

Usability in Context: Improving Quality of Use

Miles Macleod

National Physical Laboratory, DITC, Teddington, Middlesex, TW11 0LW, UK
Tel: +44 81 943 6097 Fax: +44 81 977 7091 Email: miles@hci.npl.co.uk

1. INTRODUCTION

This paper considers the usability of information systems and IT products in terms of their quality of use for specific users seeking to achieve work goals in particular environments. It describes Usability Context Analysis (UCA), a practical cooperative method for identifying and recording contextual aspects of usability in system development or redesign, and for helping ensure that usability evaluations reflect the context of use and give data with acceptable ecological validity. It draws on experience of applying UCA in commercial settings, working cooperatively with people who have a stake in system development and procurement – including users and managers – to arrive at a clear, shared, documented view of the context of system use. UCA has been developed by the UK National Physical Laboratory (NPL) and HUSAT Research Institute as part of the MUSiC (Measuring Usability of Systems in Context) toolkit. The paper briefly outlines MUSiC methods and tools for quantitative usability evaluation, which complement UCA and support the measurement and improvement of usability.

There is still a demand in many parts of Europe, especially in the field of software engineering, for a one-shot ('waterfall') development process for IT systems. Unfortunately, it is rarely possible to prespecify adequately the real-world needs of users and organisations. For users, the outcomes of one-shot development too often fail to deliver hoped for benefits. While the methods described in this paper can be used in enlightened one-shot information system production, the developers of the methods emphasise the value of an iterative, participative prototyping approach, which aims to shape systems to meet user needs.

The broad view of usability as quality of use, which underlies the work reported here, stresses the importance of the contexts in which an IT system is used. It avoids the dangers of preoccupation with superficial features of a user interface. Sometimes it is suggested that simply adding a graphical interface, and providing a selection of widgets, will 'solve usability'. As many good designers appreciate, usability is deeper than that. What they may not fully recognise is that designing for usability means providing users with a manner of interaction which meets the needs of those users for achieving their task goals in their own work environments. Even where this is recognised, designers and evaluators may lack access to adequate information about the characteristics of users, tasks and environments.

Viewing usability in terms of quality of use opens the way to evaluation which can inform design and redesign, to enable improvement for users in the workplace. It also makes it

possible to obtain meaningful *measures* of usability, as well as qualitative data. Measurement of usability enables comparative testing against agreed criteria expressed in terms of levels of effectiveness, efficiency and satisfaction with which task goals are achieved, in context.

2. EVALUATING USABILITY

There are two prerequisites for any evaluation, if it is to have valid and useful results: the data must be drawn from circumstances which have acceptable ecological validity; and an appropriate method must be applied for analysing the data.

It was recognised in the 1980's that usability testing has often failed to meet the first prerequisite [1], and it has been suggested that some laboratory studies have been so remote from conditions of actual system use that the relation of the data to life was at best irrelevant and at worst distorting. This probably understates the case. At its worst, such testing employed inappropriate users – often viewed as 'subjects' in an 'experiment', and perhaps chosen largely because of their availability – and assessed how subjects interacted with isolated parts of an information system, when instructed to perform a few low-level tasks in circumstances unrelated to actual work goals or the conditions of the workplace. Resulting data lacked validity and tended to focus on micro-issues, but the use of detailed statistical analyses could give the findings a gloss of credibility which might mislead the unwary.

The concern here is not only with the physical and organisational setting of the evaluation, but also the characteristics of users and tasks. Since a user-based evaluation can only study a subset of all possible tasks which a system can support, it should be based on studying representative tasks, chosen for their frequency or criticality. User characteristics are also important determinants of usability. For example, observing system designers using a system intended for use by administrative staff may tell us little about its usability for those administrative staff. The system designers' knowledge, background, and approach to computer systems, and hence the quality of use they attain with the system under test, are likely to be very different from those of the administrative staff, as is their knowledge of administrative tasks.

In MUSiC, the term 'context' includes the characteristics of the users and the work goals they are seeking to achieve, as well as the technical, physical and organisational environments in which they work. One of the principal aims of MUSiC in its research phase (a European collaborative project, partially funded by the CEC, which ran from 1990-93 and involved eight partners) was to develop a set of practical methods and tools for usability testing in context. Usability Context Analysis (UCA) [2] helps us specify systematically the characteristics of the users, the tasks and work goals they seek to achieve, and the circumstances of use. UCA underpins the MUSiC user-based evaluation methods. This paper focuses on the application of UCA within organisations.

3. COMMUNICATION AND QUALITY OF USE

The need for increased user involvement in system development is widely recognised, and in the field of Human-Computer Interaction (HCI) the case for user-centred design and development has long been made explicit [3], as has the case for participative design [4]. There is a long history of user participation in Scandinavian information system development. However, it is still widespread practice for much European development to be led from a software-centred perspective [5]. Even where companies employ human factors engineers to look after at least some user needs, the findings of human factors evaluations may be ignored

[6], rejected, or simply misunderstood by managers. In the UK HCI community, there has been much debate about how to get HCI into organisations, although the focus has been largely on reconciling HCI and software engineering.

Over the past two years NPL has pursued broader solutions to the problem. NPL Usability Forum [7] has brought together people from industry, commerce and academia with a professional interest in usability. The Forum explores issues of current concern, and meetings have involved 370 different participants from 160 organisations. Within organisations, evaluation work led by NPL with a range of European IT developers and procurers employing MUSiC methods has applied usability context analysis cooperatively. Although one possible way of applying the UCA method is for the context questionnaire to be completed by a usability analyst after interviewing a few members of the development team – and UCA has on occasions been used in this way – this manner of use misses many of the benefits of UCA. Usability context analysis works most effectively as a cooperative process, bringing together a range of people who have a stake in the development or use of an IT product or interactive system, whom we shall here refer to as stakeholders. Cooperative application of UCA has the effect of raising awareness of usability factors, and enabling agreement and shared understanding on user-centred issues.

3.1. Fostering communication through UCA

It is in the interests of managers with responsibilities for information systems to implement systems which are efficient and satisfying to use, and which meet user needs. What appears to be lacking in many organisations is effective and timely communication about user needs and usability. UCA can be employed as a vehicle for bringing together stakeholders representing different interests and different levels in an organisation. In commercial usability evaluation work at NPL we encourage the formation of a small, multi-interest usability team in client organisations. As a minimum this should include someone with human factors knowledge, someone representing user interests and someone from the development team. We recommend a training course in the use of MUSiC methods, including UCA. These people participate in the planning and conduct of usability evaluations, and inform and maintain contact with other stakeholders.

It is important to recognise that this team is neither a user panel nor a substitute for a user panel. A major element of UCA is to identify the characteristics of the various types of user of an information system. Then when planning an evaluation, users are chosen for each study who are representative in that they match the required user characteristics. In contrast, members of user panels who participate in the design of a system are likely to become increasingly unrepresentative users, as they absorb the designers' viewpoint. This is not a criticism of the value of user participation, merely a caveat about one means of achieving it.

The formal work of UCA centres on one or more group meetings. The requirement is for the usability team to bring together a number of relevant key stakeholders (typically 6 to 10) who are willing to make the time to be involved. The participants must be given adequate briefing in advance about the aims of UCA, and the information they should bring to the meeting. Stakeholders may include: product managers; project managers (procuring or developing systems); designers; quality managers; users; user support managers; documentation managers and technical writers; training managers; change management teams; work process analysts; people with responsibility for certification and audit; people with responsibility for health and safety; and human factors professionals.

The group should include people with sufficient seniority to make or influence decisions concerning the evaluation of usability of the product and the course of its development. The benefits of bringing stakeholders together as a group for the purpose of context analysis, at an early stage of system development, have become increasingly apparent as we have applied and refined the method with a variety of organisations. It gives a basis for airing possibly differing views, and arriving at a shared – or at least agreed – view of those issues which are relevant to quality of system use. It focuses the attention of decision-makers, in a structured way, on contextual factors relevant to the quality of use of their systems. It facilitates the subsequent process of acting upon the findings of evaluations. In applying the method, we have been surprised at the degree to which opinions can differ in an organisation about just who an information system is for, and the principal work goals it will support.

4. APPLYING USABILITY CONTEXT ANALYSIS

UCA is divided into a number of clearly-defined steps. When stakeholders have been identified and a usability team set up, the first steps are description of the product, and characterisation of its Context of Use. This can beneficially be carried out relatively early in system development. Subsequent steps identify characteristics potentially relevant to usability, define the Context of Evaluation, and produce a concise Evaluation Plan.

The process for defining context of use helps stakeholders collectively arrive at a clearly documented statement of the characteristics of the information system's (or product's) users, the tasks it is intended to support, and the anticipated circumstances of system use. These factors are described at a fairly broad level under a number of headings. The Context Questionnaire gives guidance on what to consider in answering each question.

In defining context of use, participants are explicitly instructed *not* to consider the constraints or circumstances of system evaluation. The aim is to arrive at a fair summary of the contextual factors relevant to use when a system is implemented. Once agreed, each answer is recorded by the person leading the context meeting, and entered in the Context of Use column of the UCA Report Table. We recommend that the completed table should be circulated among the full list of stakeholders for comment, where the development or evaluation timescale permits.

The aim of the subsequent steps is to ensure that evaluation is carried out in a context, or in a specified subset of contexts, which fairly reflect real life system use. Each documented factor of the context of use is considered, and its relevance to usability assessed. This requires at least one person with a background in human factors or HCI, and it is recommended that this part of UCA is done separately from recording context of use. For each contextual factor identified as possibly affecting usability, the usability analyst (in consultation with members of the usability team) must decide how to control or monitor that factor in the evaluation. Decisions are recorded in the right hand column of the UCA report table, which summarises the 'context of evaluation'. This specifies the conditions under which the evaluation should take place. An evaluation plan describing the practical details of how the evaluation will be carried out is then derived from this information.

In practice, key issues to be decided are the choice of the evaluation tasks, and identifying the profiles of users for the evaluation, taking into account the availability of suitable users within the resources and timescale of the evaluation. The difficulties of locating appropriate users are well known, and have been described in several recent reports of experiences of usability testing [5,8]. UCA offers two advantages. Firstly, it provides advance notice of the characteristics of users required for an evaluation. It may be necessary, for example, to give

users training in use of a prototype system. Involving a training manager in UCA helps in the early setting up of an appropriate training programme, both for the evaluation and for use of the implemented system. Secondly, UCA enables subsequent interpretation of evaluation findings to be informed by knowledge of how well the users employed in an evaluation matched the profile of intended users of the system, in terms of those characteristics identified as being relevant to usability.

5. USABILITY MEASUREMENT IN CONTEXT

A principal concern of the work reported here has been the evaluation of usability in context. That is, evaluation of the quality of use of a product (or information system) as part of a work system which also includes user(s), task goals and environments. All the MUSiC user-based methods for usability evaluation and measurement draw on UCA for their contextual validity. The first phase of MUSiC under ESPRIT developed and verified methods and tools for measuring the effectiveness, efficiency and satisfaction with which specified users can achieve specific work goals when interacting with a system in a given environment, and the cognitive workload imposed. These factors can be measured when a working prototype or an implemented system is available. Applying the methods in different contexts enables measurement of the efficiency and satisfaction for first time users of a system, and the rate at which people can learn to use a system.

In MUSiC's second phase the methods and tools were refined to meet commercial needs more closely, through application in commercial settings. Refinement principally involved making methods and tools more cost-effective to apply, and increasing the amount of diagnostic data they deliver. Training packages and support services were developed for organisations adopting the methods.

5.1. Applying MUSiC methods

MUSiC provides a flexible set of evaluation methods and tools for usability measurement and identification of problems. For any evaluation, evaluators can choose the methods and measures most appropriate to their organisational and development needs and constraints. MUSiC user-based methods deliver measures of three central components of usability: satisfaction, performance and cognitive workload.

SUMI, the Software Usability Measurement Inventory [9] provides measures of user satisfaction: the users' perception of the quality of use of a system. SUMI is a standardised, fifty item questionnaire available in Dutch, English, French, German, Italian, Spanish and Swedish versions. It gives a global measure of perceived usability, and measures of five relatively orthogonal and empirically discovered dimensions of perceived usability: Efficiency, Affect, Helpfulness, Control and Learnability. For several classes of software application, SUMI analysis gives a comparison with expected levels, for each dimension. SUMI also gives diagnostic data, through Item Consensual Analysis which identifies questions which receive particularly untypical responses from a group of users. This helps guide subsequent interviews with users. SUMI can be applied in two ways: survey and controlled study. Surveys measure the perceived usability of software systems already in use. Controlled studies typically employ prototypes, and often use SUMI in combination with performance measures.

The MUSiC Performance Measurement Method [10] supports assessment of performance-related factors in the quality of use of a system, in context, and is designed to be applied in

conjunction with UCA. It gives measures of effectiveness – how correctly and completely work goals are achieved when using a system in context – and efficiency, which relates effectiveness to cost in terms of time. It (optionally) gives a measure of the proportion of time spent working productively towards task goals, and identifies time spent overcoming problems, seeking help, and searching unproductively; these provide valuable diagnostic data. The method involves observing selected users in controlled studies, carrying out tasks identified as a result of UCA. The full method employs video, and analysis is supported by a software tool [11]. As well as assisting usability measurement and diagnosis of problems, video evidence is particularly effective in persuading designers and managers of the existence of problems with a system.

The performance measurement method has been applied to standalone commercial IT products, and organisational information systems. It is particularly in demand in organisations which are re-engineering business processes and associated information systems. It enables work performance with prototype systems, in context, to be compared with alternative or existing means of achieving work goals. It is typically applied in combination with SUMI, thus giving measures of effectiveness, efficiency and satisfaction, the core factors of usability.

6. CONCLUSION

The use of MUSiC methods and tools in commercial development of information systems and IT products has shown how usability measurement in context can be taken up successfully by organisations. Even where there is no pre-existing human factors expertise, evaluations can be carried out in-house after limited training, with some guidance where required. Organisations are increasingly aware of the benefits of usability testing for assessing and improving the quality of use of information systems. Much demand comes from organisations redesigning existing systems, and wishing to compare usability of prototypes against previous versions or old systems. Managers appreciate the importance of context in usability evaluation. Usability context analysis provides a means for identifying relevant contextual factors, enabling more valid evaluation of the intended (revised) information system before implementation. Applied cooperatively, UCA can help improve communication in an organisation about user needs and quality of use.

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