Simula Research Laboratory
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— by thinking constantly about it

Springer
When researchers gather around lunch tables, at conferences, or in bars, there are some topics that are more or less compulsory. The discussions are about the hopeless management of the university or the lab where they are working, the lack of funding for important research, politicians’ inability to grasp the potential of a particularly promising field, and the endless series of committees that seem to produce very little progress. It is common to meet excellent researchers claiming that they have almost no time to do research because writing applications, lecturing, and attending to committee work seem to take most of their time. Very few ever come into a position to do something about it.

With Simula we have this chance. We were handed a considerable annual grant and more or less left to ourselves to do whatever we thought would produce the best possible results. We wanted to create a place where researchers could have the time and conditions necessary to reflect over difficult problems, uninterrupted by mundane difficulties; where doctoral students could be properly supervised and learn the craft of research in a well-organized and professional manner; and where entrepreneurs could find professional support in developing their research-based applications and innovations.

This book is about what we did. It describes the philosophy behind Simula Research Laboratory, how we have tried to implement it, and the results that have come out of it. We have tried to describe this through a mix of articles and interviews. Most of the book is intended for anyone interested in research, whereas some of the articles are written for experts interested in Simula’s research subjects.

At the time of this writing, Simula has existed for slightly more than eight years and it is fair to say that we still have a long way to go. The vision is still a vision, but by reading this book we hope you will sense a strong will to work towards this goal. We do not claim that we have found the solution but we are looking for it and will keep working towards that goal because our conviction is stronger than ever. We need researchers who are able to fully concentrate on their problems, we need to improve the way we educate new researchers, and we must become much better at developing applications based on our research.

Writing a book such as this is a big project involving many contributors. We would like to thank all of them for a fruitful collaboration. In particular, we would like to thank Arvid Hallén, Ingolf Søreide, Arild Underdal, Paul Chaffey, Odd Reinsfelt, Ine Marie Eriksen Søreide, Bjørn Rasmussen, Hans Christian Haugli, Morten Dæhlen, Hans Gallis, and Viktor S. Wold Eide for taking the time to be interviewed.
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At Simula’s opening, Dr. Martin Peters of Springer-Verlag attended as a guest alongside half the Norwegian government. Since then, Dr. Peters has been a frequent guest at Simula and all those visits have paid off handsomely for both parties. A total of ten Springer books have been produced by Simula employees. As always, our collaboration with Dr. Peters and with Springer-Verlag has been outstanding.

Special acknowledgements are due to the Norwegian Government represented by the Ministry of Education and Research, the Ministry of Trade and Industry, and the Ministry of Transport and Communications. It was a bold decision of them to create Simula, and we are grateful for the continuous financial and political support they have provided. We would also like to thank the Research Council of Norway for skillfully administering our relations to the Government.

Furthermore, we would like to thank StatoilHydro for their long-term commitment in research undertaken at Simula. Together with them we have built a strong activity on computational geosciences, and the yield of this collaboration forms the basis of several chapters of this book. We are also grateful for collaboration with and financial contributions from the Municipality of Bærum, Telenor, Det Norske Veritas, and Sun Microsystems.

If you have views, questions, or comments about the contents of this book, please do not hesitate to contact the authors of the chapters or Aslak Tveito at aslak@simula.no.

We hope you will find something to think about.

Fornebu, Norway, June 2009

Aslak Tveito  
Professor  
Managing Director  
Simula Research Laboratory

Are Magnus Bruaset  
Professor  
Assistant Director  
Simula School of Research and Innovation

Olav Lysne  
Professor  
Director of Basic Research  
Simula Research Laboratory
Contents

Part I The Scene

1 What Would you do if you Suddenly got an Annual Grant of About Ten Million Dollars? ........................................ 3
   Aslak Tveito and Morten Dæhlen

2 By Thinking Constantly About It .................................. 7
   An interview with Aslak Tveito by Dana Mackenzie

3 The Simula Culture — How we do Research, Education and Innovation . 17
   Aslak Tveito and Marianne M. Sundet

4 Impressed with Targeted Research Strategy ........................ 29
   An interview with Arvid Hallén by Bjarne Røsjø

5 The Hamming Experience ........................................ 33
   Hans Petter Langtangen and Olav Lysne

6 Richard Hamming — You and Your Research .................... 37
   Transcription of the Bell Communications Research Colloquium Seminar 7 March 1986

7 Simula Research Laboratory — A Different Research Institution ...... 61
   Marianne M. Sundet and Bjarne Røsjø

8 IT Fornebu and the Political Battle that led to the Creation of Simula . 77
   Bjarne Røsjø

9 The Right Step at the Right Time ................................. 89
   An interview with Paul Chaffey by Bjarne Røsjø

10 A Brief History of Norwegian Science and Research Policy ........... 93
    Christian Hambro
11 Simula — The Language ........................................ 113
Olav Lysne and Are Magnus Bruaset

Part II Basic Research

12 Introduction to Basic Research ............................. 121
Olav Lysne

13 Networks and Distributed Systems — Why, What, How and What’s Next 123
Carsten Griwodz and Olav Lysne

14 Scalable Interconnection Networks .......................... 129
Lysne et al.

15 Providing Resilience in Communications Networks ............. 163
Amund Kvalbein and Yan Zhang

16 From Gilgamesh to Star Wars .................................. 189
An interview with Carsten Griwodz by Dana Mackenzie

17 RELAY — On the Performance and Resource Utilisation of
Time-Dependent Large-Scale Distributed Systems ............... 199
Carsten Griwodz and Pål Halvorsen

Hans Petter Langtangen and Joakim Sundnes

19 Catching the Beat ................................................. 249
An interview with Kirsten ten Tusscher by Dana Mackenzie

20 Computer Simulations of the Heart ............................ 259
Glenn T. Lines and Joakim Sundnes

21 A Message from the Heart ....................................... 277
An interview with Per Grøttum and Bjørn Fredrik Nielsen by Dana Mackenzie

22 Can ECG Recordings and Mathematics tell the Condition of Your
Heart? ................................................................. 287
Nielsen et al.

23 Past and Future Perspectives on Scientific Software ............ 321
Anders Logg, Hans Petter Langtangen, and Xing Cai

24 Software Engineering — Why, What, How and What’s Next ............. 363
Dag I. K. Sjøberg and Stein Grimstad

25 A Matter of Judgement .............................................. 369
An interview with Magne Jørgensen by Dana Mackenzie
Contents

26 Software Development Effort Estimation — Demystifying and Improving Expert Estimation .......................... 381
Magne Jørgensen and Stein Grimstad

27 Faulty Until Proved Correct ................................................. 405
An interview with Lionel Briand by Dana Mackenzie

28 Software Verification — A Scalable, Model-Driven, Empirically Grounded Approach ..................... 415
Lionel C. Briand

29 The industry is our lab — Organisation and Conduct of Empirical Studies in Software Engineering at Simula ............................. 443
Dag I. K. Sjøberg

30 A Series of Controlled Experiments on Software Maintenance ............. 459
Erik Arisholm

Part III Research Education

31 Educating Researchers — a Virtue of Necessity ....................... 483
Are Magnus Bruaset and Kristín Vinje

32 Thinking Outside the Box .................................................... 495
An interview with Ingolf Søreide by Bjarne Røsjø

33 A Little Competition and a Lot of Cooperation .......................... 499
An interview with Arild Underdal by Bjarne Røsjø

34 Are you Planning to Take a PhD? .................................. 503
Aslak Tveito

35 An Extraordinary Investment ........................................... 519
An interview with Odd Reinsfelt by Bjarne Røsjø

36 Simula can do Much Better! ............................................. 523
An interview with Morten Dæhlen by Bjarne Røsjø

37 Achieving Relevance ....................................................... 527
An interview with Ine Marie Eriksen Søreide by Bjarne Røsjø

Part IV Research Applications

38 Bridging the Gap Between Industry and Research .......................... 533
Are Magnus Bruaset and Marianne M. Sundet

39 Making the Invisible Visible ............................................. 541
An interview with Are Magnus Bruaset and Bjørn Rasmussen by Dana Mackenzie
40 Turning Rocks into Knowledge ........................................... 553
Are Magnus Bruaset

41 A Tale of Three Start-ups .............................................. 601
An interview with Christian Tarrou, Hans Gallis, and Viktor Eide by
Dana Mackenzie

42 Spinning Off from Simula .............................................. 613
Bruaset et al.

43 We're Not a Telco, We're a Webco .................................... 627
An interview with Olav Lysne and Hans Christian Haugli by Dana
Mackenzie

A Simula Facts ................................................................. 637

B External Contributors ...................................................... 641

C Colour Figures ............................................................... 643

Some common abbreviations

CBC Center for Biomedical Computing
CoE Centre of Excellence
DNV Det Norske Veritas
FFI Norwegian Defence Research Establishment
ICT Information and Communication Technology
Ifi The Department of Informatics, University of Oslo
ND The Network and Distributed Systems Department
NR Norwegian Computing Center
NTNU The Norwegian University of Science and Technology
RCN The Research Council of Norway
SC The Scientific Computing Department
SE The Software Engineering Department
SI Simula Innovation AS
SSRI Simula School of Research and Innovation AS
SRL Simula Research Laboratory AS
UiO University of Oslo
PART I

THE SCENE
WHAT WOULD YOU DO IF YOU SUDDENLY GOT AN ANNUAL GRANT OF ABOUT TEN MILLION DOLLARS?

Aslak Tveito and Morten Dæhlen

Funding is one of the very few problems that every researcher on the planet has in common. Most will have to confront this burden repeatedly during their careers, and a dream of a grand solution is common amongst researchers. We have lived that dream and this book tells the story of how we have spent the grant we got.

The genesis of the huge grant was—believe it or not—the need for a new airport in Norway. When the Norwegian Parliament decided to shut down the national airport located at Fornebu, an extensive political process ensued to decide what should be done with the structure. After many rounds in the Parliament, it was decided that an IT centre should be established, which was to include a research lab with considerable basic funding. You will find more about the political turbulence surrounding this process in chapter 8.

The research lab was named the Simula Research Laboratory, after the programming language developed in Norway by Kristen Nygaard and Ole-Johan Dahl. Professor Morten Dæhlen was appointed as the first managing director, a post subsequently assumed by Professor Aslak Tveito after a hectic initial period. Our discussions of how a really good research lab should be organized and operated began in the 1980s.

Aslak Tveito
Simula Research Laboratory

Morten Dæhlen
Department of Informatics, University of Oslo, Norway
when we (Aslak Tveito and Morten Dæhlen) worked together studying numerical analysis. Later, we both worked at SINTEF, a large research lab primarily run on industry funding. SINTEF is an extraordinarily well-operated institution, but the funding model is difficult if basic research is your prime interest. Following our stint at SINTEF, we were both hired as professors at the University of Oslo. Later, Morten Dæhlen left the university to become director of the division of natural sciences in the Research Council of Norway. Throughout our careers, our debate about how to best organize and run a research lab continued. If we were to establish a new research lab, we agreed that a close collaboration between the university, private companies, and existing research labs would be necessary in order to obtain the necessary funding.

An opportunity to test our ideas about to organize and run a research lab appeared more or less out of the blue. The IT centre at Fornebu was purely a political concept, and so was the idea of furnishing it with a research lab. We had never foreseen such an opportunity; how many times have politicians ever volunteered to form a new research lab? It was indeed a bold move to establish Simula, and this was spelled out clearly by the lab's advisory board:

The Norwegian government and the research leaders who established Simula Research Laboratory (SRL) should be congratulated on their courage and foresight in crafting SRL. It is unusual these days for governments to take such a long-term view, to concentrate resources and to trust independent leadership. In this case it has paid off handsomely—establishing more rapidly than the founders could possibly have hoped an exceptionally successful institution, which has all the prerequisites for a research centre of considerable international importance.

The Simula Scientific Advisory Board; July 2004.

Since its inception, Simula consistently has enjoyed strong political support and has been visited by many political delegations. Because Simula is a newcomer in the Norwegian research system, such support has been extremely important.

Given the opportunity, we seized it and started to implement our ideas that really were a true mix of a research lab (e.g., SINTEF) and a university. The platform Simula was built on can be summarized as follows:

1. After talking to active researchers in Norway and around the world, we had formed the impression that surprisingly few full-time researchers exist. Some have hefty teaching duties, some have to spend a large part of their time supervising students or young researchers, some spend a lot of time trying to obtain funding, and all complain about endless meetings. We wanted to create possibilities for researchers to focus more or less completely on their research.

2. The management model used in universities at that time had serious deficiencies. At the institutional level, the process of making a decision was very complex, time demanding, and hard to comprehend. It consisted of both formal and highly infor-

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1 The Simula Scientific Advisory Board consists of internationally renowned scientists; their role is explained on page 66.
mal hierarchies. In contrast, the SINTEF model was much clearer, more transparent, and more efficient; SINTEF was operated more or less like a private company. Thus, Simula followed the SINTEF method of management.

3. The process of hiring scientists at the university is overly bureaucratic. It was created with the best possible intentions—and it has resulted in employment for a large number of brilliant scientists—but it is extremely time consuming, thus the risk of losing excellent candidates in the process is significant. Simula implemented a very efficient way of hiring that is based on headhunting. In particular, this was important in the early days when Simula had to deliver strong results within a few years.

4. In general, university researchers (in Norway) argue that the direction of research must be completely free of outside constraints, and most attempts to change this situation result in strong protest. The idea of research driven by the curiosity of the individual scientist is a good one that historically has generated a wealth of important results. However, other models are possible. At Simula, we decided that research should be more strongly directed than is the case at universities. This policy has enabled us to focus on a limited number of projects. Furthermore, many researchers find it reassuring to know that there is a plan for their activities. On the other hand, within each project and from day to day, each researcher has great freedom.

5. We have always felt a strong obligation to be able to explain to our politicians and to taxpayers at large why we are doing what we are doing. Thus, we focus on research projects with foreseeable useful applications. This approach does not discourage high-risk projects; indeed, few of our projects are likely to have a commercial outcome. However, the motivation for each of our projects lies in real-life situations. We do not support purely curiosity-driven projects, which distinguishes us from the Norwegian universities.

6. We strongly believe that research labs should promote collaboration with industry at large. Such collaborations were extremely important at SINTEF, but there the projects often were of short duration and had strict specifications. At Simula, we wanted to invite companies or other institutions to collaborate on long-term projects to address really challenging problems. In one particular case this has turned out to be successful; read more in chapter 40.

7. No one knows how to create business based on research. However, as part of a commercial IT centre, Simula was more or less expected to create new businesses, and this has been an important task since its inception. Examples of businesses that have been created are given in chapter 42, and these results are based on continued efforts to identify, support, and develop commercial ideas at Simula.

These seven ideas that constitute Simula’s research platform have been refined through numerous discussions with many employees at Simula, with members of our Board of Directors, and with members of our Scientific Advisory Board. Our attempts to implement these ideas are discussed further in chapter 3. Certainly, these ideas are clearer now than they were initially, but their implementation must still be regarded as a beta-version. Our initial ideas were naïve and not based on under-
standing of the laws and regulations surrounding the day-to-day operations of limited companies; meeting the realities involved a dazzling series of challenges.

The efforts undertaken at Simula have, to a certain degree, impacted other parts of the Norwegian research system. Morten Dæhlen currently is the chairman of the Department of Informatics at the University of Oslo, where he applies ideas and experiences attained at Simula. Furthermore, the Research Council of Norway is about to evaluate the organizational model used at Simula to assess the merits of applying this model in other national research initiatives.
In 2000, Aslak Tveito, the current Managing Director of Simula, and his predecessor Morten Dæhlen were handed a once-in-a-lifetime opportunity to build a new academic institution from scratch. Although Simula owes its existence to a political decision; it owes its scientific vision to Tveito, who has led the laboratory since Dæhlen’s departure in 2002. Most of all, Tveito wanted Simula to be a place where scientists could do research, freed to the greatest extent possible from extraneous duties such as teaching, committee meetings, or the constant search for funding.

The commitment to research at Simula starts at the top. Before founding Simula, Tveito was the head of the research group in scientific computing at the University of Oslo—one of the three groups that came together under the aegis of the new laboratory. He has continued to be actively involved in the research of the Scientific Computing division of Simula, even while managing a large enterprise that now boasts 120 employees and a budget of more than 100 million Norwegian kroner. Though he is a manager by necessity, Tveito (a big fan of the *Dilbert* comic strip) still seems to be a Dilbert at heart.

In this interview, we talked with Tveito about his vision for Simula, how that vision has been put into practice. We also discussed how computing has come to be at the forefront of modern-day science.

“What is the story behind Simula’s slogan ‘By thinking constantly about it’? Where did it come from, and what does it mean?”

“The story is that many employees argued that we should have a slogan or that we should come up with the shortest possible description of what Simula is about. I thought that it was completely impossible. You would have to write a whole docu-
ment about it; and there would be no way to condense it into a slogan. In fact, I made several jokes about slogans. At that point I read a lot of *Dilbert*, and there were lots of slogan jokes in Dilbert, and I enjoyed them. So I didn’t like the idea.

“But then I read an interview with Lennart Carleson by Björn Engquist, which was published by Springer in a book called *Mathematics Unlimited*. Carleson mentioned that he had seen a statement by Newton, where somebody had asked him how he came up with the law of gravitation. Newton said, “By thinking constantly about it.” It occurred to me that this was really the essence of Simula: having a place where you can think constantly about something undisturbed, with no other duties.”

“*Why did you choose the name Simula? Are you concerned at all about people confusing the name of the laboratory with the computer language?*”

“Not at all! There are not that many really well-known results from Norwegian scientists. But Norwegian scientists made a really significant contribution to object-oriented programming. Ole-Johan Dahl and Kristen Nygaard created this beautiful language, Simula, that was used at the University of Oslo for many years in the introduction to computer programming\(^1\). I learned programming in that language, and a whole generation did. It was a language that you could really find beautiful, very different from C and C++ which looked very ugly.

“It was my idea to name the organization after Simula and to call it Simula Research Laboratory. I remember exactly where I was sitting the first time I came up with the idea. I was at home, meeting with Morten Dæhlen, who was the first director (at that point the director-to-be) and I remember that I argued strongly that it should be Simula Research Laboratory. I had always wanted to work in a laboratory! In the beginning, of course, some people thought that we would like to start working on the Simula computing language again, but that was never the intention at all.”

“*Getting back to the business of full-time research. . . Now that you are an administrator, you can’t do research full time, but what is the proportion of time that you spend on it?*”

“I think I’m a 50–50 guy, and I think many people are in that position. Fifty per cent research and fifty per cent something else. Of course, teaching is the most common something else. I don’t teach, but I supervise students, and I still have plenty of time to do research. I think that is related to the way Simula is organized. It is a well-functioning business, and we don’t have disasters every other week or things that I have to clean up. It is a peaceful place and things are running smoothly, so there is no reason for me to be involved all the time. I don’t really want to be. I’m not the kind of leader who wants to put my mark on every possible thing. I am perfectly happy seeing that someone is doing things totally different from what I would have done, and I wish them the best of luck!

\(^1\) Simula is generally regarded as the first object-oriented programming language.
"I am told that Morten’s office was in the library, right in the middle of things. But your office is at the end of the hall. Was that deliberate?"

“That changed one and a half years ago, after I went to San Diego for two months and just worked on my own. Up to then, I had been really in the middle of things, not in Morten’s old office but an ordinary office up in the administration. It struck me that when I sat there and people saw me all the time, it was always so very easy for people to drop by. They knew if they had my decision on something, it would be the final decision, and there would be no more fuss about it. So it was very tempting for them just to drop by my office. But if you have six or seven or eight people just dropping by your office in a day, then your day is more or less destroyed. You cannot concentrate on anything for more than twenty minutes. I was really not satisfied with this, so I decided to move away from the front. I told everyone that before lunch I am doing mathematics, and after lunch we are free to talk. For a while I was really strict about this. I’m not so strict now. But people really feel that they need a good excuse to come all the way up here, so it’s working. I cannot be available for 120 people all the time. That’s impossible."

“Has this change made an impact on your knowledge of what is going on at Simula?”

“Yes. Four or five years ago I knew everyone and really felt what the atmosphere was. I knew what was going on all the time. I’ve lost that. But also, I’ve got two young kids now, and so I work less. At that time I worked perhaps 60 or 70 hours a
week, but now I work about 45. So I have to be stricter on what I am doing, and of course I have lost something. You cannot know everything."

"Also, with 120 people, even if you did have your office in the centre it would be hard to know everybody. Will Simula continue to grow, or is there a right size where it will stabilize?"

"I think it will continue to grow for a while. I think it is a natural tendency for a lab to grow, because the mechanism is that new people enter the lab, they have new ideas, and they want to do things. In order to do new things, you have to hire new people. It’s not like in pure math, where many papers are written by just one author. I don’t think you’ll find a single-authored paper at Simula. There’s always a group doing something. The students I had 15 years ago are in a position now where they want to do things on their own. They don’t just want to work together with me; they want to be their own project leader. That means growth.

"If you look at the figures on how Simula has developed, you notice that the fraction of non-scientific or support staff has been reduced from 23 per cent to 17 per cent from the start to now. So we are getting more efficient. If you look at the number of permanently hired research scientists, that fraction has also gone down. That means it is hard to get a permanent position here. I think that is good. The number of PhD students has increased very much, the number of postdocs has increased, and also the number of people working with applications has increased.

"I don't know the asymptote on Simula's size, but at least for as long as I can imagine we will stick to our three core subject areas—networks, scientific computing, and software engineering."

"Hiring is obviously an extremely important part of building an organization. Could you talk to me about your general strategies for hiring?"

"In the universities, at least the ones in Norway and Sweden that I know very well, the procedure for hiring a professor is extremely time-consuming. You have to write documents that have to be agreed upon by the department. There is a lot of preparation to post a position, and then you have to open it up for anyone to apply, and often you have quite a large number of applicants. Then there are scientific committees that go through all of the applications and write about all the candidates. This process often takes two years.

"At Simula we wanted to do it differently. We wanted to be fast, and we wanted to do it much more like an ordinary company. The idea in the Norwegian and Swedish universities is very good and very fair, but the practice is poor. We really wanted to do this much more efficiently, looking for really good people and trying to go for them."
"Two of the people I have interviewed for this book, Lionel Briand and Kirsten ten Tusscher, seem to be perfect examples. Can you tell me what attracted you about Lionel and Kirsten?"

"Lionel spent a year here and I talked with him from time to time. He was very enthusiastic about what he was doing and he had very clear thoughts about what to do. When we started talking about a permanent position, I had more of a formal interview with him. We talked for two hours, and he talked for 1 hour and 50 minutes of those two hours. His main topic was how to run Simula! Of course that was a bit unusual for a job interview, but he impressed me very much. I felt we needed that kind of person here. He is very enthusiastic and good with his students, and he has good results coming. He is into deep problems but also problems of relevance for the information technology industry.

"Kirsten is a completely different story. She was invited here by one of our employees to give a talk. I listened to her talk and I enjoyed it very much. I had heard about her earlier and I knew that her papers were well-regarded. At dinner we discussed her job situation, and it turned out that she had a contract that would end in a little bit more than half a year from that time. I asked if she would be interested in coming to Simula, and after a month or so we agreed that she would start here as a research scientist with a little group around her."

"It seems to me, especially in that second case, that the speed with which you were able to act was crucial."

"Yes, absolutely. But I think that was also true for Lionel as well. I think he enjoyed the speed of the process, and the fact that we really went after him."

"Is it difficult to persuade people to leave academia and leave the safety of tenure?"

"We do have tenure, in the sense that people who finish their postdoc can be considered for a permanent position. They are employed permanently in the sense that they have a job as long as Simula will exist. Of course, it's not the degree of certainty you have at a 200-year-old university. Some people enjoy that kind of security, but some enjoy the way we have of working at Simula. There are so few places, at least in Norway, that you can do only research, without having to get money or supervise or teach students. That, of course, is very appealing to many scientists."

"Getting back to the three areas of concentration of Simula, why were those three areas chosen?"

"There was a process arranged by the Research Council, where you could apply to be part of Simula when it was started. That was a national contest. There were 12 applicants, and three groups were selected. None of them were particularly good at the time. That's the truth—you can write that. But in eight years they have become very
good. They are at an international level, producing science in international journals at a good rate.

"If you look at these three subjects, you can trace them all back 50 years. Software engineering is about how you program computers to solve large, challenging problems, and design programs that you can renew and that are robust. That has been a problem since the beginning of the computer age, how to create reliable software. It's a very important subject because the entire society depends on software today. If you make a car, 40 per cent of the cost is related to software.

"Of course, also if you go back at least to the 1960s, you will see that communication between computers started very early. That's still a big challenge. Mobile networks break down all the time, but people depend on them, especially in Norway because mobile phones exploded very early here. So we are completely dependent on networks, and the robustness of them is an important problem and has been important for at least 40 years.

"Scientific computing is the same, a very classical problem. The computer was really invented for solving problems in scientific computing. Scientific computing today is what mathematics was 100 years ago. Mathematics was about solving problems and computing solutions. Now scientific computing is about computing solutions."

"That's an interesting point. I noticed that in one of the papers you sent me, there was actually a little proof. I thought, wow, here's a computer guy, and he's still doing proofs! Just asking you to speak as a mathematician, do you think it's a good thing that we have become so dependent on computers? Can it be overdone?"

"That is a question I was not expecting! Actually, my PhD is on proving theorems in hyperbolic conservation laws, proving stability and existence of solutions in nonlinear partial differential equations. That's really what I was trained to do.

"Of course, the frustrating thing about proving things is that you can only address simple problems. When you start digging into the literature about the heart, you see that the more applied the problem is, the more real the problem is, the fewer mathematicians are involved. In the really very challenging problems in that field, you see almost no mathematicians at all. Why is that? I think it is because the tools you traditionally have in math are not really adjusted to deal with those problems. But those problems are extremely important. The only way to relate to them is to use the computer.

"I think my ideal is that you somehow try to figure out a much smaller problem on a simpler geometry and try to understand what is really going on in this equation, from a mathematical point of view. Then you try to complexify it, step by step. You lose the theorems and the estimates, but somehow you keep track of the properties of the problem. Then when you enter a really complex problem and you see that structure, you have understood something even though you don’t have the estimates or the theorem that is valid on that geometry. If I have a scientific program for my own research, it's like that. I try to understand the simplest possible problems. Simplify, simplify, simplify. Then I go back the other way and try to keep track of the structure. It's possible!"
“When I went to high school, I read about the early 1900s, when there was a revolution in physics. That was when physicists first understood the atom and the nucleus and electrons and how these things work. I thought it must have been extremely exciting to live and to work at that time.

“Many years later I understood that the present period is so much more exciting, and it’s because of the computer. It’s a fantastic tool to understand physics, and to really solve equations that have been known for 200 or 300 years. For example, in the Navier-Stokes equation, it’s only for the last ten years that you have been able to do realistic computations. If you go back to the mid-1980s, the typical geometry would be the unit sphere, the typical number of nodes would be on the order of 1000, and the typical model that you could solve would be a Laplace equation or a heat equation. Now you can do fully realistic geometries and fully realistic models. You can really address the problems that scientists have been aware of for centuries, but have been totally unable to attack in a rigorous manner. That’s new! That ability is only ten years old.”

“What would Newton think? I think he would have loved this.”

“Or von Neumann! I think they would have been thinking about biology. That is the most complex area of computational mathematics.

“If you look at this book (Mathematical Physiology) by Jim Keener, who is one of the few mathematicians who has entered this field, you will find a couple of hundred partial differential equations. We are really unable to solve all of them. If you read the preface of that book, Keener says that it would be completely impossible to think of studying astrophysics without doing math. But you can be a medical doctor and do things in physiology without doing math. He thinks that this is completely wrong. You have to do modeling of the parts of the body, of the organs and so on, and you have to format this in the only language available, and that is mathematics.

“The models, both the mathematics and the physics involved in them, are so complex that computers are the only way into these problems. People in these fields realize that.”

“How do doctors or physicians respond to these models?”

“Many people we talk to are open-minded, because they are so interested in progress. They don’t care so much how the progress is created as long as it is really progress. Many of them see that there is potential in using computers.

“There must be a thousand papers in the field of cardiac arrhythmias and sudden death now, and all of these papers are based on partial differential equations. So there is a strong belief that these equations model these phenomena in an appropriate manner. That is really not questioned. The models are more or less realistic and more or less accurate. We can start to see what really triggers these arrhythmias. That was a bit amazing for me, going into that field from a very theoretical perspective on partial differential equations. I quickly realized that no one would be interested in proofs of existence or things like that. They are only interested in what this equation
Aslak Tveito tells you. What is the content here, what are the properties? All the beautiful theories and all the maximum principles are not interesting at all.

“It’s not an easy field for a mathematician to enter, because there are all these funny words that you’ve never heard before. So I made a living solving these equations in that field for several years before I tried to dig into what the equations were about. I worked on numerical methods to solve them, without really caring too much about the applications. But now, more and more, we are really trying to understand what is going on.”

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“Hiring people like Kirsten, who is actually a biologist, must be a step in that direction.”

“That’s not an accident. Absolutely, we want to move in that direction, while keeping a firm grip on modern techniques to solve these equations. That can be our contribution, because we can solve these equations better than the people in the field.”

“Changing subjects a little bit, how does Simula inform the public about its work?”

“I don’t think we are doing a great job of informing the public about what we are doing, but we are doing a very good job of informing politicians. We have had about 50 members of parliament or the government visiting Simula. When we invite politicians to see Simula, they always accept the invitation. We have one or two scientists telling about what they are doing. The politicians listen and ask good questions, and we have a good dialogue with them. I always have the feeling that they listen to us and understand us. We don’t always get what we want, but when we don’t get it, I have the feeling that they have at least understood what I’m asking for and why I’m asking for it. I feel we’ve had a good dialogue, and that’s important because this is an enterprise that is different from anything else in Norway.

“Of course there has been a fair amount of Simula in the media. We always try to talk to journalists who want to ask about something, answer them properly and give them the information that they ask for. We haven’t spent much money on it, but I think we have been friendly towards anyone asking questions.”

“Last question: Where do you see Simula going in the next five years?”

“Morten Dæhlen said that he thought Simula could do very much better on ICT and politics. I totally disagree; that is exactly what we are not going to do. We are going to do much better on figuring out how networks are working, how we do scientific computing and how we develop software. That’s really the focus. I think we are on the right track in those directions. I think the Simula School of Research and Innovation will grow and become much better. With Simula Innovation, we have started to understand a little bit more about how to create new businesses. We haven’t been successful with that yet, and I’m not satisfied with that part. But we have started to understand more that we really need to focus on these projects.

2 See the interview with Dæhlen on page 524.
“I think when you come back in five years, you will see that we are in the same fields but we are much better positioned in each field. I hope we don’t spread out; I hope we don’t do ICT politics; and I hope that we still try to think constantly about it.”
THE SIMULA CULTURE
— HOW WE DO RESEARCH,
EDUCATION AND
INNOVATION

Aslak Tveito and Marianne M. Sundet

This article describes the culture at Simula; not necessarily as it actually is, but how we would like it to be. It is an attempt to set out some of Simula’s defining characteristics.

Describing what is meant by a company culture is no easy task. What are the key characteristics of Simula? What is it that sets us apart? What does a good work atmosphere mean, and how should things be done here to achieve that? An overall, abstract description of workplace culture is likely to be difficult to understand and to relate to daily work, and will also probably be rather similar from one company to the next. That is why we give concrete examples here to make this all more tangible. These examples are not more important than other aspects of the work environment we could have chosen, but have been used merely to make this easy to understand and easier to relate to.

The work of creating a Simula culture involves developing a research laboratory in which a strong focus on high-calibre research is key. Simula will only be successful if its employees are successful. Developing a Simula culture is about creating a work environment where people are happy and feel they are able to do a good job. It is about establishing ground rules for how we act in the research community and interact with society in general, and it is about working to ensure that the name “Simula” is synonymous with quality, honesty and efficiency.
It is important that we all share the same ideas about what sort of culture we want to have, what the culture means and how it can be sustained in the future. Members of staff who have been at Simula for a number of years, some even since its establishment in 2001, will recognise the ideas in the article and hopefully find that the descriptions comply with their own experience. However, Simula has grown and is still growing, and the number of employees is rising. For us, it is paramount that all newcomers, and especially research fellows who are in temporary positions, get the feel of how we relate to each other, our tasks and the world around us. By reading and relating to this article, we hope all employees will understand and find guidance as to how things are done at Simula. For other readers, we hope the article can provide ideas for improvements or at least be a source of thought and discussion about how to organise and run a research lab.

The Simula model

Before we describe the Simula culture, it may be useful to go over the main features of the Simula model:

1. **Organisational model.** The organisational and management models used in the Norwegian research system can basically be divided into the university model and the company model. Research institutes in Norway employ the latter. We strongly favoured the company model, as it appeared to be much clearer, more transparent, and easier to comprehend. Simula is thus managed more or less like a commercial company, with the prominent exception that commercial companies are set up to produce revenues, whereas Simula is constructed to produce research results, educate researchers, and enable innovations. Specifically, Simula is managed according to the Limited Company Act.

2. **Full-time researchers.** At Norwegian universities the teaching and supervising duties are rather severe. On the other hand, at Norwegian research institutes most researchers have to spend a large part of their time trying to obtain funding from industry. Based on the financial freedom that came with Simula, we wanted to establish a situation where highly skilled researchers were allowed to focus more or less exclusively on research; we wanted to revive the full-time researcher.

3. **The recruitment process.** A research lab is as good as the researchers employed there. Therefore it is impossible to exaggerate the importance of a sound recruitment policy. As a part of that, efficiency is crucial; we need to be able to move forward very quickly when a unique opportunity arises. At Simula, we try to recruit extremely promising candidates and the best researchers will be given funds to build their own activity. The recruitment process aims at setting up a truly international lab and whenever possible we try to achieve gender balance.

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1 This description of the Simula model was originally written for the Annual Report 2008.
4. **Directed research.** We never subscribed to the view that excellent research can only be performed when each individual researcher is completely free to follow his or hers individual ideas. Rather, we wanted a model where we could determine a set of long-term goals and collectively work towards these in an organised manner. The research at Simula addresses fundamental problems, but the research is directed more or less as if the activity were organised in a private company. The freedom in day-to-day or week-to-week assignments is very great but the long-term goals are decided in a comprehensive process and everyone has to adapt to these goals. In particular, we have derived a careful procedure of initiating new projects.

5. **Usefulness.** The aim of basic research is rarely to be of use in the short term; indeed, it is widely acknowledged that deep knowledge ultimately is useful but that the path from science to application may be very long. At Simula we address research questions whose solutions would be applicable; that is, we do not pursue strictly curiosity-driven projects. Generally speaking, we address problems where the likelihood for important applications of a positive result is high.

6. **Concentration.** Diffusion is a natural process that moves a substrate from an area of high concentration to a region of low concentration. The process is extremely strong and affects many parts of life. Given a substantial amount of money, there are very strong mechanisms trying to spread these resources over a large number of worthy assignments. At Simula we have tried very hard to maintain focus on core issues and avoid the diffusion of resources.

7. **Collaboration with industry.** Since we want to deliver applicable results, we seek strong collaborations with industry at large. Such collaborations, however, must be long-term and directed towards really challenging problems; short-term consulting should be completely avoided at Simula. Furthermore, our aim is to educate PhDs and postdoctoral candidates with a firm grasp of the problems of industrial interest in their field of research.

8. **Creating new businesses.** Since real-life applications are the long-term goal for our research, Simula consistently aims at aiding researchers to enable the application of their research efforts.

9. **A characteristic culture.** We wanted to create a strong and characteristic research culture based on a few governing principles accepted by everyone, enabling efficiency, quality, excellent results, and a very good working atmosphere. The present version of Simula is based on these building blocks. Of course, none of these parts are unique to Simula, but at least in Norway their combination has apparently not been tried before. Clearly, some of these elements are rather ambitious and we do not claim to have reached good solutions at every point.

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2 In OECD terms, our research can be classified either as oriented basic research, which is defined to be research carried out with the expectation that it will produce a broad base of knowledge likely to form the background to the solution of recognised or expected current or future problems or possibilities, or as applied research, which is defined to be an original investigation undertaken in order to acquire new knowledge directed primarily towards a specific practical aim or objective (see [http://stats.oecd.org/glossary](http://stats.oecd.org/glossary)).
Note, however, that creating Simula was founded on very strong ambitions and the determination to create an excellent lab.

**How did it all begin?**

We were assigned a task and receive State funding to fulfil that task. The task Simula has been set is to carry out research of a high international calibre, to educate students at MSc and PhD level in collaboration with Norwegian universities, and to set up business activities based on the work done at the centre. Simula’s research activities fall within three subject areas: networks and distributed systems, scientific computing and software engineering. These are also the three subject areas in which we help to educate students. Readers interested in finding out more about the scientific work carried out at Simula may consult chapters 13, 18, and 24 for networks and distributed systems, scientific computing and software engineering, respectively.

**Focus**

*The area of ambitions equals the width multiplied by the height.* All else being equal, the area of ambitions is constant; we may have broad ambitions that are not particularly high, or we may have narrow ambitions that are extremely high, but we must never believe that we can have high ambitions across a wide range of fields. In this respect, Simula has made its choice: we will have high ambitions in a few select fields. That is why the three subject areas we have chosen will remain constant, and we will not spread ourselves too thinly even within these fields. All our research efforts will be devoted to these few carefully chosen areas. But in these areas we will make every effort to succeed. We will participate at the international elite level; we will be invited to speak at professional events; we will be sought-after partners; we will be a natural destination for visiting researchers the world over; we will educate good PhD students; we will be attractive partners for Norwegian industry, and we will develop companies based on our research in these areas. If we are to achieve all of this, we must concentrate our efforts and resources.

**The full-time researcher**

Wherever researchers meet and discuss their work situations there is one issue that comes up time and time again; researchers find that they simply do not have enough time to devote to research itself. There are a number of reasons for this; they have to apply for research funding to secure the resources needed to run their research groups, they have to teach, they have to serve on committees, they have to mark papers and theses, and they have to support the work of the research councils. A lot of experienced researchers find that their entire working days are spent on activities that are related to research, but that are not research itself.
At Simula, we will make every effort to shield skilled researchers from other duties. We will work hard to revive the concept of the full-time researcher. This is an ambition that is extremely difficult to achieve. We cannot redesign the realities of research policy. All over the world, researchers have always had to work to secure research funding. However, it is widely believed that all these research-related activities are taking up too much time and getting far too much attention. At Simula, we will work constantly and deliberately to reduce the administrative burdens placed on researchers. We want ours to be an efficient organisation. We will not be overly bureaucratic. We will give rapid, clear answers. We will have short meetings. We will have few committees and those that we have will be small. We will not write reports that no one will read. We will not ask for information no one needs. We will know what we want and what our aims are, and we will work with determination to reach those goals. In everything we do, we will be conscious of the fact that it is the scientific staff that is our productive force. They are the ones who produce the results that are the lifeblood of Simula. They are the justification for our existence. That is why we will all strive to ensure the best possible conditions for them to work under.

**Research fellows**

A large proportion of our researchers are research fellows. Both doctoral and postdoctoral research fellows are employed by Simula. Research fellows are an essential research resource and should be integrated as well as possible into the planning and execution of projects. As far as possible, they should participate on an equal footing throughout the whole research process. Just as a lack of time to conduct research is a recurring topic in discussions among many experienced researchers, the absence of genuine academic supervision is a recurring theme in discussions among research fellows. Research fellows need to receive in-depth feedback on what they are doing. It is both frustrating and inefficient for research fellows to be left to their own devices without feedback about their work. At Simula, supervisors will be accessible to their research fellows electronically, physically and, not least, as mentors. Supervisors must ensure that the research fellows’ projects are central to their own research so that supervision is not seen as an “extra”, that comes in addition to research. As far as possible, supervision should be research. Further discussion of the role of young researchers is presented in chapter 34 on page 503.

**IT Operations and administration**

Excellent research needs excellent support. It is the responsibility of the IT Department to ensure that the IT infrastructure supports the research activities as effectively as possible. Operational decisions should always be taken with a view to finding solutions that enhance the focus on research. Solutions that make great demands on

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3 The relation between scientific staff and support staff is discussed on page 74. It is worth noting that the relative number of support staff has declined and the relative number of scientific staff has increased as Simula has expanded from some 30 to some 120 employees.
researchers’ time should be avoided as far as possible. We need to use solutions that are stable and that keep operating problems to a minimum. We will try to avoid exposing researchers to unstable solutions from second-rate providers. In this context, quality and stability are, within reason, more important than price. Today, researchers are more or less unable to do anything useful if their PCs are not working. Reliable back-up solutions to all common problems\(^4\) must be available at all times.

The Simula administration provides support for the researchers at the centre and it is this support function that should inform any decisions that are taken. It is the task of the administration to ensure that the research can be carried out under optimal conditions. Procedures should be kept simple, and efforts should be made not to waste other peoples’ time unnecessarily. All employees must be aware of and must respect the relevant procedures. The Intranet is an important source of information and must be used actively.

**Management**

Simula is a limited company. The Board of Directors employs a managing director. He or she takes on directors responsible for Simula’s three main units: basic research, research application and research education. Together they constitute the corporate management. The units are defined areas with clear lines of responsibility and communication. The unit directors employ heads of department, directors of subsidiaries, group leaders and other employees. There are no elected positions at any level at Simula. In this respect, Simula differs from universities as we know them today.

The corporate management of Simula, heads of the departments, subsidiaries and of the groups, should always bear in mind that Simula employs extremely well-educated and highly gifted individuals. Strategic issues should be discussed throughout the organisation and any employee who wishes to should have the opportunity to express his or her opinions at all levels. All leaders should be highly accessible and open to discussion about everything that goes on at the centre. All leaders should encourage employees to express their opinions and be prepared to discuss them thoroughly, so that all aspects of an issue are considered before a final decision is made by a leader.

This mode of operation presents great challenges to all leaders at Simula, and it is now fully acknowledged that we have to invest much more in the process of educating our leaders. From 2009, Simula will have its own programme for research leaders.

**Directed basic research**

At Simula everybody works on research projects that involve other people. The research addresses fundamental problems of an applied nature. The research activities

\(^4\) PCs are stolen, they break down, they are left at airports; mobile phones are also lost and—believe it or not—flushed down the toilet in airplanes. Our IT support staff has to be able to come up with back-up solutions at short notice.
are managed along the same lines as the centre itself. In carrying out the research, it is especially important that all the researchers take part continuously in discussions about how the research should proceed. But here too, decisions are ultimately taken by a leader, who will be accountable for his or her decision. Within the parameters that are set and the research projects that are defined, Simula will strive to ensure that each individual researcher has the freedom to work in the most effective way possible.

Freedom for individual researchers to pursue their own ideas is a key feature of Norwegian universities. There is less freedom to do that at Simula. Everyone has the opportunity to take part fully in discussions about the choice of strategy, working methods and research tasks. However, once those decisions are made, everyone must work to achieve the targets set for the research group. The researchers will have the greatest possible freedom to make their own choices within the parameters set, but they cannot choose their own areas of research independent of the constraints chosen for the project as a whole. In other words, the freedom of individual researchers at Simula is limited compared with similar positions at universities.

At Simula we carry out directed basic research. We set targets for our activities and then work hard to achieve them. This places restrictions on the freedom of the individual. However, the freedom of a group is considerable, the freedom of a department is even greater and the freedom enjoyed by Simula is extremely large. But, we must have a common understanding of what we are trying to achieve, the problems we intend to solve and how we intend to solve them.

Although the freedom of individual researchers to pursue their own ideas at Simula is restricted, Simula is an organisation characterised by openness and intense debates. Traditional academic ideals regarding free debate and vigorous discussion are a key part of the Simula culture.

### Freedom, responsibility and initiative

At Simula, freedom divided by responsibility is constant. A large amount of freedom carries with it a large amount of responsibility. All the researchers and all the research groups have considerable freedom, but this freedom is accompanied by responsibility; the responsibility to conduct valuable research and deliver valuable results, and to carry out that research in accordance with the Simula culture. Simula will welcome good initiatives, but they need to be followed up and developed. At Simula, employees must be able to support their ideas and be prepared to work hard to put into place any necessary measures.

### Publications

Simula aims to publish its scientific results in the leading professional journals, in books and/or in good conference proceedings. The research will be focused on issues that are important and relevant. It will not be focused on the most publishable issues. Researchers at Simula will publish when an important problem has been solved or