Midterm review evaluation report CWI
August 2008

1. Introduction

Between the external evaluations 1999-2004 and 2005-2010, this midterm review for CWI in 2008 should evaluate whether CWI is in control of its mission and ambition. The assignment of the review committee was threefold: (1) to comment on the quality and productivity of the 16 research groups active within CWI, taking the 1999-2004 evaluation as a point of reference; (2) to comment on the composition of the current research agenda from the perspective of the international developments in the fields of mathematics and computer science; and (3) to comment on the current management research structure of CWI.

The midterm review committee is selected as a subset of the International Advisory Board of CWI and consists of the following five persons:

Frank van der Duyn Schouten (chair)	Tilburg University
Philip Holmes	Princeton University
Frank Kelly	University of Cambridge
Gerhard Weikum	Max-Planck-Institut für Informatik
Reinhard Wilhelm	Universität des Saarlandes

2. Overall evaluation

The review committee used as its information the report of the external evaluation 1999-2004, the midterm self-evaluation 2008, and recent annual reports. The general conclusion of the review committee is that there is no reason for specific concern about the quality and productivity of any of the 16 current research programmes. For the current programmes the performance is close to the conclusions of the evaluation 1999-2004 and the performance of CWI in total is in line with CWI's ambition to act at the international frontiers of research in mathematics and computer science. A short specific comment on each of the programmes is presented in section 3. In this section we comment on some issues of more general nature and interest.

2.1. Position and mission

According to its mission CWI is supposed to (1) perform frontier research on selected topics in mathematics and computer science and (2) to transfer new knowledge in these fields to society in general, and to trade and industry in particular. These two goals do not necessarily go together and there is a risk that CWI is torn apart between the attempts to being viable in basic research and having impact in industry. In the view of the review committee it is of utmost importance for the mission of CWI that it maintains excellence in central mathematical and computer science sub-disciplines, which should be the main criteria for tenured hires and appointments, and which should guide the overall administrative and management structure. Only in this way CWI can maintain flexibility so as to be able to adapt to future societal and scientific challenges.

In the view of the committee the four strategic themes could be used to create a clear profile of CWI to the outside world of society and industry. As there is no one to one correspondence between the clusters and the strategic research themes and since not every cluster contributes to the same extent to each of the strategic themes, the responsibility for the development, management and positioning of the strategic research themes should be positioned at the top-level of the institute (director and his management team).

A general concern of the review committee is that the number of PhD students within CWI is relatively low. CWI should position itself more prominently within the Dutch research infrastructure as the breeding place for young talent in mathematics and computer science. PhD students can also play a substantial role in the transfer of knowledge to industry and society at large, as a certain percentage of PhDs will choose not to pursue an academic career but to consider a transfer to industry after PhD-completion.

It is extremely important for CWI's mission that there is a steady stream of young talented post-docs who consider CWI as a challenging place to spend a couple of years after PhD completion. In this respect CWI should improve its visibility in the international academic arena. Other European research institutes, like Newton Institute, Max Planck or CNRS institutes seem to enjoy a higher reputation than CWI. This will have an impact on the selection process of young talented researchers. The visibility of an institute like CWI is not only dependent on the visibility of its researchers, but also depends on the number of conferences and workshops organised or sponsored by CWI.

2.2. Research agenda

CWI's present research agenda is highly relevant from an international perspective. In the general context of life sciences, neuroscience is an exciting frontier into which CWI could expand, and which would offer potential connections with other Dutch and European laboratories.

2.3. Managerial structure

The present managerial structure consisting of 16 research programmes, combined into four research clusters and with four more or less related strategic research themes might not be optimal.

As argued in the previous section the four strategic research themes should be primarily used to create a pronounced face of CWI to the outside world and should play only a limited role in the internal management of the day-to-day research programmes. This has implications for the management of the strategic themes. A management structure of four people each responsible for one strategic theme is suboptimal. Also it is not evident that the leaders of the research clusters, with day-to day responsibility for continuity and human resources, are the most appropriate persons to play this role. Anyway, the director should have a central and decisive role in the positioning and management of the strategic themes. His internal advisors on this issue should be researchers with a broad view and able to abstract from the immediate needs of the existing research groups.

Secondly, a critical assessment of the number of research groups (16 at present) and the four clusters could be beneficial. The present management load seems to be rather heavy and might be suboptimal from the perspective of internal quality control and human resources management. A research and management structure with larger research groups could also be

beneficial for the potential interaction of researchers within CWI, but it may be short-sighted to restructure management solely to fit the present strategic themes. These may change; mathematical fundamentals will not.

3. Comments of individual research groups.

3.1. Probability, networks and algorithms

PNA1 - Algorithms, combinatorics and optimization
Overall rating 5 in 2005. This group had a very positive assessment in 2005. Since then the group's work with industry on timetabling has won the Franz Edelman Award, for excellent research in the field of operational research with influence on companies or daily life. The number of non-tenured staff has increased significantly, but no change in PhD student numbers.

PNA2 - Probability and stochastic networks
Overall rating 5 in 2005. This group had a very positive assessment in 2005. The research group is internationally renowned. Since 2005 the number of non-tenured staff has increased significantly, and there are a more healthy number of PhD students.

PNA3 - Stochastic dynamics and discrete probability:
Overall rating 4 in 2005. Merged with PNA2.

PNA4 - Signals and images
Overall rating 4 in 2005. This group had a positive assessment in 2005. But since then there has been a significant decline in staff numbers across most headings, which have not been commented upon in the self-evaluation. There appear to be no "key publications".

PNA5 - Cryptology and information security:
Too new for an overall rating in 2005. The group appears to have made really excellent progress, growing well into a fully-fledged group, with several prestigious awards. Surprisingly, it appears to have no recent PhD students.

3.2. Software engineering

SEN1 - Interactive software development and renovation
The group covers a quite broad area in the centre of SE overlapping with SEN3 in component-based design and coordination languages. However, SEN1 concentrates on the tools supporting the SW development process, such as static program analysis and program transformations. The publication productivity has been quite high, varying between 7 and 10 publ./ten.res./year with a decline to 4 in 2007. The reason for this decline is not clear. The work of the researchers is well cited.

SEN2 – Specification and analysis of embedded systems
SEN2 has been disbanded. In the past, it has served as a breeder for many academic careers. The publication productivity has been very high, ranging between 6 and 22 publ./ten.res./year. One should, however, say that the area of process algebras is a weapon of mass production of articles. The number of PhD students was roughly 2 per tenured researcher, which is very good.

SEN3 – Coordination languages

SEN3's topics are in the centre of current SE research. The work stretches from highly theoretical, somewhat esoteric work on coalgebraic approaches to design and implementation of languages and environments. The latter seems to have quite some impact given the number of citations. There is an overlap of the covered area with SEN1. Both consider component-based design and coordination languages. Publication productivity has been very high, ranging between 5 and 12 publ./ten.res./year. The number of PhD students was rather low in the past. However, there is an increase in 2007.

SEN4 – Computational intelligence and multi-agent games

The research domain is not really centred in SE. Only in the multi-agent area it overlaps with SE. The rest of the focal areas are in quite modern parts of heuristic algorithmics. However, there is a potential for synergy, namely to choose applications from SE for the algorithmic parts. Publication productivity is very high, ranging between 11 and 20 publ./ten.res./year. Number of PhD students per tenured researcher has been very high and has decreased in recent years and is rather low now.

SEN5 – Distributed multimedia languages and infrastructures

This topic is not really well placed in the SE cluster and lacks a strong connection to main core SE. The distributed-systems aspect comes closest to main-core SE. The group seems to be far too small for the very broad and heterogeneous multimedia research domain. On the other hand, the topics are very close to application. Thus a research group at an academic research institute often has to compete with commercial projects with much higher investments. The publication productivity is satisfactory, ranging between 3 and 4.5 publ./ten.res./year. This is the lowest publication productivity in the SE cluster. Number of PhD students per tenured researcher is rather low. There may be several factors influencing this low publication productivity. The active role of the group in the development of the W3C SMIL 3.0 recommendation seems to have cost its toll. This confirms the old wisdom that if you want to get your competitor out of the way, send him to a standardization body. However, it should be stressed that standardization is extremely valuable for the community and for society in general. It just often is incompatible with basic research.
The group has also done significant implementation work.

3.3. Modelling, analysis and simulation

MAS1 – Dynamical systems and numerical analysis

Publication rate 2005-07 is good (~4/ten. staff/year), although totals are lower than 2002-04, probably because of reduction in tenured staff. MAS1 had been increasing in total staff until 2007, when it evidently lost a tenured member. This is a concern if it is to increase its PhD numbers.

MAS2 – Scientific computing and control theory

Publication rate 2005-07 is very good (~9/ten. staff/year!), showing increase over 2002-04

MAS3 – Multiscale modeling and nonlinear dynamics

Publication rate 2005-07 is very good (~8/ten. staff/year), showing increase over 2002-04. After adding a senior applied mathematician, MAS3 is still low on tenured staff. In general it is good to reduce tenure levels and increase non-tenured staff (young blood is

healthy!), but in this case another 1-2 tenured members might help, especially if MAS 3 is to become a focal group for the earth and life sciences theme.

There seem to be good interactions among all 3 MAS groups, so detailed balances of tenure/non-tenured staff in individual groups are probably less important than overall levels in MAS. Increased interaction between MAS and PNA would probably be beneficial, as recommended in the 2005 evaluation.

3.4. Information systems

INS1 – Database architectures and information access

The group is among the world leaders in research on system architectures for data-intensive applications and platforms. It has impressive results on experimental research, and has made very high impact by its open-source software, most notably, the MonetDB family. MonetDB exemplifies the group's leading role in architecting data-management systems for modern hardware, including pioneering work on column-store architectures. The group has excellent potential for successfully addressing the new challenges that come with technological trends like many-core processors or flash RAM and the ongoing explosion of digital information. Several group members have excellent standing and recognition in the CS research community, as demonstrated by keynotes, PC chair and similar positions in premier conferences, etc. The publication output is quantitatively very good, and qualitatively excellent as the group is very successful with papers in the premier, most competitive and most prestigious, venues like SIGMOD, VLDB, ICDE, SIGIR, ECIR, etc.

INS2 – Semantic media interfaces

This group has a fairly applied research agenda by developing and studying semantic-web technologies for e-culture and multimedia scenarios. This is an important direction that will further gain relevance with the data-explosion theme. The group leader has very good standing and visibility in the semantic-web and hypermedia communities, and the group seems to be very active and successful in collaborations with external partners. The publication productivity is fine; it includes some high-quality papers in ISWC and similar venues, but it does not have many outstanding papers in the absolutely premier, most highly visible conference like WWW. The productivity regarding graduate students is insufficient (one dissertation in six years). A theme that the group could perhaps explore more is to what extent semantic-web and particularly multimodal technologies could be harnessed for life sciences.

INS3 – Visualization and 3D interfaces

This group carries out very interesting work on visualization and virtual reality, an area that will further gain importance with the themes of data explosion and scientific data analysis in the life sciences. The group leader has strong standing and visibility both nationally and internationally. The group has a very good publication record, with a fair number of papers in first-rate venues; this is remarkable when considering that, in addition to its head, the group currently consists solely of PhD students. As visualization research is, to a large extent, driven by applications, the group already maintains connections with several application areas. Given that earth and life sciences are a strategic theme of CWI, it would be good to intensify exploring applications in these areas.

INS4 – Quantum computing and advanced systems research

The group is among the world leaders in quantum computing as well as specific topics of information and complexity theory, and cryptography. The group has a very agile mix of senior researchers of world-class reputation and junior people including a good number of graduate students. The publication record is outstanding, with papers in the absolutely best venues like STOC, FOCS, etc. The group has also produced very good software tools and established productive connections with life-science applications.

4. Recommendations

The review committee would like to give the following recommendations.

1. Keep a close eye on the research groups that are not (yet) positioned at the world top in their field. As a publicly sponsored research institute, without a mission in undergraduate teaching, CWI cannot afford any spots within its research profile that do not play a role in the forefront of international research
2. Increase the number of PhD students, but **not** at the expense of quality.
3. Stimulate PhDs to consider a transfer to industry after PhD completion.
4. Position CWI, both nationally and internationally, more explicitly as the breeding place for young international talent in mathematics and computer science, where they can make as post-doc a head-start for a good scientific career.
5. Intensify CWI's visibility in the international research arena through more direct involvement in conferences and workshops.
6. Place the responsibility for the development, positioning and 'selling' of the four strategic research themes at the top-level of the institute.
7. Consider a reduction of the number of research groups (and clusters) in order to improve the internal quality control, to reduce management load, to improve human resources management and to stimulate internal interaction between researchers.