

# KTH International RAE 2008

## REPORT PANEL 7: APPLIED MECHANICS

### GENERAL ASSESSMENT OF THE RESEARCH FIELD

There are a number of general observations on the state of this Field of Research. To start on the positive side, we would like to point to a laudable consensus amongst all Units of Assessment about **PhDs as the single most important output** from the research activities.

There is much excellent research being carried out within the Field. In this report we will expound our views on how that excellence might have an even greater impact. The most obvious general remark may be that there is **a definite potential for exploiting synergies** within the Field. Perhaps the most apparent example, but not the only example, of this is in the area of biomechanics. An explicit (virtual or more tangible) linking of the several nuclei pertaining to this subfield, within different UoAs in the Field, would undoubtedly be beneficial. The link need not be an organizational unit in a department, but could be a biomechanics centre of some kind. Apart from facilitating cooperation, it could bring greater visibility (as well as other positive effects like attracting funding) to the work in the subfield.

For the future successful development of the Field of Research, there are also threats that need be dealt with. One such threat is the difficulties involved in ensuring that the UoAs have a sufficient number of excellent researchers. In particular the problem of how to **attract and retain faculty members from abroad** must be solved. And we suspect that this problem is not specific to the Field (or, for that matter, even to KTH) but must be addressed on the level of the whole University.

Another threat that must be addressed by the University as a whole, is that posed by the **high space charges**. We have observed that excellent experimental work in the Applied Mechanics area is at risk from this, but again we strongly suspect that the problem is system wide.

It is a truism that in any knowledge intensive organization, the most valuable resource resides in the people of the organization. We have seen some indication that the present **scarcity of decentralized administrative support** at KTH results in an inefficient utilization of the talent in the organization.

### UoA: Vehicle Engineering

#### General Assessment

Potential for greater output if less fragmentation of the UoA.

#### Single Strongest Aspect

Pockets of excellence.

#### Strong Groups/Persons

Lightweight structures and Acoustics. Annika Stensson Trigell is a vital leader.

## **Performance Against Evaluation Criteria**

### **Scientific Quality (basic research)**

The majority of the UoA currently performs at an internationally high standard. However, the partially low level of scientific international communication implies low visibility. Production of knowledge is good, but interest in publishing in good journals should be increased.

### **Applied Quality**

Here lies the strength of this UoA, as part of the UoA currently performs at a world-leading standard with the main part performing at an internationally high standard. The strength lies both in the high emphasis on educating engineers for industry, and the awareness of industrial problems; the ECO2 Centre of Excellence is a clear example of this approach. The UoA has state of the art experimental facilities.

### **Scholarship**

Part of the UoA currently performs at a world-leading standard with the main part performing at an internationally high standard.

### **Vitality**

Good across the majority of the UoA. Some groups are too small. Career paths are partially unclear. At least one example of vital leadership and activity, but some groups lacking in this respect. There are a relatively large number of female assistant professors active in the UoA which is positive for the future.

### **Strategy**

Strategy is weak. The larger groups have strategies for their specific areas, but a clear overall strategy is missing.

### **Single Weakest Aspect**

Too much focus on industrial development to the detriment of research output.

### **Recommendations**

- To formulate an overall strategy, restructuring into groups of critical mass is recommended.
- Exploit further possibilities of communication and collaboration within KTH.
- Improve rate of scientific publication.
- Raise awareness in the staff for the need of publishing in ISI journals.

### **Comments**

One of the strengths in Vehicle Engineering was the Lightweight Structures group, which is renowned internationally for its work. The contributions of leading members of this group to the fundamental understanding of the mechanical behaviour and characterization of sandwich structures are noteworthy. Their treatment of almost all their projects through a combined experimental and analytical/numerical modelling approach has led to advances in both the appreciation and understanding of the applied physics phenomena, as well as modelling capability.

## **UoA: Mechanics – Biomechanics**

### **General Assessment**

Ambition to focus is commendable.

### **Single Strongest Aspect**

Scientific quality.

### **Scientific Quality (basic research)**

Part of the UoA currently performs at a world-leading standard with the main part performing at an internationally high standard. There were a sufficient number of international publications.

### **Applied Research Quality**

Due to low external funding for applied research, the Panel felt that part of the UoA currently performs at an internationally high standard with the main part performing at a nationally high and internationally recognised standard.

### **Scholarship**

Emerging in some parts/individuals of the UoA

### **Vitality and Potential**

Difficult to assess on the basis of interviewing only one person but was good in some parts of the UoA, needs to be improved in the remainder.

### **Strategy**

Strategy was weak, but future ambition to focus is commendable.

### **Single Weakest Aspect**

A subcritical and fragmented group.

### **Recommendations**

This group should be split up and integrated elsewhere.

### **Comments**

The presentation of this UoA was delivered somewhat *ex tempore* due not to any fault of the UoA, but rather due to the fact that several versions of the RAE schedule were in circulation. The entire UoA was thus presented by Prof. Anders Eriksson rather than by a group of researchers.

While the UoA contains researchers of a high standard, the impression was formed of Mechanics- Biomechanics having been assembled out of what remained of Mechanics when Fluid Mechanics had formed a separate UoA, regardless of the lack of cohesion within that remaining part.

The Panel's conclusion is that some of the research, e.g. that on superconduction, would belong more naturally within a physics environment, while others, like that on biomechanics and on deployable structures, could form a valuable addition to, as well as benefit from, a solid mechanics environment.

## **UoA: Solid Mechanics**

### **General Assessment**

Excellent performance and leadership.

### **Single Strongest Aspect**

Interplay between experiment and theory in conjunction numerical modelling.

### **Performance Against Evaluation Criteria**

#### **Scientific Quality (basic research)**

The majority of the UoA currently performs at a world-leading standard.

#### **Applied Research Quality**

The majority of the UoA currently performs at a world-leading standard

#### **Scholarship**

Excellent in some parts/individuals of the UoA. Relatively large proportion of upwardly mobile young staff. Just wait five years...

#### **Vitality and Potential**

Excellent across the majority of the UoA.

#### **Strategy**

Outstanding with real potential to achieve.

#### **Recommendations**

Ensure the continuity on the experimental support side.

#### **Comments**

The Panel got a 20 minute presentation of the UoA on the first day and visited the experimental facilities for an hour in the afternoon. On the third day we heard presentations by several members of the faculty, and several questions were posed to faculty members and PhD students. The UoA gave the impression of a homogeneous group with strong focus on high quality research in several areas of material modelling and strength of materials. It was good to hear that PhD students present their work at conferences about once per year.

The experimental facilities were impressive, showing the ability to perform a wide range of mechanical testing, from large specimens down to the micrometer range. The facilities are much employed as the UoA attempts to include an experimental part in all student projects. In addition tests are carried out for industry, which helps fund this expensive activity.

The collection of CVs provided for the panel showed a high international publication activity. In their written material the UoA stated that a recent bibliometric study of publication frequency and citation rate had shown them at the top of all departments at KTH. The panel asked for a copy and obtained it. It was clear that publication in international journals is an important goal for this UoA.

The written material showed that more than half of the funding is external. Half of this comes directly from industry and about a quarter from research councils. It was stated in the material that Mårten Olsson was appointed one of the top ten "Professors important to Swedish

industry”. Upon further question we were informed that only two of these ten came from KTH, and that only this one was in the area of our Panel.

The conclusions of the panel are that this UoA has high scientific quality as well as high applied quality. They have a clear strategy for where they are going, and they showed a high level of vitality.

## **UoA: Fluid Mechanics**

### **General Assessment**

Excellent performance and leadership.

### **Single Strongest Aspect**

Combination of strengths in experiments, theory, and simulation.

### **Recommendations**

Ensure the continuity on the experimental support side.

### **Scientific Quality (basic research)**

The majority of the UoA currently performs at a world-leading standard

### **Applied Quality**

Part of the UoA currently performs at a world-leading standard with the main part performing at an internationally high standard. Not to be seen as a weakness.

### **Scholarship**

Outstanding across the majority of the UoA.

### **Vitality and Potential**

Excellent across the majority of the UoA.

### **Strategy**

Outstanding with real potential to achieve.

### **Comments**

The Panel listened to a presentation by several members of staff, was shown round some of the laboratories and interviewed some members of staff and several research students. Certain questions were put to all UoAs which were interviewed by this Panel.

A general overview was presented about the research in fluid mechanics in the Applied Mechanics group at KTH. Only one of the coordinators was able to attend the interview. Individual reports were provided on the following research strategies of the group:

- Stability and Transition,
- Flow control and Optimization,
- The Telfona Project (by a PhD Student),
- High Reynolds number turbulence including geophysical flows,
- Micro- and complex fluids and Applied Fluid Dynamics.

A list of publications 2003-2007 was provided on request of the reviewing Panel.

This is a large group in the field of fluid mechanics, even from a European perspective, equalled only by a few groups in France, Germany and the UK, for example. The KTH group combines experimental, theoretical and computational research projects. The infrastructure of the laboratory was impressive and could be used both for basic research and for applied fluid mechanics. In the latter field new impetus is expected from the new group member L. Fuchs, especially in the fields of combustion processes and medical applications. The access to, and availability of, a new high power computer will allow the extension of the numerical work to a considerably higher Reynolds number range of the flows under consideration.

The high rent for lab space implies a possible risk, viz. that experimental work will be minimized. This would be a great loss, which should be avoided by all means.

As for publications, 4 of the 6 professors have published about 6 papers per year in refereed journals and the other members of staff about 2 per year.

There is a close cooperation with the Linné Centre and CICEREO.

Student education and international contacts were much improved by the establishment of two national graduate schools where lecturers from abroad share in the curriculum. In order to keep up the highest standards in teaching and research high, standards are applied to the recruitment of younger staff members and great emphasis is put on the teaching of students.

The conclusions of the Panel are that this UoA has a very high scientific quality and that there are many fruitful connections and successful cooperations with peer institutions, both in Europe and overseas. Conferences and symposia of high international standing have been and will be organized in the future.

The research strategies, as outlined in the documents presented to the Panel, are very promising and timely, especially when they focus on problems related to energy and climate change.