HMI
GRADUATE SCHOOL FOR HUMAN-MACHINE INTERACTION

Final report
including an economic report
for the period 1997-2001

HMI – Graduate School for Human-Machine Interaction

Ort och datum:

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Final report for the Human Machine Interaction (HMI) graduate school

Summary

The current report is based on the mid term report delivered to SSF in 1999. The graduate school for Human Machine Interaction (HMI), with the Swedish Foundation for Strategic Research as major sponsor, has been operative in Linköping and Stockholm since November 1997, when the first students were recruited. At present about 60 students are enrolled in the programme. More than 30 supervisors are engaged at Linköping University, KTH and Stockholm University. Approximately two third of the HMI budget is supplied by external sources, like industries and other research agencies.

The goals are to support Swedish industry with excellence in human-machine interaction, and to enhance academic achievements to an outstanding position in a global context. Research is primarily conducted within two areas: IT design and Real-Time Interaction. Initially 15 interdisciplinary research themes were identified as follows:

1. Human interaction with digital media.
2. Smart things and environments for art and daily life.
3. HMI meets PCC. Personal computing and communication: Artefacts and services.
4. Document design and management in shared environments.
5. Persona
6. Scenario based environments for learning and development of competence.
7. Models for human interaction with mobile service robots.
8. Intuitive interfaces and public services.
9. Team collaboration.
10. Decision support.
11. Multimodal dialogues.
12. Organizational usability.
13. Distance learning.
14. Interaction design and intuitive interfaces.
15. Aspects of Human Factors in transportation systems.

In 2001 these themes were merged into 3 main themes:

- Intelligent artefacts and environments,
- Multimodal interaction and information management,
- Joint cognitive systems engineering.

Visions of human-machine interaction are focused on the ease-of-use of Swedish IT products. Thus, Swedish IT products will be:

- Productive, safe and satisfying to use.
- Intuitive to use- even for the novice or inexperienced.
- Designed to be used without a manual.

The disciplines involved are Computer Science, System Science, Human Machine Interaction, Human Work Sciences, Cognitive Psychology, Art, Ethnography, and Communication.

Together with other SSF graduate schools HMI is running several interdisciplinary research projects. Many European projects are currently emerging together with Swedish and foreign institutions and industries.

As a result of the HMI, co-operative activities are initiated and the supply of graduate courses has increased substantially, which is a prerequisite for a stipulated output of 10 graduated a year in a steady state.

HMI has meant a lot to an increased awareness of the importance of bringing developers, manufacturers, researchers and users of IT-products and/or real-time systems together. The graduate school has gained a lot of interest from universities abroad, and co-operation in projects and student exchange has increased.

Our visions are to make HMI to a truly national graduate school and simultaneously an international resource for knowledge in the field. Accordingly, other universities in Sweden will be increasingly involved in research co-operation. Collaboration between the disciplines involved has been successfully achieved within several domains.

1. Background, objectives and organization of the program

1.1 Background, motive and long-term goal/vision

The Swedish Foundation for Strategic Research (SSF) established the graduate school for Human Machine Interaction (HMI) in 1996 with two nodes in Linköping and Stockholm, respectively. The long term goals are to:

- Improve the Swedish competence in human-machine interaction by educating specialists in HMI.
- To make these HMI specialists useful to Swedish industry for the purpose of improving productivity and safety in system design**.**
- To bring the quality of Swedish HMI research and academic standards to the highest international level.

The prime motive for the establishment of HMI is an increased awareness of the importance of knowledge in HMI for a successful competition on a global market for IT-products and Real-Time Systems. Since Swedish industry is quite diversified, there is still a lack of knowledge about HMI issues at many companies. One reason for this might be increased time pressure, and difficulties to retrieve and comprehend research results. HMI graduate school might be conceived of as a remedy for these problems. HMI knowledge has world-wide become a strategic investment for both large industries and SME´s. For instance, Nokia´s early investment on HMI-competencies, has paid off well and is considered to be a paragon case of capitalisation on HMI knowledge. In order to maintain a high level of usable IT products and real-time systems Swedish industry has to increase its knowledge in IT-design and real-time interaction. In-house HMI research is rarely conducted in Swedish industry. Interdisciplinary holistic perspectives are usually missing in the development of new products and systems. Design of computer based artefacts and media from a human perspective builds on knowledge of computer science, usability and user-oriented design, as well as the aesthetic arts. Research on IT-design must consider usability of products from both an individual and a group perspective, and when applicable simultaneously support the kernel activity of an organization. Research on Real Time Interaction aims at collecting, analyzing, presenting and conveying information for human decision making and humans´ actions in real time.

With respect to the initial goals it still seems too premature to evaluate these goals (goal fulfilment) and the initial motive, since the Graduate School was initially planned to embrace at least two students cycles (i.e. approximately 10 years).

Visions of human-machine interaction are focused on the ease-of-use of Swedish IT products. Thus, Swedish IT products will be:

- productive, safe and satisfying to use.
- intuitive to use- even for the novice or inexperienced.
- designed to be used without a manual.

Visions of HMI is that the graduate school shall be recognized as the top level HMI school in the world. But, for this to come true additional financing is needed. Another vision is that HMI will be considered as a natural source of wisdom by society in large and that HMI will be well reputed among large industries as well as SME´s.

1.2 Commission given by SSF, including objectives stipulated in the contract with SSF

Swedish industry needs experts who are able to create system design solutions with mutual support from humans and machines. HMI will be built on two strong nodes in Stockholm and Linköping, respectively, with research mainly conducted on IT-Design and Real Time Interaction. Following long term goals are identified:

- HMI will be one of top ten graduate schools within the field in the world.
- At least 10 licentiates/doctors will be delivered yearly, with at least 70 % adopted by Swedish industry.
- HMI will have a significant influence on undergraduate education within the field.
- HMI shall produce industrially usable research results, with both theoretical and practical significance.

HMI graduate school is managed by Linköping University. Information about the programme is provided via Internet (www.hmi.kth.se). Written documentation shall be is available on request. Intellectual property rights is regulated between parties involved through an approved policy of SSF. The programme board annually delivers

a written economy report to SSF. It shall also be possible for SSF to follow the work of the programme board. SSF has continuously been informed about all significant events within HMI. The host for HMI is obliged to separately account the HMI activities. SSF is also entitled to assign a special accountant for the programme. The receivers of the grants from SSF shall be committed to attract new potential financial partners, which shall be approved by SSF.

1.3 Start-up process and delays

HMI was initiated in fall 1996 and suffered from a slow start with minor organisational problems. For instance, there have been some incompatible rules at different departments to overcome. With respect to the previously almost non-existing co-operation between the departments involved a number of meetings were necessary. In 1997 a smooth collaboration between different disciplines emerged. Today, more activities are interlinked between Linköping and Stockholm as well as between departments on a local level. The first students were enrolled in November 1997 and the majority were recruited in February 1998.

1.4 Basic organization, programme board, program director, advisory committees etc.

HMI is organized with nodes in Linköping and Stockholm, respectively. HMI is managed by a board of directors appointed by Linköping University. Adhered to the board was an executive committee, consisting of professors from the five departments involved in HMI. HMI has also a central administration containing a program director and a secretary in Linköping. In Stockholm HMI has a local vice program director in charge. A graduate School Committee was responsible for course development, manning of courses, course requirements and admission of graduate students to the programme. A person responsible for HMI curriculum is appointed both in Stockholm and Linköping. An Academic Advisory Board and an Industrial Advisory Board are committed to specific evaluation tasks regarding HMI. In 2001/2002 the graduate school was reorganized due to a changed ambition level from SSF. Due to decreasing external financial support the Graduate School turned into a more academic enterprise and the board was reorganized, with an explicit ambition to primarily support educational achievements. However, in practice industrial financing of our graduate students slightly increased. The Executive Committee and the Graduate School Committee merged simultaneously into one committee. Eventually the Industrial Advisory Board was slowly fading away, partly due to reorganization at the industries involved, and partly due to limited possibilities to redirect the students research focus to participants' own interests. Over all these measures made the entire HMI-organization more efficient.

2. The research of the programme

2.1 Participating researchers

Participating researchers are listed (together with graduate students, affiliations, research themes and topics) in Appendix A3.

2.2 Scientific results

Below the research efforts of the HMI programme are briefly described. A more detailed presentation of the HMI theses works is given at our Web-site; www.hmi.kth.se. A list of publications from main actors in HMI is presented in Appendix C.

Research is devoted to two broad areas: IT-design and Real-Time Interaction. 3 different main research themes, are in focus (see, Appendix A.7)

2.2.1 Original research areas

Research on IT Design

IT design deals with the design of computer-based artefacts and media from a human perspective. It builds on knowledge of computer science, usability and user-oriented design within human-computer interaction, as well as aesthetic arts. Research on IT design must take into account the usability of products by individuals as well as group of users. Within the area of Human-Computer Interaction (HCI) there has been a gradual shift of focus, from controlled laboratory experiments, to an emphasis on situated use, with qualitative methodology and field studies in the users' natural environment as important ingredients. This shift of perspective has emerged along with research in Computer Supported Co-operative Work (CSCW). CSCW emphasizes the ties between workplace activity and the organizational context of work. Accordingly, IT design today needs to address interaction with technology in the broadest relevant context and must not confine itself to low level features or short term usage of artefacts. The design process itself will also be studied. It is important to understand the

”synthetic character” of design work and the implications for the development of IT-based tools that can be used to support designers in their work. As an example ”Design History” may be used to store arguments why specific design solutions were chosen.

Research on Real-Time Interaction (RTI)

Systems for real-time interaction collect, analyze and present information for human decision making and human actions in real time. With the term Real-Time Systems we refer to systems such as:

- process supervision in advanced manufacturing and telephone maintenance.
- intelligent transportation, such as for optimal on-hand-road routing of trucks, and
- medical equipment for treatment and supervision in patient care.

These processes are dynamic and change states continuously. Therefore, decisions generally have to be made in a sequence, where one decision depends on the previous decision. Couplings among sub-systems often have the effect that performed operations influence not only intended processes, but other processes as well, which makes control more difficult. Collaboration between co-workers, introduces another task variable, since work patterns are not set, but may vary depending upon the different schemes for collaboration and task assignments. Major goals of RTI-research are to develop efficient and safe control systems and to improve availability, productivity and quality. There are three important application areas: process control, intelligent transportation and telematics.

2.2.2 Research environments at the five departments involved in HMI.

HMI activities at IPLab and CID, NADA, KTH

IPLab is an interdisciplinary research laboratory, which has been a centre for research in human-computer interaction at NADA, KTH since 1985 (the group formed as early as in 1982). IPLab is currently engaged in the research areas computer-supported co-operative work, computer-supported writing, user-centered design and human-robot interaction.

IPLab is responsible for all undergraduate and graduate education in HCI at NADA. There is a popular HCI specialization for the last year several of the Master level programmes at KTH. Since 1998, HCI has been established as a subject for graduate study at NADA, with its own curriculum separately from computer science and numerical analysis.

CID was created in 1995 as a competence centre, financed by NUTEK (1/3), industrial and user-organisation partners (1/3) and KTH (1/3). It is co-located with and co-operates closely with IPLab. As an interdisciplinary endeavour, CID has particular emphasis on collaboration between different design and media disciplines in the development of IT products. Its current research areas are Smart things and environments, Digital worlds and Interactive learning environments.

Altogether, IPLab and CID have about 15 post-graduate researchers and 25 graduate students. Fifteen of the graduate students are connected to HMI, of which 8 have been fully or partially funded by HMI and the rest were funded by external sources. Of CID's 15 graduate students, 10 are research students at NADA, whereas the others are registered in film and media departments.

The HMI students at IPLab and CID work in the following projects:
- Models for human interaction with mobile service robots
- Writing and document design in shared environments
- Human interaction with digital media
- Smart things and environments for art and daily life

HMI activities at K2LAB/DSV (The Knowledge and Communication Laboratory at the Department of Computer and Systems Sciences) at KTH and SU

The research includes work on human-computer-interaction, computer supported co-operative work, artificial intelligence and software for distributed systems. The lab has a good track record for graduate studies with more than 25 PhD thesis and 25 Licentiate thesis during the last decade. The faculty of the lab is also responsible for all undergraduate education in human-computer-interaction at DSV. All Masters students of the department take about 10 credits mandatory HCI courses. Furthermore the lab is responsible for two HCI related specializations in the masters education both at KTH and SU (more than 70 students/year). K2LAB has a well-established co-

operation with the HUMLE laboratory at SICS which is also illustrated in one of the HMI projects below. K2LAB has currently four chairs (artificial intelligence, human machine interaction, intelligent software services and computer-mediated communication), five post graduated researchers and 30 graduate students.

K2LAB has had four fully HMI funded graduate students and another five externally funded HMI graduate students. They have all worked within larger projects, three at DSV and the fourth primarily at SICS. The current projects are the following:

- Ubiquitous computing and communication: Artefacts and services.
- Social and emotional computing
- Computer mediated communication
- Computer supported learning environments

HMI activities at IDA (Department of Computer Science and Information Systems), LiTH

In the Computer Science department, IDA, the division for Human-Centred Systems participates in the HMI School. The HCS division has four full professors (Computational Linguistics, Knowledge-Based Systems, Human-Computer Interaction and Computer Science), three adjunct research professors (Language Technology, Information Psychology and Geographical Information Systems) and more than ten PhD faculty involved as supervisors. There are about twentyfive doctoral students active in HMI areas at HCS division.

The Division is involved in several undergraduate study programmes with HMI orientation, in particular the interdisciplinary Cognitive Science programme, with a special Interaction Design profile offered. Co-operation with industry is extensive, with a number of industry doctoral students in areas such as usability and interaction design and in the language technology and multi-modal interaction. Project cooperation with industry under the auspices of the Santa Anna IT Research Institute is extensive. A special laboratory for dialogue and language technology studies is used for advanced studies of animation in connection with speech synthesis, sponsored by Telia Research. Another lab for home communication studies, the e-Habitat workshop, has recently been set up with core equipment from Nokia Home Communications.

HMI research areas covered by the laboratories in the Human-Centered Systems Division include

- Language technology and multimodal interaction
- Knowledge-based systems and intelligent support
- Cognitive systems Engineering
- Humans, computers and work.

HMI activities at TEMA, LiU

At the department of Tema, research is organized in different interdisciplinary and broad themes. One of these is Communication Science, with a group lead by Yvonne Waern, who is deeply involved in the HMI programme. Research is conducted in the domain of (distance) learning, HMI and HCI. After professor Waern's retirement the graduate students moved to IDA.

HMI activities at IKP (i. e. Division of Industrial Ergonomics, Department of Mechanical Engineering, LiTH)

Research is focused on recent trends in technical development, such as use of large systems of great complexity and use of computers to augment operator performance. Presently, there are projects in following areas:

- Human-Computer Interaction
- Human Decision Support
- Road Informatics
- Adaptive multimodal systems
- Interface/Display Design
- Product Design
- Design for Manufacturability
- Design of Industrial Production Systems
- Biomechanics and Hand Tool Design
- Ergonomics and Quality in Manufacturing
- Work Organization
- Safety in Complex Systems

The division of Industrial ergonomics is involved and responsible for a number of undergraduate courses at different engineering programs. The division is also responsible for a special Master program in Industrial

Ergonomics, and a special Masters Program in Human Factors Engineering. Within the latter program a mutual exchange program (students and teachers) together with Nanyang University in Singapore is developed.

HMI has its administration at IKP. Presently, eight faculty members, and 16 graduate students are engaged in the HMI programme.

IKP is also hosting the Swedish Centre for Human Factors in Aviation, which is a network organisation, embracing aviation schools, aviation authorities, flight operators, aircraft manufacturers, military establishments and university departments. A close co-operation between HMI and HFA is taken place. Thus, HMI students have excellent opportunities to participate in internationally oriented courses provided by HFA, with the most prominent HFA specialists as teachers.

IKP has developed a Virtual Reality Lab, with great capabilities for simulation and modelling.
In this environment the HMI students have excellent opportunities to work with a very advanced technology, allowing them to create simulators, devices, products, and dynamically simulate "real" or virtual events in artificial environments. Similar possibilities (Cave-system) are available at KTH and SICS in Stockholm.

IKP is conceived of as an important node in CMTO (Centre for Man Technology and Organization) at Linköping University. IKP is also considered to be an important node for several international networks, for instance, the Human Factors Society, International Ergonomic Society, ENOP [European Network of work and Organization Psychologists (elected professors)], GARTEUR (Group for Aeronautic Research and Technology in Europe, Working group for pilot mental workload) etc.

2.2.3 Research Themes

Human interaction with digital media (Theme 1)
(IPLab, CID and IKP)
Project managers: Yngve Sundblad, John Bowers and Kerstin Severinson Eklundh.
HMI graduate students: Cristian Bogdan, Eva-Lotta Sallnäs, Kai-Mikael Jää-Aro, Kristina Groth, Fredrik Winberg.
Funding: HMI/SSF, KFB, EU/Esprit, CID/Vinnova, KTH

With current computer technology it is feasible, even with ordinary personal computers, to handle not only text and graphics but also dynamic media such as video, sound (incl. music) and animations. This gives possibilities for more full-fledged human-computer and human-human interaction, using several senses and with emphasis on aesthetic aspects. For making these new forms of interaction useful, interdisciplinary research in media, design, art, communication and technology is necessary.

Many research questions arise from the increased variety of communication possibilities in new digital media. Virtual meeting places can be designed and "furnished" by the users themselves and adapted for particular tasks and purposes. New forms of presence are enabled in these environments which have implications for leisure as well as professional activities.

This project has roots in computer supported co-operative work activities at IPLab since more than 10 years. It also draws on recent development and studies at CID of the informal video café, multimodal interfaces for information assistance situations, and work (partly within EU projects) on collaborative and expressive Virtual Reality environments

Current activities include:
• User oriented studies of and tool development for informal wide-spread communities such as radio-amateurs and European student co-operation networks
• Social presence in collaborative multimodal interfaces; especially focusing on the role of the haptic modality
• Study and development of subjective visualisation methods for interaction with and understanding data from Collaborative Virtual Environments
• Computer support for sharing knowledge within organizations.
• User oriented development of sound based interaction for blind people.

Project manager at IKP: Håkan Alm
HMI graduate student: Kerstin Norman, Working and health conditions at call centers in Sweden.
Funding: Previa, Örebro.

Smart things and environments for art and daily life (Theme 2)
(CID in collaboration with the Interactive Institute)
Project managers: Yngve Sundblad (CID, NADA)
HMI graduate students: Sara Ilstedt, Sinna Lindqvist
Funding: HMI/SSF, Interactive Institute/SSF, CID/Vinnova, Disappearing Computer / EU

Computing power can take very different forms than the current dominating keyboard-mouse-screen, making new forms of human-human and human-environment interaction possible. Colloquial objects at the workplace and in the home as well as the environment itself can have built-in communication, sensors and information processing power, making them "smart".

Activities in this area started in CID in 1997 in close co-operation with industrial partners viewing smart things and environments as an important part of the human communication facilities of the future, esp. Ericsson and Telia.

From 1999 the activities form a common "studio" with the newly established SSF initiative The Interactive Institute (II). "Smart things and environments for art and daily life" is one of the first four studios of II and joint with CID. II has an other studio in Stockholm, "Emotional and intellectual interfaces", an initiative from the University College for film, radio and television (Dramatiska Institutet) and two studios in Malmö, in close co-operation with "Media and Communication" at the new university there.

The first studies have been connected with subtle forms of communication and awareness of other humans via objects and environment such as lamps and lighting and computer mediated video communication in home and work settings. In close co-operation with CID, Telia has built a full-scale (living room + kitchen + sleeping/working room) apartment at their network laboratory in a suburb of Stockholm. This "smart home" is a setting and resource for the activities in this area. Field studies of daily life use of broadband network facilities in a "real" apartment area in Stockholm are also performed by CID, Ericsson and Telia informing the project.

In the HMI school these activities are very new, the first two research students have just been recruited. The first projects will include studies of use and development of installations in the "smart apartment" at Telia and development of gesture-based video interaction in "smart settings".

Current work in the HMI school is focussed on Smart things in daily life, especially for family communication and health care. In the EU interLiving project three intergenerational families (8 households) each in greater Stockholm and in greater Paris are design partners and evaluators.

Ubiquitous computing and communication: Artefacts and services. (Theme 3)
(DSV/K2Lab in co-operation with another SSF funded graduate school: PCC)
Project manager: Carl Gustaf Jansson.
HMI graduate students: Fredrik Rutz, Martin Jonsson Fabian von Scheele and Peter Lönnquist.
External funding: HMI/SSF, PCC/SSF, Wireless@KTH/SSF, KFB, VINNOVA, EU/IST, Wallenberg Foundation
Project size at DSV: 10 people.

The project started in September 1997 and is considering the ubiquitous access to services in highly distributed heterogeneous computing and communication environments. An increasing number of artefacts in our normal work and home environments will very soon be digital. These digital devices will be part of out personal accessories, elements of the rooms and vehicles in which we dwell or autonomous entities that can be controlled remotely. The commercial availability in the near future of robust WLANs and context sensitive devices, will speed up this development even more.

Today we a run number of applications or services on our workstations or "PCs" or utilize them on our phones. The need for accessing these applications or services in a variety of situations will rapidly increase. There are pros and cons with this development. On one hand the flexibility of the technology will be able to generate an optimal functionality in each situation through the ad hoc configuration of the available computing and communication facilities in each physical space. On the other hand we do not want the functionality of an application or service to change drastically when moving from one situation to another. The primary goal for our research is

to study how to maintain a reasonably uniform functionality for each kind of service, while still utilizing the properties of each situation to optimize local performance.

The services should not only consider the physical properties of each usage situation but also the organizational context. Most uses of services in a professional setting are parts of specific work processes and by including knowledge about these work process, the functionality of the services can be improved. To include such knowledge in the services is the second important goal of our research. The services should be intelligent in the same sense of the word as in ”intelligent interfaces”, that is the functionality of the service should not be static, but generated dynamically taking into account a plethora of contextual factors, primarily the physical and organizational as described above. To design such dynamic behaviour is our third main goal.

We will also see a very rapid development towards more autonomous artefacts and services. The digital world will not consist only of passive hardware and software but of a plenitude of robots and software with increasing degree of autonomy. The existence of artificial active counterparts will change the conventional man-machine interaction models of communication towards more collaborative models. A fourth goal for our research is to investigate the impact of this development.

Two important aspects of the functionality of a service is the choice of metaphors and modalities of interaction, so when adapting the service with respect to physical and organizational context the choices and variations of metaphors and modalities will be a crucial aspect. An appropriate handling of metaphors and modalities is our fifth concern. Finally the availability of standards and high level programming environments for highly distributed environments with small embedded computing and communication elements are our final concern.

PhD projects:
1. Fredrik Rutz (Ph D student at DSV/K2LAB), Trust in semi-autonomous systems. Finished licentiate in 2002.
2. Martin Jonsson (Ph D student at DSV/K2LAB), Context modelling, finishing licentiate thesis in may 2003.
3. Fabian von Scheele (Ph D student at DSV/K2LAB), Time perception for mobile work, Finished PhD thesis in 2001.
4. Peter Lönnquist, (Ph D student at DSV/K2LAB), Supporting co-located work for mobile users.
5. Hillevi Sundholm, (Ph D student at DSV/K2LAB, HMI applicant), HMI properties of interactive spaces.
6. Johan Matsson, (Ph D student at DSV/K2LAB), Novel interactive devices for interactive spaces.
7. Li Wei, (Ph D student at DSV/K2LAB), Context sensitive composition of services.
8. Fredrik Espinoza, SICS, Finished PhD in 2002, Personalized Service Provision.
9. Patrik Werle, (Ph D student at DSV/K2LAB), Active documents.

Writing and document design in shared environments (Theme 4)
(IPLab)
Project manager: Kerstin Severinson Eklundh
HMI graduate students: Ann Fatton, Henrry Rodriguez, Hee-Cheol Kim, Rickard Domeij, Ola Knutsson.
Funding: HMI/SSF, SU, KTH, HSFR, KFB, NUTEK/Vinnova

Writing and reading processes are today embedded in the global context of the distributed electronic office. They are shaped both by the access to new tools and media, and by the fact that user groups and applications are connected in networks. Traditional forms of writing are being complemented with new forms of design that both challenge and enrich the user's knowledge and skills.

This project departs from previous research at IPLab on computer-supported writing and document design since the mid 80's. Recently the work has consisted of three parts: alternative representation and interaction models for writing, collaborative writing, and language tools for writers.

The work on representation and interaction models focuses specifically on support for overview and navigation in long texts. The "paper model" for computer-based writing extends the writer's perspective of the text beyond the scroll-window to allow flexible page-based screen views. This model has been shown to increase overview and spatial memory for the text. A series of studies have assessed the implications of the model for planning, reviewing and co-operation during the writing process.

The development of the World Wide Web implies that large groups of users have continuous access to a global multimedia knowledge repository which also serves as an infrastructure for collaboration. We have developed Web-based collaboration tools that support document design and reviewing in distributed working groups. Our

work on collaborative writing also includes studies of change notification and representation, with the purpose to inform design.

IPLab's work on language tools for writers is a collaboration between HCI specialists, linguists and theoretical computer scientists, and has also involved the Swedish Language Council. The work has included development of a grammar checking word processor for Swedish, based on fast methods for morphological tagging and a powerful rule language. Within HMI we particularly study the importance of the interface design and the advice given by the system. Recently the work has been applied to the study of the role of language tools for second language writing and learning.

Social and Emotional computing (Theme 5)
(DSV/K2Lab,NADA in co-operation with SICS)
Project manager: Kristina Höök **HMI graduate students:** Martin Svensson, Marie Sjölinder and Mattias Forsberg.
External funding: I3/EU, HMI/SSF, SITI **Project size at SICS + (DSV, NADA):** 10 people.

Most of this work has been carried out in conjunction with an EU funded project called Persona. The issue of how users can navigate their way through large information spaces is crucial to the ever expanding and interlinking of computer systems. Computer users live in a world of information spaces. One of the most critical activities which users need to undertake is to retrieve information from such spaces and thus the problem of how to help the user to navigate, explore and identify the objects of interest is critical to the success of the system. We shall investigate a new approach to navigation, based on a personalised and social navigational paradigm. Most information retrieval in the ”real” world is accomplished through communication between people. We trust certain individuals to possess the information we are looking for. In addition, we expect them to be able to express the information so that it becomes personalised to our needs, understanding and abilities. Often the information seeking is done through talking to several persons, comparing the advice given, reformulating the original need for information, and only sometimes turning to other information sources such as books or on-line databases. This project seeks to develop our understanding of human activities in information spaces.

Specifically we will:
- Create a navigational instrument: a tool/method that can help designers of systems that include navigational aspects, to choose appropriate metaphors and navigational aids, and to design tools. This instrument will be a computer-based system similar to e.g. the Cognitive Walkthrough method, only it will be directed at identifying and understanding the particular problem of navigation in information spaces. It will build upon a review of differing approaches to issues of navigation in spaces, drawing upon e.g. architectural design, semiotics, sociology, cognitive science (both traditional and modern), geography (both traditional and modern), linguistics, urban studies and spatiology, narrative approaches and other social forms of navigation.

- Design solutions that implement support of social navigation. We shall study social navigation as it happens in existing information spaces. Isolate what makes it appealing to users and then design solutions that support social navigation from this basis.

The project will achieve these aims by using a wide variety of methods of investigation including ethnographically based approaches to studying navigation in the real world and experimental studies of users navigating in information spaces. We intend to complement such studies with detailed and wide-ranging literature reviews and prototype- and/or Wizard-of-Oz based studies of socially based interaction.

Our results will have an impact on the design of the navigational aspects of information spaces. The aim is to bring social navigation on the agenda as one possible design solution for how to help users. The result of our work will be communicated through scientific reports, prototype implementations built, described and used, and through the usage, testing and spread of our navigational instrument (for evaluating design of the navigational aspects of systems) to designers.

Martin Svensson finished his PhD thesis in 2003. Current work is now focussing more on emotional aspects of interfaces as part of Kristina Höök's program for her new chair.

PhD projects:
1. Martin Svensson (Ph D student at DSV/K2LAB), Social navigation in electronic worlds.
2. Marie Sjölinder (Ph D student in Psychology), Age differences in navigating virtual spaces.
3. Mattias Forsberg (Ph D student at NADA), Navigating in pharmaceutical information spaces.

Computer supported learning environments (Theme 6)
(DSV/K2Lab and IKP)
Project manager: Robert Ramberg **External Funding:** HMI/SSF **Project size at DSV:** 5 people.
HMI graduate students: Klas Karlgren, Patrik Dahlquist, Jacob Tholander, Eva Fåhræus and Peter Berggren

Today's society puts stronger demands on development of competence, learning, responsibility, flexibility and mobility for a large category of professions. In the transition to the post-industrial society it is claimed that these demands will increase. A renewed study of learning in the activity of work and what role the computer can have are called for. A deeper, and in part a new, understanding of the learning process is called for.

In the development of computer tools for learning it is important with a firmly rooted theoretical base and to choose and evaluate techniques accordingly. A social and situated view on learning with an emphasis on activities, language and language use is adopted within the project. Language is in the project not referred to in a narrow sense, as referring to only spoken or written language. The use of illustrations, animations, graphs, tables, and other expressions are thus included. Focus will be on creating learning scenarios where the learner is enabled to observe, act and use a specific language of a certain domain. Learning is not regarded as the acquisition of propositional knowledge/ content but as a process of socialization where the learner is/will become a part of a community or culture in which language and language use is a crucial part.A point of departure for the project is a view on knowledge that can be contrasted with an individualistic, cognitivistic view on knowledge. The importance of social and situated aspects of knowledge are in the project acknowledged and ascribed an important role. How this point of departure influences design of computer-based learning environments is in itself an interesting research question.

The project strongly relates to questions of IT-design and problems of multimodality. Results obtained from subprojects and studies conducted can be implemented in different technical environments, for instance in distance learning (WWW-courses) and cd-rom productions.

The goals of the project are to;
Define a set of guidelines for the development and design of scenario-based learning environments to transfer and adapt theories of learning and ideas of learning to the research area of design of computer based learning tools. The idea is not to simply borrow theories, but also to study how these can be adapted to and further developed for use in the field of design and analysis of computer based learning tools. There are several interesting and challenging problems associated with adapting psychological/pedagogical theories in such a context. It is on no way self-evident how one with a certain view on human cognition and learning should proceed to give recommendations for how education preferably should be carried out or how computer based learning environments should be designed.

Ph D projects:
1. Patric Dahlqvist (Ph D student at DSV/K2LAB), The effects of different presentation formats/illustrations on understanding and learning; animations, graphs, pictures etc.
2. Jakob Tholander (Ph D student at DSV/K2LAB), will defend his PhD thesis in June 2003, The use and significance of the apprenticeship metaphor in a context of design of computer-based learning- or training environments.
3. Klas Karlgren (Ph D student at DSV/K2LAB), will defend his PhD thesis in June 2003, The significance and attainability of authenticity, superficiality and language use in learning scenarios
4. Eva Fåhræus (Ph D student at DSV/K2LAB),Teacher support in tutoring of students in distance education.
5. Peter Berggren (Ph D student at IBV, LiU), Scenario generation for pilot training. This project is performed in close collaboration with Department of Human Sciences, at the National Defence Research Establishment, with professor Erland Svensson and associate professor Maud Angelborg Thanderz (retired since 2000) as the local advisors.
6. Ylva Fåhreus, (Ph D student at DSV/K2LAB), Support for science education for 10-12 year old kids.

Models for human interaction with mobile service robots (Theme 7)
(IPLab in collaboration with the Centre for Autonomous Systems)
Project managers: Kerstin Severinson Eklundh, Henrik Christensen (CAS)
HMI graduate students: Helge Hüttenrauch, Lars Oestreicher, Anders Green
Funding: HMI/SSF, AMS (The National Labour Market Board), KFB

This project concerns the development of models for human interaction with and control of mobile service robots. An autonomous service robot operates in the users' own environment, performing independent tasks to reach a user's goals. Applications include e.g. delivery agents in hospitals and factories, and cleaning robots in the home or in supermarkets. The interaction models should apply to users that are not computer experts, and must consider both normal and exceptional situations. The work touches on many central HMI issues, including the following:

• What are the conditions for humans' acceptance of a service robot in their immediate physical environment?

• How can "natural" interaction with a robot be designed, for instance, in terms of suitable channels and modes for communication? What metaphors might underlie the design? How can the robot's state be represented in a form accessible to the user?

• How can the interaction design ensure safety, by allowing users to easily stop the robot or change its instructions?

An initial survey was performed to assess user acceptability of service robots for various tasks in the home, and user preferences with respect to interaction modalities. Subsequently, an application project was initiated, funded by AMS and SSF, with the purpose of designing a fetch-and-carry robot for disabled people in an office environment. The early work in this project included adaptation of the robot’s exterior design, development of user interface prototypes and integration with an autonomous navigation system developed at CAS. The robot has subsequently been evaluated in a longitudinal field study at KTH as well as in experimental studies. Our current work on human-robot dialogue includes generalizations of the use scenarios, and studies of a multimodal interaction paradigm (speech and gestures) for service robots.

Computer mediated communication (Theme 8)
(DSV/K2Lab in co-operation with Dept. of Ethnology)
Project manager: Jacob Palme **HMI graduate student:** Sirkku Männikkö
External funding: Telematics/EU **Project size at DSV:** 4 people.

The focus of this work has been a project concerned with the use of networks for reducing the isolation of elderly people and people with mobility impairments. Senior Online is a EU-financed co-operation project between six European countries: Austria, Germany, Great Britain, Ireland, Italy, and Sweden. The project involves both developers and users of ICT with the aim of improving the possibilities for the elderly population to use the information and communication technologies in their everyday lives. The project started in Oct. 1998 and will run for two years time.

The main objectives of Senior Online are the integration of existing technologies (and their modification to satisfy the requirements of the elderly people), and the provision of a service infrastructure with appropriate content and means for awareness raising and training. The goal of the project is to stimulate people above 55 years of age to use the information and communication technologies. The services will be available in the native languages of the user groups within the project.

In order to achieve the goals of both reducing the isolation of the elderly people and to increase their interest in computer mediated communication and the information and communication technologies the project will:

- set up a customised on-line service for the elderly;
- stimulate the formation of organisations for elderly people interested in information technology and the Internet, such as SeniorNet;
- investigate the special needs of elderly people in using CMC and IT;
- select technology of special value for elderly people;
- develop, demonstrate and use methods to teach elderly people about the exploitation of CMC and IT;
- develop Internet-based tools for communication with and between elderly people, based on existing Internet standards, World Wide Web, e-mail and existing group ware.

The role of the Dept of Computer and Systems Sciences, Stockholm University/KTH, in the project is twofold: firstly, to participate in the development of the technical solutions based on the special requirements expressed by the user organisations; secondly, to give a baseline description of the user organisations and evaluate the effects of the project efforts from the user perspective.

Ph D project:

1. Sirkku Männikkö (finished PhD thesis at DSV in 2002), Domestication of the ICT.

Team collaboration in process management. (Theme 9)
(IDA, Tema and IKP)
IDA faculty involved: Sture Hägglund, David Carr, Kjell Ohlsson
Tema faculty involved: Yvonne Waern
IKP faculty involved: Håkan Alm, Sidney Dekker, Kjell Ohlsson
HMI graduate students: Henrik Artman, Rego Granlund, Fredrik Elg, Nalini Suparamanian, Björn Johansson, Jens Alfredson.
HMI funding

A project entitled C*o-operation in management of dynamic systems* started as a COST-project at Tema, and was continued under the auspices of the HMI graduate school. Here it covers the work of three graduate students, who are put together to form a group with various levels of experience and somewhat different approaches. This has proved to be a very successful way of working, both for the more and the less experienced students. It has resulted in one book, one doctoral thesis, a couple of articles to be published and some conference proceedings.

PhD projects:

1. Henrik Artman (Ph. D. exam 1999 at Tema) had started his work already before the start of the HMI graduate school and has functioned as our "senior". Most of his empirical work falls within the HMI graduate school. His work has resulted in a theoretical frame of reference as well as in some practical suggestions. He'll defend his doctoral thesis on the 5th of March. (Relation to other activities: Henrik Artman's work has led to a course for the students of the Cognitive Science Programme, covering 5 points in the third (nowadays second) year of these studies. The course, called "Communication and cognition" has been elective, but so popular, that most students have selected it. Moreover, many students in their fourth year of studies have selected the choice of "Humanistic Information Technology" at the Department of Communication Studies for their master of arts studies).
2. Christer Garbis (Ph. D. exam 2001 at Tema) linked his work to this topic in spring -97, where his graduate work was linked to the Department of Communication Studies. He has collaborated with Henrik in studying Training of emergency staff (Räddningstjänst), but also collected data alone in the Stockholm centre for underground control. Here, the importance of a big public display is investigated within the work settings of day and night work.
3. Fredrik Elg (Ph. D. Student at Tema/IDA) is accepted as a graduate student within the HMI graduate school. His work is experimentally oriented, and he has participated in collecting data in two microworlds: one concerned with collaborative fire-fighting, the other concerned with handling a community (Moro). He works with a system dynamics perspective, and is presently writing up his results, in parallel with studies within the graduate school.
4. Rego Granlund (Ph. D. exam 2002 at IDA), Micro-World Simulation for Emergency Management Training. This research project deals with design and construction of computer systems for computer supported collaborative learning and group distance exercise, with a focus on training of basic co-ordination and collaborative work in emergency management and command and control situations. Our research addresses the problem of integrating pedagogical goals and monitoring strategies in the computer systems. The goal was to explore ideas about monitoring functionality, that will help the training managers and trainees to observe, control and evaluate the exercises. In the project we have developed the C3Fire micro-world, a web-based distributed interactive simulation system, that can be use to experiment with different strategies for training team collaboration and monitoring strategies. In our work with the C3fire micro-world and in experiments performed with the C3Fire environment, we have focused on studying the monitoring possibilities to support situation awareness evaluation in team collaboration.
5. Nalini Suparamaniam (Ph. D. Student at IKP) is studying team decision making in complex systems (situations), and training implications. Two application areas are studied. Computer based training (CBT) for civil airline crews is scrutinized at SAS Flight Academy, Arlanda. Another topic is natural dynamic decision making of international rescue teams deployed by the Swedish Rescue Board (Räddningsverket) in Karlstad. Ms Suparamaniam received her licentiate degree in 2002; on International Rescue Team Cooperation, and plan to graduate in Spring 2003.
6. Björn Johanssson is a doctoral student in Cognitive Systems Engineering, sponsored by the National Defence College. His research interests are in the area of information management and presentation, studied in the context of the ROLF project, which is an effort to create not only a new command and control environment (the Aquarium) but also an attempt to investigate and possibly create new organisational forms within the Swedish total defence. A strong suggestion within the field of military

science is that network-centric organisations are to replace the hierarchical command structures of today, allowing a more rapid response to the high pace of modern warfare. It is also suggested that by sharing information to a greater extent than today, nodes in the organisation could self-co-ordinate their activities.

7. Jens Alfredson is a doctoral student in Industrial Ergonomics, sponsored by FOI (The Swedish Total Defence Research Institute). His dissertation is about Shared Situational Awareness among civil aviation pilots and military fighter pilots. He is working in a civilian, EC funded project, Vinthec II, and a project on Improved Situational Management in Network-based Defence. Alfredson received his licentiate degree in 2001.

Decision support. (Theme 10)
(IDA and IKP)
IDA faculty involved: Henrik Eriksson, Toomas Timpka.
IKP faculty involved: Fang Chen, Martin Helander, Erik Hollnagel.
HMI graduate students: Magnus Bång, Greger Wikstrand, Arne Worm.
HMI funding at IDA
HMI funding at IKP 1998: 370 KSEK

At IDA, we are working with interfaces for registration and classification of medical data at the appropriate level of detail in computer systems, which is a time-consuming and difficult task. Information overload when browsing extensive classification schemes and terminologies is a major cause of the problem. As a result, the quality of the data registered is often insufficient for adequate statistical studies and for other uses (e.g., planning and actions).. We believe that by using domain and context knowledge, that is gathered from several sources in the health-care chain, it is possible to develop adaptive and predictive user interfaces. For example, such an application could present only the viable classification terms/codes in different situations. This approach would off-load professionals (e.g., clinicians) from the peripheral registration task. Also, the context knowledge could be used for safety purposes to verify the input from the workers.

In summary, we are working with adaptive and predictive decision-support systems that reduce the cognitive load on the workers in time-constrained situations by only presenting the appropriate amount of information in the user interface. The research is being done in co-operation with the WHO Safe Community Program for injury prevention, the Health Services Board of Östergotland County, and the Swedish National Road Administration.

PhD projects at IDA:
1. Magnus Bång, Context Models for Decision Support in Computer-Based Patient Records.

At IKP ***Process management*** has been in focus for a number of years. This issue has to do with the design of manufacturing processes, power plants, paper mills, steel factories. But, there are other pertinent environments outside industry, such as telephone network management, traffic control and emergency systems. We are dealing with design of work organizations, as well as the hardware and software used for process management. The main problems in these environments is to convey appropriate information to the operator, so that the operator can make useful decisions. Swedish hardware and software for process management and control is a large business for companies, such as ABB. For example, Swedish industry has more NC-machines and robots per capita than any other country, and Swedish industry also manufactures these products. Hence, there is an interest to ensure productive and safe use of IT-based tools for production control in industry, and to design environments for process control. One traditional application with much Human Factors emphasis has been nuclear power plant safety. Nuclear safety has deep implications for design of nuclear power plants as this is done by some Swedish companies. Nuclear safety affects the daily life of power companies, and there are strong political and public opinions about the safety aspects. HMI experts will no doubt continue to play a very significant role in the nuclear industry. Bång plans to defend his doctoral thesis in fall, 2003.

PhD projects at IKP:
3. Greger Wikstrand, Decision making. Currently Wikstrand is on a graduate programme at Umeå University.
4. Arne Worm, TRIDENT (Tactical Real Time Information Processing). Worm received his PhD in 2001.

Design of the Multimodal Interface. (Theme 11)
(IDA)
Faculty involved: Lars Ahrenberg, Nils Dahlbäck, Arne Jönsson, Bertil Lyberg, Lena Strömbäck.
HMI graduate students: Annika Flycht-Eriksson, Pernilla Qvarfordt, Fredrik Arvidsson, Jörgen Skågeby.
Flycht-Ericsson received her licentiate degree in 2002, and Qvarfordt will receive hers in 2003.

HMI funding.

Our work on design of multimodal interfaces is currently focused on one application; timetable information for local bus traffic. As a base for the design, several investigations were made. Conversation about timetables requests where recorded in a telephone setting between travellers and the timetable informant and analysed in order to reveal what kind of information was being exchanged in the dialogue. An investigation of usage of paper-based timetables was also conducted in order to get an insight in how tables and maps were used by the travellers.

After the initial study a prototype interface was developed. The prototype had four different parts, a fill-in form for asking questions to the database, a map that could be used for pointing out points of arrival/departure timetable questions, and finally an area for messages from the system. The map consisted of a an overview map and a map showing magnified parts of the overview map. The magnified map had two fixed magnification factors, that also showed different amounts of detail. The prototype is fully functioning except for the speech-recognition part, which is simulated by a Wizard.

One of our assumptions is that travellers with different amount of domain knowledge require different support by the interface. In our application the users are all travellers, the main differences are travelling frequency and knowledge of the domain, i.e. knowledge of the city the travelling takes place in. Each user category also has their own requirements on the interaction and different combinations of interaction modalities addresses different information needs. If the user, for instance, does not know the name of the actual bus stop but only knows that it is in a certain area or near some other place, filling in a form is not of much help. In these cases a map might be more useful. A map on the other hand requires that the user knows the geographic location of a bus stop. This is not always the case, especially if the user is not familiar with the town. In such cases it might be better to enter the name using for example speech input.

To investigate these assumptions we conducted an experiment where we compared traditional interaction, that is, keyboard and mouse, with multimodal interaction, that is, allowing also speech interaction. The investigation showed that multimodal interaction was more efficient than interaction by traditional means. It also showed that users with weak domain knowledge were better supported by interacting multimodally, than by only keyboard and mouse, and vice versa for users with good domain knowledge.

The investigations also provided implications for further refinement of the multimodal interface. For example, we could see indications that the users needed support through a more elaborated dialogue with the system. We also found that efficiency is not the only important feature for multimodal interaction. The users' subjective experience of the dialogue's co-operativeness and reliability must also be taken into account in the design of the system. This points at investigations into the nature of how multimodal interfaces are to be developed in order to be regarded as usable and co-operative.

Another future research issue involves efficiency. We found that although our measures of efficiency showed that multimodal interaction was more efficient in terms of sequence of actions and zooming in the map, the actual time to perform a task was the same under both conditions. This needs to be further investigated. One hypothesis is that the use of multiple perceptual channels can explain the discrepancy, but it could also be that the speech interface, that is, the Wizard, is too slow.

Distance learning. (Theme 13)
(IDA and IDA)
IDA faculty involved: Sture Hägglund.
TEMA faculty involved: Yvonne Waern.
HMI graduate students: Stefan Holmlid, Eva Ragnemalm
HMI funding

PhD project at IDA:

1. Stefan Holmlid, Q-D-LITE: Design for quality-in-use and learnability. PhD received his PhD in 2002.

   The goal of this project, which is carried out together with industry, was to develop knowledge of qualities-in-use through a focus on users' learning to use software for the quality and efficiency of their work. Also to develop a methodological approach to designing learning environments that drive not only development of the user's knowledge but also the increment of quality-in-use.

In close collaboration with designers of learning environments theories and artefacts were developed and tested. The research partner acts within projects with expert knowledge on methods for formulating and assessing qualities-in-use. Intended deliverables were a model of usability as a quality-in-use, and a method for designing learning environments to increase quality-in-use.

2. Eva Ragnemalm, Student Modelling with a Learning Companion. PhD exam 1999.

When using computers to support learning, one significant problem is how to find out what the student understands and knows with respect to the knowledge the computer system is designed to help him/her to learn (the system's content goal). This analysis of the student is based on the input he/she provides to the system and it is evaluated with respect to the content goals of the system. This process is called student modelling. In essence this problem can be seen as that of bridging a gap between the input to the system and its content goals. It is difficult to study the student's reasoning because it is not directly observable. With respect to the gap, this is a problem of paucity of student input. One possible solution is to have the student work collaboratively with a computer agent, a Learning Companion, and eavesdrop on the emerging dialogue.

This project explores the feasibility of this idea through a series of studies. Examples of naturally occurring collaborative dialogue from two different domains are examined as to their informativeness for a student modelling procedure. Spoken as well as written dialogue is studied. The problem of information extraction from collaborative dialogue is briefly explored through prototyping. Prototyping is also used to study the design of a Learning Companion, whose behaviour is based on observations from the dialogues in the informativeness study.

The project ***Telematics for Distance Learning/Distance Teaching*** at TEMA includes three different activities as follows:

- A co-operation within the European SOCRATES programme. This co-operation aimed at analysing cultural differences in open distance learning. Daniel Pargman participated in this project. It resulted in a book, covering different aspects of this issue.
- An analysis of a course within the DUKOM programme (Distansutbildningskommittén). This analysis was performed as a Master of Arts thesis by Anna-Carin Ramsten.
- A co-operation with IDA, where Eva Ragnemalm has been a HMI student.

Interaction design and intuitive interfaces. (Theme 14)
(IDA and IKP)
IDA faculty involved: Sture Hägglund, David Carr, Jonas Löwgren, Kjell Ohlsson
IKP faculty involved: Sidney Dekker, Martin Helander, Kjell Ohlsson.
HMI graduate students: Mikael Eriksson, Martin Howard, Mikael Kindborg, Mattias Arvola, Jonas Lundberg, Torbjörn Alm, Eve Riimus, Peter Svenmarck.
Industry doctoral students: Pär Carlshamre and Lars Hult.
HMI funding at IKP 1998: 370 KSEK.

Designing software is a knowledge-intensive activity, and the process of designing and implementing the user interface (UI) of a system is no exception. An important part of current user interface design work is the use of design knowledge, for example style guides and guidelines, but also experience and input from previous projects. Previous research has shown such information valuable, yet very hard to access and use. A large part of the problem stems from the overflow and the distance between the designer's work and the information.

In one PhD student project, we address the question of how to provide support for handling this problem. Previous research has shown the feasibility of different intelligent support approaches, especially commenting techniques; an agent evaluate the designers work and provide comments based on formalised design knowledge. We want to assess the usability and value of this approach, and, in case of a positive result, inform future development of such tools.

Our recent work aims at taking the previously obtained empirical results and apply them in a professional setting. The goal is to develop and evaluate a prototype support tool in co-operation with designers. Results from an empirical study was analysed and used to design a series of interviews, and to initiate the conceptual design of an improved support tool. We interviewed designers from three different software development companies in Sweden, investigating their work practice, their use of design knowledge, their needs and their expectations on support tools.

In another PhD student project we are engaged in the study of user programming of social agents. Intuitive programming has the potential to enrich the user experience and work productivity in the same way as graphical user interfaces and direct manipulation techniques have done. Central for this project is the ability to program emotional aspects of mediated human to human communication. Such communication can take place using programmable agents, also called avatars. The agent, representing the user, conducts social activities and manages information exchange between people. A tool such as a programmable agent can help managing large contact networks and information spaces.

PhD projects at IDA:

1. Mikael Ericsson, Supporting design of usable systems - Evaluating agent-based support for handling formalised design knowledge. PhD exam 1999.
2. Mikael Kindborg, Programming of social agents by children. Planned dissertation in 2003.
3. Mattias Arvola, Design Patterns for Grading of Privacy. Arvola received his licentiate degree in January, 2003.
4. Jonas Lundberg, Interaction Design of Networked News Media Services.
5. Pär Carlshamre, A usability perspective on requirements engineering. PhD exam 2002.
6. Lars Hult: Publika informationstjänster. PhD exam, March 2003.

PhD projects at IKP:

1. Torbjörn Alm, Information Processing and Display Design in Flight Displays.
2. Martin Howard, Visualization of Workflow. PhD exam 2002.
3. Eve Riimus, Cognitive Aspects on Colour Display Design. Currently a PhD student at Department of Psychology, Stockholm University.
4. Peter Svenmarck, Local Co-ordination in Dynamic Environments. PhD exam 2001.

Intelligent transportation. (Theme 15)
(IKP; Uppsala Universitet, Department of Computer Science)
There are strong commercial interest in the area of intelligent transportation. Autoliv, BT Industries, Volvo Lastvagnar, Volvo Personvagnar, SAAB Automobile, SAAB Aircraft, Ericsson/SAAB Avionics, Scania, ABB are good examples. These companies take a great interest in the design of new environments for information handling that will be integrated in the vehicle or aircraft. In addition, several Swedish companies sell training services in aviation. One example is SAS Flight Academy, which runs a 24-hour operation of seventeen full scale dynamic flight simulators. They receive flight crews from the entire world, who fly to Arlanda to do their annual certification check-up. Transportation is an area of tremendous Swedish expertise – a true hallmark of distinction. Few other countries can boast of having two car manufacturers, two truck manufacturers, and one manufacturer of aeroplanes – each requiring a sophisticated infrastructure of suppliers and engineering services. It is of strategic importance to HMI to serve the transportation industry with Human Factors experts. HMI will work with ECSEL, ENDREA, FOA and VTI on the design of intelligent transportation aids.

Operator environments like drivers´, pilots´ etc. are subjected to investigation within the area of intelligent transportation. Thus, we have students working with trucks, cars, cockpits, locomotion driver cabins, and two forthcoming projects on bridge environments and cabins of ”Forrest harvesters”, respectively (together with NADA and CAS). In total about 20 persons at IKP are involved in this research theme.

IKP faculty involved: Håkan Alm, Sidney Dekker, Jörgen Eklund, Claes von Hofsten, Erik Hollnagel, Martin Helander, Eva Lovén, Kjell Ohlsson, Erland Svensson, Gunnela Westlander.
HMI graduate students: Lisbeth Almén, Martin Castor, Cecilia Chressman, Margareta Lützhöft, Staffan Magnusson, Kaisa Nolimo, Arne Nåbo, Björn Peters, Nalini Suparamanian, Jörgen Trued, Trent Victor, Katja Vogel.
HMI funding: Annually about 400´ until 2000.
PhD projects:
1. Lisbeth Almén, How to minimize driver distraction and to have control over driver mental workload. Financed by Saab Automobile.
2. Martin Castor, Unarmed vehicle-operator environments. Supported by FFA and FOI.
3. Cecilia Chressman, Knowledge transfer. Supported by National Railway Administration.
4. Margareta Lützhöft, Marine Automation and safety. Supported by Vinnova and Sjöfartsverket.
5. Björn Peters, Handicap adaptation of vehicles. Supported by VTI and Swedish Road and Transportation Board. Licentiate in 2002.

6. Arne Nåbo, Vehicle Ergonomics. Supported by Saab Automobile.
7. (Kajsa Nolimo), Methodology for analysis of human-machine systems. Supported by BT Industries. Licentiate in 2001.
8. Staffan Magnusson, Performance and SA in flight simulation. Supported by FOI.
9. (Jörgen Trued), Cognitive Cockpit. Supported by FOI.
10. Trent Victor, Driver-support by recognition of visual behaviour. Supported by Vinnova and Volvo Technology.
11. Katja Vogel, Vehicle ergonomics. Supported by VTI. Received her PhD in 2002.

UU faculty involved: Bengt Sandblad, Anders Jansson
HMI Graduate students: Eva Olsson
PhD projects:
1. Eva Olsson: Decision making in transportation systems and consequences for user interface design.

2.3 Future plans for HMI Graduate School

Since the overall impression of the last five years is very prosperous with respect to achievements, contacts and external financing of graduate students as well as research projects, the ambition is to make sincere efforts in order to preserve the organization and even to augment and further develop the HMI education concept. Despite the recession, that negatively affected the outcome of research applications and external funding, we are quite optimistic about the necessary investments in HMI-knowledge in a number of domains vital for Swedish competitiveness. When the economy is changing direction we will be well prepared with a large number of well educated HMI-experts ready to enhance Swedish industrial potential. We will also continue the recruitment of internationally recognized scholars and continue to be engaged in international research programs and especially the 6th framework programme. HMI researchers are taking part in several Network of Excellence, and a few integrated projects.

Contacts will be enlarged with other HMI-research groups in, for instance, Uppsala and Chalmers. An application to the Swedish Road and Transportation Board will be finalised, with the expectation to receive future economic support to the administration and enlargement of HMI Graduate School. Also contact with a graduate school in Tampere, Finland, with a partly overlapping research agenda, has been established. In this context applications to NORFA will be delivered, with an ambition to finance a Nordic Summer School within the HMI area.

One goal is also to find additional support for HMI related research from other potential sources. One of these is a recently planned Institute for Humane Technology (IHT) in Bollnäs/Högskolan i Gävle, with a scope on HMI for handicap and health care under the motto "Design for All".

Another long-term goal is to widening the recruitment base for graduate studies within the HMI field by development of attractive undergraduate HMI courses.

2.4 Short-term and long-term relevance of the research programme for industry and society at large

2.4.1 Short-term relevance: The HMI programme will contribute to:

- An increased awareness of HMI related problems and solutions, daily experienced by Swedish industries.
- Establishment of co-operative projects.
- Initiation of state-of –the art projects.
- Participation in European projects as an academic partner.
- Provide industry and society in large with knowledge within the HMI area, disseminated by means of scientific papers, open seminars, presentations in popular/professional journals, workshops and conferences etc.
- Integration of HMI knowledge into other SSF supported graduate schools.

Long-term relevance: The HMI programme will contribute to:
- Increased utilisation of HMI relevant methods in product and system design.
- Employment of HMI experts in all kind of large-scale projects.
- Enhancement of general HMI competence in society in large.
- The establishment of a large population of internationally demanded HMI experts.
- A substantial impact on undergraduate education, with more industry relevant topics.

- A world wide top ranking of HMI education.
- A better competitiveness of Swedish industry.

2.5 Interdisciplinarity

Both research projects and courses have become more interdisciplinary during the course of the planned HMI activities. An increased amount of interdisciplinary HMI projects is predicted, as a result of more communication and mutual activities, as well as identification of common problems. Social encounters are still important and must be maintained in a more distributed environment.

2.6 The programme's own routines for quality assessment.

Both an Academic Advisory Board and an Industrial Advisory Board have been established, with the explicit purpose to improve the quality and relevance of the programme.

Considering the increased awareness of the importance of self evaluation Martin Helander has been appointed as Quality Officer by the HMI board and in addition elected as an associate member of the Academic Advisory Board.

All courses are regularly evaluated by both teachers and students. All students have at least two supervisors. All students are entitled to give seminars about their research topics. Feedback on course plans are sometimes received by professors at foreign universities.

Graduate Student Fora have been established both in Linköping and Stockholm.

The HMI board also demands quarterly status reports.

Two self assessment questionnaires were distributed to HMI supervisors during spring 1999.

Students will also be encouraged to take part in exchange programs, and accordingly a few stipends will be elicit by the HMI board.

Students are subjected to an annual evaluation of their performance, and are indeed jeopardizing their position if they don't meet HMI requirements.

3 The graduate training of the programme

An important goal of HMI has been to build up a strong graduate school, combining the resources and competencies of the two centres in Stockholm and Linköping. This work has been given high priority during the first period of the programme and has served as a unifying endeavour among the participating departments. A particular challenge has been to design the programme in such a way that it helps students to reach the Ph.D. level in 4 years. We haven't reach that goal yet. The average time for graduation seems to be longer, but shorter in comparison to the situation before the HMI Graduate School. Swedish industry, with bearing on HMI issues, has gone trough a severe transition with downsizing, lean production, and economic strangulation during the last few years. Suddenly the terms for our graduate students have changed drastically. Hence, inevitable delayed examinations.

The graduate school committee, with representatives from both sites (see section 5), has worked with development of the curriculum and organisation of the school, and has met (face-to-face or via tele-conferencing)about eight times/year during the period Sept. 1997- Jan. 2000. In particular, the committee has worked with admission of students, rules for graduation, proposals for new courses, principles for evaluation of courses, and planning of information events and workshops for the graduate students. During 2001 the number of meetings were slightly reduced.

The positive experiences of the graduate training from the first two years have confirmed the long-standing need for an organised HMI graduate education in Sweden, both from an industrial and academic perspective. Further, the successful recruitment so far shows that there is a strong basis for HMI graduate education in terms of qualified Ph.D. candidates.

3.1 Recruitment

The number of graduate students in the programme has reached beyond 60 full-time students. Of these, about 25 had full or partial HMI funding and the rest of the students are financed by other sources. A peak of more than 70 students was reached in 2001. The budget til 2000 allowed financing of 25 part time students or 8 full-time students. About 30% of the students are females (a distribution that is also reflected among faculty members), which is fairly good with respect to traditionally male dominated departments. We are still striving for a better gender distribution.

Two major periods of recruitment have taken place through advertising for new Ph.D. candidates. The first recruitment (in December 1997), attracted 80 applicants, whereas the second (in November 1998) attracted 40 applicants. The HMI positions were advertised in major national newspapers (Dagens Nyheter, Svenska Dagbladet, Östgöta Correspondenten) as well as in professional journals (Ny Teknik) and on the Internet.

To apply, a candidate should submit an application form, transcripts of grades from gymnasium (high school) and university, three letters of recommendation, and a single page typed letter, where the student explains his/her HMI interests and goals for graduate studies. A basic requirement for admission to the HMI School has been to have a Masters degree or corresponding qualifications.

Reflecting the interdisciplinary nature of HMI, there was a broad spectrum of competencies among the applicants, representing degrees in engineering, behavioural and work sciences, communication and design. Because of the strong competition, those who were admitted generally had previous HMI experience (either professional or academic) apart from excellent academic records. The recruitment of HMI Graduate Students continuous, but is conducted on a more individual basis, with requirements of substantial external financial support.

3.2 Affiliation

In accordance with the programme plan's goals, a number of Ph.D. students with external funding have been affiliated to the programme. These students have access to courses and supervision within the programme, but their salaries are paid by "doktorandtjänst", financed either by research councils (HSFR, NUTEK, KFB), by local university- or department-funded Ph.D. positions or by industry. Some of the affiliated students have already reached an advanced level of study and a few graduated during 1997-1999 (see section 3.8 below). The number of graduations will continue to grow.

To apply for affiliation, a student writes a letter to the graduate school committee, describing their HMI interest and goals for graduate work, as well as the results so far of their research.

Appendix A.8 contains a complete list of HMI students in December 2001, with information about their department, advisors, date of admission and the research project in which they are engaged.

3.3 Organisation of graduate training

There has been an effort within HMI to create a graduate training programme, which both guarantees a high quality, and is compatible with requirements at different departments. Every student is registered at their home department (in subjects such as Computer Science, Human-Computer Interaction, Work Science, and Communication) and is simultaneously connected to the HMI School, which thereby provides an overall educational framework. Upon graduation, the students will acquire a HMI diploma in addition to their ordinary degree.

3.4 Curriculum

The organisation of the graduate school in terms of requirements for Ph.D. and licentiate levels, has been established through the work in the graduate school committee. The development of common education standards for such an interdisciplinary group of students is a great challenge, especially with respect to methodological and technical skills. The rules and guidelines for courses and other requirements established so far will therefore need continuous revision and updating.

There are two different HMI degrees, licentiate degree (comprising 2 years of full-time study) and Ph.D. degree (4 years of full-time study). At most departments, 60 course credits in total are required for a Ph.D degree, and 40 credits for a licentiate degree.

Within this framework, the course requirement for HMI students is to have 30 credits of HMI courses, 15 of which should be methodology courses and 15 credits thematic courses. This holds both for the licentiate level and the doctoral level, that is, a student who wishes to receive a HMI diploma already at the licentiate level must have completed his/her HMI course requirements at that level.

The model described here gives room for a student to conform to local course requirements at the different departments at the same time as the requirements for a HMI diploma.

Apart from the course requirements, a HMI student must complete a thesis about a relevant HMI-related topic.

3.5 Study plan and research plan

A graduate student within HMI must submit a study plan within three months of admission. The study plan specifies the date of admission, the advisors, fulfilled course credits, and planned courses. Also, the plan specifies how far the student has reached in their work towards a Ph.D. (0%, 30%, 50% or 80%). The study plan should be updated each year and is signed by the advisors.

Within the first year, students should also submit a plan for their thesis work, including an overview of the theoretical and methodological framework as well as a specification of the planned studies.

3.6 Courses

A large number of new HMI courses have been developed, and this process is on-going. Certain courses have been adapted from courses previously given within the departments, which made it possible to start the program with a sufficient collection of courses for the first year.

A particularly important goal has been to establish a common nucleus of methodology courses, fulfilling the need for a solid methodological knowledge for all HMI students, whereas the thematic courses give room for each student's own research interest, as well as the research profiles of the respective department or local HMI centre.

There are three levels of courses in the HMI program. 500-courses are annually recurring courses which may be mandatory at some departments; 600-courses are given regularly (usually bi-annually) and represent courses that are of general interest to HMI. Some of these courses are also mandatory for some of the students, depending on specialization. 700-courses are courses about special topics, and may be taught only once. Typically these are research seminars conducted by a faculty member or a visiting scientist, who has a special interest or competence in the particular topic.

400-courses are advanced undergraduate courses that are adapted for graduate students.

3.7 List of new courses developed for the HMI programme

Examples of new courses (usually 5 credits) developed are as follows:

Stockholm

HMI 652	Design for Human-Machine Interaction, NADA	Fall, 1997
HMI 653	Computer-Supported Cooperative Work, NADA	Spring, 1998
HMI 751	Activity Theory, NADA	Fall, 1997
HMI 651	Research Methods in Human-Computer Interaction, NADA	Fall, 1998 + spring 1999
HMI 661	Cognition, Learning, Instruction and Computers, DSV	Fall, 1998
HMI 662	Intelligent Interfaces, DSV	
HMI 752	Computer support for the writing process	
HMI 651b	Research methods in human-computer interaction; continuation.	
HMI 624	Seminar in user interface software engineering	
HMI 754	IT and Ethics.	
HMI 421	Användbarhetsorienterad systemutveckling. (Undergraduate level)	
HMI 423	Human Computer Interaction. (Undergraduate level)	
HMI 753	Social studies of work and technology	Fall, 2002
HMI 652	Design for HMI.	Fall, 1999
HMI 656	Theoretical Perspectives in Human-Computer Interaction	Spring, 2002
HMI 657	Programming for Non-Computer Scientists – for research students from human and social sciences	Spring, 2002
HMI 663	HMI Aspects of Ubiquitous Computing	Fall, 2002
HMI 721	Qualitative Approaches till HCI	Fall, 2002
HMI 753	Social Studies of Work and Technology	Fall, 2002

Linköping

HMI 603	Organization Management and Work Physiology, IKP	Spring, 1999
HMI 623	Fundamentals in Human-Computer Interaction, IDA	Fall, 1998
HMI 622	Seminar in User Interface Software Engineering, IDA	Spring, 1999
HMI 721	Qualitative Approaches to HCI, IDA	Spring, 1999
HMI 722	Cognitive Modeling, IDA	Spring, 1999
HMI 611	Humanistic Information Technology, Tema K	Fall, 1998
	An introduction to HMI Graduate School	Fall, 1999
HMI 710	Learning, Conversation and Information Technology, Tema K	Fall, 1997
HMI 605	Human Reliability, IKP	Fall, 1998
HMI 705	Cognition and Creativity in Design Work	Fall 2000
HMI 501	Human Performance	Fall, 2001
HMI 503	Human Factors Research Methodology and Field Experimentation	Fall, 2001
HMI 625	Semiotics	Fall, 201
HMI 702	Innovative Visualization Design	Fall, 2001
	"Aspects of Scientific Writing"	Fall, 2001
HMI 504	Experimental Design and Statistical Methods	Spring 1999;Spring, 2002
HMI 721	Qualitative approaches to HCI	Spring 1999
HMI 601	Biomechanics and Work Physiology	Spring, 2002
HMI 602	Cognitive Systems Engineering,	Fall, 2002
HMI 626	Cognition, Learning and IT	Fall, 2002
HMI 723	Play and Designing Media for Participation.	Fall, 2002
HMI 758	Current Topics in Interaction Devices, Techniques and performance and modelling	Fall, 2002
HMI 501	Human information processing.	Fall, 2002

There are also a number of previously given courses that have been adapted and included in the HMI curriculum, as well as undergraduate courses relevant for HMI graduate students. Appendix D presents a list of all courses given during 1997- spring 2003.

3.8 Examinations

Currently following students have graduated within the HMI programme (A more comprehensive list is to be found in Appendix A.6 and A.7):

Ph.D. degree:

Mikael Eriksson, Dept of Computer and Information Sciences, Linköping University.
Henrik Artman, Dept. of Communication Studies, Linköping University
Olle Bälter, NADA, KTH, Stockholm
Eva Ragnemalm, Dept of Computer and Information Sciences, Linköping University.
Hee Cheol Kim, DSV/ NADA, KTH, Stockholm
Fabian von Schéele, DSV/NADA, KTH, Stockholm
Peter Svenmark, Dept. of Mechanical Engineering, Linköping University
Arne Worm, Dept. of Mechanical Engineering, Linköping University
Daniel Pargman, Dept. of Communication Studies, Linköping University
Rego Granlund, Dept. of Computer and Information Sciences, Linköping University.
Stefan Holmlid, Dept. of Computer and Information Sciences, Linköping University.
Martin Howard, Dept. of Mechanical Engineering, Linköping University
Sirkku-Männikkö Barbitui, DSV/NADA, KTH, Stockholm
Katja Vogel, Dept. of Mechanical Engineering, Linköping University
Martin Svensson, DSV/ NADA, KTH, Stockholm
Rickard Domeij, Stockholms universitet, Stockholm

Licentiate degree:

Kai-Mikael Jää-Aro, NADA, KTH, Stockholm
Peter Svenmarck, Dept of Industrial Ergonomics, Linköping University
Arne Worm, Dept. of Industrial Ergonomics, Linköping University
Dag Caldenfors, Dept. of Mechanical Engineering, Linköping University
Kristina Groth, NADA, KTH, Stockholm
Klas Karlgren, Dept. of Computer and Systems Sciences, Stockholm University/KTH

Ann Fatton, DSV/ NADA, KTH, Stockholm
Christina Groth, NADA, KTH, Stockholm
Martin Howard, Dept. of Computer and Information Sciences, Linköping University.
Jens Alfredson, Dept. of Mechanical Engineering, Linköping University
Annika Flycht-Eriksson, Dept. of Computer and Information Sciences, Linköping University.
Eva Olsson, Uppsala University
Lars Oestericher, DSV/ NADA, KTH, Stockholm
Eva Rydberg-Fåhraeus, DSV/ KTH, Stockholm
Anders Hedman, NADA, KTH, Stockholm
Ola Knutsson, NADA, KTH, Stockholm
Fabian von Schéele, DSV/ NADA, KTH, Stockholm
Kaisa Nolimo Sohlman, Dept. of Mechanical Engineering, Linköping University
Björn Peters, Dept. of Mechanical Engineering, Linköping University
Henry Rodriguez, NADA, KTH, Stockholm
Jacob Tholander, DSV/ NADA, KTH, Stockholm
Martin Svensson, DSV/ NADA, KTH, Stockholm
Fredrik Winberg, NADA, KTH, Stockholm
Fredrik Elg, Department of Communication Studies, Linköping University
Maria Normark, NADA, KTH, Stockholm
Marie-Louise Rinnman, DSV/NADA, KTH, Stockholm
Fredrik Rutz, DSV/NADA, KTH, Stockholm
Nalini Suparamaniam, Dept. of Mechanical Engineering, Linköping University
Matias Arvola, Dept. of Computer and Information Sciences, Linköping University.
Pernilla Qvarfordt, Dept. of Computer and Information Sciences, Linköping University.

3.9 Course exchange between Stockholm and Linköping

The courses given in Linköping and Stockholm have partly different focus due to the variations in research profile and teacher competencies. Against this background, it is important that students have access not only to the courses at the home centre, but also are encouraged to take courses at the other centre. To this end, HMI courses are routinely scheduled on different days in Linköping and Stockholm. Also, the students' travel to the other centre has been financially supported through partial refunding of ticket fares.

The Board of HMI decided at an early stage to support distance education through telecommunication between the two sites. So far, the technical obstacles have been partly eliminated, but no full courses have yet been transmitted.

3.10 Summer schools

The HMI Board has decided to support summer schools, as they can unite students from different projects in focused interaction and give them opportunities to meet international scholars. A summer school on Interface Design was given at KTH, Stockholm, in June, 1999. An industrial summer school was also given in Vadstena in 2000. Students are also encouraged to take part in other summer schools with HMI orientation.

3.11 Supervision

To secure an interdisciplinary basis for the Ph.D. students' work, there is a goal within HMI that every student has an advisory committee consisting of a main advisor and at least one additional advisor. As a minimum, it is recommended to have two advisors while working towards the licentiate degree, and a third advisor during the rest of the period until the Ph.D. level. This goal has been fulfilled to a significant extent, though some recently admitted students still have only a main advisor.

With few exceptions, the graduate students in the programme have their main advisor within the programme. Few students affiliated to the HMI programme have a main advisor at their department outside HMI[1]; in this case the student is connected to one of the research projects in the programme, and thus has a second advisor within HMI.

[1] The following departments outside the HMI programme each have one affiliated HMI student: Dept. of Psychology, Dept. of Linguistics, and Dept. of Ethnology, Stockholm University; Dept. of Information Technology, and Dept. of Information Science, Uppsala University; and Department of Economic Psychology, Stockholm School of Economics, and Division of Engineeering Psychology, Luleå University of Technology.

The advisory committee for a student may change during the period of study, reflecting the fact that the student's work and his/her need for help and guidance may develop in new directions.

3.12 Research

An important aspect of HMI is that all students carry out their Ph.D. research within one of the research projects in the programme. This gives access to qualified advisement and provides a rich and relevant context for their work, including other students, industrial contacts and international collaborations.

Some of the projects have been established through the HMI programme, whereas others have independent funding but are compatible with HMI goals and the research themes in the programme plan.

3.13 The impact of HMI graduate education so far

The HMI graduate school has already implied a significant improvement of the graduate studies within the participating departments. There has been a substantial increase in the number and quality of graduate courses in HMI, as well as increased access to relevant research contacts for the graduate students. Furthermore, the increased number of Ph. D. students and the unifying educational framework has created many synergies and thereby strengthened HMI research at the two centres.

4 Collaborations

4.1 Scientific collaboration between different disciplines and departments

Collaboration has increased a lot between the departments involved in HMI, but there is also a lot to improve and gain. For instance, administrative routines could be considerably facilitated. Generic incentives within the academia are usually lacking, although Linköping University has been considered as a forerunner of interdisciplinary research. Usually intra disciplinary work gains attention and is formally rewarded, whereas interdisciplinary work over faculty barriers might be at stake. Despite these obstacles the HMI initiative has been a success so far. Increased collaboration is also manifested in jointly publications over disciplines.

4.2 International collaboration

4.2.1 International project collaboration

A large number of international projects is ongoing and the number of projects is predicted to increase. American, English, German, French, Spanish, Dutch and Australian universities are involved in many of these projects. For instance, DSV runs a collaborative project together with Stanford University (Terry Winograd, CS dept.) on design of interactive spaces. Also Nils Dahlbäck at IDA is collaborating with researchers at Stanford University.

4.2.2 European collaboration within the 4:th, 5:th and the 6:th framework programme

HMI researchers have been engaged in few European funded research projects. Examples of this is CID as a partner in two EU projects:

- eRENA, Electronic Arenas for Art, Culture, Performance and Entertainment, where CID co-ordinates researchers from computer science, social science and art institutions in Britain, Germany and Switzerland, 1997-2000.
- KidStory, Collaborative Storytelling for Children - with Children, partner with Univ. of Nottingham (co-ordinator), SICS and two elementary schools, Rågsvedsskolan and Albany Infant School, 1998-2001.
- InterLiving - IST Disappearing Computer project. CID coordinates researchers from Université Paris Sud and INRIA, Paris, 2001-2003.
- SHAPE - IST Disappearing Computer project. CID coordinates researchers from Universities of Limerick and Nottingham and King’s College London, 2001-2003.
- Playground and Weblabs projects at DSV
- FEEL IST DC project at DSV.
- IKP has been engaged in several European projects within the Telematics area (directed to SME's) and Cockpit design. A number of researchers have also been involved in COST-projects, which will continue in some cases. At present researchers from IKP collaborates with several consortia funded by the European Commission, for instance, the Vintech II project, involving National Aerospace Laboratories in Amsterdam; British Aerospace´s Human Factors group at Sowerby, Bristol; DERA, Farnborough; ISPRA, Varese;

Kemi/Tornio Polytechnics; Risölaboratorierna, Denmark; Technion, Haifa, Israel; University of Oulo; University of Helsinki; University of Bergen; Qinetic, Bedford; University of Aarhus; University of Poznan etc.

- IDA participates in an EC-funded project, ELIN (The Electronic News Inititative) with collaboration with Loria, Nancy, Universidad Politecnica de Catalunya, Barcelona; Forchung Zentrum Informatik, Universität Karlsruhe; Fraunhofer Institute, Darmstadt; and three industrial partners.
- Presently, IKP and IDA take part in several European applications.

4.2.3 Student exchange

Considering the short existence of HMI, student exchange has not been prioritised yet. As a recommendation students are invited to spend some time at a foreign university after the completion of their licentiate thesis. However, despite possibilities to receive stipends etc. few of our students have taken the opportunity to spend one or two semesters at a foreign university, while we have hosted a large number of foreign students, primarily at the undergraduate level.

Universities and research institutes listed below are proposed for student and faculty exchange. We have formal Memorandum of Agreement with some of them.

Institution	**Area of research**
Aachen Technical University	Industrial HCI and Human Factors
Carnegie Mellon University	Cognitive Modelling
Eindhoven University	Human Factors Engineering
King's College London	Collaborative Environments
Interval Research	Media Interactivity
Lancaster University	CSCW
MIT, Media Lab and Mech. Eng.	Media Development and Design Engineering
Nanyang University, Singapore	Human Factors Engineering
NASA Ames	Civil Aviation
NLR, Amsterdam	Civil Aviation
Open University	Distance Learning
San José State University	Human Factors Engineering
Stanford University	Tele-education
Sussex University	Multimedia, Process Control
University of Aarhus	Participatory Design
University of Colorado, Boulder	Cognitive Science, HCI
University of Columbus, Ohio	Cognitive System Engineering
University of Illinois	Cognitive Engineering, Display Design
University of Limerick	HCI, Virtual Environments
University of Maryland	HCI, Computers in Education
University of Nottingham	Virtual Collaboration
University of Paris Sud	HCI, User Oriented Design
University of Nottingham	Virtual Collaboration
University of Valencienne	Automation, Process Management
University of Washington	HCI Programming Tools
Virginia Tech. CS and Ind. Eng. Depts.	HCI, Human Factors Engineering
Wright Patterson Air Force Base	Human Factors in Aviation
Wright State University, Dayton	Human Factors in Aviation
Xerox PARC	HCI

4.2.4 Shorter visits

Some of HMI´s faculty members have been visiting universities abroad for shorter periods of time during the last few years. For instance, Martin Helander spent half a year visit in Hong Kong. Sidney Dekker spent the first semester 2002 at Nanyang University, Department of Mechanical Engineering. Erik Hollnagel has spent several months during the last years at Japanese universities.

4.2.5 International networks

HMI researchers are engaged in a large number of professional networks, which arrange international conferences, symposia, workshops and summer schools. HMI researchers had been responsible (and co-organizers) for several of these events.

4.2.6 International guest researchers

International guest researchers are regularly invited to the departments in question. Thus, our own research environments are enriched by foreign perspectives on HMI. At the same time we are anxious to present the Swedish (and Scandinavian) HMI research to foreign guests.

4.3 Co-operation between different universities

We have a co-operation for instance, with University of Lund (CERTEC), Uppsala University (CMD), Luleå University of Technology (Engineering Psychology). A large number of students have participated in our courses, which are open to other universities as well.

4.4 Co-operation with other SSF programmes

PCC (Personal Computing and Communication)

The motto of this program is ”Mobile multimedia services for the same cost as present stationary telephony”. HMI meets PCC is a large project, where researchers from HMI and PCC collaborate with several Ph D projects within a well-defined area. (see, section 2.2.3)

CAS (Centre for Autonomous Systems)

In the home of the future, less time than today will be spent on routine household work, such as cleaning, ironing, watering of plants etc. Further, an increasing number of people will need home assistance due to disability problems in mobility. In such contexts, an electronic Home Assistant, or a service robot, would be both useful and interesting to employ. A co-operation between HMI and CAS has been going on since 1998 on these issues. The project includes investigation of different forms of interaction with a service robot. Within CAS research is being devoted to the investigation of how robots can be instructed through visual means (gestures) and speech recognition. Within HMI we have complemented this research through studies on how users interact with robots in realistic situations, bringing an interdisciplinary perspective to the various phases of the design process.

Interactive Institute

The intention of this newly started SSF initiative is to provide a ”media laboratory” for creative co-operation between researchers, artists and students from various disciplines in projects pointing towards future use of interactive media technology. We expect that several research projects at the ”Institute” will explore issues of common interest. This includes research on Smart Products, Interactive Media and Personal and Group Communication areas. A close co-operation between HMI and the ”Institute” will provide synergetic effects for both parties and will focus on usability aspects of creative information technology.

ECSEL (Excellence Centre in Computer Science and Systems Engineering)

The original ECSEL proposal included an area called ”Engineering Interfaces”, with the intention to cover HMI aspects of systems engineering. This area was omitted in the budget cut, but retained as a potential area for co-operation with HMI. Examples are interfaces for:

- Manoeuvring (pilot/driver interfaces as well as consumer appliances,
- Engineered products and services,
- Simulated realities (for command and control, prototyping and training).

Of particular interest is the co-operation between HMI and ECSEL in the area of reconfigureable consumer devices. Research topics include the possibility to redefine functionality and services by remote software update and reconfiguration, as well as design of design of intuitive user interfaces for small displays.

In addition the STEM board of ECSEL, has taken a decision to promote co-operation with HMI in the area of usability engineering. Research in this area includes the study of usability-driven development methods for designing user-friendly products and systems, aiming for a competitive edge on the market. Our view emphasise the design oriented nature of the software development work.

ENDREA (Engineering Design and Research Agenda)

This program deals with engineering design. One important collaboration area considers investigations of how designers go about designing. The purpose is to understand how engineering aids, as used in CAM and CIM, could be designed so that they can effectively support the design process. There is presently one collaborative project concerning the development of Design History, a tool for recording design decisions that can be accessed in retrospect to understand past design decisions. The Defence Material Administration (FMV) is sponsoring this

project with 700 SEK per year during three years. HMI is also planning for a co-operation regarding Virtual Reality in Product Design with ENDREA and Department of Mechanical Engineering at University of Oulo, that probably will the main contractor of a European project.

Energy Systems
There is a joint interest in the development of equipment for process control in power plants. His interest is shared by ABB Industrial Systems, which may support research in this area. HMI is primarily interested in the representation of complex systems, which will enhance the operators' understanding and possibilities for effective control. The project has not started yet.

VISIT (Visual Information Technology)
During a period HMI had a joint interest in design of visual information. Areas for research include:

- Principles for visualization of complex information in a format that is easy to understand for the user. For example, is it possible to integrate several images into one by using principles of perceptual compatibility and cognitive compatibility?
- Investigation of the effect of low bandwidth presentation of visual information. To what extent does degraded colour rendering and resolution affect perception of visual information?

4.5 Co-operation with industry

Following industrial partners have been cooperating with the HMI Graduate School:
ABB, BT Industries, Celsius Tech, DataDoktorn, EMW, Möndal, Enator, Ericsson Infocom, Ericsson Radio, Ericsson/SAAB Avionics, FFV, FOA, FMV, Föreningssparbanken, Hjälpmedelsinstitutet, Luftfartsinspektionen, Nokia Home Communications, NOMOS, No Picnic, Industrial Designers, Pharmacia Upjohn, Posten, RFV, RSV, SAAB Aerospace, SAAB Automobile, SAAB Training Systems, SAS Flight Academy, SICS, Skolverket, SRV, Sveriges Radio, TCO, Telia Nättjänster, Telia Research, UI Design, Vattenfall, Volvo TU (Technology), Östgötacorrespondenten. We are also working together with a number of industries abroad in collaborative projects. Additionally we have a large number of Master Theses financed by industry.

5 The organization and management of the programme

The HMI graduate school is an umbrella organisation for interdisciplinary research and education in the area of human-machine interaction, with a board of directors subordinated to the Board of LiTH (styrelsen för Linköpings tekniska högskola). The president of Linköping University (after considering input from KTH/SU), appoints the HMI board of directors, which initially consisted of following members:
Hans Ahlinder, Ex vice president of SAAB Avionics, Linköping. *Chair*.
Birgitta Frejhagen, President of InfoKomp and member of the IT Commission, Stockholm.
Staffan Liljegren, Ericsson Telecom/Medialab, Stockholm.
Hans Robertsson, President of SAAB Training Systems, Huskvarna.
Sture Hägglund, Professor at LiTH.
Carl Gustav Jansson, Professor at Stockholm University/KTH.
Martin Helander, Professor at LiTH, ex officio, non-voting.
Kjell Ohlsson, Professor at LitH, Director HMI, ex officio, non-voting.
Kerstin Severinson Eklundh, Professor at KTH, Associate Director HMI, ex officio, n-v.

Presently the board of directors consists of following members:

Surname	*Prename*	*Title*	*Program-function*	*University/ Company*	*Telephone*	*E-mail address*
Karlström	Urban	GD	President	VTI	013-204210	urban.karlström@vti.se
Ohlsson	Kjell	Prof	Program Director	LiU/IKP	013-281687	kjeoh@ikp.liu.se
Severinson Eklundh	Kerstin	Prof	Vice Program Director	KTH/ NADA	08-7909103	kse@nada.kth.se
Hägglund	Sture	Prof	Board member	LiU/IDA	013-281431	sth@ida.liu.se
Jansson	Carl-Gustaf	Prof	Board member	SU/DSV	08-161605	calle@dsv.su.se
Frejhagen	Birgitta	CEO	Board member	Information & Kompetens AB	08-7258701	Birgitta.frejhagen@infokomp.se

The HMI board of directors has the overall responsibility for the organization of HMI. All decisions involving costs and resource allocation are taken by the HMI board, but following decisions are usually delegated:

- Acceptance of graduate students. The decision to accept a student is made by the Committee for Graduate Studies after hearing the intended professor/research group. Hence, there is a double acceptance of students: to HMI and to the intended program.
- Decisions about courses leading to a compensation to the university department that arranged the course. This decision is taken by the Committee for Graduate Studies.

HMI is managed by a Program Director, Kjell Ohlsson, who also is a member of the HMI board, and affiliated both to IKP and IDA. The role of the program director is to glue the different researchers and disciplines together and in close co-operation with the chair of the HMI board approach Swedish industry for mutual benefits of the advancement of the HMI graduate school. The Associate Program Director is Kerstin Severinson Eklundh at NADA, KTH. HMI has its central administration consisting of the Program Director and a secretary at IKP, LiTH.

The Executive Committee had the operative responsibility for the HMI graduate school in general and following tasks in particular:

- Preparation of the recruitment of graduate students and interviews.
- Jointly with the Program Director prepare decisions to be targeted at board meetings.
- Scrutinize initiatives and alternatives for collaboration and cohesiveness.
- Consider proposals for collaboration generated by other universities.
- Jointly with the Program Director and the HMI board approach HMI mecenates.

Initially there was two local committees for co-ordination of HMI-research; one for Linköping and one for Stockholm. Together these committees constituted the Executive Committee; that consisted of following members:

Linköping Research Committee
Martin Helander, IKP
Sture Hägglund, IDA
Kjell Ohlsson, IKP/IDA
Yvonne Waern, Tema

Stockholm Research Committee
Kerstin Severinson Eklundh, NADA
Carl Gustav Jansson, DSV/NADA
Yngve Sundblad, NADA

The Committee for Graduate Studies was jointly organized by Linköping and Stockholm. The purpose was to accept graduate students, organize course work, and determine rules for graduation (see also URL:

www.ida.liu.se/hmi). These rules and procedures have to be updated at regular intervals. Additional tasks are to propose new courses, supervise the quality and the cohesion of the graduate study program, finance graduate courses, which are given by external or internal teachers, and consider feedback from course evaluations performed by the students and teachers. The Committee for Graduate Studies consisted of following members:

Linköping	**Stockholm**
Nils Dahlbäck. IDA	Kerstin Severinson Eklundh (Chair),NADA
Martin Helander, IKP	Carl Gustav Jansson, DSV/NADA
Lena Strömbäck (local director of studies), IDA	Ann Lantz (local director of studies), NADA

In order to assure an internationally high academic standard an Academic Advisory Board was appointed by the HMI board. Members of the Academic Advisory Board will evaluate the program with respect to:

- Viability of the research program and individual research studies.
- Graduate curriculum.
- Procedures for accepting students to the program and advising students.

There are currently 3 members of the Academic Advisory Board. They are professors and each of them belongs to university departments with a well established graduate education program similar to HMI. Members are appointed for a time period of 3 years. They are invited to Sweden once a year to comment on the program and the progress during the last year. The current members are:
Dr. Liam Bannon, Professor, ICSE Dept., University of Limerick.
Dr. Martin Helander, Professor, Dept. of Mechanical Engineering, Nanyang University, Singapore.
Dr. Mary Beth Rosson, Associate professor, Computer Science Department, Virginia Tech, USA.
Initially also Dr. – Ing. Holger Luczak, Professor, Department of Mechanical Engineering, Aachen, Germany, was appointed as a member of the academic advisory board.

An Industrial Advisory Board was also appointed by the HMI board with the intention to:
- increase funding of industry sponsored graduate students,
- facilitate initiation of industry relevant R&D projects,
- magnify HMI´s visibility within the industry sector,
- market our most precious future ”product”, the HMI expert.

The purpose of this board was formally to:

- Evaluate the HMI programme with respect to the relevance to Swedish industry.
- Provide industrial contacts that may lead to collaboration in research.
- Help in identifying opportunities to fund graduate students.
- Disseminate information about HMI to colleagues and other interest parties.
- Help to plan the HMI Industry Day once per year.
- Provide a listing of individuals at Swedish companies with HMI interest.

In 2001 the HMI Graduate School was reorganized due to changed prerequisites and financial conditions. The board was changed (e.g. new chair) with slightly different tasks. HMI became a more pure graduate school, with the academic interests in focus, but still with the ambition to support Swedish Industry with HMI competence. In fact the HMI Graduate School became more dependent on industrial financing than before, since SSF decided to reduce the direct support to HMI.

In order to make the Graduate School more efficient the Executive committee and the Graduate School Committee were merge into a single committee.

The industrial advisory board had limited influence on the direction of HMI projects and was accordingly displaced in 2001.

The advantages with the HMI organisation is the focus on HMI issues that we have attained from the society in general and industry in particular. HMI also attracts students, which the present number of accepted students indicates. The supply of graduate courses within the field has doubled in Stockholm and tripled in Linköping. That has been impossible to achieve within the traditional system of disciplinary graduate courses. The output from the HMI Graduate School is therefore expected to substantially increase the number of graduates from the universities of Linköping and Stockholm. HMI also attracts senior researchers and teachers, which is considered to be of uttermost importance, since the competition has drastically increased during the last few years. In general, there is a shortage of competencies within the HMI field in Europe, probably with an exception for UK.

The HMI organization has already affected basic education at different departments. Research results are normally fed into undergraduate courses. A large number of project works and master theses are conducted within projects initiated by the HMI programme. Also the supply of basic courses at undergraduate level is influenced by course development in the HMI programme.

6 Handling of immaterial rights

Currently there are no widely accepted universal rules or laws regulating immaterial rights. However, continuos work at universities involved in the programme is under way (e.g. Forskarpatent AB). Intellectual property rights are usually regulated with respect to authorship, but not entirely clear when it comes to patent, which have to be negotiated with the employer and SSF.

7 The continuation of the programme's activities after 5 years

Originally the programme was planned for two student cycles (i.e. 10 years). After a slow start, an extremely successful work by senior researchers in the programme resulted in a rapid growth of HMI, far beyond expectations. With the ambition of maintaining the highest academic quality a withdrawal of SSF financing could be devastating for HMI. The basic funding is of uttermost importance for the survival of Swedish HMI research with a profound academic profile, and further competence development of designers and decision makers at Swedish industry. In case of lack of basic funding there is a great risk that HMI research develops entirely towards consultancy work within traditional disciplinary design projects. Our ambition is, however, to continue the graduate school, and external funding is looked for.

Our long-term goals are twofold. We have a unique possibility to create world's largest graduate school in HMI. With this plausible scenario our ambitions will increase with respect to number of students, supervisors and output in general. Our goal is to become the number one HMI graduate school. Reaching this goal would be impossible without enhancing research capabilities and advisory capacity by means of competence development and recruitment of senior researchers from top ranked universities.

A recent possibility is to apply for financial support for the augmented HMI Graduate School at the Swedish Road and Transportation Administration; within the IVVS (In Vehicle Safety Systems) programme.

8 The budget and financing of the programme

The total HMI-budget embraces approximately 60 million/year. In 2002 and 2003 the SSF support will be approximately 2.5 million/year.

9 External information and other activities

9.1 Kick-off meeting

A kick-off meeting was held in Stockholm in May, 1998. All HMI-affiliated persons were invited, including a number of representatives from industry, authorities, research councils, and prominent keynote speakers.

9.2 Annual Workshop

An annual workshop for graduate students is held in order to encourage students to present their research activities and make contacts in the HMI network. This workshop is also accompanied with the involvement of the Academic Advisory Board.

9.3 Industrial workshops

Industries involved in HMI are encouraged to arrange workshops as an important input to HMI. Industry relevant topics will be on the agenda. For instance, workshops have been hosted by ABB, Västerås, Saab Aerospace, Linköping, Ericson/Saab Avionics, Kista and Volvo Technology, Gothenburg. ABB internal HMI-network visited HMI-Graduate School in Linköping September 11, 2001.

9.4 Seminars

HMI seminars are regularly held at departments in Linköping and Stockholm.

9.5 Conferences

The HMI-Graduate School has been involved in the arrangement of several international conferences during 1998-2001.

9.6 Summer schools

Summer schools were arranged by KTH in June, 1999, and in June 2001. Another summer school is planned for 2002 at DSV. (see Appendix A.5).

9.7 Industrial summer school

An international summer school on Human-Centred Automation was held under the auspices of HMI at Kungs Starby, Vadstena, September 6-10, 2000. This summer school was entirely self financed by participants. (see, Appendix A.5)

9.8 Mass media

Since start many of our graduate students have presented their research work and their affiliation to the HMI Graduate School in daily newspapers, for instance, in Svenska Dagbladet, DN, Östgötacorrespondenten, New York Times, etc. A few of them has also presented their work in Radio and TV. Also some of the senior researchers have been favourable exposed in mass media, such as Radio, TV, newspapers and magazines.

9.9 Flyers

Flyers have been distributed at other universities about graduate student positions of HMI.

9.10 Industry visits

A number of industry visits took place during fall 1998 with the explicit purpose to expose the HMI graduate school and to promote the exquisite expertise in the HMI field, that could be directly called for or indirectly be supported by sponsor treaties. In 1999 -2000 a number of industry visits took place, but during 2001 -2002 these were drastically reduced due to financial limitations.

9.11 Presentation at international conferences and symposia

The HMI graduate school has been advertised at a number of international conferences, since 1998 - 2003.

9.12 WEB-pages

Information about HMI graduate school is available at:
URL: www.hmi.kth.se
Local WEB-masters had been working in Stockholm and Linköping. There have been some problems with the updating of WEB-pages, but this is taken care of now. Currently the Web-master is Henry Rodrigues at NADA, KTH.

9.13 Advertisements

The HMI graduate school has been presented in Forska, a magazine reaching a pertinent student population of about 15.000.

9.14 Presentation at other universities

The HMI Graduate School has been presented at several universities and for colleges in Sweden. The Graduate School has also been presented at universities in England, France, Germany, Holland, India, Norway, Spain, and USA.

Linköping, 2002-03-25