

Evaluation of the Research and Professional Activity of the Institutes of the Czech Academy of Sciences (CAS) for the period 2010–2014

Final Report on the Evaluation of the Institute

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

Fields, in which the Institute registered its teams:

Computer and information sciences

Observer representing the Academy Council of the CAS: Jan Šafanda

Observer representing the Institute: Július Štuller, substitute observer Diana Piguet

Commission No. 2: Computer and information sciences

Chair: Professor Edwin Hancock PhD, DSc.

Date(s) of the visit of the Institute: November 23, 2015

Programme of the visit of the Institute: see attached Minutes from the visit

Evaluated research teams:

No. 2 - Department of Theoretical Computer Science;

No. 3 - Department of Nonlinear Modelling;

No. 4 - Department of Medical Informatics and Biostatistics;

No. 5 - Department of Nonlinear Dynamics and Complex Systems;

No. 6 - Department of Optimization and Systems;

No. 7 - Department of Fundamental Topics

A. Evaluation of the Institute as a whole

1. Introduction

The institute mission is stated as solving open and fundamental problems in computer science. In this respect it has a number of seminal achievements, particularly in the areas of logic and randomised algorithms.

The institute has recently addressed structural problems, particularly with respect to age. The director seems well equipped for this role, having a background in management consultancy as well as mathematical logic. As a result there has been a recent re-organisation and rationalisation of research groups. It was hard to get a sense of institutional research ethos following this re-organisation. Moreover, the current groups are not particularly representative of Computer Science as a discipline, and seemed to have evolved rather than being created in response to a strategic plan. From Phase 1 of the evaluation, the output quality of the six groups we examined was highly variable. For instance the best group had more than 75% in two top categories (i.e. 1+2), whereas the weakest group has less than 15%.

2. Strengths and Opportunities

The Institute has some excellent groups, which are internationally leading in their areas of expertise. There are good opportunities for synergy both with other groups inside CAS and within the group of national universities. The Institute is successful in attracting grants from a variety of sources. The staff of the institute are engaged in an extensive range of pedagogic activities in Czech universities. There is also a substantial amount of schools outreach via classroom activities and more general science popularisation via TV, radio and other media.

3. Weaknesses and Threats

Both low salaries and the difficulty in recruiting research students, are recurring problems for the different groups. The former affects the ability of the Institute to recruit overseas staff, and retain the best national staff. Although the institute's groups cover a wide set of research interests, they are to some extent complementary and coherent in their coverage. However, the groups are not ideally positioned to respond in an agile way to recent developments in computer science, and taken as a whole CAS's portfolio of activities omits important areas of computer science which are potentially both economically and strategically important. Moreover, the Institute does not appear to have a strategy for developing new research areas or creating new groups, and there appears to be no set of priorities for doing so. Finally, although pedagogical activities and outreach are strong, there are relatively few examples of the impacts of its research commercially (economic), on policy making or on the quality of life.

4. Recommendations

That the Institute incorporates into its strategy a set of priority areas where it would hope to develop research strength if the opportunity presents itself, and considers ways of facilitating the development with existing resources (e.g. through retirement or redeployment of staff) or new or external funding. The institute needs to investigate why the quality of

research outputs is so variable across groups. There need to be substantial mitigations for this, or the weaker groups need to develop publication strategies aimed at achieving more world leading and internationally excellent publications. The institute should consider having a strategy to encourage these commercial, policy making and quality of life impacts from its research, and proactively encourage the development of routes to impact if opportunities present themselves.

5. Detailed evaluations

Declaration on the quality of the results and share in their acquisition. The quality of the outputs is quite variable over the groups in the institute. For instance, if one looks at the fraction of outputs in the quality profile that are world-leading or internationally-excellent, then four groups have substantially more than 50% in the top two categories, while for three groups (Medical Informatics, Nonlinear Modelling and Fundamental Topics) the fraction is significantly less than 50%.

Declaration on the involvement of students in research: A number of students at all levels are involved in the research. The number of completed theses is 23 for Bachelor, 67 for Master, and 20 for PhD. The PhD students are very satisfied with the environment provided. They receive a very good amount of personal attention from supervisors and there are sufficient funds to support presentation of their results at conferences. Several of the teams report that they find it difficult to recruit the best PhD students as the teams do not have direct access to potential candidates at universities. The teams try to recruit PhD students via their teaching activities at universities, but this is only partially successful and they would have capacity to take on additional strong students.

Declaration on societal relevance: This is variable. Several of the teams focus on basic research and so the main impact is on academia. However, there are also a number of good examples of societal impact, such as the substantial range of contractual research (e.g. in relation to weather forecasting) in Nonlinear Modelling or the collaboration with Avast software (where research results have found their way into widely used anti-virus software) in Nonlinear Dynamic and Complex Systems. The Department of Theoretical Computer Science also reported the case of a discovery in 2008 (regarding detection of statistical dependence in random number generators) that has found use in the financial sector in investment banking. The teams are involved in a good number of educational activities at different universities and teach a number of courses. The Institute also maintains a well-stocked library that is well used by internal and external users (e.g. via inter-library loans). The Institute is also involved in a substantial number of outreach and research popularization activities, e.g. participating in the “100 scientists to high schools” project and providing the MEDARD system for weather and air pollution forecasting.

Declaration on the position in the international and national context: This is variable. Historically, some results of seminal importance have been obtained by staff associated with the institute, e.g. in graph theory and logic. Recent results also have the potential to have significant scientific impact. However, other groups operate at an essentially national level, and there is scope for improving their profile through higher level publications and enhanced international collaboration.

Declaration on the vitality and sustainability: This is variable, with the groups having different age profiles (with one group having a significantly older profile than the rest).

However, the age profile of the current group leaders is relatively youthful, and there are good numbers of young people in the permanent researcher roles. The main problem facing most groups is recruiting international staff with the low salary levels, and recruiting good PhD students. If the salary issue remains intractable, then one solution is to attract visitors. For one of the groups we have recommended that this be done by setting up a themed visitor centre.

Declaration on the strategy and plans for the future: The strategy seems well stated at the group level, but is left rather vague at the Institute level. It would be good, to see at least a list of shared aspirations for the future, with new potential directions identified. While there are many advantages in a bottom up approach, there need to be some meaningful overarching principles and goals to which the groups can respond in formulating their plans.

B. Evaluation of the individual teams

Evaluation of the Team No. 2: Department of Theoretical Computer Science

1. Introduction

The team is primarily engaged in theoretical research in the areas of logic and computation.

2. Strengths and Opportunities

The team has strong researchers that have obtained several significant research results, addressing fundamental issues and long-standing open problems. It has a healthy age structure and the flexibility to adapt research topics and build bridges between areas. Furthermore, the team has a strong grant record with a good spread between national and European funding, with $\frac{2}{3}$ of the overall income provided by grants. The team is involved in a number of beneficial international research collaborations. One opportunity is to build on the recently established activity in contract research with Javlin Data Solutions and explore further cooperation with businesses and expand the cooperation with Javlin. Another opportunity is to apply for structural funds to establish a visitor centre, which would help to attract leading experts to interact with the members of the team.

3. Weaknesses and Threats

While the team has produced research results of very high quality, with the majority of submitted outputs being classified as internationally excellent, the proportion of world-leading outputs is relatively small. Representation at the leading mainstream conferences in theoretical computer science and logic (e.g. STOC, FOCS, ICALP, LICS) could increase the visibility and impact of the research. Similar to other teams in the Institute, the team find it difficult to recruit PhD students, due to difficulties in getting access to students at universities and convincing them to do their PhD at CAS. This is also shown by the lack of PhD completions in the reporting period. A threat or obstacle is that salaries are not considered competitive internationally or compared to industry, making it difficult to attract researchers.

4. Recommendations

Pursue the plan of applying for funds to establish a visitor center. Cooperate with universities to apply for larger grants and to manage those grants if successful. Review publication strategy and explore options for increasing visibility and impact by targeting also some of the leading mainstream conferences in theoretical computer science to present results.

5. Detailed evaluations

Declaration on the quality of the results and share in their acquisition. The department focuses on the fields of logic and computation (theoretical computer science), and interactions between the two. Main achievements in the reporting period included the

edition of, and major contributions to, the Handbook of Mathematical Fuzzy Logic by several group members. Moreover, significant new results in the theory of computational complexity have been obtained. The total number of outputs is 117 with 53 of them included in the WS. Given an average annual personal capacity of 10.2 FTE for researchers and 3.7 for other workers, the productivity of the department can be considered satisfactory. The quality of the publications, as assessed in Phase I, is very good with a Quality Profile median value of 2 (internationally excellent) and an average of 2.3. Based on the AIS journal ranking, the quality of the publication venues, with only 4 papers appearing in a journal ranked in the upper half, could be raised though. The contribution of the team to these publications is very significant. The work of the department received a satisfactory degree of international recognition as evidenced by the number of citations.

Declaration on the involvement of students in research. Recently, five doctoral students held paid positions at the Department and thus actively participated in the main fields of the departmental research. One doctoral student was a guest of the Dept. and also participated on a related problem. Several specific involvements of the students in the research and the respective results have been reported; particularly, solving a proof theorem in cooperation of a PhD student with a team member should be mentioned. None of the PhD's has been defended so far; but one PhD dissertation has been submitted. Problems concerning difficulties with recruitment and management of doctoral students due to the necessity to share the direction of study with universities were reported.

Declaration on societal relevance. The impact of the results that are theoretical is primarily in the scientific community; it may be expected that they will be mediated to the wider society by the reported 15 application results. The members of the Department are involved in MSc or BSc courses at several main Czech universities (Charles University – 14 courses, Czech Technical University – 3 courses, Palacky University – 3 courses, Ostrava University – 3 courses, Liberec Technical University – 1 course) and at one university abroad (Vienna – 2 courses). Besides that, the Dept. members were involved in tutorials at international conferences, at a workshop and a summer school. Further, they were mentoring 2 PhD dissertations, 5 MSc theses and 3 BSc theses. No collaboration with business sector (applied research and collaboration with the application sphere) was originally reported, however, at the meeting, a new perspective contract on graph transforms was announced. Public policy decisions naturally do not seem to be directly affected by the theoretical results. Based on an EC grant, a popularization project on Conversations with Computer Professionals has been run successfully, attracting a wider qualified public response including academic dignitaries. The team members participated in the Open Days of the Institute and in the similarly oriented project of the Institute “100 researchers to high schools”.

Declaration on the position in the international and national context. The team performs predominantly internationally excellent research at a similar level as international competitors. The level of international collaborations is good with co-authors from a range of universities including Kyoto University, University of Denver, University of Melbourne and Vienna University of Technology. The team have also hosted 13 foreign visitors from 9 countries. Part of the research of the team is focused on non-standard approaches in logic and computation. This has the effect that the team has a leadership role in some its research directions (e.g. mathematical fuzzy logic). On the other hand, many internationally leading groups tend to focus more on mainstream research topics and thus have more visibility in the top conferences that cover logic and computation more broadly. The international reputation

of the team is strong as shown by editorial positions in very good journals, edited special issues, program committee memberships of good international conferences, and organisation of workshops and special sessions: Four thematic special issues in international journals have been edited by the Department members, one book has been co-edited by the team members. Numerous memberships (~14) in programme committees of international conferences and workshops were reported. The Dept. organised one international conference and several workshops; further there were memberships in the evaluation panel of the Czech Grant Agency, in the council of a respective Czech scientific society and in the supervisory board of another AVCR institute. The team members are frequent reviewers in numerous journals and conferences in the field; also members of boards for several PhD studies at universities. The team has been able to attract one foreign scientist, three foreign post-docs and one foreign PhD student. On the national level, the team holds a good position among the groups in logic and computation. Additional collaboration with other teams within CAS or with strong groups at universities might benefit the team.

Declaration on the vitality and sustainability. The team consists of strong researchers and has a healthy age structure, with a majority of young researchers (age 25-45) and also researchers at higher levels of seniority. Involvement of foreign researchers, post-docs and PhD students is appropriate, and there is a good number of foreign visitors. Recruitment of PhD students appears to be somewhat difficult as the team does not have direct access to students at universities and some of the research topics may not be the most attractive for students. The team is well funded with $\frac{2}{3}$ of its income from grants (with a good mix of European and national funding), and makes effective use of its resources to produce excellent research. The management structures appear appropriate.

Declaration on the strategy and plans for the future. The team plans to broaden its research into new areas (especially finite model theory and graph theory) while maintaining research in the areas where it has an established track record. This appears to be an appropriate direction, as these new areas link nicely to the existing strengths. The team also plans to apply for joint grants with foreign institutions and for structural funds together with university partners, and for a Computer Science visitor centre following the example of e.g. the Isaac Newton Institute for Mathematical Sciences. These appear to be good opportunities, and the strategy aiming to exploit these opportunities is appropriate. One hopes that capacity limitations will not prevent the team from pursuing all of these opportunities. Together with the broadening of the research agenda, it would seem beneficial to aim to increase visibility and impact of the research by targeting also the leading conferences in the general areas of logic and theoretical computer science.

Evaluation of the Team No. 3: Department of Nonlinear Modelling

1. Introduction

The primary focus of the team is on modeling atmospheric phenomena, energy production and consumption, and traffic flow.

2. Strengths and Opportunities

The team demonstrates capability of solving practical tasks requiring know-how from different disciplines, not only from computer science. The research in environmental informatics, in particular the work in air pollution and energy forecasting has very high

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potential as fields of growing importance and as topics of rapidly increasing public awareness. (The new Paris Agreement on climate change emphasises this dramatically).
The institute has solid international contacts.

3. Weaknesses and Threats

Some work of the team could be better interfaced with the international research community in the field of environmental modeling and simulation, especially since the team in itself may not be large enough to remain competitive in the full breadth of its research field. Though the team has already participated in several international projects, obtaining such projects is increasingly becoming more and more difficult, so alternative ways of funding must also be considered. Some of the research topics, in particular those that can have a maximal impact, will in the future increasingly require access to advanced high performance computing technology and the corresponding human expertise. This lacking, the work may fall behind the state of the art.

4. Recommendations

The current research of the team is multidisciplinary. However, teams of Institute of Computer Science should still consider the area of informatics as the primary domain. This should also better reflect the publication platform of the future.

5. Detailed evaluations

Declaration on the quality of the results and share in their acquisition. The work of the department focused on the interdisciplinary field of environmental informatics with a special emphasis on the modeling of atmospheric phenomena, energy consumption and production, and traffic flow. The most important achievements include novel results on photovoltaic power modeling and prediction, and on data assimilation in atmospheric modeling for the purpose of improving forecast accuracy. The total number of outputs is 122 with 37 of them included in the WS. Given an average annual personal capacity of 7.4 FTE for researchers and 4.1 for other workers, the productivity of the department can be considered good. The quality of the publications, as assessed in Phase I, is good with a Quality Profile median value of 3 (recognized internationally) and an average of 2.73. Based on the AIS journal ranking, the quality of the publication venues is good as well with 15 papers appearing in a journal that is ranked in the upper half. Because very few publications were submitted to the CS Panel in Phase I, it is not possible to make a general statement about how significantly the team contributed to their publications. The work of the department received a good degree of international recognition as evidenced by the number of citations.

Declaration on the involvement of students in research. The MSc and particularly PhD students are encouraged to participate in the team research, in which the suitable themes are sought by the team members. So far, two PhD dissertations have been defended.

Declaration on societal relevance. Modelling using mass data is obviously one of the themes the importance of which is publicly understood and evaluated, namely in daily-life occasions like providing weather, traffic, energy distribution etc. forecasts. This way, the results may have obvious impact on many aspects of life.

Several team members are teaching at some important universities: Czech Technical university – 3 courses, Charles university – 8 courses, Masaryk university – 1 course.

Occasionally, they offer lectures and tutorials also for other other universities and institutions, including institutes of the Czech Academy of Sciences. One BSc and one MSc thesis were supervised, besides 4 PhD dissertations.

The team had several important contractual projects with industry - 6 concerning the weather forecast and 5 the area of energy distribution modelling. The importance of this collaboration is obvious from the related total amount 601 kEUR.

The research results in weather forecasts, energy distribution modelling / forecasts and traffic modelling obviously may influence public policy decisions.

The team members provide reviewing of the applications to the Czech Grant Agencies, Austrian Science Fund, Office of scientific Research Italy. They are also regularly involved in reviewing papers submitted to scientific journals. There is one membership in the Editorial Board of international journal. In several cases, the team members were opponents in professor and associate professor promotion processing and members of the respective committees. One team member participates in the Space Activities Board of a Czech Ministry.

Important activity that goes beyond the mere scientific area is the work on weather forecasting algorithms and running the respective real-time Internet page publicly available, which popularizes the science perhaps better than specific popularisation activities. The team members regularly participate in the Institute popularisation activities "Open door day", "Science in streets", "Week of science and technology" and provided also lectures in frame of the "100 scientists to high schools" activity.

Declaration on the position in the international and national context. The team seems to be aware of importance of international contacts and tries to capitalize mainly on participation in EU COST programs and subcontracting from European Space Agency. Though this is important, some major international projects, within for example Horizon 2020 are still missing. Assuming the declared fact that the primary objective is on Environmental Informatics, the major publication platform of this research domain and the spectrum of reported conference and journal papers have very little overlap. The future objectives should be to try report results in platforms with the highest international reputation, preferably in area of computer science. As the team is relatively small, it does not seem to be realistic to play a managerial international leading position. However, they should join the main streams internationally, and achieve high quality results in specialized domains. In this respect, the Big-Data framework is certainly an important though extremely broad direction. Suggested dimensionality reduction and uncertainty quantization research topics certainly belong to this stream, though the team does not demonstrate a strong reputation in this respect. Besides, these topics in informatics usually go together with the scalability and high performance computing issues, which should also be considered.

Declaration on the vitality and sustainability. The team seems to be sustainable, building mainly on 7 researchers and two senior researchers. This staff is suitably complemented by postdocs and collaborating students. Important is also cooperation with prof. Jan Mandel from Colorado, Denver. As the activity of the group is also connected quite well with practical applications, it attracts students and young generation in general. The applicability looks also quite important (useful) when searching for funding. To improve the scientific level of the group, more grants of basic research funding, such as GACR, would be convenient. The management strategy of the group is to participate by a specialized expertise in more projects rather than to integrate resources to organization a single large project. Considering the size of the group, it seems to be a reasonable strategy which might also work in the coming years. However, it might also be a bit restrictive in achieving more significant results.

Declaration on the strategy and plans for the future. The strategy for the future reflects the general situation in the management of contemporary data – increasing number and complexity resulting in utilization of non-conventional data types. Such problems are a part of the well-known and now often abused term of Big-Data. However, when taken seriously and recognizing that only concise models make data useful, it offers a long list of relevant and challenging research topics for computer science. Dimensionality reduction and uncertainty management certainly belong to the positive cases. It also requires the development of new statistical and data mining methods, as well as computational models of the processes behind the data. These are necessary for the management and interpretation of such data, for data assimilation techniques and data interpretation e.g. in the form of inverse modeling. In any case, scalable algorithms using suitable high performance computing systems are able to process large volume of data in real time and/or processing many requests simultaneously are necessary. This is certainly a relevant research issue, which would, however, require a partial change of activities of the group, and which might even put in question the vague name “Nonlinear Modelling” of the department. Probably, something more specific could better characterize activities of the group.

Evaluation of the Team No. 4: Department of Medical Informatics and Biostatistics

1. Introduction

The team is oriented towards combining applied research in medical informatics and biostatistics with a methodological research. The department was reduced in size in 2012 when a Czech national research center financing scheme was terminated. This happened one year before the reorganization in 2013, which left the previously reduced department virtually intact.

2. Strengths and Opportunities

The group has a number of int. journal publications. Important are the strong links to the medical faculties of leading national universities and to other national medical or health-care institutions, thus providing support for interdisciplinary biomedical research. The age structure of the team is favourable.

3. Weaknesses and Threats

The international cooperation appears limited, as well as the mobility. The research is primarily oriented towards specific applications at a national level.

4. Recommendations

Besides working on the applications in national co-operations, the group might formulate one or two topical methodological problems to concentrate on in future research that would be clearly internationally recognized and might also lead to increasing international cooperation and mobility.

5. Detailed evaluations

Declaration on the quality of the results and share in their acquisition. The activities of this group were mainly focused on two directions, namely, biostatistical analysis of medical data and reduction of complexity of high-dimensional data, where the second direction was motivated by the field of molecular genetics. A major accomplishment was a large study in the Czech Republic relating cardiovascular diseases with a particular subset of human genes. Other accomplishments include advanced procedures and devices for electronic health care, new nonparametric statistical tests, and robust algorithms for image analysis. The total number of outputs is 147 with 42 of them included in the WS. Given an average annual personal capacity of 8.1 researcher FTE and 4.4 FTE for other workers, the productivity of the department can be considered good. The quality of the publications, as assessed in Phase I, is good with a Quality Profile median value of 3 (recognized internationally) and an average of 3.25. Based on the AIS journal ranking, the quality of the publication venues is good as well with 11 papers appearing in a journal that is ranked in the top half. The contribution of the team to these publications is significant. The work of the department received a very good degree of international recognition as evidenced by the number of citations.

Declaration on the involvement of students in research. Students are involved in research either as institute-based or as visiting students because of their supervisors' association with an external degree awarding body. One PhD student graduated during the evaluation period.

Declaration on societal relevance. Given the area where the group works, there is substantial potential for the research leading to real improvements in the quality of life. However, no concrete examples were given. It is also not clear whether there has been any work aimed at commercialisation. Good amount of effort at university level dissemination by members of the group giving a number of courses in the Medical Faculty of Charles University, and Valenta giving project supervisions at various levels. Members of the group are also actively involved in masters and doctoral boards at the Charles University, CTU, Brno U. and Masaryk U. There is also good evidence of popularisation activities with public lectures, popular articles and TV/radio appearances[1]. Finally, members of the group are members of a number of journals editorial boards, but the journals are mostly recently launched and not listed in ISI.[2][3]

Declaration on the position in the international and national context. The international activities of the group are primarily related to the previous Head of the Dept., who provided links to international contacts and societies. Otherwise, the international collaboration is rather limited (a team member at a visiting research stay with the Seattle University; no foreign team members or formal participation in international projects). The team members are involved in many int. community serving tasks (int. journals, representatives of CzR in int. scientific societies, programme committees of int. conferences). The research activities, basically widely conceived, are primarily oriented towards specific applications, as required by cooperation with important national medical institutions.

Declaration on the vitality and sustainability. The age structure of the small team is good, being evenly distributed from the youngest (PhD students) to senior age. The team

is obviously conceptually influenced by the personality of the senior researcher, while younger experienced researchers are complementing the team with the perspective publishing abilities. No postdocs and foreign nationals are involved. Mobility is limited to the two year visiting stay of a team member with the Seattle University. The research was supported by two research grants from public sources during the evaluated period and a small support came also from the contractual research; new grant applications are planned. Considering the size of the team, its management is not a problem.

Declaration on the strategy and plans for the future. The outlined research strategy appears basically adequate as a qualified support for the medical research at national level. The human resources seem adequate for realization of these plans. However, concentrating also on a specific topical methodological research area in med. informatics or biostatistics and increasing international cooperation might be recommended.

Evaluation of the Team No. 5: Department of Nonlinear Dynamics and Complex Systems

1. Introduction

The team studies complex systems and nonlinear phenomena. The field of work includes mathematical methods and algorithms for data mining (dimension reduction) and time series analysis with the goal of identifying causalities. Further work is in the fields of graph analysis and computer security.

2. Strengths and Opportunities

The department has a good scientific output that is spread over a number of different disciplines and is published in high level journals in these fields. With its interdisciplinary setup, the department is well positioned for collaboration and for further increasing its impact. The department has a good outreach to young researchers through teaching activities at universities.

3. Weaknesses and Threats

The team and its topics are somewhat heterogeneous and the number of projects pursued are in their diversity possibly too large for the size of the team. As many other departments, the team is in the danger of losing qualified senior researchers due to better offers from outside without being able to attract qualified young researchers in sufficient numbers.

4. Recommendations

The department should prioritize its research directions and attempt to further strengthen its outreach, both to universities as well as external partners. The goal should be to develop

further collaborations and to attract excellent early stage researchers. A potential field of emphasis can be data mining when it is based on statistical or computational models. Possibly also a change of the name of the group can be considered since the current one is not ideally descriptive of the current work areas.

5. Detailed evaluations

Declaration on the quality of the results and share in their acquisition. The work of this department concentrated on the analysis of time series data and was in particular concerned with the detection of nonlinear phenomena, interactions in complex systems, modeling emergent phenomena in complex dynamics, and – more generally – data mining and optimization. Main results include new procedures in these areas and findings obtained with the developed methodology when applied to data from brain research, meteorology, and other fields. The total number of outputs is 74 with 33 of them included in the WS. Given this, the department produces high level scientific output and has a wide project portfolio spread over a wide range of topics. This is explored e.g. for applications in fields such as neuroscience, climatology and chemical dynamics. Especially interesting and potentially attractive for the future is the application of these methods in the field of computer security, a topic that is explored in collaboration and through funding from AVAST. Given an average annual personal capacity of 5.9 FTE for researchers and 4.1 for other workers, the productivity of the department can be considered satisfactory. The quality of the publications, as assessed in Phase I, is very good with a Quality Profile median value of 2 (*internationally excellent*) and an average of 2.08. Based on the AIS journal ranking, the quality of the publication venues is excellent with 5 papers appearing in a journal that is ranked in the top decile and 15 papers appearing in a journal ranked in the upper half. Because very few publications were submitted to the CS Panel in Phase I, it is not possible to make a general statement about how significantly the team contributed to their publications. The work of the department received an excellent degree of international recognition as evidenced by the number of citations.

Declaration on the involvement of students in research. The number of students involved is high, especially on the Master and PhD level. 28 high quality publications are the result of PhD driven research. About 10 PhD students are associated with group, and one thesis defence during the period.

Declaration on societal relevance. Some of the environmental and brain imaging work has the potential to improve the quality of life, but this aspect of the department's work is not discussed and could possibly be further emphasized. There is a reasonable level of involvement of the department in university teaching, at a number of institutions - but this might be increased with the aim of stimulating potential research student recruitment. The group gives courses and has other links too with Charles University and CTU. There is a

good set of outreach and popularisation activities including TV appearances[4]. The has also been involved in the “100 Scientists in Schools” programme. There is good involvement in scientific meeting organisation, but the group might consider getting involved in more upscale meetings to increase its visibility (for instance bidding to bring GECCO or ECCS to Prague). Similarly, the group needs to be involved in more journal editorial work to improve its international profile.

Declaration on the position in the international and national context. The department has a good scientific reputation and visibility. This applies both in a national as well as an international context. The outreach can be further strengthened and the department’s efforts in these directions, e.g., in the form of Horizon 2020 grant applications to the EU, should be supported with priority.

Declaration on the vitality and sustainability. The department structure and its dynamics are healthy and are promising for the future. The progress should be monitored and if necessary the plans should be adjusted according to the development that is expected. If the field of computer security based on graph analysis, as it is being currently pursued jointly with AVAST, proves successful, it can potentially become a very important field for the future.

Declaration on the strategy and plans for the future. The department’s strategic plans include both a focussing of the current topics and a dynamic extension into new areas. This seems promising, as detailed above, and should be supported.

Evaluation of the Team No. 6: Department of Optimization and Systems[5][6]

1. Introduction

The department works in the field of modeling and optimizing complex systems. The work strives to automatise model building and model analysis with focus on the underlying optimization and constraint solving techniques for so-called hybrid discrete and continuous systems. This group was the strongest from the Institute in Phase 1 in terms of the fraction of outputs ranked 1 or 2. It is newly formed and making rapid strides.

2. Strengths and Opportunities

The department was formed relatively recently and has seen a good start driven by the enthusiasm of its members based on their diverse backgrounds and based on a solid theoretical foundation. The field of hybrid systems is originally driven by immediate interest from many key applications. This provides significant potential for the team to enter into interdisciplinary collaboration with other fields. The work area of the institute, though currently still predominantly of theoretical nature, offers plenty of opportunities to reach out towards applications of the methodology and also towards industrial projects.

3. Weaknesses and Threats

Research in hybrid systems has been ongoing for two decades and has now reached a high level of maturity. As with many maturing research fields, the important theoretical results can be increasingly brought to bear fruit in external research areas, here in particular also in industrial applications. Such a successful outreach requires a broad interdisciplinary constellation that is founded on a solid theoretical basis. With key personnel leaving and an unclear funding situation it may be difficult to successfully follow such a strategy and to consolidate the still young research team.

4. Recommendations

The team should give emphasis to extend their methodology into new fields and to bring the established methods of the field into application areas where they can be applied profitably (in particular also in industry) and where a good potential to attract projects and to raise funding should be given.

5. Detailed evaluations

Declaration on the quality of the results and share in their acquisition. The department was established only in July 2013, with members coming from other organizational units of CAS. In the reporting period, its researchers worked on the automation of model building and analysis with a special emphasis on the underlying optimization and constraint solving techniques. Major accomplishments include new approaches to determining the robust satisfiability of systems of equations and verification of non-linear hybrid systems. The quality of the outputs is commendable. Their total number amounts to 143 with 49 of them included in the WS. Given an average annual personal capacity of 7.1 FTE for researchers and 0.8 for other workers, the productivity of the department can be considered very good. The quality of the publications, as assessed in Phase I, is very good as well, with a Quality Profile median value of 2 (internationally excellent) and an average of 1.86. The contribution of the team to publications that have co-authors from outside is significant. Although only partly reflected in the provided bibliometric indicators, the degree of international recognition of the team is excellent. [7]

Declaration on the involvement of students in research. Members of the team participate in educational activities of several Czech universities and the number of taught courses is quite high. On the other hand the number of supervisors involved in this process, following the bachelor, master, and doctoral theses, is rather limited. What seems to be a problem is the number of supervisors and defended theses of Ph.D. students. In fact, PhD students in general represent a group of researchers that are able to perform serious research. The positive thing is that the group is trying to support the Ph.D. students financially. However, the quantity is low - the reason might be not enough additional (grant) funding for the activity of the group. Possibly the group still needs time to reach their full momentum especially since the recruitment of PhD students and their successful completion will suffer a time lag after the formation of a new research team.

Declaration on societal relevance. Up to the present, the activity of the group can be considered as basic research rather than application oriented. As stated above, the high potential of the group's research in (industrial and engineering) applications is not yet exploited. The group is well involved in teaching activities on several Czech universities.

They are also active in editorial boards of three journals and program committees of scientific conferences. They also try to popularize research by media interviews and lectures in high schools. Collaboration with business sector is not as rich, but the group reports two short projects with Volkswagen AG Wolfsburg, which were financed by the industry. The limited number of such activities could however be understood, considering the character of primary group's current objectives, to be still the basic research. Some of the recent publications come from very good publication platforms. The full success will hopefully be demonstrated by numerous future citations.

Declaration on the position in the international and national context. The department has a good scientific reputation and visibility. This applies both in a national as well as an international context. The outreach can be further strengthened and the department's efforts in these directions, e.g., in the form of Horizon 2020 grant applications to the EU, should be supported with priority.

Declaration on the vitality and sustainability. The newly formed research team is still in an orientation phase and must be expected to need more time to develop its full potential. In particular, the outreach into applications and transfer of the theoretical results should be supported and its progress should be carefully monitored.

Declaration on the strategy and plans for the future. With the recent formation of the team and its research showing good initial success, the development of a further reaching strategic plan now must be pursued with priority. In the field of hybrid systems whose inception more than two decades ago was driven by engineering and industrial needs, such a plan must identify both: (i) opportunities where new applications may require additional fundamental research, and (ii) areas where existing results can be profitably adapted to the use in important engineering and industrial problems. The latter should offer a high potential for external collaboration and may open the possibility to raise substantial external funding.

Evaluation of the Team No. 7: Department of Fundamental Topics

1. Introduction

The research of the team covers a range of fundamental topics concerning abstract theory of informatics and procedures for advanced computation.

2. Strengths and Opportunities

The majority of the team are very experienced senior researchers with strong track records in their respective areas. Collaborative research projects may present an opportunity to broaden the research areas to attract young researchers and start activities in additional modern and timely fundamental topics.

3. Weaknesses and Threats

The expertise of the team members is somewhat narrow and focuses on traditional research areas that have existed for many years (or even some decades). The quality profile of the

submitted outputs indicates more outputs at internationally recognized level than at internationally excellent level, and a lack of outputs deemed to be of world-leading quality. The age structure of the team shows a lack of young researchers who could refresh the range of research areas and sustain the team into the future. The lack of young researchers may threaten the existence of the team over time as the current researchers retire.

4. Recommendations

Maintain traditional areas of strength and continue to produce strong research results in these areas. Aim to attract young researchers to ensure sustainability of the team beyond the end of the active period of its current senior members. Review portfolio of research areas and consider expanding into modern and timely areas whose study may lead to increased visibility and impact in the current international research environment. Review publication strategy and aim to achieve some outputs of world-leading quality and increase the proportion of internationally excellent outputs versus internationally recognized outputs.

5. Detailed evaluations

Declaration on the quality of the results and share in their acquisition. The department focuses on a number of topics, including linear algebra, neural networks, computer arithmetic, and others. Main achievements during the evaluation period include the establishment of G-Matrix Theory, new results on model complexity in neural networks, and findings related to finite precision in computer arithmetic. The total number of outputs amounts to 271, out of which about one third made their way into the Web of Science (WS). Given an average annual personal capacity of 8.25 researcher FTE, the productivity of the department can be considered excellent. The quality of the publications, as assessed in Phase I, is good with a Quality Profile median value of 3 (recognized internationally) and an average of 2.76[8][9][10]. Based AIS journal ranking, the quality of the publication venues is good as well with 1 paper appearing in a journal that is ranked in the top decile and 16 papers appearing in a journal ranked in the upper half. The contribution of the team to these publications is significant. The work of the department received a good degree of international recognition as evidenced by the number of citations.

Declaration on the involvement of students in research. The team supervises some students on the Bachelor, Master, and Doctoral level. The number of completed theses is 4 for Bachelor, 11 for Master and 10 for PhD. The department is also involved in teaching activities at universities. The age structure of the department considered, this is respectable.

Declaration on societal relevance. The topics covered by the department are diverse and in most cases essentially of fundamental nature rather than aimed at direct practical usage. Of course, the personal stature and reputation of members of this particular department contribute per se significantly to the reputation of the CAS internationally.

Declaration on the position in the international and national context. The team consists of a majority of senior researchers with strong and long-standing international reputations and substantial track records spanning several decades. The team is a collection of individuals that mainly pursue research in their own specialised areas of expertise, but they benefit from interactions and discussions within the team. The individual nature of

research makes it difficult to compare the team to other teams internationally, but the individual researchers each clearly have a strong standing in the international research community. They have a number of international collaborators at good universities in countries such as Austria, the Netherlands, Slovakia and USA. There are also numerous national collaborations with different universities or within the CAS. The international standing of the team is further evidenced by editorial board memberships for a number of international journals, including the high impact-factor journal Neural Networks (Elsevier). The team does not seem to attract many foreign researchers, however. The research on computational models addresses fundamental questions that have been posed many years ago, but a broadening of this research to cover more modern computational complexity questions might increase the visibility and impact of the research.

Declaration on the vitality and sustainability. The age structure of the team, with the majority of team members being at least 55 years old and only a single researcher with age below 55, is worrying, as there is a clear lack of young researchers who could follow in the footsteps of retiring team members and sustain the research efforts. While 10 PhD students have defended their theses in the reporting period, it is not clear how many new PhD students the team can recruit and whether any of the graduating PhD students will potentially be able to join the team as researcher in the future. The team has a substantial level of grant income from national funding sources, with a total of 970K Euros brought in during the reporting period. The team uses the resources effectively to produce research of high quality. The management arrangements appear to be effective as well.

Declaration on the strategy and plans for the future. The team's strategy for the future consists in continuing to pursue the current research areas and to seek grants that foster collaborative work with internal and external collaborators. While this is meaningful given the current composition of the team, it might be beneficial for the future of the team to review the traditional research areas and investigate if there are any related areas that are timely and modern and of wider interest in the current international research community, for example, in the area of computational complexity. Expanding or adapting the research portfolio to cover such areas could help with the recruitment of young researchers to sustain the team in the future and increase visibility and impact of the research.

Date: January 01, 2016

Commission Chair: Professor Edwin Hancock PhD, DSc.