

Historical Analysis and Conflicting Perspectives - Contextualizing HCI

Susanne Bødker

Department of Computer Science
Aarhus University
Ny Munkegade 116
DK-8000 Aarhus C
Denmark

tel. +45-86202711 x5082, fax. +45-86135725, e-mail bodker@daimi.aau.dk

Abstract. This paper develops two ways of analyzing the human-computer interaction of a computer application in use in an organization. The techniques, historical analyses and conflicting perspectives analysis, and the interplay between them, are used in providing the basis for a more detailed analysis.

Historical analyses focus on the historical development of artifacts and their use. Conflicting perspectives analysis reflects on the roles of the artifact in use, as system, tool, or medium. Combined, the two types of analysis allow for a focus in particular on conflicts between the roles of a specific artifact in use.

The techniques are based on human activity theory. They are illustrated by means of a case study of a computer application from a project with the Danish National Labour Inspection Service.

1 Introduction

Re-framing human-computer interaction from within the field has been discussed extensively in recent years, driven by a growing concern for practical use of the theory. In particular [7] focuses on this theme, but without much to say about real-life computer applications. Here, I shall present and discuss two techniques to analyze such real-life applications, providing ways to contextualize HCI. Theoretically the techniques are based on a human activity framework as presented in [4,1]. The paper first gives a short introduction of the theoretical basis and vocabulary. Following is a presentation of the case; the analysis of the case based on the two techniques: historical analysis and analysis of conflicting perspectives. The case is rather mundane and meant to illustrate the techniques. It does not as such represent an application which is outstanding in any way.

2 The Human Activity Framework

In human activity theory, the basic unit of analysis is human (work) activity. Human activity is what a group of people engage in to achieve a certain purpose. This activity is usually mediated by one or more instruments or tools, and it is directed towards a certain object. Tools, as well as the division of work, norms and language can be seen as *artifacts* for the activity: they are created by humans and they mediate the relations among human beings or between people and the object of their activity, the material or product in different stages. They are there for us when we are introduced into a certain activity, but they are also a product of our activity, and as such they are constantly changed through the activity.

The *mediation* is essential when understanding artifacts. That artifacts mediate use means that we are normally not aware of them in use, they are *transparent* to us. Our attention is with the materials and products even though many of our experiences with these are made through the artifact. In many cases of computer-based artifacts, the materials and products worked on have no physical presence outside the artifact [4, see also 12].

In this perspective we cannot study computer applications as *things*, we need to look at how they *mediate use*. Furthermore, artifacts are not just means for individuals, they also carry with them certain ways of *sharing and dividing work*. They are given meaning through their incorporation into social praxis. Human beings always participate in various activities which are collective and structured according to the praxis of the particular society in which they take place.

Artifacts can be seen as *historical devices* which reflect the state of praxis up until the time that they are developed. This praxis in turn is shaped by the artifacts used, and so on. Artifacts can be characterized as *crystallized knowledge* which means that operations which are developed in the use of one generation of technology may later be incorporated into the artifact itself in the next. To learn something about the present shape and use of an artifact, we may apply a *historical analysis of artifacts* [8].

Although *collective*, each activity is conducted through *actions* of individuals. Activity is what gives meaning to our actions, though actions have their own focus. Each action is implemented through a series of *operations*. Each operation is connected to the concrete physical or social conditions for conducting the action, and it is "triggered" by the specific conditions which are present at the time.

Activities are not taking place in isolation but interwoven with other activities, which deal with the same or connected objects, which produce the instruments used in the activity in case, etc. While conducting a specific activity, the object change which may be viewed as a change of activity, or as a change in the purposeful actions, or *clusters* of actions. We can analytically separate the categories of activity, action and operation by the questions: *why* something takes place? *what* takes place? and *how* is it carried out? Actually, we may prefer to look at human-computer interaction as exactly focusing on *how* a certain use of a computer application takes place.

Artifacts may be the instruments of a *web* of activities: In particular computer-based artifacts are often contributing to several activities or clusters of actions conducted by several users.

In literature such metaphors as “system”, “media”, and “tool” have been discussed extensively as design metaphors to illustrate the role of the computer application in use (See e.g. [9, 10]). In [2,4] they are discussed as analytic perspectives: as different roles for an artifact as seen from the point of view of human activity theory: The systems perspective is the birds-eye, control perspective, viewing human user and computer component as rather equally functioning in exchanging data. The subject is lost in the systems perspective, or removed from the level of those who are conducting actions and operations. In this perspective we may say that overall planning and conception of the activity is detached from the actual conduction of the actions and operations that contribute to the activity. In other words, the people who do the work (the actions and operations) do without knowing why, and those who know why, do not do the work. *A system mediates between the individual contributors of actions and operations, and their object. At the same time the system is the instrument of the acting subject, who is not directly contributing to the production of the outcome.*

The tool perspective emphasizes the human engagement with materials through the computer application. *A tool mediates the relation between the subject and the material object being worked on.* The tool perspective emphasizes production of outcome, and the direct learning taking place by the material “speaking back” to its user.

The media perspective, in a similar way, emphasizes the human engagement with other human beings through the computer application. *A media mediates the relation between the acting subject and the community of practice surrounding the subject and the activity,* thus it is the perspective emphasising communication, and learning through conceptualization and negotiation.

Both of these perspectives may be extended, when at the same time focusing on computer support for cooperative work: Sørgaard’s [14] concept of shared material, can be seen as a tool perspective focusing on cooperation, whereas Robinson’s [13] concept of common artifact can be seen as an extension of the media perspective.¹

For both the tool and the media perspective the transparency of the artifact is in focus: it is a quality criteria that computer applications can mediate the normal use activity without “being in the way”, i.e. that they can be worked through operations only, not through deliberate actions. Together with this, the perspectives emphasize the human possibilities of planning and controlling the activity.

A brief summary the characteristics of the system, tool and media perspectives with respect to how the view human-computer interaction is given in the following:

	<i>system</i>	<i>tool</i>	<i>media</i>
<i>why</i>	planning/control	material production	communication
<i>what</i>	data entry +extraction	shaping material	creating and interpreting signs
<i>how</i>	“low risk” data entry	transparency good access to material	transparency no disturbance in interpretation

Analytically these perspectives will be applied by tracing and characterizing the web of different activities that takes place around a computer application and in particular contradictions among the different uses. Relating the various use activities to a historical account of the underlying perspective(s) helps, as we shall see, in understanding the contradictions and problems with use of a particular computer application.

3 The NLIS Case

The NLIS project [6] is a research project co-operating with the local branch of the Danish National Labour Inspection Service (NLIS). At NLIS, a centralized computer system (VIRK) is applied to record the interaction of NLIS with companies in the geographical area covered by the local branch. Visits to work sites as well as correspondence with companies are recorded, and various materials can be extracted, ranging from lists of a specific kind of companies within a geographical zone to lists of which recommendations and demands the NLIS has put on a specific company. Also lists of cases under investigation by a single NLIS inspector can be extracted.

VIRK was designed based on a company database shared with other authorities dealing with company inspection and counselling. It is a menu-based system running on terminals. VIRK has been used in the organization for several years. It was developed by a Danish state owned software house, and has **not** been designed in the project.

In our initial investigations we found that people used VIRK in many ways, and that some people actually asked for facilities which existed in the system. Only very few people knew what VIRK really allows for. Thus we sat out to investigate how to help the secretaries and inspectors at NLIS make better use of the system that they had already available. This made an evaluation of the human-computer interaction aspects of VIRK a necessity. To illustrate the techniques, parts of this evaluation will be presented here.

3.1 Historical Analysis

Markussen [11] provides a useful historical account of the NLIS as institution and the interwoven development of the work environment laws, the bureaucracy, and the role of the inspectors. This analysis will be used here with more direct emphasis on the implications for the use of VIRK.

Until the mid-1970s NLIS was primarily dealing with the inspection of physical work environment in factories, what was called workers' safety which in particular concerned the set-up of machines etc. The inspectors were engineers, there was little bureaucracy around the activity, and basically each inspector was responsible for selecting and inspecting the factories that he found appropriate. With the work environment act of 1975, the scope was widened to include also non-factory work, and a more holistic approach to work environment. The act prescribed a certain more bureaucratic organization of work, more resources were spread in the organization, and the professional profile of the organization changed: therapists and psychologists were

employed, and prevention became a central issue. With the late 80s came further decentralization coupled to client orientation. This also meant a focus on quality assurance and accounting "upwards" in the bureaucracy for what had been achieved locally (i.e. centralization). Furthermore, more and more work was put into cooperative and structured activities, e.g. "the cancer effort" or some other campaign instead of the traditional "random" and individually planned visits to companies.

This is the setting into which VIRK was created.

First of all, VIRK was created to help various groups of people, primarily management, get an overview of the many cases and documents that came into play when the organization grew and diversified. Management, furthermore, needed to make sure that all incoming requests were handled according to the law. Historically, VIRK substituted a number of paper based lists, which were kept to maintain an overview of files with material about companies and inspections. With the growing organization these lists had become insufficient. The files are still used, only VIRK has made retrieval easier, and also some overview facilities for statistics have been added. Much of the mechanisms for accounting for, and statistics of the activity were added later, as further decentralization and "upwards" accounting took place. Some of the paper-based lists are still maintained in situations where the support given by VIRK is too poor, e.g. lists of various expiration dates, sorted according to expiration month are still kept, because VIRK offers little support for extracting such lists. Though VIRK was developed rather late in the historical development of work at the Labour Inspection, it has not been designed to reflect this development. In many ways VIRK works to support only a very traditional quantitative perspective, coupled to management planning and control, whereas the more holistic, qualitative perspective underlying the work of contemporary labour inspection is not supported, neither with respect to information and activities regarding a company, that can be accounted for in the system, nor with respect to how the work of the inspectors is viewed. The lacking facilities are typically related to the individual and group case handling, an area that has not been given much attention historically, or with respect to design of the system.

3.2 The Roles of the Artifact in Use - a Conflicting Perspectives Analysis

The context of this specific piece of research is hours of interviewing the NLIS employees, of hanging around their offices and of partaking in seminars with them on other aspects of the project [6]. With the specific purpose of understanding VIRK and the HCI problems, three activities, all of which were videotaped, were in focus: A session with two secretaries discussing their daily activities, in particular with respect to documentation and information retrieval in VIRK, a session where a secretary is demonstrating VIRK to the researchers, and finally a similar session with a secretary who is also the "super user" of VIRK. In total we have more than four hours of video-tape of the use of the system.

The initial analysis began by identifying the different activities in which VIRK is applied: who are the users? what are the objects? which are the activities in which VIRK is used (why is a certain activity taking place)? as to identify the role that VIRK

plays in use. There are many different use activities going on simultaneously, and VIRK has several roles in this web of activities:

- VIRK is the instrument of management of NLIS to make sure, that the people who contact NLIS get answered in due time (VIRK acts as a **system** with respect to this purpose, because management is not in any direct contact with VIRK - the work is delegated to secretaries, primarily, who enter registration of documents, distribute the documents to the inspectors physically, and follow up on deadlines, using the system, as well as paper based lists). This is the real *raison d'être* of VIRK, and most of the organizational structure as such. The parts of VIRK that have to do with lists of correspondence and with deadlines are important for this activity.

why (management) people get answered in due time

what (secretaries) enter registration of documents,
distribute documents
follow up on deadlines

how (using VIRK) key in document data
extract inspectors deadlines

- VIRK is used when following up on the work of the inspectors, and more overall of the whole branch office. Various statistics are important output. These statistics are used by management to control and plan the activity. Data entry for this is done by inspectors, in VIRK and in another registration system. Secretaries too do data entry, and extract the statistics, but have little to do with the contents of the statistics or what they are used for, thus VIRK is again a **system** for this purpose.

why (management) following up inspectors, and branch office

what (management) statistics

how (using VIRK) (inspectors and secretaries) key in production data

- VIRK is used when distributing cases to inspectors. In the current version of VIRK the secretaries and inspectors complain that they lack access to appropriate statistics to see the work distributed to the individual inspectors, and to plan the work. VIRK should act as a **media** with respect to this purpose, but does not.

why distributing cases

what statistics,

how (using VIRK) (mainly secretaries) look up who has case/area, how many cases, etc.

- Furthermore, VIRK is used by the individual inspector and secretary to handle a certain case. The inspector "takes the travel card", he makes notes, he looks for correspondence of relevance to the present case, etc. The secretary pulls out information about a company for a campaign, she follows up on deadlines, etc. For this purpose VIRK is a **tool**, and in some ways also a **media**, yet, for this purpose as well, the inspectors and secretaries would like more support. In particular the kinds of information that can be

written down regarding a visit or a case is very limited, and in most cases very quantitative.

why (inspector) handle case

what (inspector) "takes the travel card", makes notes, looks for correspondence, etc.

how (using VIRK) browse for relevant data, uses search facilities

- Finally, VIRK is used by a secretary every time a document is registered in the system (**tool**).

why (secretary) register document

what (secretary) register document

how (using VIRK) key in data using the correspondence form

This analysis brings into focus, that *VIRK is designed as a planning and control system, which works rather well*: management gets what it wants, both with respect to the delegation of cases, and to monitoring the activity of the individual inspectors and branch offices. Data-entry works rather well too.

VIRK is organized hierarchically, and it is hard to get from one function of the system to another. This is very much in line with the hierarchical way the organization as such is built up, and the division of work, when viewed only from the point of view of planning and control.

With the current organization of work, the inspectors and secretaries try to use VIRK as a *tool* to work on the individual cases, both when registering information about the case, and when retrieving information to get an overview of a case. VIRK is less successful in this respect.

Furthermore VIRK should function as a *media* when distributing cases and working together on or taking over cases, and again there is little support in VIRK for this kind of use.

The needs and wishes of the secretaries and inspectors go in the direction of integration, of media for co-ordination of cases, tools for over-viewing ones own cases, and for registering more informal and qualitative data about the cases. The facilities which are available in the application at present, are not very suitable for these purposes, and there seems to be no easy way of extending VIRK to fulfil these needs even though the data is available in the database. This is because the application is built according to a systems perspective, viewing the human end-user primarily as somebody who provides accurate input to the system, thus input data need to be very well defined, etc.

Generally, the objects that one can work on, in or through VIRK, have to do with recording the state of the overall activity. Descriptions and lists of documents, lists of cases, of deadlines, and various statistics, are the objects *in* VIRK. The contents of the cases, which are the objects dealt with by inspectors and secretaries when handling a case are almost absent in the system. There are some objects of normal daily activity present in VIRK:

- travel cards that the inspectors take (print out and mark in VIRK as "taken") before leaving for an inspection. They contain information about the company, but are also

meant to prevent several inspectors from going to the same company, by coincidence, at the same time.

- various lists and overviews, such as companies sorted by street name, and correspondence with respect to individual companies.
- lists and overviews of cases held by the individual inspector.

The latter ones are hard to retrieve in VIRK because they can only be reached through the programming of a report generator. A detailed analysis of the focus shifts during a use situation [5] shows that the artifact is definitely not *transparent* with respect to these lists and overviews. Also the fields available on e.g. the travel cards get in the way of noting what needs to be noted about the case. The user never gets the impression that he or she is working through the artifact. One may say that the few attempts in VIRK to add media or tools features to the system are rather problematic, and that in this case the traditional purpose, the *why*, has caused problems for a good *how* for the new functions, a good user interface. With the activity, or clusters of actions that have to do with planning and control, matters are somewhat different. Since these actions take place remotely from the actual controlling activity, the registration becomes a purpose of its own, handling of the artifact and of the contents, are almost becoming one and the same thing, and the human-computer interaction works rather smoothly. In a way VIRK is a tool for this very limited cluster of actions that have to do with routinized data entry.

3.3 Conclusions About the Combined Analysis

In many ways the interaction of VIRK seems to work appropriately with respect to the original core functionality of distributing cases and collecting statistics for "upwards" accounting. The division of work, by which the secretaries are entering data about single documents and cases, and these clusters of actions are rather well supported by VIRK. The additional functionality that is needed to make the branch offices, teams within these, and individual inspectors work with their cases through VIRK is hardly supported at all. These types of work are newer and the pieces of VIRK which support activities related to this are add-ons to the original system, and hard to get to. This despite the fact that VIRK was built after most of these changes of work had been taking place. It is no coincidence that the secretaries and inspectors are the ones who ask for computer support that can be characterized as media or tools, whereas what management has asked for in VIRK is a system. Clashes between these views are seen throughout the use of VIRK.

An open question remains: to what extent does the original systems perspective and purpose restrict possibilities for adding easier and better access to the functions needed by branch offices, teams within these, and individual inspectors? To what extent do the original purpose set limits to a better human-computer interaction?

4 Discussion and Prospects for the Approach

Reflecting on use of computer applications as a web of activities with different purposes, in which the computer application plays different roles helps focus on problems and contradictions in the interaction with the computer application. The roles that the computer application plays are appropriately, but in no way exhaustively, described using the perspectives of *systems*, *tools* and *media*. These are used to characterize important properties of *how* the computer application mediates activities, in particular regarding control of the interaction and transparency of the artifact.

Historical analyses of artifacts and work activities are useful in situating this analysis, bringing focus to the question of *why* use is organized the way it is, why the different roles of the artifact come into play, and in particular in understanding why some of the above contradictions occur. This *why* is reflected in what can be achieved by using the computer application and in how this is done; in the possible actions and operations undertaken by the user in each specific use situation.

My approach provides an alternative to traditional analysis of human-computer interaction which most often has no way of bridging to the specific use context of the artifact. What I have tried to show is that such a bridge can be developed when starting from human activity theory, whereas this paper does not account for a detailed analysis of the human interaction with VIRK in a use situation. In Bødker (in preparation) the actual interaction of users with VIRK is mapped out and studied.

Historical analysis and conflicting perspectives analysis are first steps towards a more contextualized analysis of human-computer interaction. Much more empirical work needs to be done, and more techniques need to be developed. In the end a major challenge may well be to come up with a theoretical framework which is different from but as detailed and operational as the traditional approach in HCI based in cognitive science.

Acknowledgements

Thanks to Morten Kyng, Markus Stoltse and Kaj Grønnebæk for comments on this paper, to Randy Trigg and Liam Bannon for comments on earlier drafts, to Mike Robinson and Ellen Christiansen for recent inspiring discussions about tools, media, etc., to the NLIS project group (Ellen Christiansen, Pelle Ehn, Randi Markussen, Preben Mogensen, and Randy Trigg) and to the folks at NLIS. The work has been supported by the Aarhus University Research Fund.

References

1. L. Bannon, S. Bødker: Beyond the Interface: Encountering Artifacts in [7] pp. 227-253.
2. O. Bisgaard, P. Mogensen, M. Nørby, M. Thomsen: Systemudvikling som lærevirk-somhed, konflikter som basis for organisational udvikling (DAIMI IR-88). Århus, Aarhus University, 1989.

3. S. Bødker: A Human Activity Approach to User Interfaces. In Human Computer Interaction, T. Moran, (Ed.), Vol. 4, No. 3, 171-196 (1989).
4. S. Bødker: Through the Interface – a Human Activity Approach to User Interface Design, Hillsdale, NJ: Lawrence Erlbaum Associates, 1991.
5. S. Bødker: Understanding computer applications in use - a human activity analysis. In P. Bøgh Andersen, B. Holmquist H. Klein, R. Posner: The semiotics of the work-place, in preparation.
6. S. Bødker, E. Christiansen, P. Ehn, R. Markussen, P. Mogensen, R. Trigg: Computers in Context. Report from the AT-project in Progress. Report of the 1991 NES-SAM conference, Ebeltoft, Denmark, 1991.
7. J. M. Carroll (Ed.): Designing Interaction: Psychology at the Human-Computer Interface, New York: Cambridge University Press, 1991.
8. Y. Engeström: Learning by expanding. Helsinki: Orienta-Konsultit, 1987.
9. J. Kammersgaard: Four different perspectives on human-computer interaction. International Journal of Man-Machine Studies, 28: 343-362 (1988).
10. S. Maass, H. Oberquelle: Perspectives and metaphors for human-computer interaction. In C. Floyd et al. (Eds.): Software development and reality construction., Berlin: Springer Verlag 1992, pp. 233-251.
11. R. Markussen: A historical perspective on work practices and technology. In P. Bøgh Andersen, B. Holmqvist, J. F. Jensen (Eds.): The Computer as a Medium, Cambridge University Press, in press.
12. D. Norman: Cognitive artifacts. In [7] pp. 17-38.
13. M. Robinson: Introduction to "common artefact". COMIC-SF-4-1, 1992.
14. P. Sørgaard: Object Oriented Programming and Computerised Shared Material. In Second European Conference on Object Oriented Programming (ECOOP '88), ed. S. Gjessing, K. Nygaard, 319-334. Heidelberg: Springer Verlag, 1988.

¹In the Esprit EuroCODE project, Ellen Christiansen, Mike Robinson, and I have worked to characterize shared material and common artifact in terms of activity theory.