

Centre for Advanced Study
at the Norwegian Academy of Science and Letters

Annual Report 2001



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1. Administrative matters

The Centre for Advanced Study (CAS) is a foundation, and it was established by the Norwegian Academy of Science and Letters. The resolution to establish the Centre was passed in 1989, and its activities commenced in full from 1992. Its purpose is to promote basic research and interdisciplinary theoretical work on the highest academic level.

The governing bodies of the Centre are the *Council* and the *Board*.

The Operating Fund at the Centre for Advanced Study was established in 1993. Its purpose is to contribute to the running of the Centre. This fund is administered by the Board of the Centre.

1.1 The Council

In the year 2001 the Council was composed of the following members:

- Rector Kirsti Koch Christensen, University of Bergen (chair)
- Rector Kaare R. Norum, University of Oslo
- Rector Tove Bull, University of Tromsø

- Rector Emil Spjøtvoll, Norwegian University of Science and Technology, Trondheim
- Professor Inger Moen, President of the Norwegian Academy of Science and Letters, Oslo
- Arne Bjørlykke, President of the Norwegian Academy of Technology and Science, Trondheim
- Ranveig Frøiland, Member of the Storting and leader of its Standing Committee on the Church, Education and Research
- Tore Li, Head of Department, Confederation of Norwegian Employers
- Per Gunnar Olsen, First Secretary, Norwegian Federation of Trade Unions
- Professor Roy H. Gabrielsen, Executive Board of the Norwegian Research Council

The Council had one meeting in 2001 (6 June).

1.2 The Board

The composition of the Board is regulated by Article 4 of the Memorandum of Association, in which the relevant provisions subsequent to the amendment of 1998 read as follows:

“The Board of the Norwegian Academy of Science and Letters, and the Norwegian Universities Council each appoint two members with alternates to the Board of the Centre. In agreement with the Universities Council the Academy appoints one additional member who shall be the chairman of the Board, and it appoints the latter member’s alternate. ... The State nominates the sixth member of the Board. In agreement with the Universities Council the Academy appoints one of the other members to be vice-chairman of the Board. ... The Board of the Norwegian Academy of Science and Letters has the right to appoint one of its members to serve as an observer on the Board of the Centre for Advanced Study.”

In the year 2001 the Board was composed of the following members:

- Professor Aanund Hylland, University of Oslo (chairman)
- Professor Jan Fridthjof Bernt, University of Bergen (vice-chairman)
- Professor Bjørn Tysdahl, University of Oslo
- Professor Tore O. Vorren, University of Tromsø
- Professor Kathrine Skretting, Norwegian University of Science and Technology
- County Governor Ann-Kristin Olsen, County of Vest-Agder
- The Academy's observer: Professor Reidun Sirevåg, Secretary General

Alternates:

- Professor Ragni Piene, University of Oslo (for Hylland)
- Professor Erling Eide, University of Oslo (for Bernt)
- Professor Sølvi Sogner, University of Oslo (for Tysdahl)
- Professor Hanna Mustaparta, Norwegian University of Science and Technology (for Vorren)
- Professor Erik H. Egeberg, University of Tromsø (for Skretting)
- County Governor Leif Arne Heløe, County of Troms (for Olsen)

The Board had 4 meetings in 2001.

1.3 Location, management and administration

The Centre rents offices in the premises of the Norwegian Academy of Science and Letters at 78 Drammensveien.

The year 2001 was the first full year of operation with a scientific director in a full-time post. Previously this management function had been performed by the Chairman of the Board in addition to the Chairman's normal work. The establishment of a full-time post of this kind has therefore represented a significant strengthening of the Centre's management.

The administration consisted of Scientific Director Ole-Jørgen Skog, Office Manager Unn Haaheim Hagen and Executive Officer Marit Finnemyhr Strøm. The University of Oslo's Centre for Information

Technology (USIT) was responsible for the running of the computer system and for providing computer support for the researchers. Ellen Stokland was editor of the year's first Newsletter, while Bjarne Røsjø at Faktotum AS was editor of the second. Additional help was provided during certain periods by engaging people on an hourly basis.

1.4 Other matters

The working environment at the CAS is considered to be good, and there is very little absence on account of illness among the staff. No member of staff had sick leave in 2001. The Centre's activity does not pollute the external environment.

2. The objectives of the Centre and the work of the Board

Also in the year 2001 the Board saw it as its most important task to work to realise the ambitious objectives that were formulated in 1994:

1. The academic activity at the CAS shall be known to satisfy the highest international standards and thereby contribute to raising the level of basic research in Norway.
2. The academic work of the CAS is long-term in nature. It shall be permanent and academically independent in relation to political and economic influences including research policy.

The Board worked to realise the first objective with the aim of making the CAS into a spearhead, which through its quality and scientific results shall serve as an example to others and thereby contribute to raising the level of Norwegian basic research.

The most important element in this work is the recruitment of collaborators who can show evidence of international academic results on the highest level. At the same time the Board wishes to encourage the

broadest possible co-operation within the framework of the system of research groups. This form of teamwork appears to be functioning extremely well with the size, the academic weight and the youthful constituents (at post-doctoral level) that each group has. The interdisciplinary atmosphere created between the three subject groups strengthens both the academic and the social environment at the CAS. The research groups, as they function at the CAS, are unique in an international context, and many of the leading researchers who have stayed here, have had extremely positive things to say about this arrangement.

In its work towards achieving the second objective the Board was well assisted by the recommendations of the Evaluation Committee (the Bjørgo Committee). Bringing together the Centre's grant into one item on the budget of the (then) Ministry of the Church, Education and Research is in conformity with the Committee's recommendation and the Board's wishes. The Ministry's requirements that research must satisfy apply exclusively to its quality and are not linked to specific purposes.

The increase in the budget from which the Centre benefited at the end of the 1990s made possible the establishment of a new full post of scientific director. The Board also strengthened the administration by increasing the operating budget to improve the computer services and to be able to provide more help with simple office services. In addition to this the basic grant to each of the research groups was strengthened in real terms.

Nevertheless the Board must admit that there is still some way to go before the CAS reaches the financial level recommended by the Bjørgo Committee. The budget for 2001 provided no increase in real terms in the Centre's grant. It is therefore all the more encouraging that the Centre got an increase in real terms of 2 million kroner in the budget for 2002. It is true that this is still somewhat less than the Board asked for in its budget proposal, but it nevertheless represents a significant move in the right direction. Compared with the proposal from the Bjørgo Committee, the difference between ideals and realities after this has been reduced to roughly four to five million kroner.

The budget increase from 2002 puts the CAS in a position to implement a long needed strengthening of the administration at the CAS. The organisation has been vulnerable with the level of staffing it has had until now. At its meeting on 7.12.01 the Board resolved to appoint one more person to the administrative staff. Through an exchange arrangement with the Academy, the CAS has furthermore been given the possibility of making one more room in the basement into an office for this purpose. The increase in the budget will also make it possible to increase the resources for the research groups from 2002.

In 2001 the groups had to manage within an annual budget of approx 1.7 million kroner each. That this is possible at all is related to the fact that visiting researchers from Norwegian universities receive their salaries from their respective universities. The funds that the CAS makes available are mainly spent on project costs and guests from abroad, including their accommodation and travelling expenses. The available resources are however much too tight for it to be possible to bring to Norway a sufficiently large number of really leading international researchers. The budget increase for 2002 will to some extent improve this situation, but it would have been desirable for the amount to have been at least half a million kroner higher per group.

In the light of the fact that the Centre's present name may lead to misunderstandings with respect to what type of institution the CAS is, the Board took the initiative to change its Norwegian name. With effect from 1 August 2002 the Centre will be called Senter for grunnforskning ved Det Norske Videnskaps-Akademi [centre for basic research at the Norwegian Academy of Science and Letters]. Its English name will, however, continue to be the Centre for Advanced Study (CAS), since this name is well established internationally. In addition the Centre's logo will be changed. The new logo has the same design as the old one, but is based on a combination of the letters CAS with Oslo underneath.

The Board refers otherwise to its reports for earlier years. In our Report for 1997 we included central sections of the Evaluation Committee's positive comments on the academic qualities of the CAS and on the considerable amount of work that had already been done to achieve the Board's objectives. In our Report for 1998 we described the development of the constructive co-operation the CAS now has with the

Norwegian universities. In the course of 2001 these agreements were renegotiated and extended by five years with effect from 2002. At all the universities with the exception of Tromsø these agreements ensure that university researchers get extraordinary research leave in connection with periods spent at the CAS. In Tromsø, however, researchers must continue to have stays at the CAS counted as part of their ordinary research leave.

3. Research groups and academic activity

The Board continued its work on quality assurance. High quality and broad composition characterised the research groups that worked here in 2001, and the results were good (see item 4).

The three groups that started their work in the autumn of the year 2000 continued their projects in the spring of 2001, on the following topics:

- ***Dynamics of Fluid Rock Systems***
headed by Professor Bjørn Jamtveit, University of Oslo
- ***Editing Medieval Manuscripts***
headed by Professor Odd Einar Haugen, University of Bergen
- ***Decision Making under Uncertainty***
headed by Professor Stein W. Wallace, Norwegian University of Science and Technology

The “Editing Medieval Manuscripts” project covered both the concrete work of publication and the development of new standards for the encoding of texts in electronic format. The work of publication spanned a broad spectrum of Old Norse texts, but had a particular focus on the Kings’ Sagas in *Heimskringla*. Here the question of Snorre’s authorship was discussed. The development of new standards took its point of departure in the recommendations from the Text Encoding Initiative, which were discussed with Old Norse textual material in mind and concretised in the form of an electronic manual, published on the Web pages of the CAS. The establishment of the Nordic collaborative enter-

prise, the *Medieval Nordic Text Archive* (www.menota.org), in the autumn of 2001 was a direct follow-up to the work done by the research group.

The project entitled “Dynamics of Fluid Rock Systems” involved cooperation between geologists and physicists. The group included 7 Norwegian researchers (2 geologists and 5 physicists) and 9 participants from abroad (1 physicist and 8 geologists from 4 different countries). The results that were achieved in the course of the project period have among other things produced new insight into the formation of oceanic islands, into how rock types crack on account of high fluid pressure, and into what happens when two mineral grains are pressed against each other. Reports in the Norwegian and foreign press show great interest in this research group and the results that were achieved. Furthermore the CAS group constituted the basis for a final-round application for recognition as a Centre of Excellence.

In the “Decision Making under Uncertainty” project the group’s aim was to analyse such decisions in the light of two subject areas – mathematical modelling (optimising) and social science. This was done via analyses of many practical decision problems and by means of theoretical and methodological works on modelling and decision theory. Some important questions recur in very many of these works: What does it mean to make decisions under uncertainty? What is optimality in such a context? What tools lead us along the right path, and which ones lead us astray? What may go wrong if one specifies optimality wrongly?

The autumn of 2001 saw the start of the activity to be carried out in the research groups that are to function in the period 2001/2002, on the following topics:

- ***Non-commutative phenomena in mathematics and theoretical physics***
headed by Professor Magnus B. Landstad, Norwegian University of Science and Technology and Professor Stein Arild Strømme, University of Bergen
- ***Buddhist manuscripts in the Schøyen Collection***
headed by Professor Jens Braarvig, University of Oslo

- ***The constitution as a (legal) norm***

headed by Professor Eivind Smith, University of Oslo

Newsletters Nos. 1 and 2, 2001 give an account of the groups' activities. Both these Newsletters are also available in an English edition and are also to be found on the Centre's web pages.

In June 2001 the Board completed its business relating to the nomination of the researchers who are to head each group in 2003/2004. The selection procedure for new research groups is of a high international standard. After a preceding two-stage perusal of a total of 21 proposals put forward by the universities in the previous autumn, 9 candidates were short-listed, of whom one later withdrew. The remaining 8 candidates were the object of an international peer review in the spring of 2001. The Centre procured a total of 35 evaluation reports from outstanding, independent international researchers, i.e. an average of 4.4 reports per candidate, and this material constituted the basis of the Board's final decision at its meeting in June.

In the autumn of 2001 the selection process was begun for 2004/2005. The number of applications that had come in this time was somewhat lower than last year, namely a total of 14. The drop may be connected with the on-going selection of the Centres of Excellence at the Research Council, where many of this country's leading research communities have been drawn in. This drop is therefore assumed to be a transitory phenomenon. The Board chose to go further with all 14 proposals.

4. Objectives and results

The Board can show evidence of very good academic results during the first nine years of operation at the CAS. Such results have been easier to achieve since 1995, when the relationship with the Ministry of the Church, Education and Research (KUF) was better clarified and the first university agreements were put in place.

The Board also feels that activities are being conducted with full recognition by both KUF and the Norwegian universities. The good results,

according to the CAS researchers themselves, are to a great extent due to the infrastructure, which is appropriately maintained by a very small but extremely efficient administration. Nevertheless the workload falling upon the administration is at times very heavy, and it was therefore resolved, as mentioned earlier, to strengthen the administrative staff with a further post.

In the spring of 2001, 26 researchers were working at the Centre for long stays (periods of more than one month). Eleven of our most outstanding Norwegian senior researchers within 3 main academic areas were working together with 11 international authorities from 7 countries in 3 continents. In addition the CAS was the workplace for 4 younger researchers (doctoral degree students and post-doctoral research fellows). In the autumn of 2001 thirty-five researchers were working at the CAS – of whom 13 were leading Norwegian senior researchers, 19 were outstanding researchers from abroad and 3 were younger researchers. A number of outstanding researchers from abroad are also guests at the CAS for short periods, i.e. a month or less.

Major seminars with broad national/international participation have now become a natural part of the academic activity in all the groups. In addition a number of internal seminars have been arranged.

The interaction at the CAS between the researchers from abroad and those from Norway, and the many lectures they have given at universities and in other academic fora, represent an important contribution to the internationalisation of Norwegian research and are a significant result in themselves.

As a result of the Centre's activities, the Board is expecting a number of publications in the form of databases, books and articles in international journals. On account of the long delay before material is printed, it is naturally impossible at the present time to have any real overview of these results in relation to the work carried out in the year 2001. Some works have already been published, but most of them are either being evaluated or further revised, or they are available in manuscript form. A complete survey of the results of the work performed in the year 2001 will not be available for some years. The Board will in the time ahead be working to establish a better documentation system for this purpose.

This has hitherto been somewhat delayed on account of a lack of administrative resources. Otherwise reference is made to reports from the research groups for 2000/2001.

In addition the following objectives were achieved in the year 2001:

- The academic activity was performed in conformity with the planned result targets.
- The selection procedure for new research groups is now of a high international level.
- The Newsletter has now achieved a good form and is of a high quality. It appears twice a year in Norwegian and English editions, and it is sent to all those who are working with basic research in Norway. Web pages have also been established for the Centre.
- Contact with good Norwegian researchers outside Oslo was improved and there has been a significant increase in the number of group leaders from other universities.
- Improvement of the contact with the subject communities in the universities was brought about through the fact that contact persons have been nominated in all the universities. This arrangement is functioning well.
- In the course of the year a more permanent solution was found for our computer services, in that the Centre for Information Technology at the University of Oslo took over the running of our computer system.
- The excellent, constructive and mutually obligating co-operation with the universities in Norway and the Norwegian Academy of Science and Letters was carried further.

Work on establishing closer contact with international sister organisations was started in the course of 2001. In the autumn of 2001 the Chairman of the Board and the Scientific Director visited the Netherlands Institute for Advanced Study (NIAS) in Wassenaar and the Zentrum für interdisziplinäre Forschung (ZiF) in Bielefeld. This work will continue in 2002.

5. Finance

5.1 *The Centre for Advanced Study*

From and including the budget year 1999 the former grant from the Norwegian Research Council has been included in the grant from KUF. The total grant in the year 2001 was NOK 8,367,000. Beyond this the individual research groups received a direct contribution amounting to a total of NOK 75,000. The sources were the Research Council and the Tibet-Norway Network. In addition the agreement with the universities indirectly brought in considerable resources in the form of approx. 8.5 research man-years.

The Norwegian Academy of Science and Letters also contributes to relieving the Centre's financial burden in the form of a favourable lease. The lease was renegotiated in 2001 and although the rent was adjusted upwards relatively steeply, it is still moderate in comparison with market prices. Furthermore the Academy has put its meeting premises at the disposal of the research groups.

The Centre's Statement of Accounts for the year 2001 shows a deficit of NOK 317,135. This deficit was as expected and was calculated into the operating budget for 2001. The explanation for this deficit lies in the fact that the 2000/2001 research groups had spent a smaller proportion than usual of their project grants in the course of the autumn of the year 2000. These project funds were carried over to 2001 and the expenses were not entered in the books until the spring of 2001. In other words the deficit in 2001 was covered by a surplus the preceding year.

In comparison with the preceding financial year, expenses increased by almost 1.7 million kroner. This is only to a certain degree a real increase. Most of this sum is only a reflection of the said project funds carried forward, and in other words simply illustrates the fact that the academic year does not correspond with the accounting year. A minor proportion of the increase is real and may be explained by among other things the fact 2001 was the first full year of operations with a scientific director in a full-time post.

By resolution of the Board the sum of 4 million kroner was transferred from the Centre's high-interest deposit account to the disposable share of the Operating Fund at the Centre for Advanced Study (see below). From earlier years the Centre for Advanced Study had an accumulated surplus placed in a high-interest deposit account. This has to do with the circumstances prevailing during the Centre's first years of operation. These funds are to serve as a reserve for the Centre in case of need, since the Centre incurs long-term financial obligations by inviting research groups more than two years before they in fact start their projects.

The balance sheet shows a balance of NOK 2,077,026. Of this sum, just on 600 thousand kroner is short-term debt, while a good 400 thousand kroner is project funding for the groups that has not yet been spent. The groups will have this latter resource carried over to 2002. The Centre's net liquidity at the end of 2001/beginning of 2002 was in other words a little more than 1 million kroner.

The Centre's balance sheet shows a drop in assets of nearly 4.3 million kroner. This is connected with the above-mentioned transfer from the Centre's high-interest deposit account to the Operating Fund at the Centre for Advanced Study (see section 5.2), and the deficit on the operating budget.

The Accounts for 2001 were produced on the assumption that operations would continue.

5.2 *The Operating Fund at the CAS*

The disposable share of the Operating Fund at the Centre for Advanced Study was credited with the sum of 4 million kroner from the Centre for Advanced Study's high-interest deposit account by resolution of the Board on 8 February 2001. The Operating Fund's income from interest was NOK 335,240, of which 10 per cent was added to the basic capital and the remainder to the disposable share. At the end of 2001 the basic capital, which is untouchable, amounted to NOK 1,190,410 – an increase of 2.9 per cent on the previous year. Disposable funds (which are

the Centre's buffer) amounted to NOK 4,603,537, which is approx. 4.3 million kroner more than the year before. The Operating Fund is administered by the Board of the CAS.

The Accounts for 2001 were produced on the assumption that operations would continue.

CAS 11 February 2002

Attachments:

1. Report from the "Dynamics of fluid rock systems" Group
2. Report from the "Editing medieval manuscripts" Group
3. Report from the "Decision making under uncertainty" Group

Dynamics of Fluid Rock Systems

Report by Bjørn Jamtveit

1. Introduction

Our CAS group represented an extended version of the theoretical part of a major cross disciplinary NFR-funded geology-physics program first started in 1996, called Fluid-Rock-Interactions. The activities were focused towards the following scientific problems: 1) Pressure solution; 2) Crack healing; 3) Hydrofracturing and deformation assisted fluid flow in rocks; 4) Growth and dissolution processes and its coupling to stress; 5) Hydrothermal vents associated with sill-intrusions in sedimentary basins; 6) Continental margin processes and the formation of micro-continents; and 7) Geological pattern-formation in general.

CAS collaboration resulted in major advances in our research on pressure solution, hydrofracturing, hydrothermal vent generation, the origin of ocean islands and in the coupling between fluid flow and deformation in the Earth's crust. Two Nature papers were published by CAS participants during the project period, and 3 papers are currently under review in Nature, Science or Geology – the most prestigious journals in our field. This witnesses the high quality of your CAS-products.

Two international and one internal CAS-seminar were organized in the project period along with a weekly seminar series. The international seminars effectively communicated our research to key players in the international research community in our field, and clearly helped making CAS visible in international Geoscience.

The effects of putting together a group of internationally established scientists are never completely predictable. Synergies may arise by unexpected combinations of approaches, and analogies between problems that at first glance appear too different to mingle. On the other hand scientists with obvious common interests may refrain from optimal interactions due to a certain competitiveness.

In our group, the most valuable international scientist was without doubt Dr. Yuri Podladchikov, who was involved in nearly all our projects and directly contributed to solve problems that had puzzled us for quite a while. Podladchikov will probably be offered a Prof II position at UiO in 2002, and has been nominated as an international member of the Norwegian Academy of Science and Letters. In this connection it should also be mentioned that one of our Norwegian participants, Dr. Eirik Flekkøy, became full professor in computational physics at UiO shortly after his period at CAS.

2. The research group

Our CAS group included the following participants	Periods of stay
Prof. Bjørn Jamtveit, UiO (group leader)	11 months
Dr. Hans E.F. Amundsen	ca. 6 months
Dr. Dag Dysthe	ca. 6 months
Prof. Jens Feder, UiO	10 months
Prof. Eirik Flekkøy	10 months
Prof. Torstein Jøssang	ca. 6 months
Dr. Anders Malthe-Sørenssen	ca. 1 months
Dr. James Connolly, ETH-Zürich	ca. 7 months
Dr. Daniel Köhn, Univ of Mainz	ca. 6 months

Prof. Paul Meakin, USA	ca. 9 months
Prof. Enrique Merino, Univ of Bloomington	ca. 3 months
Dr. Steve Miller, ETH-Zürich	ca. 3 months
Dr. Yuri Podladchikov, ETH-Zürich	ca. 3 months
Dr. Francois Renard, Univ of Grenoble	ca. 1 months
Dr. Renaud Toussaint, Paris	ca. 1 months
Prof. Alan B. Thomspon, ETH-Zürich	ca. 0,5 months

Total number of man-months:

Norwegians – 50

Internationals – 33

Meetings and seminars

Our group arranged three meeting including CAS members and invited speakers. In addition we arranged weekly seminars at CAS, including a number of invited speakers.

The programs for these seminars are listed below:

'Dynamics of fluid rock systems'

International CAS-seminar at Sem Gjestegård, Asker

21-22.9 2000

Thursday 21.9

Cracks and flow in cracks

Bjørn Jamtveit (CAS) *Opening remarks*

Francois Renard & Dag Dysthe (Oslo) *Closing the crack problem*

Mohsine Zahid (Mainz) *Cracking, crushing and pressure solution*

Anders Malthe-Sørenssen & Eirik Flekkøy (CAS) *Hydro-fracturing*

Anders Elverhøi (UiO) *Submarine avalanches*

Migration of fluidized sediments and melts in sedimentary basins

Joe Cartwright (Cardiff) *Silly sand*

Marcia Bjørnerud (Lawrence University) *Tectonic structures in subducted unconsolidated sediments*

Sverre Planke, Anders Malthe-Sørensen, Bjørn Jamtveit (Oslo/CAS) *Sills in sedimentary basins*
Steve Miller (CAS) *Tremors after failure*

Friday 22.9

Focused fluid flow

Jamie Connolly & Yuri Podlachikov (CAS) *Connolly-waving and Podlachikov-choking revisited*

Bruce Yardley (Leeds) *Hyperventilating skarn pipes and the sucking power of the basement*

Michel Raith (Bonn) *Arrested charnockitization: Patterns of fluid migration*

Non-equilibrium growth & dissolution processes

Marian Holness (Cambridge) *Growing up far from equilibrium*

Enrique Merino (CAS) *Consequences of stress produced by crystal growth in rocks: Replacement, creep, fracturing. Also: Vein formation, quake triggering, ore-body self-ocalization*

Andrew Putnis (Münster) *Is there a solid solution to nonequilibrium growth*

'Dynamics of fluid rock systems'

CAS-seminar at Masai Mara, Kenya

23–30.3 2001

15. March

Preparation seminar

Odd Nilsen (UiO) – *The development of the East African Rift System*

Aud Talle (UiO) – *Masais and masai culture*

Johan B Steen (UiO) – *Dyreliv i Masai Mara*

Talks at Masai Mara

Dag Dysthe and Francois Renard: *Deformation, growth and dissolution of geo-materials*

Enrique Merino and Paul Meakin: *Stylolites*

Yuri Podlachikov: *Diapirs*

Anders Malthe-Sørenssen and Steve Miller: *Brittle deformation in the presence of fluids*

Eirik Flekkøy and Jamie Connolly: *Compressible fluids in unconsolidated materials*

The 14th Kongsberg seminar

MAY 2001

'Spatio-temporal patterns in the Earth'.

Program available at:

<http://www.fys.uio.no/faststoff/sup/Meetings/Kongsberg01/index.html>

'In house' CAS seminar series

- 31.8 Rocky Hardy (Conoco, USA) *Forward modeling of faulting and fracturing*
- 7.9 Wesley Andres Watters (MIT) *Computer models of equilibrium in stellar clusters.*
- 14.9 Wesley Andres Watters (MIT) *Computer models of Precambrian meta-zoans*
- 12.10 Haakon Austrheim (Oslo) *Fluid-induced High-P metamorphism and intermediate deep earthquakes*
- 19.10 Marcia Bjørnerud (Lawrence University, Wisconsin) *A reservoir/flux model for a metamorphic transition*
- 20.10 Roy Wogelius (University of Manchester) *When atoms go offside: Mineral Surface Chemistry in the 2+X Dimension.*
- 2.11 Hans Amundsen (Oslo) *Debris flows on Earth and Mars – the movie.*

- 9.11 Julia Masloboeva (Oslo) *Directional solidification in confined space*
- 23.11 Lukas Baumgartner (Mainz) *Laccolite intrusions in Patagonia*
- 30.11 Lina Uri and Jens Feder (Oslo) *Primary migration: Squeezing oil out of a packet of spaghetti*
- 1.12 Pierre Adler (Paris) *Fractures and fracture networks*
- 11.12 Renaud Toussaint (Rennes) *Fracturation of rocks in compression: Localization process as a critical phenomenon*
- 18.12 Daniel Koehn (Mainz) *Development of antitaxial strain fringes in simple shear flow: an experimental and numerical study*
- 11.1 Preparing for an SFF proposal
- 30.1 Ivar Ramberg (Hydro) *SFF and Konkraft*
- 1.2 Elisabeth Gundersen and Eirik Flekkøy (UiO) *A simple model for the spacing between hydro-fractures in a cap rocks*
- 8.2 Roy Gabrielsen (Bergen) *The practical significance of the Mohr-Coulomb and Griffith fracture criteria in the study of geological materials*
- 16.2 Torgeir Andersen (UiO) *Late orogenic extensional tectonics: Extensional structures in a crustal section.*
- 22.2 Yuri Podladchikov (CAS) *Spinoidal patterns*
- 14.3 Paul Bons (Mainz) *An analogue experiment to model primary migration and melt migration in the Earth's crust.*
- 5.4 Bjørn Jamtveit (CAS) *Water in rocks – how it gets there and how it moves. Invited talk at the Norwegian Academy of Science*
- 19.4 Panos Papanastasiou, (Schlumberger Cambridge) *Hydrofracturing*

- 18.5 Daniel Köhn (CAS) *Modelling crack and anti-cracks*
- 25.5 Alan Thompson (ETH/CAS) *Assimilation of crustal rocks by mantle magmas*
- 29.5 Günter Gottstein (Aachen) *Microstructure control by grain boundary dynamics*
- 5.6 Eirik Flekkøy (CAS) *Modelling hydrofracturing*

4. Research and research production

The research carried out at CAS represented an extension of the theoretical activity within the Strategic University program 'Fluid Rock Interactions', which ran at UiO in the period 1997-2001, lead by B. Jamtveit.

The majority of the work started at CAS has not yet been published, and some of the ideas produces at CAS are still at a stage where the outcome is hard to predict.

Before presenting a reference list containing all papers produced by our CAS members in the project period, I choose to highlight the production where the *central ideas* are a direct outcome of CAS collaboration. This production is separated in a) completed, or almost completed papers and b) ongoing research projects. Papers produced by short time visitors at CAS, based on ideas developed at CAS are not listed here.

a) CAS-idea based papers

Amundsen, H.E.F., Schaltegger, U., Jamtveit, B., and Torsvik, T., 2002, Reading the LIPS of Iceland and Mauretius. *Nature* (submitted)

Dysthe, D.K., Podladchikov, Y., Renard, F., Feder, J., Jamtveit, B., 2002, Universality during transient creep. *Journal of Geophysical Research* (submitted)

Gundersen, U.E., Flekkøy, E.G., Bjørlykke, K., Feder, J., and Jamtveit, B., 2002. Interactions and spacing between cap-rock hydrofractures. *J.Geophys Res.* (submitted)

Gundersen, E., Renard, F., Dysthe, D., Bjørlykke, K., and Jamtveit, B. (2001) Effects of clay particles on pressure solution creep and diffusive mass transport in porous rocks. *Journal Geol. Soc. London*, submitted

Jamtveit, B., Svensen, H., Podladchikov, Y., and Planke, S., 2002, Hydrothermal vent complexes associated with sill intrusions in sedimentary basins. *Geology* (submitted)

Köhn, D., Jamtveit, B., Malthe Sorensen, A., Numerical Experiments on the Dissolution of Stressed Solids: the Formation of Anticracks. *Journ. Geophys. Res* (in prep)

Renard, F., Dysthe, D.K., Feder, J., Jamtveit, B. 2002, Crack healing. *Geology* (submitted)

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5. Impact on future activities

The CAS project represented perhaps the most active period in the cross disciplinary Geology-Physics collaboration that's has been going on from 1996 onwards. The CAS research group forms the core of a research centre called "Physics of Geological Processes", directed by Jens Feder and Bjørn Jamtveit, that today competes in the finals for one of the Centres of Excellence (CoE) launched by the Norwegian research Council in 2002. We received extremely good reviews during the first CoE evaluation, partly based on the work carried out at CAS.

Regardless of a possible CoE our research will be continued in the Strategic University Program “Physics of Geological Processes” to be carried out in the period 2002–2006.

Editing medieval manuscripts

Report by Odd Einar Haugen

1. Background

The project “Editing medieval manuscripts” was planned during the spring of 1998 with the aim of developing procedures for the encoding, interpretation and presentation of Old Nordic texts. The list of members was drawn up at this stage, and remained unchanged until the group met in Oslo in August 2000. At the time when the group participants were invited, a Network for the electronic processing of Medieval Nordic manuscripts, financed by Nordisk Forskerutdanningsakademi (NorFA), had already been working on a handbook for the encoding of Medieval manuscripts for some time. The work on this handbook should have been concluded by the end of 1998, and the initial purpose of the research group was to apply these recommendations to a number of Old Norse manuscripts. However, work on the handbook was not finished, so the group was faced with the choice between taking over this work or proceeding in another direction. The group chose to continue working on the handbook, and succeeded in presenting a first draft by the end of the stay in Oslo. In addition to the handbook, the group worked on a number of editorial projects, focusing on *Heimskringla* and other kings’ sagas.

2. The research group

The group included eight members. Five members, Odd Einar Haugen, Jonna Louis-Jensen, Karl G. Johansson, Rune Kyrkjebø and Jon Gunnar Jørgensen, stayed at CAS throughout the academic year. Jon Gunnar Jørgensen, however, shared his time between the Centre (three days a week) and the Ibsen Centre (two days a week). Two members, Hubert Seelow and Kolbrún Haraldsdóttir, worked full time at the Centre, but left at Easter due to teaching commitments in Germany. Espen Ore participated as an IT consultant on a 20 % basis, joining the group one day per week. The group thus carried out the equivalent of 64 months' work.

Odd Einar Haugen, University of Bergen (group leader)	10 months
Jonna Louis-Jensen, University of Copenhagen	10 months
Karl G. Johansson, University of Växjö	10 months
Rune Kyrkjebø, University of Bergen	10 months
Jon Gunnar Jørgensen, University of Oslo	6 months
Hubert Seelow, University of Erlangen-Nürnberg	8 months
Kolbrún Haraldsdóttir, University of Erlangen-Nürnberg	8 months
Espen S. Ore, HIT centre, University of Bergen	2 months

In addition to the permanent members, Tone Merete Bruvik and Vemund Olstad, both of the HIT centre at the University of Bergen, worked as consultants for the group in matters of text encoding. Bjørg Dale Spørck, of the National library in Oslo, joined the group as a visiting scholar one or two days a week from the beginning of October.

3. Meetings and seminars

The group held plenary meetings on average twice a month to discuss text encoding and manuscript interpretation. Those who concentrated on the handbook (see section 5 below) held frequent consultations throughout the period, in certain periods on a daily basis.

Four scholars were invited to short but stimulating visits:

- Andrea van Arkel-de Leeuw van Weenen, University of Leiden
- Peter M. Robinson, De Montfort University, Leicester
- Matthew J. Driscoll, University of Copenhagen
- Tarrin Wills, University of Sydney

4. Editorial work on medieval manuscripts

The group members varied with respect to how much of their time they spent on individual editorial projects, but all members submitted texts encoded in TEI/XML format. A substantial amount of work was devoted to the kings' sagas, including *Heimskringla*. Work was done on both redactions of *Heimskringla*, as well as other kings' sagas such as *Hulda–Hrokkinskinna* and *Flateyjarbók*.

The manuscripts varied from small and partially illegible fragments (e.g. AM 162 E fol.) to the largest of all Icelandic manuscripts, *Flateyjarbók*, GKS 1005 fol. Editorial work was carried out on the following manuscripts:

SIGNATURE	TEXT	DATING
AM 35 fol.	<i>Ynglinga saga</i> and <i>Óláfs saga helga</i> in <i>Heimskringla</i> , in Asgeir Jónsson's transcription of the <i>Kringla</i> ms., ca. 1700	ca. 1260
GKS 2365 4to	Eddic poems	ca. 1270
Holm B 59	<i>The older Västgöta law</i>	ca. 1280
AM 162 E fol.	<i>Laxdæla saga</i>	ca. 1300
AM 37 fol.	<i>Haralds saga hárfagra</i> in <i>Heimskringla</i> , in Jens Nilssøns's transcription of the <i>Jøfraskinna</i> ms., 1567	ca. 1325
AM 595 4to	<i>Rómverja saga</i>	ca. 1325–50
AM 127 4to	<i>Jónsbók</i> ca. 1350	
AM 657 a–b 4to	<i>Clárus saga og ævintýri</i>	ca. 1350
AM 242 fol.	Snorri Sturluson's <i>Edda</i> and the four grammatical treatises	ca. 1350
AM 233 a fol.	<i>Niðrstigningar saga</i>	ca. 1350–60
GKS 1005 fol.	<i>Flateyjarbók</i>	1387
NKS 1824 b 4to	<i>Völsunga saga</i>	ca. 1400–25
NRA München perg. 4292	<i>Aslak Bolt's land register</i> ("jordebok")	ca. 1430
JS 8 fol.	<i>Huga saga Skaplars</i>	1729

Preparing an edition of a Medieval manuscript is a painstaking process with extraordinarily high demands on the quality of the transcription. Many rounds of proofreading are required, so that the production of a traditional printed edition normally takes several years, in some cases even decades. However, electronic versions were produced and encoded during the stay at CAS, and will in the near future be published in preliminary versions on the new website of Menota (see section 8 below).

In a few years' time we expect to see the following editions, most likely in printed form, but probably also in digitised form accompanied by facsimile images of the manuscript(s):

Odd Einar Haugen: *Niðrstigningar saga*

Karl G. Johansson: *Codex Wormianus* (containing Snorri's *Edda* and the four grammatical treatises) and *The older Västgöta law*

Jon Gunnar Jørgensen: *Heimskringla* part I in the x version (Kringla)

Kolbrún Haraldsdóttir: *Flateyjarbók*

Rune Kyrkjebø: *Heimskringla* part I in the y version (Jøfraskinna)

Jonna Louis-Jensen: *Hulda–Hrokkinskinna*

Hubert Seelow: *Völsunga saga*

5. Handbook

In the last two decades a large number of text corpora have been established around the world, but it is still a major problem that many texts are not mutually interchangeable. In addressing this problem the Text Encoding Initiative (TEI) has laid down general recommendations for text encoding, based on the well established ISO standard SGML. The most recent version of the TEI guidelines is P3, published in 1994. An increasing number of projects have applied these recommendations to their texts, but since the recommendations are of a general nature, much work remains to be done with respect to the application and modification of the TEI guidelines for specific text corpora.

It soon became clear to us that some of the recommendations of TEI P3 would be difficult to implement in the encoding of Old Nordic texts, especially if the aim was to record the manuscript text in a strictly diplo-

matic version, including all abbreviation marks and graphemic variation, as well as giving regularised versions of the text. The group finally decided to solve this problem by defining three focal levels of transcription, ranging from strictly diplomatic till fully normalised. These levels can be encoded as simultaneous, but distinct text strings, so that a manuscript can be represented in the form of up to three separate strings. However, a text string may be converted from one level to another semi-automatically, and any one of the three levels is sufficient to create a well-formed transcription. This modular type of encoding is discussed in Ch. 3 of the handbook.

A substantial amount of work was devoted to the encoding of special characters and abbreviations, which are highly frequent in Old Nordic manuscripts, especially in Old Norse ones. While raising a number of technical problems, these issues are basically of a philological nature. Chapters 5 and 6 in the handbook set out the group's recommendations with respect to what constitutes the essential components of the graphemic inventory for Old Nordic.

The majority of Old Nordic texts are in prose form. These texts are the focus of Ch. 2 of the handbook, which stipulates how manuscript prose should be subclassified and labelled. Ch. 9 raises the issue of metrical texts, such as Eddic and Skaldic poems, and gives recommendations for the encoding of metrical features exclusive to Old Nordic.

The handbook also discusses a number of other problems, such as the encoding of damage, corrections, omissions etc., in the manuscripts (Ch. 7), and the lemmatisation of texts (Ch. 8). The latter is a crucial problem since there is a high degree of orthographic variation in Old Nordic texts. The group decided to apply the recommendations given by the EAGLES work group, but since these are of a general nature, it was necessary to adapt them to the morphological structure of Old Nordic.

Thanks to the contribution of Espen S. Ore, Tone Merete Bruvik and Vemund Olstad, the handbook also includes a modified Document Type Definition to be used in all transcriptions, XSL style sheets for the presentation of encoded texts (in print and on the web), and Perl script for

text conversion. Other members of the group authored modified fonts for manuscript transcription and FrameMaker applications. All utilities can be downloaded free from the web version of the handbook.

The handbook and the accompanying utilities are published on the group's web site:

<http://www.shs.uio.no/Groups/EdMa2000/handbok/aksess/cover.html>. Please note that the handbook is constantly being updated on the Menota site (see section 8 below).

6. Conferences

One member of the group was the main organiser of the conference *Bok og skjerm*, held by "Nordisk nettverk for edisjonsfilologer" on the premises of Det Norske Videnskaps-Akademi, 20–22 October 2000. The proceedings of this conference have already been published by Fagbokforlaget.

Four members of the group planned and organised a conference on a similar scale, viz. *Nordiske middelaldertekster: Utgivere og brukere*. The conference was held on 27–29 April 2001 on the same premises as *Bok og skjerm*, and brought together 60 participants, mainly from the Nordic countries. Programme, abstracts and list of participants are set out on <http://www.shs.uio.no/Groups/EdMa2000/symposium/inngang.html>

We were particularly pleased to see a number of young and promising students at this conference, and feel confident that many of them will be future scholars in the field.

7. Budget

The group had at its disposal a budget of NOK 1,650,000. Since the majority of the group's members were given leave of absence with full pay from their respective institutions, it was possible to finance the salary

for a doctoral student, Rune Kyrkjebø, as well as engaging two consultants from the HIT centre in Bergen. Since CAS as an institution can not act as an employer, the engagement of Rune Kyrkjebø was done in cooperation with the *Senter for prosjektservice* at the University of Bergen, which undertook formal responsibility for his employment (“arbeidsgiveransvar”). It was furthermore possible to arrange the above mentioned conference, *Nordiske middelaldertekster: Utgivere og brukere*.

The budget can be broken down into the following approximate figures:

Stipends to scholars	460,000
Housing	340,000
Employment of doctoral student	330,000
External consultants	50,000
Travel expenses	170,000
Conference in Oslo 27–29 April	170,000
Software, books, equipment	20,000
Visiting scholars	30,000
Other	20,000
Surplus	60,000
Sum	1,650,000

The administration at CAS helped with all practical details in budget planning and implementation. This was done in a most efficient and unbureaucratic manner.

8. Further work

A major part of the group’s work concentrated on recommendations for the encoding of Medieval Nordic texts. It has thus been a logical next step to establish an electronic text archive for this corpus. The idea was discussed at several informal meetings of the group, and also launched at the conference *Nordiske middelaldertekster: Utgivere og brukere*. Both Claus Huitfeldt of the HIT centre in Bergen and Christian-Emil Ore responded favourably to this idea, and they subsequently invited representatives from leading Nordic editorial societies and departments

to a meeting in Oslo on 10 September 2001. The participants agreed on establishing a text archive with the working title *Medieval Nordic Text Archive* (Menota). A board of four members, one from each of the Nordic countries, was appointed until the archive can be formally established in 2002. Members of this board are Odd Einar Haugen (leader), Karl G. Johansson, Matthew J. Driscoll and Guðvarður Már Gunnlaugsson. The archive will include Medieval Nordic texts written in the Latin alphabet, both in the Nordic languages and in Latin. The focus will be on texts earlier than the late 16th century, but younger paper manuscripts of medieval texts will also be included. A web site and domain has now been established, www.menota.org

9. Evaluation

The Centre for Advanced Study Study gives scholars the opportunity of uninterrupted work in quiet surroundings, far from the turmoil of everyday life in a university department. However, many scholars have a number of obligations which they simply can not leave behind during the stay. Thus, one member of the group sat on an assessment committee in Iceland, another on a committee in Germany, and a third member sat on two doctoral committees, one in Norway and one in Denmark, in addition to functioning as public opponent on the former. Several members kept up their supervision of graduate and doctoral students, and one member had teaching duties in Germany during the spring term. Three members also kept up their responsibilities as editors; one member in the journal *Collegium medievale*, another in *Maal og Minne*, and a third in the series *Bibliotheca Arnarnagnaana* and *Editiones Arnarnagnaanae*. These obligations made inroads into the total amount of time available for the group. The aim of the Centre is to attract the leading scholars in their fields, but it should be pointed out that these scholars are likely to have many and time-consuming obligations.

The projected handbook for encoding Medieval Nordic texts raised more problems than anticipated, and was unfinished when the group started its work. It was thus necessary to spend a certain amount of time on matters of text encoding. A number of strategies were discussed, especially in the area of encoding abbreviations, but no convincing solutions

were found. Perhaps the most difficult period was from November to the end of February, when a number of solutions were finally discarded in favour of a modular mode of encoding (described in Ch. 3 of the handbook). It is perhaps typical that the discarded solutions were highly complex, sometimes to the point of being completely *ad hoc*. The favoured recommendations, on the other hand, are fairly straightforward, although not as obvious as it may seem with the benefit of hindsight.

Some of the group members were more frustrated by this process than others, and this led to some tension in the group. The majority, however, felt that it was worthwhile to continue the work, which culminated in a highly productive period from the middle of March to the beginning of June. Although not complete, the handbook, which appears on the server at CAS as of 12 June 2001, contains recommendations concerning a large number of encoding problems.

The work on the handbook is being continued by three of the group members, viz. Odd Einar Haugen, Karl G. Johansson and Rune Kyrkjebø, together with Matthew J. Driscoll of the University of Copenhagen. This editorial group will work in close cooperation with the recently established Medieval Nordic Text Archive (Menota), which was started as a direct consequence of the work in the research group. Had it not been for the year in Oslo it is highly unlikely that the work on the handbook would have reached its present stage, or that Menota would have been established.

The group also made considerable progress on a number of editorial projects, as outlined in section 4 above, and although the publication of the printed editions will still take some time, preliminary electronic versions are ready for publication on the Menota site. The facilities at CAS are excellent. There is, however, the problem of too little office space. The group was allocated six rooms, which meant that two rooms had to be shared. Although this did not cause any problems, it is not ideal.

The staff at CAS deserve special mention. They have been unusually helpful, invariably good-humoured and have always done their utmost

to assist the group members. The group also appreciated the close cooperation with Det Norske Videnskaps-Akademi, as well as the opportunity to work in such beautiful surroundings.

10.1 *Conference papers, presentations and lectures*

Haugen, Odd Einar. "Synoptisk tekstutgjeving i historisk perspektiv." Paper read at the conference *Bok og skjerm*, Oslo, 20–22 October 2000.

. "Koding av handskriftstekst i samsvar med retningslinjene i Text Encoding Initiative (TEI)." Paper read at the conference *Nordiske middelaldertekster: Utgivere og brukere*, Oslo, 27–29 April 2001.

———. "Medieval Studies and Information Technology." Round table contribution at the *International Medieval Congress*, Leeds 9–12 July 2001.

Johansson, Karl G.. "Elektronisk utgiving – manuskripttext eller edition?" Paper read at the conference *Bok og skjerm*, Oslo, 20–22 October 2000.

———. "*Völuspá* – versioner och tradition." Lecture held at Institut for Nordisk Sprog og Litteratur, Aarhus University, 23 March 2001.

———. "Electronic Computing and Electronic Editions: Possibilities and Old Habits." Paper read at the conference *Skaldic Editing*, Reykholt, Iceland, 4–6 May 2001.

Jørgensen, Jon Gunnar. "In Finnur's footsteps: Editing sagas and stanzas." Paper read at the conference *Skaldic Editing*, Reykholt, Iceland, 4–6 May 2001.

Kyrkjebø, Rune, and Espen S. Ore. "Tekstkoding: praktisk gjennomføring." Presentation held at the conference *Nordiske middelaldertekster: Utgivere og brukere*, Oslo, 27–29 April 2001.

Louis-Jensen, Jonna. "Om Ólúvu kvæði, V.U. Hammershaimb og Madam Larsen." Paper read at the Chr. Matras centenary celebration, Fróðskaparsetur Føroya at the Nordic House, Tórshavn, Faroe Islands, 7 December 2000.

———. "Stanzas and stemma." Paper read at the conference *Skaldic Editing*, Reykholt, Iceland, 4–6 May 2001.

Louis-Jensen, Jonna, and James E. Knirk. "Anvendelse av Hulda-tekst i maskinell form." Presentation held at the conference *Nordiske middelaldertekster: Utgivere og brukere*, Oslo, 27–29 April 2001.

10.2 Books and articles

- Haugen, Odd Einar. 2001. *Grunnbok i norrønt språk*. 4th ed. Oslo: Gyldendal Akademisk.
- . 2001. [Review of] Ottar Grønvik, *Hávamál: Studier av verkets formelle oppbygning og dets religiøse innhold*, Oslo 1999. *Norsk lingvistisk tidsskrift* 19/1: 151–54.
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- . 2001. “Det synoptiske problemet.” In *Bok og skjerm: Forholdet mellom bokbasert og digitalt basert tekstutgivelse*, eds. Jon Gunnar Jørgensen et al., 19–46. Oslo: Fagbokforlaget.
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- Johansson, Karl G. 2000. [Review of] Ursula Dronke, ed., *The Poetic Edda, II: Mythological Poems*, Oxford 1997. *Gardar: Årsbok för Samfundet Sverige–Island i Lund–Malmö* 31: 55–61.
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- . Forthcoming. “Har filologin någon relevans inom modern humanistisk forskning.” To appear in a report edited by Birgit Rønne et al. Vilnius: Vilnius university.

- . Forthcoming. “Jordeböcker, språknormer och dialekt under 1500-talet.” To appear in the report from the 6th conference on the history of the Swedish language. Helsingfors.
- Johansson, Karl G., Jon Gunnar Jørgensen, and Jonna Louis-Jensen. 2001. Ch. 9 “Metrisk koding”. *Håndbok for koding av nordiske middelaldertekster i samsvar med TEI P3 og XML*. Oslo: Centre for Advanced Study.
- Jørgensen, Jon Gunnar. 2000. “Internvariasjon i Henrik Ibsens skrifter.” *Edda* 3/00: 192–202.
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Decision making under uncertainty – A summary

Report by Stein W. Wallace

1. Introduction

Decision making under uncertainty has two major facets:

- A descriptive science, answering questions like “how do people make decisions when facing uncertainty?”, and “how do people understand uncertainty in general?” This type of research is mostly covered by behavioral psychologist, but also organizational psychologists and other social scientists focusing on organizations.
- A normative science, focusing on how to find optimal decisions under uncertainty, given a certain set of premises for the decisions. On a theoretical level, this is covered, for example, by economists using utility theory. When looking for actual decisions in real contexts, we may need to turn to other fields, such as decision theory and operations research.

Some approaches/theories certainly contain mixtures of the two. For example, the theory of satisfiability (the “administrative man”) by Nobel laureate Herbert A. Simon is a decision theory based on an alternative theory of how decisions are being made.

The theories of how decisions are being made and how uncertainty is understood have many practical uses already. This is particularly true for marketing (including the marketing of political agendas) and many types of data collection and polling. In some of these cases the issue is to utilize to your own advantage the systematic errors made by most people when relating to uncertainty, in other cases the issue is to offset the errors so as to obtain unbiased estimates.

A major controversy among specialists of decision theory is the usefulness of complex quantitative decision tools. The controversy relates to both the usefulness of such tools, and to the questions of whether or not they are actually being used. The disagreement rests partly on observations of the success in models that have been made (or lack thereof), partly on the psychological research on how models are being used and understood (as referred to above), and partly on folklore with no scientific basis.

This project subscribed to the view that in many contexts of both strategy and production, quantitative decision tools are being and should be used. Hence, the premise here is that in some contexts models are useful, and the issue is: What makes a model good? The simple answer is that a model is good if it facilitates good decisions. This may sound like a tautology, but it is not. It means, among other things, that we do not measure models by their likeness to what we model, but rather to their usefulness for decisions.

However, this project is not named “quantitative decision tools”, but rather focuses on the uncertainty aspect of decision-making. This is because few, if any, decisions are made under certainty, and because popular tools such as sensitivity analysis and what-if-analysis are not valid tools for decision making under uncertainty.

A major focus of this project was therefore on aspects that can make a decision model which explicitly contains uncertainty good. To do this, a team was put together. It consisted of

- Stein W. Wallace, leader of the group, and professor of operations research at NTNU, and a specialist of stochastic programming. He has published many technical papers on the subject, coauthored the first

textbook in the field, and chaired the international organization for stochastic programming from 1992 to 95. He has applied stochastic programming to e.g. fisheries management, portfolio management in life insurance, portfolio management in electricity production and telecommunications. Wallace is now professor of quantitative logistics at Molde University College.

- Julia L. Higle, Professor of Systems and Industrial Engineering, University of Arizona, Tucson, Arizona, USA. Ph.D. in Industrial and Operations Engineering received in 1985 from the University of Michigan. She is a leading specialist in stochastic programming, with a strongly expressed interest in the development and verification of models for decision making under uncertainty. She is co-developer of the stochastic decomposition method, and has applied stochastic programming to problems arising in the telecommunications and commercial airlines industries. Research and publications interests include stochastic programming models and methods, especially statistically based computational methods. Associate editor for Operations Research, Vice-Chair of the Optimization Section of INFORMS (Institute for Operations Research and Management Science).
- Yannick Frein received the Docteur-Ingenieur degree and the degree of Habilitation à Diriger des Recherches from the Institut National Polytechnique de Grenoble in 1983 and 1991, respectively. He was a lecturer at Université Joseph Fourier from 1988 to 1994, and became full professor at ENSGI (Ecole Nationale Supérieure de Génie Industriel) in 1994. He is the founder of the laboratory GILCO. GILCO covers the subjects automation, industrial management, operations research and applied mathematics. A total of 20 people are attached to the laboratory. Frein has many years of experience in the use of complex stochastic decision tools in manufacturing. He has worked with modeling and performance evaluation of manufacturing systems, especially pull controlled systems. He now focuses on dynamic scheduling of production systems. This is done in the context of applications with the French car industry (car producers and suppliers of parts).
- Stein Bråten is professor of sociology at the University of Oslo, and a member of the Norwegian Academy of Science and Letters. He has been invited guest professor of cognitive science at The University of Bergen (1987–89), and consulting scientist at Bergen Scientific Centre IBM in the same period. For 30 years he has studied intersubjective communication and understanding in the laboratory, in the field and

through computer simulation. He developed the first object-oriented computer model ever written to simulate interpersonal communication (1968, 1971). His cybernetic models of mental simulation of other minds (1973) anticipated current theory of mind approaches in psychology and went beyond—to the issue of domination of mind by model power (standard reading in Scandinavian sociology). His recent models of preverbal communication (1988, 1992) has been acknowledged in infant psychology for their explanatory and predictive power. He chairs the international Theory Forum on the foundation of inter-subjective communication, and has headed a group recruited from that network in the Centre for Advanced Study (1996–97).

- Jan Hovden is professor in safety management at Department of Industrial Economics and Technology Management, NTNU, Trondheim. PhD in political science, Univ. of Oslo (1968), specialization in public politics and administration. Main research subjects: safety management, accident modeling and analysis, risk and vulnerability analysis, acceptance criteria and decision behavior in organizations, risk communication. A great number of international publications and articles, e.g. Singleton and Hovden (1987, 1993) *Risk and Decisions*, Wiley. Member of the editorial board “Safety Science”, Elsevier. Current and planned international research collaboration: TU Delft, Université de Paris I, Panthéon-Sorbonne, Monash Univ., Melbourne, RISKCENTRUM, Karlstad, EU Joint Research Centre, Ispra. Scientific adviser at SINTEF Industrial Management, Safety and Reliability Group.
- Ragnar Rosness is Senior Scientist at SINTEF Industrial Management, Trondheim. M.Sc. in psychology from the University of Oslo (1981) and Ph.D in industrial engineering from NTNU (1999). His main interests are safety management, human reliability, resilient organizations and decision behavior in organizations. He has edited a textbook on prevention of occupational accidents. Spent the spring semester at SHS.
- Les Foulds is professor of management systems, University of Waikato, New Zealand. Has held full time positions at The university of Florida and The university of Canterbury. Has long time experience in the development of decision support systems for industry. His main interests are Operations management, management science and management information systems. He has (co)authored three books and more than 100 refereed articles. Spent the autumn semester at SHS.

- Horand Gassmann is associate professor at the School of Business Administration, Dalhousie University, Halifax, Canada. He is particularly interested in stochastic programming and financial applications. He is known internationally for his work with codes for stochastic programs (MSLiP), model management, and formats for storing stochastic information. Spent the spring semester at SHS.
- Bård Reitan, doctoral student at NTNU, supervised by Stein W. Wallace, financed by Telenor. Works on the use of quantitative models in strategic planning.
- Thorkell Helgason, Director General of the National Energy Authorities in Iceland spent several weeks in two periods with the group.

During the year, we also had a number of guests from Norway and abroad. These are

- Senior Advisor Jan Audestad, Telenor, gave a talk and initiated discussions about safety in computer networks.
- Professor Fred Murphy, Temple University, Philadelphia, spent a week with us, discussing mostly problems related to capacity expansion of production facilities, particularly in the energy sector. Professor Murphy is particularly well known for his work on modeling.
- Professor Andrew Hale, the Technical University of Delft, a colleague of Jan Hovden, spent about a week with us. He is interested in safety management.
- Director Eivind Jahren, the Ministry of Industry and Trade had discussions with us about problems related to research on the vulnerability of ICT systems.
- Dr. Kjetil Høyland, Gjensidige-NOR Capital Asset Management, visited us several times on the subject of portfolio selection in financial markets.
- Dr. Nils Jacob Berland, Pantarei AS, also visited us several times discussing strategic planning in general, mostly focusing on joint work with Reitan.
- Michal Kaut, doctoral student at NTNU, supervised by Wallace, financed by Gjensidige-NOR spent much time with the group for supervision and for useful discussions with senior scientists.

2. Activities

Complex quantitative decision tools which incorporate uncertainty have been under investigation for many years. Much of the focus has been on necessary mathematical theory and solution procedures. Although there will always be a need for better and quicker tools, this project let these aspects rest as research topics. Below is a list of subjects that were covered by the group.

2.1 Scenario trees

Data often needs to be processed to fit with decision models. Typically, we need the stochastic data in the form of event trees or Markov chains. This question breaks down into two parts.

- For a given problem, how do we find out which stochastic properties and variables are important in a statistical sense, and which are not?
- Given the knowledge of which properties are needed, how do we as best as we can process the data so as to capture these properties at the same time as we utilize the format required by a method?

The following article was finalized during the stay:

Kjetil Høyland and Stein W. Wallace, Generating scenario trees for multistage decision problems, *Management Science* 47 (2001) 295-307.

This work was continued, and a new method was developed. It is described in

Kjetil Høyland, Michal Kaut and Stein W. Wallace, A heuristic for generating scenario trees for multistage decision problems. *Stochastic Programming E-Print Series* (<http://dochoost.rz.hu-berlin.de/speps/>), 18, 2000. Submitted to a journal.

A related question is as follows. Given a scenario tree and the optimal solution of some optimization problem using this tree; What is the

weakest point of the tree, that is, if we were to increase the number of branches in the tree, where should that be done? A major work was initiated on this subject:

H.I. Gassmann, Th. Helgason, J. Hagle and S.W. Wallace, Scenario generation in stochastic programming. In progress.

2.2 *Probability distributions*

During his stay at the centre Gassmann prepared an extensive revision of this paper, including rerunning all the numerical experiments. The object of the paper is to compare several different methods for computing multivariate normal rectangle probabilities. Particular attention was paid to the limitations of each method, since unlike previous studies we started from the assumption that no one method would be best under all circumstances. He also presented this paper at the Euro 2001 Conference in Rotterdam, July 9–11, 2001.

H.I. Gassmann, I. Deak and T. Szantai: Computing multivariate normal probabilities: A New Look. Submitted to Journal of Computational and Graphical Statistics.

After the preparation of the previous manuscript, he became aware of another method that had been published in 1954 but never really implemented. Initial numerical tests were very encouraging. He carried out much of the implementation and numerical testing during his stay at the centre.

H.I. Gassmann, Multivariate normal probabilities: Implementing an old idea of Plackett. In progress.

2.3 *Models and organizations*

With an emphasis on the aspect of uncertainty, how should models be introduced into organizations? How should models adopt to organizations, and organizations to models? On this subject Wallace and Høyland produced an article, presently under revision after a conditional acceptance:

Kjetil Høyland and Stein W. Wallace, Developing and implementing a stochastic decision-support model within an organizational context, to appear in Journal on risk finance.

Much work was also spent on a forthcoming article on portfolio management in Elsevier's Handbook on Finance.

2.4 *Decisions and organizations*

During the stay at SHS Jan Hovden was project manager for the project "Risk and uncertainty: management, understanding and adaptation". For information about this Research Council based project see: www.risiko-forsk.no. Ragnar Rosness was part of the project team, and they worked mainly on subjects related the resilient organizations and safety related organizational decision-making. Jan Hovden was also running a joint survey study with the Employers Security Organization (NSO) on security management in Norwegian industry. The results are published in a NTNU/NSO report (2001) "Security i næringslivet".

Ragnar Rosness (2001): "Om jeg hamrer eller hamres likefullt så skal der jamres". SINTEF Report STF38 A01408. Trondheim: SINTEF Industrial Management.

Based on presentation at "Sikkerhetsdagene 2000", Trondheim. Discusses how conflicting objectives typically are resolved in various contexts. Five types of decision processes are proposed, and these are related to the authority level of the decision maker(s) and the decision-maker's distance from the hazard source.

Ragnar Rosness (2001): "Slank og sårbar? Om verdien av organisatorisk redundans," SINTEF Report STF38 A01413. Trondheim: SINTEF Industrial Management.

Based on presentation at "KNUS-konferansen", Trondheim 6–7 september 2000. Organisations may build redundancy in a way that resembles hardware redundancy (e.g. the use of two separate hydraulic circuits in the braking system of a car): An organisation may deliver performance that is more reliable than the performance of an isolated individual by establishing suitable patterns of co-operation. People may

e.g. ask each other for advice, check each other's performance, challenge each other's decisions, or correct each other's slips. However, such organisational redundancy may be vulnerable to organisational changes such as outsourcing and downsizing.

Ragnar Rosness and Jan Hovden (2001): From power games to hot cognition. A contingency model of safety related decision making. Working paper.

This paper formed the basis for a presentation at the workshop on Decision Making Under Uncertainty, Molde, May 19–21, 2001. Discusses how conflicting objectives typically are resolved in various contexts. Five types of decision processes are proposed, and these are related to the authority level of the decision-maker(s) and the decision-maker's distance from the hazard source. Ethical aspects and power mechanisms related to the five types of decision processes are discussed.

2.5 *A vulnerable society*

Jan Hovden was a member of the Governmental commission "A vulnerable society" (the Willoch commission with the report NOU 2000:24). His stay at SHS gave the opportunity for a lot of follow-up work in terms of consultative work for the Government and ministries regarding the commission's recommendations for improved societal risk management. The observations of the political processes gave a basis for writing a paper on challenges and points at issue in dealing with new (post modern) risk scenarios beyond the institutions and control regimes developed for risk handling in a traditional industrial society.

Jan Hovden, Public Policy and Administration in a Vulnerable Society. Proceedings of the 5th Conference on Technology, Policy and Innovation "Critical Infrastructures", in Delft, The Netherlands, June 26–29, 2001. Submitted and accepted for the journal "Safety Science", Elsevier.

2.6 *Intersubjective communications*

Stein Bråten and Ragnar Rosness (2001): Intersubjective communication and simulation of mind in two laboratory groups assessing safety measures. Working paper.

When specialists from a variety of fields meet to jointly evaluate risk reducing measures they are faced with the challenge of achieving intersubjective understanding through communication. The paper offers a group-level systems analysis of two laboratory task groups assessing risk reducing measures with reference to fire hazards in ships, and distinguishes at the interpersonal level different modes of intersubjective understanding.

2.7 *Bookmobile routing and scheduling*

This is a joint work between Foulds and Wallace, in addition to Professor John Wilson from The University of Loughborough and librarian Liv Sagvolden from Buskerud County Library.

A bookmobile is a specially adapted bus or van used as part of the outreach operations of public library systems. The question of how best to utilize bookmobiles can be modelled as an interesting variation of one of the classical models of operations research, the vehicle scheduling and routing problem. We developed models and solution techniques for the bookmobile problem and applied them in a practical situation in Norway.

L R Foulds, S. W. Wallace, J. Wilson, and Liv Sagvolden “ Bookmobile Routing and Scheduling in Buskerud County, Norway. “ Proceedings of the 36th Annual Conference of the Operational Research Society of New Zealand, Christchurch, New Zealand, December 2001.

L R Foulds, S. W. Wallace, J. Wilson, “Models and Techniques for Bookmobile Routing and Scheduling.” Not yet submitted.

The work has been presented at several conferences by members of the team.

2.8 *Subassembly Combination in the Automobile Industry*

A common problem in automobile manufacturing involves the selection of wiring combinations that reflect the features that different cars of the same model can possibly possess. Foulds and Frein began to develop models and solution techniques for this problem using techniques from combinatorics and optimization, two areas of discrete mathematics.

L R Foulds, Y. Frein, “Subassembly Combination in the French Automobile Industry.” Not yet submitted.

2.9 *Safety and decision tools*

This is work by Hovden, Rosness and Wallace. There is an understanding among safety scientists that pressure on financial success in the development of oil and gas fields has caused safety to be reduced. We ask if this could partly be caused by methodology chosen by economists /decision analysis specialists, and that in fact safety and financial success are not so contradictory. A working paper has been produced. This paper is an example where the mathematical and social science based scientists of the group have managed to combine forces.

Jan Hovden, Ragnar Rosness and Stein W. Wallace, Exploring beliefs in modeling decision making. Proceedings of the 5th Conference on Technology, Policy and Innovation “Critical Infrastructures”, in Delft, The Netherlands, June 26–29, 2001. Submitted to a journal.

The following presents ideas from the above in a more popular style, focusing on how various aspects hindsight bias may lead to decisions that are not robust.

Rosness, R. (2001): Fanget i etterpåklokkens klamme grep. Presentation. KNUS-konferansen 2001, Trondheim 6.–7. september 2001.

2.10 *Proper use of methodology*

This is connected to the item above. Higle and Wallace have initiated three pieces of work. The first is an expository article on the failure of

sensitivity analysis for decision making under uncertainty. The article is finished and submitted to a journal. The second was a response to an earlier article in IEEE Computer Applications in Power, dealing with the treatment of price risk in deregulated energy markets. The article has been conditionally accepted as a feature article in the April issue of the magazine. The third activity is the start of a booklet on stochastic programming, meant to be used by instructors who otherwise use a standard textbook in optimization, but would like to also cover stochastic programming. This work is not finished.

Julie Higle and Stein W. Wallace, Managing risk in the new power business – a sequel. To appear in IEEE Computer Applications in Power.

Julie Higle and Stein W. Wallace, Rethinking Sensitivity Analysis. Submitted to a journal.

Julie Higle and Stein W. Wallace, Stochastics in optimization. Booklet for educational use. In progress.

2.11 *Strategy and stochastic programming*

As part of his doctoral thesis Reitan has written a report on the role of stochastic programming in strategic planning.

Bård Reitan, Opportunities for stochastic programming in strategic planning. In progress.

2.12 *ITC-enhanced services*

Reitan has also written and presented some work on ICT enhanced services in telecommunications.

Bård K. Reitan, Stein W. Wallace, Nils J. Berland, Modeling a Market of Services Enhanced by Information & Communication Technology. INFORMS Miami, November, 2001. Submitted to a journal.

2.13 *The Contractor's Problem*

Foulds and Higle studied the scheduling of the harvesting of renewable resources from a process scheduling viewpoint. The processes under study have: activity precedence relationships, minimal and maximal time lags, require resource levelling, and have various stochastic elements. They developed models for a number of harvesting scenarios and discussed possible solution approaches for some of them.

L R Foulds, J. Higle, Stochastic Models for the Contractor's Problem. In progress.

2.14 *Dynamic scheduling in the car industry*

In this work we develop new algorithms for the management of physical flows in a car assembly factory. The idea is to manage the flow of cars such that we can easily synchronise this main flow with components flows. It leads to solve local scheduling problems with local criteria under general management constraints.

This work has been developed in the context of a collaboration with PSA (Peugeot). It was the subject of a PhD student (V. Bernier). This thesis was defended on November 2000. During this year we have written a paper for a conference (1) on a local scheduling problem. An extended version will be proposed for a journal. The following report was finished at SHS.

Bernier V. and Yannick Frein, Study of the reordering obtained with a buffer management policy based on the due dates. Presented at MOSIM 2001, April 2001, Troyes, France

Two more reports were started. These are Bernier V. and Yannick Frein, Sur des problèmes d'ordonnancement locaux sous contrainte de gestion globale FIFO. Submitted to Revue Francaise de Gestion Industrielle.

Bernier V. and Yannick Frein Y, Etude de la remise en ordre d'une liste par une gestion d'un stock basé sur les dates de livraison. (Extended version of the paper presented at MOSIM 2001). Submitted to Journal Européen des Systèmes Automatisés.

2.15 *On the design of a supply chain*

In this work we consider the design of a supply chain. Logistics problems are becoming more and more important since several years and the industrial approach of such problems has significantly evolved (5). In this work we consider mainly strategic decisions as the “make or buy decision” or the “supplier selection” for which we have proposed new approaches. This work has been developed in the context of a PhD thesis (M.R. Akbari Jokaar). This thesis was defended in December 2001.

Lionel Dupont, Jokaar Akbari and Yannick Frein, Toward a global approach to make or buy decision: Integrating strategic and operational visions. Presented at 4e Congrès International de Génie Industriel, June 2001, Aix-Marseille, France.

Jokaar Akbari, Yannick Frein and Lionel Dupont, The vendor selection decision: a multi criteria procedure. Presented at The 16th International Conference On Production Research ICPR-16, Prague, Czech Republic.

Jokaar Akbari, Yannick Frein and Lionel Dupont, Sur l'évolution du concept de logistique. Submitted to Revue Francaise de Gestion Industrielle.

Jokaar Akbari, Yannick Frein and Lionel Dupont, A global approach to make or buy decision. Submitted to International Journal of Logistics: Research and Applications.

Jookar Akbari, Yannick Frein and Lionel Dupont, An approach to supplier selection. Submitted to European Journal of Purchasing & Supply Management.

2.16 *Production scheduling*

Joint work between Frein and Wallace. A paper, mostly developed before the stay at SHS has been finalized for Journal on Scheduling, and new work has been initiated on the role of uncertainty and strategy in production planning in the car industry. The goal is to see how the different decisions in the production of a car fit together, from the location of plants for production of parts, via the choice of logistics and ware-

housing, to the role of just-in-time production of intermediate parts and finished cars. The idea is that many papers and procedures dealing with these issues fail to see the whole picture, particularly the time frame for the different parts of the production.

Lyès Benjoucef, Yannick Frein, Bernard Penz and Stein W. Wallace, Synchronous delivery: New dynamic scheduling problems. To appear in Journal on Scheduling.

Yannick Frein and Stein W. Wallace, On relations between static and dynamic scheduling? In progress.

2.17 *Energy modeling*

Wallace, together with Stein-Erik Fleten from NTNU, spent time working on an invited handbook article on energy models in stochastic programming. This article will be finished in 2002.

Stein W. Wallace and Stein-Erik Fleten, Stochastic Programming Models in Energy. To appear in a volume on Stochastic Programming in the Series Handbooks in Operations Research, North Holland.

2.18 *Income redistribution*

Wallace, together with professor Dominique Thon from Macau, continued their work on income redistribution. No articles reached a final form during the year.

2.19 *Other*

In addition to the abovementioned joint work, Stein Bråten worked on the following articles.

Modellmakt og altersentriske spedbarn: Essays on Dialogue in infant and adult. Finished for a bilingual collection of essays, published by Bergensforlaget Sigma, 2000.

Moral account. Essays on Moral Decisions and Communication. Under preparation with Luhmann, Pruzan and Bråten for possible publication.

Delaktige spedbarn og dialogpartnere: altersentrisk persepsjon. Presentation at Videnskapsakademiet February 2000. Prepared for Årboken.

Altercentric perception by infants and adults in dialogue. Key-note address at Mirror neurons and the evolution of brain and language, Hanse Institute for Advanced Study, Delmenhorst, 2000. To appear in proceedings edited by V. Gallese and M. Stamenov.

Virtually moving with others: the discovery of mirror neurons and altercentric perception (with G. Rizzolatti). Prepared for submission.

And then three talks given at University of Bergen, University of Parma and University of Leipzig.

3. An international workshop

During three days late May the group organized an international workshop on decision making under uncertainty at Håholmen near Molde. About 25 scientists from the US and Europe came together to present new developments. All group members from SHS, except one, took part and presented their work. Most of the participants represented the mathematical side of the subject, and as a result, the presentations from the social sciences were particularly well received.

4. *Summing up*

In total the group has been very productive with papers covering many different aspects of decision making. Some work has fallen outside this general framework, as a natural effect of the team members having a wider interest than the theme of the group. The cooperation between the social scientists and those with a more mathematical basis could have been better, but can still be said to have been successful. It has been our view that it is in the spirit of SHS to take chances. And when one takes chances one does not always win. We feel we came out reasonably in this respect, but the cooperation, particularly in terms of articles, was limited. Fruitful discussions were plentiful.

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