TECHNICAL REPORT

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Electronic imaging — Human and organizational issues for successful Electronic Image Management (EIM) implementation

Imagerie électronique — Aspects humains et organisationnels pour la mise en œuvre réussie de la gestion d'image électronique

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

Attention is drawn to the possibility that some of the elements of this Technical Report may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TR 14105 was prepared by Technical Committee ISO/TC 171, *Document imaging applications*, Subcommittee SC 2, *Application issues*.

Introduction

Computer technology has unequivocally contributed to the efficiency and speed of data processing. Automated systems reduce staffing requirements by eliminating the need for human intervention and facilitating increased human productivity. Ironically, the intense focus on increased productivity of both systems and operators has traditionally limited creative methods for sustaining long-term human productivity. However, recent advances in the understanding and implementation of ergonomic principles have produced a comprehensive framework for human-engineered computer systems design, implementation, and work practices.

The proliferation of computer technology has impacted a majority of the work force. It is predicted that by 1997, 50 % of workers would be using VDTs (Visual Display Terminals) at work. The significant increase in the use of VDTs has caused the research community to investigate the impact to humans of working with VDTs. In 1988, in a collaborative effort with an organization specializing in the area of human factors, a standards organization published a document for Human Factors Engineering of Visual Display Workstations. This document, written for those VDT applications described as text processing, data entry, and data inquiry, “specifies conditions that have been established as representing acceptable implementation of human factors engineering principles and practices in the design of VDTs, associated furniture, and the office environment in which they are placed.” More recently, the International Organization for Standards (ISO) has initiated a 17-part standard (ISO 9241) that identifies requirements for both hardware (parts 1-9) and software (parts 10-17) associated with VDTs.

This trend in the development of standards and legislation responds to the lack of widely accepted and practical guidelines associated with the design, implementation, and use of VDTs. These voluntary and legislative guidelines would provide recommendations and requirements for the selection and operation of VDTs. It should be noted that the ergonomic requirements associated with electronic image management (EIM) systems do differ somewhat from those associated with standard VDTs. These differences come primarily from image-initiated re-engineered task requirements (that is, requirements for tasks in which humans interact with the image workstation with minimal paper) that create unique implementation and environmental considerations.

A growing body of research points out that the potential of information technology to transform businesses remains largely untapped not because of technical problems but because of failure to address human and organizational issues. According to some management experts, “The effective management of people is critical to the successful implementation and use of new technical systems. Unfortunately, the “human” resource receives only cursory or after-the-fact attention when technological decisions are considered.” Experts in this area note that “a recent study of 20 organizations with new office automation systems found that 16 systems had failed in some way. The reasons: MIS departments missed project deadlines by months. Costs mounted beyond projections. End users operated systems improperly or not at all or even sabotaged them openly. What variables lay behind these reasons? Most common were the following human factors: the system didn’t match the organization’s needs; supervisors didn’t promote use of new systems; senior management didn’t fully understand how systems should be implemented.”

The issue of implementing new technology was perhaps best summarized by a case study of five office automation projects: “Implementation: it’s not so much what you do, but how you do it.”

This Technical Report systematically identifies and reviews the ergonomic and organizational issues and considerations associated with the selection criteria, implementation criteria, and work practice criteria for EIM systems.

Electronic imaging — Human and organizational issues for successful Electronic Image Management (EIM) implementation

1 Scope

This Technical Report provides a framework for understanding and maximizing the human factors associated with successful implementation of Electronic Image Management (EIM) systems.

It focuses on cognitive, physical, organizational, and human factors as they apply to usability criteria for imaging technologies development, selection, and implementation. It provides a fundamental framework for understanding the basic issues and concepts of organizational factors, human factors, and ergonomics for EIM systems. The principles of sociotechnical systems theory are applied to the introduction of EIM into an organization. The principles of human factors and ergonomics are applied to usability criteria for the development and selection of EIM equipment, to environmental and implementation issues, and to training for long-term productivity benefits.

2 References

ISO 9241-10:1996, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 10: Dialogue principles*

ISO 9241-11:1998, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 11: Guidance on usability*

3 Terms and definitions

For the purposes of this Technical Report, the following terms and definitions apply.

3.1
culture
pattern of beliefs and expectations shared by the organization's members

NOTE These beliefs and expectations produce norms that powerfully shape the behaviour of individuals and groups in the organization. An organization's culture defines the ways in which people behave as encouraged by the organization's values and beliefs.

3.2
ergonomics
human factors
applied science that studies, designs, and adapts the equipment, the work, and the environment to meet human capabilities and limitations and to enhance safety and comfort

3.3
flicker
image instability caused by the fading and refreshing of the phosphors that create the characters on a display screen

NOTE Flicker-free images give the perception of stable images.

3.4
glare
visual discomfort, legibility impairment, or both caused by excessive variations in luminance between objects within the visual field

3.5
invisible grid
specific indents for various levels of information and blank lines or spaces that group related information

3.6
operations
business process used to carry out the objectives of an organization

3.7
readiness
willingness of employees to adapt to changes in their jobs and work environment

3.8
repetitive strain injury
class of medical condition of the joints caused by repetitive motion, which is often rapid, forceful, and/or extreme motion

EXAMPLE Examples of repetitive strain injuries include tendinitis and carpal tunnel syndrome.

3.9
visual display terminal
VDT
electronic device that consists of an input device (for example, a keyboard or mouse), a monitor unit (for example, a cathode ray tube), and a connection to the central processing unit of a computer and that visually presents information communicated to or stored in the computer

4 Usability and Ergonomic Interfaces

4.1 General

This clause provides a framework for evaluating the ergonomics of user interfaces associated with electronic imaging systems.

4.2 End-User Analysis and Usability

To tailor any image application to fit user behaviour, the developer must understand the general capabilities and limitations of the human being in the areas of perception, learning, memory, and attention. This analysis is a fundamental component of the re-engineering process associated with the move from conventional paper processes to EIM systems implementation. ISO 9241-11 was developed to ensure this understanding as part of the VDT development protocol. ISO 9241-11 addresses usability requirements specifications, providing a format for the communication and shared understanding of the factors that determine usability. ISO 9241-11 stresses the importance of end-user requirements analysis, because the tasks for which a product is used, the characteristics of the user, and the environmental conditions are as important as the characteristics of the product itself as determinants of usability.

ISO 9241-11 provides guidance on how to describe the context of use and the measures of usability in an explicit way. The resulting usability requirements specification typically includes the following sections:

a) name and purpose of the product;

b) context of use, including

1) intended users (skills, knowledge, and physical attributes),

2) environmental requirements, and

3) specification of tasks;

c) usability measures for particular contexts:

1) effectiveness;

2) efficiency;

3) satisfaction.

The consumer of imaging systems technology should carefully review EIM-system vendor proposals to ensure the inclusion of a system-specific end-user analysis. This analysis should be the basis for conceptual design of the system's user-interface as well as the criteria for usability verification testing.

4.3 Ergonomic Criteria for Selection of Electronic Imaging Systems

The principles in this section are based on five fundamental qualities that make application interfaces usable and easy to learn. These five qualities follow:

— consistency;

— simplicity;

— flexibility;

— user control;

— system responsiveness.

4.3.1 Consistency

To design for consistency means to produce an application that is predictable in appearance and behaviour. Consistency in user-interface design has two dimensions: internal consistency and external consistency. *Internal consistency* refers to consistency of look and of behaviour of screens throughout the application (and even across applications). *External consistency* refers to the users' conceptual model of how an application should work. A leading computer manufacturer suggests that "the user interface should confirm the conceptual model by providing the outcome users expect for any action. This occurs only when the application model is the same as the users' conceptual model."

Consistency in user interactions

— reduces the memory load on the user,

— reduces the time it takes to learn the application,

— enables the user to perform tasks more quickly and easily, and

— minimizes the confusion of the user who must navigate between multiple applications.

4.3.2 Simplicity

To design for simplicity means to produce an application that the user finds both easy to learn and easy to use. The fewer concepts, commands, and menus the user must know or traverse to perform an operation, the simpler is the operation for the user. The substantial variability of image applications and platforms reinforces the requirement of

the above end-user analysis. For example, it is often appropriate to hide Graphical User Interfaces (GUIs), with their multiple access task-swapping capabilities, in image workstations that are dedicated to limited image tasks. This reduces the learning requirement of operators who do not require the capabilities of GUIs.

4.3.3 Flexibility

Flexibility in an application is reflected in how well the application responds to the needs of different kinds of user expertise. For example, to perform a given task, a flexible application provides menu-based commands for novice users to reduce their memory load and equivalent shortcut, keyboard-based commands for expert users to reduce command input time and increase their task efficiency. Because some imaging tasks are fairly complicated, requiring operator training and expertise, providing multiple-input or access mechanisms enables the sophisticated operator to modify interaction styles based on specific task or situational requirements.

4.3.4 User Control

User control is the degree to which the user perceives himself or herself to be directing the interactions within the application. In general, the more the user feels in control, the more satisfied with the application he or she feels. Users should be allowed to initiate actions and control the interaction, including terminating any command, easily reversing or undoing unwanted actions, or setting the pace of interactions. For example, some bank and remittance-processing image systems allow operators to select the key ahead option. This option increases operator speed by presenting the next imaged item after the operator has entered only a portion (selectable by number of key depressions) of the currently displayed item. However, a mandatory requirement for systems implementing this key ahead option is the ability of the operator to recall an imaged item once it has disappeared; this provides control for the user, which positively affects satisfaction and performance.

4.3.5 System Responsiveness

System responsiveness is the degree to which the system responds to the user's input. Whenever a user performs an action, the system should — at minimum — provide basic feedback acknowledging the user's command. The system should never leave the user wondering whether the system has accepted his or her input. This responsiveness is especially critical when long delays (in excess of two seconds) occur between screen transmissions. Ergonomic studies have shown that displaying some visual indicator of progress (such as an hourglass) greatly increases the user's acceptance of variable length delays.

The impact of system delay varies greatly depending on the task. Imaging applications used for document management work generally have tolerances for longer delays than image systems dedicated to high-speed data entry. Image systems dedicated to high-speed data entry should have the ability to display images faster than the human operator can process them. Exception-based delays should always be accompanied by some visual acknowledgement or status message.

4.4 Software Usability Checklist

The following software usability checklist provides explicit usability criteria for software development and selection. Although these usability heuristics are not EIM-specific, they are relevant to EIM applications.

When evaluating EIM software interfaces, ask the following questions to ensure that related criteria are satisfied; usable interfaces fulfil these criteria.

a) *Is display information organized and presented in a clear and useful manner?* Criteria include whether

   1) information appears in an expected, natural, and logical (task) order,

   2) readability is optimized (text is of mixed case, use of abbreviations is minimal, and menus and user-entry areas are visually distinct from other displayed information),

   3) the command names or menu items are meaningful and distinctive,

   4) use of colour is appropriate (four or fewer colours are used consistently, and an optimal contrast combination is used),

5) when available, on-line help or documentation is formatted for easy scanning,

6) pull-down menu options are formatted as single column lists and logically grouped, and

7) irrelevant or rarely needed information is displayed on request only.

b) *Is the language of menu items, commands, error messages, and on-line help appropriate?* Criteria include whether

1) the language uses task-related terms familiar to the user rather than system-oriented terms, and

2) the language does not use jargon that is difficult to understand and translate.

c) *Does the application minimize the amount a user must remember?* Criteria include whether

1) information appears in a familiar and directly usable form,

2) the application does not require the user to remember information from one display to another,

3) the application visually maintains the conceptual thread when a procedure requires that the system display ancillary screens,

4) at the user's request, the application provides prompts for command syntax, and

5) the application makes available text labels for screen icons.

d) *Is the user interface consistent?* Criteria include whether

1) the user interface uses the same term for a given item, action, or concept throughout the application,

2) the user interface is consistent in the format and placement of information in the displays,

3) the user interface provides a standard display area for command entry, and

4) the user interface makes the behaviour of objects on the screen consistent with the user's mental model.

e) *Does the application provide sufficient feedback?* Criteria include whether

1) the application highlights items that are selected,

2) the application acknowledges processing delays,

3) the application informs the user of the success or failure of a requested action, and

4) when an error does occur, the application provides understandable information that includes both a statement of cause and a suggested remedy that the user is able to perform.

f) *How easy is it to navigate and exit the application?* Criteria include whether

1) the application provides a home menu or display,

2) the means of navigation is visually distinct,

3) the structure of the application is optimally organized for the most common or most important user tasks and reflects a natural sequence (according to experience, cultural norms, and the like),

4) the menu structure does not require the user to transverse more than three levels to perform a task or to access information,