

The Grand Challenges Exercise of the UKCRC.

Report to the UKCRC from the Programme Committee. 29 May, 2003

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Background

The UK Computing Research Committee (UKCRC) is a joint expert panel of the British Computer Society and the Institute of Electrical Engineers. It is seeking an appropriate status with the Committee of Professors and Heads of UK Computing Departments (CPHC). It has undertaken as its primary goal that of promoting the good health and high international standing of UK research in Computer Science.

Inspired by the recently completed Human Genome Project, the Committee has noted that the progress of a mature branch of science can occasionally be accelerated by the promotion of a Grand Challenge Project. It has therefore embarked on an Exercise to explore the views of UK academic research scientists on possible topics for a Grand Challenge Project, and on the means for addressing it.

From the beginning, the Committee set severe criteria for judging the maturity of a project proposal for promulgation as a Grand Challenge: the aim was to distinguish a Grand Challenge Project from other kinds of computing research initiative that are promoted currently, or have been in the recent or more distant past. Such a project would be distinctive, but entirely complementary to the more familiar modes of conducting and organising research. A Grand Challenge should enjoy the widest support from the whole scientific community, though only a minority of the community will be actively collaborating in it.

Criteria of maturity of a proposal for a Grand Challenge Project

A Grand Challenge Project is a long-term, large-scale international research project, with clearly defined deliverables, mile-stones, and plans for development, evaluation, and validation of its research results. As a ball-park figure, we took a fifteen year time-scale, involving (say) fifteen leading research laboratories spread over several different countries of the world.

A Grand Challenge Project is a significant commitment of scientific resources, and its promotion needs justification by a strong case that the project, which has been infeasible in the past, can now succeed. This case must be based on a survey of the current state of the art, and its predictable development using known research methods and available research skills.

A Grand Challenge Project has as its primary goal the advancement of scientific understanding or engineering accomplishment in a particular branch of research. It may be specific to that single branch of science, examining its essential nature, its

foundations and its limitations; the results of the research may be applicable only within that single branch of science or engineering.

The case for promotion of the Challenge may be strengthened by speculation about the relevance of the eventual research results to the welfare of human society. Any promise of achievement of these benefits should apply to the period which follows completion of the scientific research.

The adoption and promotion of a Grand Challenge Project is pointless unless it leads to a beneficial change in the attitudes and behaviour of scientists, including those not engaged in the project.

The strictness of these criteria, and their novelty in the context of UK computing research, explain why progress towards the emergence and general approval of a good Grand Challenge proposal will be slow. It is quite likely that no suitable Challenge will emerge in the early stages of the current UKCRC Exercise; such a deferred outcome would be far better than the waste of scarce scientific resource that would result from embarking on an immature Grand Challenge Project.

Progress to date

The UKCRC began the Grand Challenges Exercise by appointing a Programme Committee to organise and conduct it, beginning with a Grand Challenges Workshop. The Programme Committee consists of Malcolm Atkinson, Alan Bundy, Jon Crowcroft, Tony Hoare (chair), John McDermid, Robin Milner, Johanna Moore, Tom Rodden and Martyn Thomas. The Workshop was held in Edinburgh on November 2002, and discussed 109 submissions from the UK computing research community.

The details of the call for submissions, together with the planning and conduct of the Workshop and what should follow it, are all reported in detail on the website of the Grand Challenges Exercise:

http://umbriel.dcs.gla.ac.uk/NeSC/general/esi/events/Grand_Challenges/ .

In summary, a set of up to ten possible topics for Grand Challenges was identified at the Workshop for further development, and a champion for each chosen to carry the development forward. A drafting phase followed the Workshop, and in January 2003 several draft proposals were mounted on the website, each to be discussed publicly by email, moderated by the champion, with the discussion archived on the website. The Discussion, to continue until May 26 2003, was advertised to the research community via the CPHC mailing list.

A particular feature of the Exercise is that no submission from the community is ever rejected by the committee; thus, all 109 original submissions (except those withdrawn by authors) are still accessible on the website. Indeed further submissions may be made at any time.

At the date of this report, there are seven discussion group reports, each of which has been subject to considerable discussion both publicly and in private among its drafters. These proposals, with their moderators, are as follows:

In Vivo \Leftrightarrow In Silico: High fidelity reactive modelling of (GC1) Ronan Sleep

development and behaviour in plants and animals	
Science for Global Ubiquitous Computing	(GC2) Robin Milner
“Memories for life” – Managing information over a human lifetime	(GC3) Andrew FitzGibbon Ehud Reiter
Scalable Ubiquitous Computing Systems or just Ubiquitous Systems	(GC4) Jon Crowcroft
The Architecture Of Brain and Mind	(GC5) Mike Denham Aaron Sloman
Dependable systems evolution	(GC6) Jim Woodcock
Journeys in Non-Classical Computation	(GC7) Susan Stepney

The Programme Committee has considered these reports, and their degree of maturity as judged by the criteria, and makes the following recommendations.

Conclusion

In summary, the results of the Exercise to date have fulfilled our reasonable expectations of progress. The reports of the discussion groups are extremely well written, interesting, relevant and convincing. They reveal considerable enthusiasm for the concept of a Grand Challenge, and they have identified certain groups of researchers who are keen to work together towards the clearer definition of a common Grand Challenge Project.

In general, the reports of the Discussion Groups have addressed most of the points that distinguish a Grand Challenge Project from other kinds of research initiative. However, there is considerable variation in the depth and detail with which the various points have been addressed. The form and content of the reports is very varied, principally because of the difference among topics, and we recommend that CRC should not prioritise them. We judge that all the reports have provided a firm basis for a long-term research activity or initiative.

We therefore recommend that CRC should invite and encourage each group to progress their proposal in whatever way is most feasible and appropriate. An initial step that would be suitable in most cases is to organise one or more workshops, together with email discussion among a broad group of potential participants. In several cases the stage is now reached for further involvement of scientists from other disciplines and from other countries.

We recommend that CRC should facilitate and coordinate this process, to the extent that the groups wish it to do so. The format of public discussion on the GC website should be continued, and CRC should offer to publish the concluded reports after a prescribed period (perhaps one year). We recommend that, in publishing the reports, CRC acknowledges the conclusions of each report and does not offer further judgement of its own.

We recommend that each group in its concluded report should be asked to judge the extent to which, and the sense in which, their proposal constitutes a Grand Challenge Project or some other form of long-term research programme. (The group may choose to use the CRC guidelines for a Grand Challenge.) For example, it may suggest how current research practices, policies, priorities and funding arrangements should be adapted if necessary to promote the topic for the long-term benefit to UK computing research and its international standing.

We suggest that a suitable mode of publication should be as proceedings of an open Conference in about a year's time, which could be promoted by UKCRC, preferably jointly with CPHC, BCS, IEE, Foresight, As invited speakers, a representative of each discussion group would be given the opportunity to present a summary of the group's report that would attract encouragement and support from the general computing community; that support is important for a Grand Challenge, or any other significant long-term research initiative. Submissions should be requested that address a relatively narrow brief. The hope is that participants should declare interest in one or more of the Grand Research themes, by describing how their own research accomplishments, skills and hopes might contribute to its progress. If necessary these submissions would be presented in parallel sessions. There should also be room for suggestions for Grand Challenges that fall outside the pre-determined areas.