

Scientific Advisory Board  
Computational Complex Systems Research

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Helsinki, December 8, 2009

### Progress Report on Centre of Excellence in Computational Complex Systems Research

#### General comments:

The main conclusion of our previous report on the Centre of Excellence in Computational Complex Systems Research (COSY), dated May 7, 2008, was that the center's direction was excellent. However, we expressed strong worries that the deteriorating funding of the center would eventually stifle it. We are happy to see that our warning was followed up by a restoration in the funding level. We, in turn, see this in the scientific evolution of the center over the 15 month period since our last report. However, the full effect of the restored funding levels has not yet come into play and we expect to see a continued evolution towards the center's full potential. At the present stage, the center is at the cutting edge of international science within disciplines that – to our knowledge – are not joined in a single research group anywhere else. The center is simply unique. We recommend strongly that the funding of the center is at least maintained at the present level to ensure that the center continues this extremely positive evolutionary curve.

#### 1. Scientific Activity, Production and Progress.

The number of papers being produced is high. Compared to earlier years, the number is somewhat lower. This is, however, intentional. The center wants to write fewer papers for better journals. This strategy has paid off in that the average impact factor of the journals that publish the center's work is fluctuating around four – which indeed is high. The citation rate of the center's published work is increasing. We also note the increasing number of invitations to conferences.

#### 2. Development of the CoE Profile

The four research groups that constitute COSY,

Models and Methods (MM),  
Engineering and Artificial Systems (EAS),  
Cognitive and Social Systems (CSS), and  
Computational Systems Biology (CSB),

have evolved since our last report. We see a healthy exchange of group members between the groups and the distinction between the groups are much less pronounced. For example, it is clear that work in the Cognitive and Social Systems group on cognitive neuroimaging draws heavily upon the ideas being created within the Models and Methods group in connection with network theory.

It is notable how well the different disciplines that are represented within COSY have been tied together. The “glue” that holds the structure together scientifically is the evolution of a general toolbox based on concepts from the physics of complex systems. The COSY members have been able to break the communication barrier between disciplines and they are now able to sit together and tailor the advanced methods from complexity research to problems that have never before been formulated quantitatively.

There is the danger that such trans-disciplinarity remains within a narrow group of researchers that are regarded as eccentric by the scientific community in general. This is not the case here. Having papers published in journals such as *Social Networks* which is run by sociologists, is a clear indication that the center’s research is being heeded by the main-stream researchers in fields traditionally far removed from any quantitative approaches. The SAB wishes to stress what a remarkable feat it is to succeed in this.

### 3. Added Value and Synergies.

As has been noted under session 2, the interdisciplinarity of the center is remarkable. It is, to our knowledge, the most successful project of this type. Within the EAS group, the activity on engineered nanosystems seems less integrated with the other activities than the rest. The synergy of polymer translocation project within the MM group also seems somewhat less integrated with the rest of the activity. The COSY should seek to improve the integration of these projects.

We note that spin-off companies, e.g., the Zenrobotics from EAS, are now appearing. This is extremely valuable for society.

### 4. Institutional Support/Core Facilities.

The SAB applauds the restoration of COSY’s funding. As described in the introduction, this has led to a strengthening of the good trends we noted 15 months ago. The center is still evolving and we are confident that it will be even stronger in the future.

### 5. International Visibility.

We noted in our report of May 7, 2008, how the center has achieved visibility internationally both in the scientific press and in a wider perspective. This trend is continuing. We applaud this. As will be noted below under point 6, COSY is now coming into the position where it is able to choose from the top shelf of international postdocs. This is an opportunity that should not be missed.

### 6. Researcher Career Development and Gender Equality

The SAB recognizes the success of promoting the career development of COSY’s personnel, during the 15 months period since the last SAB meeting, with the professorship achieved by

Drs. Mika Ala-Korpela and Jukka Heikkonen in Oulu University and Turku University, respectively. Dr. Kaisa Tiippana also assumed the lecturer position in the University of Helsinki. Apart from scientific knowledge, this is one of the center's main "products" – and one which Finnish society will benefit strongly from.

The award PhD degrees to females was improved from 20% to 50% over the period since the last report. This is a positive trend which the SAB hopes will continue.

While the center has been standing above average in Finland in terms of recruiting postdocs with a diversity of foreign nationalities, the SAB recommends that this trend is continued and strengthened. The percentage of foreign researchers in Finland is surprisingly low and COSY has a mission here to demonstrate how successful diversity in nationalities – and therefore scientific backgrounds – is to science. COSY is luckily in a very good position to do this given its international reputation and the existing pool of good postdocs abroad.

A concrete measure in this direction would be to organize international workshops in the areas of COSY's focus, for instance the IEEE satellite meeting in biomedical engineering <http://www.thaiembs.org/isbme2009/>. Such meetings are excellent tools for a strategy for both global visibility and recruitment of top international researchers.

#### 7. International and National Collaboration

The SAB is pleased to observe the enhanced international collaborations coordinated by COSY on the EU Framework Program 7 STREP project, involving partners at the University of Oxford, the Institute for Scientific Interchange (Turin, Italy), the Budapest University of Technology and Economics (Hungary) and the University of Warsaw (Poland). The national collaboration in the biomedical and imaging research in linking with National Institute of Health and Wellbeing was successfully funded by the Academy. However, with the redirection of CSB after the departure of its key personnel, increased attention should be taken to fill the expertise in the area of bioimaging and image processing, which are commonly demanded in the tasks of other COSY projects, for instance, the MRI and the pattern classes of CCS and EAS, respectively.

#### 8. Societal Impact.

Our remarks of the 2008-report still stands: *The Centre is doing basic research. As such, society must expect a considerable delay before its investments pay off. However, we see immediate return from several of the ongoing projects.* We noted in our report of May 7, 2008 that the computational health project was an example of this. We may now add the projects that have spawned spin-off companies.

The Centre is training exceptionally talented young scientists as future scientific leaders for the nation. They are now being recruited into academic positions around the country.

#### 9. CoE Planning Recommendations for Next 3-Year Period.

COSY is evolving as planned, and in terms of e.g. candidate production, it is ahead of schedule. The scientific production is high and the profile – interdisciplinarity joined together by the key word complexity – is becoming clearer. We have made specific recommendations earlier in this report as to what adjustment in our opinion would be helpful. However, we see

no reason to make any suggestions as to changes at a more general level.

10. Recommendations for Planning the Center's Future after the CoE Period.

We would find it natural that COSY applies for CoE status in 2010. The CoE status has relieved the principal scientists from spending their time writing proposals. They have instead been able to use their time at science. The status as a CoE has also been very helpful as a door opener for example in obtaining data sets which otherwise could have been difficult to gain access to.

We repeat here the main conclusion drawn already in the introduction to this report:

*COSY is at the cutting edge of international science within disciplines that – to our knowledge – are not joined in a single research group anywhere else.*

The SAB is satisfied with the Centre's follow up of our recommendations given in the report submitted in 2008.



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