Advanced School for Computing and Imaging

ASCI

Internal Assessment Report

July 2004

p/a TUD
P.O. Box 5031
2600 GA DELFT
The Netherlands

+ 31 15 27 88032
Fax: +31 15 27 86632
asci@ewi.tudelft.nl
http://www.asci.tudelft.nl

ASCI is a Dutch graduate school established in 1993 and accredited by the Royal Netherlands Academy of Arts and Sciences. Research groups of Delft University of Technology, Vrije Universiteit, University of Amsterdam, Leiden University, University Utrecht, University of Twente, University of Groningen and Eindhoven University of Technology participate in ASCI.

Preface

This report describes the research and education within the Research School ASCI (Advanced School for Computing and Imaging) during the period 1999-2004. ASCI is a Dutch national research school on advanced computing and imaging systems. The school was founded in 1993 and obtained its first accreditation by the KNAW (Royal Netherlands Academy of Arts and Sciences) in 1995.

This accreditation has to be renewed every five years (in the future every six years). Because ASCI is at the end of its second period of accreditation, a new request has to be submitted before the end of this year.

One of the steps to be taken for the accreditation request is to have an assessment by an external international committee of experts, that gives its opinion on the research and education within ASCI. As input for this committee this report has been produced.

The structure of this report reflects the two important tasks of ASCI . Part 1 gives a description and evaluation of the ASCI research activities during the past period, and a short view on the future. Part 2 gives an overview of the ASCI educational program and its results during that period. The appendices contain specific information on the educational program, the course program and the numbers of PhD students and dissertations.

Contents

1. Research in ASCI

1.1 Introduction

In this report we present a short evaluation of the research activities of ASCI. This report will serve as input to the external Evaluation Committee which has been installed by the Board of ASCI to produce an external assessment of ASCI.
We will first discuss the position of ASCI and give a brief overview of its research topics. Most of this document discusses the achievements of ASCI, including the many externally-funded collaborations between different ASCI groups and the Distributed ASCI Supercomputer infrastructure.
The increased synergy within ASCI has recently resulted in two large-scale collaborations on e-Science and multimedia, in which ASCI plays a leading role. Given the sheer size of these two projects (36 M Euro funding together), they will play a vital role in the future of ASCI research, so we discuss them in a separate section. Finally, we present some conclusions.

1.2 Position of ASCI

The research school ASCI combines on a national level research in parallel and distributed computing and imaging. Research within the school can be characterized as applied, experimental and technical computer science, focused on the integration of parallel and distributed processing techniques with the processing of sensor data, image data and other media.
Participants in ASCI are groups from Delft University of Technology, University of Amsterdam, Vrije Universiteit of Amsterdam, the University of Leiden, University of Twente, University of Groningen, Utrecht University and Technical University of Eindhoven.

The scientific position of ASCI has improved quite strongly since the previous evaluation. For many years, ASCI has tried to stimulate collaboration between its various groups by organizing (well-attended) scientific conferences and workshops, by setting up a common teaching program, and by having a common experimental computer infrastructure (DAS).
Initially, this resulted mostly in relatively small-scale collaborations between a few individual ASCI groups. The number of such collaborations has increased substantially over the past five years, which already shows the increasing synergy within ASCI. More recently, however, the long-term investments resulted in truly large-scale collaborations in which ASCI plays a leading role. In particular, two such

collaborations have been awarded by the Dutch government as part of the Bsik program (which aims to improve the knowledge infrastructure in the Netherlands):

- VL-e (Virtual Laboratories for e-Science) was a awarded a subsidy of 20 M Euro. ASCI groups from the University of Amsterdam, the Vrije Universiteit and TU Delft form the academic core of the VL-e consortium.

- MultimediaN (handling of multimedia data) was awarded 16 M Euro.
ASCI plays a pivotal role in this project; ASCI groups from the University of Amsterdam and TU Delft are the major partners in it.

In addition, the Distributed ASCI Supercomputer (DAS) now is the dominating computer infrastructure for the experimental research in ASCI. The current, second-generation system, DAS-2, is used extensively, both for local (single-cluster) experiments as well as for distributed, wide-area experiments. These systems also received much recognition in the research world. DAS-2 is currently also being opened up for several application scientists outside ASCI, for studying Grid applications. ASCI recently submitted a proposal to NWO to fund a new system (DAS-3) that should be operational in 2006.

1.3 Overview of ASCI Research

ASCI research historically comprises two main themes: Computing and Imaging. Within these themes, activities can be divided into methods & algorithms and systems & architecture. Methods & algorithms deals with the development of models and tools for scientific and industrial applications. Systems & architecture deals with the large scale integration in areas like telematics, embedded systems, communication and networks. Both types of activity are targets for fundamental and applied research within ASCI.

These themes and target areas make it possible to construct the following matrix, in which four fields can be defined.

	Methods & Algorithms	*Systems & Architecture*
Computing	A High Performance Computing and Computational Science	B Large scale distributed Information Systems and Embedded Systems
Imaging	C Image and Multimedia Sensing, Processing, Interpretation and Visualisation	D Multimedia Information Systems

1.4 Achievements

In the period 1999-2002 ASCI produced 1732 publications in journals, conference proceedings and books. The number of publications per year is given in the table below:

1999 360
2000 440
2001 442
2002 481

In addition, ASCI stimulated collaborations between its various research groups, the result of which is described in Section 1.4.1.
Many of these collaborative projects use the DAS system as experimental platform, as described in Section 1.4.2.

1.4.1 Collaborations within ASCI

The number of research projects in which different ASCI groups participate has increased substantially. Below is a summary of the most important projects:

ALIE - Advanced Logistics Information Exchange
2002, Funding: "Connect Mobiliteitsmanagement Goederen program"(45 Keuro)

AMIS (multimedia information analysis)
1996 - 2001, Funding: NWO, (1 Mfl)

An Application Driven Programming Model for High Performance Image Processing
1998-2002, Funding: NWO, 2 Ph.D. students.

ARCHER (Architecture Exploration)
2000-2004, Funding: Philips, (0.5 Mfl)

Artemis (methods and techniques to support the design of highly programmable embedded systems)
1999-2004, Funding: Progress/STW, (2 Mfl)

A structure for maintaining a shared world model in a dynamic environment between differentiated embedded systems and their interaction with human supervisors
2001-2003, Funding: STW/Progress (490 Kfl)

Biologically inspired context operators for medical image analysis
2001-2005, Funding: TUE-BME (240 Kfl)

CACTUS (Context Aware Communications, Terminal and User) 2002-2004, Funding: EZ Freeband Kennisimpuls, 3 postdocs and 2 Ph.D. students for ASCI

Corporate web structures
1997-2001, Funding: EZ-HPCN, (Kf 80)

COMBINED systems: innovative methods for disaster management.
2002-2006, Funding: ICT doorbraakproject Economische zaken (800 Keuro)

Cp2pc: a generic interface for peer-to-peer file-sharing networks.
2002, Funding Nlnet (60 Keuro).

4D imaging (tracking movement in 2D, 3D images)
1999 - 2002, Funding: NWO, (300 Kfl)

DIOC-NanoComp (subproject Multiparadigm simulation)
1999-2003, Funding: TUD, (Kf. 400)

DIPEX Project 2: Image processing, 3D visualisation and Computer Aided Surgery
2000-2004, Funding: TUD, 1 Ph.D. student, 0.5 postdoc

FAME: Flexible Application Mapping Environments
2002-2006, Funding: NWO (270 Keuro)

Gigamobile (ambient awareness for users of GSM en UTMS systems)
2000-2004, Funding: Telematica Research Center, 2 Ph.D. students for ASCI

Globedoc
1997-2001, Funding: HPCN, (fl.250,000)

IMDS (Intelligent Molecular Diagnostic System)
1997-2002, Funding: DIOC

I-SHARE (Sharing technologies for multimedia)
2004-2008, Funding: EZ BSIK Freeband, 2 postdocs and 4 Ph.D. students for ASCI

MISIT3 (Minimally Invasive Surgery and Interventional Techniques)
1999-2003, Funding: TUD (2 promovendi 0,5 postdoc

NODES (shape description methods for image analysis and image synthesis)
2000-2001; Funding: EC, (200 Kfl.)

Relevance feedback in multi-media search
1999-2003, Funding NWO (220 Kfl).

Tools for non-linear data analysis
2000-2004, Funding: STW (700 Kfl),

Ubiquitous Communications (UbiCom)
1998-2002, Funding: DIOC UbiCom (Delft University of Technology),
3 postdocs and 3 Ph.D. students for ASCI

Some of the projects (Dipex, MISIT3, UbiCom, Gigamobiel, IMDS, NanoComp) are joint projects between ASCI groups from different faculties of TU Delft, often funded by TU Delft itself (DIOCS program). All other projects are collaborations between (typically two or three) different ASCI universities. This overview thus clearly illustrates the strongly increasing collaboration within ASCI, often in the form of externally funded research proposals.

1.4.2 The Distributed ASCI Supercomputer (DAS)

DAS is the computer infrastructure used by ASCI for its experimental research. It is a wide-area distributed cluster designed by ASCI researchers. The initial system was used during 1997-2000 and was funded mainly by NWO (Kfl 810) and partially by the participating universities. It consisted of four cluster computers located at different ASCI universities. A unique property of DAS is its homogeneous structure: all clusters use the same CPU, operating system, and network, making DAS an ideal vehicle for research on parallel and distributed computing and Grids. A new system, DAS-2, was funded by NWO, the participating universities, and ASCI itself. The NWO funding (Mfl 1.6) was based on a research proposal written by an ASCI committee. DAS-2 is operational since January 2002. It also is a homogeneous system. It contains five clusters, located at Vrije Universiteit, TU Delft, and the universities of Amsterdam, Leiden, and Utrecht, and interconnected by the Surfnet network.

The usage of DAS and DAS-2 for research within ASCI has increased substantially over the years. A summary of the research on DAS-1 is given in [Bal et al., 2000]. DAS and DAS-2 have been used by more than 20 Ph.D. theses.

The DAS and DAS-2 systems also received much international attention.Workshops have been organized for the inauguration of both systems, with international keynote speakers like Ian Foster and Carl Kesselman.
Also, NWO/NCF (Dutch national computer facility) has invested 650 K Euro to extend the DAS-2 system into a Grid that can be used by application scientists outside ASCI to experiment with Grid applications.

ASCI has submitted a proposal "DAS-3: the Next Generation Grid Infrastructure in the Netherlands" to NWO for a successor system. DAS-3 will be used and co-funded by the Bsik projects VL-e and MultimediaN. Also, about 20 other projects within ASCI that have already obtained research funding plan to use DAS-3.

1.5 Future Large-Scale Collaborations within ASCI

This increased collaboration within ASCI recently led to several much larger research initiatives, in which many dozen researchers from ASCI collaborate with scientists from elsewhere. Two such proposals have recently been selected by the Dutch government for substantial funding from the Bsik program. Since these two projects will have a huge impact on future ASCI research, we describe them in more detail

below. In addition, ASCI has set up a research program together with Philips, which will also be described below.

1.5.1 The VL-e project

The VL-e (Virtual Laboratories for e-Science) project studies a topic that was already identified in the previous re-accreditation document as an "Integrated ASCI Theme": Distributed Virtual Laboratories. This research is motivated by the increasing demand for worldwide scientific collaborations and by the developments in networking and Grid computing. The VL-e project aims to boost e-Science by creating an e-Science environment and doing research on methodologies. The project will do concerted research along the complete e-Science technology chain, ranging from applications to networking, focussed on new methodologies and reusable components [WTCW, 2003]. The project consists of four program lines: applications, generic VL methodology and large scale distributed systems, and scaling-up & validation.

ASCI groups from the University of Amsterdam, the Vrije Universiteit and TU Delft collaborate in the project and together are the core of the computer science academic research of the project. These groups also receive a substantial amount of funding, about 40% of the 20 M Euro subsidy. Other partners include CWI, several research labs (AMOLF, NIKHEF) and industry (Philips, Unilever, IBM, CMG). Also, the scientific director (Prof. Hertzberger) and one adjunct director (Prof. Bal) are ASCI members. Finally, the DAS-2 infrastructure and the NCF extensions are the core of the experimental testbed used for VL-e.

1.5.2 The MultimediaN project

Multimedia is defined as audio, pictorial and textual expression of information. These forms of information are becoming an integral part of the information flow in many economic clusters. From the technical side, MultimediaN [MultimediaN, 2003] considers four themes of multimedia:
- the acquisition, extraction, and analysis of multimedia data streams
- multi-modal context-aware interaction between man and machine
- database systems and standards that organize multimedia information
- gathering or learning knowledge and metadata to gain access to the multimedia items.

In the quickly changing world of information, where the emphasis quickly shifts towards multimedia, the objectives of MultimediaN are:
- To build an outstanding science core and a virtual multimedia lab with a co-ordinated and steerable research plan with strong industry participation;
- To transfer fundamental and applied science and know-how to the ICT-world;
- To articulate questions into new research challenges;
- To demonstrate their use in pilot applications;
- To reinforce the skill- and innovation-transfer between multimedia research and the market by generating a transparent view on technology by means of demonstrators.

ASCI plays a major role in this project too. It provides the leadership of MultimediaN through the University of Amsterdam (prof. Smeulders is director of the project), with a contribution in image and video retrieval. MultimediaN also contains TU Delft as a major partner (e.g.,
prof. Biemond is a member of the steering committee), with a contribution in video and speech analysis. The University of Utrecht (dr. Veltkamp) participates in MultimediaN for music retrieval. In MultimediaN, ASCI has active collaboration with SIKS through the contributions of CWI and the University of Twente, another sign of the interactive research
potential of ASCI. Other contributors of MultimediaN include TNO, the Telematics Institute, Philips, IBM, LogicaCMG, the Forensic Lab of the Netherlands, Oce and some ten more high tech industries, content owning institutions, first time users, and application fields.

1.5.3 The Progress projects on embedded systems

ASCI has set up a research program together with Philips Corporation on future consumer electronics (CE) devices. In order to set the goals of the research programs, two workshops have been organized (one in 2002 and one in 2003). Subsequently, three related project proposals have been submitted to and granted from STW (the Dutch national technology foundation) in the Progress program on embedded systems. The three projects are SCALP, Artemisia, and PreMaDoNa.

- The SCALP project focuses on new software engineering methods for the design of scalable, portable, and predictable CE applications on a new generation of embedded architectures;
- The Artemisia project focuses on the optimal mapping of a set of representative domain specific (video) applications onto a domain specific NoC-based platform under a set of non-functional constraints;
- The PreMaDoNa project focuses on the design of NoC-based (netwerk-on-a-chip) real-time systems in a predictable way and guaranteeing proper response under dynamic resource changes.

The three projects in total account for 29 FTE PostDoc and PhD person years, plus 300 kEuro investments (in total approximately 1.8 Meuro). Additionally Philips will invest over 2 Meuro in person-years in the projects.

1.6 Conclusions

Despite the lack of funding for research schools, ASCI has managed to make much progress over the past five years. The long-term investments to foster collaboration (e.g., joint conferences, workshops, education program) are now showing clear results. Many collaborative projects have been initiated and funded. The shared computer infrastructure, DAS, has proven to be an extremely useful facility for experimental research. These developments have almost naturally led to two very large-scale collaborations on e-Science and multimedia, which will play a dominant role in ASCI research over the next five years.

References

[Bal et al., 2000] H.E. Bal et al.:
"The distributed ASCI supercomputer project",
ACM Special Interest Group, Operating Systems Review,
Vol. 34, No. 4, p 76-96, October 2000.

[WTCW, 2003] WTCW n.v.:
"Virtual Lab e-Science - Towards a new Science paradigm",
A Bsik proposal, Febr. 2003.

[Stichting MultimediaN, 2003] Stichting MultimediaN:
"MultiMediaN", A Bsik proposal, Febr. 2003.

2. Education in ASCI

2.1 Introduction

In order to be accredited by the KNAW (Royal Netherlands Academy of Arts and Sciences), every Dutch research school has to provide an educational program for its PhD students. In this chapter we present this program as it is organized in ASCI, and an evaluation of it.

2.2 The ASCI Educational Program

The ASCI educational program consists of the following elements:

- **The ASCI course program.** ASCI has a course program consisting of courses taught by ASCI staff members. These courses last up to five days and may involve lab work. The form of examination varies among the courses; for instance, courses may require completing a set of exercises, writing a short paper, and/or giving a presentation. ASCI PhD students are required to take three courses, at least two of which are offered by ASCI and a third of which may be taken from another research school in computer science in the Netherlands. The next section provides more detail about the course program.

- **The annual ASCI conferences.** In 2004, the tenth annual ASCI conference has taken place. The annual conference has a format of 2.5 days and is meant to be a meeting place for ASCI staff and PhD students. The program includes keynote lectures by outstanding scientists from abroad, theme presentations on research areas in ASCI by staff members, and paper and poster presentations by ASCI PhD students and staff members. Here, PhD students may get their first experience in presenting their research in public. The attendance of the 2004 conference was about 40 staff members and 60 PhD students. In 2004 for the first time, for every presentation by a PhD student, another PhD student was asked to give feedback on the quality of the presentation.

- **ASCI workshops.** In principle in the fall of every year, PhD students in computing organize the so-called GNARP workshop (GNARP stands for Graduate Network of Applied Research in Parallel systems). At these workshops, PhD students present and discuss their current research in a very informal atmosphere, and get feedback on their presentations from ASCI staff members. Due to a temporarily rather low number of PhD students in computing, the GNARP workshop was not organized in 2002 and 2003, but it has been successfully revived in march 2004. In view of the increasing number of PhD students in computing, we do expect GNARP also to be organized in the coming years. There is also an Imaging workshop every two or three years, which is organized by staff members. As part of their education plan, ASCI PhD students have to give presentations at least at three conferences or workshops (of ASCI or otherwise).

- **Summer schools.** PhD students can also earn credits by attending summer schools in their field.

- **Local training.** The active participation in local colloquia and progress meetings are also considered to be part of the educational program.

The ASCI Education Regulations (see Appendix 1) specify the requirements for the individual education plans of the PhD students. Before a PhD student is admitted to ASCI, his education plan has to be approved by the PhD Admissions Committee, which consists of the scientific director of ASCI and the chairmen of the Educational and Scientific Committees of ASCI. After having completed his individual education plan and after having defended his PhD thesis, a PhD student receives the ASCI certificate signed by the scientific director of ASCI.

2.3 The ASCI Course Program

Appendix 2 contains the current list of ASCI courses. These courses reflect the main areas of computing and imaging in ASCI.

At the start of the assessment period (july 1999), ASCI offered 16 courses. In 2001, the course Highly Parallel Computer Architectures (a3) was discontinued because one the lecturers of the course left ASCI. In addition, in 2003, the low participation in the computing courses was perceived as a problem. Therefore, it was decided to discontinue the two courses Exploiting Instruction Level Parallelism: Architectures and Code Generation (a7) and Performance Modeling of Parallel and Distributed Systems (a15), and to restructure the course Embedded Systems (a16) to include some elements of courses a7 and a15. As a result, the number of courses currently offered by ASCI is 13.

In order to improve the attendance of the computing courses, in march 2004 the course Embedded Systems was organized as a one-week “winter school” at a nice location in Zeeland (in the south of the country) where all the participants stayed overnight. The first four days consisted of the course proper with lectures by the ASCI lecturers of the course and by 12 experts in the field (including 5 other ASCI staff members, 4 scientists from Philips, and 2 from abroad). On the fifth day, the GNARP workshop was organized. This winter school was very successful with an attendance of the course of 28 ASCI PhD students, 5 non-ASCI PhD students, and a total of 15 senior researchers. The attendance of the GNARP workshop with 12 presentations was about 20 PhD students and 5 staff members. We do intend to organize such a winter school again, although probably not already in 2005.

As has been mentioned above, PhD students are allowed to take one course offered by another research school. For this purpose, ASCI has formal relationships with the research schools DISC, ImagO, IPA, SIKS, and OzsL. The courses offered by these schools are recognized by ASCI, and ASCI PhD students have free access to them. In return, students of these schools have free access to courses of ASCI. ASCI has a similar agreement with an imaging group at the Ecole des Mines in Paris.

In order to stimulate the integration of the two main research areas in ASCI, two courses of the ASCI course program have an introductory character: the basic courses

on computing (Parallel Programming, a14) and imaging (Front-End Vision and Multiscale Image Analysis, a8) are especially meant for PhD students in the fields of imaging and computing, respectively. Except for the basic imaging course, which takes place every year, all ASCI courses are taught every two years, which enables PhD students to attend their courses in the first half of their PhD period.

As a matter of policy, ASCI courses are taught by staff members of at least two participating universities. An obvious advantage of this way of cooperation between lecturers is that the material covered by the courses is taught from different points of view.

2.4 Evaluation

In Appendix 3 we show the enrollment in the ASCI courses in the assessment period 1999–2004. In this period, in total 286 ASCI PhD students and 226 non-ASCI PhD students took an ASCI course, so the ASCI courses also attract large numbers of students from outside ASCI. Clearly, some courses attract many more students than others, with the imaging courses overall having the largest numbers of (external) participants. The current course program covers the ASCI research quite well, although there is some concern that the number of computing courses is rather low.

In Appendix 4 we show the total number of PhD students in ASCI and the number of PhD admissions and PhD thesis completions. As can be seen, the number of admissions and the total number of PhD students is increasing, with currently over 25 admissions per year. The number of PhD theses is about 15 per year, but this number is based on the number of admissions of five years ago. In the assessment period 1999-2004, in total 81 PhD students have successfully defended their theses, of which 65 have also completed their education plan and obtained the ASCI certificate. The list of PhD theses can be found in Appendix 5.

At the end of each ASCI course, the participants get a questionnaire with questions about such things as the quality of the course content, the course material, and the lectures. The lecturers get a summary of the results of these questionnaires.

The ASCI Educational Committee meets once a year. At these meetings, all ASCI courses are discussed and evaluated based on the results of the questionnaires and the numbers of participants. This evaluation may result in a proposal to the Board of ASCI for modifications of the course program. Among the reasons for discontinuing a course are too low a number of participants and a lecturer leaving ASCI; a reason for including a new course is when a new research group becomes part of ASCI. At the last meeting in April 2004, it turned out that overall, the results of the questionnaires for all courses were very good. For two courses with many lecturers, the relation between the subjects of the course was considered non-optimal. The coordinators of these courses have been asked to see whether this can be improved, although we consider this to be a not necessarily negative consequence of different views on the subjects. We conclude that the current course program consists of very good courses.

2.5 Recommendations of the ASCI 1999 Evaluation

In this section we comment on the recommendations of the ASCI Evaluation Committee 1999 that are related to the educational program.

2. The KNAW should endorse a stronger legal status of the course education within the Dutch research school system.

   Since 1999, no action has been taken.

3. The boards of the universities should provide an adequate financial reward for the educational (courses) program.

   Since 1999, no action has been taken, and so the lecturers and their groups do not receive any compensation for their work on courses. We do perceive this as an obstacle for lecturers to propose new courses, or to update current courses.

4. Whenever it becomes possible without loss of ASCI students, the course content of the PhD study should be increased.

   In the current situation, quite a few PhD students have difficulty completing their education plan. As there is no obligation to do so in the Dutch system, we do not regard increasing the course content a viable option.

2.6 Appendices

1. ASCI Education Regulations
2. ASCI Course Program
3. Enrollment in ASCI courses in 1999-2004
4. Numbers of ASCI PhD students in 1999-2004
5. List of PhD theses produced in ASCI in 1999-2004