

Evaluation of research and professional activity of research-oriented institutes of the Czech Academy of Sciences for the period 2015–2019

Final Report

Name of the Institute: Institute of Computer Science of the CAS, v. v. i.

Evaluated teams and their leaders:

1. Department of Computational Mathematics (Stefan Ratschan)
2. Department of Theoretical Computer Science (Petr Cintula)
3. Department of Machine Learning (František Hák)
4. Department of Statistical Modelling (Zdeněk Valenta)
5. Department of Complex Systems (Jaroslav Hlinka)

Part A: Evaluation of the institute

Strengths:

The teams of the Institute are composed of strong researchers. They are involved in many national and International research projects. Every year a group of young PhD students joins the research activities of the Institute. They are responsible for a significant part of the research output. The Institute has themes of variable size and quality. The Complex Systems Team has an (inter-) national high standard with an outstanding research output. Researchers of the Institute are for many years involved in research involving the fundamental aspects of neural networks. The institute owned Ariel cluster is an important basis for fundamental research in applications that require high compute power.

Weaknesses:

High performance computing and Artificial Intelligence play an important role in modern computer science. Advanced predictive computations of high societal relevance, such as for the future energy supply, climate change, and many more are impossible without the use of high-performance computing, similarly, the newly developed deep-learning algorithms and their application in social media require high computer power. The use of modern high-performance computing depends critically on computer science research and its interface to mathematics. The research in parallel and high-performance computing is not linked to supercomputing as possible at IT4I in Ostrava, while the existing Ariel cluster in the institute is insufficient to reach full supercomputer performance. It is also necessary to build up databases of human behaviour. To secure privacy aspects of civilians is an important issue. The involvement of the Institute in these developments could be improved. Members of the Institute have many International contacts. But this has not resulted in participation of many European projects or start-up of new European projects. It is recommended to select and invest in a group of preferred partners.

Opportunities:

The Institute has a long tradition in research on fundamental aspects of Neural Networks. This is a good starting point for new research in new learning algorithms, deep learning, data mining and analysis of data from social media. The Institute has some excellent researchers which guarantees research of high standards and output the coming years. The Czech Republic has positioned itself with IT4I in Ostrava successfully in the European high-performance computing field. This opens opportunities for leading edge computer science research in high-performance computing.

Threats:

The transition from individual based research to more projects-based research in national and international context is a difficult process. To find a balance between both types of research requires some time and effort. Some teams have to attract young researchers, acquisition of additional funding from national and international sources is needed. Project acquisition and management of projects consumes valuable time, limiting research time and human resources.

Main criterion: 1. Quality of results (H1.1-H1.5)

H1.1	Quality of selected outputs of Phase I								
<p>Altogether 103 outputs were evaluated in Phase I with the following distribution of ratings</p> <table border="1"> <tr> <td>1</td> <td>2</td> <td>3</td> <td>1 or 2</td> </tr> <tr> <td>17,5%</td> <td>49,5%</td> <td>29,1%</td> <td>67,0%</td> </tr> </table> <p>1 „world leading“, 2 „internationally excellent“, 3 „recognized internationally“</p> <p>The quality of the selected outputs of Phase I is comparable with the other institutes evaluated by this commission in Phase I. There are 18 world-leading outputs, the majority of the evaluated outputs belong among the internationally excellent ones.</p> <p>The result of the assessment of the selected Output in Panel I as well as its evaluation in Phase II lead to the conclusion that the Institute can compete with the best international institutes in most of its fields.</p>		1	2	3	1 or 2	17,5%	49,5%	29,1%	67,0%
1	2	3	1 or 2						
17,5%	49,5%	29,1%	67,0%						
H1.2	Contribution of workers on the outputs reached								
<p>The number of scientific publications has increased significantly in the evaluated period. But the results are different for different teams. The implementation of the huge reorganisation took some time.</p>									
H1.3	Quality of all outputs and results								
<p>There is a significant increase in the quality and quantity of scientific publications.</p>									
H1.4	The most valuable discoveries and findings in the fields, their importance for the field								
<p>The ability to process massive data using immense computational power increases tremendously. Traditionally the Institute researched the foundation of neural networks. Now the Machine learning Department focussed on deep network structure and deep learning algorithms. The team involved in statistical modelling cooperates successfully with researchers from the social sciences and biomedical. The Department of Complex systems studied complexity of algorithms, complex systems and its involvement in related sciences.</p>									
H1.5	Contribution of the participation of the authors in large collaborations								
<p>Members of the Institute co-operate with national and international partners in 2 European and 29 national projects. These collaborations are visible in the list of publications. Members of the Institute cooperate with members of many Foreign Institutes, Institutes of CAS and Universities. There is no list of preferred partners and partners with cooperation over the years.</p>									

Main criterion: 2. Societal relevance (H2.1-H2.5)

H2.1	Societal relevance of outputs and results pursuant to CAS and institute mission
<p>The development of the weather forecasting system MEDARD changed from a global forecast to local weather developments in the context of smart cities. New climate models have been developed. The research can play a prominent role in climate control of urban regions.</p>	

H2.2	System functionality for knowledge transfer into practise, its usefulness for society. The impact of the institute´s activity on proper practice in society in the area of social sciences and humanities
The research team has the potential to do research in the area of social sciences and humanities. Especially the research experience in neural networks enables research in data from social media applying deep learning algorithms and datamining technology.	
H2.3	Relation to practice
Members of the Institute are involved in supervision of Master students from several Universities. The focus of some master thesis projects is applied research of high social relevant research.	
H2.4	Participation in AV21 strategy
<p>Since 2016, the institute has participated in two programs in the framework of research Strategy AV21, namely “Hopes and risks of the digital era”, and “Efficient energy conversion and storage”.</p> <p>Researchers from the Institute also contribute in cooperation with researchers from Charles University, to the mission of an informal platform named “the Karel Capek Centre for values in Science and Technology. The research focus of this platform is to investigate ethical and socio-political issues related to AI, robotics and biotechnology and related education.</p> <p>The Department of Statistical Modelling was involved in a CAS program on vibrodiagnostics in the framework of Strategy21. During the period 2015-2019, twenty seminars were organized for high-school students and teachers, distributed over the whole Czech Republic and Bratislava in Slovakia.</p>	
H2.5	Cooperation with regions of the Czech Republic
Researchers from the Institute cooperate with other Institutes, Universities and industrial research centres distributed over the Czech Republic. The Institute cooperates with the city Hall of Prague on measurement of pollution and air quality.	

Further criterion: 1. Position in international and national context (D1.1-D1.3)

D1.1	Comparison of the teams and the institute with similar international and national institutes
The Institute has recently been reorganized. As a consequence, some teams are more mature than others. The most developed subteams belong to the top of comparable International and national Institutes.	
D1.2	Scope and quality of international and national cooperation and the role of the institute in such cooperation; engagement in broad international cooperation
The most mature teams cooperate in national and international networks. Some of them are scientific leading experts. Also the cooperation in joint papers is good. A minor point is the participation in the organization of projects. Next future more members and teams of the Institute have to take a leading role in the foundation of research projects.	
D1.3	Participation of the workers in scientific community activities (organizing of conferences and workshops, invited lectures, awards)
In the period 2015-2019 the research output of the Institute has been improved. A highlight was the award of Research Professor Milan Palus for his contribution to the field of	

complex systems. But it may be expected that next future the number of awards will increase significantly.

Further criterion: 2. Vitality, sustainability and strategy (D2.1-D2.9)

D2.1	Direction in line with the perspective of the planned research directions
<p>The mission of the Institute is clearly defined. The goal was to carry out scientific research in the field of Computer Science, contribute to the utilisation of its research findings and provide research infrastructure.</p> <p>In the evaluated period the Institute had to face the exponential growth of computer power and the increased role of Artificial Intelligence.</p>	
D2.2	Assessment of the previous research objectives and their achievement
<p>One of the problems is that research objectives are not defined in operational terms. Missing quantitative criteria hinders the measurement of yearly improvement. The number of papers can be quantified and shows a significant improvement.</p>	
D2.3	Assessment of implementation of recommendations from past evaluation
<p>One of the recommendations from the last evaluation was that teams have to cooperate. To realize that the Institute started a yearly and monthly seminar where researchers present their recent achievements. For doctoral students a yearly seminar has started. The cooperation between Institute teams is also stimulated by 15 joint research projects funded by the GACR.</p> <p>The salary of members of the Institute has been improved significantly in 2019. By attracting European Funds the Institute has improved the salary of PhD students. The biggest improvement was the increase of scientific publications from 51 in 2014 to 93 in 2019.</p> <p>We mentioned already the changes in organisational structure and new research direction in machine learning.</p>	
D2.4	Success in receiving grants
<p>Members of the Institute received several grants, and best papers awards. Professor Milan Palus got the most prestigious scientific award in the Czech Republic (the Praemium Academiae of the Czech Academy of Sciences).</p>	
D2.5	Adequacy of instrumental equipment
<p>Since sufficient computing capacity could not be easily provided by IT4I, the Computing Centre of Ostrava, computer experts from the Institute designed the ARIEL mid-size cluster with help of the CAS. This computer system is currently very busy, since it is too small for leading edge research computations. Its size is adequate for the development of software and computational experiments, but quickly reaches its limits for challenging high-performance computing tasks. Particularly, new research activities in machine learning using key technologies in artificial intelligence use a lot of the available computer power and communication infrastructure.</p>	
D2.6	Effectiveness of management
<p>At the start of the current evaluation period some teams did not function adequately. The new director started a profound reorganisation. New teams were established and old teams dissolved. The transition from old to new structures is still going on. The HR policy has been changed, more young and international researchers are attracted. The Management took</p>	

	the initiative to start an International Advisory Board of experts providing advice on research.
D2.7	Assessment of professional structure, development strategy and the strategy of keeping best scientists, age structure, career and qualification growth
	The Institute defines transparent rules for academic positions and career progress. Most young researchers are appointed as tenure track researchers.
D2.8	Creating work-life balance conditions, assessment of approach towards possible gender issues
	The Institute supports work-life balance of its employees, such as support for housing, food, crèches, sport facilities etc. There are no special programs to stimulate female researchers. The age structure of the Institute shows a bimodal distribution with a low peak of employees older than 50 years.
D2.9	Relation of the institute with regard to the integration, development and sustainability of the research centre funded by the National Programme of Sustainability II.
	Not relevant.

Further criterion: 3. Cooperation with universities and participation in education (D3.1-D3.6)

D3.1	Scope of cooperation with universities on national and international level
	Members of the Institute give semestrial lectures, seminars and courses on Charles University and Czech Technical University. The Institute has joint accreditation of doctoral degree programs with these Universities. There is also cooperation with other Czech universities such as University of Plzen, Ostrava, Masaryk, Olomouc, Ostrava. Members of the Institute give lectures as visiting researcher, invited lecturers at many foreign universities.
D3.2	Effectiveness of joint research centres
	Members of the Institute are active in three research centres: Necas Centre, Karel Capek Centre and Laboratory of reliable systems. The participation and cooperation with members of those institutes resulted in yearly publications. However, the current activity in Necas center is only formal since the key persons left the institute.
D3.3	Success rate in supervision of PhD students
	In total 32 thesis were defended successfully in the evaluation period.
D3.4	Participation of PhD students in the outputs
	From the list of publications it can be concluded that PhD students had a great part in the number of publications. All publications are joint publications with their supervisors.
D3.5	Participation of the institute in master or bachelor studies
	More than hundred BSc and master thesis were successfully defined in the evaluation period. Members of the team were mostly involved in supervising Pregradual.
D3.6	Assessment of cooperation intensity with universities in the form of teaching

Many members of Institute present lectures, give seminars and courses at the Universities. They were positively evaluated by students in the lecture halls and highly appreciated by colleagues at the University.

Further criterion: 4. Outreach activities (D4.1-D4.3)

D4.1	Sufficiency of media strategy and activities in the area of research popularisation
<p>The Institute is very active in the area of research popularisation, by interviews on radio and TV and giving popular lectures. The Institute organized a special day on Robotics and Artificial Intelligence and takes part in the yearly “open doors” day. In the framework of AV21 the institute organised a meeting for talented secondary school students. The Institute organises many interviews via the Karel Capek Centre for Research on values in Science and Technology.</p>	
D4.2	Publishing activities and its quality
<p>In 1991 the Institute started its own Journal on Neural networks which has not an impact factor more than one. Members of the Institute organized many International Conferences and workshops. Prague is still an attractive city to host International Conferences and Workshops.</p>	
D4.3	Participation in professional organisations in the area of research and development
<p>Members of the Institute participated in many professional organisations. But this is mostly limited to key researchers.</p>	

Recommendations and comments of the commission:

The Institute has been in a state of significant flux since the last evaluation. There has been a change of Director, and a substantial reorganisation of the Institute and its team structure. This reorganisation is relatively recent and needs a period of time to bed-in before further changes are made. For this reason, we have recommended that all teams remain at their current level of support. There are of course significant variations in the quality and quantity of outputs, and the ability to attract funding among the teams. We therefore recommend that the Director works to share good practice between teams. When talking to research students from the Institute we got the sense that they have become isolated during the pandemic, and need greater support both in terms of establishing a research student community and pastoral support to overcome the effects of isolation. We also encourage greater contact between this and other Institutes within the CAS structure. For instance, UTIA is just a few hundred metres away and pursues cognate research, yet there appears to be very little co-operation.

At the team-level below we consider there to be significant issues relating to a number of teams, and the overall direction of the institute. At a strategic level, the Institute should develop a strategy relating to how both AI and High-Performance Computing can be given greater prominence and coherence in the new team structure. We have made recommendations relating to the Computational Mathematics which have potential impact on the overall structure of the Institute. We have also given some steer in terms of research direction for the Statistical Modelling and Machine Learning Teams.

Part B: Evaluation of teams

1. Department of Computational Mathematics

Strengths:

The main strengths of the team in the evaluated period were the key leading persons in the Numerical Linear Algebra subteam. The published results are of excellent quality. However, this team does not exist currently, all persons moved to Charles university or the institute of mathematics of the CAS. The position of the department at the intersection of mathematics and computer science is promising and covers a research direction with growing importance.

Weaknesses:

The main weakness lies in the structure of the department and its size that prohibits it to address many of the research questions that arise between mathematics and computer science. The Numerical Linear Algebra subteam does not exist anymore and it can hardly be recreated within the Institute of Informatics. The subteam of numerical optimization is not viable in the long term. The formal verification subteam is currently too small and its future is questionable.

Opportunities:

The Formal Verification subteam can become a more viable provided that it can be reinforced by several (2-3) PhD students and/or postdocs. Additionally, the team has to employ and harness the expertise of other teams from the institutes of CAS and Prague universities. Furthermore, the department could become the nucleus to address the modern topics in computational science and high-performance computing. This is however, a significant expansion beyond its current focus on a narrow interpretation of computational mathematics. However, such an expansion strengthened the positioning of the whole Institute of Computer Science.

Threats:

Although the first step in the strengthening of the team was recently successful, it will remain a challenge to sustain such a team in the mid-term future. A successful upgrade path to exploit the strategic opportunities will require significant support from the management of the Institute of Informatics and the CAS.

Main criterion: 1. Quality of results (H1.1-H1.5)

H1.1	Quality of selected outputs of Phase I
The team achieved the following distribution of ratings	
1	2
14,3%	57,1%
3	1 or 2
28,6%	71,4%
1 „world leading“, 2 „internationally excellent“, 3 „recognized internationally“	
The quality of the selected outputs of Phase I is comparable with the other mathematical teams evaluated by this commission in Phase I. There are a few world-leading outputs, the majority of the evaluated outputs belong among the internationally excellent ones.	
H1.2	Contribution of workers on the outputs reached
The contribution of team members to the evaluated outputs is comparable to the other mathematical departments. However, the authors of 13 evaluates outputs (from the total	

number of 21) already left the institute so these values are currently not too much informative.	
H1.3	Quality of all outputs and results
The total number of outputs was 62, the number of outputs evaluated in Phase I was 21. The average quality of the outputs, which have not been evaluated in Phase I, are significantly smaller from the point of view of the quality of the outputs by journal ranking and quality of outputs by intensity of citations in comparison to the other mathematical departments.	
H1.4	The most valuable discoveries and findings in the fields, their importance for the field
Among the most valuable results belong the papers of the numerical linear algebra team developing efficient and numerically stable algorithms. Moreover, the paper [Papež, Strakoš, Vohralík: Numerische Mathematik 2018] dealing with a posteriori analysis including algebraic errors and the paper [Franeek, Ratschan, Mathematics of Computation 2015] presents an efficient algorithm computing topological degree.	
H1.5	Contribution of the participation of the authors in large collaborations
There are no large collaborations in the sense of category “D”.	

Main criterion: 2. Societal relevance (H2.1-H2.5)

H2.1	Societal relevance of outputs and results pursuant to CAS and institute mission
The research interests of the department have a potential for high societal relevance of outputs. Although the strongest team of numerical linear algebra does not exist any more, the team of formal verification can contribute to the verification of models of technical systems, pharmacology, biology and machine learning. However, since the team is currently small, the societal relevance is not high currently.	
H2.2	System functionality for knowledge transfer into practise, its usefulness for society. The impact of the team’s activity on proper practice in society in the area of social sciences and humanities
Due to the reasons mentioned above and the limited size of the department, there does not currently exist any system for knowledge transform into practise.	
H2.3	Relation to practice
The research interests of the department have a close relation to practice. Particularly, outputs of numerical linear algebra and numerical optimization can contribute to the solution of large problems arising in engineering applications. The focus of the Formal Verification subteam is on verification of models in many engineering, biology, medicine, etc.	
H2.4	Participation in AV21 strategy
Neither the report on the research activity of the department nor the presentation during the on-line meeting do not mention any activities in AV21 strategy. However, the institute participates in the research program “Hopes and risks of the digital era” of AV21 strategy.	
H2.5	Cooperation with regions of the Czech Republic

The department declares the cooperation within Nečas Center for Mathematical Modeling and Czech Network for Mathematics in Industry EU-MATHS-IN.cz. However, after the leaving the key persons from the Institute of Informatics and a shift of research interests of the remaining persons, the current activity of the departments in these centres is only symbolic.

Further criterion: 1. Position in international and national context (D1.1-D1.3)

D1.1	Comparison of the team with similar international and national institutes
<p>The comparison is difficult mostly because the umbrella name <i>Computational Mathematics</i> includes a wide variety of subfields to facilitate proper comparisons. However, considering the size of the team and its age profile, the team seems to be too small at the moment to stand-up to any research team with the focus on computational aspects of mathematics. A strong team in numerical linear algebra has disappeared and a new subteam in formal verification is currently too narrow in its scope. In particular, modern computational science depends heavily on high performance computing and is thus in the focus of international research activities.</p>	
D1.2	Scope and quality of international and national cooperation and the role of the team in such cooperation; engagement in broad international cooperation
<p>If one considers the current state of the team, the international collaboration is only facilitated through joint authorship. Since the team is small and undergoing a dramatic change of its research focus, broad international cooperation does not seem feasible.</p>	
D1.3	Participation of the workers in scientific community activities (organizing of conferences and workshops, invited lectures, awards)
<p>Three to four members of the team are engaged in such activities. Since there are only seven researchers in total, this seems to be satisfactory.</p>	

Further criterion: 2. Vitality, sustainability and strategy (D2.1-D2.9)

D2.1	Direction in line with the perspective of the planned research directions
<p>The team is undergoing a major transition but a reported success in hiring a new member suggests that there may be a chance to rebuild a team although its focus would probably be in the field of formal verification.</p>	
D2.2	Assessment of the previous research objectives and their achievement
<p>A complete reorganization of the institute and disappearance of the numerical linear algebra subteam prevented from achieving the previous research objective for a team that has been created in the middle of the evaluation period.</p>	
D2.3	Assessment of implementation of recommendations from past evaluation
<p>The recommendations have not been implemented. However, for the same reasons as stated above, such an implementation was not possible.</p>	
D2.4	Success in receiving grants

The team in the report mentions successful national grant applications, however, it is not clear which subteams received the funding and what were the topics of the proposals.	
D2.5	Adequacy of instrumental equipment
In computer assisted formal verification the computational resources in the possession of the top players in the field are beyond the reach of the team.	
D2.6	Effectiveness of management
It appears that the new leader of the team does what can be done given the circumstances.	
D2.7	Assessment of professional structure, development strategy and the strategy of keeping best scientists, age structure, career and qualification growth
The team is in a very critical situation with the small overall number of members and a significant number of researchers about to retire. It appears that the new hiring may bring some revitalization of the team but it is rather doubtful that one person will be sufficient to change the gloom picture of the team in this respect.	
D2.8	Creating work-life balance conditions, assessment of approach towards possible gender issues
It is hard to assess given that no criteria or standards are provided.	
D2.9	Relation of the team with regard to the integration, development and sustainability of the research centre funded by the National Programme of Sustainability II.
Not relevant.	

Further criterion: 3. Cooperation with universities and participation in education (D3.1-D3.6)

D3.1	Scope of cooperation with universities on national and international level
There was ongoing strong cooperation with the Nečas Center for Mathematical Modeling however it has disappeared together with the Numerical Linear Algebra subteam. Other collaborations are at the level of organizing jointly with the universities in Prague the supervision of the students and teaching some courses.	
D3.2	Effectiveness of joint research centres
<p>The cooperation in the Necas Center for Mathematical Modelling was successful in promoting joint research and education projects, workshops, conferences and schools, and other activities strengthening Mathematics and its Applications. It is a prime example of how substantial added value can be created for all involved partner institutions. But it is also an effective tool for shaping and enabling cooperation, especially between institutes of the Academy and with the University, despite the well-known obstacles.</p> <p>The available information concerning Necas Center gives an overall positive impression, which is in line with that gained in discussions with doctoral students currently supervised at the Institute. A more detailed analysis of the situation of cooperation between the CAS institutes and the universities in education seems necessary.</p> <p>However, the current activity in Necas center is only formal since the key persons left the institute.</p>	

D3.3	Success rate in supervision of PhD students
It seems that two Ph.D. students received their degree. It is not clear if some resigned.	
D3.4	Participation of PhD students in the outputs
Five papers out of 49 had a student as a co-author.	
D3.5	Participation of the team in master or bachelor studies
The unit is engaged in teaching at master and bachelor levels however and surprisingly there are no bachelor or master theses supervised.	
D3.6	Assessment of cooperation intensity with universities in the form of teaching
The teaching activities seem to be quite well established with around 20 courses taught per year.	

Further criterion: 4. Outreach activities (D4.1-D4.3)

D4.1	Sufficiency of media strategy and activities in the area of research popularisation
Research popularisation has been realized through three lectures in the Institute Open Doors Day. The effort is probably not adequate.	
D4.2	Publishing activities and its quality
No publishing within the outreach framework.	
D4.3	Participation in professional organisations in the area of research and development
Editorial and board membership adequate and in line with the standard within the mathematical/computation science community.	

Other comments of the commission:

Considering the current status of the team and the restructuring challenges in the Institute, the team should be given the opportunity to expand through securing external research funding or if this fails it should be merged with another cognate team. One direction the team might consider is high performance computing and this could help to close a strategic gap in the Institute of Computer Science, but this must also be considered a challenging path. The alternative of dissolving the team and merging its staff with other teams would also be problematic since this would take place only a few years after the last restructuring. Clearly the department has not yet been given enough time and enough resources to refocus properly. Nevertheless, currently another restructuring may be considered the less risky option and would possibly be the most beneficial to the current team members. One option is that the Machine Learning Team could smoothly integrate the researchers from the team and benefit from their presence too.

2. Department of Theoretical Computer Science

Strengths:

The composition of the team with respect to age and gender distribution is very good. The team has been successful in obtaining small and medium size grants. The team takes an open view to new research directions, as witnessed, for example, by the recent impressive developments in graph theory. This subject relates well to number theory and other parts of mathematics, as well as to computer science, and shows this part of the team is well placed.

Weaknesses:

The number of PhD students is too small, possibly related to the fact that only a very small number of master level courses have been taught at universities. The scientific connection of the logic subteam to the other two subteams seems rather weak.

Opportunities:

Following the successful recruitments at the international level and the successful new research developments, the team might try to obtain larger (e.g., ERC) grants. The Logic subteam investigates a wide variety of systems, and might consider focusing on systems with a clear relevance in a more specific direction, be it computer science or linguistics, for example. In addition, the team might intensify the collaboration with several other units of CAS in order to tighten connections between theoretical aspects of computer science and more practical ones.

Threats:

The lack of PhD students is a threat for the long-term vitality of the team.

Main criterion: 1. Quality of results (H1.1-H1.5)

H1.1	Quality of selected outputs of Phase I								
<p>The team achieved the following distribution of ratings</p> <table border="1"> <tr> <td>1</td> <td>2</td> <td>3</td> <td>1 or 2</td> </tr> <tr> <td>23,3%</td> <td>56,7%</td> <td>20,0%</td> <td>80,0%</td> </tr> </table> <p>1 „world leading“, 2 „internationally excellent“, 3 „recognized internationally“</p> <p>The team selected 30 outputs for the evaluation. Among them, a high proportion of 24 (80%) was classified into categories 1 and 2. These publications appeared in top area-relevant journals and high-impact conferences proceedings.</p>		1	2	3	1 or 2	23,3%	56,7%	20,0%	80,0%
1	2	3	1 or 2						
23,3%	56,7%	20,0%	80,0%						
H1.2	Contribution of workers on the outputs reached								
<p>Members of the team played an essential role in the selected publications. The fractional count in categories 1 and 2 is 91%.</p>									
H1.3	Quality of all outputs and results								
<p>The team has been quite productive over the evaluation period, and a high proportion of the publications is excellent and even world-leading. The team also published in good journals and at established conferences, including some high-impact venues.</p>									
H1.4	The most valuable discoveries and findings in the fields, their importance for the field								
<p>The team made a series of good and valuable theoretical contributions in the three fields, in particular the progress in graph theory is impressive.</p>									

H1.5	Contribution of the participation of the authors in large collaborations
There are no large collaborations in the sense of category “D”. The team has widespread international collaborations on an individual basis.	

Main criterion: 2. Societal relevance (H2.1-H2.5)

H2.1	Societal relevance of outputs and results pursuant to CAS and institute mission
This team is devoted to basic research at the interface of mathematics and computer science that is per se theoretical. Thus, the potential societal relevance of its outputs and results can only be expected in the long term, e.g., to fertilize AI research and other fields like logistics and robotics.	
H2.2	System functionality for knowledge transfer into practise, its usefulness for society. The impact of the team’s activity on proper practice in society in the area of social sciences and humanities
Not relevant.	
H2.3	Relation to practice
The theoretical results of this research may provide deep insight into more applied areas of computer science, which in turn will have an impact on research fields mentioned above.	
H2.4	Participation in AV21 strategy
No information is provided about participation in AV21 strategy.	
H2.5	Cooperation with regions of the Czech Republic
No related information is provided.	

Further criterion: 1. Position in international and national context (D1.1-D1.3)

D1.1	Comparison of the team with similar international and national institutes
Since the three subteams are typically organized in different institutes, it is rather difficult to make a comparison on the team level. The three subteams each act at internationally competitive level in their respective areas.	
D1.2	Scope and quality of international and national cooperation and the role of the team in such cooperation; engagement in broad international cooperation
In all three research areas the team has rather intensive cooperation with national and international institutions. The cooperation includes several prominent researchers like Endre Szemerédi (Abel Prize winner 2013). The team has been and continues to be active in abroad secondments within the MSCA RISE framework. In addition, the team also contributes to the teaching at Charles University.	
D1.3	Participation of the workers in scientific community activities (organizing of conferences and workshops, invited lectures, awards)

The team has (co-)organized several important conferences, partly combined with summer school for young researchers. The Combinatorics Webinar posted on YouTube enables to easily involve international speakers (e.g., IMPA, MIT, ETH) and broadens the audience. Members of the team are active in editorial boards of international journals.

Further criterion: 2. Vitality, sustainability and strategy (D2.1-D2.9)

D2.1	Direction in line with the perspective of the planned research directions
The team has described clear plans and goals for future research (in the short term) in all three research areas. It will continue with the activities in research events like online seminars, conferences and workshops.	
D2.2	Assessment of the previous research objectives and their achievement
The establishment of graph theory as a new research area was a success. In all three research areas the team has achieved highly visible research results in the past period.	
D2.3	Assessment of implementation of recommendations from past evaluation
The team has been successful in implementing the recommendations related to cooperating with universities to apply for larger grants and targeting the leading mainstream conferences for publication. The application for a visitor centre was not successful, however with a minimal margin from the approval level only. Pragmatically, the team has started an initiative for long-term collaborative stays without external funding resources that appears already fruitful after the first implementation period.	
D2.4	Success in receiving grants
The team has been quite successful in terms of small/medium-size grants. Also towards larger collaborative grants it has achieved success on the national level.	
D2.5	Adequacy of instrumental equipment
Not relevant.	
D2.6	Effectiveness of management
The three subteams act relatively independently and that seems to work well.	
D2.7	Assessment of professional structure, development strategy and the strategy of keeping best scientists, age structure, career and qualification growth
The strategies for both the recruitment and qualification growth are reasonable and seem to be productive in practice. The team is well balanced in terms of age, level, and internationality.	
D2.8	Creating work-life balance conditions, assessment of approach towards possible gender issues
The team has dealt adequately with issues like maternity leave.	
D2.9	Relation of the team with regard to the integration, development and sustainability of the research centre funded by the National Programme of Sustainability II.
Not relevant.	

Further criterion: 3. Cooperation with universities and participation in education (D3.1-D3.6)

D3.1	Scope of cooperation with universities on national and international level
The team contributes to the teaching at Charles University and the Czech University of Life Sciences. Internationally, team members taught at the Technische Universität Wien.	
D3.2	Effectiveness of joint research centres
The team is part of the CSF-funded Institute of Theoretical Computer Science – Centre of Excellence. No organisational details are reported. The scientific output from this collaboration is considered very good.	
D3.3	Success rate in supervision of PhD students
Only two PhD students defended their theses in the evaluation period.	
D3.4	Participation of PhD students in the outputs
One PhD student is the first author of two papers published in one of the top journals in logic. Another PhD student received the best Student Paper Award at an international conference. Overall, the PhD students actively participated in the publication activities.	
D3.5	Participation of the team in master or bachelor studies
The team taught a rather high number of bachelor courses and 8 master courses. The number of defended theses is small (1 bachelor, 2 master).	
D3.6	Assessment of cooperation intensity with universities in the form of teaching
The participation in master teaching is limited, particularly in relation to the participation at the bachelor level. An increase should help attract good PhD candidates.	

Further criterion: 4. Outreach activities (D4.1-D4.3)

D4.1	Sufficiency of media strategy and activities in the area of research popularisation
The team members were encouraged and supported for outreach activities. Some members are very active in this respect.	
D4.2	Publishing activities and its quality
One member of the team is very active in the popularisation of mathematics and also of achievements of mathematicians.	
D4.3	Participation in professional organisations in the area of research and development
Nothing has been reported.	

Other comments of the commission:

3. Department of Machine Learning

Strengths:

There is a strong portfolio of theoretic machine learning research which is delivering important results. There is a strong set of international collaborations both with other universities and individual researchers. The Department is committed to outreach activities and has a good record in this regard.

Weaknesses:

The focus of the Department is mainly on theoretical research and it is not clear how this will translate into impact on other researchers, particularly in more applied areas. There is no clear strategy in this regard. The publications presented to Phase I and the overall set of outputs could be better. There seems to be a lack of coordination and cooperation between this Department and other teams and subteams within UTIA which are conducting related research or research in the general area of AI.

Opportunities:

Further developing some lines of research could lead to important results in some areas which could be quite influential. There is a substantial body of research in the general area of AI within the Institute of Computer Science and in the Institute of Information Theory and Automation; coordination of the research in this area could lead to a more substantial and effective program of research. The age profile in the Department means that there may be an opportunity to appoint some talented mid-career academics in the near future.

Threats:

The strong demand for skills in AI and machine learning may make it difficult to appoint and retain good researchers. The age profile of the Department means that some experienced researchers may end their careers soon.

Main criterion: 1. Quality of results (H1.1-H1.5)

H1.1	Quality of selected outputs of Phase I								
The team achieved the following distribution of ratings <table border="0" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 25%;">1</td> <td style="width: 25%;">2</td> <td style="width: 25%;">3</td> <td style="width: 25%;">1 or 2</td> </tr> <tr> <td>11,8%</td> <td>41,2%</td> <td>41,2%</td> <td>52,9%</td> </tr> </table> 1 „world leading“, 2 „internationally excellent“, 3 „recognized internationally“ The quality of the Phase I outputs is a little below the comparable departments within the Institutes. In particular the number of level 1 and 2 outputs (particular level 1) is not as good as it could be. The number of outputs achieving impact in high-quality journals is low.		1	2	3	1 or 2	11,8%	41,2%	41,2%	52,9%
1	2	3	1 or 2						
11,8%	41,2%	41,2%	52,9%						
H1.2	Contribution of workers on the outputs reached								
The number of authors in the outputs is typically small (1,2 or 3) and so the contribution of the researchers in the Department to the work is highly significant.									
H1.3	Quality of all outputs and results								
There are few outputs published in the top-level outlets, although the bibliometric data is not so significant for computer science. The number of papers in unranked journals is quite large (nearly 60%) and, while there are some papers in mid-level conferences, there are no papers in the top-level machine learning conferences.									
H1.4	The most valuable discoveries and findings in the fields, their importance for the field								

<p>The work on the approximation capacity and complexity of shallow neural networks is of some significance. It has theoretical importance and, if it can be further developed to understand deeper networks, could have a significant impact on a large community of AI researchers.</p> <p>Automatic architecture selection for neural networks is an area which is getting increasing attention, and the evolutionary approach studied in the Department has important applications in this area.</p> <p>The work on high-dimensional data analysis (both using copulas and boolean factor analysis) is also of some significance.</p>	
H1.5	Contribution of the participation of the authors in large collaborations
<p>Members of the team are involved in two national collaborations (FERMILAB-CZ and the Cybernetics and AI centre), which has led to some significant outputs.</p>	

Main criterion: 2. Societal relevance (H2.1-H2.5)

H2.1	Societal relevance of outputs and results pursuant to CAS and institute mission
<p>Much of the Department's work is theoretical, and the path from this work to applications in machine learning (and hence of societal relevance) is not made clear. The work is important but the impact of this work is not well established at the moment. There is a smaller amount of applied work but this does not seem strongly connected to the main lines of research.</p> <p>There is some excellent outreach and collaborative work which has much larger societal relevance which utilizes the team's subject expertise rather than their research results.</p>	
H2.2	System functionality for knowledge transfer into practise, its usefulness for society. The impact of the team's activity on proper practice in society in the area of social sciences and humanities
<p>Knowledge transfer is brought about by participation in research centres and individual sponsored grants. There is little information about these activities.</p>	
H2.3	Relation to practice
<p>The work is mainly theoretical. This can influence practice if the work feeds through to more practical research, but it is not clear to what extent this is happening.</p>	
H2.4	Participation in AV21 strategy
<p>There is no mention of AV21.</p>	
H2.5	Cooperation with regions of the Czech Republic
<p>No activity in this field is documented.</p>	

Further criterion: 1. Position in international and national context (D1.1-D1.3)

D1.1	Comparison of the team with similar international and national institutes
<p>The team is dynamic, created only in 2017 as a result of reorganization of the institute. All this considered, the team compares favourably to similar units by establishing a decent research record and having the right dynamics of the development. The spectrum of research interests seems a bit narrow and the capacity of the team of this size is limited in the area where a lot of research is application driven. This and the lack of instant access to the top computing facilities may limit its chances to compete with the top players in the field but with a proper structure of research expertise it may assure respectable international status.</p>	
D1.2	Scope and quality of international and national cooperation and the role of the team in such cooperation; engagement in broad international cooperation
<p>The team established collaboration with the following units: <i>Leibniz Institute for Catalysis, Rostock, Germany, National Academy of Sciences of Ukraine, Science and Technology Center in Ukraine</i>, and <i>Fermilab, Chicago, Illinois, USA</i>. Moreover, individual members of the team have collaborated with international researchers. The outcome of these collaborations was not sufficiently elaborated to assess how valuable they are for the team and its future. From the conversation with the team it could be inferred that the collaboration with Fermilab is particularly cherished and has potential to result in valuable research results, details on this are missing in the report.</p>	
D1.3	Participation of the workers in scientific community activities (organizing of conferences and workshops, invited lectures, awards)
<p>Organization of the conferences is well documented and is at an appropriate level. The field of machine learning is driven by the research communicated at the key conferences. The activity on such events has to be established to increase visibility of the team.</p>	

Further criterion: 2. Vitality, sustainability and strategy (D2.1-D2.9)

D2.1	Direction in line with the perspective of the planned research directions
<p>This is a young unit that needs to settle down in the area that by its nature is rapidly changing in its scope. In some sense it justifies why the strategy of future development presented by the team is ambitious but rather chaotic. The key to the stability and ability to follow most promising research directions is acquiring prominent and experienced researchers that have a good overview of the field. Finding such recruitment prospects may be a challenging task due to enormous competition in the field. The strategy drawn at the institute level is needed in order to succeed in this challenge. Overall the vision that is presented by the team is adequate and points at the right directions.</p>	
D2.2	Assessment of the previous research objectives and their achievement
<p>Not applicable, the team did not exist during the previous evaluation period.</p>	
D2.3	Assessment of implementation of recommendations from past evaluation
<p>Not applicable, the team did not exist during the previous evaluation period.</p>	
D2.4	Success in receiving grants

While there is evidence of several grants received by the teams, the scope of the grants, amount of funding, the shared international vs. national grants, and the role of the funding in financing the team is not sufficiently elaborated. Nevertheless, it seems that the team is active in collaboration with diverse partners both on research and on applications.	
D2.5	Adequacy of instrumental equipment
While the computational capacity is crucial for the field of machine learning, very little is mentioned about it in the report and the attitude during the meeting toward advanced computing facilities was not on par with what a machine-learning unit should represent. On the other hand, there are more than 3 full-time equivalents of additional workers which is a relatively large support group. The relation of the staff to the computing facilities and the needs of the team in this respect should be addressed much better.	
D2.6	Effectiveness of management
The management of the team seems to be efficient although the issues mentioned in D2.5 should be taken care in a more explicit manner.	
D2.7	Assessment of professional structure, development strategy and the strategy of keeping best scientists, age structure, career and qualification growth
The professional structure at the moment is representing a newly created unit and the dynamics is good, with a noticeable increase of the personnel, and Ph.D. students. However, there are evident worries about the ability to replace the senior retiring researchers as well as bring new researchers to the institute. The team is aware of this and has a strategic plan for recruitment. However, it is not clear how realistic this plan is. In particular, giving up on applications of machine learning because one cannot compete with the industry for the talent may lead to irrelevant research directions in the field that the applicability is often the main criterion of the value. There is a need for the institute or even CAS to step in to discuss the recruitment competition problem.	
D2.8	Creating work-life balance conditions, assessment of approach towards possible gender issues
It is hard to assess given that no criteria or standards are provided. The department is dominated by male researchers but so are essentially all other departments.	
D2.9	Relation of the team with regard to the integration, development and sustainability of the research centre funded by the National Programme of Sustainability II.
Not relevant.	

Further criterion: 3. Cooperation with universities and participation in education (D3.1-D3.6)

D3.1	Scope of cooperation with universities on national and international level
The cooperation is essentially only with the two main universities in Prague. The collaboration is only at the master level education. Some of the members teach an unreasonable amount of master level courses: 40 courses over the period of five years? The teaching effort at the Ph.D. level is missing.	
D3.2	Effectiveness of joint research centres
The team actively participate in activities of <i>The Karel Čapek Centre for Values in Science and Technology</i> . The centre seems to be more of popularizing and outreach character. It is	

not clear what is the effect of the centre on the research level in the team. A general impression is that the Centres does not result in enhancement of research capacities and were mentioned reluctantly during the conversations and meetings.	
D3.3	Success rate in supervision of PhD students
For the just created unit with the two current Ph.D. students and six defended overall, it is hard to assess. The reported competition from the industry seems to be the major problem to keep the talent on the skimpy Ph.D. salaries.	
D3.4	Participation of PhD students in the outputs
The participation is well-documented and adequate.	
D3.5	Participation of the team in master or bachelor studies
Nineteen Master theses and seven Bachelor theses show the interest in the field. It will be only growing in the future.	
D3.6	Assessment of cooperation intensity with universities in the form of teaching
The cooperation at the master level is very good, on bachelor and Ph.D. levels is inadequate. There is a need of creating a flow of talent from the master level to the Ph.D. level with active participation of the team at the Ph.D. level.	

Further criterion: 4. Outreach activities (D4.1-D4.3)

D4.1	Sufficiency of media strategy and activities in the area of research popularisation
The team seems to be very active in popularizing its field as well as broadly understood data science that also include statistics.	
D4.2	Publishing activities and its quality
Three articles, one published lecture, and a chapter in a book all popularizing data science and/or machine learning.	
D4.3	Participation in professional organisations in the area of research and development
The team members are active members in professional organizations, editorial boards, etc. thus the participation is at a good level.	

Other comments of the commission:

4. Department of Statistical Modelling

Strengths: The department has a strong applied and interdisciplinary research component. This interdisciplinary profile seems to help to secure external funding. The team has a clear vision of its future. Considering a very short time of its existence, this vision sets a clear path to create a stable and diverse team in the broadly understood data science field.

Weaknesses: The team is small for the research range it aims at. It has been established recently mostly from the former biostatistics group but the currently reported research spectrum is very broad and clearly exceeds the current capacity of the team. The publication record is very biased towards project driven publications with multiple authorship and lacks fundamental contribution to statistical methodology.

Opportunities: The team may benefit from the interdisciplinary research, especially in bioscience and from expansion of the basic research component. There are a number of ambitious collaborative projects mentioned in the future activity plan for the team.

Threats: Building a strong team in statistical modeling that have both basic and interdisciplinary research components requires a success in competitive recruitment with a little margin for error. Increasing the number of Ph.D. students may be a challenge considering the competition from the industry. The biggest threat may come from the dominance interdisciplinary project driven research and the ensuing lack of fundamental research.

Main criterion: 1. Quality of results (H1.1-H1.5)

H1.1	Quality of selected outputs of Phase I								
<p>The team achieved the following distribution of ratings</p> <table> <tr> <td>1</td> <td>2</td> <td>3</td> <td>1 or 2</td> </tr> <tr> <td>13,3%</td> <td>33,3%</td> <td>40,0%</td> <td>46,7%</td> </tr> </table> <p>1 „world leading“, 2 „internationally excellent“, 3 „recognized internationally“</p> <p>The outputs are mostly interdisciplinary with multiple authorships (typically exceeding three authors). There is the lack of publications in the top statistical/data science journals with most of the publications being in other fields. The quality of these journals is rather good.</p>		1	2	3	1 or 2	13,3%	33,3%	40,0%	46,7%
1	2	3	1 or 2						
13,3%	33,3%	40,0%	46,7%						
H1.2	Contribution of workers on the outputs reached								
<p>The contribution is significant although it is difficult to assess it precisely due to a large number of authors per paper.</p>									
H1.3	Quality of all outputs and results								
<p>Overall quality is decent although there is evident lack of methodological results. Many of the interdisciplinary publications have contributions only to empirical data analysis. Some of the outputs are only unpublished reports or publications in proceedings of a conference. Since the department is set only in 2017, this profile of output is understandable but in the future more fundamental works should be considered.</p>									
H1.4	The most valuable discoveries and findings in the fields, their importance for the field								
<p>The team lacks breakthrough research results but there are several important contributions that may have a lasting effect in statistical methodology: new methods of estimation of the</p>									

tail index, new characteristics of the centre of a continuous distribution, plus some interdisciplinary research results that may affect other fields of research.

H1.5 Contribution of the participation of the authors in large collaborations

There are a lot of papers published with multiple authorships. In these publications, the team members mostly contributed to empirical data analysis and designing statistical models for the data. These contributions are significant and important although they have only an ancillary role.

Main criterion: 2. Societal relevance (H2.1-H2.5)

H2.1 Societal relevance of outputs and results pursuant to CAS and institute mission

Societal relevance of outputs is quite high due to the interdisciplinary and applied character of the research. There is a lack of modern computational techniques in the current research focus, which to some extent contradicts the mission of the institute which promotes computing and numerical methods. There is also a lack of the basic research component that is an integral part of CAS. However, the current seems to be aware of this and has ambition to build this component into the department.

H2.2 System functionality for knowledge transfer into practise, its usefulness for society. The impact of the team’s activity on proper practice in society in the area of social sciences and humanities

The team is heavily engaged in a programme focussed on research for practice and participates in many interdisciplinary projects: Statistical modelling for the Czech Ministry of Finance, Calibration of numerical weather forecasting models, Statistical methods for vibrodiagnostics (nuclear power plants), Modelling uncertainty in thermodynamic calculations, applications in Energy, Detection of defects in the gas pipeline operated by NET4GAS, Statistical methods for psychometric analysis of behavioural measurements. The last project may have an impact for education research and practical consequences for educators.

H2.3 Relation to practice

Most of the interdisciplinary research is close to real applications and should have a direct practical impact.

H2.4 Participation in AV21 strategy

Participation in AV21 strategy, programmes 1-4, has been explicitly mentioned by the team in its report and during the meetings. Perhaps, the connection to the AV21 strategy should be enhanced and made more visible in the presentation of both the team and the institute as a whole.

H2.5 Cooperation with regions of the Czech Republic

This aspect was not elaborated in the report. There seems to be some collaboration established with Masaryk University, Brno, where some lecturing was done by a member of the team.

Further criterion: 1. Position in international and national context (D1.1-D1.3)

D1.1	Comparison of the team with similar international and national institutes
The team carries out high quality research on several different subfields mainly working in quite interdisciplinary contexts. The team can be considered as outstanding compared to similar teams both nationally and internationally.	
D1.2	Scope and quality of international and national cooperation and the role of the team in such cooperation; engagement in broad international cooperation
The team has documented a number of initiatives related to international collaborations of different kinds with different universities and research centres worldwide including some top centres as the one in the University of Washington or the Max Planck Institute in Germany.	
D1.3	Participation of the workers in scientific community activities (organizing of conferences and workshops, invited lectures, awards)
Several members of the team regularly participate in scientific activities. In particular, membership to scientific societies as ISBC, organization of conferences and workshops and invited lectures. Several different scientific awards have also been obtained by some researchers of the team.	

Further criterion: 2. Vitality, sustainability and strategy (D2.1-D2.9)

D2.1	Direction in line with the perspective of the planned research directions
The team has suffered a recent reorganization at the institute level and several of its research lines are still converging. It looks that the intention of the team is to concentrate on some of them while carrying on collaborating on a wide spectrum of other scientific disciplines.	
D2.2	Assessment of the previous research objectives and their achievement
The team considers that all previous objectives and plans have been fulfilled given its current context and size.	
D2.3	Assessment of implementation of recommendations from past evaluation
As previous recommendations correspond to a different team this is difficult to answer. Nevertheless, the team has concentrated on basic statistical methodology and has increased efforts towards international cooperation and grant application.	
D2.4	Success in receiving grants
Several grants have been obtained. Worth mentioning is the 2-year Fulbright Masaryk fellowship. But a team of this size with this paper acceptance rate should be capable of obtaining a significantly higher number of grants of different kinds.	
D2.5	Adequacy of instrumental equipment
No special equipment is required of the kind of research the team develops.	
D2.6	Effectiveness of management

It looks that the institute has a knowledge transfer unit for this. Nevertheless, it looks that the kind of research activity of the team does not need much management.	
D2.7	Assessment of professional structure, development strategy and the strategy of keeping best scientists, age structure, career and qualification growth
The team has an adequate size but the age spectrum is slightly biased towards older scientists. The number of PhD students (2) looks very poor. And it seems that the team is not very capable of retaining or attracting enough young talent.	
D2.8	Creating work-life balance conditions, assessment of approach towards possible gender issues
Not relevant for the team, see Institute report.	
D2.9	Relation of the team with regard to the integration, development and sustainability of the research centre funded by the National Programme of Sustainability II.
Not relevant.	

Further criterion: 3. Cooperation with universities and participation in education (D3.1-D3.6)

D3.1	Scope of cooperation with universities on national and international level
The team presents a large number of collaborations with neighbouring and international universities that include teaching and research.	
D3.2	Effectiveness of joint research centres
According to the documentation, none of the external scientific collaborations is carried out under joint research centres.	
D3.3	Success rate in supervision of PhD students
Only 1 PhD thesis has been defended in the evaluated period (along with 2 MSc ones). This is a very poor number for a team of this level and size.	
D3.4	Participation of PhD students in the outputs
The 2 PhD in the team were employed full time by the institute and fully participated in several outputs. There were other students partially involved in some outputs.	
D3.5	Participation of the team in master or bachelor studies
Some members of the team participate in teaching and theses advising at master level.	
D3.6	Assessment of cooperation intensity with universities in the form of teaching
The team teaches advanced subjects at neighbouring universities. But according to the current number of theses defended they do not have much success attracting students.	

Further criterion: 4. Outreach activities (D4.1-D4.3)

D4.1	Sufficiency of media strategy and activities in the area of research popularisation
The team reports a number of different outreach activities mainly related to open doors or dissemination at their own and other neighbouring institutions.	
D4.2	Publishing activities and its quality
No activities related to publication are reported.	
D4.3	Participation in professional organisations in the area of research and development
Activities related to professional organizations are not mentioned in the documentation.	

Other comments of the commission: The team needs time to define itself better considering that it was created only in 2017.

5. Department of Complex Systems

Strengths:

A strong team with a good international profile working in a rapidly emerging field, with many interdisciplinary themes, and in particular strengths in climate modelling and computational neuroscience. Relatively youthful age profile. Excellent publication record.

Weaknesses:

Difficulties in securing long term funding to stabilise the team. Low numbers of PhD students. Some of the research topics pursued by the team, and in particular climate modeling, depend critically on the availability of high-performance computing resources. The ability to make internationally leading research contributions in these fields might be improved if the team developed additional competences in high-performance computing and gained access to supercomputers.

Opportunities:

This type of research opens up many potential interdisciplinary research opportunities, both within CAS, the Czech Republic and internationally. Its interdisciplinarity means that there is no shortage of potential project partners both nationally and internationally. There is the potential to co-author publications in the highest level science journals, and facilitate fundamental discoveries.

Threats:

Failure to secure stable funding. Departure of key staff. The team, as well as the institute lack a strategy of how to access and exploit high performance computing technology to its best advantage. This may prove a limitation for making leading edge research impact in the future.

Main criterion: 1. Quality of results (H1.1-H1.5)

H1.1	Quality of selected outputs of Phase I
The team achieved the following distribution of ratings 1 2 3 1 or 2 20,0% 50,0% 25,0% 70,0% 1 „world leading“, 2 „internationally excellent“, 3 „recognized internationally“ The overall quality is high, with 70% in quality levels 1 and 2, making this one of the strongest teams in the computer science area. Notable papers in Phys Rev Lett, Scientific Reports and Nature Neuroscience.	
H1.2	Contribution of workers on the outputs reached
The strongest outputs appear to have been led by members of the team, with particularly strong contributions from Palus in the climate modelling area and Hlinka in computational neuroscience.	
H1.3	Quality of all outputs and results

Overall the team appears to have a selective publications policy targeting high quality publication outlets, and in particular reporting interdisciplinary findings in appropriate cross disciplinary high visibility publication venues.	
H1.4	The most valuable discoveries and findings in the fields, their importance for the field
New approaches to climate dynamics and urban micro-climate analysis, and understanding neuronal signals and their role in epilepsy. Work with AVAST on cybersecurity.	
H1.5	Contribution of the participation of the authors in large collaborations
There are no large collaborations in the sense of category “D”.	

Main criterion: 2. Societal relevance (H2.1-H2.5)

H2.1	Societal relevance of outputs and results pursuant to CAS and institute mission
The climate modelling and analysis has major societal relevance, and in particular the work on urban microclimate analysis has strong local relevance. The work on understanding neuronal signals in epilepsy has important clinical relevance.	
H2.2	System functionality for knowledge transfer into practise, its usefulness for society. The impact of the team’s activity on proper practice in society in the area of social sciences and humanities
Progressing well given that the team is recently established.	
H2.3	Relation to practice
Work is well grounded in practical real-world problems.	
H2.4	Participation in AV21 strategy
No mention in documentation provided.	
H2.5	Cooperation with regions of the Czech Republic
No cooperation with regions is documented. However, there is a fruitful cooperation with the Prague Municipality and the Prague Institute of Development and Planning.	

Further criterion: 1. Position in international and national context (D1.1-D1.3)

D1.1	Comparison of the team with similar international and national institutes
The Department is nationally leading and comparable internationally with the best teams working in the area of complex systems.	
D1.2	Scope and quality of international and national cooperation and the role of the team in such cooperation; engagement in broad international cooperation
The level of national and international cooperation is very high. More than half of the journal outputs are international collaborations, and half national collaboration. There is extensive involvement in internationally collaborative grants and research programs.	

D1.3	Participation of the workers in scientific community activities (organizing of conferences and workshops, invited lectures, awards)
The activities here are good, a number of focussed workshops have been awarded. Paluš received the CAS academic prize and has a number of keynote and invited talks. Geletič received the Josef Hlávka Award. The activity is centred around a small number of researchers.	

Further criterion: 2. Vitality, sustainability and strategy (D2.1-D2.9)

D2.1	Direction in line with the perspective of the planned research directions
There is an exciting plan for the future research direction of the Department.	
D2.2	Assessment of the previous research objectives and their achievement
There was a reorganization of the team in 2017 which led to some changes in research direction. The goals for the last period were largely achieved, with some excellent research carried out.	
D2.3	Assessment of implementation of recommendations from past evaluation
Seven recommendations were given in the past evaluation. All of these recommendations have been implemented successfully.	
D2.4	Success in receiving grants
Limited information is available on the grants, but there have been a significant number of successes.	
D2.5	Adequacy of instrumental equipment
Not relevant.	
D2.6	Effectiveness of management
The management of the Department is impressive. The senior members of the team have a good understanding of the national and international context and a clear and effective plan for the Department.	
D2.7	Assessment of professional structure, development strategy and the strategy of keeping best scientists, age structure, career and qualification growth
The age profile is good and engenders a vital research culture. This seems to be a magnet for attracting high quality research talent, with a healthy churn of staff.	
D2.8	Creating work-life balance conditions, assessment of approach towards possible gender issues
This is dictated by the overall Institute policies, and the team itself does not appear to augment these with any of its own.	
D2.9	Relation of the team with regard to the integration, development and sustainability of the research centre funded by the National Programme of Sustainability II.
Not relevant.	

Further criterion: 3. Cooperation with universities and participation in education (D3.1-D3.6)

D3.1	Scope of cooperation with universities on national and international level
There is a significant level of cooperation through joint research projects and publications, both nationally and internationally. The level of involvement in joint research centres is less, and this could be increased.	
D3.2	Effectiveness of joint research centres
Not relevant.	
D3.3	Success rate in supervision of PhD students
The number of PhD students qualified by the Department in the period is low (just 2 in the period) and the Department should work to increase this.	
D3.4	Participation of PhD students in the outputs
The Department reports that 70% of journal outputs included a PhD student as co-author (40% for students employed in the Department). This is an excellent outcome.	
D3.5	Participation of the team in master or bachelor studies
16 Bachelor theses and 3 Masters theses were defended in the period.	
D3.6	Assessment of cooperation intensity with universities in the form of teaching
A significant number of courses were given across a wide range of topics. The cooperation with Universities looks excellent.	

Further criterion: 4. Outreach activities (D4.1-D4.3)

D4.1	Sufficiency of media strategy and activities in the area of research popularisation
There is an excellent portfolio of outreach activities, including television appearances, newspaper and public lectures. This is commendable.	
D4.2	Publishing activities and its quality
The team is involved with a number of international journals through editorial board associations. They do not run or sponsor their own publication outlets.	
D4.3	Participation in professional organisations in the area of research and development
There is nothing exceptional to note.	

Other comments of the commission:

The team should consider the possibility of using high performance computing resources available at IT4 in Ostrava for the climate modelling and neuroscience work.

Final report was elaborated by:

Commission 1 - Mathematics and computer sciences

Evaluated teams No.: 1, 2, 3, 4, 5

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