

EVALUATION AND ACCREDITATION
DOCUMENTS

**COMPUTATIONAL AND DATA SCIENCE
AND ENGINEERING (CDSE) DOCTORAL
PROGRAM**

Skolkovo Institute of Science and
Technology
(Skoltech)

Russia

APRIL 2020

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International evaluation and accreditation

EVALUATION REPORT

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Russia

JANUARY 2020



After the evaluation of its *Life Sciences* doctoral program, Skoltech has mandated Hcéres to perform its *Computational and Data Science and Engineering* doctoral program evaluation. The evaluation is based on the “External Evaluation Standards for doctorates out of France”, adopted by the Hcéres Board on March 26, 2018. These standards are available on the Hcéres website (hceres.fr).

For the Hcéres¹ :

Nelly DUPIN, Acting President

On behalf of the experts committee² :

Prof. Yves ROBERT, President of the committee

In accordance with the decree n°2014-1365, November 14th, 2014,

¹ The president of Hcéres "contresigne les rapports d'évaluation établis par les comités d'experts et signés par leur président." (Article 8, alinéa 5) – « countersigns the assessment reports made by the experts' committees and signed by their president » (article 8, paragraph 5)

² The evaluation reports "sont signés par le président du comité". (Article 11, Alinéa 2) – « are signed by the president of the committee » (article 11, paragraph 2)

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I. NATIONAL CONTEXT AND INSTITUTION IDENTITY SHEET

GENERAL CONTEXT AND HIGHER EDUCATION

The Russian Federation spans over 17.125.200 square kilometers, making it the biggest country in the world. With some 145 million inhabitants, it is the 9th most populated country in the world. Its Gross Domestic Product (GDP) comes to 4.180 trillion US \$ (6th in the world), representing 30.039 US \$ per capita (49th in the world).^{1, 2} The country is rich in resources and has a long tradition in higher education and research. Russia is amongst the world's top countries in the current rankings.³

The 766 Russian universities cover the whole scope of hard and soft sciences. The 2019 World University Ranking of Shanghai University ranked Lomonosov Moscow State University in 87th position, St Petersburg State University among the best 301-400 and both Moscow Institute of Physics and Technology and Novosibirsk State University in the 401-500 group.⁴

Higher education in the Russian Federation is mostly provided by public universities and institutions. In recent years, the offer has been extended to include private higher education Institutions.⁵ In order to issue State-recognized degrees, they need to possess (i) a license for educational activity and (ii) a national accreditation certificate. The license for educational activity allows an institution to train specialists in fields of higher vocational education. The national accreditation certificate guarantees the issue of a State-recognized degree certificate.⁶ In 2017, Skoltech obtained both the "License for educational activity" as well as the "State accreditation" from the Federal Service for Supervision in Education and Science.

Since 2011, the curricula of Russian universities have followed the Bologna system, with some flexibility. A Bachelor's degree (4 years) is followed by a Master's degree (2 years). After obtaining a Master's, Russian students may enter postgraduate courses and obtain a Candidate of Sciences degree within 3-4 years.⁷ International students must display a B1 level in the Test of Russian as a Foreign Language (TORFL)⁸.

SKOLKOVO INSTITUTE OF SCIENCE AND TECHNOLOGY (SKOLTECH)

Skoltech is a private research university that was established in 2011 by nine Russian universities, faculties and organizations.⁹ For setting up its research and education programs, Skoltech signed a contract with the Massachusetts Institute of Technology (MIT) and the Skolkovo Foundation. Up to now, Skoltech programs have focused on Master's and PhD studies in the following domains: Data Science & Artificial Intelligence, Life Sciences and Biomedicine, Cutting-edge Engineering & Advanced Materials, Energy Efficiency, Quantum Technology, and Advanced Studies.

Research is organized into ten research centers covering the domains of biology (Life Sciences; Neurobiology and Brain Restoration), IT (Computational and Data-Intensive Science & Engineering) and including different domains such as mathematics, physics, chemistry and economics (Energy Science and Technology; Hydrocarbon Recovery; Design Manufacturing and Materials; Space; Advanced Studies; Photonics and Quantum Materials).

The Skoltech Center for Computational and Data-Intensive Science and Engineering (CDISE) conducts cross-cutting interdisciplinary research in the fields of computational and data sciences. It comprises 23 research laboratories and runs two 2-year MSc programs in Data Science (DS) and Information Science and Technology (IST), in addition to the 4-year PhD program in Computational and Data Science and Engineering (CDSE). The CDISE has 28 professors, 50+ researchers, and 120+ PhD students.

¹ <https://en.wikipedia.org/wiki/Russia>

² <https://www.imf.org/en/Countries/RUS>

³ <https://www.master-and-more.eu/en/top-40-education-systems-in-the-world/>

⁴ <http://www.shanghairanking.com/ARWU2018.html>

⁵ <https://studyinrussia.ru/en/why-russia/russian-education-in-figures/>

⁶ http://www.obrnadzor.gov.ru/en/higher_education/

⁷ <https://studyinrussia.ru/en/study-in-russia/info/levels-of-education/>

⁸ <http://english.spbu.ru/torfl>

⁹ Moscow Institute of Physics and Technology; Tomsk Polytechnic University; Moscow School of Management Skolkovo; New Economic School; Rusnano; Russian Venture Company (RVC); Bank for Development and Foreign Economic Affairs (Vnesheconombank); Foundation for the Assistance to Small Innovative Enterprises in Science and Technology; RAS Scientific Center in Chernogolovkain

KEY FIGURES

Skoltech has been conceived as a small university that will have 1,200 graduate students (MSc and PhD) and employ 200 faculty members by 2020. At present, Skoltech faculty comprises 136 professors, 143 postdocs and researchers, 202 engineers and technicians and over 1,000 students, among them 350+ PhD students. With 28 professors, 80 research staff, and 122 PhD students (as of November 2019), the CDISE is a large department that accounts for nearly one fourth of Skoltech research programs.

SKOLTECH GOVERNANCE

Skoltech's governance¹⁰ is based on the Assembly of Founders, the Board of Trustees, the Academic Council and its President. The Assembly of Founders (with representation of 10 institutions in 2019) is the highest collegial body that approves the charter, appoints the Board of Trustees, the Academic Council and the President, as well as making decisions on Skoltech membership in associations and legal entities. The Board of Trustees (including 17 members from academia, economics and politics, including representatives from the Massachusetts Institute of Technology and from King Abdullah University of Science and Technology) conducts general oversight of the Institute's activities. It approves the Strategic Action Plan, the Financial Plan, related reporting, and reviews proposals for major structural changes (such as the launch or reorganization of the Centers for Research Education and Innovation — CREIs). The Academic Council is appointed by decision of the Skoltech Board of Trustees. It oversees the Institute's educational, scientific, R&D and Innovation activities. Its 19 members are from Skoltech senior faculty or management, as well as invited members. The President of Skoltech heads the leadership board of Skoltech. Vice presidents have been designated for Industrial Cooperation, International Business Affairs and Intellectual Property, Community Development and Communication, Finance and Operations, as well as Real Estate and Facilities. Three deans of Faculty, of Research and of Education and a Provost complete the leadership board. They are responsible for the strategic issues of the Institute, supervising educational programs and research strategies.

POSITIONING, STRATEGY AND CHALLENGES

Skolkovo Institute of Sciences and Technology was created to become a leading university in the Russian Federation and one of the top institutes worldwide. Goals and missions of Skoltech include performing cutting-edge fundamental and applied research and fostering academic excellence.

Educational and research programs at Skoltech have been implemented to provide the intellectual and material environment to educate the next generation of leaders in science, technology and business.

Challenges include establishing successful research programs in a rapidly evolving international competition, which is predominantly dependent on optimal financial resources and access to highly qualified persons at each level of the hierarchy. The leadership of Skoltech and the association with its collaborative partner, the Skolkovo Foundation, have been organized to address these challenges.

¹⁰ <https://www.skoltech.ru/en/about/governance/>

II. EVALUATION PROCEDURE

PRESENTATION OF THE INSTITUTION'S SELF-EVALUATION APPROACH

The CDSE PhD program has submitted a clearly organized self-evaluation report which follows the structuring in four areas of the Hcéres PhD evaluation framework:

Area 1 – Positioning of the doctorate;

Area 2 – Organization and management of the doctorate;

Area 3 – Supervision and training for doctoral students;

Area 4 – Integration of doctors into the job market.

Each of these four items has been concisely described in 30 pages backed up by extensive appendices, providing additional information on individual points, often in the form of tables. The self-evaluation report is accompanied by a SWOT analysis.

COMPOSITION OF THE COMMITTEE

The committee was composed of four members:

- Dr. Maïder Estécahandy, Engineer at Alstom Transport, Séméac
- Dr. Mireille Régnier, INRIA Research Director, Lille
- Prof. Yves Robert, Professor at Ecole Normale Supérieure de Lyon, Lyon (chair of the committee)
- Prof. Farouk Toumani, Professor at Clermont Auvergne University, Clermont-Ferrand

The committee was accompanied by Professor Pierre Sebban, Science Advisor at Hcéres.

ON-SITE VISIT DESCRIPTION

The committee, together with the Hcéres representative Professor Pierre Sebban, visited Skoltech from November 11 to November 13, 2019.

On day one of the visit, president Professor Alexander Kuleshov received the committee in the presence of the Associate Provost, Dean of Faculty and Postdoctoral affairs Professor Clément Fortin, Associate Provost and Dean of Education Professor Anna Derevnina, for a general presentation of the University and to introduce the importance of the CDISE Center within the institution. This meeting was followed by a more detailed presentation of the CDISE Center by its program director, Professor Maxim Fedorov, in the presence of all faculty members of this Center. After this presentation, Professor Fedorov answered the questions of the committee.

Subsequently, the new campus and Technopark were shown to the committee during a visit that included the presentation of the research and teaching building, which was recently opened in fall 2018. The campus visit was completed by a discussion with representatives of the Skolkovo Innovation Center.

In the afternoon, the experts split into two groups to interview representatives of the Skolkovo Innovation Center, of the CDSE Program Committee, of stakeholders and of industrial partners. In addition, the experts could interview some research supervisors and lead instructors.

On day two, the committee members continued their meetings with representatives of PhD students, alumni and representatives of the "Individual Doctoral Committee", as well as the "PhD Defense Jury" committee. In addition, the experts could interview representatives of the Department of Education and of the Doctoral Study Office, as well as the staff in charge of the "Learning Management System" and of the "Quality Assurance Framework". The whole committee had a meeting with Arkady Dvorkovich, co-chair of the Skolkovo Foundation board.

At the end of day two, the experts met a panel of junior faculty members, and a panel of recent doctors from Skoltech. The committee also visited the research laboratories of the CDISE.

On the last day of the visit, the whole committee discussed with the Director of the CDSE PhD program to clarify the points that had come to its attention during the two days of interviews and campus visits.

The committee acknowledges the very efficient organization of the visit by the CDISE and Skoltech.

III. EVALUATION REPORT

AREA 1 – THE POSITIONING OF THE DOCTORATE

1-1: The doctorate's distinct features and objectives are clearly defined

The CDISE focuses on some clearly defined topics in a close partnership with nearby Skolkovo Innovation Center. The balance between fundamental mathematics and core computer science techniques on one side, and applications on the other side, must be preserved.

The goal of Skoltech is “to perform cutting-edge basic and applied research, educate the next generation of science, technology and business leaders” The CDISE (Center for Computational and Data-Intensive Science and Engineering) was launched in 2013 and targets data science and artificial intelligence. Core topics are Machine Learning, Data Science and Artificial Intelligence, Mathematical Modeling, Emerging Computing Technologies, High-Performance Computing, Internet of Things, Computational Biomedicine, Computer Vision and Robotics, which are also developed in Skolkovo Innovation Center. The interplay between fundamental mathematics and core computer science techniques on the one side, and applications on the other side, is a prominent characteristic of the CDISE. In the future, this interplay must be preserved by devoting a fair share of research on both sides.

Graduates are expected to carry out outstanding research to be applied to practical innovation. Through interdisciplinary learning and entrepreneurial skills developments, they are expected to impact the country's economy, notably through Skolkovo Innovation Center. Learning outcomes are Disciplinary Knowledge and Reasoning, Personal Attributes such as beliefs and values, Professional Relations and Leadership in the Innovation Process.

The international vocation of Skoltech is supported by programs taught entirely in English and by academic mobility for students through internships and partnerships with foreign institutions.

1-2: The positioning of the doctorate is consistent with its environment

The positioning of the doctorate is coherent but must remain focused in the future by identifying a small set of priority application areas aligned with its capabilities and scientific objectives. The CDSE doctorate is also encouraged to set up an explicit and comprehensive policy with an operational framework to reinforce its internationalization.

As part of a young institution, the doctorate of the CDSE program formally started in 2013 and more effectively in 2014. It is therefore too early to draw a thorough assessment of the doctorate program with respect to its environment. The committee's opinion is based on the analysis of the current processes and set up arrangements, and on the trends observed in the evolution of the program during this short period.

The CDSE doctorate falls in an original and clear scientific domain based on a combination of traditional mathematical modeling and data analysis (an area where Russia is traditionally strong), with a timely and high priority technology field related to machine learning and artificial intelligence (AI). In line with the identity and the strategic goals of Skoltech, the CDSE doctorate: (i) aims to combine fundamental and applied research, seeking an impact on the economy; (ii) enforces international openness; and (iii) implements an education model that is consistent with international standards.

However, while the scientific positioning is clear, the target application areas (digital agriculture, medicine, chemical informatics, economy, manufacturing, digital pharma, etc.) tend to expand over too large a range. Indeed, although AI techniques could successfully be applied to all these areas, there is a risk of dissipating activities and efforts. The committee recommends that the CDSE program should stay focused by identifying a small set of priority application areas aligned with its capabilities and scientific objectives.

The doctorate is supported by 23 research units, internal to the CDISE, whose scope and scientific topics remain broadly consistent with the doctorate objectives. The involvement of the research units in the monitoring of the doctoral students and in the doctoral programs is quite satisfactory.

The CDISE develops relationships with local academic partners at the graduate level, for example joint Master's degrees with HSE (Higher School of Economics), MIPT (Moscow Institute of Physics and Technology) and SUAI (State University of Aerospace Instrumentation), while the interaction of the doctorate with academic partners is less intensive and could be improved. In particular, the committee encourages the CDISE to set out more intensive and formal relationships with Moscow Universities at the doctoral level.

The doctorate's interaction with the socio-economic environment has developed positively in recent years. The CDISE doctorate is well integrated within its local environment, specifically with the Skolkovo Innovation Center, leveraging both the central role of Skoltech in the Skolkovo project as well as the CDISE's target domain, machine learning and AI, which is highly sought after by industry. Research projects and, in a few particular cases, joint laboratories, are operated with industrial partners. This enables companies to be involved in the training of doctoral students. The close connection with industry, together with the target domain of the doctorate and its educational model based on "learning by doing", act as key factors that facilitate the integration of doctoral graduates into the job market.

The CDISE doctorate program displays few international links with foreign institutions (e.g., MIT, Grenoble Labs) that are formally set out, while an important part of its international collaboration remains handled in the context of individual collaborations. The doctorate program has a clear international orientation with a number of incentives and support mechanisms (conferences, internships) to enrich the PhD students' international experience. However, the doctorate still lacks an explicit and comprehensive policy with an operational framework to enforce its internationalization.

AREA 2 – ORGANIZATION AND MANAGEMENT OF THE DOCTORATE

2-1: Effective organization and management is in place for the doctorate

The CDISE program provides an excellent organization and efficient management procedures. However, there is a severe supervision imbalance among potential CDISE thesis advisors. This imbalance should be corrected. A centralized procedure is needed to assign PhD students more fairly and monitor the global situation every year.

The CDISE program provides an excellent organization and efficient management procedures for the doctorate. There are several organizations that oversee the doctorate:

- The PhD committee is in charge of the supervision of all PhD students. Progress is monitored through annual reviews which are organized to monitor the progress of each PhD student by the Individual Doctoral Committee. If an annual review is not passed, another one is conducted a few months later.
- The Individual Doctoral Committee selects the members of the defense jury.
- The Individual Doctoral Committee helps students to solve personal and technical difficulties.
- Conflicts are handled by the head of the CDISE program and by the education department

However, the strong growth of the number of PhD students, and the lack of a centralized policy to assign the students to advisors, has led to a strong imbalance in terms of supervision within the CDISE program. The data available in the self-evaluation report (Table 8) showed inhomogeneous distribution of students between research advisors as of June 2019. Recent data shows that the current 122 PhD students are supervised by only 30 CDISE members: 9 supervise 1 PhD student, 5 supervise 2 students, while some professors supervise 16, 13, 11, 9, 8 students. This imbalance should be corrected in the future. A centralized procedure is needed to assign PhD students more fairly and to monitor the overall situation every year.

2-2: There is an explicit policy for funding and recruiting doctoral students which is adapted to their program

The CDISE program keeps updating its selection procedure and provides full financial support for each enrolled PhD student. Altogether, selection and funding mechanisms are excellent.

The CDISE doctorate receives a considerable number of applications. In previous years, admission was decided by several committee panels working in parallel. These panels review files and interview students. To make the

process more efficient, the CDISE has decided to publish future PhD proposals on faculty members' webpages. The idea is that interested applicants can contact potential advisors based upon relevant topics and initiate a discussion ahead of the interview by committee panels. Applicants are also subject to an English examination (TOEFL). The admission process represents a considerable workload but runs smoothly. Newly hired administrative staff is helping to organize the admission.

Skoltech does not charge tuition fees for doctorate students. Student scholarships are regulated through a formal policy¹¹ which defines the types and amounts of scholarships and the other forms of support that students can benefit from. As for funding, all doctoral students receive a monthly stipend from the Skolkovo foundation. This stipend is much higher than a typical stipend for a Russian student and allows them to work full-time on the thesis without any difficulty. The stipend amount is subject to variation depending on an annual review of the student results.

AREA 3 – SUPERVISION AND TRAINING FOR DOCTORAL STUDENTS

3-1: The doctorate applies a strict doctoral student supervision and follow-up policy

The doctorate closely monitors the progress of doctoral students and achieves very good supervision overall. However, no specific action is taken for PhD theses financed by industry.

The PhD supervision and follow-up policy are fully described in the PhD policy document.¹² This document implicitly assumes that the same policy is enforced regardless of the funding (Skolkovo foundation or industry).

As part of the admission process, a full-time member of the Skoltech faculty shall be identified as Initial Supervisor. A co-Initial Supervisor can also be identified according to the subject and their availability by the admission interview committee. The co-Initial Supervisor may be a researcher at Skoltech, a faculty member from an external university, or an industry employee, and must hold a PhD degree or equivalent. No numerical criteria are fixed for the staff-student assignment, which is decided by the Doctoral Program Committee (as already mentioned, the number of supervised PhD students ranges from 1 to 16 students per supervisor).¹³ There are 4 annual progress reviews. 240 ECTS must have been validated by the PhD student before its defense can take place. The members of the Qualifying Exam Committee and the Individual Doctoral Committee must be approved by the Doctoral Program Committee.

One year after admission and the qualifying exam, the PhD students may change or keep the same supervision team, called after that “Final Supervisor” and “Final Co-supervisor” until they graduate. A reorientation of the subject can also be made. The choice of the supervisors is slightly different in the case of a thesis in industry: the co-supervisor is identified within the company.

During the fourth year of the thesis, in addition to the progress review, a final review precedes the defense. Authorization to defend depends upon the level and number of publications, conference attendance, and credits (refer to §3.3 for details).

Each review provides the opportunity to follow-up the technical background of the PhD students, and their ability to conduct research. Each review leads to three options: Pass, Marginal Pass (Pass with modification to be taken into account within a short period) and Fail. This grading is defined and available at the following link.¹⁴ In addition, the annual evaluations have an impact on the scholarship (refer to §2.2) in case of a thesis financed by Skoltech, but no precision is given for a thesis in Industry.

In addition to the technical follow-up, the PhD students are also supported for administrative tasks (educational board), social issues or events (Student council) and conflict management (Assurance Quality framework, Doctoral committee). On the other hand, in case of a violation of any Skoltech policy, the disciplinary board can be appointed to manage the conflict, up to a potential exclusion if necessary.

¹¹ https://www.skoltech.ru/app/data/uploads/2015/04/SCHOLARSHIPS_POLICY-ON-STUDENT-2016.pdf

¹² https://www.skoltech.ru/app/data/uploads/2015/03/Skoltech_PhD_Policy_FINAL.pdf

¹³ Data communicated after the visit of the CDISE by the committee.

¹⁴ https://www.skoltech.ru/app/data/uploads/2015/03/GRADING-AND-ECTS-CREDIT-SYSTEM-REGULATIONS_upd.pdf

The visit confirmed the quality of supervision and follow-up due to the proximity and involvement of the different stakeholders, as well as the high level of material resources provided, financial support for international internships, and offering of a comprehensive set of courses. The size and the budget of Skoltech contribute to this success. If growth continues, it will be challenging to keep the same level of quality.

3-2: The doctorate offers diverse teaching and organizes supplementary events

The doctorate provides an extended set of supplementary activities, and achieves a comprehensive coverage of student training and education.

Doctoral students admitted to the CDSE program must complete a 4-year full-time doctoral program based on a properly balanced scheme that includes scientific and technical teaching. Advanced courses cover the domains of applied mathematics and machine learning. General doctoral courses are also proposed. They cover a wide range of topics related, among others, to research methodology, history and philosophy of sciences, intellectual property and academic communication. The doctoral program also comprises a thesis preparation and defense seminar, besides a professional experience activity.

All core courses are based on the expertise of the CDISE research units and involve their economic partners. In addition, doctoral students have the opportunity to take courses from the Skoltech course catalog¹⁵ which provides a wide range of courses from other program curricula, extracurricular activities or Entrepreneurship & Innovation trainings. This enables doctoral students to have access to professional training that is well-suited to their profile and career plans.

The CDISE encourages doctoral students to take part in the scientific and/or professional events (guest lectures, professional conferences, seminars) that take place at Skoltech. However, such doctoral student activities seem not to be monitored and assessed by the doctoral program.

The CDSE PhD program is clearly defined and communicated to the students. The rules for validating the teaching credits and earning the PhD degree are formally set out and made publicly available. Doctoral students graduate after completing the doctoral program and defending their thesis in accordance with the Skoltech PhD Thesis Defense Policy.¹⁶ This policy requires the PhD thesis to comply with the international ethics standards, while the thesis manuscripts are systematically checked for plagiarism. However, Skoltech should make this policy more explicit and should detail the means used to raise the awareness of doctoral students about research ethics and scientific integrity issues (these issues seem not to be addressed by the current general doctoral courses).

3-3: The doctorate is based on explicit rules for thesis duration and defense

The rules for thesis organization, follow-up, duration and defense at the CDSE doctorate comply with highest international standards.

The PhD program requirements are clearly described in Skoltech's PhD Defense Policy¹⁷.

As for the defense, it is organized in three steps:

1. PhD Thesis approval by the Individual Doctoral Committee. It includes a pre-defense and a written report for the Program Committee.
2. Thesis Final review. It aims to evaluate the thesis, with a grading scale from A to E, for success and F for Failure.
3. PhD Thesis defense. It is public and the jury members consist of 5-9 experts in the research area. Criteria on their academic expertise, scientific independence and reputation are extensively given in Section 2.3 of PhD Defense Policy. The thesis supervisor is not a member of the committee. Two internationally recognized external members are mandatory; jury members cannot be co-authors of the PhD student. All members declare that they have no conflict of interest.

The expected duration of a PhD thesis is four years. Besides exceptional events such as health problems, this is a strict deadline for the Thesis Final Review. The thesis format is either a conventional doctoral dissertation or a coherent academic treatise based on publications. This choice is made by the Individual Doctoral Committee and the Doctoral Program Committee, after consultation with the student.

¹⁵ <https://www.skoltech.ru/en/education/course-catalog/#>

¹⁶ <https://www.skoltech.ru/app/data/uploads/2018/10/PhD-Thesis-Defence-Policy.pdf>

¹⁷ <https://www.skoltech.ru/app/data/uploads/2018/10/PhD-Thesis-Defence-Policy.pdf>

The thesis work must contain an original contribution, assessed by stringent conditions on publications. At least 2 papers affiliated with Skoltech in Web of Science (WoS)/Scopus indexed journals and at least 2 conference publications are required by Skoltech. In addition, at the CDSE program, the PhD student must be the first author once. The papers must be accepted by the time of the defense. This is more demanding than in most other Russian Universities. Plagiarism is strictly prohibited and checked.

As a general conclusion, the rules for thesis duration and defense at the Skoltech CDSE Program comply with highest international standards.

AREA 4 – INTEGRATION OF DOCTORS INTO THE JOB MARKET

4-1: The doctorate includes mechanisms to promote the integration of doctors into the job market

The doctorate includes excellent mechanisms to promote the integration of doctors into the industry market. The integration of doctors in the academic world could be improved.

Skoltech aims to propose an attractive PhD program at the highest international level in terms of research and real-world applications. To support this objective, the CDISE proposes a program of high-quality standards:

- Faculty members recognized nationally and internationally in their domain;
- English as official language;
- Cross-disciplinary research;
- Free tuition fees, and supportive scholarship, to allow each PhD student to be focused, and full-time active, on their research;
- Publications in the Q1/Q2 journals or A*/A rank conferences;
- Financial support for mobility to attend international/national conferences and work within laboratories abroad;
- Relationships with well-established institutions (MIPT, Moscow State university, Higher School of Economics, HEC, Grenoble Alpes University, MIT, etc.) and companies (Sberbank, Huawei, Samsung, Phillips, Yandex, etc.);
- New generation devices to experiment and develop new methodologies;
- An active Center for Entrepreneurship and Innovation to propose training in entrepreneurship and ethics, in order to help students develop their own start-up with Technopark support.

The CDISE's scientific positioning and doctoral educational model enable PhD students to gain and develop fundamental knowledge in a set of target domains that are in high demand in industry. In addition, the close connection of CDISE research units with local and national industry is a key factor to make CDSE PhD graduates very well prepared to enter the job market. The Vice-President for Development is in charge of this aspect, with an office dedicated to students. Meeting events to enhance relations with potential employers, such as Big Industry Day on 30/10/2019, are organized.

To validate the learning skills and diploma, a selective process is defined: different credits have to be validated in terms of research but also working behavior, communication, and ability to work in a group, which guarantee a high level of the diploma and a good integration into the job market. In addition, joint projects with innovative companies provide a challenging context for advanced research training, while promoting entrepreneurial and innovative culture among the PhD students. However, one important point remains unknown in view of the small number of PhD defenses, due to the youth of the program, namely integration into the academic world. No CDSE program doctor is yet involved in a university other than Skoltech (4 in Industry vs 1 in Skoltech). The relationships between Skoltech and other universities in general should be formalized to facilitate the enrolment of PhD graduates in national and international universities.

4-2: The doctorate has effective monitoring of the integration of doctors into the job market

The monitoring of the integration of doctors into the job market appears to be being structured. No monitoring system is yet effective. Nonetheless, the job status of the first graduates is known, owing to their proximity with the CDISE. The monitoring mechanism has to be clarified as quickly as possible to prepare for the increase in PhD graduates.

Due to the recent set up of the CDSE program, only very few PhD students have graduated so far and there are no significant statistics. The very early results about professional integration of PhD graduates are highly satisfactory: the first 5 PhD graduates of the CDSE program (at the time of the visit) are all employed (4 in Industry vs 1 in Skoltech).

A member of staff from the CDISE Doctorate is dedicated to the integration of doctors into the job market. Nonetheless, no monitoring system is yet effective. The small structure of Skoltech allows it to be close to the PhD students, and doctors to track their integration into the job market, but no information on the kind of contract, remuneration and time necessary to find their first job is available.

An alumni association¹⁸ has been put in place at Skoltech level to create a link between the Skoltech graduates. No specific Alumni association seems to be dedicated to the PhD graduates, and thus, to the CDSE PhD program.

Although the number of graduates is not yet significant due to the recent set up of the CDSE program, the structuring of the monitoring system should be formalized. This work is in progress according to the staff in charge to manage this point, but no template has been communicated to the committee.

4-3: The data collected is analyzed, communicated and used

Since the monitoring system of the doctor integration is still being structured, no communication appears to be set-up at PhD level. Nonetheless, the resources have been identified to perform this task.

As a young program, the CDSE program is not yet equipped with a formal monitoring system that enables the effective follow-up of alumni employment. While Skoltech has the appropriate structures and technical resources to ensure such a task, it still has to work on the design of a fine-grained tracking system that will enable the CDISE to remain in touch with PhD alumni and follow-up their career development (job profile, type of company, geographic location, remuneration evolution, career development, etc.). Nevertheless, an active Alumni club exists and also includes former Master's students, some of whom have possibly become PhD students. They are entitled to keep their Skoltech emails. They receive a quarterly request about their situation, and statistics are compiled.

¹⁸ <https://www.skoltech.ru/en/student-life/the-skoltech-alumni-association/>

IV. CONCLUSION

PAST ACHIEVEMENTS

Launched in 2013, as part of an ambitious and long-term strategic vision that aimed at making Skoltech a world-leading academic institute in science and technology, the CDISE doctoral program has enjoyed continuous expansion, thanks to its strong positioning in a highly attractive scientific domain, together with its innovative and attractive education model, organized in accordance with the highest international standards.

During this initial phase, the CDISE has undeniably succeeded in imposing itself as an established and recognized research institution at local and national levels. The CDISE and Skoltech display appropriate technical and managerial resources, and have deployed adequate structures to develop a doctoral program of very good quality.

TODAY'S CHALLENGES

As of November 2019, the CDISE is a large department within Skoltech and accounts for nearly one fourth of Skoltech research programs. After impressive initial growth, the major challenge faced by the CDISE today is to reach stability and operate in steady-state mode. The challenge is twofold: (i) on the scientific side, the positioning of the doctorate must remain focused, by identifying a small set of priority application areas; (ii) and on the management side, the CDISE needs to consolidate the procedures that regulate its daily operations for student enrollment and supervision.

OUTLOOK TO THE FUTURE

Overall, the information provided in the self-evaluation report has been confirmed during the interviews carried out by the committee. Additional data sent after the visit by the head of the CDISE has proved very useful. The achievements since creating Skoltech, and more specifically the CDISE Center and its PhD program, are remarkable.

The CDISE has excellent cooperation with industry, which will expand through common research laboratories. Future challenges lie in the ability of the CDISE to consolidate its position within the academic world, while intensifying collaborations with academic institutions, and to strengthen its scientific leadership potential, in order to improve its recognition worldwide. These are key to further increasing its attractiveness internationally.

Finally, we summarize below the main strengths, as well as some potential weaknesses, with some recommendations to remedy the latter

STRENGTHS:

- Context: Within a few years, the CDISE PhD program has established itself as a leading program in Russia, focused towards excellence. The program is well-structured and organized at both the academic and administrative levels. It currently hosts 122 PhD students and aims to grow another 20% in size.
- Research: The CDISE focuses on an original and clearly defined scientific domain, based upon combining mathematical modeling and data analysis with machine learning and artificial intelligence. The CDISE PhD program is supported by 23 research laboratories, the vast majority of which work in close cooperation with industry, and in particular with the Skolkovo Innovation Center.
- Students: The students are extensively supervised and accompanied throughout their PhD studies. They are rigorously selected. All are supported 100% by a high-rate stipend. Their progress is closely followed through regular meetings and formal annual reviews. The requirements to obtain the PhD (number of course credits, publications, etc.) match or exceed typical international standards. Many committees have been installed

to monitor and organize the life of the students, both professional and personal. Finally, students are regularly exposed to seminars and working sessions conducted by local and international visitors.

- Facilities: The working environment is excellent, be it in terms of office space, equipment of research labs, and computing platforms.
- Collaborations: The CDISE has established formal collaborations with a few international universities, as well as with several Moscow institutions.

WEAKNESSES:

- Research focus: The growth in terms of research laboratories has led to a very large range of target applications, which may spread out research and negatively impact the overall focus of the CDISE internally, as well as its perception and recognition from the outside.
- Imbalance of supervision: The growth in enrolled PhD students has led to a severe imbalance in terms of supervision. Some advisors supervise more than 12 students, while some (potential) advisors supervise none. Clearly, the imbalance must be corrected in the future. Some steps have already been taken in this direction, such as 'guaranteeing' the supervision of at least one PhD student for each potential advisor.
- PhDs in industry laboratories: Recently, some PhD have been conducted within an industry laboratory, and exactly the same rules for monitoring students apply as for those working in the CDISE. It might be valuable to adopt specific rules to guarantee the right positioning, long-term orientation and quality of the research conducted in industry.
- Positions in the academic world for graduates: the limited number of exchange programs and formal collaborations with Russian institutions, together with the strong industry-oriented focus, may make it more difficult for graduate students to be hired as post-docs or assistant professors in the academic world.

RECOMMENDATIONS:

The recommendations are made to alleviate the weaknesses mentioned above:

- Select a limited set of priority application fields to enhance the applicative focus of CDISE
- Enforce a better assignment of students to supervisors. Ensure that all CDISE members susceptible to supervise are offered the possibility to do so. Avoid concentrating a large number of students under the supervision of the same colleague.
- Enforce new guidelines (and ways to implement them) to monitor the work and professional life of students conducting their PhD within an industry laboratory.
- Develop new collaborations and increase CDISE visibility in the academic world, in order to facilitate the hiring of students.
- Intensify collaboration and establish formal relationships and joint PhD thesis with Moscow and other national and international Universities.
- Monitor growth carefully and anticipate the hiring of more administrative staff to accompany more students with the same level of quality as of today.

V. COMMENTS OF THE INSTITUTION

Skoltech

Сколковский институт науки и технологий

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Professor François Pernot,
Directeur/Director
Département Europe et International
Europe and International Department
2 rue Albert Einstein - 75013 Paris

March 04, 2020

Dear Professor Pernot,

I am writing to you in appreciation of the valuable contribution of the Expert Committee and HCERES team in the evaluation process of the Skoltech Computational and Data Science and Engineering PhD program. Results of the evaluation report will be extremely useful in the continuing improvement and revision of the PhD program and Skoltech in general, to ensure compliance with the high Standards and Guidelines for Quality Assurance in the European Higher Education Area.

Based on the evaluation report of the Expert Committee, Skoltech respectfully requests that the Council of HCERES approve the accreditation of the Skoltech Computational and Data Science and Engineering PhD program.

Sincerely yours,

Anna Derevnina



Associate Provost, Dean of Education

ACCREDITATION DECISION

COMPUTATIONAL AND DATA SCIENCE AND ENGINEERING (CDSE) DOCTORAL PROGRAM

Skolkovo Institute of Science and
Technology
(Skoltech)

Russia

APRIL 2020

SCOPE OF THE ACCREDITATION GRANTED BY HCERES

HCERES has built its evaluation process based on a set of objectives that higher education institution study programmes must pursue to ensure recognised quality within France and Europe. These objectives are divided up into four fields among which are the accreditation criteria.

As for the “External Evaluation Standards”, the accreditation criteria have been specifically designed for foreign programmes. The accreditation criteria were adopted by the Board on June 2016 and are available on the HCERES website (hceres.fr).

The accreditation committee, meeting his accreditation decision, has wholly taken into account the final evaluation report of the study programme. This accreditation decision is the result of a collegial and reasoned process.

The accreditation decision issued by HCERES shall not grant any rights whatsoever, whether in France or abroad. The decision on training programme accreditation confers an accreditation label and does not infer recognition of the accredited qualifications. The HCERES accreditation process therefore has no impact on the qualifications recognition process in France.

THE HCERES CRITERIA FOR DOCTORATE ACCREDITATION

HCERES has built its doctorate evaluation and accreditation process on a set of values and objectives that doctorates must pursue to ensure a certain level of quality.

These objectives are organised around four areas:

- Area 1: Positioning of the doctorate
- Area 2: Organisation and management of the doctorate
- Area 3: Supervision and training of doctoral students
- Area 4: Integration of doctors into the job market.

AREA 1: POSITIONING OF THE DOCTORATE

Accreditation criteria

- The positioning, the content and the objectives of the doctorate are clearly defined. Its interactions with the stakeholders (lead institution(s), foreign partners, socio-economic environment) are formally set out and effective. Its links with the research units and the institution's scientific policy are effective.

Criterion assessment

Within a few years, the CDSE PhD has been established as a leading program of excellence in Russia. It is well-structured and organized at both academic and administrative levels. It currently has 105 PhD students and is targeting a further 20% growth. CDSE focuses on an original and clearly-defined scientific domain combining mathematical modelling, data analysis, machine learning and artificial intelligence. The CDSE PhD program is supported by 23 research laboratories, the majority of which work in close cooperation with industry, in particular with the Skolkovo Innovation Center. The CDSE PhD program is well characterized and identifiable within the Skoltech Institute and in the Russian academic environment more generally.

AREA 2: ORGANISATION AND MANAGEMENT

Accreditation criteria

- The doctorate's organisation and management are clearly defined and rely on material and human resources adapted to the requirements of programmes at ISCED level 8. Internal quality assurance mechanisms are in place and effectively used in order to improve continuously the doctorate. The doctoral students recruiting is formally set out, their funding is fair and sustainable.

Criterion assessment

The CDSE PhD program is very well organized with excellent administrative support from the Department of Education (DoE) and Doctoral Study Office. Quality control is provided via student feedback, internal communication from faculty and administrative offices. The recruitment of students is very well organized through a clearly-defined two-step procedure. The fellowship policy is clearly advertised and carried out, including annual reviews and adjustment of the amount of stipends according to students' achievements. All students benefit from a high level of support. Their progress is followed closely through regular meetings and formal annual reviews. The requirements to obtain the PhD (number of course credits, publications, etc.) match international standards. Several committees have been set up to monitor and organize the professional and personal life of the students. Finally, students regularly attend seminars and working sessions conducted by local and international visitors.

AREA 3: SUPERVISION AND TRAINING FOR DOCTORAL STUDENTS

Accreditation criteria

- A strict policy of supervising and follow-up of doctoral students is set. Doctoral students have access to various teaching and professional trainings and take part in scientific/professional actions. Explicit rules are defined concerning the thesis duration and defense. Measures to combat fraud, plagiarism and corruption are applied within the doctorate.

Criterion assessment

Supervision and training of the PhD students are conducted to the highest international standards. Several committees are involved in accompanying the students during their thesis: the Doctoral Study Office; the CDSE Doctoral Program committee; the Individual Doctoral Program committees; the Disciplinary Board; and the PhD Defense Jurys. These committees guide the students closely and can be called in on demand, in compliance with Skoltech policy. In addition, an extensive and high-quality teaching offer is proposed to the students, from which they can compose their personalized curricula. The number of students directed by the different supervisors is very uneven. Action is currently being taken to fix these discrepancies.

AREA 4: INTEGRATION OF DOCTORS INTO THE JOB MARKET

Accreditation criteria

- The doctorate implements systems to promote the doctorate and the integration of doctors into the job market. The integration monitoring and analysis are effective and used to perform the continuous improvement of the doctorate.

Criterion assessment

Due to the very recent creation of the CDSE PhD program, few PhD students have graduated so far. No conclusive assessment of this criterion can be provided as yet.

However, the first 5 PhD graduates of the CDSE program were all employed at the time of the visit. The strong links established by CDSE laboratories with industry should help students find their place on the job market in the forthcoming years. Integration into the academic world must be enhanced, however.

FINAL DECISION

Considering the accreditation criteria analysis detailed above, the accreditation committee issues the following decision:

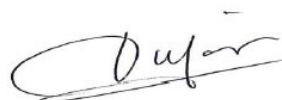
“Five-year unreserved accreditation decision”

and draws attention to the following points:

- **Enforce a better assignment of students to supervisors. Ensure that all CDSE members susceptible to supervise are offered the possibility to do so. Avoid concentrating a large number of students under the supervision of the same colleague.**
- Select a limited set of priority application fields to enhance the applicative focus of CDSE.
- Enforce new guidelines (and ways to implement them) to monitor the work and professional life of students conducting their PhD within an industry laboratory.
- Develop new collaborations and increase CDSE visibility in the academic world, in order to facilitate the hiring of students.
- Intensify collaboration and establish formal relationships and joint PhD thesis with Moscow and other national and international Universities.
- Monitor growth carefully and anticipate the hiring of more administrative staff to accompany more students with the same level of quality as of today.

SIGNATURE

For HCERES and on behalf of



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Nelly DUPIN,

Acting President

Date: Paris, April 15th, 2020



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