

User System Interaction Standards

Ken Holdaway and Nigel Bevan explain why standards for the user interface are needed, and review the standards in preparation

Within the past few years, several standards organisations have started work aimed at producing standards for user system interfaces. This activity has been motivated by a desire for more usable interfaces and many believe that such standards are long overdue. Others however, believe that quite the opposite is true - that it is far too early think about developing standards in an area we know so little about. This article examines both sides of the issue, and reviews the work of several of the major standards organisations, describing their mission, scope and status. Finally an attempt is made at some projections for where all these activities will lead. No international standards have yet been adopted, but a great deal of effort by many dedicated people continues.

User System Interaction, Human Computer Interaction, Man Machine Interface, Software Ergonomics: all these are general terms used to identify an area of activity currently underway in several standards committees. While there may be subtle differences in the meaning of these terms, the potential standards all concern a human being sitting at a computer terminal, receiving information from the computer, usually by reading what is displayed on the visual display or by

observing symbols or sounds; then, responding to the computer by typing information on the keyboard, positioning a pointing device, or pressing a function key.

User system interaction usually refers to the human dealing with the logic of the process and not the physical attributes. For example, the keyboard is a physical device that the human uses as part of the interface. However, the concern is with the logic of the keyboard - how are the function keys used, what do the page-up and page-down keys do - not with the physical characteristics such as key height or slope. The physical issues are addressed separately in other national and proposed international standards that deal with the ergonomics of Visual Display Terminals (VDTs), keyboards, and work places (eg parts 3 - 5 of ISO9241 in Table 1).

WHY STANDARDISE?

Less than ten years ago there was very little activity within the various national and international standards organisations directed towards the development of standards taking account of User System Interfaces. The industry was more concerned with standardising the hardware, or in standardising some parts of the software such as languages or communications protocols. Little attention was given to the human user.

However, about five years ago the scope began to expand. Various groups began to consider the impact of visual display devices on the human user. Human Computer Interaction emerged as an important research area, and the published papers described problems with

current user interfaces and suggested better ways of constructing interfaces that would increase user satisfaction and productivity ¹. At first these suggestions took the form of guidelines that offered advice to interface designers ². There was no thought that this could or should be standardised.

However, within the past three years, the level of activity has increased as a result of pressure from users for standards to regulate the quality of the interface. There are two separate international standards groups, with multiple subgroups within them, both developing standards for the user interface. In addition, there are numerous national standards efforts underway - all aimed at the same target of user system interfaces.

What was the motivation that would cause so much activity within such a short amount of time? The reasons vary, but can probably be summarised into four categories.

1. Need for consistency

Anyone who has used several different computer terminals, or multiple applications on the same system, will recognise this need. For instance, the inconsistent use of function keys can easily lead to the frustration of deleting a file instead of saving it.

Once we learn how a system operates, it would save a great deal of time and mental anguish if other systems worked in an identical or at least similar fashion. It is routine in today's business to use terminals from several manufacturers. It would be very desirable if users could move from one system to another without having to learn or relearn

how the system operates. Proponents of a standardised interface claim it is the most effective way for consistency to be achieved.

2. Need for enhanced usability

The usability of a product can be defined operationally as "the degree to which specific users can achieve specified goals in a particular environment, effectively, efficiently, comfortably and in an acceptable manner" ³. Clearly, the business community has a strong incentive to push for anything that could increase productivity while keeping employees content. Many believe that standards for the user interface are one way of achieving this. After all, if standards are based on laboratory research which has identified generally accepted techniques for creating more effective and acceptable interfaces, then conformance to the standards should result in systems which are themselves more usable and productive.

3. Need for assurance of the user's comfort and well being

This is perhaps the most widely discussed reason for developing standards for the user interface. This concern started with claims of pregnancy problems caused by radiation or electro-magnetic emissions from the VDT. User groups and legislators picked up on this issue and pressed for standards and laws to protect the users. At present it seems reasonable to conclude that users are not harmed by using a VDT and that statements to the contrary are not soundly based ⁴. However the controversy continues. Furthermore, it has broadened into how the use of software can have an adverse impact on the well-

being of the end user.

The concern is that a poorly-constructed user interface will cause stress and mental anguish to the end user. Several examples are cited as ways in which this can occur.

- a) The system interface takes control away from users and requires them to respond within certain time limits, thereby causing stress.

- b) The system interface does not adequately permit the user to recover from mistakes and try again. Nor does it help correct user errors. This leads to a reluctance by users to explore or try anything new for fear that they will do something catastrophic or "break the system". This further heightens the user's sense of stress.

- c) The system interface is constructed so as to intimidate the user by issuing threatening messages or inappropriate instructions. This frustrates, angers, and further increases the user's stress and dissatisfaction.

Many believe that standards for user interfaces are a means to ensure that the interfaces are free from these health and well being problems.

4. Procurement and product evaluation

When procurers of software have the task of deciding which among the tens or hundreds of products is the best one for their organisation, the user interface has traditionally been difficult to specify, assess or compare. It is difficult enough to evaluate the product function - it is

practically impossible to evaluate the interface without exhaustive tests ⁵.

There is an increasing belief that user interface standards could be of significant help in the procurement process. By specifying that the product must conform to Standard XXX, the procurer would like to be able to ensure that the product will provide some nominal level of consistency and usability. In addition, by using only products with a "standard interface", employers can hope to convince the using employees that there is no cause for concern relative to health and well being.

When the potential benefits of user interface standards are appraised, this explains the ever-increasing level of activity throughout the world to develop those standards. It is believed to be a worthy goal that will yield rewards - if it can be achieved.

IS IT DESIRABLE OR POSSIBLE?

It is comforting to think that as soon as the standards organisations have finished their work on user interfaces, all the frustrations and dissatisfactions will disappear. Professionals in the area would say that such an attitude is not only premature but very naive. In fact, some argue that standardising the user interface is not a desirable thing to do, even if it were possible. Their objections can be grouped into four main categories.

1. The basics are not known

It would seem to be easy enough to pick one of the more common user interfaces and declare it to be an international standard. But, if asked to defend your decision, you would probably be hard pressed to articulate your reasons for selecting one over another. Presumably your decision would be based on some research or measurement of user performance that supports your selection. However such data are extremely scarce. Standards imply measurement, conformance, repeatability, and stability. The research has not yet been done that would permit us to resolve the cognitive processes associated with individual user performance into standards with such rigour and precision. This is particularly true when we know that the interface must respond to the influence of differences in culture, technology, task and environment.

2. Standards will inhibit advances

This statement can be made about all kinds of standards. Generally it is not true. If you can standardise the correct elements, those elements can be put together in a variety of ways that allow creativity and innovation to progress. However, in the case of user interfaces, the statement could be true.

What are the fundamental building blocks of the user interface? If you standardise the wrong ones, then you are locked into a scheme where innovation will be difficult or impossible. For example, if five years ago we had decided to standardise the user interface, we would have preempted many of the features we see in the advanced, object oriented, interfaces of today. We would be stuck with primarily character-based,

command line, scrolling interfaces. We know that new, creative, innovative interfaces are arriving with almost every new system. Poorly framed standards must not get in the way of this new development. However, without the proper research and caution in standards construction, this is quite likely to happen.

3. Standards will not guarantee usable software

A full understanding of usability requires an understanding of the cognitive processes which enable users to achieve their goals effectively, efficiently and comfortably. Since we do not totally understand the cognitive processes, we do not therefore totally understand all the dimensions of usability. What makes one software design more usable than another? How much does usability depend upon the type of user, task and technology? What do we standardise - high level principles, or low level details?

If we aim our standards at high level principles we can probably find some safe ground. However, can these principles be interpreted in a practical way by interface designers so that their implementations meet the usability goals of consistency, productivity, and satisfaction? Would any two designers interpret the principles in the same way so that their interfaces were consistent?

If we try to develop our standards around low level elements, we run the risk of not finding those fundamental to the cognitive process. And even if we could, the interface designer is still faced with the task of combining those elements into an overall implementation that satisfies the usability objectives.

4. Standards will not provide measurable benefits

We should not standardise just for the sake of standardisation, but should start with the assumption that some measurable benefits should accrue to the end users as a result of using a "standard interface". For example, let us take a trivial case. Should letters or numbers be used to designate options in a menu? Will it make a difference? What is the value of standardising it one way or the other? Does it depend on the type of task, class of user and the technology so that different standards would be required for each application?

Standardising, when there is no identifiable benefit, would result in interfaces which are constrained, rigid and cannot be adapted to the varying needs of the users and the marketplace.

These are some of the issues raised by those who believe that the time has not come to attempt standardising the user interface.

CURRENT STANDARDS ACTIVITIES

In spite of the detractors, the perceived benefits to be derived from standardising the user interface are such that several standards producing organisations are actively working in this area. In many cases they have avoided the dangers listed above by finding alternatives to the conventional style of IT standard which places explicit requirements on hardware or software. Other types of standard, which may be more appropriate when dealing with human behaviour, specify procedures (eg the procedure an organisation follows to ensure the quality of a product ⁶), or minimum levels of user performance with a product (eg speed and accuracy using a

particular keyboard ⁷), or the method by which characteristics are measured (eg stress in a hot environment ⁸).

Standards may also be limited in their scope. At one extreme many standards have universal applicability (eg codes for character sets ⁹). However other standards may be explicitly limited in their field of application (eg a keyboard layout for use with multiple Latin alphabet languages ¹⁰), or may contain recommendations rather than explicit requirements (eg design of office tasks ¹¹).

The following information is not meant to be a complete directory of who is doing what, but it will discuss the mission, scope and status of several major groups which have efforts underway.

ISO TC159 SC4 WG5: Software Ergonomics and Man Machine Dialogue

Technical Committee 159 (TC159) of ISO is responsible for standards in the area of ergonomics. Sub Committee 4 (SC4) of TC159 is working in the area of signals and controls as related to Visual Display Terminals. SC4 had previously concerned itself with task and physical issues associated with VDTs, but in 1985 Working Group 5 was set up to look at the ergonomics of software.

SC4 is currently planning to produce a 13 part standard (see Table 1). The earlier parts are already Draft International Standards or Draft Proposals.

[Table 1 about here]

The scope of WG5 is "Standardisation in the field of human-computer interaction, especially dialogue interfaces, with the aim of enabling users to perform their tasks under ergonomically favourable conditions". In order to focus their efforts, and yet have a wide area of applicability, they have decided to concentrate on activities found in the office environment.

WG5 is responsible for Parts 10-13 of the standard. Most of the work thus far has been in the areas of Dialogue Interface and Software Usability. In the area of Dialogue Interface, they are investigating two approaches: deductive (top down, based on the cognitive theory and models), and inductive (bottom up, based upon empirical data). They are considering how these two approaches can be used to produce standards that will provide both quality (for overall quality of the user interface), and uniformity (for consistency across the interface and systems). The technical input is being provided by the associated national committees.

The objective of the Software Usability group is to provide a standard which specifies the content of a usability assurance statement. This will contain a statement of what procedures a manufacturer has adopted to assure the usability of a product for particular tasks and groups of users. It can also include the results of an experimental validation of the usability of the product. It is also possible for procurers to use the usability declaration to specify their needs, or to assist in comparing the usability of several alternative products.

Thus far, none of the work of WG5 has progressed beyond the working

paper level. It will be at least another year before the work starts to reach the level of a Draft Proposal.

ISO/IEC JTC1 SC18 WG9: User System Interfaces and Symbols

Joint Technical Committee One (JTC1) of ISO/IEC has responsibility for standards in the area of Information Technology. Sub Committee 18 (SC18) is responsible for standards in the Text and Office Systems area. Within SC18, Working Group 9 (WG9) is responsible for User System Interfaces. WG9 has divided its work into three areas, each with a separate sub-group and document editor:

- Keyboard Layout
- User Interface (Dialogue Interaction)
- Symbols

The work on Keyboards consists of developing a multi-part standard that will update, extend and replace the existing standards for keyboard layout. So far, three parts of the standard dealing with the numeric section are currently being balloted for approval as Draft International Standards. Five additional parts of the standard dealing with the alphanumeric and editing section of the keyboard are currently being registered as Draft Proposals and are out for review and comments by ISO member bodies.

In the User Interface group, they have thus far defined three areas of work:

- Dialogue Techniques

- User Guidance
- Names of Objects and Actions Common in Office Systems

Significant progress has been made on naming and defining a basic set of objects and actions common to a wide range of user interfaces. The objective is to encourage more consistency in the basic editing and file manipulation interface.

The Symbols group is working on:

- Graphic Symbols Used on Equipment

(such as copier and printer control panels). This work is well underway and many symbols have been approved and forwarded to ISO for registration.

The User Interface and Symbols groups are jointly working on:

- Symbols Used in Screen Menus

The intention is to agree on standard symbols to be used as icons for basic office system objects, particularly those used in interfaces employing the "desk-top metaphor". Work is currently concentrating on evaluation techniques for icons

DIN (Deutsches Institut für Normung)

For some time Germany has been working on a multi-part standard addressing various aspects of information processing. This collective

standard has the number DIN 66 234 (See Table 2). Part 8 of this standard, which has been approved in Germany, deals with "Principles of Ergonomic Dialogue Design for the Workplaces with Video Display Units".

It consists of a statement of 5 high level ergonomic principles that apply to humans dealing with software. These five principles are supported by guidelines and examples that are used to explain how the principles might be interpreted and implemented. Although it gives useful guidance, the standard admits that: "At the present time there is no way of checking that particular guidelines have been adhered to since no methods of testing are known".

[Table 2 about here]

Human Factors Society - Human Computer Interaction Committee (HFS-HCI)

In the United States, this committee operates under the auspices of the American National Standards Institute (ANSI), and is the technical advisory group for ISO TC159.

The HCI group has developed a framework for how the various areas of human computer interaction fit together. They are now working to fill in the various areas with details based on reports of laboratory research or on empirical data. Their first aim is to produce guidelines which may then be elevated to the level of a standard with explicit requirements if enough evidence can be found to warrant doing so. Each guideline is further qualified by criteria for its use - when and

under what conditions the guideline is intended to be used.

So far the work has focussed on Dialogue Interaction Techniques (with particular attention to the use of Menus), User Guidance, and Output Devices and Techniques. Their work, while not yet adopted as a national standard, has been reviewed by ISO TC159 SC4 WG5, which is considering it as the basis for international standards.

ANSI X3V1.9: User System Interfaces and Symbols

This United States group has been chartered by ANSI to develop standards in the area of Text, Office and Publishing Systems. Within X3V1, Task Group 9 (TG9), has the responsibility for User System Interfaces and Symbols and is the national mirror group to JTC1 SC18 WG9. TG9 is a major contributor to the work being done in the international group.

BSI PSM/39/-/2: Applied Ergonomics - Signals and Controls

This UK panel has made substantial contributions to TC159 SC4. It has pioneered the user performance approach, and has produced a UK VDT standard equivalent to ISO 9241 Parts 1-5. (The UK standard will be replaced by the ISO standard when this is published.)

BSI IST/18/-/9U: User Interface

This group shadows the user interface topics in JTC1 SC18 WG9, and also contributes to TC159 SC4 WG5 via BSI PSM/39/-/2. It has been particularly active in developing the theoretical and experimental basis for the standardisation of icons.

CONCLUSIONS

With the many standards groups working in this area, it is inevitable that international standards will eventually emerge. When the standards are produced, will they be useful and lead to more consistent, usable interfaces? Or will they be ignored because they are too difficult to interpret, too costly to implement, or already obsolete? We will not know until we make the effort and see some final results.

From all the effort that has gone on thus far however, there is general agreement about the way the standards will probably progress.

If a standard is to have the desired impact on the user interface, it must be written with a content and structure which enables the users of the standard - the system designers - to interpret it unambiguously and apply it directly to their design decisions.

Care must be taken not to standardise interface components that deal with style or fashion or are rapidly evolving. For example, the behaviour of the desk top metaphor, or pop up windows. These are merely today's implementations and are likely to change and disappear in favour of the new innovations of tomorrow.

Standardisation must recognise that the user interface serves a broad range of user classes, technologies, and tasks, in many different environments. Standards must accommodate, not preclude, any of these combinations because they are the real world.

Standards will be some time in coming. We are learning as we go, both about the interface itself, and about the process of trying to standardise it. The progress has been slow and the job gets bigger the more we learn.

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7. **ISO/DIS 9241** *Ergonomics of visual display terminals: Part 3: Visual requirements* (1988)
8. **ISO 7243** *Estimation of the hot stress on working man based on the WGBT index*
9. **ISO 6937** *Text communication character sets*
10. **ISO DIS 8884** *Keyboards for multiple Latin alphabet languages* (1988)
11. **ISO DIS 9241** *Ergonomics of visual display terminals: Part 2: Task*

requirements (1988)

Table 1. ISO 9241: Ergonomics of Visual Display Terminals

	Status
1. Introduction	DIS
2. Office VDT Task Requirements	DIS
3. Visual Requirements for the VDT Screen	DIS
4. Keyboard Ergonomics	DP
5. VDT Workplace Design	DP
6. VDT Working environment	DP
7. VDT Surfaces and Filters	P
8. Use of Colour and Graphics	P
9. Non-keyboard Input Devices	P
10. Dialogue Interface	P
11. Methods for Evaluating and Testing Software Usability	P
12. Coding and Formatting of Information on the VDT	P
13. Terminology	P

DIS: Draft International Standard, DP: Draft Proposal, P: planned.

Table 2. DIN 66234: VDU Workstations

Part	Title	Date of Standard/Revision
1.	Character shapes	1980
2.	Perceptibility of characters	1983
3.	Grouping and formatting of data	1981/1983
4.	not used	
5.	Coding of information	1981/1988
6.	Design of workstations	1984
7.	Design of work environments	1986/1988
8.	Principles of dialogue design	1987
9.	Measurement techniques	1989
10.	Minimum fact sheets	(draft 1988)