

## **KTH International RAE 2008**

### **REPORT PANEL 1: MATHEMATICS and COMPUTER SCIENCE**

#### **GENERAL ASSESEMENT OF THE RESEARCH FIELD**

Our panel found the Research Assessment Exercise (RAE) to have been well organized. Time was short, but was sensibly allocated. Our impression was that the people we interviewed expected a more traditional evaluation, concentrating on individuals or research groups, while we as a panel were instructed to focus on evaluating whole Units of Assessment (UoA).

This report explains our observations up to the evening of Thursday of the exercise week. In particular, the remarks on recruitment and the cost model were formulated based on our interviews, and without the extra information given afterwards. Similarly, our interviews created considerable activity within the research field, directed towards formulating a collective vision for the future – we learned about this at the debriefing on Friday. This response to our assessments indicates that the potential for strategic thinking and leadership needed to create a world leading centre of mathematical sciences in Stockholm is already present.

#### **Recommendation: join forces**

All the Units show great strength and potential at the level of individuals and groups. However, due to a lack of collective vision, strategy and communication, this potential has not yet been translated into a world leading research environment. We nonetheless believe that the collective can form the core of an outstanding academic institution. The panel therefore recommends that KTH puts in place a process that combines the Units into one tightly coupled and integrated research entity, in the form of a centre for mathematics, computation & life sciences. This centre should be housed in a single, coherent way, and should include mechanisms of integration such as shared MA and PhD programmes, seminars, etc.

The medium term vision for the centre should be to form close ties with neighbouring high-profile research centres, including other departments at KTH, the Karolinska Institute, the International Neuroinformatics Coordination Facility (INCF), the University of Stockholm and the Mittag-Leffler Institute.

#### **Recruitment and cost model**

The panel observed across the board that there is an inconsistency between the recruitment policy, teaching load, career planning and promotion strategies and their financing. This situation suggests that an antiquated administrative system is at the point of collapsing in the face of the current demands upon it. Hence, the panel recommends that a modern model for both career planning, teaching, recruitment and its financing be put in place. The model should be rational and consistent, and should take on board central elements of the well established Anglo-Saxon model.

## **Strategy and vision**

The panel has observed that, within the UoAs, there is a general lack at all levels of the vision, strategy and commitment that are needed to address the current and future challenges faced both by the research fields themselves and by KTH in general, although there are some notable exceptions at an individual level. The panel has the sense that this is an institution-wide weakness, and that changes of policy at the highest levels of the organization would be needed to combat a culture of lethargy and complacency. Hence, the panel recommends that KTH puts in place a strategy that would motivate its constituents to actively engage with current and future challenges, including its wider responsibilities within society.

## **UoA: MATHEMATICS**

### **General Assessment**

This is a high quality Unit that includes a number of world-leading researchers. It aims to be the leading mathematics department in Sweden, with research activity of a high international level, comparable with that in mathematics at the ETH or at the Courant institute. This goal is entirely realistic, but the high teaching loads compared to those, say, at the ETH or at Courant, hamper the research of the junior faculty, who have to do a lot of undergraduate teaching. Within its financial limitations, the Unit is very accommodating towards junior faculty. However, there appears to be no established mentoring system to guide them in developing their careers. The Unit would benefit from a tenure track system, and the appointment processes could be improved at all levels (this appears to be a common problem for Swedish universities).

The coming retirement of many full time teachers offers an excellent opportunity to further strengthen the Unit, provided that the financial situation is such as to allow it to retain the strong people currently there, and to offer competitive working conditions for new recruits. The support for postdocs comes to a large extent from grants from the Wallenberg and Gustafsson foundations, and is thus unstable.

Even though the Unit did not define themselves as a (future) flagship of the KTH, the panel strongly feels that they, together with other units of the mathematics department, have the potential to become one, especially if combined with the appropriate units from computer science. The combined entity could also well include mathematics departments from Stockholm University.

### **Performance Against Evaluation Criteria**

#### **Scientific Quality**

The Unit has around ten world-leading researchers, and the rest are of high international standard. The situation could become even better in the future, if the teaching loads were made more reasonable.

#### **Applied Research Quality**

Even though the majority of members perform typical pure mathematics research, some are engaged in applications oriented research, even to the point of forming their own companies. It is clear, therefore, that the majority of the UoA currently performs at an internationally high standard.

### **Scholarship**

Some parts and/or individuals in this UoA are excellent. Overall, the Unit is great in terms of scholarship, but the leading mathematics department in Sweden could shoulder a larger responsibility in communicating the importance of mathematics to the wider community than is indicated by the self evaluation.

### **Vitality and Potential**

In general, vitality and potential are good across the majority of the UoA. There is great potential visible, but the vitality is not so apparent.

### **Strategy**

Unfortunately, the view of the future was as a repetition of the past and was therefore considered weak. No forward strategy or vision could be discerned in the interviews.

## **UoA: MATHEMATICAL STATISTICS**

### **General Assessment**

The Unit is small, and in the process of transition. Over the preceding 10 years, it has developed a completely new and highly successful programme of teaching (at masters' level) and research in financial mathematics, which now accounts for a substantial fraction of all diploma theses in mathematics. This effort is now being reinforced by the recruitment of two new junior faculty members, who both show great promise in research. In addition, the Unit has recently hired a senior faculty member in statistics proper.

However, the unit suffers under an extremely high teaching load, not only because of providing the range of courses required for the masters programme, but also from the service courses in basic probability and statistics that are given for students throughout KTH. This load currently threatens to stifle the further development of research activity in the field, and to curtail the links being forged with the financial industry. The need to provide such a wide range of teaching also makes a small unit very vulnerable, should unforeseen events lead to a sudden reduction in teaching capacity. Finally, the one genuine statistician in the Unit finds himself in a very isolated position.

### **Performance Against Evaluation Criteria**

#### **Scientific Quality**

The majority of the UoA currently performs at an internationally high standard. Scientific quality can be expected to strengthen further, as the impact of the recent recruitments makes itself felt.

#### **Applied Research Quality**

Although external funding has only recently begun to be generated, an impressive range of contacts has been developed with the financial sector, and these are likely to result in much greater levels of external support in the future. Thus, the majority of the UoA currently performs at an internationally high standard.

#### **Scholarship**

Scholarship can be seen to be emerging in some individuals of the UoA. Here, there is strong potential for improvement, as the junior faculty members gain in experience.

### **Vitality and Potential**

This is good across the majority of the UoA. The Unit, although small, is very enthusiastic in developing its activities, both within and outside the KTH, despite the crushing teaching burden.

### **Strategy**

The strategy of developing financial mathematics has been good, with a real potential to achieve. The Unit has been extremely successful in its appeal to students, and promises to lead to the acquisition of significant external funding in future.

### **Recommendations for action**

The unit could benefit greatly from being incorporated into a larger group, if this can be achieved in an appropriate way. Possible partners include mathematics, optimization and systems theory, and theoretical computer science, all at the KTH, as well as the statistics units at Stockholm University.

## **UoA: Optimization and Systems Theory**

### **General Assessment**

The Division of Optimization and Systems Theory is important in creating an effective bridge between pure mathematical theory and applied projects. The Unit is well linked within KTH to other research units and centres, and plays an important role within the Centre for Industrial and Applied Mathematics (CIAM). The panel observed that three of the four full professors carry a very large administrative responsibility for the whole mathematics department. This takes important time which could otherwise be used for research and grant applications. It also seems that the Unit would run into financial difficulties if they relinquished these administrative tasks.

Nonetheless, the panel felt that research is carried out at a high international level, and that the Unit is well funded from outside sources. Several of its members serve on the editorial boards of international journals, and a number of former PhD students are now placed in good academic positions. It was the sense of the committee that more effort could still be made to get involved in research projects at a European level.

### **Performance Against the Evaluation Criteria**

#### **Scientific Quality**

The UoA consists of four professors and is relatively small. However, parts of the UoA currently perform at a world-leading standard with the main part performing at an internationally high standard. The Unit is led by one of the best known researchers in mathematical systems theory. The other three professors are of high international standard. Several former students of the UoA hold tenured positions in good academic institutions.

#### **Applied Research Quality**

The fact that the Unit is involved in a number of successful applied projects, it is clear that parts of the UoA currently perform at a world-leading standard with the main part performing at an internationally high standard.

### **Scholarship**

This unit ranks high in scholarship with some parts and/or individuals in the UoA being excellent. Several members of the unit serve on the editorial boards of international journals.

### **Vitality and Potential**

The Unit is actively involved in many research projects of academic and industrial nature, and has had considerable success in acquiring grants. The Unit is therefore excellent in some parts of the UoA, and good in the remainder

### **Strategy**

The unit is aware of its special position within the university, linking the pure side of the mathematics department with applied researchers in engineering. Thus, the strategy was considered good with real potential to achieve.

## **UoA: Computer Science**

### **General Assessment**

This UoA consists of four departments with a diverse range of interests. The overall quality of research and visibility is excellent. The Unit has several young researchers with strong research profiles and an exciting research agenda, and is successful in attracting research funding. However, each department seems to operate in a self-contained manner, and there appears to be a lack of discussion among the various departments with a view towards advancing the goals of the Unit as a whole. Going forward, an idea that appears to have broad support is to form a centre for computer science and mathematics, by combining departments from this Unit with the mathematics units at KTH as well as at Stockholm University. If executed properly, this strategy has a clear potential to create a highly visible centre, with a leading presence in Europe and beyond. Such a centre is also likely to be considerably more successful in recruiting high-profile researchers from outside of Sweden, something currently seen as a problem.

In its present state, the Unit suffers from a number of problems, some of which appear to be institutional problems that may affect many other units at KTH. In particular, the recruitment process appears to be “broken”. It can take up to a year to hire a new faculty member. This time frame is too slow for attracting strong researchers, who will be tempted to accept competitive offers that are made more quickly.

There also appear to be organizational problems in the planning of courses. The curricula for PhD students appear to be arranged in an ad-hoc manner, and at short notice. Moreover, the choice of available courses seems to be limited to those within departments or smaller units. These planning problems are perhaps further accentuated by an implicit “split” of the faculty members into two groups, one primarily teaching, and the other primarily engaged in research.

The separation of the School of Computer Science and Communication between two locations is not conducive to collaborative research. There are departments at different locations whose research interests have natural areas of overlap.

## **Performance Against Evaluation Criteria**

### **Scientific Quality**

Part of this UoA currently performs at a world-leading standard with the main part performing at an internationally high standard. The UoA has a number of first-class computer scientists, and some spectacular research breakthroughs have originated from this unit in recent years. The unit has also produced several highly successful students, some of whom have for instance won best paper awards at prestigious computer science conferences.

### **Applied Research Quality**

All departments in the unit are visibly involved in applied research meaning that part of the UoA currently performs at a world-leading standard with the main part performing at an internationally high standard. However, given that their research focus is typically directly aligned with a domain of application, one would expect to see more high impact applied research being produced. In particular, active collaboration with the Karolinska Institute could be beneficial in this regard.

### **Scholarship**

This unit ranks high in scholarship according to most measures and is excellent in some parts/individuals of the UoA. However, it does not appear to have any significant engagement in terms of raising its profile in society at large. The all-pervasive nature of computation in the modern world offers a great opportunity for the unit to educate a wider community as to the nature and importance of research in the area of computer science.

### **Vitality and Potential**

The Unit has terrific young researchers with an exciting and dynamic research agenda meaning vitality and potential are good across the majority of the UoA. The ongoing research encompasses fundamental computational questions as well as problems motivated by newly emerging areas.

### **Strategy**

Each department within the Unit was able to outline a vision about its future goals and directions. However, the strategy was considered weak, with no collective coherent vision for the Unit as a whole. There was hardly any indication that the departments had engaged in discussion to develop a unified vision. As judged from our interviews, the idea of a center for Computer Science and Mathematics appears to have a strong current of support within the Unit.