ECCE-2 - Second European Conference on Cognitive Ergonomics *

MODELS AND METHODOLOGY *

Representational Frameworks And Models For Human-Computer Interfaces *

On Models And Modelling In Human-Computer Co-Operation *

Information Systems Design Methodologies And Their Compliance With Cognitive Ergonomy *

Introducing Statistical Computing - Evolution Of The Cognitive System Of The Novice User *

COGNITIVE ASPECTS *

Human Cognition And Human Computer Interaction *

Understanding Complex Descriptions *

Do we really have conditional statements in our brains? *

Cognitive Ergonomic Research At SAPU, Sheffield *

SOFTWARE ENVIRONMENTS *

Active Help Systems *

Fatal Error In Pass Zero: How Not To Confuse Novices *

NOVICES AND LEARNING *

On The Implications Of Users' Prior Knowledge For Human-Computer Interaction *

Web Teaching As A Design Consideration For The Adaptive Presentation Of Textual Information *

The Computer In The Classroom *

INTERFACES IN THE FIELD *

A Realisation Of A Human-Computer Interface For Naive Users - A Case Study *

Real Time Graphic Simulation Of Visual Effects Of Egomotion *
European Association For Cognitive Ergonomics

ECCE-2 - Second European Conference on Cognitive Ergonomics

Gmunden, Austria, September 10-14, 1984


ABSTRACTS

MODELS AND METHODOLOGY

Representational Frameworks And Models For Human-Computer Interfaces

Gabriele Rohr, Michael J. Tauber

IBM Germany Heidelberg Scientific Center, Federal Republic of Germany

This paper is mainly based on discussions between a computer scientist and a psychologist concerning models of human-computer interaction. It tries to specify what a model is, which purpose it serves, and which components of human-computer interaction have to be modelled. Furthermore, these specifications are compared with already existing models.

Models are discussed recently in connection with building up an adequate user interface architecture. Design criteria are needed to construct interfaces which take into consideration human information processing abilities as well as task structures represented by the human. Hereby, "Architecture means the complete and formal description of the surface of a system seen
from a well-defined interface. Therefore, architecture is more than the usual specification. Architecture also contains a model of the user and a model of the communication between a user and a system ... Architecture does not refer to the product only. With the same weight, architecture refers to the production process and its documentation” (Zemanek 1982; translated by the authors).

To meet these requirements, models of human behaviour in interaction with computer systems are needed. Several models of human-computer interaction have been worked out in the past. They differ however very much in the aspects they describe. A classification of these models has not been done yet.

In this paper an attempt is made to clarify the knowledge and methods that are required to build up an adequate model of human-computer interaction and would help to formulate an abstract architecture. Central roles in the discussion play the terms model and representational framework. It must be pointed out that the first step in building up an architecture is the complete formal specification of the virtual system from an intended user's point of view.

**On Models And Modelling In Human-Computer Co-Operation**

*Horst Oberquelle*

*Universität Hamburg, Fachbereich Informatik, Schlüterstr.70, D-2000 Hamburg 13, Germany*

"System designers take note. Design the system for the person, not for the computer, not even for yourself .... Provide the user with an explicit model." D. A. Norman (Norman, 1981)

In the recent literature on human-computer communication (HCC) 'models' have become a central notion. State/transition models of interactive systems are discussed again and again (from Parnas (1969) to Jacob (1983)), the sites/modes/trails model of Nievergelt is praised as a solution for problems many users encounter (Nievergelt, 1983), the model human processor is designed to analyse user behaviour (Card, Moran & Newell, 1983), an abstract model of communication between two partners has been applied to HCC (Oberquelle, Kupka & Maass, 1983). There are lots of other papers discussing conceptual models or mental models of interactive systems, user models or the role of metaphors (see e.g. Carroll & Mack, 1982).

Obviously, humans need and use models of their 'relevant system' to be able to plan their actions and to control the obtained effects. As soon as several persons cooperate their communication will be based on their respective models. Part of their communication will serve to develop, to explain and understand models. To communicate about models presupposes that models can be represented externally and that the means of representation are known to the communicating parties.

Communication about modelling tools might be necessary in addition. All kinds of modelling, formal models included, are based on the human ability to communicate in the informal mode inherent in natural language (cf. Naur, 1982).
Users of computerized systems have great difficulties in acquiring adequate models of the systems they are forced to work with. The development of systems for HCC is not just the creation of programs according to some specification, but the design of working situations for humans. That's why principles of both, hardware and cognitive ergonomics, should be applied.

One basic principle is controllability (Troy, 1981) which means that the working environment must be transparent and predictable and that the worker must be able to influence it. Models of the working environment and modelling procedures can serve exactly for this purpose.

Researchers in cognitive ergonomics are asked to improve the situation by looking for suitable models, modelling tools and modelling procedures. But to date their notions of model, relations between partial models and modelled aspects as well as the purposes of models have not been discussed in a systematic way.

A suitable model of the system relevant for HCC research may help to evaluate different proposals, to improve scientific communication and to give hints for further research activities. A uniform representation technique for different but related models might improve communication between researchers, designers and users.

Before going into the details of any specific model or representation technique the following questions shall be answered (section 1):

What do we mean by 'model'? Which aspects of 'the relevant system' are covered by models?
What is the role of 'modelling tools'?

In section 2 we show how the focus of interest in HCC has been extended in recent years and illustrate this by means of nets. Today three major roles (as abstractions of agents with similar aims) influence human-computer interfaces: designer, dialog system and user. For the researcher in HCC they determine 'the relevant system', which can be represented by a meta-model.

This model is taken as a framework according to which we discuss and classify some models from the literature (section 3).

In view of the problems users have with systems and models predefined by others we ask: "When, how, by whom and for whom are models developed and transferred?" The meta-model shows new ways of improving the modelling process. This will be discussed in section 4. Section 5 indicates some open problems and gives directions for further research.

Information Systems Design Methodologies And Their Compliance With Cognitive Ergonomy

Roland Traunmüller

Institut fur Informatik, Johannes Kepler Universität, Linz
As methods and tools for the design of information systems have mushroomed in recent years, IFIP has carried out a review process on the methodological development (CRIS - Comparative Review on Information Systems Design Methodologies /1,2,3/). Based on the author's participation in the review process a précis of pivotal methodological approaches is given. According to the scope of this symposium four topics relevant to cognitive ergonomics are stressed.

So the following sections focus on four subjects' reasons for the development of methods and methodologies (2,3); pivotal approaches and methods for the design (4,5); topics of product models and process models with relevance to cognitive ergonomics (6,7); information modelling as an example for methodological issues (8).

**Introducing Statistical Computing - Evolution Of The Cognitive System Of The Novice User**

_Gerrit van der Veer_

_Vrije Universiteit, Amsterdam_

_Bert van Muylwijk, Jan van de Wolde_

_T.H. Twente, Enschede, Netherlands_

The project that is reported in this paper is a pilot study. the main goal is the development of a method to investigate real life situations in which novices receive an introduction to a computer system, determining the interrelations between characteristics of the student; strategy and content of the course; development of a model of the system in the student's mind.

If this investigation takes place in an existing course the investigator is normally not allowed to interfere with the teaching method or with the curriculum. The investigation therefore will not have the character of an experiment, the testing of hypotheses will not be a central goal. A description the phenomena is the main result, the teaching strategy (and the subject matter of the course, the task domain for which the system is introduced) not being a variable in the individual study. The results of these sources may only be speculated upon, albeit that comparison with similar studies in the long run will result in clarity about the relations (Eason, 1983). The authors plan to repeat this study with a number of different institutions for other task domains.

**COGNITIVE ASPECTS**

**Human Cognition And Human Computer Interaction**

_Werner Schneider, Mats Lind, Robert Allard, Bengt Sandblad_

_Uppsala University, Sweden_
Not too long ago the programmer and the program user were one and the same person. Since the user had created the program he knew what to expect from it, what it could and couldn't do, how to control and change it etc. The diffusion of computers in our society and their usage in an ever increasing number of professional fields has changed this picture. In most cases the user is no longer the person who has written the program in question. This separation causes a considerable number of problems concerning the cognitive ergonomics of human computer interaction. It is the purpose of this paper to define some of these important problems and to indicate a way of solving these problems. Other important aspects of human computer interaction such as physical and social factors will not be considered.

Understanding Complex Descriptions

Collin Potts

Department of Computing Imperial College of Science and Technology, London, UK

User-system interaction is starting to receive the attention it deserves. A picture is starting to emerge from work in cognitive ergonomics of the requirements for user interfaces, for example for text editors (Card et al., 1983), command languages (Barnard et al., 1981) and programming language syntax (Green, 1980). In a short sketch of the research opportunities that exist, Shneiderman (1982) lists several similar issues, such as menu selection, on-line assistance, etc. He also draws attention to issues such as overcoming anxiety and fear of computer usage. I shall not comment on such social and organisational issues, but I wish to suggest that attention to ergonomic issues of the first type neglects a range of important human factors in system use. These operate at a conceptual level beneath the external (e.g. graphical or pretty-printed) characteristics of the interface. The problem I want to address relates to these. It is this: how can an information system be designed so that the complex descriptions it supports and which are manipulated by the users can be rendered into forms that are harmonious with the users' mental models?

In the first part of the paper I shall discuss a conceptual architecture for information systems, which emphasises the understandability of the descriptions they embody. The architecture consists of an internal description which may be manifested by applying two classes of transformation, forming separate conceptual and external interfaces. In connection with the conceptual interface, I discuss the relevance of current work in cognitive science, especially text linguistics. I shall ignore the external interface, as this has received the most attention in the cognitive ergonomics literature.

In the second part of the paper, I shall concentrate on a class of complex descriptions of particular relevance to software engineering, specifications. A specification is usually thought of as a text and a specification language as a language. A specification, however, is simply a description of a reality that does not exist yet and a programming support environment is, amongst other things, an information system for manipulating such descriptions. Thus in addition to the effects of syntactic and physical factors (e.g. layout) on the understandability of specification, we should also be examining the conceptual models required of the specifier by different specification language.
Do we really have conditional statements in our brains?

Jean-Michel Hoc

Laboratoire de Psychologie du Travail de l'EPHE (ERA CNRS), Paris, France

Programs which beginners are asked to write, more often than not, correspond to tasks that can be executed by hand. The programming strategy usually employed is one in which a well-known procedure is adapted to adhere to the rules of operation of the formal machine underlying the programming language being used (Hoc, 1983a).

However, it is not enough to simply adapt a procedure, it must be explicated as well. This requires an awareness of the control structure, in other words, data identification operations and transfers of control. This paper will examine the nature of the control structures on which this awareness is based, and not the complex mechanisms involved in becoming aware (Piaget, 1974a, b).

In procedural programming language control is expressed by means of tests. It has been shown however (Miller, 1981), that beginners find it difficult to construct those test statements in conditional structures or at the ends of iterations.

Several research papers have been devoted to this question and in particular to the facilitating effects of different languages (Sime et al., 1977; Green, 1980; Van der Veer and Van de Wolde, 1983). But it is possible to go even further and to examine the effect of such tests in control structures of procedures which seem to be algorithmic and which are executed by hand. If not, this would explain one of the reasons for the difficulties experienced by beginners. This hypothesis can be considered in the light of two current areas of research in psychology: (a) Research on attention (Richard, 1980) which has highlighted the importance of states of preparation (expectation phenomena) linked, in particular, to frequency and recency effects; (b) Research on typicality (Cordier & Dubois, 1951) which exploits the delay in decision-making in class-sorting problems in order to show that, in the subject's representations, there are typical (short delay) and atypical (long delay) examples which are not necessarily linked to frequency effects.

If such effects exist, it can be expected that certain identifications will be omitted during the execution of the procedure, either: (a) because the subject adapts to the frequency of events or he is sensitive to the recency effect or, (b) because the data being processed are represented semantically in the long-term memory, implying typicality effects.

This experiment mainly examines the second phenomenon by comparing the control structures during the execution of procedures in two different situations. in the first, the subjects rely on a strongly semantic representation of the data and in the second, on a much more abstract representation. In both situations, tile data to be processed have the same "objective" structure. In the "semantic" situation we anticipate that the subjects
will not be able to deal with certain identifications that could have been made in the "abstract" situation in which exhaustive search is possible.

The subjects are placed in a command situation in front of an interactive computer device. The data transformations are controlled by function keys so that the control structures can be identified by response latencies. The different representations are achieved by modifying certain characteristics of the device, which affect neither the data structure nor the commands available, but only the way in which the data can be accessed.

**Cognitive Ergonomic Research At SAPU, Sheffield**

_T. R. G. Green_

_MRC/ESRC Social and Applied Psychology Unit, University of Sheffield, Sheffield S10 2TN, U.K_

This is a report on recent research by my colleagues, Max Sime, Stephen Payne and David Gilmore and myself. Where I say "we" and "our" it refers to all of us. I hope I have not misinterpreted their ideas too much.

Previous research at this Unit into the causes of difficulty in comprehending programs led us to the conclusion that it is useful to regard programs in the same light as other forms of presentation of complex information, and to ask how easy is it to extract necessary information from them. This viewpoint emphasises the role of structure: the program structure must be easily perceived, and it must make it easy to perform the user's task given the usual human abilities and disabilities.

Structure must be well-specified, visible, and appropriate.

In the first section of this paper I shall briefly outline the course of our work on program comprehension, in order to establish our views on structure. The following sections describe recent research at this Unit into the causes of difficulty in learning and using text editors. We believe that the notations of command languages and of programming languages need to satisfy very similar requirements as regards visible and appropriate structure. The final section offers some conclusions, necessarily tentative.

**SOFTWARE ENVIRONMENTS**

**Active Help Systems**

_Gerhard Fischer, Andreas Lemke & Thomas Schwab_

Research Group on Knowledge-based Systems and Human-Computer Communication, Department of Computer Science, University of Stuttgart, FRG

Good on-line help systems are of crucial importance for the computer systems of the future. An increased functionality (required by the many different tasks which a user wants to do) will lead
to an increased complexity. Empirical investigations have shown that on the average only 40% of the functionality of complex computer systems are used. Passive help systems (which require that the user requests help explicitly from the system) are of little use if the user does not know the existence of a system feature. Active help systems should guide and advise an user similar to a knowledgeable colleague or assistant.

**Fatal Error In Pass Zero: How Not To Confuse Novices**

*Benedict du Boulay*

*Cognitive Studies Programme, University of Sussex*

*Ian Matthew*

*Department of Computing Science, University of Aberdeen, United Kingdom*

ALL novice programmers find that their initial programs are rejected by the compiler in a flurry of incomprehensible error messages. Some messages are even hostile (e.g. fatal error in pass zero) and Leave the novice sadder and certainly no wiser.

The quality of error messages is usually the Loser when the compiler writer attempts to balance conflicting design constraints such as size, speed, quality of target code and utility of use by competent programmers.

We believe that novices' programs should be passed through a series of Checkers which are designed to trap and comment on the particular kinds of errors made by them. Such systems may have to make several passes through the program even to provide an apposite comment on a syntactic error. For logic checking such systems will need access to a description (in some form) of what the novice's program is supposed to do. only when a novice's program passes through all the Checkers successfully should it be submitted to the standard compiler.

This paper surveys existing attempts to build "intelligent" compilers which are considerate of novices' difficulties. It then describes our own progress towards the construction of program Checkers for use by undergraduates Learning Pascal.

**NOVICES AND LEARNING**

**On The Implications Of Users' Prior Knowledge For Human-Computer Interaction**

*Yvonne Waern*

*University of Stockholm, Sweden*

This paper analyses the situation in which a beginning computer user tries to handle a computer system by only having had a brief period of instruction and manned with a manual. The situation is analysed as a problem solving situation, in which knowledge about how similar tasks are
handled outside of the system plays a great role. At is suggested that the following situations will lead to slow learning: When the problem space is great, when necessary methods are difficult to access, when prior methods are inadequate and strong, when prior models are inadequate, and when the problem formulation is misleading. It is further suggested that one following may be learned in this situation: situation specific goal-condition-method rules, higher order rules, problem schemata, and causal explanations.

Empirical observation by means of think aloud protocols and registering of actual interactions are presented. These show that difficulties encountered by beginning users may be interpreted as suggested above. As to the learning content, the observations suggest that beginning users primarily learn situation specific goal-condition-method rules. They may furthermore redefine old or create new problem schemata. Higher order rules and causal explanations were not evident in the data collected.

**Web Teaching As A Design Consideration For The Adaptive Presentation Of Textual Information**

*Pier Kommers*

*TH Twente, Enschede, Netherlands*

The understanding and the successful acquisition of textual information seems to be highly dependent on the presentation sequence employed. System control and learner control can be optimally combined if there is a conceptual graph which represents the structural relations between the concepts in the text. Primarily based on the notions of Web Teaching (Norman, 1973), one can design an adaptive presentation mechanism. One algorithm for the computation of the centrality index of concepts in a network will be proposed. Consultancy of reader ratings based on prior knowledge seems to be necessary in order to match prior and new information.

**The Computer In The Classroom**

*Gerrit van der Veer, Jos Beishuizen*

*Vrije Universiteit, Amsterdam, Netherlands*

The project that will be described in this paper focussed on three topics: (a) the extent to which the computer may be used to facilitate the adaptation of the learning process to the individual differences found between pupils; (b) the impact of the computer on the learning environment as an enrichment, especially because of the opportunities it can provide for problem solving behaviour; (c) the possibilities of the computer for training cognitive skills in the classroom situation.
INTERFACES IN THE FIELD

A Realisation Of A Human-Computer Interface For Naive Users - A Case Study

Günter Haring, Theodor Krasser

Technische Universität, Graz, Austria

The realisation of a human-computer interface for an information storage and retrieval system used by the staff of a company in mechanical engineering industry is described in this paper. The system had to be designed according to the needs, skills and data processing background of the user group, taking the tasks to be performed into consideration. The system design process, based on human factor design goals and integrating quality control, is compared with the usual software development procedure. The description of the system explains the way in which different dialogue tools such as menu selection, form filling, function keys etc. nave been integrated. Data entry and query functions are used as examples.

Real Time Graphic Simulation Of Visual Effects Of Egomotion

Patrick Peruch, Viola Cavallo, Jean Pailhous

Laboratoire de Psychologie de l'Apprentissage, Marseille

Christian Deutsch

Société Opeform, Malakoff, France

Both spatial displacements and their visual consequences which allow analysis and control of trajectories are now an important research topic. This activity plays a large role in our everyday life and so it largely exceeds the preoccupations of cognitive psychology: for example, it poses some problems for the ergonomist who has to elaborate graphic job-aids for manoeuvring large ships.

We present 3 important aspects of our method: (a) A multi-disciplinary team (mathematics, software engineering, ergonomics, cognitive psychology) works on a collective project. (b) We have constructed a model of the mental (cognitive) processes involved in this task. (c) We have produced dynamic images in real time with a computer and graphic display; we have simulated some aspects of active movement in definite spaces.
Broadbent (1958) postulated that human information processing is restricted by a limited capacity filter between the large variety of sensations we have and the attentive stages of input analysis. He claimed that both the visual and the auditory sensory systems function as parallel information-processing channels; that all environmental inputs (e.g., sounds and visual stimuli) can be received simultaneously. A precategorical analysis is performed: certain physical features are discernible (e.g., pitch and size), and others aren't (content, context, or meaning). The filter mechanism allows only one message at a time to pass from sensory memory into the attention system. For example, in an environment within which two human speech tracks run simultaneously only one can be attended to at a time. Broadbent claims that about 1.5 sec. is necessary to switch attention from one sensory input modality to another (Broadbent, 1971; Davis, Moray & Treisman, 1961; Moray, 1960), whilst others have estimated a much shorter span. Moray (1960) for example, indicates that 50 msec. is needed for very simple auditory stimuli (in our proposed studies, much more complex stimuli will be used). The degree to which our attention can switch between different inputs is also deemed limited. Treisman (1968) and others modified Broadbent's model considerably to incorporate findings indicating that some content material from the unattended channels do indeed break through to active attention.

These models imply that although stimuli in unattended channels are severely attenuated they have not ceased to exist.

Neisser (1967) made a major central distinction between "preattentive processes" and "focal attention". In the preattentive stage holistic parallel processes use the stimulus information, arriving simultaneously, to construct the separate sensations involved. These result in rather crude impressions of the stimuli's properties (movement, general location, brightness, etc.) which have little or no effect on behaviour. This differs from the phase in which the stimulus information has become the focus of attention. Attention, according to Neisser (1967), is serial: Only one object can be attended to at any given moment, and each attentive act takes time.

When simultaneous processing of multiple sensory inputs is required, one often refers to "divided attention" situations. The serial-controlled mechanisms of attention produce divided attention limitations, but Schneider and Shiffrin (1977) and Shiffrin and Schneider (1977) have shown that these limitations can be bypassed when automatic-parallel processing is utilised. Automatic processing takes place in long-term memory, is triggered by specific inputs and operates largely independently of the subject's control. When automatic-attention processing is activated, it will not necessarily affect ongoing controlled processes. There is an obvious similarity between the distinction Neisser (1967) makes between preattentive and attentive processing and the distinction Shiffrin and Schneider make between automatic-parallel and serial-controlled processing. These are however also a number of dissimilarities, one of which has influenced our research proposal: contrary to Neisser (1967), parallel processing from multiple external stimuli to meaningful content and context is possible within the approach of
Shiffrin and Schneider insofar as the automatic-parallel processes for the appropriate multiple inputs are well learned.

One of the assumptions found in recent theories is that short-term memory has automatic and controlled processing and storage functions that, in some cases and especially with serial-controlled processing, compete for a limited capacity within the short-term memory. This conception can be contrasted with the more traditional theories that view short-term memory, now more commonly labelled "working memory"

(Baddeley & Hitch, 1974), as having storage functions only. The more recent theories that agree upon the existence of demanding processes (processing and storage) that consume the available capacity and activities with no capacity trade-off (with parallel processing), have led Navon and Gopher (Gopher et al., 1982; Navon & Gopher, 1979, 1980) to propose, and to provide evidence for a multiple-resource allocation theory. In this approach, the human-information processing system incorporates a number of mechanisms, each having its own capacity. These capacities can be allocated among several processes at any given moment.

From Surface Form To The Structure Of The Interface - Studies In Human Computer Interaction At Inria

Pierre Falzon

Institut National de Recherche en Informatique et en Automatique, Le Chesnay, France

The central problem in man-machine interaction is the compatibility between two elements: (a) the operator, and his physical, perceptual and cognitive characteristics; (b) the machine, and its different aspects: dimensions and lay-out, information coding and information structure.

At a first level, the designer must endeavour to attain a certain compatibility between the physical characteristics of the system and the physiological and perceptual characteristics of the human. At this level, the designer is concerned with work place dimensions and general lay-out, information visibility, etc. This field - ergonomics - is now very well established. At a second level, the designer's task concerns the compatibility of the system with the elementary operations performed by the operator. These operations consist of acquired schemes, which can be sensory-motor, procedural and/or anticipatory. This rule-based behaviour must be matched by appropriate surface aspects of the machine. The designer has to choose, for each sub-task, the optimal way to encode information in order to facilitate the use of these schemes. To give an example, for a tracking task, different types of displays will be studied (pursuit, compensatory, predictive, analogical, pictorial, etc.).

The studies of stereotypes (which are sensory-motor or cognitive routines) belong to this second level of compatibility. This is the field of human factors. Finally, at a third level, the designer has to take two fundamental human activities into account: information processing and mental representation. The relevant questions become: which information is processed? Which variables are elaborated by the operator? Which heuristics, which reasoning algorithms are used to reach the goal? What are the characteristics of the mental representation of the system? At this level,
studies of the knowledge activities are fundamental. On the machine side, the designer is no longer concerned with information encoding, but with information structuring. This is what cognitive engineering is about. The global compatibility of a man-machine system can be achieved only if compatibility exists at each of these three levels.

As a matter of fact, the available body of knowledge is very unbalanced. We know a lot about ergonomics, quite a bit about human factors, and not much about cognitive engineering. The aim of the Ergonomic Psychology Project at INRIA is to contribute to the development of knowledge on the cognitive activities of the human elements of the systems: this knowledge can be used to design machines adapted a priori to their users’ functioning logic. Our work is then clearly focused on the third level of compatibility described above. However, it is sometimes difficult to have a clear-cut separation between the different levels, especially between the second and third one. In fact, surface form and deep structure interact in several ways. The aim of this text is to present some aspects of these interactions, which will be illustrated by examples from different studies we have conducted. We are concerned with all problems related to human-computer interaction, whatever the domain of application: process control, office work, data base interrogation, programming, etc.

ORGANISATIONS AND SYSTEMS

New Technology: Choice, Control And Skills

Chris Clegg, Nigel Kemp & Toby Wall

Social and Applied Psychology Unit, University of Sheffield, UK

This paper examines some of the psychological and organizational aspects of computer-based technology, with particular focus on the use of Computerised Numerical Control (CNC) machine tools in manufacturing engineering. The objective is to introduce and develop some ideas from the fields of occupational psychology and organizational behaviour in ways that will promote an understanding of the uses and impact of advanced computerised technology.

The paper argues against the technological determinist view that once an organization has chosen its technology, then this inevitably leads to a particular form of organization and style of management. The aim is to demonstrate the reverse, that organizations have a choice in how to organize for and manage new technology and that one very important aspect of this choice concerns who has day-to-day operational control of the equipment. The argument is that such choices need analysing in their organizational context since they are in part dependent upon other factors in the organization. Furthermore these choices have major implications for the profile and distribution of skills required in the organization and, at the same time, have a major bearing on the pattern of economic and social benefits and costs which accrue.

The paper draws on material from two case studies undertaken by the authors and refers to relevant theoretical literatures. Before presenting the case material we describe what is involved in CNC machine tool working: first however we briefly outline our research interests in this area and our normal method of working.
Semiotics And Informatics: The Impact Of Edp-Based Systems Upon The Professional Language Of Nurses

Lars Mathiassen

Computer Science Department

Peter Bøgh Andersen

Department of the Integrated Study of Computer Science and the Humanities, Aarhus University, Aarhus, Denmark

The aim of this paper is to stress that the use of computers may entail very radical changes indeed in the professional languages used in the affected parts of an organisation. A consequence of this is that analyses of professional languages may be applied advantageously in connection with system development. This paper builds its arguments around a single example: The change in the professional language of nurses in connection with the use of computers in a hospital ward. In the first part of the paper we give a description of the situation before and after the system concerned was introduced. Furthermore we present some basic concepts of semiotics. The second part of the paper contains a semiotic analysis of the situation within the hospital ward under examination. And finally, the last part of the paper draws some general conclusions from the analysis.

What does real work analysis tell us about system design?

Leonardo Pinsky & Bernard Pavard

Laboratoire de Physiologie du Travail, Conservatoire National des Arts et Mètiers, Paris, France

Human-computer interface design is explicitly or implicitly based on specific representations of the user's activity. Several strategies are used for system design. Some of them are based on "user's models" (for example: Cuff, 1980), Which are not usually precise enough to predict the numerous difficulties in the system use. Others rely on general principles to elaborate command languages or to structure the man computer dialogue. These general principles may be: (a) the simplicity and coherence of the commands, (b) the "natural" aspect of the actions during dialogue, (c) the personalisation of the human-computer interface.

The design of command languages based on an analogy with natural languages, whether verbal (Treu, 1982; Landauer et al., 1980; Ledgard et al., 1980), graphic (Buxton, 1982) or musical (Buxton et al., 1983) does not systematically lead to solutions which will be appropriate for the functions the language is to fulfil (Fitter, 1979).

In general, these principles come from either informal observations of the use of different systems, or from the designer's intuition (Treu, 1976). This procedure may result in an incorrect representation of the operator's real activity and thus in models which have little to do with
reality, leading to errors in the design. A correct representation of the activity is needed from the appropriate which characteristics of the system to be designed can be deduced. Several attempts have been made to develop general models for particular cases. Card et al., 1983, used a very detailed model of the activity of an operator while working on a word-processing task. Although this model provides precise data on the operator's behaviour, it only concerns tasks for which most of the aspects of the activity have been defined in advance. Although analysis of procedural errors is essential for the improvement of a system, this model cannot predict them.

This paper means to show that work analysis can help to elaborate activity representations wide enough to fulfil design requirements. Work analysis is not only concerned with performance, but also tries to define the structure of the activity as well as the cognitive processes of the operator within the real work situation. It aims at describing the complexity of the activity without making any a priori reduction. In order to gather relevant data from work analysis, the ergonomist must deal with a situation (man + computer + task) closely related to the one he has to design. in this case, the ergonomic work proceeds in degrees: the designer does several ergonomic experiments in the work place in order to improve the description of the functional characteristics of the system (see part one).

Work analysis can be integrated in a different way: in the design process it can provide pertinent data by allowing experiments to take place in a laboratory, in order to study certain aspects of the cognitive processes involved in specific tasks. The difficulty associated with this approach depends on the choice of the variables used for the experiment. For validity's sake, the experiment must consider constraints due to both the environment and the task. But, in fact, the environmental constraints which affect the cognitive processes are often difficult to define in advance. This experimental approach proceeds by "reducing" the real situation, but this "reduction" is made "a posteriori", that is to say: after identification of the constraints due to the environment. This paper describes two examples of the ergonomic research which is being undertaken in our laboratory, each within their own context: (a) a close relation with a team of designers working on a particular on-line data coding system, (b) a more general study aiming at the design of text composition systems.

Through these two examples, we will point out the two aspects of work analysis contribution to system design.

**Psychological Selection Of Personnel For Data Processing Professions**

*Horia Pitariu*

*Universitatea Cluj-Napoca, Roumania*

The introduction and implementation of computers in Roumanian society have been phased, following a programme which will result in a national data processing system. In order to achieve this goal electrical data processing equipment is being constructed and training programmes are being given to "selected" candidates. These training programmes include
intensive courses for analyst-programmers, junior programmers, cardpunch and computer operators. The psychological selection method by which the trainers are chosen from the large number of candidates with their diverse backgrounds, is the subject of this study.