUT) | Student Exchange
Toyo University Bio Nano Electronics Research Center | Academic Exchange
RIKEN Center for Biosystems Dynamics Research | Academic Exchange
Kindai University | Student Exchange
University of Electro-Communications (UEC) | Academic Exchange
RIKEN Center for Advanced Intelligence Projects | Partnership Agreement
Kyoto University | R&D Projects

SAUDI ARABIA

Saudi Aramco | R&D Projects

SOUTH KOREA

LG Electronics | R&D Projects
Samsung | R&D Projects

THAILAND

National Science and Technology Development Agency (NSTDA) | Academic Exchange
Vidyasirimedhi Institute of Science and Technology | Partnership Agreement

UAE

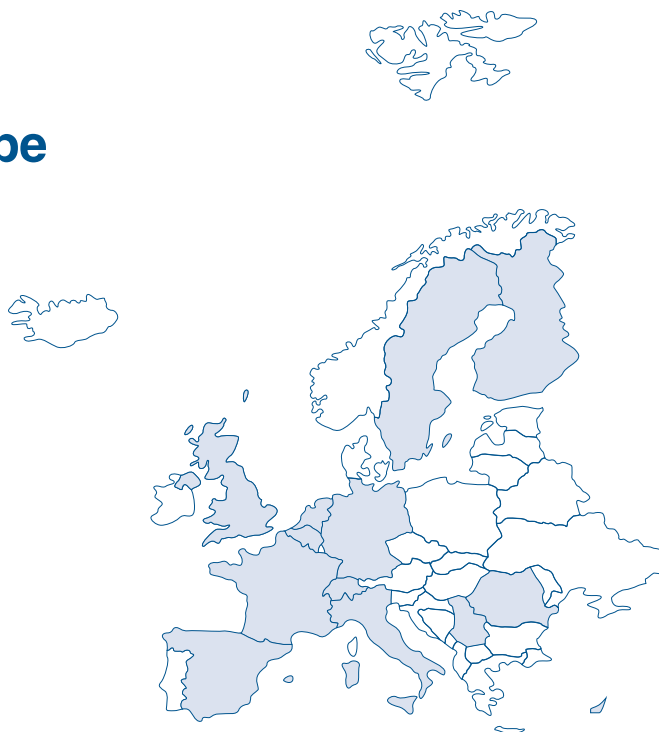
University of Sharjah | Partnership Agreement

AUSTRALIA

AUSTRALIA

Curtin University of Technology | Cotutelle Agreement
University of New South Wales | Partnership Agreement

Europe



BELGIUM

KU Leuven | Partnership Agreement

CYPRUS

Cyprus Institute | Partnership Agreement

FINLAND

Aalto University | Cotutelle Agreement

FRANCE

Grenoble Institute of Technology (Grenoble INP) | Student Exchange
Airbus | R&D Projects
College de France | R&D Projects
Total | R&D Projects
Université Grenoble Alpes | Cotutelle Agreements
Institut Supérieur de l'Aéronautique et de l'Espace | Partnership Agreement
National Institute for Agricultural Research | Partnership Agreement

GERMANY

Bayer | Joint Center for Crop Production
Bosch | R&D Projects
Brainlab AG | R&D Projects
AM Munich Research Institute GmbH | Joint Lab
Technical University of Munich (TUM) | Strategic Partner
German Aerospace Center (DLR) | Academic Exchange
Ulm University | Academic Exchange
Bergakademie Freiberg TU | Partnership Agreement

ITALY

University of Salerno | Joint Research
Politecnico di Milano | Student Exchange
University of Pisa | Academic Exchange
Università degli studi di Perugia | Partnership Agreement
Bruno Kessler Foundation | Academic Exchange

NETHERLANDS

Philips | Joint Lab

ROMANIA

Babes-Bolyai University | Partnership Agreement

SERBIA

University of Belgrade | Partnership Agreement

SPAIN

Technical University Madrid (UPM) | Partnership Agreement

SWEDEN

Huawei Technologies Sweden AB | R&D Projects

SWITZERLAND

University of Lausanne | Academic Exchange
University of Geneva | Partnership Agreement
Oerlikon | Joint Lab

UK

Iskania | R&D Projects
University of East Anglia | Partnership Agreement

Russia



All-Russian Rice Research Institute | Joint Research
Bashkir State Medical University | Joint Lab
Bashkir State University | Joint Lab
Bauman Moscow State Technological University | Network educational Program
BIOCAD | R&D Projects
Mendeleev University of Chemical Technology of Russia | Research Center
Far Eastern Federal University | Network Educational Program
Gazprom Neft | Joint Lab
Generium | R&D Projects
Higher School of Economics | Research and Education Activities
Immanuel Kant Baltic Federal University | Partnership Agreement
Institute of Gene Biology | Joint Research

Institute of Problems of Chemical Physics | Research Center
Institute of Solid State Physics | Partnership Agreement
ITMO University | Partnership Agreement
Kazan Federal University | Research and Education Activities
Keldysh Institute for Applied Mathematics | Partnership Agreement
Koltsov Institute of Developmental Biology | Partnership Agreement
Landau Institute for Theoretical Physics | Partnership Agreement
Lebedev Physical Institute | Partnership Agreement
LUKOIL-Engineering | R&D Projects
Messoykhaneftegaz | R&D Projects
Miratorg Genetics | R&D Projects

Moscow Institute of Physics and Technology | Research and Education Activities
Moscow State University | Research and Education Activities
National University of Science and Technology MISIS | Partnership Agreement
Novosibirsk State University | Network Educational Program
Peter the Great St.Petersburg Polytechnic University | Partnership Agreement
Research Center of Neurology | Joint Lab
Rosatom | R&D Projects
Rosseti | R&D Projects
Russian Post | Joint Lab
Saint Petersburg State University of Aerospace Instrumentation | Network Educational Program

SamaraNIPIneft | R&D Projects
Sberbank | Joint Lab
Severstal | R&D Projects
St. Petersburg Academic University | Partnership Agreement
St. Petersburg State University | Partnership Agreement
Stavropol State Agrarian University | R&D Projects
Surgut State University | Partnership Agreement
TESIS | R&D Projects
Tomsk State University of Control Systems and Radioelectronics | Network Educational Program
TsAGI | R&D Projects
TsNII Mash | R&D Projects
Ufa State Aviation Technical University | Joint Lab
Ural Federal University | Partnership Agreement
VNIINEFT | R&D Projects
Zarubezhneft | R&D Projects

Visits & delegations

In 2019, Skoltech welcomed 171 national & international high-level delegations at the new campus. The majority of delegations were

representatives of international governmental organizations, research institutions, and business (France, Germany, Serbia, China, South Korea).



German Federal Minister of Foreign Affairs, Heiko Maas, visited the Skoltech campus. He met with the Skoltech leadership, students, and faculty. Skoltech students talked about their projects, scientific developments and research.



Deputy Prime Minister of South Korea Hong Nam-ki headed a delegation of Korean Ministry of Finance and the Ministry of Economics. This was the first time that a Korean delegation visited Skoltech, and during the visit the Deputy PM toured the campus, visiting the FabLab, and met with Innovation Workshop student groups who talked about their projects.



On October 23, 2019, Skoltech played host to the Russia-Thailand Round Table on Education and Research. This is a follow-up from last year's Thailand-Russia Round Table on Education and Research 2018. One of the key achievements of last year's Thailand-Russia Round Table was that it led to the formal signing of the collaboration agreement between Skoltech and the National Science and Technology Development Agency of Thailand, and the establishment of the **"HRH Princess Maha Chakri Sirindhorn Scholarship,"** each year giving three gifted Thai students the opportunity to study at Skoltech.



A Japanese delegation comprised of nineteen representatives from major Japanese corporations and institutions (Mitsubishi Chemical Corporation, Toshiba Corporation, Shibaura Institute of Technology, etc.) visited Skoltech. The visit was part of an overseas study mission of the 14th Japan CTO Forum program, an annual event that brings together chief technological officers from Japan's leading companies to help strengthen industrial competitiveness and product development ability.

SKOLKOVO ECOSYSTEM

Being a part of the Skolkovo ecosystem, Skoltech is involved in numerous activities with the Sk International Gymnasium, the Sk Foundation, and Technopark.

Courses and lectures were delivered to Skolkovo Gymnasium kids.

Professor Oseledets, Dr. Muravleva and Talgat Daulbaev (PhD student) organized a course on Olympiad mathematics.

Professor Somov gave a talk titled “How to Become a Pro-eSports Player.” There is a newly organized e-sports team at the gymnasium requiring insights and background on how to perform professionally in this domain. Professor Somov discussed recent advances in the area and shared recommendations on how to evaluate the quality of the training process.

The Space Center held school hackathons and lectures.

The Open Learning Center developed a special education program composed of 20 thematic modules. Jointly with FabLab, collections of 3D objects were made for the Evolution Biology program. The center also organized a weekly Skoltech Day, when kids have laboratory work on molecular biology, bioinformatics, zoology, and ecology.

Regular visits to CDISE, CHR, Fablab for the gymnasium kids were organized; kids could gain knowledge as well as see how the laboratories function.

Skoltech also supported a number of visible events organized in the Skolkovo ecosystem.

Professor Fedorov, Professor Oseledets, Professor Lakontsev, Professor Biamonte, Professor Dylov, and Professor Koroteev participated in talks, round tables, and plenary sessions at Open Innovations 2019.

A computational thermostabilization of GPCRs lecture was given by Professor Popov at the Astra Zeneca Startup Challenge.

A lecture titled “Anomaly Detection and Failure Prediction” was given by Professor Burnaev at the Skolkovo Robotics Forum.

Denis Stolyarov, Head of the Student Department participated as a speaker in the annual Technopark event titled “Job & the City.”

Skolkovo based companies hosted students during the summer industrial immersion – GeoSteerTech, Microscopy and Analysis Systems, Digital Petroleum, Boeing, Georezonans, Fidesys, TetraQuant, MiLaboratory.

Joint projects were held between the CREIs and Skolkovo companies. The project for Antilatency was successfully completed by Professor Tsetserekou's team. The Intellectual Space Robotics Lab provided technical expertise to validate results of tracking system development. The R&D contract between CHR and Petroboost is ongoing – CHR performs a unique laboratory simulation of the technology of multistage thermal and chemical impact of reservoir.



On September 25, 2019, Skoltech opened its doors for young guests – second grade kids of the Skolkovo International Gymnasium.



Professor Dmitry Koroteev takes part in the discussion of the “Open Innovations 2019” forum.

SERVING THE WIDER COMMUNITY

Skoltech @ Zaryadie park

The agreement on collaboration signed in 2018 was activated with numerous lectures on molecular, evolutionary biology, neurobiology, AI and robotics, oil & gas industry, Mars exploration expeditions, cybersports, IT, cryptography, and other topics:

- Artificial intelligence and sensors to benefit e-sports gaming, How to Become a Pro eSports Player? (Professor Somov)
- Cryptography: the mathematics of mystery, Fermat's Last Theorem: a centuries-long quest to solve the enigma (Dr. Zaytsev)
- Internet of Things – a supersmart kettle or a connected world? (Professor Lakontsev)
- Big Data and their smaller varieties in network analysis, How the Internet knows what do you need? (Professor Panov)
- How much oil is left on Earth? (Professor Cheremisin)

- Chronicles of Mars: a dead planet or a new home for humanity? (Professor Ivanov)
- Embraced by the Sun (Professor Podladchikova)
- Digital Twins: a game-changing approach to innovation (Dr. Gusev)

Skoltech Open Learning Center carried out a molecular biology course for high school students that included lectures and hands-on activities on extracting the DNA of crickets, tomatoes, mushrooms, and yeast and constructing the molecule using dynamic 3D models.

Skoltech lectures @ Zaryadie project received 2000+ off-line visitors and 20,000+ online views. The Mayor of Moscow, several universities, educational organizations, foundations, and various projects including Biomolecula, Guttenberg Kurilka, and Schrodinger's Cat became Skoltech media partners.

Letovo School for gifted students

Three lectures were delivered – Mars Chronicles: a Dead Planet or a New Mankind Habitat? (Professor Ivanov), Internet of Things (Professor Lakontsev), Eco monitoring, and whether it is worth knowing more about surrounding environment (Evgenia Lazareva with Maria Yarina).

The STEM summer camp was successfully

organized in tracks Biology and Ecology: eco check-up of Letovo forest, IoT: microclimate in Letovo classrooms, and engineering: how to launch a rocket & its saving system.

In November, the Memorandum on Collaboration was signed between Skoltech, Letovo School, the Skolkovo Gymnasium, and Skolkovo Technopark.

Online School of Novel Technological Competencies

The Open Learning Center, in collaboration with the Ministry of Science and Higher Education, Innopractica, and Fund of New

Forms of Development of Education, participated in designing the project concept. A program on IoT was developed with Professor Lakontsev.

Sirius Educational Center

Skoltech continued its activities for gifted kids of the Sirius center. CDISE professors (Professor Nikolaev, Professor Oseledets), researchers, and PhD students gave a number of lectures. The Space Center supported the 1st international Sirius project school Big Challenges of Sustainable Development, with

an attendance of 25 Indian and 25 Russian schoolchildren. The kids worked in teams to explore five areas: earth remote sensing, biology (genetics), materials science, IT, and robotics. Each team completed a project aligned with the sustainable development strategy set forth in the UN Declaration.



Letovo Research School. January, 2019.



The president of Skoltech and academician of the Russian Academy of Sciences Aleksander Kuleshov took part in a press conference devoted to the launch of a training school at the “Correspondence School of New Technological Competences”. October 2019.

Academic & Technology Excellence

/02

The Skoltech academic & technology framework is built on target domains which are broad areas of concentrated research, education, and innovation activities. The six domains are:



DATA SCIENCE &
ARTIFICIAL INTELLIGENCE



LIFE SCIENCES &
HEALTH



CUTTING-EDGE ENGINEERING
& ADVANCED MATERIALS



ENERGY
EFFICIENCY



PHOTONICS & QUANTUM
TECHNOLOGIES



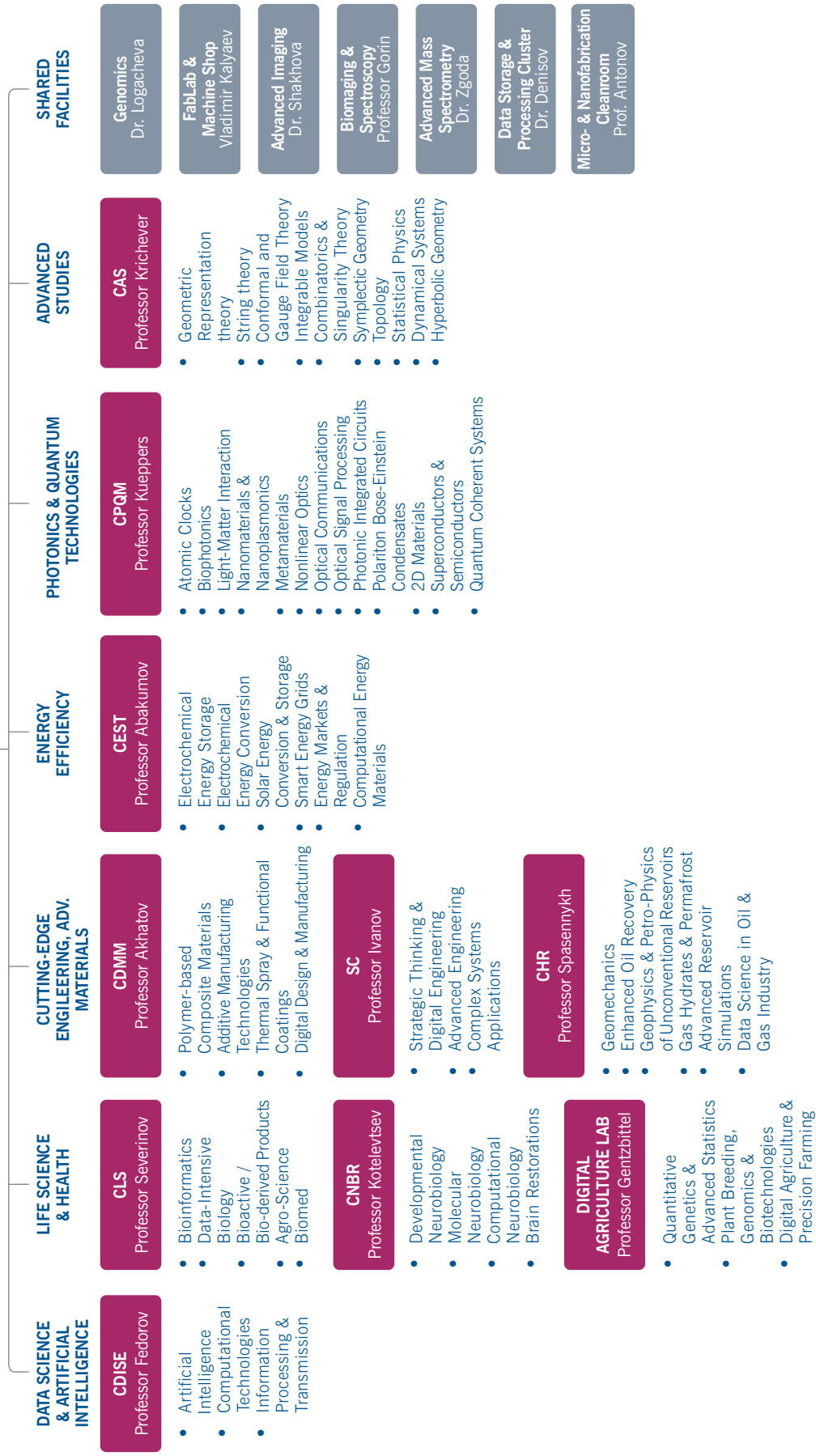
ADVANCED
STUDIES

To date, Skoltech has nine Centers, which contribute to the Institute's mission by implementing long-term programs on academic and technology excellence and value generation in priority areas of science and technology development for Russia and the world.

Programs of the Centers are subject to international expert review with a goal to assess achieved results, relevance to strategic goals, and elaborate recommendations on improving activities. The review is scheduled for 2021.

Skoltech academic & technology framework (as of December 31, 2019)

PROVOST Professor Stevenson

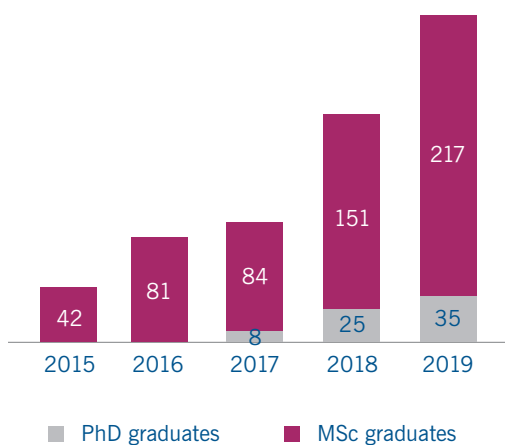


Teaching & Learning

To achieve academic excellence and execute graduate programs to the highest international standards, Skoltech is working continuously on positioning the programs, educational process management, quality of teaching, and supervision of students.

Skoltech is delivering and continues to develop 10 MSc and 7 doctoral programs and educates 1062 students. In 2019, Skoltech graduated 252 MSc and PhD students. The number of issued diplomas has increased significantly since 2015 when the first cohort graduated and now totals 643.

MSc program	MSc students	PhD program	PhD students
Data Science	180	Computational and Data Science and Engineering	117
Information Science and Technology	65		
Life Sciences	79	Life Sciences	64
Advanced Manufacturing Technologies	35	Materials Science and Engineering	56
Materials Science	39		
Petroleum Engineering	43	Petroleum Engineering	57
Space and Engineering Systems	68	Engineering Systems	76
Energy Systems	28		
Photonics and Quantum Materials	55	Physics	38
Mathematical and Theoretical Physics	21	Mathematics and Mechanics	41
Total	613		449



MSc thesis defenses

In June defense period, 217 MSc students successfully defended thesis research projects in front of the state attestation committees. The committees comprised 90 high level experts, of whom 53 were external members, including representatives

of industrial companies and partner institutions. Committee members commented on the very high level of thesis research and defenses. The top ten thesis research projects of the year 2019 were nominated by the committees.

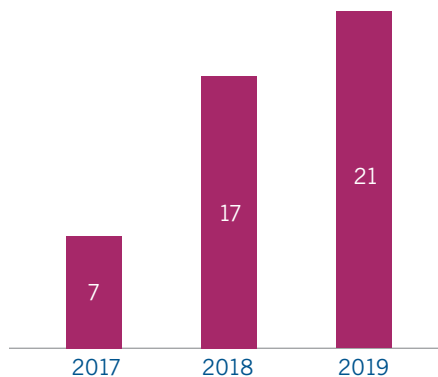
MSc Program	Student	Thesis Title	Research Advisor
Petroleum Engineering	Evgenii Kanin	Multiphase Flow Models for Oilfield Services Technologies	Professor Osiptsov
Advanced Manufacturing Technologies	Sergei Belov	Combined Physics-based and Data-Driven Modeling of a Gas Engine Power Plant for its Prescriptive Maintenance	Professor Uzhinsky
Energy Systems	Aleksandr Malakhov	Distributed Solutions for Power Systems State Problems	Professor Gryazina
Materials Science	Valery Okatenko	Oxide Materials with Tetrahedrally Coordinated d-metal as Bifunctional Catalysts for Oxygen Reduction and Oxygen Evolution Reactions	Professor Abakumov
Information Science and Technology	Vladislav Pimanov	Efficient Methods for Elliptic Problems in Heterogeneous Media	Professor Oseledets
Data Science	Aliaksandra Shysheya	Textured Neural Avatar	Professor Lempitsky
Space and Engineering Systems	Evgenii Safronov	Development of Mission Execution System for Unmanned Aircraft Systems	Professor Tsetserukou
Mathematical Physics	Vasilii Krylov	Schieder Bialgebra and the Geometric Satake Correspondence	Professor Finkelberg
Theoretical Physics	David Saykin	Absolute Poisson Ratio of 2D Crystalline Membranes	Professor Burmistrov (HSE), co-advisor Professor Skvortsov
Photonics and Quantum Materials	Iliia Fradkin	Optical Properties of Hybridized Resonances in Plasmonic Lattices	Professor Gippius
Life Sciences	Svetlana Kalmykova	Impact of Somatic Mutations Disrupting RNA Structure on Alternative Splicing	Professor Pervouchine

Skoltech is working continuously to improve MSc thesis defense procedures and increase transparency. The state attestation committees commented positively on the following aspects: general organization, new assessment

system based on unified criteria, and the pilot implementation of an extended grading scale. The majority of graduates were satisfied with their thesis project experience, including research, supervision, facilities, and support services.

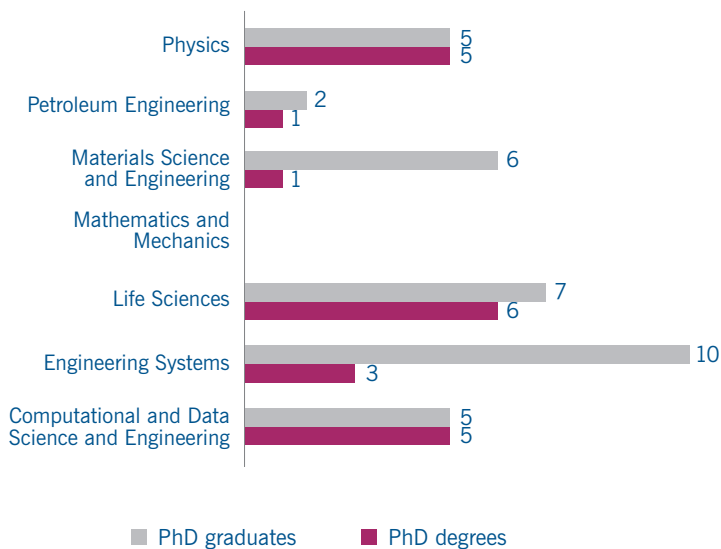
PhD defenses and PhD degree

During the last three years, 45 students have been awarded a *Doctor of Philosophy* degree in accordance with high international and national standards.



In 2019, 21 students successfully defended their PhD theses. For the first time, *Physics* doctoral program graduated students, and all of them successfully defended.

The *Life Sciences* and *Computational and Data Science and Engineering* programs once again demonstrated a high percentage of defenses.





Dr. Anja Tekic becomes the first PhD graduate of the Center for Entrepreneurship and Innovation on September 24, 2019.



Dr. Vsevolod Iakovlev, PhD program Physics (Supervisors: Professor Nasibulin, Skoltech; Professor Kauppinen (Aalto University, Finland). Joint PhD defenses. October 2019.

To intensify international collaboration with leading universities, Skoltech is implementing joint doctoral programs. Based on a customized cotutelle agreement for each student, the partners are providing co-supervision, sharing financial support and research facilities, as well as organizing joint defenses and

awarding double degrees. Partners include Aalto University (Finland), Curtin University (Australia), Sorbonne (France), the University of Paris (France), and the Université Grenoble Alps (France). For the first time, four joint PhD defenses were organized, and double degrees were awarded under cotutelle agreements.

PhD student	Supervisors	Double degrees	PhD Program	Thesis title
Alexey Tsapenko	Professor Nasibulin, Skoltech / Professor Kauppinen, Aalto	Skoltech, Aalto	Physics	Enhancing optoelectronic performance of randomly oriented single-walled carbon nanotube films
Vsevolod Iakovlev	Professor Nasibulin, Skoltech / Professor Kauppinen, Aalto	Skoltech, Aalto	Physics	Advanced synthesis of single-walled carbon nanotubes films by aerosol method for electro-optical application
Sofia Medvedeva	Professor Severinov, Skoltech / Assistant Professor Krupovic, Institute Pasteur, France	Skoltech, Sorbonne	Life Sciences	Natural diversity of CRISPR spacers
Anna Maikova	Professor Severinov, Skoltech / Professor Soutourina, University of Paris-Saclay, France	Skoltech, University of Paris	Life Sciences	The CRISPR-Cas system of human pathogen <i>Clostridium difficile</i> : function and regulation

International accreditation

To verify the quality of Skoltech graduate programs in compliance with the Standards and Guidelines for Quality Assurance in the European Higher Education Area, international accreditation was initiated.

In March 2019, international accreditation of the Life Sciences PhD program was successfully completed by the independent accreditation committee of the French High Council for Evaluation of Research and Higher Education (HCERES). As mentioned in the HCERES evaluation report, “the establishment of the Skoltech Life Sciences PhD program during the first five years of its existence has resulted in convincing results with respect

to the organization and management of the doctorate, as well as for the supervision and training of the doctoral students.” The Life Sciences program is the first PhD program in Russia accredited in accordance with high international standards.

The next two PhD programs, Materials Science and Engineering and the Computational and Data Science and Engineering, conducted required self-assessment procedures and were evaluated onsite by the expert HCERES committees in fall 2019. The final decision of the French High Council for Evaluation of Research and Higher Education about international accreditation is expected in 2020.

Teaching excellence

The Skoltech Teaching Excellence Award has been created to recognize and reward efforts of teaching faculty who exemplify commitment to enhancing learning experience of Skoltech students. In 2019, the annual reward “Best Professor of the Year” was

granted to Professor Nasibulin. In addition, four professors were awarded: Professor Podladchikova (Best in Lecturing), Professor Abakumov (Best in Research Supervising), Professor Tekic (Best in Mentoring), and Professor Oseledets (Best in Career Training).



In 2019, the annual reward “Best Professor of the Year” was granted to Professor Nasibulin. An additional four professors received awards: Professor Podladchikova, Professor Abakumov, Professor Tekic, and Professor Oseledets.

Programs development

The uniqueness of Skoltech educational programs is based on integration of a broad variety of courses with advanced training in entrepreneurship and innovation and deep immersion of students into industrial and research projects. The key results in the programs' development in 2019 are:

- The range of courses was expanded significantly with almost 250 curriculum elements for 2019/2020 academic year.
- Entrepreneurship and Innovation stream was broadened to 15 courses; the number of courses focused on soft skills development was also increased to 15.
- The new course, *Teachers Toolkit for Higher Education*, for PhD students was developed in collaboration with the Moscow Pedagogical State University.

	2017	2018	2019
Courses in the catalog (total)	170	207	250
Entrepreneurship and Innovation courses	8	10	15
Soft skills courses	7	13	15

The Skoltech online course catalog⁹ contains the full syllabi of all courses and is publicly accessible for all internal and external customers. Information about Skoltech education¹⁰ is in high demand, as confirmed by the number of visits, which increased twofold to 382,000 throughout the year.

Examples of putting educational initiatives into practice include unique Skoltech courses and activities like *Innovation Workshop*, *Independent Studies Period*, *Industrial Immersion*, and the *academic mobility* program.

Skoltech is keeping its tradition to start MSc studies with *Innovation Workshop* led by the Center of Entrepreneurship and Innovation, which is an intense, one-month "boot camp" to foster innovators. Students' feedback is very positive because of the "spirit of active learning and innovation," "atmosphere of creativity," and "team work" under the supervision of "mentors with great experience and advice."

The *Independent Studies Period* is a unique part of MSc studies. ISP focuses on

interdisciplinary learning, help students to broaden horizons, go beyond profession, gain knowledge for career development, and boost soft skills. The Skoltech community and invited instructors were encouraged to create and deliver 37 courses, for instance, *Introduction to Social Studies of Science and Technology* (Professor Kharkhordin, European University, Russia), *Science in Contemporary Art* (Professor Shpanin, Rutgers University, USA), *Privacy and Data Protection* (Professor Dmitrik, MSU), *Modernism in Literature of the 20th century* (Professor Zhuk, Far Eastern Federal University, Russia), *Science Communication Crash Course* (Professor Prodanovic, University of Novi Sad, Serbia, Professor Tekic), *Roots of Scientific English* (A. White, Skoltech student), *Industry Career Building – How to Get a Job of Your Dream* (Industry Liason Office), *From Idea to Start-up* (Professor Shavit, Ben-Gurion University of the Naglev, Israel, Professor Nikolaev), *Disrupt Skoltech Hackathon* (Professor Tekic), and others.

⁹ <https://www.skoltech.ru/en/education/course-catalog/>

¹⁰ <https://www.skoltech.ru/en/education/>

Industrial Immersion is an essential part of MSc studies performed during the summer term. The aim of the immersion is to familiarize students with the demands of industry and to prepare graduates for job placement. More than 200 individual and group student projects were co-supervised by Skoltech faculty and representatives of 137 high-tech Russian and international companies.

Academic mobility is a special facet of Skoltech education in the Russian context – each student has the opportunity to conduct research in a partner host university or to participate in international conferences or summer schools. A large number of the 349 MSc and PhD students were supported for academic mobility, including 137 long-term trips for research.

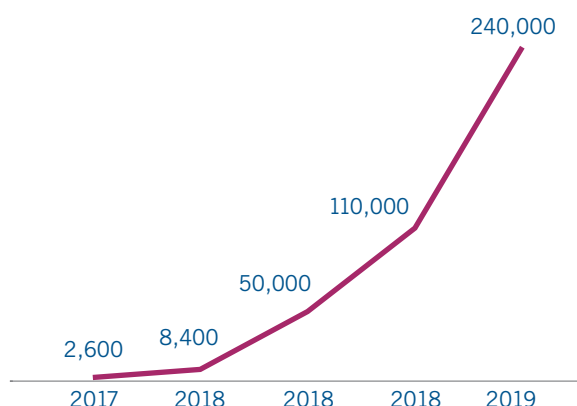


ISP – Independent Studies Period.



Digital Learning Commons

To stay relevant in the digitalization era, Skoltech library is focusing mainly on digital resources. The usage of on-line resources at Skoltech has been growing exponentially since 2015, and is now reaching the level of the world's leading universities.



Students have access to more than 30 different products, which include the world's leading scientific databases such as Science Direct, Springer or IEEE, and four bibliographic databases (Scopus, Web of Science, etc.). The basic needs for a broader

range of scientific literature are covered by Springer e-books collection (71,000 books) provided by the Russian Foundation for Basic Research grant. In 2019, Skoltech received access to the Elsevier Freedom Collection, which added 4900 books to the e-library.

	2017	2018	2019
Print books collection	700	930	1 100
Skoltech e-books	220	370	420
Elsevier Freedom Collection	-	-	4 900
Springer e-books	70 000	85 000	71 000
Full-text documents downloads from e-library databases	50 000	110 000	240 000

Research

Skoltech continues to rise rapidly in its research visibility with increasing momentum. Significant strides have been made in 2019 to guide and support our research enterprise, including the development of state-of-art research

infrastructure and our aggressive pursuit of research funding and alignment of strategic target domains. Research in these prioritized target domains link to complex problems that demand innovative solutions to both national priorities and to global grand challenges.



KEITH STEVENSON, *Provost*:

"Skoltech has had many successes, especially with regards to publications and research prominence. The Institute has been able to recruit world class faculty that are focused on solving global problems. They are publishing their work in highly visible journals with a high impact and citation index. The Nature Index is a special index that is defined by a specific set of criteria; it is a young ranking index, but some of the universities in it are nearly 50 years old. If you were to normalize by the size and the age of Skoltech, our ranking would be far higher than 97, based on the number of years as well as the faculty that contribute to the index."

Select papers published in Nature Index journals are presented below:

Authors	Title	Journal	CiteScore
You, L., Ma, Artamonova, D., Wang, M., Liu, L., Xiang, H., Severinov, K. , Zhang, X., Wang, Y.	Structure Studies of the CRISPR-Csm Complex Reveal Mechanism of Co-transcriptional Interference	Cell	26.41
Seplyarskiy, V.B., Akkuratov, E.E., Akkuratova, N., Andrianova, M.A., Nikolaev, S.I., Bazykin, G.A. , Adameyko, I., Sunyaev, S.R.	Error-prone bypass of DNA lesions during lagging-strand replication is a common source of germline and cancer mutations	Nature Genetics	20.33
Zasedatelev, A.V., Baranikov, A.V., Urbonas, D., Scafirimuto, F., Scherf, U., Stöferle, T., Mahrt, R.F., Lagoudakis, P.G.	A room-temperature organic polariton transistor	Nature Photonics	20.13
Tyshkovskiy, A., Bozaykut, P., Borodinova, A.A., Gerashchenko, M.V., Ables, G.P., Garratt, M., Khaitovich, P. , Clish, C.B., Miller, R.A., Gladyshev, V.N.	Identification and Application of Gene Expression Signatures Associated with Lifespan Extension	Cell Metabolism	16.26
Gladush, Y. , Mkrtchyan, A.A., Kopylova, D.S., Ivanenko, A., Nyushkov, B., Kobtsev, S., Kokhanovskiy, A., Khagai, A., Melkumov, M., Burdanova, M., Staniforth, M., Lloyd-Hughes, J., Nasibulin, A.G.	Ionic Liquid Gated Carbon Nanotube Saturable Absorber for Switchable Pulse Generation	Nano Letters	12.43
Salke, N.P., Davari Esfahani, M.M., Zhang, Y., Kruglov, I.A., Zhou, J., Wang, Y., Greenberg, E., Prakapenka, V.B., Liu, J., Oganov, A.R. , Lin, J.-F.	Synthesis of clathrate cerium superhydride CeH ₉ at 80-100 GPa with atomic hydrogen sublattice	Nature Communications	12.18
Wang, J.W., Zepf, M., Rykovarov, S.G.	Intense attosecond pulses carrying orbital angular momentum using laser plasma interactions	Nature Communications	12.18
Han, H., Wei, Z., Filatov, A.S., Carozza, J.C., Alkan, M., Rogachev, A.Y., Shevtsov, A., Abakumov, A.M. , Pak, C., Shatruk, M., Chen, Y.-S., Dikarev, E.V.	Three to tango requires a site-specific substitution: Hetero: tri metallic molecular precursors for high-voltage rechargeable batteries	Chemical Science	9.80
Obrezkov, F.A., Ramezankhani, V., Zhidkov, I., Traven, V.F., Kurmaev, E.Z., Stevenson, K.J. , Troshin, P.A.	High-Energy and High-Power-Density Potassium Ion Batteries Using Dihydrophenazine-Based Polymer as Active Cathode Material	Journal of Physical Chemistry Letters	7.24
Marshakov, A. , Semenyakin, M.	Cluster integrable systems and spin chains	Journal of High Energy Physics	5.01
Yang, J., Hassanpouryouzband, A., Tohidi, B., Chuvilin, E. , Bukhanov, B., Istomin, V. , Cheremisin, A.	Gas Hydrates in Permafrost: Distinctive Effect of Gas Hydrates and Ice on the Geomechanical Properties of Simulated Hydrate-Bearing Permafrost Sediments	Journal of Geophysical Research: Solid Earth	4.31

Students also demonstrated academic excellence. Below are examples of papers published in high profile journals, A*rank conferences:

Aliaksandra Shysheya and Artem Sevastopolskiy (advisor Professor Lempitsky)	Shysheya, A. , Zakharov, E., Aliev, K., Bashirov R., Burkov, E., Iskakov, K., Ivakhnenko, A., Malkov, Y., Pasechnik, I., Ulyanov, D., Vakhitov, A., Lempitsky, V. Textured Neural Avatars, The IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 9, pp. 2387-2397 (2019) Grigorev, A., Sevastopolsky, A. , Vakhitov, A., Lempitsky, V. Coordinate-Based Texture Inpainting for Pose-Guided Human Image Generation, The IEEE Conference on Computer Vision and Pattern Recognition (CVPR), pp. 12135-12144 (2019)
Valerii Likhoshesterov (advisor Professor Chertkov)	Likhoshesterov, V. , Maximov, Y., Chertkov M. Inference and Sampling of K33-free Ising Models, Proceedings of the 36 th International Conference on Machine Learning (2019)
Andrei Znobishchev (advisor Professor Cichocki)	Gruenwald, J., Znobishchev, A. , Kapeller, C., Kamada, K., Scharinger, J., & Guger, C. Time-variant linear discriminant analysis improves hand gesture and finger movement decoding for invasive brain-computer interfaces, Frontiers in Neuroscience (2019)
Daria Burova and Anna Iarchuk (advisor Professor Abakumov)	Burova, D. , Shakhova, I., Morozova, P., Iarchuk, A. , Drozhzhin, O. A., Rozova, M. G. Abakumov, A. M. The rapid microwave-assisted hydrothermal synthesis of NASICON-structured Na ₃ V ₂ O ₇ : X(PO ₄) ₂ F _{3-2x} (0 < x ≤ 1) cathode materials for na-ion batteries, RSC Advances, 9(34), pp.19429-19440 (2019) Iarchuk, A. R. , Nikitina, V. A., Karpushkin, E. A., Sergeyev, V. G., Antipov, E. V., Stevenson, K. J., & Abakumov, A. M. Influence of carbon coating on intercalation kinetics and transport properties of LiFePO ₄ , ChemElectroChem, 6(19), pp. 5090-5100 (2019)
Sofia Kasatskaya (advisor Professor Chudakov)	Memory CD4 ⁺ T cells are generated in the human fetal intestine. Li N, van Unen V, Abdelaal T, Guo N, Kasatskaya S , Ladell K, McLaren J, Egorov E, Izraelson M, Chuva de Sousa Lopes S, Höllt T, Britanova O, Eggermont J, de Miranda N, Chudakov D, Price D, Lelieveldt B, Koning F Nat Immunol. 21.01.2019;20(3):301-312.
Anna Shiryayeva, Yana Fedorova (advisor Professor Severinov)	Detection of spacer precursors formed in vivo during primed CRISPR adaptation. Shiryaeva A , Savitskaya E, Datsenko K, Vvedenskaya I, Fedorova I , Morozova N, Metlitskaya A, Sabantsev A, Nickels B, Severinov K, Semenova E Nat Commun. 10.10.2019; 10(1).



CHRISTOPH BORCHERS, Head of the Laboratory of Omics Technologies and Big Data for Personal Medicine and Health (CDISE):

«The Laboratory of Omics Technologies and Big Data for Personalized Medicine and Health at Skoltech, established in 2019, is focused on quantitation of the protein expression, modification status and mutation rate in biological/clinical samples. One emphasis is on the development of the "Next Generation Proteomics", making protein analysis more sensitive, multiplex and faster allowing for more applicable and comprehensive analysis which is significant for personalized medicine and health assessment».

Grant support

In 2019, Skoltech stated 72% of growth in annual grant funding received from national and international foundations. The top awards of the year include:

- **Professor Borchers, Professor Nikolaev** – Megagrant for setting up the Laboratory of Omics Technologies and Big Data for Personalized Medicine and Health.
- **Professor Stevenson, Professor Bischi, and Mikhail Pugach** – Horizon 2020 grant for the project “Computer aided design for next generation flow batteries (CompBat).”
- RFBR grants for projects in partnership with international research institutions –

Israel – **Professor Zatsepin** (A novel strategy for pre-mRNA splicing correction by site-specific pre-miRNA recruitment).

Norway – **Professor Chuvilin** (Experimental modeling of influence of geothermal conditions and sediment composition on gas hydrate formation and distribution in permafrost areas).

Taiwan – **Dr. Yudin** (Microscopic theory of spin optical phenomena in low-dimensional magnetic materials).

France – **Professor Shlosman** (Mathematics of modern mathematical physics).

Germany – **Professor Shapeev** (Machine learning the thermodynamics of complex materials with ab initio accuracy), **Professor Lagoudakis** (Hybrid polariton condensates and transistors based on organic and inorganic semiconductors), **Professor Akhatov** (Enabling prediction of ice loads on structures in the Arctic (ICELOAD)).

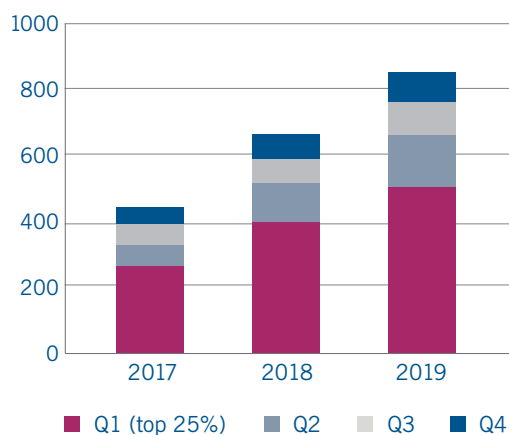
Megagrant awarded to **Professor Cichocki** (deep learning and tensor networks) has been positively evaluated and extended for the next two years (2020-2021) by the Ministry of Science and Higher Education. Over the last three years, the Laboratory of Tensor Networks and Deep Learning for Applications in Data Mining published more than 30 peer-review papers in high impact factor Q1/Q2 Journals and more than 10 works have been presented in high ranking A/A* AI Conferences (ICML, NIPS, CVPR, AAAI).

PhD students were active in attracting grants; below are some examples of funding awards:

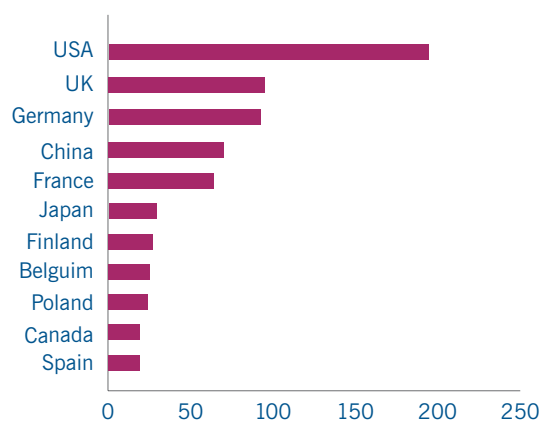
- **Anastasia Fursova** (advisor Professor Nikolaev) – Development and testing of the mechanical components of a miniaturized high-precision multi-electrode harmonic kingdon trap produced by 3D printing,
- **Stanislav Kruglik** (advisor Dr. Kabatyansky) – Confidentiality in distributed information storage systems,
- **Ekaterina Sosnina** (advisor Professor Fedorov) – Using multitasking training methods to search for new promising drug candidates,
- **Evgeny Ponomarev** (advisor Professor Oseledets) – Acceleration, compression and improvement of neural network algorithms for classification and recognition of objects in images and video stream,
- **Alexey Uvarov** (advisor Dr. Yudin) – Effectiveness of variational quantum eigensolver in minimizing quantum Hamiltonians,
- **Albert Matveev** (advisor Professor Burnaev) – Machine learning methods for surface reconstruction by constructing local direction fields on discrete representations of surfaces of three-dimensional objects.

Summary Data

Publication output

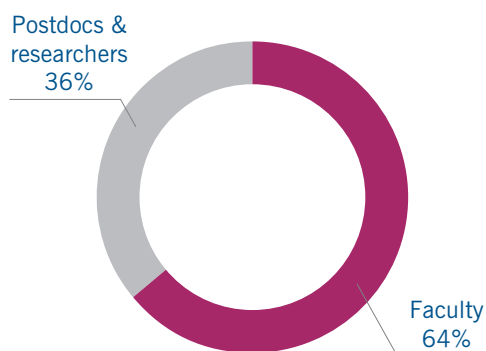


Top-10 countries for collaboration (publications)

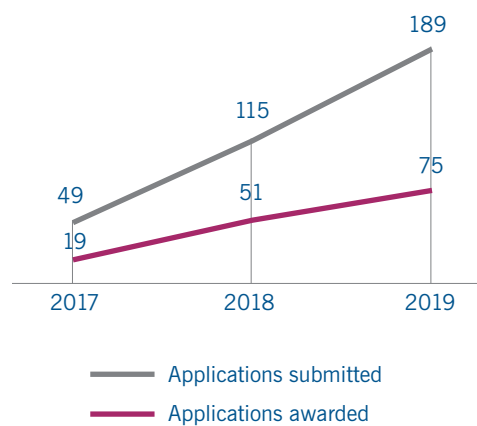


Data as of Feb 27, 2020 (SciVal)

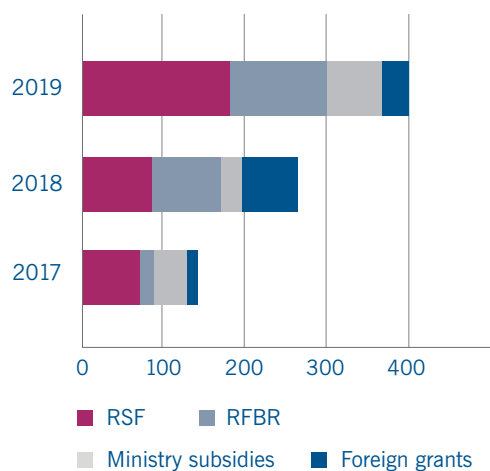
Grants projects per PI



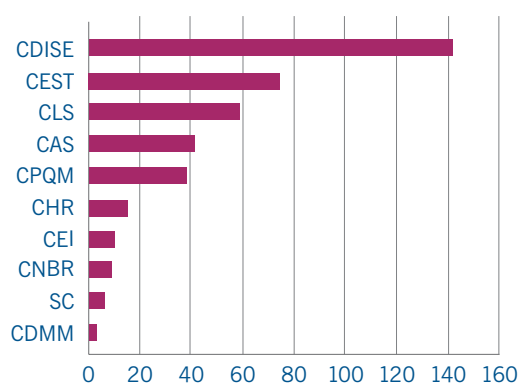
Grant activity



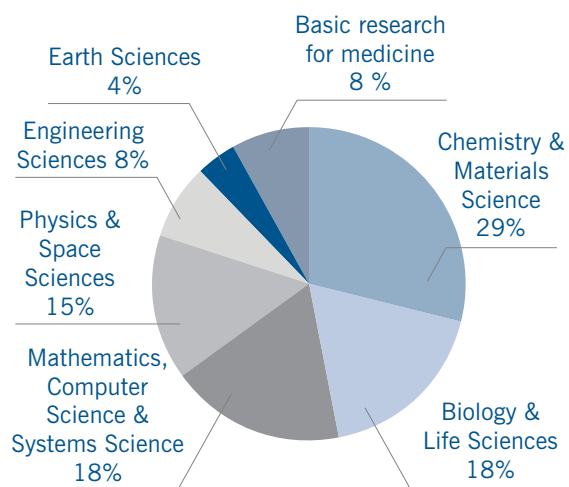
Grant funding per source (mln RUB)



Grants funding 2019 (mln RUB)



Grant funding 2019 per area



Academic & technology conferences

International School on Hybrid, Organic and Perovskite Photovoltaics

The School gathered leading scientists working in the field of photovoltaics (conversion of solar energy into electricity) from across the world.

The advisory board was comprised of members from the UK, Germany, United States, Italy, Israel, Spain, Japan, Germany, Russia, Netherlands, and Singapore.

Machine Learning Summer School

A large-scale international event organized by Professor Burnaev, 500+ participants from leading industrial companies and universities in Moscow, 21 presentations, 2 round tables, poster session. MLSS was one of the largest ML events in Russia in terms of number and the level of speakers and participants from different countries.

The IFIP 16th International Conference on Product Lifecycle Management

This annual event that has been going since 2003, facilitating networking between academia and industry. Ninety participants represented 20 different countries, and presented 45 papers representing 57 different research facilities.

5th International Conference on Matrix Methods in Mathematics and Applications

The conference was held in collaboration with Marchuk Institute of Numerical Mathematics, RAS, and Huawei Technologies CO. Ltd. Top researchers from Russia, Switzerland, Germany, Italy, UK, USA gathered to present the most recent developments and results in matrix methods, numerical linear algebra, tensor decompositions in both fundamental and applied scopes.

International Skoltech Summer School on Mathematical Physics Moscow

Mini courses from top-class mathematicians – Professor Okounkov (Columbia University and Skoltech), Professor Bezroukavnikov (MIT), Professor Nekrasov (Stony Brook), Professor Braverman (Skoltech), Professor Etingof (MIT). Most of the 100 participants were from Russian & intl. universities.

The 3rd Summer School on Nonlinear Photonics

The event brought together the world's leading experts to discuss topics of laser science and technology, fiber optics, photonic materials and meta-materials, telecommunications, multi-photon bio-imaging, nonlinear photonics for quantum technologies, sensing, spectroscopy, solitons, mid-IR technology. Up to 40 early stage researchers participated.



ANDREI OKOUNKOV, *Fields Medal Laureate (2006):*

«In Summer of 2019, Skoltech launched its international summer school in mathematical physics, and already the first edition of this school attracted significant international attention. Over 100 scientists from more than 20 countries (USA, Canada, Japan, China, Great Britain, France, Russia, etc.) participated in it, fostering important interaction between the Russian and the global mathematical physics communities. Skoltech, where special attention is paid to development of mathematical sciences, is ready to continue to be the center of attraction of world mathematics: The Second International Summer School in Mathematical Physics will be held here from June 15 to June 26, 2020».



Skoltech's Machine Learning Summer School (MLSS), drew 800+ participants from 40 countries across the world.



The IFIP 16th International Conference on Product Lifecycle Management, at Skoltech's new campus. A total of 90 participants from 20 different countries, presenting 45 papers, and representing 57 different research facilities.



The 1st International School on Hybrid, Organic and Perovskite Photovoltaics. October 2019.



The Third Summer School on Nonlinear Photonics. August 2019.

RESEARCH FACILITIES

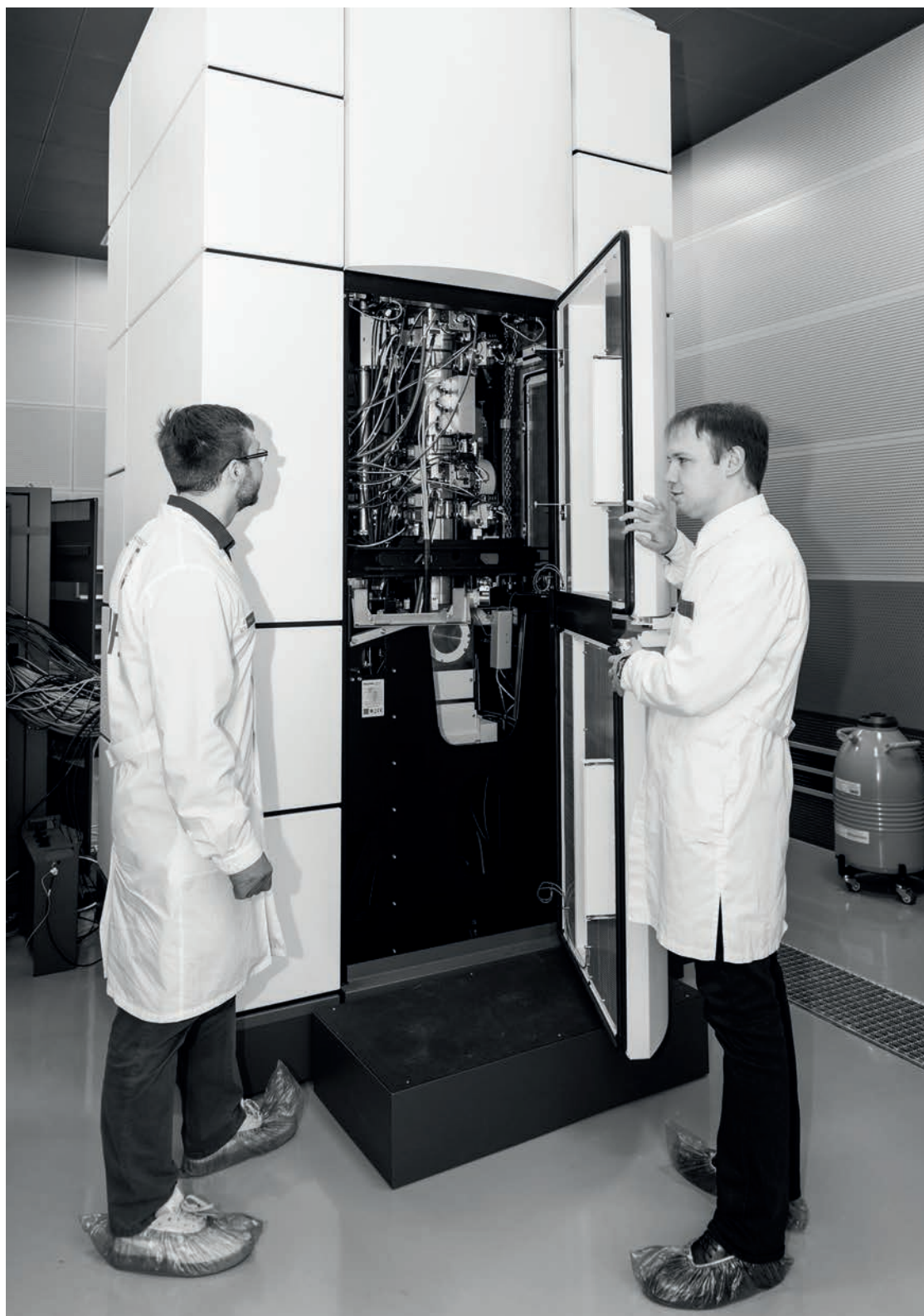
With six state-of-the-art facilities operating at interim and the new campus, 2019 was marked with wide support for the Institute's own research across all target domains as well as a broad range of R&D services provided to external academic and industrial partners, including international ones. The shared facilities had more than 50 external contracts (College de France, Finance and Investment Corporation Alel (Nordgold), A.N. Severtsov Institute of Ecology and Evolution of the Russian Academy of Sciences, Semat LLC, Sputnix LLC, and others).

Two new facilities were established. Advanced Mass Spectrometry (Head Dr. Zgoda) provides a broad range of services in mass-spectrometric research. It is equipped with a wide range of mass-spectrometers covering all needs in the field of proteomics and metabolomics: Bruker maXis impact, Bruker timsTOF, Bruker rapifleX MALDI, ThermoFisher Q Exactive and others. Together with state-of-the-art mass-spectrometric equipment, sample preparation, and bioinformatics support, the facility will comply with the whole experimental cycle for research. The Data Storage and Processing Cluster (Interim Head Dr. Denisov) was established on the basis of high-performance computing platform Arkuda (Lenovo) and a parallel file storage system. The cluster provides computational resources for scientific research conducted by Skoltech laboratories, external academic and industrial partners. The facility supports users in terms of utilization of supercomputing resources, resource intensive software, organization of data processing, analysis as well as visualization. Based on the cluster, infrastructure for processing and storing data from other shared facilities was deployed.

The concept of a micro- and nanofabrication cleanroom shared facility

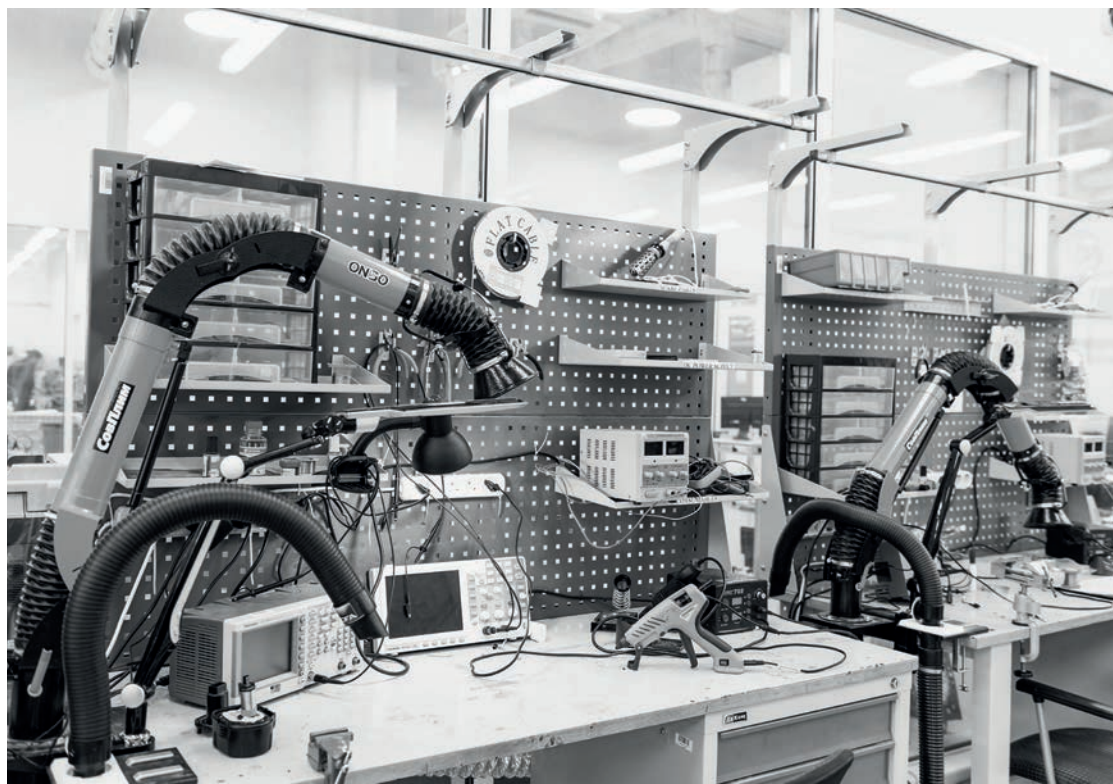
was finalized. The facility will serve as a technological platform for the development of integrated photonics solutions for optically enriched systems of the generation 2025-2035 such as IT, sensor, and quantum systems where high-speed microelectronic components will be replaced by purely photonic or hybrid solutions. The application areas of these systems are vital for the digital transformation of society and include IT and sensorics, telecommunications, health and medicine, security, and others.

The CREIs infrastructure was further developed. CEST significantly expanded research facilities by completing design and construction of a new laboratory for material science, redox flow batteries and educational activities in electrochemistry (TPOC4, ~130 m²), the laboratory for battery cell prototyping (~70 m², TPOC3) and the laboratory for pilot production of LiFePO₄ cathode materials (~35 m², TPOC3). CHR maintains running 24/7 a state-of-the-art laboratory with a world-class equipment for development, testing and validation of new technologies for exploration and production of unconventional and hard to recover hydrocarbon reserves. A number of unique experimental setups were installed and commissioned in 2019 for the study of hydrocarbons of unconventional reservoirs, including a new high-pressure and high-temperature core flooding system with X-ray control for development of chemical, gas and hybrid methods of enhanced recovery, and other experimental units. The Teaching Laboratory (CLS) in Skolkovo Technopark became fully operational. It is the basis for several courses and also allows all students, irrespective of their final specialization in bioinformatics or experimental research, to perform individual research on laboratory equipment.



Transmission electron microscope "Titan Themis Z G3".





FabLab and Machine Shop.





Laboratory of the Center for Energy Science and Technology.

Integrating Innovation

Innovation Workshop

More than 290 students participated in the Innovation Workshop of 2019 gaining exposure to the entrepreneurial journey. Over four weeks, students developed tangible product and service prototypes that could eventually become commercially viable. The strong background of the intake allowed for the production of quality outputs. Forty mentors (85% of them international) provided guidance and constructive feedback, boosting the quality of their projects. A wide variety of the

mentors' expertise allowed students to learn and experience how to work with different types of stakeholders and professional profiles. The mentors provided further guidance and engaged their professional network after the Innovation Workshop to support some of the project teams.

The main result is that out of the approximately 50 teams that started their projects during the Innovation Workshop, more than 10% continued working on their projects during the year.

IW 2019 Projects	Description	Status	Team	Achievement
Move.Now	<i>Sensor for remotely tracking rehabilitation progress knee surgery.</i>	Prototype improvement stage	3 MSc students + CEI Team	Waiting customers ¹¹
SmartNet	<i>Net that uses nanotubes to detect when a player touches it.</i>	Prototype improvement stage	3 MSc students + CEI Team	Waiting customers
Smart Cage	<i>Smart cage for small pets to monitor pet's wellbeing when owner is away from home.</i>	Prototype improvement stage	6 MSc students + CEI Team	Concept validated ¹² by market
Electric Failure Monitor	<i>Device that attached to an electric wire monitors electric consumption to conduct predictive maintenance before failure happens.</i>	Prototype improvement stage	2 MSc students + CEI Team	Concept validated by market
Apple Sorting	<i>Device that detects apple's quality and sorts them through image recognition.</i>	Prototype improvement stage	2 MSc students + CEI Team	Concept validated by market
Smart Cupboards	<i>Cupboards that allow tracking of check-in and check-out of objects.</i>	Prototype improvement stage	2 MSc students + CEI Team	Concept validated by market
Life Extension	<i>Starting from a genetic test, service that designs customized routines to extend users' life.</i>	Service design stage	3 MSc students + CEI Team	Concept validated by market
Blind people smart-guide	<i>Device that detects obstacles and assists blind people by using ultrasound sensors.</i>	Prototype improvement stage	2 MSc students + CEI Team	Concept validated by market

¹¹ Customers that expect to buy/start using the product once it meets the specifications they required.

¹² Prototypes were displayed to potential customers who expressed willingness to buy them and provided feedback to finish the development of the product.



Innovation Workshop. September 2019.

Translational Research Program

The projects supported within the Call 2018-2019 were successfully conducted in accordance with the plans of development. All projects resulted in creating new enterprises

with Skolkovo residency. Patents applications are planned for submission. Negotiations are held with high-tech companies and investors for attracting external funding.

PI	Project title
Professor Abakumov	Development of potassium-ion batteries
Professor Akhatov	Pultrusion structural profiles based on fibre reinforced thermoplastic pre-impregnated materials
Professor Gelfand	Metagenomic approach for oil and gas industry
Professor Gorin	Platform for Detection of Human Health Markers at Point-of-Care (POC): An Interface of the Physical and Life Sciences
Professor Nasibulin	Strong coaxial filament for 3D printing
Professor Somov	G(ame)-psycho
Professor Fedorov	Syntelly – Computer aided organic synthesis

The new wave of STRIP projects was selected by reviewers representing national and international companies and universities – 3M, Google, Microsoft, IBM, Dell, Siemens, NASA, L-3 Communications Inc., Hitachi Cambridge Laboratory,

Thermo Fisher Scientific, RVC, Imperial College of London, Tampere University of Technology, Carnegie Mellon University, European Space Agency, Korea Advanced Institute of Science and Technology, the University of Michigan.

PI	Project title
Professor Gelfand	Platform for Microbial-induced Allergen-specific Tolerance (MAT)
Professor Abakumov	Prototyping sodium-ion battery
Professor Troshin	Solar Roof: The Application of Organic Solar Cells for Building-Integrated Photovoltaics
Professor Dylov	VeinCV: (10X Less Expensive) Subcutaneous Vein Scanner aims to make a new vein visualization technology using near-infrared light
Professor Popov	Digital Platform for GPCR-specific drug discovery aimed to develop a digital platform for G protein-coupled receptors (GPCRs)-specific screening of drug candidates
Professor Akhatov	Thermoplastic Composite Tape
Professor Cheremisin	Microfluidics as a NextGen Technology for Experimental Studies in Oil and Gas Industry
Professor Uzhinsky	Emmotion: Electric drive unit for a wheelchair with universal mounting system



Skoltech Translational Research and Innovation Program conference. August 2019. The conference consisted of an array of 20+ presentations before a panel of judges and industry experts.

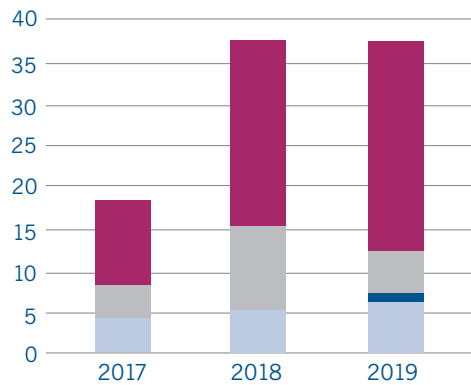
Patent activity

In 2019, Skoltech academic personnel submitted 37 patent applications; the majority of applications are for inventions. The scope of the applications is presented by a variety of CREIs specializations. Select examples:

- Methods of data processing for construction of neural-network based segmentation models for remote sensing images with boundary-aware loss (CDISE).
- A system for compression of deep neural networks using interactive tensor approximation (CDISE).
- A method of designing the surface of the orbital ion trap electrode (CDISE).
- Tools and methods for compound identification using mass spectrometer (CDISE).
- A database of pig genotypes (CNBR).
- A database of lipid composition of adipose and muscle tissue of pig meat (CNBR).
- A method of chromatographic separation of single-layer carbon nanotubes by chirality (CPQM).
- Nano- and microparticles for isolation of specific exosome subpopulations and their analysis (CPQM).
- A procedure for the preparation and assembly of a battery utilizing the transition metal hexacyanometallates as the cathode, hard carbon as the anode and anhydrous electrolyte for potassium-ion batteries (CEST).
- A method to produce homogeneous carbon coating with controlled thickness on the surface of cathode materials for metal ion batteries, and cathodes coated therewith (CEST).
- A system and method of automated electrocardiogram analysis and interpretation (SC).

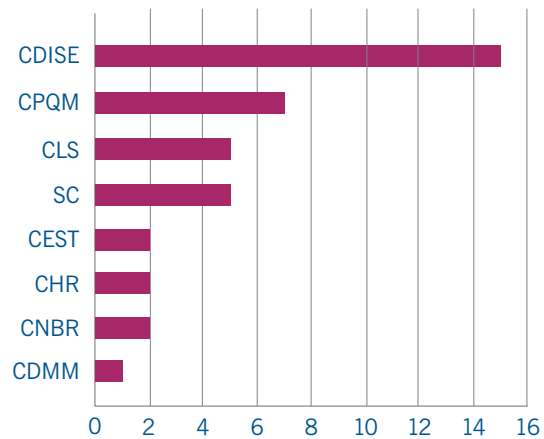
As of the end of the year, Skoltech IP is comprised of 28 patents and 21 authorship certificates granted (cumulative).

Patent applications per type

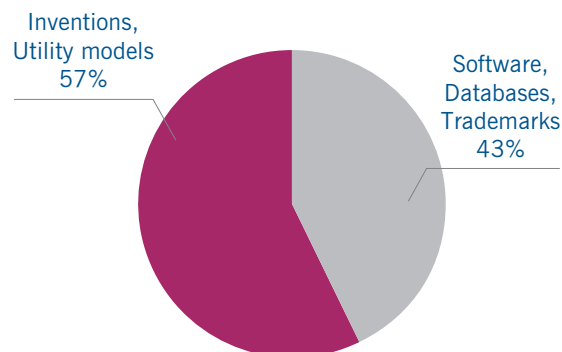


- Patents (Inventions, utility models)
- Copyright (software, databases) and trademarks
- Know-How
- PCT and foreign

Patents application per CREI



IP granted per type (cumulative)



Value Generation

/03

Industry Funded Research

Compared to 2018, Skoltech annual funding under R&D contracts showed 34% growth – the amount of work performed totaled to 1,1 bln RUB. The CREIs conducted 155 R&D projects under contracts with national and international companies, such as Sberbank, Huawei, Gazprom Neft, Philips, VNIPneft, Lukoil, Samsung, Bayer AG, Alibaba, and others. New contracts have been signed for more than 1,3 bln RUB for the period of 2020-2023.

Select projects include:

- **Huawei** (both Russia based and Chinese branches) was a key industrial partner of CDISE. The Skoltech-Huawei Innovation Joint Lab, with Professor Frolov as the head, started 12 new projects in dense pose, novel methods for (semi) automatic search of new NN architectures, automatic hyperparameters' tuning; low-level image processing (camera ISP pipeline + Image restoration + enhancement).
- The Joint Applied Research Laboratory with **Sberbank** (CDISE) was established to carry out research projects in artificial intelligence and machine learning technologies, Internet of Things and wireless communications, robotics, and other digital technologies, provide educational services to Sberbank employees and design new trajectories for Skoltech students (Dr. Zaytsev is the head). Six projects have begun.
- The **TOPCON** contract for the joint laboratory was launched. That is a fully commercial project with a USA navigation solutions provider in the field of autonomous vehicles for construction and agriculture industries and has great potential for synergy with other Skoltech research directions. In the framework of joint laboratory collaboration, a new course for Advanced GNSS applications was developed, and four PhD positions sponsored with company funds were opened.
- The Research Training Center of Plant Biotechnologies in partnership with **Bayer AG** (320 mln RUB for 2020-2023) has been established. The partners of the Center are the Russian Moscow Timiryazev Agricultural Academy, the Federal Research Center Institute of Cytology and Genetics, the Siberian Branch of the Russian Academy of Sciences (ICG SB RAS), and Belgorod State Agricultural University named after V. Gorin.

Results on ongoing projects

- A technology for predicting a multidimensional time series with a hierarchical structure of dependences between components has been developed and adapted to solve the problem of demand forecasting. The technology is based on machine learning methods and automatic approaches to features generation based on topological data analysis. Using this technology, it is possible to automate the selection of the model type for each of the time series components and speed up the construction of models for a large number of time series.

The technology has been adopted and tested in Alibaba and Huawei solutions (Professor Burnaev).

- A quantum circuits simulator that allows for assessing the achievement of quantum supremacy has been implemented on classical computers: if circuits can be modeled on modern supercomputers, more complex quantum circuits need to be implemented on physical devices. New decentralized resource scheduling algorithms have been developed and showed potential benefits in

case of coordination. The key indicators for service quality in large-scale experiments has been obtained under the joint project with Huawei on building a distributed scheduler prototype in wireless networks (Professor Oseledets, Dr. Ovchinnikov, Dr. Schutsky).

- The Applied Information Theory Group (Professor Frolov) has successfully finished the "Deep Neural Network Based Decoder Design for 5G LDPC Codes" Huawei cooperation project with an "Excellent" evaluation result. The project is aimed at improving the performance of 5G short LDPC codes. As soon as traditional Min-Sum or Sum-Product algorithms show poor performance on short LDPC codes, the deep neural network based (DNN) approach has been suggested to tackle this problem. Authors have improved the performance of the decoder and suggested a method to reduce the number of trainable parameters in the known DNN based decoding architectures. They have also constructed a scheme that allows reusing optimal weights in many decoders varying by code length and rate (called rate and length adaptation, respectively).
- Typical to healthcare, there is an all-pervasive lack of well-annotated and balanced data required to tackle clinically relevant analytical tasks. Artificial intelligence approaches that mitigate this shortage are at the core of all effort in the joint laboratory with Philips (Professor Dylov). In 2019, an assertion classification methodology was developed based on recurrent neural networks, attention mechanism and two flavors of transfer learning (language modeling and heuristic annotation) that achieved state of the art results on MIMIC-CXR radiology data. As a result, a new method of "Deep Text Prior" (alike the infamous "Deep Image Prior" also developed at Skoltech) was released, which allows for the building of decision-making models with weakly annotated records. A new method for synthetic generation of computer tomography images (CT)

from MRI Using Improved DualGAN was developed. For cancer patients, the latter modality is typically used to analyze the anatomy of an organ, while the former is needed to determine correct dose of required radiation therapy. The new invention of MRI-CT translation holds the potential to eliminate the need for the patients to undergo both examinations and to be clinically accepted as a new tool for radiotherapy planning.

- A model for predicting hidden interactions in the network of bank clients was developed which outperforms the existing approaches to link prediction and also allows to improve the quality of credit scoring by more than 1 percentage point which is very significant for the bank (Professor Panov).
- The Center of Excellence CoBrain-Analytics developed an algorithm by order of Brainlab AG (Germany), one of the world leaders in production of software and equipment for medicine. The CoE integrated into the CoBrain-Analytics platform a number of medical AI solutions of their partners – Third Opinion, Care Mentor AI, Ftizisbiomed, Total Vision and Z-Union. To stream medical data to the CoBrain-Analytics platform, a production connection was made to medical organizations such as the State Scientific Center of Coloproctology named after A.N. Ryzhih, the Institute of Surgery named after A.V. Vishnevsky, and the Scientific Center of Neurology. An acceleration program, AI & Big Data in Medicine, was made in collaboration with Philips in the frame of CoBrain-Analytics.
- Major results from the research projects in molecular neurobiology (Professor Khaitovich) – components of methods for diagnostics of depressive states and schizophrenia based on lipid biomarkers in blood plasma – are valuable for commercialization. They will be further developed into a cognitive disorders diagnostic method for medical applications under an industry funded

R&D project. A MoU with an industrial partner on the project has been in the final stage of approval.

- Within the Oerlikon project experimental studies has performed devoting to mechanical and structural properties of AM 316LSS. The fatigue behavior up to 10⁹ cycles (VHCF regime) of 316LSS specimens manufactured by the L-PBF and DMT technologies has been investigated to compare the two production routes. Fatigue strength and the S-N curves of the materials have been obtained; the microstructural analysis of fracture surfaces has been performed. Overall, the specimens produced by DMT technology have demonstrated higher fatigue performance than those produced by LPBF technology. Non-melted powder particles have been observed on the fracture surface of the L-PBF printed specimen and identified as stress concentrators and initiation points for fatigue crack nucleation. The absence of such defects in DMT-specimens has explained the higher fatigue resistance in comparison with LPBF-specimens. For both technologies, the initiation of the fatigue crack in low- and high-cycle range started from defects at the surface. Furthermore, the fracture surface is usually clearly divided into two or three zones: zones of fatigue crack propagation, final static failure zone. The size of the zones has been found to depend on the fatigue life of the specimens (Professor Akhatov, Professor Kasimov, Professor Shishkovsky, Dr. Evlashin, and Dr. Chugunov).
- The CyberFRAC project was successfully completed for Gazprom Neft by the Skoltech Digital Laboratory for Modeling of Multiphase Flows in Oil & Gas Industry (Professor Osiptsov) in a consortium led by CET MIPT. The project aimed at development of Russian software for design of hydraulic fracturing treatments for Russian oil producing companies (successful completion and commercialization in December 2019). The key contribution of Skoltech team is in the module for multiphase flow inside fractures, as well as in the new advanced models for hydraulic fracture tip propagation. These results have been achieved in collaboration partners, including from Dalhousie University (Canada), Aberystwyth University (UK) and University of Houston (USA), and Russian academia (Institute for Hydrodynamics SB RAS, Institute of Oil & Gas Geology and Geophysics SB RAS).
- New algorithms and a software module for real-time geonavigation during drilling in unconventional formations. The software for 3D geomechanical simulation of wellbore stability was developed and validated. The license agreement was signed with Geonaft Company to commercialize the technology (Professor Cheremisin).
- The research group of Professor Koroteev in collaboration with Professor Oseledets and Professor Burnaev developed for Gazprom Neft STC a new computational core for multiphase flow modeling in reservoir systems based on deep learning algorithms. This core allows to accelerate hydrodynamic modeling of a reservoir by several orders of magnitude and minimizes risks when investing in field development, well construction and well treatment. Deep learning algorithms also open up the possibility of using the new history matching method based on AI – approximations for real production data.
- A comprehensive study of deformation, elastic, acoustic and mechanical strength characteristics was carried out for extremely dense and strong rock samples taken out from a depth of more than 5 km below the Earth's surface. A special objective of the project was the physical modeling of hydraulic fracturing in a laboratory under thermobaric conditions equivalent to those of the reservoir (temperature over 130 °C and pressure over 37 MPa). During laboratory studies of hydraulic fracturing, an acoustic emission technique was applied

to monitor the dynamics of hydraulic fracture propagation – such kind of monitoring is analogous to microseismicity monitoring in field conditions. This was the first time that such a verification of modeling with the results of experiments was carried out in the Russian Federation. The outcome confirmed a good correspondence of modeling results with experimentally measured values in more than 50% of cases.

- Project “Integrating Model Based Systems Engineering based Concurrent Design with Technology Roadmapping” with Airbus was completed by Space Center, resulted in a software package called CONTOUR, which implies developing roadmaps for large enterprises and technology programs. This allows to eliminate the duplication of technology development, define key technologies and, finally, increase profits.



Skoltech Multiphase Systems Lab runs field testing campaign on new technologies for oil production stimulation in the oilfields of Gazpromneft-Khantos (the largest operating subsidiary of JSC Gazprom Neft).

New Enterprises & Technology Licensing

Since 2012, more than 70 startups have been founded by Skoltech personnel, students, and alumni. The vast majority of companies are Russian based. 40 startups are with Skolkovo residence status. Here are some examples of companies that were established in 2019:

- **MRM Proteomics R** (Professor Nikolaev, Professor Borchers, Maxim Mironenko). The company specializes in a new generation of products in quantitative mass spectrometric proteomics for personalized medicine. The developed test kits for the quantitative assessment of protein biomarkers make it possible to determine with high accuracy the concentration of 1000 proteins simultaneously in one blood plasma sample, which makes it possible to diagnose various diseases in humans at an early stage, primarily oncological, cardiovascular, metabolic, neurological and hematological disorders. MRM Proteomics R is Winner of the Russian Chapter at the IPIEC GLOBAL 2019 competition and included in top-30 of the World Final at the IPIEC GLOBAL 2019.
- **LMA Technologies** (Professor Uzhinsky, Dr. Derevnin, Professor Drachev, Dr. Seregin) – will focus on research, development, and commercialization of antenna systems for mobile satellite communication of low-orbit broadband access systems based on two new critical technologies – dielectric lens elements made of metamaterials using 3D printing technology and automated beam position control systems.
- **Helix Tank Lab** (Professor Sergeichev, Professor Safonov, Dr. Gusev, Professor Akhatov) will conduct design, simulation, manufacturing, testing, and certification of composite portable tanks and pressure vessels for transportation of chemicals.
- **HEAD KRAKEN** (Professor Somov, Professor Burnaev) was a result of the Skoltech STRIP program and the project G(ame)-psycho. The company develops and commercializes a platform based on artificial intelligence technologies for

collecting e-sports data and detecting the psycho-emotional condition of players.

- **TetraQuant** (Dr. Yashchenok, Professor Gorin, Dr. Chernyshev, Dr. German) produces high-throughput bioanalytical platforms for early stage diagnosis and monitoring of patient's health during and after medical treatment. The company has engineered and tested a platform that allows capturing and quantifying exosomes containing signatures of ovarian cancer at low limit of detection. This proof-of-concept will allow for the expansion and application of the TetraQuant technology. The end-goal is to create devices based on this platform that can detect exosome markers of different cancer types, neurodegenerative diseases, viral infections, and other diseases in a short time with minimal sample volume at the point-of-care.

The companies established in 2018 were further developed. **Syntelly** (Professor Fedorov and PhD student S. Sosnin) is developing a software platform that will be able to plan organic synthesis better than humans. Soon the MVP will be ready, and then intensive search for further investment will start.

Tensor Fields (Professor Oseledets, Professor Pukalchik, I. Khlebnikov, M. Kuznetsov) received two commercial contracts; researchers finally found a way to simulate and project crop growth in a region scale by using our flagship supercomputer Zhores. **Geoalert** (Dr. Ignatyev, Dr. Potapov) won the Russian Post acceleration program. At the final stage, only 10 projects were selected among 300+ applicants.

In 2019, a few licensing contracts devoted to eight items of intellectual property (2 registered software, 2 databases, 3 utility models, and know-how for engineering documentation) were signed:

- **Exclusive License Agreements for Software and Know-How devoted to Autonomous Mobile Platform.** The platform is capable of delivering items in stores and warehouses with dynamic changes in the environment. Skoltech designed not only software but

also hardware for such a system and has successfully demonstrated its technical and economic feasibility through pilots in collaboration with Decathlon. Licensed to LLC Platforma – SPV of Decathlon Russia.

- **Non-exclusive License Agreement for testing Software ERA-GLONASS.** The program is designed to perform functional testing of the ERA-GLONASS emergency call devices, including a GSM base station and core (MSC/HLR) emulators. Due to a high market demand, Skoltech has renegotiated the previously signed exclusive license in 2018 and provided the solution to several partners under non-exclusive terms. Licensed to Russian company Vi Tu Lab, LLC.

- **Non-exclusive License Agreement for several inventions devoted measurement of surface quality for roads and rails.** The three utility models that together describe a software-hardware system with a broad practical application in construction were licensed to the stock company Minimax-94.
- **Non-exclusive License Agreement for databases of genotypes and phenotypes of oilseeds.** Through long-term research activities, Skoltech has collected a comprehensive data set related to oilseed crops that found commercial applications in 2019. Licensed to LLC Agroplasma.



Three Skoltech startups/projects ranked among Sberbank Accelerator's top-30 projects and top-500 startups in 2019.

Professional Training & Advisory Services

Professional training

The major clients for professional training contracts were leading national high-tech companies such as Gazprom Neft, Sberbank, TsNII Mash, Rostelecom, Russian Grids and others. Among the courses delivered:

Professor Burnaev, Dr. Zaytsev for Gazprombank:

- A course on Time Series.
- A course on Python for Machine learning.

Professor Burnaev, Dr. Zaytsev, Professor Ferrer for Gazprom Neft:

- Lectures on Industry 4.0.
- A session on AI in the oil & gas industry.
- A session on digital technologies in logistics.

Professor Burnaev, Dr. Zaytsev, Professor Fedorov for Sberbank:

- A program for machine learning for employees of Risks Block.
- A course on the fundamentals of machine learning for senior management.
- Bayesian methods and PyTorch.

The new approaches for diversification of Skoltech proposal included a corporate course about Systems Engineering (Professor Ivanov), CDMM open enrollment course about certification (Professor Sergeichev), a partner

program with Skolkovo Business School; corporate programs with ILIM, Sibur and Russian Grids are also under development. In addition, an online course, A Brief Theory and Immediate Practice of Innovation on the Internet of Things, was designed by Professor Somov, Professor Kulish, and Professor Nikolaev. The target audience of the course is young entrepreneurs willing to learn on innovation and what a user IoT product is; the course will be available on YouTube.

The large scale educational intensive Ostrov 10-22, hosted on campus, became a platform for lectures, seminars, and round tables organized by the CREIs. Space Center held a lab titled Infocommunications for Digital Economy: New Generation Space Technologies, Expert Lectures on Remote Sensing (Dr. Gershenzon), CDIO-methodology implantation for Cyber Physical Systems (Professor Fortin), and Systems Engineering (Professor Ivanov). CDISE, presented by a group of professors and researchers, covered the most important topics of this conference – ML and DL, IoT, 5G, e-sports, digital agriculture, brain machine interface, quantum computing, and Earth observation. More than thirty educational activities were organized in total, three of them jointly with CDISE startups (Syntelli, Head Kracken, Tensor Fields).

Advising

Skoltech Analytical Department on Science & Technology Development was engaged in organizing and conducting analytical work and research in the field of science and technology policy. Among the key results and activities:

- White Paper on Perspective Directions in Neuro technologies (in press)
- Analytical report on tuition fees policies in Russia and the world
- Analytical support to development of National Project “Science”
- Analytical support to the Ministry of Economic Development on topics of leading innovation centers, megagrants, suggestions on indicators for evaluation of the Strategy for Scientific and Technological Development implementation
- Consortium of Developers and Manufactures of telecommunication equipment (for 5G telecom networks) established
- Developed and presented to the Russian Government, Rostec, Rostelecom a draft of governmental regulation “on state support for complex technology projects for development and implementation of domestic technologies for fifth-generation telecom networks.”
- Proposals for guidelines for the Ministry of Industry and Trade for state-owned companies on reducing barriers to the implementation of innovative technologies (1st Phase of Technet Legislative Roadmap)
- Preparation of materials for the project of regulations of the government of Russia on amendments to the action plan (roadmap) on legislation and reducing of administrative barriers to the implementation of the National Technological Initiative Technet (2nd Phase of Technet Legislative Roadmap)
- Substantiated measures for the stimulation of demand for domestic telecom equipment, which led to the provision of subsidies to financing institutions in the National Program Digital Economy (Project Digital Technologies)
- Analytical support for newly established international collaboration of Skoltech in the field of electric vehicles and energy storage systems¹³.

¹³ NDA topic.

Expert groups

Skoltech broadened its presence in large-scale initiatives and programs; here are some select examples:

- President Alexander Kuleshov and Professor Fedorov were invited to the 40th Session of the UNESCO General Conference as technical experts to discuss issues related to artificial intelligence.
- The Space Center is included in the ROSCOSMOS project office for the SPHERA program, which is currently the largest program under development in the Russian space industry.
- Professor Khaitovich, a member of the BRICS Working group on biotech and biomed, was involved in the BRICS Biotechnology and Biomedicine Innovation Collaboration Conference in Taizhou, China, and at the 3rd meeting of BRICS STI Working Group on Biomed and Biotech in Campinas, Brazil.
- CDISE specialists participated in National Technology Initiative working groups, and the Research Coordination Council of the Center of Excellence Artificial Intelligence, led by MIPT.
- Professor Spasennykh heads the expert group on innovation development of the oil and gas industry in the Commission on Technological Modernization of Russia under the President of the Russian Federation.

In 2019, CDISE started participation in standardization activities with Rosstandart and the International Organization for Standardization (ISO). Professor Fedorov chairs the Trustworthiness working group and its subgroup AI Ethical Concerns of the Technical committee for standardization 164 Artificial Intelligence. This committee acts in the field of AI technologies on the international level. In particular, Trustworthiness group is responsible for creating the position of the Russian Federation in standards related to the properties of autonomous intelligent systems and its ethical concerns. By the end of 2019, CDISE representatives participated in the balloting for two standards by sharing clear arguments with the international community.

The technical committee for standardization 194 Cyber-physical systems is acting under the guidance of CDISE manager for standardization N. Utkin. The following standards have been developed and promoted in 2019:

- Methods of functional testing of a device/emergency call system installed on a wheeled vehicle during pre-sale preparation and technical inspection of a vehicle (ERA-GLONASS)
- Protocol for wireless data transmission for high-capacity networks based on ultra-narrowband radio signal modulation (OpenUNB, Open Ultra-Narrowband).



Professor Khaitovich of Skoltech's Center for Neurobiology and Brain Restoration took part in the "BRICS Biotechnology and Biomedicine Innovation Collaboration Conference," which was held in Taizhou, China, on November 1-2, 2019.



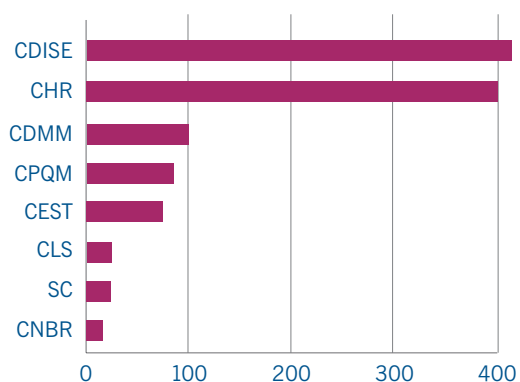
The 40th Session of the UNESCO General Conference Plenary Session. November 21, 2019.

Summary Data

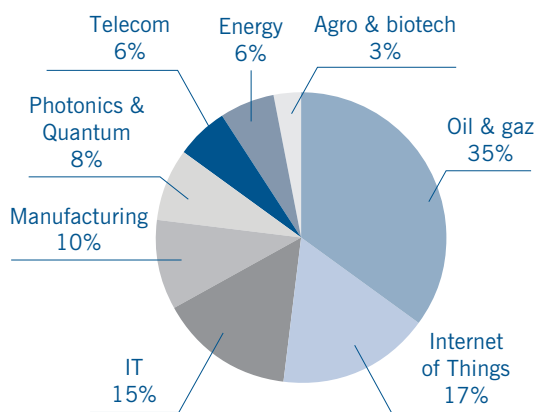
Contracted funding per source (mln RUB)



Contracted funding for 2019 (mln RUB)

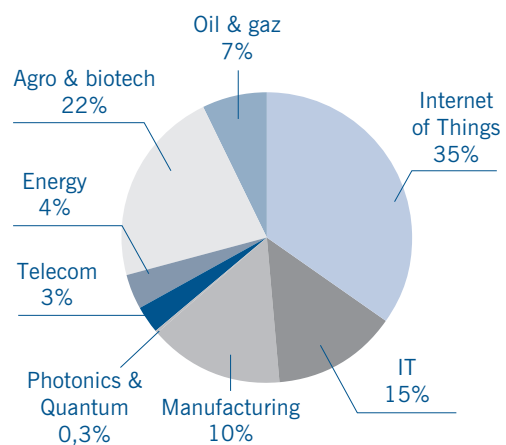


R&D contracts
(funds contracted for 2019)



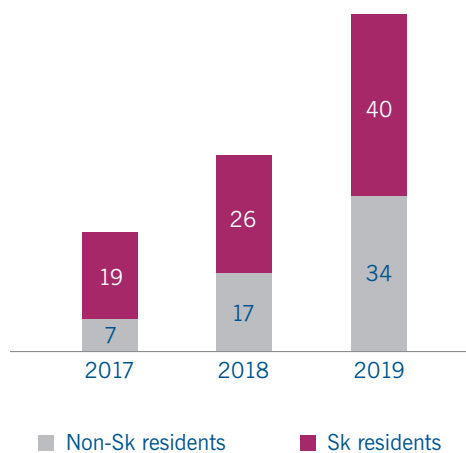
Total amount – 1,1 bln RUB

R&D contracts portfolio
2020–2023

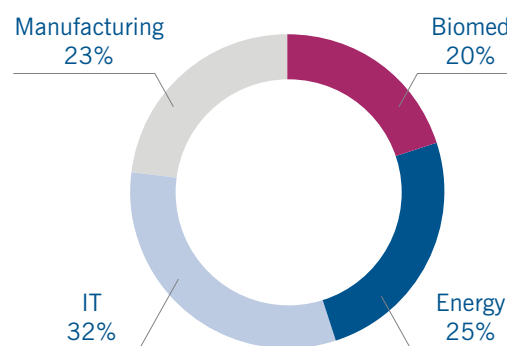


Total amount of portfolio – 1,4 bln RUB

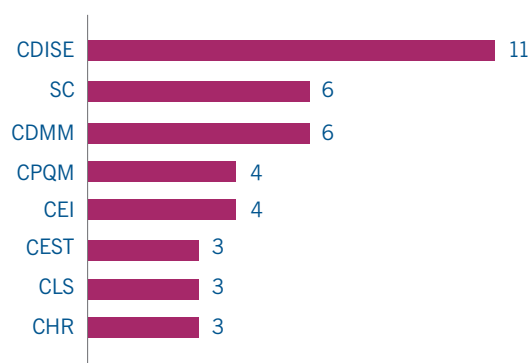
Skoltech startups (cumulative)



Skoltech startups with Sk residence per clusters



Skoltech startups with Sk residence per CREI



Operational Management

/04

The Operational Management block ensures delivery of services including financial planning and controlling, accounting, human resources management, IT systems, and services, legal support, procurement, internal control, and safety. The major activities in 2019 included:

- Implementation of a new financial approach aimed at efficiency and sustainability of industrial projects.
- Launch of a new operational support model of business partnering approach to support CREIs and departments on issues of finance and procurement.
- Registration of a revised charter, Skoltech legal address.
- Provision of legal and administration services to Skoltech startups.
- Intensification and tuning of controls in procurement procedures through processing through purchase requisitions in ERP solely (prior to any payment), improvement in procurement procedures timeline.
- First year operation in newly implemented ERP (Microsoft Dynamics AX 2012 R3), adjusting the system to current activities, conducting quality assurance of automated business processes, support of further optimization. Full integration with EPS Cognos and Directum (EDMS).
- Launch of the project module in Directum.
- Completed audit of the Skolkovo Foundation (KPMG) for target use of the Foundation Grant; audit according to IFRS and RAS (unqualified (positive) opinion received).
- Implemented internal controls in main operational processes.
- Completed IT Security audit to comply with 152 FZ (Personal Data safety).
- Provision of housing opportunities for students and faculty.
- Development and improvement of operational business processes with regards to risks.



Skoltech campus awarded Prix Versailles 2019 prize at UNESCO HQ in Paris. September 2019.

GLOSSARY

CAS

Center for Advanced Studies

CDISE

Center for Computational
Data-Intensive Science
and Engineering

CDMM

Center for Design,
Manufacturing and Materials

CEI

Center for Entrepreneurship
and Innovation

CEST

Center for Energy Science
and Technology

CHR

Center for Hydrocarbon Recovery

CLS

Center for Life Sciences

CNBR

Center for Neurobiology
and Brain Restoration

CPQM

Center for Photonics and
Quantum Materials

CREI (CENTER)

Institute's structural unit
implementing a long-term
(at least three years) development
program, aimed at integration of
research and education activities,
value generation (Centers
for Research, Education
and Innovation (CREIs),
Center for Advanced Studies)

RFBR

Russian Foundation for Basic
Research

RSF

Russian Science Foundation

SC

Space Center

**STRATEGIC ACTION PLAN
(SAP)**

Institutional Plan for
Development which sets vision,
strategic goals and initiatives,
KPIs, tasks and actions,
responsibilities, budget. The
SAP is developed for a three
years' cycle, annually updated
and approved by the Board
of Trustees. The SAP serves a
basis for the Grant Agreement,
reporting to the stakeholders

TARGET DOMAIN

strategic focus area of
the Institute's education,
scientific, research and
development and (or)
innovation activities.
Approved by the Board
of Trustees within the SAP.



**Skoltech. Gateway
to the World**

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