

VERSIÓN ORIGINAL:

USER MODELLING: A GLOBAL PERSPECTIVE

INTRODUCTION

It is now widely recognized that the design of computer-based information systems is more than a technical or technological problem. Participative design technologies such as that developed by Mumford [1] and the use of Soft Systems Methodology [2][3], are now widely recognized as necessary to ensure that systems devised for organizational use fit the needs of departmental users. Thus, in the financial services sector one might expect to find a majority of departmental staff on a development team rather than a majority of systems analysts and programmers.

However, there is still something of a gap between the recognition of departmental or organizational needs and their satisfaction in systems terms and the recognition of the perspective of the individual information user. This paper seeks to address that issue by proposing a wider perspective of the user than that commonly adopted in modelling user behaviour.

USER MODELLING: THE COMPUTING PERSPECTIVE

The computing perspective on user modelling appears treats the information user from several different perspectives [4]:

- from the position of the designer's view of the system user;
- from the perspective of the user's cognitive style; and
- as a source for the automatic modelling of user interactions with the system.

As a machine user, the individual has to use particular pieces of technology, such as a keyboard, a mouse, possibly a touch-screen pen, a floppy disc and to manipulate these to gain access to files and applications to create documents of one kind or another, or to engage in more advanced work such as the production of multimedia products.

Computer manufacturers, therefore, have been interested in the ergonomics of these interactions and have designed tools with the appropriate characteristics to meet human physiological needs. Thus, Microsoft has produced an 'ergonomic mouse' and an 'ergonomic keyboard', designed to reduce fatigue and the possibility of carpal tunnel syndrome [5]. Similarly, a considerable amount of work has been carried out on the design of screens [6] and on the problems of creating and using text on screens [7].

However, the computing perspective also sees the user as a system user and, therefore, attention is devoted to such matters as how the system user typically gains access to different parts of the systems; how he or she 'navigates' over a screen or set of screens to locate necessary parts of, for example, a data input form; how the system as a whole is used, for example, by logging the way the user moves from part to part of the software; and how

the user formulates questions and queries when searching help files [8] or using SQL routines.

This takes the work into the area of cognitive modelling where the intention is that, through understanding the cognitive processes of the computer user or information-seeker, systems that are more in tune with those processes can be developed. Work at Sheffield, for example, has focused on the effect of cognitive style on information-seeking behaviour [9] [10] [11] and reveals differences in such behaviour by people with different learning styles. A more general perspective on cognitive styles was presented by Benbasat & Taylor [12] who showed that analytic decision-makers had different styles from those who employed heuristic methods, and that there was another division of style into perceptive and receptive, which also had implications for system design. Thus, ANALYTICS preferred quantitative decision aids, while the heuristics needed more search capabilities and, preferably, simulation routines built into systems through which they could employ trial and error techniques. The PERCEPTIVES wanted data categorization and exception reporting, while the RECEPTIVES needed access to 'every piece of historical data'.

INFORMATION IN THE ORGANIZATION

Before moving on the present a wider perspective on the information user it is necessary to define more clearly what we mean by information, since the word is used in many different ways. For example, there has been a tendency to drop the use of the phrase "data-processing system" in favour of "information system", without actually changing the nature of the system and most so-called information systems are still data-processing systems.

The distinction is that data only becomes information when meaning is attached through interpretation. Thus a set of population figures only becomes information when it can be analyzed in terms of increase or decrease over time, growth or decline in various population groups, and so forth.

Intelligence, on the other hand, is information that can be put to strategic use. A weather report is useful information, but for the army general in the field of battle, it is crucial intelligence that can affect the future. Similarly, at the strategic level of organizations, information systems are likely to be less useful than intelligence systems and all intelligence needs the input of human minds to determine what the information means for the future of the organization.

Most of the intelligence that an organization needs will be drawn from outside the organization, since it relates to the competitive environment in which it finds itself - information on markets, on market trends, on competitors' actions, on economic trends generally, and on legislation that may affect the organization's future or functions. Information systems that fail to provide access to external electronic information sources and that enable some intelligent filtering of that information will be less than fully useful at the executive level.

It must also be noted that 'information' is both a product and a process. Information is regarded as a 'thing' or a 'stuff' because, traditionally, it has been embodied in artefacts such as books, journals, newspapers, etc. However, radio and television programmes, although delivered through an artefact, are less tangible, because they are less permanent - unless taped. Consequently, they draw attention to the process involved in information

acquisition, which, in these terms, is purely mental in character - we watch and/or listen to the programme and how much 'information' we receive is not a function of the number of pages of 'stuff', but of the mental processes of understanding and integrating the data into our personal knowledge structures.

When we come to consider computer-based information systems, the situation is similar: we read from a screen and can immediately delete, for example, an e-mail message. The information is transitory, reference back to it is not a matter of picking a book off a shelf, but of recalling the search strategy that took us to the information. We have to integrate not only the information, but also the steps we took to get the information - and many information systems are less than friendly in enabling access to information sources.

THE INFORMATION USER IN THE ORGANIZATION: THE WIDER PERSPECTIVE

Beyond the individual, and beyond the individual in interaction with the computer or the information system, however, lies the social and organizational world of the information seeker.

The organizational worker lives within a set of social "worlds" - the world of the work-group with whom he or she accomplishes the tasks of the organization; the world of the friendship group that may overlap but not totally encompass the work-group; the world of the reference group, that is, those persons in the organization that the individual takes as models of behaviour or of accomplishment - the persons the individual would most like to emulate; and the formal world of the organization in its totality, in which he or she has a role, a set of functions, an organizational position, and so on.

The fact that the information system user is also a member of all of these social worlds and that they are sustained through communication is something that must be remembered in designing organizational information systems - above all, they must be systems that relate to and, where possible, enhance the existing communication systems. This is one reason why electronic mail is now recognized as one of the drivers that encourages the adoption of information technology, and why a one-to-one ratio of terminals to users is essential if the full benefits of IT are to be obtained.

THE USER AT WORK

Within the work-group and the organization there are a number of issues that are likely to affect the use of information systems. First, the aims and objectives of the individual and the group or organization do not always coincide. At a fundamental level this affects the individual's motivation, for example, if he or she believes that the organization is not providing adequate support for the attainment of personal objectives, and it also affects the motivation to communicate with others and to use information/communication systems. The most evident circumstance in which this mis-match may affect performance is when there is conflict between individuals, or between the individual and the organization. In situations of conflict, one response is to withhold information, so that it can be used as a bargaining chip in any negotiations to resolve the conflict. In really serious conflicts the individual may deliberately damage the information system, for example by leaving behind a 'software bomb' when dismissed from the organization.

However, the very nature of the structure of organizations and the distribution of different kinds of work may also inhibit information flows and/or the use of information systems. For example, in some service bureaucracies the effectiveness of information systems may depend crucially upon those who work at the operational level and may fail because those workers see little benefit from the systems in terms of supporting their own work. In the UK, social services departments, which provide social welfare services to disadvantaged, elderly, and handicapped persons, have found great difficulty in creating effective information systems for management. The reason has been that such systems depend for their data on the input from basic grade social workers, who see little benefit to their own work from the efforts they are asked to make in providing the data. Consequently, they have little enthusiasm for the systems and, in a number of instances, acted in such a way as to undermine the system completely, leading to its abandonment.

A model of the user, therefore, must begin with a model of the organization in which the user works, and with an understanding of the various organizational and interpersonal influences that may affect his or her information-seeking behaviour.

COMMUNICATION BEHAVIOUR

We can begin to look at the user's information-seeking behaviour by considering communication in organizations generally. We can typify that behaviour as being predominantly oral communication, much of which takes place in meetings, and which is further characterised by frequent interruption. The higher we go in the organization, the more oral communication dominates, and the more meetings dominate. At all managerial levels, interruption is a constant fact of life. We can look at these characteristics in a little more detail:

Oral communication

First, consider the fact that oral communication dominates. This is particularly true of managerial levels and may also be true of other levels in some organizations. It may not be so true at lower levels in production-line factories, for example, where the oral communication that takes place may be partially work-related, but which also encompasses many other topics - such as sport.

Evidence for the dominance of oral communication has been gathered by a number of investigators: for example, Mintzberg [13] noted that, in his investigation, oral interaction "accounted for 78 percent of the five managers' time and 67 percent of their activities", while other investigators had found even higher percentages.

In my own work on communication in social services department in the UK, we found that 61% of all communication events involved oral communication, either face-to-face or by telephone. As the report noted:

"...one senior manager... was so alarmed by the data relating to his own behaviour that he reported... that he was now committing much more to paper because he realized that misunderstandings could arise from over-dependence on oral information transfer." [14]

Meetings

Just as investigators have found oral communication to be significant, so they have found that meetings are likely to occupy a great deal of time, especially for managers. Mintzberg found that scheduled meetings occupied 59% of the time of his five managers, and we found that directorate level staff spent, on average, almost 17 hours a week in meetings, either scheduled or unscheduled. In our own investigation the difference in time spent in meetings was obvious, with executive level spending almost 17 hours a week, line managers just over 13 hours, with the 'operational' staff spending only 5 hours.

Level of Staff	No. of staff	No. of Meetings	Ave. No. of Hours
Directorate	5	60	16.8
Line Manager	5	38	13.4
Specialist	4	21	6.5
Fieldworker	6	19	4.8
Administration	2	3	0.6
Totals	22	141	9.0

Table: Time spent in meetings

Interruptions

The other major characteristic of managerial work is the level of interruptions that take place in the ordinary working day. The lower the level of the manager, the less likely it is that a PA or secretary bars the way to telephone callers or personal callers and, in any event, the individual may be called to meet with a superior or some other person (local government politician, for example) who cannot be denied, and will have scheduled meetings in the diary that have to be attended.

This interrupted character of managerial work has been referred to by several investigators: Stewart [15], for example, in a study of 160 managers, found that, on average, they had only nine periods of uninterrupted work for at least half an hour in four weeks. Carlsson [16] also reported a similar phenomenon in analysing one managing director's work over thirty-five days: on only twelve occasions did the manager work undisturbed for periods of at least twenty-three minutes.

Our own work [17] showed that more than 70% of all communication events in social services departments were completed in three minutes or less and that when directorate level staff were in their own offices an astonishing 86.5% of events were over in one minute or less. This suggests that they can tolerate a high level of interruption since the greater portion of their work is highly fragmented.

IMPLICATIONS FOR SYSTEMS DESIGN OF THE WIDER PERSPECTIVE

There is a sufficient body of research on the nature of organizational work and on the effect of cognitive style on information-seeking behaviour to suggest that systems based on a model of the user interacting with the computer is likely to be too limited for the creation of effective systems.

Reference has already been made to the work by Benbasat and Taylor and it is clear that cognitive (or learning) styles do vary among individuals, and that it is highly unlikely that a system designed according to one cognitive model will fit the behaviour and expectations of a user whose model is different. The situation here is complicated by the fact that system designers, analysts and programmers are likely to have very linear, analytic cognitive models themselves and, hence, are likely to design systems that match their own models! However, as the research on managerial style suggests, there are other behavioural characteristics that are likely to affect the usability of information systems.

First, we do not yet have systems commonly available that enable the user to interact in the way he or she finds most congenial - that is, orally. Speech recognition systems are improving all the time, but we are some way from a totally interactive system in these terms. Yet we can hazard a guess that information systems designed for managers, and particularly for chief executives, will not achieve very great penetration until they allow for oral communication. It is interesting to note, for example, that executive information systems, originally intended for the board room and the executive office, are actually being used much lower down the organization and that it is likely that these users are specialists rather than general middle managers [18]. Further evidence for this proposition lies in the fact that in many organizations voice-mail systems are more widely used than e-mail systems and, given the oral character of organizational communication it is easy to see why this should be so.

Secondly, existing systems are designed as individual user systems: they are not well designed for common use in a meeting, nor is the normal form of a meeting particularly appropriate for using the technology. The technology is lacking, in that large-screen displays are cumbersome and more sophisticated alternatives are expensive and fitting out a meeting room with custom-built systems would be very expensive - one would need, for example, not only the large-screen display, but also individual screens for each participant in the meeting, probably embedded in the table, with touch screen displays reflecting individual use on the large screen. However, even if this was technologically successful, the nature of meetings would have to change if maximum benefit was to be derived. Changing social behaviour, even on this relatively small scale, is unlikely to be easy.

A further problem is that the information in the system may not be designed for use in meetings and, almost by definition, is unlikely to be structured around the topics of debate at the meeting. And, yet, as we have seen, meetings occupy significant amounts of time in organizations and are, in effect, the way that business gets done. The problem, of course, is that information structures and information content are not capable of being readily manipulated either in preparation for the meeting or during the meeting. By definition, new issues arise in meetings that require different analyses of data or access to information in an *ad hoc* fashion. I would guess that close to 100% of existing systems are no where near flexible enough to serve as adequate meeting support systems.

Finally, and perhaps most importantly, a manager's work is highly fragmented with many interruptions in the course of the working day. This inhibits the extent to which an individual can learn how to use a system and, given the extent to which systems change, either in functionality or in the user interface, each use of the system may involve some degree of re-learning or, if those uses are very separated in time, initial learning. In my opinion, this is perhaps the most under-rated problem of all. System designers are constant system users and find it difficult to put themselves in the position of the occasional user

who may be not only technologically naive, but also fearful of the technology. This is a major challenge for system designers - how to deliver a system that at first use and at each successive, but occasional use, will, in effect, teach the user how to use it while at the same time responding effectively to the user's needs.

CONCLUSION

This rapid review of the many meanings of the user model and of the findings of research on managerial behaviour serves to draw attention, yet again, to the fact that no part of an information system can be isolated from the contexts of individual and organizational behaviours. Leavitt's [19] famous diamond which shows the relationship between various aspects of the organization ought to be on the wall of every systems design office:

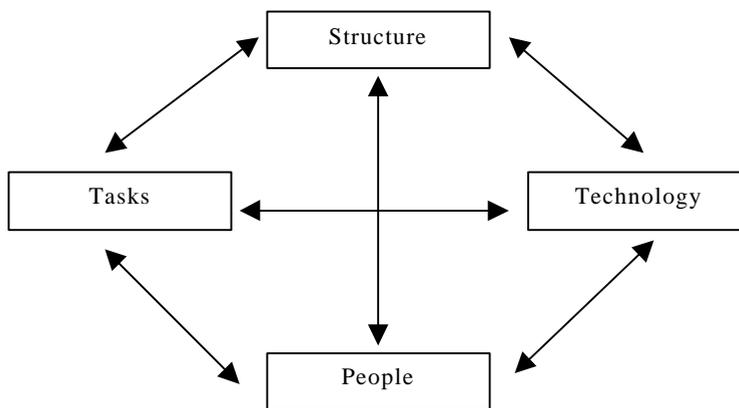


Figure 1: The Leavitt diamond

The message of Leavitt's diamond is simply - every element of organizational life affects every other: change the technology and you change the task and ought to change the structure and the people. Change the people, and they will find new ways of performing tasks and the technology must adjust, as must everything else.

A user model, therefore, must be an organizational model, not a systems model, or an individual model and a limited, system perspective of the information user in the organization will not provide a sound basis for the development of future, usable information systems. Technology will drive development but, equally, the final form of those developments must respond to the wider world of the information user.

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