This publication is produced according to the high environmental standards of the Swan ecolabel.
Simula is on a path toward being a completely international and multicultural organization.
Simula is the proud host of a Centre of Excellence and a Centre for Research-based Innovation.
Dedicated to tackling scientific challenges with long-term impact and of genuine importance to real life, Simula offers an environment that emphasises and promotes basic research while still covering the broader landscape from postgraduate education to application-driven innovation and commercialisation.

Simula RESEARCH LABORATORY

- A non-profit, public utility enterprise organised as a limited company owned by the Norwegian Ministry of Education and Research.
- Performing research at a top international level, conducting research education in collaboration with the University of Oslo, and fostering innovation based on conducted research.
- Established in 2001 and headed by Professor Aslak Tveito since 2002.

- Conducting basic research in the fields of communication systems, scientific computing, and software engineering.
- Proud of its international environment and cultural diversity, employing 126 exceptional minds from 25 different countries.
- Ranked by the Journal of Systems and Software as the world’s most productive institution in systems and software research.
- Host for the Center of Biomedical Computing, which is a Centre of Excellence (SFF) awarded by the Research Council of Norway.

- Host for the Certus Center for Software Verification and Validation, which is a Centre for Research-based Innovation (SFI), awarded by the Research Council of Norway.
- Main research partner in the Centre for Cardiological Innovation (SFI), awarded by the Research Council of Norway and hosted by Oslo University Hospital.
- Cooperating with industry in order to provide solutions and increase the research’s relevance. The largest stand-alone industry collaboration is with Statoil, and is worth 125 million NOK (2005-2015)

- Funded by the Ministry of Transport and Communications for the Resilient Networks Project, which is working to understand the vulnerability of network infrastructure in Norway.
- Since its inception in 2001, Simula researchers have supervised 54 PhDs and 227 master’s degrees to completion.

KEY FIGURES 2011

- Operating Revenue: NOK 121 mill
- Operating Result: NOK 5.8 mill
- Basic Allowance: NOK 55 mill
- Employees year-end: 126
- Active PhD students: 32

- by thinking constantly about it
Internationalization seems to be accelerating, and we see the effects of this at Simula. When I took over as leader of Simula in 2002, one year after its inception, we had employees from six countries, and 12% of our employees were non-Norwegian. Today, 25 countries are represented, 47% of our staff is non-Norwegian, and 50% of our department managers are non-Norwegian. Clearly, Simula relies heavily on researchers hired from abroad. In part, this is due to the general trend of internationalization of research, but it is also a firm result of our strategy to hire the best researchers we can find. Over the last couple of years, Simula has been extremely successful in attaining new funding. (For an overview of new projects, see page 33.) Furthermore, our production has increased significantly and we have received favourable evaluations. Many – if not all – of these results rely heavily on the excellent contributions of our non-Norwegian employees. Simula has clearly benefited from the internationalization of research.

At the end of 2011, we announced an open post-doc position and we received applications from 36 very well qualified candidates; two of them were Norwegian, and we ended up hiring a candidate from India with a PhD from the US. This illustrates the ongoing process of internationalization; Simula is on a path toward being a completely international and multicultural organization. This path is fully aligned with our overall strategy of becoming an internationally leading organization in our fields of interest.

A strong force in the internationalization of research is clustering around very strong groups. Researchers always want to be part of the leading groups within their fields. This force has important implications for organizations active in research and higher education. In Prime Minister Korvald’s time, it was an adequate goal for an institution to lead at the national level. Today, leading at the national level – at least in Norway – is of little interest, since students and researchers seem to discard national boundaries and gravitate toward internationally prominent groups. Therefore,

[1] Lars Korvald (29 April 1916 – 4 July 2006) was the Prime Minister of Norway for one year beginning October 1972 in the wake of the first referendum over membership in the EU; see http://en.wikipedia.org/wiki/Lars_Korvald.
institutions need to define a strategy that concentrates on specific fields, and they must focus their efforts and resources accordingly. Within these fields, they can become influential internationally, achieve better funding, attract the best employees, and do great science. Institutions that do not realize and accept this will become marginalized and eventually decline, and perhaps even disappear. The education market follows the same trend; why should a brilliant student follow a mediocre program in one place, if another place has excellent opportunities?

There is every reason to believe that internationalization of research and higher education will continue with full intensity. It is therefore of great importance for Norway to focus its resources spent on research and education such that it develops and maintains research groups of the highest quality, along with educational programs that can compete among the best around the world. In order to attract researchers from around the world, it is essential to offer conditions that compete with other institutions. Simula – and other research organizations in Norway – compete very well regarding conditions such as salary and infrastructure for their researchers. However, Simula has until recently suffered on one decisive point: we have not been able to assure long-term contracts for excellent researchers. This is because our basic funding has not been adjusted for inflation. We are therefore extremely pleased with the recent decision by the Ministry of Research and Higher Education to adjust our basic allowance starting with the next fiscal year. Therefore, Simula is now well positioned to fully compete in the global market for research and education.

We have kept our focus on three specific fields of research over 10 years, and there are no plans to change this. Further, we are well staffed with excellent researchers from many countries, we have identified strong international partners, and we have systematically increased our collaboration with them. As a result of this policy, I am writing this little piece sitting in my temporary home in La Jolla, California, where I am spending the year as a guest researcher at the University of California, San Diego.
THE CERTUS CENTRE

Model-Driven Software Engineering and extensive industry collaboration is the primary strategy of the Certus Centre. As in other engineering disciplines, models in software engineering should play a central role to enable abstraction, separation of concerns, and early analysis of requirements, architecture, and design. In our experience this is the most effective way to provide automated, scalable support for Verification and Validation (V&V).

Certus, initiated in 2007, is the only research group in Norway that has a strong focus on model-based software V&V. Industry collaboration is a primary focus of Certus in order to identify relevant research questions and to develop applicable solutions.

Certus partners span both the commercial and governmental sectors, and include entities such as FMC Kongsberg Subsea, Cisco, and the Norwegian Customs and Excise department. In January 2011, the Research Council of Norway awarded Certus the status as Centre for Research-based Innovation.

The maiden flight of Ariane 5 on 4 June 1996 failed, with the rocket self-destructing after 37 seconds, because of a malfunction in the control software. History is full of such software failure examples: airplanes have crashed, patients have died from incorrect medication, financial systems have broken down, and cars have been recalled from the market due to software bugs.

In 2002, the US National Institute for Standards and Technologies (NIST) estimated that the direct cost of software failures in the American economy reached USD 60 Billion annually. Today, this cost is probably much higher. NIST claimed that most software verification and validation activities are poorly managed and not supported by appropriate, scalable technologies that would be necessary to increase system dependability. The Certus Centre has the ambition to improve this situation, which has remained mostly unchanged over the last decade.
SOFTWARE VERIFICATION AND VALIDATION
Software is pervasive in all areas of society. Business and safety critical systems are increasingly using software to improve productivity, enable more sophisticated operations, and provide flexibility in handling evolving needs. To ensure successful delivery of its function and to avoid posing undue risks to its users or the environment, software must be reliable, robust, efficient, safe, and secure. All these properties are facets of a more general property often known as dependability. Improving system dependability first and foremost relies on the ability to verify and validate (V&V) software systems in a cost-effective manner. In the current state of practice, software V&V is costly, laborious, and often incomplete due to the lack of practical, automated, and scalable technologies.

INDUSTRIAL IMPACT
Despite the existence of commercial environments for test scripting and execution and a handful of tools for model-based testing, little of the V&V research has ever made it to industrial practice. Further, little is known about the cost-effectiveness of most V&V technologies because limited empirical evidence exists regarding their benefits and cost. Scalability is a particularly acute issue because many proposed analysis techniques and software testing strategies often do not scale up to the size and complexity of modern systems.

These shortcomings are not only the result of inadequate technologies and management techniques, but they are also due to a lack of technology transfer from the research community to industrial practice as well as a superficial understanding of industrial V&V challenges by many academic researchers. To have impact, one must strike a balance between rigor and effort, such that software artefacts can be analysed effectively, without being too expensive to build and evolve.

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Tao Yue, Research Scientist
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Davide Falessi, Research Scientist
Dusica Marijan, Postdoctoral fellow
Jose Gonzalez, Postdoctoral fellow
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* at end of 2011
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The Better Estimation of Software Tasks department conducts multi-disciplinary research. We build on theories from software engineering, forecasting, program comprehension and reverse engineering, architecture and project management. There is a strong link to psychology, which is the background of several of our researchers. Our research in software quality assessment builds on expertise in automated software analysis and software repository mining. Experience and understanding of project management in very large projects is required, and strengthened through industrial collaboration.

We have made important steps in improving the understanding of the mental steps of expert estimation, including a better understanding when we can trust experts’ judgments. This work has lead to improved estimation practices related to how to select proper project analogies, why and how to avoid unwanted impact from irrelevant information, and how to select proper estimation experts. We have also contributed processes that lead to more realism in the assessment of the uncertainty of the effort estimates, improved learning from experience and improved software bidding processes.

A MATTER OF JUDGEMENT
The ability of software customers to base investment decisions on accurate cost estimates is strongly tied to the ability of software providers to estimate the effort accurately. Similarly, the ability of project managers to plan a project, ensure efficient development work, and avoid failures frequently depends on accurate effort estimates. For continued development of existing software, estimations ideally build on quality assessment of the existing parts.

The potential to improve these estimations is believed to be high. First, a strong bias currently exists towards over-optimism in the cost estimates. Second, estimates suffer from a high degree of inconsistency. Third, the use of historical data and knowledge gathered from existing artifacts is limited.

Fourth, there is a lack of evidence-based selection of estimation methods. Finally, automated software inspection can correct problems early, when changes are still relatively inexpensive.
EVIDENCE-BASED EXPERT ESTIMATION
The understanding of how estimates for the cost and effort to develop software are derived is not well understood. Over the past 30 years, the software industry has been unable to improve its capability to accurately plan and estimate the cost of software projects, and the level of cost overrun and poorly managed projects remains high. Our department aims at developing an evidence-based theory of expert estimation.

MORE ACCURATE EFFORT ESTIMATES
We aim to construct new methods for effort estimation by combining the advantages of models and judgments, and improving the selection of estimation methods. We take a multi-disciplinary approach to this challenge, applying results from software engineering, psychology, forecasting, and project management.

EVIDENCE-BASED SOFTWARE INSPECTION AND ASSESSMENT
Building on research in city planning and architecture, we are investigating how a map metaphor can help software engineers explore and assess software systems. The aim is to develop novel techniques and tools that will improve the cost-effectiveness and efficiency of automated software inspection techniques, and advance the state-of-the-art in software assessments.

Our current focus is on the planning, cost estimation and quality assessment of very large projects in industry. Some of these projects have cost overruns of billions of dollars and waste huge amounts of scarce resources.

The development of the Flexus ticketing system took very long time, had a large budget overrun, and was delivered with much less functionality than planned.
The Cardiac Modeling department’s research aims to elucidate mechanisms behind cardiac pathologies and to identify targetable processes, thus contributing to both a better understanding of cardiac arrhythmias and mechanical dysfunction, and improved long-term prevention and intervention. Recently, our department has focused on the role of several factors modulating arrhythmias and cardiac disease.

An ultimate goal is to harness clinical and industrial feedback, employ developed models via advanced techniques to assist in clinical practice, and inspire further elucidative experimental studies, resulting in an iterative and integrative research pipeline.

The department is associated with a Norwegian Center of Excellence, the Center for Biomedical Computing (CBC). Cardiac Modeling is also a main research partner in the new Center for Cardiological Innovation (CCI), a Norwegian Centre for Research-based Innovation hosted by Oslo University Hospital and partnered by GE Vingmed Ultrasound.

WE NEED SAFE, EFFECTIVE, AND ACCESSIBLE THERAPIES
Despite the vast number of available pharmacological therapies to combat cardiac electrical and mechanical dysfunction, few have significant therapeuti effect. Novel strategies for drug therapy in cardiac disease are urgently required. This subfield is ripe for contributions and insight from modeling and simulation, which can not only provide novel understanding, but decrease costs associated with traditional experimental development.

Our research has focused on cardiac cell- and tissue-level electrophysiologi cal models. For instance, we have successfully employed detailed Markov and Hodgkin-Huxley-based models to predict how drugs targeting mutations of the SCN5A gene affect global electrophysiology.
WE NEED TO CLOSE THE GAP BETWEEN VIRTUALITY AND REALITY

“Patient-specific simulation” has been a buzzword in personalized medicine. Generally, this refers to use of advanced medical imaging and techniques to create biophysically-based models offering increased insights in diagnostics, intervention, and treatment planning.

Traditionally, triage for cardiac care comes from evaluating patient measurements (e.g. echocardiography, ECG, MRI) against derived statistics of outcomes. However, individual humans are extremely complex and show great diversity. The need to treat the patient, rather than the disease, represents a substantial challenge and motivates increased use of mathematical models and computer simulations in clinical cardiology.

For example, one modern clinical treatment for heart failure is pacemaker-based cardiac resynchronization therapy (CRT). However, diagnostic methods for determining who will benefit from CRT are poor. To exploit CRT’s full potential, better tools are clearly needed. A system that could predict patient-specific cardiac function directly from echocardiography and ECG measurements would be a potent and innovative clinical tool. We propose to achieve this via patient-specific computer simulations prior to pacemaker implantation, optimizing metrics that lead to a positive pacing response. Creating such a tool is a substantial challenge that requires expertise from the clinic as well as industry, but one that will allow clinicians to personalize CRT with a higher level of confidence in its success for the patient.

There is good news: all the pieces are there. We just need to close the gap.

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BIOMEDICAL COMPUTATIONS

The Biomedical Computation department is the core of a prestigious Norwegian Center of Excellence, named Center for Biomedical Computing. The center’s long-term goal for its period of duration, 2007-2017, is to develop and apply novel simulation technologies to reach new understanding of complex physical processes affecting human health, by targeting selected medical problems where insight from mathematical modeling can contribute to changing clinical practice.

A key mission is to make new methods and software accessible to computational scientists and engineers through professional, open source software. This original software (primarily FEniCS) will help to advance many other scientific fields dealing with complex multiphysics problems, because the underlying mathematics and solution methods are the same across disciplines.

Our research approach relies on well-defined projects with multi-disciplinary teams, consisting of local staff interacting with internationally acknowledged experts in physical modeling, mathematics, numerical methods, scientific software development, bioengineering, medical research, and clinical treatment. The novelty of the research lies in our ability to attack the questions by a broad natural science approach and describe medical processes by mathematics, physics and biology.

Why do people with a malformed lower part of the brain occasionally develop cysts in the spinal cord, causing severe medical problems? We use computer simulations to test medical hypotheses from a physical point of view. Extensive computer modeling and simulation have helped to confirm the idea that abnormal anatomy leads to abnormal fluid flow in the spinal canal, which again may lead to pressure deviations in the spinal cord.

Through such an approach, we can develop theories to gain new understanding that previously would be impossible, unethical or impractical with real experiments or classical theory.

EQUATIONS, BITS AND

Today, the computer can be used as a virtual laboratory. Our department in biomedicine.

CAN SOFTWARE BE SIMPLE, GENERAL AND RELIABLE, YET EFFICIENT?

Traditionally, simplicity, generality, reliability and efficiency are contradictory goals for simulation software. However, due to the FEniCS Project, simulation codes that would normally take an expert months or even years to program can now be developed by novice users in a fraction of the time. This is possible by simplifying and automating the task of solving mathematical models based on partial differential equations (PDEs).
RELIABLE COMPUTER SIMULATIONS
Numerical simulations can be inaccurate or just plain wrong. Physical and visual inspections of solutions are not sufficient because even wrong solutions may look plausible. Instead, reliable error estimates should be used to assess the accuracy of numerical results. Unfortunately, such estimates are not in widespread use because of their mathematical and programming complexity. However, in the FEniCS Project we are well underway to automate the computation of error estimates for any given numerical simulation.

CAN PATIENT-SPECIFIC SIMULATIONS PREVENT STROKES?
The computational tools we develop in the FEniCS Project enable us to investigate complex three-dimensional physiological processes taking place in individual patients. Simulations can indicate the necessity of surgery, and predict certain effects of different surgical options. These computations can be used to save lives, validate theories and hypotheses, and gain new insight capable of changing medical practice and understanding.

The upper 10% of the kinetic energy in two different aneurysms. The aneurysm to the left focuses the energy at the top and ruptures, while the right one dissipates the energy throughout the whole aneurysm.
SOLVING THE “PUZZLE EARTH”
When continental drift was discovered, scientists realised that the surface of the Earth was radically different tens to hundreds million years ago. Once the world was accurately mapped, fitting the outline of the continents together, like a puzzle, showed that the similarities weren’t a coincidence; the idea of the super-continent Pangea was born. Such reconstructions are now done by computers and refined by our understanding of the rifting processes between the continents. However, developing a single model of this type is time consuming and involves making many assumptions. Thus, hypothesis testing is difficult. We aim at solving this refined “Puzzle Earth” by applying new software and methods that allow us to track the uncertainties and enable us to evaluate the likelihood of a particular fit of the puzzle.

GOING BEYOND GAMING:
Graphics Processors in Geoscience
The graphics processing unit or GPU is the fastest developing technology in the modern computer. Recently, hybrid supercomputers with large numbers of GPUs have been developed. Such computers provide the potential for large amounts of computer power at far reduced power consumption rates but are difficult to program. Just as Google Translate automatically translates webpages from one human language to another, new technology is allowing scientific software to be automatically optimized for use on a GPU. This automated framework has the potential of considerably enhancing the productivity of computational geoscientists, letting us focus on the scientific questions.
CHALLENGES IN INDUSTRIAL COMPUTING

There are two principal challenges with geological observations: the time problem and the space problem. Geological observations are obtained in the present, but are used to infer the history of the Earth over millions of years. When developing models of the Earth's evolution on those time scales, we cannot validate the model with direct observations of its past state: the time problem. As for the space problem, we are unable to dissect the Earth except for small portions found at the surface or when drilling. While we can make indirect observations, for example by measuring the Earth's magnetic or gravity field, again models have to be developed to link that to the internal structure. To solve this problem, we are investigating ways of best using the available data to constrain model parameters, choose a particular model over another or quantify the uncertainty of our model based on our assumptions.

COMPUTATIONAL GEOSCIENCE AT SIMULA

The department consists of scientists with a mix of nationalities and academic backgrounds. Our team includes geophysicists, geologists, applied mathematicians, statisticians, computer scientists and physicists. This interdisciplinary environment breeds innovative geoscience of relevance to academia and Norwegian industry. Since 2005, Simula has had a close collaboration with Statoil, addressing computational challenges related to oil and gas exploration. Statoil funds a significant portion of the department's research and the development of supporting software by Simula's commercial subsidiary, Kalkulo.

* at end of 2011
** in adjunct position
When you press “search” on your device, a machine owned by your telecom operator authorizes your usage of the network. A second machine translates the text “www.searchprovider.com” into the physical address of the right server park. On its way from your cellphone to the server park, your request is handled and forwarded by a base station and tens of routers and switches through the Internet. Within the server park, there are thousands of processors that are connected through an interconnection network. Tens of switches and processors in the center are involved in processing your request, before the answer is sent back to you – possibly through another Internet path than the inbound one. For your simple search to work, literally hundreds of computers need to collaborate without faults.

UNDERSTANDING AND IMPROVING NETWORK ROBUSTNESS

We face the challenge of understanding and improving the robustness of complex interaction between machines. This challenge involves studying the unprotected and rugged environment of wireless communication, leading to new protocols. This understanding involves finding solutions to how millions of machines in a datacenter should be interconnected. With so many components in the center, there will never be an instance of time when all of them are fault free. Furthermore, new mechanisms are needed to keep national and global infrastructures functional through breakage incidents and unplanned events.

The complexity of data communication combined with the opaqueness of network structures and data center designs complicates the picture. Therefore, we need to approach the Internet by observations and measurements similarly to the way science has approached complex natural phenomena. Based on observed properties, we can define strategies and architecture that support the robustness and trustworthiness that we demand of our applications.

TECHNICAL CORNERSTONES IN SOCIETY

Networks are rapidly becoming the technical cornerstones of society’s infrastructure. We have seen reports of network failures having stopped businesses, grounded airplanes, halted trains, hampered hospitals and treatment services, and isolated police forces. The evidence is widespread that networks are single infrastructures of failure for many services and functions that we depend on.
When electronic communication between patients and health personnel allows disabled and elderly people to live longer in their homes, this is safe only as long as the network is operational. For these reasons, we are working on the improvement of network trustworthiness.

The Network Systems department attacks the problem of trustworthiness along multiple axes. Through detailed analysis and mathematical modeling we understand properties of protocols for wireless access. Through simulation, we can understand the properties of network devices that have not yet been realized in hardware. Through measurements of existing networks, we assess their properties, and based on these properties, we devise new solutions that build upon the strengths and weaknesses that the measurements expose.

The Network Systems department collaborates with universities in Asia, Europe and America. Equally important, however, is the contact with the owners of the problems we work on. Our research results have been taken up by multinational companies, as well as by small national ones.

When we move more of our services, software and computational platforms into the cloud, these things will be available to us only as long as the network connects us to them. When thousands of small green energy installations in the homes are able to produce power into the SmartGrid, our energy production will only work as well as the communication network that it uses to synchronize its production and distribution of electricity.
MEDIA PERFORMANCE

Multimedia services comprise a large part of the available Internet services today, and the interaction with digital media pervades most people’s everyday lives at home and at work. Video streaming, Voice-over-IP and online games are some prominent examples, which raise strict requirements to the entire system performance.

To provide best possible service quality, reduce bottlenecks and reduce costs, it is important to optimize the utilization of available resources and adaptively schedule access to all the different components.

The Media Performance department is active in several areas of distributed multimedia systems, but the branches of our research fit together to form one big picture. To maintain a firm grasp of the complete picture, we collaborate with national and international industrial and academic partners. We prefer to conduct experimental research, but do not tie ourselves to this or any other particular method.

Addressing the challenge of supplying interactive multimedia to Internet users, the Media Performance department seeks to reduce costs, increase the number of users, and optimize the perceived service quality. This goal ties together research areas that are as diverse as multicore programming and user perception. Our research keeps a global scope, since any level of a system may constitute a performance bottleneck.

VIDEO DELIVERY SYSTEMS

We cover a range of video delivery systems, from traditional video streaming, via video search, to 3D representation of content and delivery of free-view video. In a fairly mature part of the field, we address questions of efficient delivery and best user experience when using the adaptive segmented HTTP streaming that is currently favoured by industry. In a very young part of the field, we investigate means of combining video streams from sparse camera arrays that monitor large spaces to generate 3D scenes in real-time and deliver them to viewers.

One particular new result that we presented in 2011 was a new algorithm and prototype that was developed in cooperation with Netview Technology AS, which used GPS-based throughput measurements to crowdsource a database for bandwidth prediction on commuter routes; another result demonstrated that congestion control can interfere with server performance in adaptive TCP streaming systems such as MPEG DASH and Microsoft Smooth Streaming.
PERCEPTUAL VIDEO QUALITY ASSESSMENTS
To make the right decision in video coding, adaptation during transport and rendering on users’ screens, it is necessary to understand how these decisions affect the people watching the result. Limited resources always inhibit the delivery of perfect quality. Adapting to available resources involves a choice of, for example, compression method, target bandwidth, quantization factor, resolution or frame rates of videos. Whether decisions are good depends on external conditions, as well as content and user intent. We address the wide-open research field of good decision making.

Our work on perceptual quality evaluation led to new insights into video quality perception on mobile devices. We confirmed in more stringent experiments that infrequent switching of video quality is generally better for viewers’ impression of quality than frequent switching that may exploit available bandwidth better. These experiments uncovered furthermore that quantization is the most beneficial scaling factor once scaling becomes necessary.

DISTRIBUTED DATA PROCESSING
Multimedia applications, especially in 3D, generate large data volumes that must be processed in a timely manner. With growing complexity and an increased user expectation, the computational demand for multimedia data processing grows. The latest hardware architectures use an increasing number of heterogeneous multi-core processors to cope with the demand for computing power. Developers find it much harder to develop applications for such architectures than for homogeneous sequential ones. We investigate how multimedia applications can be developed for and deployed on such architectures.

DATA COMMUNICATION
Existing data communication protocols are designed for best-effort networks. Today, transport protocols are optimized for high-bandwidth applications like plain file transfers and web browsing. Interactive distributed multimedia applications, however, have a different requirement: the delivery of small amounts of data within consistently short times. Our department investigates new protocols and mechanisms that address this challenge and that are realistically deployable on the Internet.

In 2011, we extended our successful cooperation with Funcom, as well as various other national and international partners to deepen our exploration of Internet latency and ways of improving it. Our cooperation with Uninett, Cisco, CAIDA, Funcom, and the Universities of Oslo, Kaiserslautern and Karlstadt, was rewarded by the research council with the granting of a new project, Timeln, that succeeded against extremely tough competition.
Simula Research Laboratory AS is part of the Simula Group and performs fundamental long-term research on selected aspects of software and communication technologies, with the aim of contributing to creativity and innovation in business.

In its 10th operating year, the Simula Research Laboratory AS and the Simula Group achieved a turnover of NOK 97.4 million and NOK 121.1 million, and net profits of NOK 4.3 million and NOK 5.8 million, respectively.

ADMINISTRATION AND ORGANISATION
Simula is organised as a limited company under the ownership of the Norwegian Ministry of Education and Research. The company combines academic traditions with recognised business management models.

Simula Research Laboratory AS (Simula) is the parent company of Kalkulo AS, Simula Innovation AS and Simula School of Research and Innovation AS. Kalkulo and Simula Innovation are wholly-owned subsidiaries, while Simula School of Research and Innovation is owned by Simula (56%), Statoil (21%), the municipality of Bærum (14%), Telenor (7%), the Norwegian Computing Center (1%), and Sintef (1%).

The parent company and its three subsidiaries have close cooperation, and are located at Fornebu, in the municipality of Bærum.

ACTIVITIES AND PRODUCTION
Simula conducts fundamental long-term research on communication in computer and mobile networks, scientific calculations, and methods for developing and testing extensive software systems. The research focuses on fundamental challenges that combine technological development with value for industry and society as a whole.

Simula’s research is published in international scientific journals and by leading publishing companies. In 2011, Simula’s research featured in 49 articles in international journals, 1 book, 5 chapters in books and 62 conference articles.

Over the course of 2011, Simula’s scientific employees supervised 8 doctoral candidates and 20 Master’s students to the successful completion of their degrees. The University of Oslo is an important partner and granted most of these degrees.

PERSONNEL AND HSE
At the end of 2011, the Simula Group had a total of 126 employees, with 101 in full-time positions and 25 in part-time positions. Of these, 104 were men and 22 were women, with 67 Norwegians and 59 foreign nationals. 52 people were employed as research fellows, with 20 post-doctoral fellows and 32 PhD students.

At the end of 2011, Simula Research Laboratory had a total of 43 employees, with 30 in full-time positions and 13 in part-time positions. Of these, 36 were men and 7 were women, with 32 Norwegians and 11 foreign nationals.

A working environment survey was conducted in September, with positive results, confirming that our employees experience Simula as being a good working environment. The individual departments and Simula as a whole plan to follow up concrete action points based on identified areas for improvement.

The board aims to continue its focus on long-term health, safety and environment work. Absence due to illness was under 2% in 2011, which is below average compared with similar companies. The Group will be working actively to keep sick leave at continued low levels. There were no reports of occupational related sickness or accidents during the year.

Simula’s business activities do not pollute the external environment.
EQUAL OPPORTUNITY AND INTEGRATION
Simula’s board has adopted an ambitious action plan with the goal of increasing the proportion of female employees in scientific positions to 25% by 2015. The proportion of female employees in scientific positions remained unchanged from 2010, at 19%. When we examine individual categories, it is positive that the proportion of full-time female researchers has increased from zero in 2010 to 13% in 2011. Simula will continue to work actively and systematically to improve the gender balance within the organisation and, to meet our target, we will be implementing concrete initiatives for retaining good female candidates already employed by Simula, as well as attracting new and talented female candidates. These initiatives involve recruitment, employment and the working environment. Simula is conscious that retaining talented female students can be an effective contribution to meeting our goal.

The Group is also working to promote the objectives of the Norwegian Anti-discrimination Act, to promote equality, ensure equal opportunities and rights and to prevent discrimination in the workplace. There are 25 different nationalities represented in the Simula Group. Simula offers courses in Norwegian, social events and support related to visa, tax, housing and other administrative issues.

ETHICS
Simula follows ethical guidelines as described in “The Simula Code of Ethics”, which also comprises research ethics, based on the fact that Simula is an institution dedicated to truth and the pursuit of truth. The institution’s reputation is based on others being able to trust that research results are correct and have been produced in a verifiable and ethically responsible manner. For questions regarding research ethics, Simula’s researchers shall adhere to the guidelines set by the National Committee for Research Ethics in Science and Technology (NENT). In addition, all employees must follow Simula’s internal guidelines for scientific publishing, which are based on the Vancouver Convention.

RISK
The Board considers the financial risk to be limited, credit risk to be limited and the cash-flow risk to be limited. In conclusion the general risk of the business is considered limited.

POSITIVE ECONOMIC GROWTH
Simula Group saw an increase in both personnel and capacity in 2011. In its 10th operating year, the Group had a turnover of NOK 121.1 million, an increase of 11% from the previous year. Operating profits were NOK 7.9 million, with a net profit of NOK 5.8 million.

Simula’s total operating revenue in 2011 was NOK 97.4 million. External project funding was a total of NOK 36.7 million. The net profit was NOK 4.3 million, which was transferred to equity. Equity in Simula is NOK 11.7 million, giving an equity ratio of 30% of the total equity.

Simula School of Research and Innovation’s total operating revenue in 2011 was NOK 37.6 million, with a profit of NOK 1.3 million.

Simula Innovation AS had in 2011 an operating revenue of NOK 5.9 million, with a net profit of NOK -0.9 million after taxes and write-downs.

In 2011, Kalkulo’s total sales revenues amounted to NOK 13.3 million, with a net profit of NOK 1.7 million after taxes and write-downs.

FUTURE DEVELOPMENT
The basic funding has not been adjusted for inflation. It is therefore very positive for the future of Simula’s finances that, at the close of 2011, the Ministry of Education and Research confirmed that the Ministry’s share of Simula’s grant (NOK 29 million) will be adjusted for inflation as of 2013.

Simula is increasing its collaboration with industry.

The board believes that our annual accounts provide a correct picture of Simula Research Laboratory AS and the Group. The Group is in a healthy economic and financial position. In accordance with section 3, paragraph 3a of the Norwegian Accounting Act, conditions for continuing operations are confirmed present, and the annual accounts are prepared accordingly.

THE BOARD’S WORK
In 2011, Simula’s board had four meetings, with a total of 32 cases for consideration. The employee-elected board member Amund Kvalbein retired from the board in 2011. The board would like to thank him for his commitment and inputs to the board.

Erik Heggem joined the board as new employee-elected board member in 2011. The board was expanded with two representatives in 2011, and Ingrid Søreide (Statkraft) and Pinar Heggernes (University of Bergen) became board members in June. Cooperation between the board and management is good. The board would like to thank all employees for their contribution throughout the year.
## Profit & Loss Statement

### 2011

<table>
<thead>
<tr>
<th></th>
<th>Group</th>
<th>Parent Company</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operating Revenues</strong></td>
<td>108,614,673</td>
<td>121,083,635</td>
</tr>
<tr>
<td><strong>Operating Expenses</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salary and social costs</td>
<td>72,031,247</td>
<td>75,499,248</td>
</tr>
<tr>
<td>Depreciation</td>
<td>1,823,535</td>
<td>1,140,386</td>
</tr>
<tr>
<td>Other operating expenses</td>
<td>27,693,366</td>
<td>36,585,359</td>
</tr>
<tr>
<td><strong>Total Operating Expenses</strong></td>
<td>101,548,148</td>
<td>113,224,993</td>
</tr>
<tr>
<td><strong>Operating Profit</strong></td>
<td>7,066,525</td>
<td>7,858,642</td>
</tr>
<tr>
<td><strong>Financial Items</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other interest income</td>
<td>569,589</td>
<td>630,332</td>
</tr>
<tr>
<td>Other financial income</td>
<td>25,740</td>
<td>71,028</td>
</tr>
<tr>
<td>Other interest expense</td>
<td>39,948</td>
<td>14,882</td>
</tr>
<tr>
<td>Other financial expense</td>
<td>1,511,823</td>
<td>1,432,413</td>
</tr>
<tr>
<td><strong>Net Financial Items</strong></td>
<td>-956,442</td>
<td>745,935</td>
</tr>
<tr>
<td><strong>Profit Before Taxes</strong></td>
<td>6,110,083</td>
<td>7,112,707</td>
</tr>
<tr>
<td><strong>Taxes For the Year</strong></td>
<td>463,894</td>
<td>723,297</td>
</tr>
<tr>
<td><strong>Net Profit</strong></td>
<td>5,646,189</td>
<td>6,389,410</td>
</tr>
<tr>
<td>Minority interests</td>
<td>550,934</td>
<td>589,135</td>
</tr>
<tr>
<td><strong>Result after Minority Interest</strong></td>
<td>5,095,255</td>
<td>5,800,275</td>
</tr>
<tr>
<td><strong>Transfers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transferred to other equity</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Note</th>
<th>2011</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Revenues</td>
<td>6</td>
<td>97,377,913</td>
<td>88,652,000</td>
</tr>
<tr>
<td>Salary and social costs</td>
<td>5</td>
<td>57,077,092</td>
<td>54,548,793</td>
</tr>
<tr>
<td>Depreciation</td>
<td>3</td>
<td>1,049,365</td>
<td>1,670,411</td>
</tr>
<tr>
<td>Other operating expenses</td>
<td>5,14</td>
<td>35,451,308</td>
<td>29,342,124</td>
</tr>
<tr>
<td><strong>Total Operating Expenses</strong></td>
<td></td>
<td>93,577,765</td>
<td>85,561,328</td>
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<tr>
<td>Operating Profit</td>
<td></td>
<td>3,800,148</td>
<td>3,090,672</td>
</tr>
<tr>
<td>Other interest income</td>
<td></td>
<td>508,250</td>
<td>478,415</td>
</tr>
<tr>
<td>Other financial income</td>
<td></td>
<td>58,955</td>
<td>19,901</td>
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<tr>
<td>Other interest expense</td>
<td></td>
<td>9,455</td>
<td>31,160</td>
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<tr>
<td>Other financial expense</td>
<td></td>
<td>59,720</td>
<td>22,307</td>
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<tr>
<td><strong>Net Financial Items</strong></td>
<td></td>
<td>498,030</td>
<td>444,849</td>
</tr>
<tr>
<td>Profit Before Taxes</td>
<td></td>
<td>4,298,178</td>
<td>3,535,521</td>
</tr>
<tr>
<td>Taxes For the Year</td>
<td></td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Net Profit</td>
<td></td>
<td>4,298,178</td>
<td>3,535,521</td>
</tr>
<tr>
<td>Minority interests</td>
<td></td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Result after Minority Interest</td>
<td></td>
<td>4,298,178</td>
<td>3,535,521</td>
</tr>
<tr>
<td>Transferred to other equity</td>
<td></td>
<td>4,298,178</td>
<td>3,535,521</td>
</tr>
</tbody>
</table>
## FIXED ASSETS

<table>
<thead>
<tr>
<th>Group</th>
<th>2010</th>
<th>2011</th>
<th>Note</th>
<th>2011</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tangible fixed assets</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Furniture, fixtures, equipment</td>
<td>1,617,367</td>
<td>1,720,780</td>
<td>3</td>
<td>1,646,362</td>
<td>1,485,178</td>
</tr>
<tr>
<td>Total tangible fixed assets</td>
<td>1,617,367</td>
<td>1,720,780</td>
<td></td>
<td>1,646,362</td>
<td>1,485,178</td>
</tr>
</tbody>
</table>

| **Financial fixed assets**                 |            |            |      |            |            |
| Investments in shares                      | 1,566,460  | 298,232    | 12   | 0          | 0          |
| Other receivables                          | 250,000    | 0          |      | 0          | 0          |
| Investments in subsidiaries                | 0          | 0          | 10   | 5,319,700  | 5,319,700  |
| Total financial fixed assets               | 1,816,460  | 298,232    |      | 5,319,700  | 5,319,700  |
| **Total FIXED ASSETS**                    | 3,433,827  | 2,019,012  |      | 6,966,062  | 6,804,878  |

## CURRENT ASSETS

| Receivables                                | 2010       | 2011       |      |            |            |
|Accounts receivable                         | 7,001,337  | 13,155,845 |      | 4,203,837  | 2,463,682  |
|Other receivables                           | 7,192,572  | 12,250,364 |      | 9,991,242  | 6,899,158  |
|Total receivables                           | 14,193,909 | 25,406,209 |      | 14,195,079 | 9,362,840  |
|Cash and banks                              | 26,363,509 | 28,002,125 | 9    | 18,369,526 | 18,445,187 |
|TOTAL CURRENT ASSETS                        | 40,557,418 | 53,408,334 |      | 32,564,605 | 27,808,027 |
|**TOTAL ASSETS**                            | 43,991,245 | 55,427,346 |      | 39,530,667 | 34,612,905 |

## EQUITY

| Paid-in equity                             | 2010       | 2011       |      |            |            |
|Share capital                               | 1,200,000  | 1,200,000  | 7,8  | 1,200,000  | 1,200,000  |
|Total paid-in capital                        | 1,200,000  | 1,200,000  |      | 1,200,000  | 1,200,000  |
|Earned equity                               | 11,413,223 | 17,213,498 | 8    | 10,497,785 | 6,199,607  |
|Other equity                                | 1,841,734  | 2,430,869  | 8    | 0          | 0          |
|Minority interests                          | 13,254,957 | 19,644,367 | 8    | 10,497,785 | 6,199,607  |
|Total earned equity                         | 14,454,957 | 20,844,367 |      | 11,697,785 | 7,399,607  |

## LIABILITIES

| Accruals for liabilities                   | 2010       | 2011       |      |            |            |
|Deferred tax                                | 286,767    | 286,719    | 13   | 0          | 0          |
|Total accruals for liabilities              | 286,767    | 286,719    |      | 0          | 0          |

| Short term liabilities                     | 2010       | 2011       |      |            |            |
|Accounts payable                           | 5,364,330  | 7,252,624  |      | 11,692,239 | 8,907,191  |
|Tax payable                                 | 177,127    | 723,345    | 13   | 0          | 0          |
|Other duties payable                        | 4,330,814  | 6,621,582  |      | 2,336,860  | 2,405,763  |
|Other short term liabilities                | 19,377,250 | 19,698,709 |      | 13,803,783 | 15,900,344 |
|Total short term liabilities                | 29,249,521 | 34,296,260 |      | 27,832,882 | 27,213,298 |

| TOTAL LIABILITIES                          | 29,536,288 | 34,582,979 |      | 27,832,882 | 27,213,298 |
|TOTAL LIABILITIES AND EQUITY                | 43,991,245 | 55,427,346 |      | 39,530,667 | 34,612,905 |
NOTES TO THE ACCOUNTS

NOTE 1 – ACCOUNTING PRINCIPLES
The financial statements have been prepared pursuant to the regulations in the Norwegian Accounting Act of 1998. The statements have been drawn up in accordance with Norwegian accounting standards.

The main rule for the valuation and classification of assets and liabilities
Assets intended for permanent ownership or use are classified as fixed assets. Other assets are classified as current assets. Receivables to be paid back within one year are always classified as current assets. The same criteria are applied to the classification of short- and long-term liabilities.

Fixed assets are valued at acquisition cost and written down to their fair value, if the fall in value is believed to be permanent. Fixed assets are depreciated over the useful life of the asset. Long-term liabilities are recognised at nominal value on the date the liability was incurred. Long-term liabilities are not revalued to fair value with respect to interest rate fluctuations.

Current assets are valued at cost, or fair value, whichever is the lower. Current liabilities are recognised at their nominal values on the date they were incurred. Current liabilities are not restated to fair values with respect to interest rate fluctuations.

Certain items are valued according to other rules, as explained below.

Foreign currency transactions
Assets and liabilities in foreign currency are translated into Norwegian kroner at the mid-rates quoted by Norway’s National Bank on the balance sheet reporting day.

Tangible fixed assets
Tangible fixed assets are generally depreciated over the expected useful life of the asset. Depreciation is generally done on a straight-line basis over the expected useful life of the asset.

NOTE 2 – FINANCIAL MARKET RISK
The company has little exposure to financial market risk.

NOTE 3 – FIXED ASSETS

<table>
<thead>
<tr>
<th>Simula Research Laboratory AS</th>
<th>Computer Equipment</th>
<th>Furniture/Fittings, equipment</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquisition cost Jan. 1</td>
<td>5.191.349</td>
<td>7.049.419</td>
<td>12.240.768</td>
</tr>
<tr>
<td>Disposed of in 2011</td>
<td>- 620.742</td>
<td>-</td>
<td>- 620.742</td>
</tr>
<tr>
<td>Acquisition cost Dec. 31</td>
<td>5.090.121</td>
<td>7.740.455</td>
<td>12.830.576</td>
</tr>
<tr>
<td>Acc. depreciation</td>
<td>4.350.782</td>
<td>6.833.432</td>
<td>11.184.214</td>
</tr>
<tr>
<td>Net book value Dec. 31</td>
<td>739.339</td>
<td>907.023</td>
<td>1.646.362</td>
</tr>
<tr>
<td>Depreciation for the year</td>
<td>737.233</td>
<td>312.132</td>
<td>1.049.365</td>
</tr>
<tr>
<td>Depreciation %</td>
<td>20 – 50%</td>
<td>20 – 33%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Simula Research Laboratory AS – Group</th>
<th>Computer Equipment</th>
<th>Furniture/Fittings, equipment</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquisition cost Jan. 1</td>
<td>6.887.153</td>
<td>7.049.419</td>
<td>13.936.572</td>
</tr>
<tr>
<td>Acquired in 2011</td>
<td>552.764</td>
<td>691.036</td>
<td>1.243.800</td>
</tr>
<tr>
<td>Disposed of in 2011</td>
<td>- 641.888</td>
<td>-</td>
<td>- 641.888</td>
</tr>
<tr>
<td>Acquisition cost Dec. 31</td>
<td>6.798.029</td>
<td>7.740.455</td>
<td>14.538.484</td>
</tr>
<tr>
<td>Acc. depreciation</td>
<td>5.984.273</td>
<td>6.833.432</td>
<td>12.817.705</td>
</tr>
<tr>
<td>Net book value Dec. 31</td>
<td>813.756</td>
<td>907.023</td>
<td>1.720.780</td>
</tr>
<tr>
<td>Depreciation for the year</td>
<td>828.253</td>
<td>312.132</td>
<td>1.140.385</td>
</tr>
<tr>
<td>Depreciation %</td>
<td>20 – 50%</td>
<td>20 – 33%</td>
<td></td>
</tr>
</tbody>
</table>
NOTE 4 – PENSION COSTS
The Group has a pension plan that covers a total of 33 individuals in the parent company and 95 individuals in the Group. The pension plan provides defined future benefits. Pension benefits depend on the individual employee’s number of years of service, salary level upon retirement age, and social security benefits. The collective pension agreement is funded by building up pension funds under the management of the Norwegian Public Service Pension Fund.

The company has taken out an pension insurance for the managing director expensed at NOK 329,818.

NOTE 5 – COST OF LABOUR, NUMBER OF EMPLOYEES, REMUNERATION, ETC.

<table>
<thead>
<tr>
<th>Salary and social costs</th>
<th>Simula Research Laboratory AS</th>
<th>2010</th>
<th>2011</th>
<th>Simula Research Laboratory AS Group</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries</td>
<td>26,909,111</td>
<td>26,129,141</td>
<td>56,610,701</td>
<td>59,071,603</td>
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<td></td>
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<tr>
<td>Social security</td>
<td>4,346,665</td>
<td>4,115,926</td>
<td>8,607,651</td>
<td>8,774,493</td>
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<td></td>
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<tr>
<td>Pension costs</td>
<td>2,269,967</td>
<td>1,871,239</td>
<td>3,679,919</td>
<td>3,222,163</td>
<td></td>
<td></td>
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<tr>
<td>Other benefits</td>
<td>3,088,998</td>
<td>4,191,332</td>
<td>3,284,437</td>
<td>4,491,441</td>
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<td></td>
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<tr>
<td>SkatteFUNN</td>
<td>-</td>
<td>-</td>
<td>-151,460</td>
<td>-60,452</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contribution to cover cost of labour at SSRI</td>
<td>17,934,052</td>
<td>15,671,656</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contribution to cover cost of labour at SI</td>
<td>-</td>
<td>5,097,798</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>54,548,793</td>
<td>57,077,092</td>
<td>72,031,247</td>
<td>75,499,248</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average man-years of labour</td>
<td>40,3</td>
<td>37</td>
<td>92,3</td>
<td>112</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Benefits to top management</th>
<th>Simula Research Laboratory AS</th>
<th>Simula Research Laboratory AS Konsern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Managing director</td>
<td>1,533,523</td>
<td>-</td>
</tr>
<tr>
<td>Other remuneration to managing director</td>
<td>302,120</td>
<td>-</td>
</tr>
<tr>
<td>Pension costs to managing director</td>
<td>406,955</td>
<td>-</td>
</tr>
<tr>
<td>Board of directors</td>
<td>187,000</td>
<td>187,000</td>
</tr>
<tr>
<td>Audit fees to Auditor</td>
<td>54,800</td>
<td>124,800</td>
</tr>
<tr>
<td>Other fees to Auditor</td>
<td>39,800</td>
<td>63,300</td>
</tr>
</tbody>
</table>

NOTE 6 – OPERATING REVENUE

<table>
<thead>
<tr>
<th>Simula Research Laboratory AS</th>
<th>Simula Research Laboratory AS Konsern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Funding</td>
<td>50,000,000</td>
</tr>
<tr>
<td>Subsidies from the Research Council of Norway and the EU</td>
<td>36,684,100</td>
</tr>
<tr>
<td>Services to subsidiaries</td>
<td>5,764,184</td>
</tr>
<tr>
<td>Other income</td>
<td>4,929,629</td>
</tr>
</tbody>
</table>
## Notes to the Accounts 2011

### Note 7 – Share Capital and Ownership Structure
The company’s share capital consists of 800 shares with a nominal value of NOK 1,500 per share. The shares are owned by:

- The Norwegian state /repr. by the Ministry of Research and Education.

### Note 9 – Bank Deposits
The company had withheld funds of NOK 2,157,703 in connection with rent of office space and NOK 1,225,122 in withholding taxes. The Group’s withheld funds for withholding tax is NOK 2,869,471.

### Note 8 – Equity

#### Simula Research Laboratory AS

<table>
<thead>
<tr>
<th></th>
<th>Share Capital</th>
<th>Other Equity</th>
<th>Total Equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equity at Jan. 1</td>
<td>1,200,000</td>
<td>6,199,607</td>
<td>7,399,607</td>
</tr>
<tr>
<td>Profit for the year</td>
<td>-</td>
<td>4,298.178</td>
<td>4,298.178</td>
</tr>
<tr>
<td>Equity at Dec. 31</td>
<td>1,200,000</td>
<td>10,497.785</td>
<td>11,697.785</td>
</tr>
</tbody>
</table>

#### Simula Research Laboratory AS – Group

<table>
<thead>
<tr>
<th></th>
<th>Share Capital</th>
<th>Other Equity</th>
<th>Minority-interests</th>
<th>Total Equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equity at Jan. 1</td>
<td>1,200,000</td>
<td>11,413,223</td>
<td>1,841,734</td>
<td>14,454,957</td>
</tr>
<tr>
<td>Profit for the year</td>
<td>-</td>
<td>5,800,275</td>
<td>589,135</td>
<td>6,389,410</td>
</tr>
<tr>
<td>Equity at Dec. 31</td>
<td>1,200,000</td>
<td>17,213,498</td>
<td>2,430,869</td>
<td>20,844,367</td>
</tr>
</tbody>
</table>

### Note 10 – Subsidiaries

<table>
<thead>
<tr>
<th>Subsidiary</th>
<th>Office Location</th>
<th>Ownership Dec. 31</th>
<th>Net book value</th>
<th>Company at Dec. 31</th>
<th>Company result for 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simula Innovation AS</td>
<td>Fornebu</td>
<td>100 %</td>
<td>4,356,300</td>
<td>4,600,762</td>
<td>-928,254</td>
</tr>
<tr>
<td>Kalkulo AS</td>
<td>Fornebu</td>
<td>100 %</td>
<td>406,000</td>
<td>4,372,311</td>
<td>1,688,408</td>
</tr>
<tr>
<td>Simula School of Research and Innov. AS</td>
<td>Fornebu</td>
<td>55,74%</td>
<td>557,400</td>
<td>5,493,209</td>
<td>1,331,077</td>
</tr>
</tbody>
</table>

### Note 11 – Transactions Within the Group

<table>
<thead>
<tr>
<th>Transaction</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receivable on Simula Innovation AS</td>
<td>1,558,684</td>
<td>1,045,920</td>
</tr>
<tr>
<td>Payable to Simula Innovation AS</td>
<td>504,499</td>
<td>2,009,848</td>
</tr>
<tr>
<td>Receivable on Kalkulo AS</td>
<td>308,628</td>
<td>24,535</td>
</tr>
<tr>
<td>Payable to Kalkulo AS</td>
<td>199,841</td>
<td>42,015</td>
</tr>
<tr>
<td>Receivable on Simula School of R. and I. AS</td>
<td>181,288</td>
<td>863,841</td>
</tr>
<tr>
<td>Payable to Simula School of R. and I. AS</td>
<td>4,738,292</td>
<td>3,237,348</td>
</tr>
<tr>
<td>Contribution to Simula Innovation AS</td>
<td>1,500,000</td>
<td>7,597,798</td>
</tr>
<tr>
<td>Contribution to Simula School of R. and I. AS</td>
<td>17,934,052</td>
<td>15,671,656</td>
</tr>
<tr>
<td>Purchase of services from fra Simula Innovation AS</td>
<td>283,014</td>
<td>971,403</td>
</tr>
<tr>
<td>Purchase of services from Kalkulo AS</td>
<td>864,779</td>
<td>254,785</td>
</tr>
<tr>
<td>Purchase of services from Simula School of R. and I. AS</td>
<td>-</td>
<td>365,617</td>
</tr>
<tr>
<td>Sale of services to Simula Innovation AS</td>
<td>1,789,482</td>
<td>1,862,663</td>
</tr>
<tr>
<td>Sale of services to Kalkulo AS</td>
<td>1,481,950</td>
<td>1,716,693</td>
</tr>
<tr>
<td>Sale of services to Simula School of R. and I. AS</td>
<td>3,374,365</td>
<td>4,200,983</td>
</tr>
</tbody>
</table>
NOTE 14 – LEASES

The company has signed leases for four photocopiers which all expire in 2013. The company also has leases for three coffee machines, which also expire in 2013. Leasing expenses amounted to NOK 299,936 in 2011.
Til generalforsamlingen i
SIMULA RESEARCH LABORATORY AS

REVISORS BERETNING FOR 2011

Uttalelse om årsregnskapet
Vi har revidert årsregnskapet for SIMULA RESEARCH LABORATORY AS som består av
selskapsregnskap, som viser et overskudd på kr. 4.298.178,-, og konsernregnskap, som viser et
overskudd på kr. 5.800.275,-. Selskapsregnskapet og konsernregnskapet består av balanse per 31.
desember 2011, resultatregnskap og kontantsrømmeopptelling for regnskapsåret avsluttet per denne
datoen, og en beskrivelse av viktige anvendte regnskapsprinsipper og andre noteprosesseringer.

Styret og daglig leders ansvar for årsregnskapet
Styret og daglig leder er ansvarlig for å utarbeide årsregnskapet og for at det gir et rettvisende bilde i
samspel med regnskapslovens regler og god regnskapsopprinnelse i Norge, og for slik intern kontroll som
styret og daglig leder finner nødvendig for å muliggjøre utarbeidelsen av et årsregnskap som ikke
inneholder viktige feilinformasjoner, verken som følge av misligheter eller feil.

Revisors oppgaver og plikter
Vår oppgave er å gi uttrykk for en mening om dette årsregnskapet på bakgrunn av vår revisjon. Vi har
gjennomført revisjonen i samsvar med lov, forskrift og god revisjonsopprinnelse i Norge, herunder
International Standards on Auditing. Revisjonsstandardene krever at vi etterlever egnede krav og
planlegger og gjennomfører revisjonen for å oppnå betydelige sikkerhet for at årsregnskapet ikke
inneholder viktige feilinformasjoner.

En revisjon innebærer utførelse av handlinger for å innhente revisjonsbevis for beløpene og
opplysningene i årsregnskapet. De valgte handlingene avhenger av revisors skjønn, herunder
vurderingen av risikoen for at årsregnskapet inneholder viktige feilinformasjoner, enten det skyldes
misligheter eller feil. Ved en slik risikovurdering tar revisor hensyn til den interne kontrollen som er
relevant for selskapets utarbeidelse av årsregnskap som gir et rettvisende bilde. Formålet er å
utforme revisjonshandlingene som er hensiktsmessige etter omstendighetene, men ikke for å gi uttrykk
for en mening om effektiviteten av selskapets interne kontroll. En revisjon omfatter også en vurdering
av om de anvendte regnskapsprinsipper er hensiktsmessige og om regnskapsestimatomene utarbeidet av
ledelsen er rimelige, samt en vurdering av den samlede presentasjonen av årsregnskapet.

Etter vår oppfatning er innhentet revisjonsbevis tilstrekkelig og hensiktsmessig som grunnlag for vår
konklusjon.

Konklusjon
Etter vår mening er årsregnskapet avgitt i samsvar med lov og forskrifter og gir et rettvisende bilde av
selskapet og SIMULA RESEARCH LABORATORY AS' finansielle stillingen per 31. desember 2011
og av resultatet og kontantsrømme av regnskapsåret som ble avsluttet per denne datoen i samsvar
med regnskapslovens regler og god regnskapsopprinnelse i Norge.
Uttalelse om øvrige forhold
Konklusjon om årsberetningen
Basert på vår revisjon av årsregnskapet som beskrevet ovenfor, mener vi at opplysningene i årsberetningen om årsregnskapet, fortsetningen om fortsatt og forslaget til anvendelse av overskuddet er konstante med årsregnskapet og er i samsvar med lov og forskrifter.

Konklusjon om registrering og dokumentasjon
Basert på vår revisjon av årsregnskapet som beskrevet ovenfor, og kontrollhandlinger vi har funnet nødvendig i henhold til internasjonal standard for attestasjonsoppdrag (ISAE) 3000 «Attestasjonsoppdrag som ikke er revisjon eller forenklet revisorkontroll av historisk finansiell informasjon», mener vi at ledelsen har oppfylt sin plikt til å sørge for ordentlig og oversiktlig registrering og dokumentasjon av selskapets regnskapsopplysninger i samsvar med lov og god bokføringsklikk i Norge.

Oslo, den 21. mars 2012

[Signature]

Erik A. Bell
Statsautorisert revisor
SCIENTIFIC EVALUATIONS
Simula has consistently focused on quality and high goals, and this work has been recognized in the evaluation reports conducted by international evaluation committees appointed by the Research Council of Norway.

“These evaluations and numerous other measures have found Simula to be a success and Simula has established itself as a national and, in many cases, an international leader with a substantial impact beyond the borders.” ¹

PUBLICATIONS AND DEGREES
“The publication activity for Simula is generally high and positioned in journals of high impact. The connections to industry are strong and provide examples for other universities and research institutes on how to establish such connections without impacting the depth of the research.” ²

<table>
<thead>
<tr>
<th></th>
<th>2001 National evaluation of the initial research groups</th>
<th>2004 Scientific evaluation of Simula</th>
<th>2009 Scientific evaluation of Simula</th>
<th>2012 National ICT evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication Systems</td>
<td>Good</td>
<td>Good, with some very good elements</td>
<td>Very good, with some excellent projects</td>
<td>Very good</td>
</tr>
<tr>
<td>Scientific Computing</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td>Software Engineering</td>
<td>Good</td>
<td>Very good</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>2011</th>
<th>Total 2001–2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Articles in international journals</td>
<td>52</td>
<td>408</td>
</tr>
<tr>
<td>Conference proceedings</td>
<td>64</td>
<td>596</td>
</tr>
<tr>
<td>Books</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>Edited books</td>
<td>0</td>
<td>22</td>
</tr>
<tr>
<td>Chapters in books</td>
<td>5</td>
<td>73</td>
</tr>
<tr>
<td>PhD degrees</td>
<td>8</td>
<td>54</td>
</tr>
<tr>
<td>Masters’ degrees</td>
<td>20</td>
<td>227</td>
</tr>
</tbody>
</table>

² Ibid.
### Strategic Projects Initialized in 2011

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Funding Source</th>
<th>Project Leader</th>
<th>Partners</th>
<th>Project Duration</th>
<th>Funding from Source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The Certus Centre</strong></td>
<td><strong>Funding source:</strong> RCN, Center for Research-based Innovation</td>
<td><strong>Project leader:</strong> Lionel Briand</td>
<td><strong>Research partners:</strong> University of Oslo and Fraunhofer-Institut für Experimentelles Software Engineering. <strong>Other partners:</strong> Esito AS, Schlumberger, Tandberg, Det Norske Veritas AS, Tomra Systems ASA, Norwegian Customs and Excise Department.</td>
<td><strong>Project duration:</strong> 8 years</td>
<td><strong>Funding from source:</strong> NOK 78 million</td>
</tr>
<tr>
<td><strong>NorNet – Norwegian Infrastructure for Network Experimentation</strong></td>
<td><strong>Funding source:</strong> RCN, National Financing Initiative for Research Infrastructure</td>
<td><strong>Project leader:</strong> Olav Lysne</td>
<td><strong>Partners:</strong> NTNU and UNINETT</td>
<td><strong>Project duration:</strong> 5 years</td>
<td><strong>Funding from source:</strong> NOK 14 million</td>
</tr>
<tr>
<td><strong>Efficient and Robust Architecture for the Big Data Cloud</strong></td>
<td><strong>Funding source:</strong> RCN, VERDIKT</td>
<td><strong>Project leader:</strong> Tor Skeie</td>
<td><strong>Partners:</strong> Lyse AS, Oracle Norge AS, University of Stavanger, UiO</td>
<td><strong>Project duration:</strong> 4 years</td>
<td><strong>Funding from source:</strong> NOK 12 million</td>
</tr>
<tr>
<td><strong>Traffic behaviour of interactive time-dependent thin streams on the modern Internet</strong></td>
<td><strong>Funding source:</strong> RCN, VERDIKT</td>
<td><strong>Project leader:</strong> Andreas Petlund</td>
<td><strong>Partners:</strong> Karlstad University, FUNCOM, University of Kaiserslautern, UNINETT AS, CISCO Systems Norway AS, UiO</td>
<td><strong>Project duration:</strong> 4 years</td>
<td><strong>Funding from source:</strong> NOK 11 million</td>
</tr>
<tr>
<td><strong>User-friendly programming of GPU-enhanced clusters via automated code translation and optimization</strong></td>
<td><strong>Funding source:</strong> RCN, FRINATEK</td>
<td><strong>Project leader:</strong> Xing Cai</td>
<td><strong>Partners:</strong> Sintef IKT Oslo, UCSD, San Diego Supercomputing Center</td>
<td><strong>Project duration:</strong> 4 years</td>
<td><strong>Funding from source:</strong> NOK 9.4 million</td>
</tr>
<tr>
<td><strong>OPENCOSS (Open Platform for Evolutionary Certification Of Safety-critical Systems)</strong></td>
<td><strong>Funding source:</strong> European Commission, 7th Framework Programme. <strong>Project leader:</strong> Mehrdad Sabetzadeh</td>
<td><strong>Partners:</strong> Alstom, France; RINA, Italy; Atego, France; DNV, Netherlands; Eindhoven University of Technology, Netherlands; University of York, UK; and Fiat, Italy.</td>
<td><strong>Project duration:</strong> 3 years</td>
<td><strong>Funding from source:</strong> NOK 8 million</td>
<td></td>
</tr>
<tr>
<td><strong>In Silico Heart Failure – Tools for Accelerating Biomedical Research</strong></td>
<td><strong>Funding source:</strong> RCN, eVITA</td>
<td><strong>Project leader:</strong> Joakim Sundnes</td>
<td><strong>Project duration:</strong> 4 years</td>
<td><strong>Funding from source:</strong> NOK 7.7 million</td>
<td></td>
</tr>
<tr>
<td><strong>Patient-Specific Mathematical Modeling with Applications to Clinical Medical: Stroke and Syringomyelia</strong></td>
<td><strong>Funding source:</strong> RCN, funding for qualified candidates turned down for European Research Council starting grants</td>
<td><strong>Project leader:</strong> Kent-Andre Mardal</td>
<td><strong>Project duration:</strong> 5 years</td>
<td><strong>Funding from source:</strong> NOK 6.9 million</td>
<td></td>
</tr>
<tr>
<td><strong>ModelFusion: Model Management for Distributed Software Development</strong></td>
<td><strong>Funding source:</strong> RCN, FRITEN</td>
<td><strong>Project leader:</strong> Shiva Nejati</td>
<td><strong>Project duration:</strong> 4 years</td>
<td><strong>Funding from source:</strong> NOK 6.6 million</td>
<td></td>
</tr>
<tr>
<td><strong>Protection of Power electronically interfaced LV Distributed Generation Networks</strong></td>
<td><strong>Funding source:</strong> RCN, RENERGI</td>
<td><strong>Project leader:</strong> Yan Zhang</td>
<td><strong>Partners:</strong> Aalborg University, SRL</td>
<td><strong>Project duration:</strong> 3 years</td>
<td><strong>Funding from source:</strong> NOK 2.8 million</td>
</tr>
</tbody>
</table>

*Some project details have been abbreviated or paraphrased for clarity.*
January
The organizational structure of Simula is changed in order to better reflect the research activities and the financial framework. From three units with the activities organized in the several research groups, the current structure puts direct focus on seven research departments.

March
Statoil and Simula expand the collaboration further and enter into an agreement with the 5DPaleoEarth project.

April
State secretary Halvard Ingebrigtsen of the Ministry of Trade and Industry visits Simula.

Simula meets with the Labour party fraction of the Standing Committee on Education, Research and Church Affairs at the Parliament.

Collaboration with China: Simula enters into a Memorandum of Understanding with Beihang University.

May
The NorNet project receives funding from the Research Council of Norway.


Hadi Hemmati defends his PhD thesis Similarity-Based Test Case Selection: Toward Scalable and Practical Model-Based Testing.

Ahmed Elmokashfi defends his PhD thesis On BGP Inter-domain Routing: an Investigation of Scalability with Respect to Churn.

The OPENCOSS proposal (Open Platform for Evolutionary Certification Of Safety-critical Systems), with participation from the Certus centre, has been approved for funding by the European Commission under the 7th Framework Programme.

Kristian Valen-Sendstad defends his PhD thesis Computational Cerebral Hemodynamics.

June

July
The Research Council of Norway publishes the results of the midterm evaluation of eight Centres of Excellence after three and half years of activity. The Centre for Biomedical Computing (CBC), hosted by Simula, is assessed as Exceptionally good and is secured funding for the next five years.

September
In connection with Director-General Robert Madelin’s visit to Norway, representatives from the EU commission and the Norwegian Government visit Simula. Madelin is responsible for the Digital Agenda for Europe, which is one of the flagship initiatives of the Europe 2020 Strategy, set out to define the key-enabling role that the use of Information and Communication Technologies (ICT) will have to play in the realization of Europe’s ambitions for 2020.

The involved parties and representatives from the Research Council of Norway signed the agreement, and Simula’s new Centre for Research-based Innovation (SFI) – the Certus Centre – was officially opened.

The Ministry of Transport and Communications and the Resilient Networks group at Simula invited stakeholders to a workshop held at Simula, with the purpose to discuss key challenges for a more robust Norwegian network infrastructure. Representatives from Telenor, Netcom, ICE, the Norwegian Post and Telecommunications, and the Norwegian Health Network were present.
The Norwegian Government presents the national budget for 2012, and Simula appreciates that the basic allowance is increased with 1 million NOK in an otherwise constrained budget for Norwegian research. The Ministry of Education and Research maintains its allowance from 2011, and the same does the Ministry of Transport and Communications. Compared to 2011, the Ministry of Trade and Industry has increased its part of the allowance to 11 million NOK. Simula sees this outcome as a strong signal in support of our growing collaboration with industry.

**DECEMBER**

In competition with 101 applications, two of Simula’s proposals for the Verdikt program were awarded funding through the Research Council of Norway. Many of the proposals were rated excellent, but only six projects out of the 101 were selected for funding.

Simula marks the occasion of ten years in operation with the conference “Challenges in Computing”. Eight internationally recognized experts presented challenges and opportunities that lie ahead in our fields of research. Norwegian Minister of Research and Education Tora Aasland conducted the opening.

The Springer Computational Science and Engineering prize 2011 was awarded to Laura Alisic, Carsten Burstedde and Georg Stadler for their exceptional research on plate tectonics simulation. The prize was presented by Norwegian Minister of Research and Education Tora Aasland at Simula’s conference Challenges in Computing.

The Ministry of Research and Education announces that a part of Simula’s basic allowance will be adjusted for inflation with effect from 2013.


Eli Gjørven defends her PhD thesis Enabling Self-Adaptation by Applying a Technology Agnostic Middleware with Support for Integration.

**OCTOBER**

The Center for Cardiological Innovation was formally established as a new Centre for Research-based Innovation (SFI) on 31 October 2011, after the signing of the agreement between the Research Council of Norway (RCN) and the host Oslo University Hospital. Simula is research partner in the center.

**NOVEMBER**

Kristin Børte defends her PhD thesis Software Effort Estimation as Collaborative Planning Activity.

Opening of the Certus Centre
*From left: Eirik Normann (RCN), Valery Buzungu (Cisco), Merethe Gotaas (Kongsberg Maritime), Thomas Nessel (FMC Kongsberg Subsea), og Lionel Briand (Simula). Photo: Karl Branaas*

Anniversary conference
*Minister Tora Aasland and prize winner Carsten Burstedde*
KEY FACTS 2011

SCIENTIFIC ADVISORY BOARD
The Scientific Advisory Board (SAB) is appointed by Simula’s Board to provide focused professional advice on Simula’s operation. Simula Research Laboratory has appointed to the SAB internationally recognized researchers, which cover all the scientific fields represented at Simula.

- Klara Nahrstedt, University of Illinois at Urbana-Champaign
- Roch Guerin, University of Pennsylvania
- Andrew McCulloch, University of California San Diego
- David Keyes, KAUST
- Deborah Wood, DNV
- Victor Basili, University of Maryland
- Ina Schieferdecker, Fraunhofer
- Abigail Barrow, Massachusetts Technology Transfer Center

MANAGEMENT
Professor Aslak Tveito, Managing Director
Ottar Hovind, Deputy Managing Director
Professor Are Magnus Bruaset, Director of Simula School of Research and Innovation
Dr. Audun Fosselie Hansen, Director of Simula Innovation
Marianne M. Sundet, Director of Administration

RESEARCH DEPARTMENTS
The Certus Centre
Head: Professor Lionel Briand

Best
Head: Professor Magne Jørgensen

BioComp
Head: Professor Hans Petter Langtangen

Camo
Head: Dr. Molly Maleckar

CompGeo
Head: Dr. Stuart Clark

Media
Head: Professor Carsten Griwodz

NetSys
Head: Professor Olav Lysne

BOARD OF DIRECTORS
- Ingvild Myhre, Chair of the Board
- Inger Stray Lien
- Tormod Hermansen
- Gunnar Hartvigsen
- Pinar Hegghernes
- Ingolf Søreide
- Mats Lundqvist
- Erik Heggem
- Ola Skavhaug

SUBSIDIARY COMPANIES
Simula School of Research and Innovation AS
Director: Professor Are Magnus Bruaset

Simula Innovation AS
Director: Dr. Audun Fosselie Hansen

Kalkulo AS
Director: Dr. Christian Tarrou

Staff per company year-end 2011
- 13% SI
- 44% SSRI
- 34% SRL

Staff year-end 2011
- 9% Kalkulo
- 14% Management & Administration
- 14% Other scientific personnel
- 31% Research Scientists
- 16% Postdoctoral fellows

SIMULA GROUP
Board of Directors
Managing Director
Management Group

Centers and Departments
- Certus: Software Engineering
- Best: Scientific Computing
- BioComp: Communication Systems
- CaMo: Engineering
- CompGeo: Science
- NetSys: Technology
- Media: Innovation
- Adm:

Companies
- Simula Research Laboratory
- Simula School of Research & Innovation
- Simula Innovation
- Kalkulo
Scientific staff and gender proportion
As directed by the Gender Action Plan 2010–2015, Simula is aiming to have at least 25 per cent female employees in scientific positions by 2015. Simula will continue to work actively and systematically to improve the gender balance within the organisation and, to meet our target, we will be implementing concrete initiatives for retaining good female candidates already employed by Simula, as well as attracting new and talented female candidates.

Of all employees hired in scientific positions in 2011, 27 per cent were female, and it is especially positive that the number of female full-time research scientists in permanent positions has increased from zero in 2010 to 13 per cent in 2011. Zooming down to the PhD and postdoctoral level, the proportion of female employees has decreased from 27 to 23 per cent. The main reason for this is that several female PhD students have completed their scholarships and left Simula in 2011. Of the new PhD students employed in 2011, 17 per cent were female.

Simula will continue focusing on gender and diversity awareness in the recruitment and hiring processes and implement measures of the Gender Action Plan in order to reach the goal by 2015.

International employees
Simula is an international workplace, and 47 per cent of the total workforce is from countries outside Norway. As of year-end 2011, 25 different nationalities were represented among the employees.

The percentage of non-Norwegian employees at Simula has thus increased from 43 per cent to 47 per cent over 2011. On the PhD level, 72 per cent of the employees have another citizenship than Norwegian by the end of 2011. Compared to the previous year, this represents an increase of 9 per cent.

<table>
<thead>
<tr>
<th>Female proportion</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research scientists, post doctoral fellows and PhD students</td>
<td>19%</td>
<td>19%</td>
</tr>
<tr>
<td>Full-time research scientists in permanent positions</td>
<td>0%</td>
<td>13%</td>
</tr>
<tr>
<td>Postdoctoral fellows</td>
<td>21%</td>
<td>21%</td>
</tr>
<tr>
<td>PhD students</td>
<td>27%</td>
<td>23%</td>
</tr>
</tbody>
</table>
This list presents PhD or MSc degrees awarded by the University of Oslo. The degrees are obtained by candidates that are supervised throughout their projects by Simula researchers.

<table>
<thead>
<tr>
<th>Master's students</th>
<th>Supervisors</th>
<th>Theses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joakim Bjørnstad</td>
<td>Tor Skeie, Sven Arne Reinemo</td>
<td>3D visualisation of network topology, routing, path distribution and network data in simulated InfiniBand clusters</td>
</tr>
<tr>
<td>Chris Carlmar</td>
<td>Pål Halvorsen, Carsten Griwodz</td>
<td>Improving latency for interactive, thin-stream applications by multiplexing streams over TCP</td>
</tr>
<tr>
<td>Kjetil Endal</td>
<td>Alexander Eichorn, Carsten Griwodz</td>
<td>A pipeline for high-quality free-viewpoint video</td>
</tr>
<tr>
<td>Øyvind Evju</td>
<td>Kent-Andre Mardal</td>
<td>Sensitivity analysis of simulated blood flow in cerebral aneurysms</td>
</tr>
<tr>
<td>Dag Haavi Finstad</td>
<td>Pål Halvorsen, Håkon Kvale Stensland, Håvard Espeland</td>
<td>Multi-Rate VP8 Video Encoding</td>
</tr>
<tr>
<td>Ivar W. Framnes</td>
<td>Glenn Lines</td>
<td>A comparison of norms for characterizing numerical solutions arising in simulations of the electrical cardiac activity</td>
</tr>
<tr>
<td>Steffen Sandtrøen Gullichsen</td>
<td>Alexander Eichorn, Carsten Griwodz</td>
<td>Delay in camera-to-display systems</td>
</tr>
<tr>
<td>Magnus Holm</td>
<td>Magne Jørgensen, Hans Christian Benestad</td>
<td>Construction and evaluation of a tool for quantifying uncertainty of software cost estimates</td>
</tr>
<tr>
<td>Torbjørn Skyberg Knutsen</td>
<td>Lionel Claude Briand, Mehrdad Sabetzadeh</td>
<td>Construction of Information Repositories for Managing Standards Compliance Evidence</td>
</tr>
<tr>
<td>Øyvind Kolbu</td>
<td>Frank T. Johansen, Pål Halvorsen</td>
<td>QoS related admission control for Web services</td>
</tr>
<tr>
<td>Espen Angell Kristiansen</td>
<td>Håkon Kvale Stensland, Pål Halvorsen, Carsten Griwodz</td>
<td>Dynamic adaption and distribution of binaries to heterogeneous architectures</td>
</tr>
<tr>
<td>Ståle Bordal Kristoffersen</td>
<td>Pål Halvorsen, Carsten Griwodz</td>
<td>Utilization of instrumentation data to improve distributed multimedia processing</td>
</tr>
<tr>
<td>Brendan Johan Lee</td>
<td>Carsten Griwodz, Alexander Eichorn</td>
<td>Location Estimation Methods for Open, Privacy Preserving Mobile Positioning</td>
</tr>
<tr>
<td>Ronny Mandal</td>
<td>Lionel Claude Briand, Andrea Arcuri</td>
<td>Towards Safe Mutation Testing in a Sandbox Environment</td>
</tr>
<tr>
<td>Ivar Ursin Nikolaisen</td>
<td>Xing Cai</td>
<td>Bose-Einstein condensation in trapped bosons: A quantum Monte Carlo analysis using OpenCL and GPU programming</td>
</tr>
<tr>
<td>Master's students</td>
<td>Supervisors</td>
<td>Theses</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------------</td>
<td>--------</td>
</tr>
<tr>
<td>Preben Neseth Olsen</td>
<td>Håvard Espeland, Pål Halvorsen</td>
<td>Parallel Multimedia Algorithms in P2G</td>
</tr>
<tr>
<td>Gabriela Rutkowska</td>
<td>Kent-Andre Mardal</td>
<td>Computational Fluid Dynamics in Patient-Specific Models with Normal and Chiari I Geometries</td>
</tr>
<tr>
<td>Viktor Slavkovicj</td>
<td>Alexander Eichhorn</td>
<td>Live color Calibration of a Video Camera Array</td>
</tr>
<tr>
<td>Vladimir Zorin</td>
<td>Sven Arne Reinemo, Tor Skeie</td>
<td>Packet tracing in simulation environments</td>
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[2] InterMedia, University of Oslo  
[3] Department of Mathematical Sciences, NTNU  
[4] Sintef  
[5] Department of Informatics, University of Oslo  
[6] Mathematical Sciences, Chalmers University of Technology  
[7] Department of Mathematics, University of Oslo
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[149] K. Valen-Sendstad, K.-A. Mardal, M. Mortensen, B. A. P. Reif, and H. P. Langtangen. Simulation methodology for cerebral blood flow. Biomedical Simulation Lab, Institute of Biomaterials and Biomedical Engineering at the University of Toronto, 2011.


