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Usability of complex systems in the organisational context

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This paper describes research into contextual factors that appear to influence the successful implementation of a complex system in an organisation. A grounded theory approach was used to collect and analyse data on the introduction, into a large educational institution, of a timetabling system that was already well established in another similar organisations. The results of the study show that the usability of a system which supports complex tasks can be critically determined by the organisational context but this can be overlooked with detrimental consequences.

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Usability of Complex Systems in the Organisational Context

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Abstract

This paper describes research into contextual factors that appear to influence the successful implementation of a complex system in an organisation. A grounded theory approach was used to collect and analyse data on the introduction, into a large educational institution, of a timetabling system that was already well established in another similar organisations. The results of the study show that the usability of a system which supports complex tasks can be critically determined by the organisational context but this can be overlooked with detrimental consequences.

Keywords

Usability, organisational context, complex systems

INTRODUCTION

The aim of the study presented in this paper is to gain a greater understanding of contextual issues that affect the usability and usefulness of complex systems in a real working environment. Some of these usability issues may be overlooked in the processes of systems development and implementation but are critical to its success.

To maximise the usability of a product, traditional HCI wisdom recommends participatory design methods with regular usability testing of systems prototypes (for example Ehn 1988; Bannon & Bodker 1991). These should start as early as possible in the design process and involve future scenarios of use with surrogates or representatives of real users. Even though designers of organisational computer-based systems are concerned about the context of their use, most usability testing takes place either a laboratory or under conditions which cannot take account of all possible contextual issues. As Thomas and Macredie (2002) suggest "most usability testing regimes assume the context of a person facing a computer, the luxury of the person's full attention, and a comfortable environment with minimal distraction." The organisational environment is dynamic, complex, changeable and unpredictable. People, particularly those working under pressure of tight deadlines and performance targets, will invariably interact with a system in different ways depending on the particular context at the time and place of use.

When an organisation is looking for a computer system or application to support part of their operation it is not uncommon for them to consider a system that is already in use in an organisation similar to itself. Those responsible for system's acquisition are considerably influenced by any advice they receive on experiences with the intended system from those who have successfully used it. Such communications between organisations may only occur at management level so that actual end-users are rarely involved. Issues of system usability are therefore assumed to be unproblematic in the organisation, as the system has been used in a real world situation. Even less of a consideration is whether the context of use in the receiving organisations is similar to those where the system is currently being used so that systems transfer can take place with ease.

The case chosen for this research was the introduction of a comprehensive, computer-based timetabling system into a large educational institution. This choice of case study site was made shortly after the initial implementation stage of the project when it was recognised that severe problems were being encountered by several sets of stakeholders. No such problems had been anticipated by the project managers as this application was already doing well in several other similar institutions. The main aim of the research was to gain some understanding of the situation and identify issues that were making the successful generation of the timetable so difficult with the new system. It was therefore decided to adopt a grounded theory method of data collection and analysis, which approached the study with no preconceived hypotheses and allowed core categories to emerge from data and which could be investigated further. This method could potentially produce original findings and not just verify or reject predetermined concepts.

The paper begins with a brief description of background of the case. It is followed by an explanation of the research method before the data collection and its analysis is described. The paper concludes with a summary of the research data.

BACKGROUND INFORMATION ON THE CASE

The case chosen for this study was the introduction of a new computer-based system to substantially automate the timetabling process in a large educational institution. The scheduling of the annual timetable of classes in this large educational institution is a complex and time-consuming task. The number of students increases every year while resources are stretched to the limit demanding increasing efficiency in the fit of classes to space and time. Furthermore, class numbers and course offerings frequently change after the timetable has been created to match real-time demand. In order to achieve efficiency with the use of resources and produce an effective flexible timetable a sophisticate scheduling system is required.

In the chosen case, the new computer-based timetabling system had been purchased which promised to increase efficiency and transform the use of both physical and human resources by automating much of the effective timetable processes for classes. The vendors claim that the system was designed to automate all the logistical aspects of the teaching activities of an institution under every conceivable constraint, including the allocation of class space, time and teaching staff. The senior management and the registrar were also involved in the decision on the mode of introduction of the new timetabling system into the institution on advice from an external consultant. According to the external consultant, who had assisted with the introduction of this system elsewhere, the new system was successfully implemented in other similar educational institutions

In the previous timetabling process, school timetabling officers would send information of each subject to be run in their school the coming year in a spreadsheet form to the institution's timetabling officer. He would then manually create a timetable making appropriate adjustments from the current year. When the new timetabling system was implemented, the school timetabling officers were supposed to be able to enter data directly into the system on class details, resources needed and any special constraints. The timetabling officer only needed to check the consistency of the data and then run the function that would automatically allocate a time slot and space for all classes in an annual comprehensive timetable.

At the start of the research described below, the new process was underway but had completely broken down in two respects. Firstly, most of the school timetabling officers had found the system unusable and had not been able to enter data correctly. So the previous spreadsheet process had been reinstated with system data entry done by the central institutional timetabling officer who was an expert user. He was eventually given the services of an extra assistant for this. Secondly, when the timetabling function had been run, the resulting timetable had many problems most of which had to be rectified manually in a rush of overtime at the last minute.

RESEARCH METHOD AND DATA COLLECTION

The research approach was a field study, in which a variety of data would be collected through various methods with no preconceived research questions or hypotheses. A grounded theory approach has been shown to be suitable for this type of research (Glaser and Strauss, 1967; Glaser, 1998; Martin & Turner, 1986). It enables the revelation of details within complex phenomena in an organisation when a substantial system is implemented. It allows concepts to emerge from the data, which are then organised by the researcher into core categories, which are then investigated further through literature searches and, possibly, additional data collection.

The research plan was to collect data through interviews, observations, usability tests and relevant documentation. This process lasted over a year from mid 2002 until end of year 2003, covering the preparation of both the 2003 and the 2004 timetables. Key stakeholders interviewed were the senior manager responsible for the project, the registrar, the external consultant, the institution's timetabling officer, school timetabling officers, IT system support staff, teaching staff, and students. The majority of the interviews were with the school timetabling officers who were considered as the main direct users of the new system. Relevant documentation was collected from the start of the implementation and included system documentation, user training manuals, instructions to staff and a comparative evaluation of resource utilisation before and after the introduction of this new system. The grounded theory analysis involved summary, inspection and interpretation of the data.

RESEARCH DATA SUMMARY

Space restrictions prevent a complete presentation of the development and results of the grounded theory analysis. This section of the paper, therefore, contains a summary of the case emerging from the collected data, concentrating mainly on the interviews and usability tests with the school timetabling officers attempting to use the new timetabling computer-based system in support of the complex timetabling task.

Despite a small trial with two of the smaller schools in the institution, there seems to have been little anticipation that there would by any problems management decided to change completely to the new system in 2002 for the 2003 timetable. A brief introduction was provided to school timetabling officers in only one session (of about 30 minutes) by the external consultant and the institution's timetabling officer. No actual training was provided to the timetabling officers; instead they provided a manual and list of instructions about the system to the officers, most of whom had little knowledge about the system when they were interviewed by the researcher.

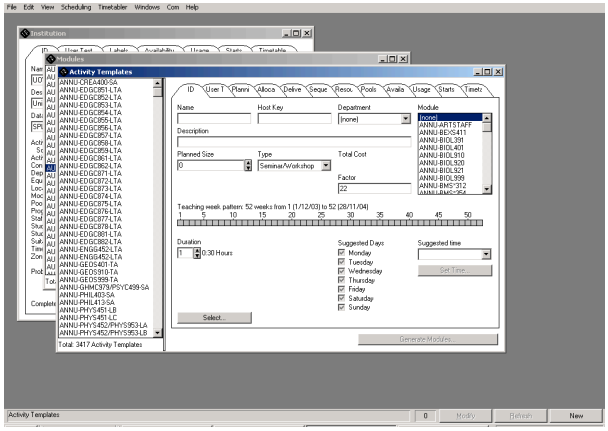

Figure 1. A typical screen of the new timetabling system showing 12 tabs from which to choose and the long pick lists in the drop down boxes. Usability tests confirmed that even experienced timetabling officers were confused and could not find desired functions or successfully complete required tasks.

The institution determined a particularly short time frame for the school timetabling officers to input data into the system (see a typical screen in Figure 1) in the introductory year. Consequently, most of the officers could not finish on time because they had problems with the usability of the new system. Most reported that they had attempted to learn to use the system by themselves. There was only one person, the institution's timetabling officer, that they could ask to help them to fix the problems. He was the one expert on using the system in the institution, and had to help more than 20 timetabling officers as well as do his own job. He was not trained to deal with this task and so it was impossible to fix problems for all of them at the same time. However it was due to his long hours of manual effort that the timetable was eventually created.

The need for the institution's timetabling officer to do most of the data entry caused the 2003 timetable to be delayed and some teaching staff could not get the correct information for their subjects in time for the start of session. When the first draft of the 2003 timetable was eventually produced by the system, there were many problems that much of the actual timetable ended up being created by the old manual process. Many complaints and requests for changes from academic staff were received and school timetabling officers were not able to respond to them promptly. This caused widespread discontent among administrative and teaching staff alike.

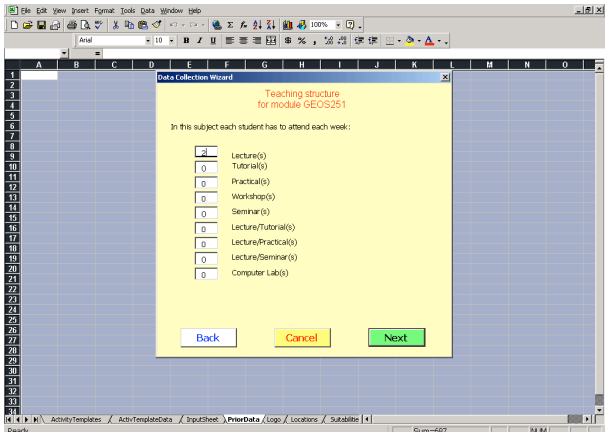

Figure 2: A screen of the simplified software module. Usability testing indicated that users were frustrated that it would not allow them to do anything but enter very routine details of subjects.

The development team, consisting of the external consultant and the institution's timetabling officer then formed a user group to gather information from school timetabling officers' problems and their suggestions. After

receiving many comments from the user group, the development team spent unintended time to created a simplified software module (see Figure 2) to enable the school timetabling officers enter the data easily. This module provides a simplified step-by-step process for entering a routine subset of data, which was stored in a spreadsheet that could be sent to the institution's timetabling officer to import into the main system. The timetabling officers had to provide this sort of information in a separate Word document form. It occurred to us that other institutions using the system must have also encountered this problem and done something similar but the knowledge was not transferred to the institution in this case.

DISCUSSION AND OTHER ISSUES

The timetabling process for the 2004 timetable was somewhat better, because school timetabling officers were becoming more familiar with the job, the process, and the system. They were provided with more training, and given better written instructions, both in the use of the new module that helped them to enter data more easily, and also in some functions of the timetabling system itself. However, there were still problems with the new simplified interface module for data entry and the resulting timetable produced by the system. The data entry process is not as straightforward as the step-by-step process in the module shown in figure 2 would suggest. There is such variety in the way different subjects run and the single simplified interface does not allow users to enter specialised information or other requests for less straight-forward classes. The timetabling system itself does not take into account much of the tacit knowledge of special conditions or information. An example of this is the varied reasons for repeat lectures. The system was programmed on the assumption that lectures were repeated because the class was too large for any available room whereas often the repeat lecture catered for different groups of students, such as part-time working students or to fit in with off-campus classes. This type of problem caused the officers to recheck the timetable drafts many times, greatly increasing their workload.

The main concern of school timetable officers, who are the main end-users, is that they cannot get their job done on time because of a lack of knowledge and understanding of the new system itself and the whole timetabling process that seems to have changed to meet the constraints of the new system. The change of the process using the new timetabling system has increased their workload while the old process was already working well from their perspective. Much of the complexity of the timetabling process may still be best handled by people and indeed are still done by system workarounds. It is generally believed that the system attempts to automate too much of the process that is not as stable and specifiable as the system demands.

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