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AMENDMENT 1
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Ergonomic requirements for office work with visual display terminals (VDTs) —

Part 1: General introduction

AMENDMENT 1

Exigences ergonomiques pour travail de bureau avec terminaux à écrans de visualisation (TEV) —

Partie 1: Introduction générale

AMENDEMENT 1

Reference number
ISO 9241-1:1997/Amd.1:2001(E)

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Foreword

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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.

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

Amendment 1 to International Standard ISO 9241-1:1997 was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 4, *Ergonomics of human-system interaction*.

Introduction

ISO 9241 covers both the hardware and software ergonomic aspects of the use of visual display terminals. The individual parts of ISO 9241, their interrelationships, and the expected users of the parts are described in the main body of ISO 9241-1.

This Amendment deals particularly with the software parts of ISO 9241, i.e. ISO 9241-10 to ISO 9241-17. These parts are concerned with the ergonomic design of software user interfaces.

The goal of this Amendment (complementing ISO 9241-1) is to help readers of ISO 9241-10 to ISO 9241-17 in

— gaining an overview on the content of ISO 9241-10 to ISO 9241-17,

— understanding the relationship between the individual software parts of ISO 9241,

— providing guidance on the relevance of individual parts to the development process, i.e. understanding where and when to use the software parts of ISO 9241,

— understanding how to select and combine dialogue techniques which are described in ISO 9241-14 to ISO 9241-17.

The ultimate beneficiary of ISO 9241-10 to ISO 9241-17 will be the end user at the VDT. It was the needs of these users that provided the ergonomic recommendations in ISO 9241-10 to ISO 9241-17. Although it is unlikely that the end user will read ISO 9241 or even know of its existence, its application should provide user interfaces that are more usable, consistent and that enable greater productivity.

Ergonomic requirements for office work with visual display terminals (VDTs) —

Part 1: General introduction

AMENDMENT 1

1 Scope

Page ii

Replace the Contents with the following text.

Contents

Page 5

At the end of clause 6, add the following paragraph.

Annex A provides guidance on the use of ISO 9241-10 to ISO 9241-17 in the development of software applications, and on the selection and combination of the dialogue techniques covered in ISO 9241-14 to ISO 9241-17.

Page 7

Delete “Annex A (informative)” and transfer the bibliography to the page after the new annex A.

Page 7

Add the following new annex A.

Annex A
(informative)

Description and application of software parts (in ISO 9241-10 to ISO 9241-17)

A.1 Structure of ISO 9241-10 to ISO 9241-17

A.1.1 Introduction

ISO 9241-10 to ISO 9241-17 cover software ergonomics issues such as:

— principles for human-computer dialogues (ISO 9241-10);

— the relevance of the context of use (users, tasks, environment) and the definition of usability in terms of effectiveness, efficiency and satisfaction (ISO 9241-11);

— characteristics of presented information and recommendations for the presentation of information (ISO 9241-12);

— recommendations for user guidance; these apply to all dialogue techniques (ISO 9241-13);

— recommendations for the usage of dialogue techniques (ISO 9241-14 to ISO 9241-17).

The specification or design of human-computer dialogues should be driven by an understanding of the requirements of the users, their tasks, the environment and the available technology. There are usually several options and the final choice may be influenced by the desire for consistency (e.g. with existing organizational practices or across a range of systems). Decisions about the overall suitability of human-computer dialogues can be assisted by reference to standards containing general principles of dialogue design i.e. ISO 9241-10. Specific recommendations for dialogue design are addressed in ISO 9241-14 to ISO 9241-17.

A.1.2 Relationship between ISO 9241-10 to ISO 9241-17

Figure A.1 illustrates the structure of ISO 9241-10 to ISO 9241-17, reflecting the nature of the individual parts in terms of principles and recommendations.

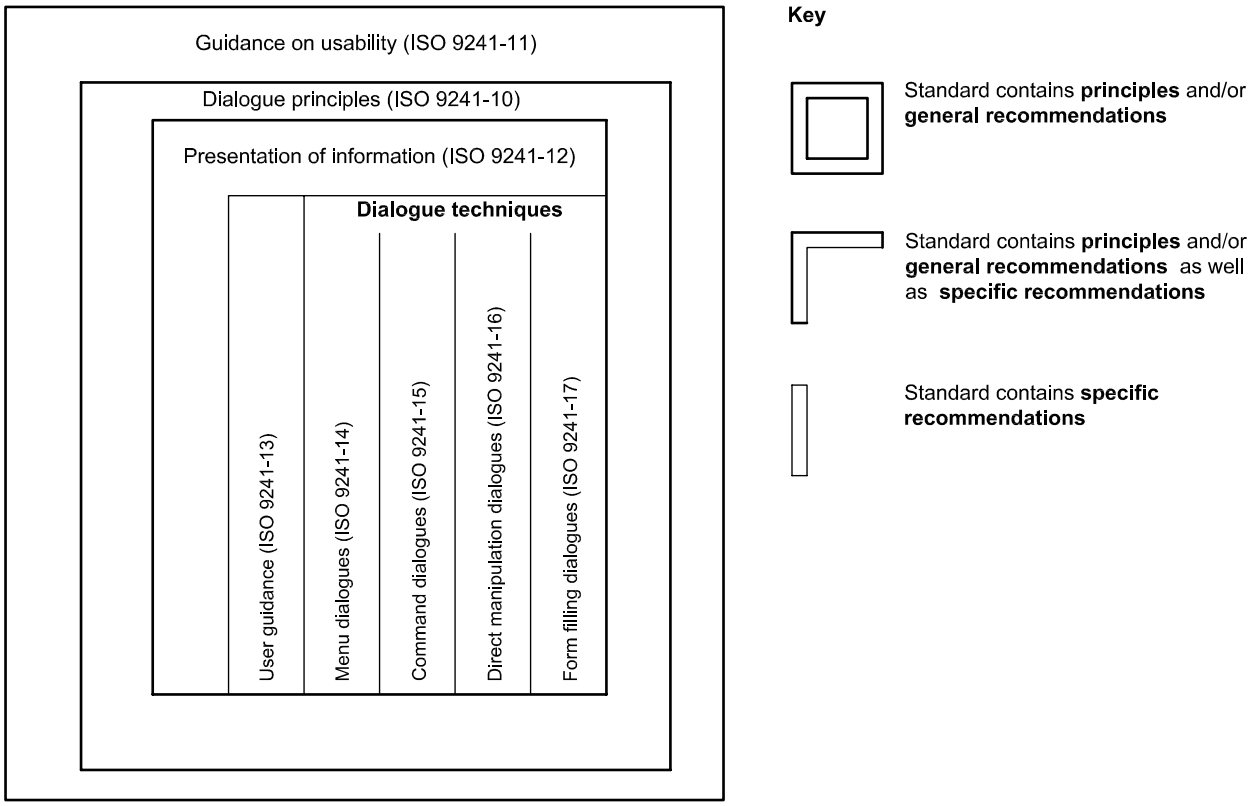

Figure A.1 — Relationship of the software parts of ISO 9241

A.1.3 ISO 9241-10 “Dialogue principles”

The purpose of ISO 9241-10 is to present high-level ergonomic principles that apply to the design of dialogues between humans and information systems. ISO 9241-10 provides seven principles of good practice for the design of the dialogue between the user and the interface software.

These seven principles are:

— suitability for the task;

— self-descriptiveness;

— controllability;

— conformity with user expectations;

— error tolerance;

— suitability for individualization;

— suitability for learning.

The principles given in ISO 9241-10 form the basis for understanding any specific software-ergonomic recommendation given in other parts of ISO 9241. These principles do not permit strict compliance checking, although it may be possible to evaluate whether these principles have been generally applied.

A.1.4 ISO 9241-11 “Guidance on usability”

ISO 9241-11 introduces the concept of usability, but does not contain specific recommendations in terms of product attributes. It is concerned with the extent to which the users of products are able to achieve specified goals effectively, efficiently and with satisfaction in a given context of use (users, tasks and environment). This framework can be used as part of an ergonomics requirements specification. It includes descriptions of the context of use, the evaluation procedures to be carried out and the criterion measures to be satisfied when the usability of the system is to be evaluated.

A.1.5 Structure within ISO 9241-12 to ISO 9241-17

A.1.5.1 Structural organization

The following structure applies to each of these ISO 9241 parts.

— Foreword

— Introduction

— Scope

— Normative references

— Definitions

— Application clause

— Recommendations

— Annexes

A.1.5.2 Application clause

Within the application clause of ISO 9241-12 to ISO 9241-17 the appropriateness of the specific part is explained in terms of

— user and organizational characteristics,

— task characteristics,

— system capabilities.

NOTE More details are provided on these characteristics in A.3.2.

The application clause also explains how the recommendations given in the standard should be applied. Each recommendation should be evaluated for its applicability and, if judged to be applicable, should be implemented in the relevant dialogue technique unless there is evidence that to do so would cause deviation from the design objectives or would result in an overall degradation in usability.

Furthermore, each part of ISO 9241-12 to ISO 9241-17 states: “if a product is claimed to have met the applicable recommendations in this part of ISO 9241, the procedure used in establishing requirements for, developing, and/or evaluating the […] shall be specified. The level of specification of the procedure is a matter of negotiation between the involved parties”.

A.1.5.3 Recommendations clause

The recommendations clause within each part of ISO 9241-12 to ISO 9241-17 contains the recommendations of the particular part of ISO 9241. Many of these recommendations are conditional recommendations (or "if" statements). Often the "if" statement refers to the context of use [e.g. in ISO 9241-14, "If appropriate for the task, in deeply structured menus (more than 3 levels), users should be provided with the capability to go from one part (node) of the structure to another without returning to the initial common node"].

A.1.5.4 Annexes

Annex A within ISO 9241-12 to ISO 9241-17 provides an example of a procedure for determining whether the applicable recommendations in the particular part of ISO 9241 have been met. It should be noted that the procedure described is provided as guidance and is not a rigid process to be used as a substitute for the standard itself. This procedure provides a two-stage process for determining which recommendations are relevant, and for determining whether those relevant recommendations have been adhered to.

Annex B of ISO 9241-14 gives examples of application.

In addition, ISO 9241-12 to ISO 9241-17 each contain a bibliography with source documents on which each standard is based.

A.1.6 ISO 9241-12 "Presentation of information"

ISO 9241-12 introduces characteristics of presented information. These characteristics are the following:

— Clarity (the information content is conveyed quickly and accurately);

— Discriminability (the displayed information can be distinguished accurately);

— Conciseness (users are given only the information necessary to accomplish the task);

— Consistency (the same information is presented in the same way throughout the application, according to the user's expectation);

— Detectability (user's attention is directed towards information required);

— Legibility (information is easy to read);

— Comprehensibility (meaning is clearly understandable, unambiguous, interpretable and recognizable).

The characteristics of presented information given in ISO 9241-12 apply to visual design aspects of user guidance (see A.1.7) and any specific dialogue techniques (see A.1.8) employed in a software package. ISO 9241-12 also gives recommendations on the presentation of information. For example, ISO 9241-12 recommends that groups of information items should be perceptually distinct by spacing and location without giving precise criteria for this. However, this recommendation can be used by tool designers and style guide designers to set up rules for their specific design environment.

A.1.7 ISO 9241-13 "User guidance"

ISO 9241-13 provides recommendations for user guidance provided by software user interfaces and their evaluation. User guidance as defined in ISO 9241-13 is additional information beyond the regular user-computer-dialogue that is provided to the user on request or is automatically provided by the system, for example, status information, feedback messages and on-line help. User guidance is always appropriate and should help users in accomplishing their goals with the system. Sufficient user guidance should be provided so that users accomplish the task that the system was designed to support without undue effort or stress. Any specific dialogue technique (see A.1.8) incorporates user guidance, for example, by highlighting a selected menu item or by underlining a field label of a required entry field. Therefore, the recommendations given in ISO 9241-13 should always be considered when designing a specific dialogue technique.

A.1.8 ISO 9241-14 to ISO 9241-17 (Dialogue techniques)

The recommendations given in ISO 9241-14 to ISO 9241-17 are more specific than the ones in ISO 9241-10 to ISO 9241-13, since they formulate recommendations for specific dialogue techniques. Often, more than one dialogue technique is employed in a user interface to meet various levels of user skills as well as various task characteristics. The appropriate selection and combination of dialogue techniques is described in clause A.3.

The dialogue techniques are the following.

— “Menu dialogues” (ISO 9241-14)

— “Command dialogues” (ISO 9241-15)

— “Direct manipulation dialogues” (ISO 9241-16)

— “Form filling dialogues” (ISO 9241-17)

ISO 9241-14 is concerned with the ergonomic design of menu dialogues (e.g. pull-down menus and pop-up menus). In menu dialogues, the dialogue system presents one or more groups of options to the user, the user chooses one or more options, and the computer executes the desired process denoted by the option(s).

ISO 9241-15 is concerned with the ergonomic design of command dialogues. In command dialogues, users input (by recall) either complete or abbreviated command phrases as required by the command language syntax, and the computer performs the actions associated with the commands and their parameters.

ISO 9241-16 is concerned with the ergonomic design of direct manipulation dialogues where users perform operations by acting on displayed objects in ways analogous to manipulating physical entities.

ISO 9241-17 is concerned with the ergonomic design of form filling dialogues. In form filling dialogues, users fill in, select entries for, or modify labelled fields on an area of the display.

A.2 Use of ISO 9241-10 to ISO 9241-17 in analysis, design and evaluation

A.2.1 Introduction

Interface design depends upon the task, the user, the environment and the available technology. Consequently, ISO 9241-10 to ISO 9241-17 cannot be applied without a knowledge of the design context and the context of use of the interface and are not intended to be used as a prescriptive set of rules to be applied in their entirety. Rather, it is assumed that the designer has proper information available concerning task and user requirements and understands the use of available technology (this could require consultation with a qualified ergonomics professional as well as empirical testing with real users).

ISO 9241-10 to ISO 9241-17 can be applied at various stages of the development process (see ISO 13407, *Human-centred design process for interactive systems*, for guidance). During the early stages of the process, ISO 9241-11 can be used to determine usability issues and ISO 9241-10 can provide information related to the overall requirements for dialogue design. In addition, ISO 9241-12 can be used to provide overall guidance about presentation of information and ISO 9241-13 can provide information related to user guidance requirements for the interface.

The intended users of the software parts and the use of particular parts during analysis, design and evaluation are described below.

A.2.2 Types of users

The following groups of individuals are addressed by the standard.

a) Designers of user interfaces, who will apply the standard during the development process.

b) Designers of user interface development tools to be used by designers of user interfaces.

When designing a user interface development tool, the applicable recommendations of ISO 9241 (in particular ISO 9241-14 to ISO 9241-17) should be applied in order to ensure that the user interface development tool is capable of producing user interfaces which meet the recommendations of ISO 9241.

c) Designers of user interface style guides to be used by designers of user interfaces.

ISO 9241-10 to ISO 9241-17 are not user interface style guides. User interface style guides typically apply to a given operating system or specific software development projects. ISO 9241 does not consider a specific operating system or a specific application domain. However, the applicable recommendations of ISO 9241 (in particular ISO 9241-14 to ISO 9241-17) should be applied when designing a user interface style guide for a particular operating system or a particular software development project. Any recommendation given in a user interface style guide should conform to the corresponding recommendation in ISO 9241.

d) The buyer, who will reference ISO 9241-10 to ISO 9241-17 during the product procurement process.

e) Evaluators responsible for ensuring products meet the recommendations in ISO 9241-10 to ISO 9241-17.

f) End users who will gain from the potential benefits provided by the standard.

Designers using ISO 9241-10 to ISO 9241-17 need to know that the interface which they are developing incorporates the principles and meets the recommendations provided in the individual parts of ISO 9241. Likewise, buyers and evaluators need a means to determine whether a product matches relevant recommendations. It is not intended that every recommendation should be applied, only those that are relevant.

A.2.3 Analysis

An important prerequisite for analysis is to determine the intended users and the “context of use” of the interface. ISO 9241-11 provides guidance on how to specify the context of use. Analysis also includes the identification of user activities (task analysis, see ISO 9241-2:1992) required to accomplish the various application functions identified during early design. ISO 9241-10 can be helpful in determining the potential impact of initial dialogue decisions on user performance. Knowledge concerning the various dialogue techniques (ISO 9241-14 to ISO 9241-17) and user guidance (ISO 9241-13) can also be useful in identifying user performance considerations at this stage.

A.2.4 Design

Based on the analysis, ISO 9241-10 to ISO 9241-17 can be used for user interface design as follows.

The dialogue principles in ISO 9241-10 can be used to determine the appropriateness of a particular dialogue technique and in trading-off solutions to optimize user performance. In addition, usability objectives developed during analysis (based on ISO 9241-11) can be used to guide the design.

Guidance for the selection of dialogue techniques is given in Clause A.3 below and in the introduction to ISO 9241-13 to ISO 9241-17.

ISO 9241-12 to ISO 9241-17 should be used as a source of information for making design trade-offs and solving design problems. Each part contains recommendations concerning the detailed design of dialogues which should be applied during the design of that particular dialogue.

Individual recommendations should be evaluated for their applicability and, if judged to be applicable, should be implemented, unless there is evidence that to do so would cause deviation from the design objectives or would result in an overall degradation in usability. In judging whether applicable recommendations have been met, designers should evaluate the product or observe representative users of the product in the context of accomplishing the user's tasks via the dialogue system. Sample procedures which support the determination of applicability and for judging whether a recommendation has been followed are provided in Informative annex A of ISO 9241-12 to ISO 9241-17.

ISO 9241-13 should be used in the design of specific user guidance to support the various dialogues in application.

A.2.5 Evaluation

The evaluation procedure should be based on an analysis of typical users, their typical and critical tasks, and other components of their context of use.

ISO 9241-11 gives guidance about how to specify and measure the overall usability of products.

ISO 9241-10 can be used for identifying general usability defects and usability problems related to the user interface. This evaluation may be based on the applications and examples given in ISO 9241-10.

ISO 9241-12 to ISO 9241-17 can be used for a more detailed evaluation by checking if each applicable recommendation in appropriate parts is met. Applicability is determined by considering any conditional If-statement in the recommendations and appropriate constraints in the design environment. Applicability can be determined by using system documentation analysis, documented evidence, observations, analytical evaluation and/or empirical evaluation. When a guideline is applicable, it is necessary to determine whether or not it has been met. Adherence can be determined by using measurements, observations, documented evidence, and analytical and/or empirical evaluation. A sample procedure for evaluating a user interface with respect to the recommendations given in these standards is described in detail in Informative annex A of ISO 9241-12 to ISO 9241-17.

A.3 Selection and combination of dialogue techniques

A.3.1 Introduction

Designers need to be able to select dialogue techniques that are appropriate to support the various interaction requirements of the user with the system. In some cases, a specific technique may be appropriate to support the entire task or group of related tasks. However, a combination of dialogue techniques is often more appropriate to support the various user activities involved with an application. In addition, it may be useful to provide more than one technique to support a given user interaction in order to take into account individual differences and preferences. To aid in the determination of which dialogue techniques may be appropriate for a particular task, user population and system configuration, a Dialogue Technique Comparison matrix is provided (see Table A.1).

A.3.2 Description of Table A.1

The left column of the Dialogue Technique Comparison matrix lists the four dialogue techniques: menus, commands, direct manipulation and form filling. In the remaining columns of the matrix, relevant task characteristics, user characteristics and system characteristic information is presented. These columns are described below.

A.3.2.1 Task characteristics

The task characteristics columns include actions/parameters, flexibility, frequency, speed and accuracy.

a) **Actions/parameters:** This column describes the types of task activities which are supported by the particular dialogue technique and the various parameters associated with these task activities. For example, menus are appropriate for selection activities where a choice is to be made from a limited set of options/alternatives. Typical parameters include the size of the command set and the need to show defaults and/or current values.

b) **Flexibility:** This column indicates the degree of flexibility (with respect to the variability in task steps and/or sequence) that the dialogue technique supports. For example, menu and form filling dialogues provide a low degree of flexibility while command dialogues and direct manipulation provide a high level of flexibility.

c) **Frequency:** This column indicates the degree to which the dialogue technique supports frequently performed tasks.

d) **Speed:** This column indicates the degree to which the dialogue technique supports tasks which need to be performed quickly.

e) **Accuracy:** This column indicates the degree to which the dialogue technique supports tasks that need to be performed with accuracy.

A.3.2.2 User characteristics

The user characteristics columns include experience, skills and training.

a) **Experience:** This column describes the amount and type of user experience which is appropriate for using the dialogue technique.

b) **Skills:** This column describes the amount and type of user skills required to use the dialogue technique.

c) **Training:** This column describes the amount and type of training that the user is expected to have to use the dialogue technique.

A.3.2.3 System characteristics

The system characteristics columns include input, output and response. It should be noted that many additional system characteristics may influence the choice of a given dialogue technique.

a) **Input:** This column describes the type of input device(s) relevant for this dialogue technique.

b) **Output:** This column describes the type of output device(s) relevant for this dialogue technique.

c) **Response:** This column indicates the maximum response time that will reasonably support the use of the dialogue technique.

A.3.3 Example of using the matrix

Assume that information about the task, user and system characteristics is as follows.

— The task requires that the user prints out a document. This is an infrequent task in the application.

— The user has little training, is not skilled at keyboard input and has very little experience with the application.

— The system display may vary in resolution and graphics capability, the system has fast response time and has both a keyboard and a mouse as input devices.

On the basis of the information in the Dialogue Techniques Comparison matrix (Table A.1):

— The Task characteristics imply that Menus, Direct manipulation, or Form filling are appropriate.

— The User characteristics imply that Menus and Direct manipulation are appropriate.

— The System characteristics imply that Menus, Commands, and Form filling are appropriate.

— Since Menus appear to be the only appropriate dialogue technique given the Task, User and System characteristics, they would become the designer's logical choice.

A.3.4 Combining dialogue techniques

As noted above, in most applications more than one dialogue technique is used to support the user's interaction with the application. If dialogue combinations are used, the recommendations in the following subclauses should be considered.

A.3.4.1 Continuity of actions

If the user moves from one dialogue technique to another, the change in psychomotor activity should be natural and not cause additional task loading.

EXAMPLE The user selects an object using a pointing device, selects an operation on that object using the same pointing device and then selects an option from a menu for that operation using the same pointing device.

A.3.4.2 Compatibility of operational metaphor

If an operational metaphor is used for an application, this metaphor should be appropriate to all of the dialogue techniques used in that application, or the aspects of non-appropriateness should be clear to the user.

A.3.4.3 Consistency in terminology

Terminology should be consistent across dialogue techniques used within an application.

A.3.4.4 Syntax consistency

If appropriate to the task and the characteristics of the dialogue techniques used, the syntax of the dialogue techniques should be consistent.

A.3.4.5 Consistency of feedback

Feedback mechanisms used in combined dialogues should be consistent across the dialogue techniques to the extent possible.

A.3.4.6 Interchangeability of dialogue techniques

If several dialogue techniques are used as alternatives within an application, these techniques should produce the same effect (change in system state, output, etc.).

NOTE The equivalency of the effect or output is particularly important when the dialogue will be used by users who have sensory, physical or cognitive challenges (or have sensory, physical or cognitive special needs).

A.3.4.7 Speed and accuracy

Moving from one dialogue technique to another within an application should not result in an increase in errors or unduly slow the user down in completing his/her task.

A.3.4.8 Complexity

Users should not be required to frequently switch dialogue techniques to accomplish a given task because frequent changes will increase the complexity of the interface.

A.3.4.9 Clear indication of appropriate technique(s)

It should be obvious to users as to which dialogue technique(s) is (are) appropriate to perform the particular operation or task.

Table A.1 — Dialogue Technique Comparison

Dialogue technique	Task characteristics					User characteristics			System characteristics		
	Actions/parameters	Flexibility	Frequency	Speed	Accuracy	Experience	Skills	Training	Input	Output	Response
Menus	– Choice selection from limited number of alternatives – Possible large command sets – Showing default/current options	Low	Low to High	a	High	Little or none with application	Some keying or pointing	Little or none	Minimal keyboard/ pointing device	Medium resolution text	Within 2 s
Commands	– Entering choices where choice not predefined – Entering options/data in arbitrary order	High – Able to extend to new situations	High	High	a	Relatively high with computers/ command language	Moderate to good typing (if keyed)	Some on command language	Keyboard Voice recognition in some cases	Medium resolution text Audio (if voice)	Within 2 s
Direct manipulation	– Control of objects – Objects need to represent real world objects – Complex object attributes – Input/command hard to describe – Transformation of visual attributes – Manipulate many objects as one	High – Task sequence can be variable	Low	a	Medium (may be high with magnifi-cation)	With graphical representations	Psycho-motor skills for movements	Some on direct manipulation	Pointing device	High resolution graphics capability	Within 500 ms
Form filling	– Choices from small sets of alternatives – Defaults/current values needed – Data for input from another source (paper, customer) – Input dominated by parameters	Low	Low to high	High	High	With form or paper equivalent Limited with computer, but familiar with keyboard	Moderate to good typing	Little	Keyboard Pointing device in some cases	Medium resolution text Graphics in some cases	Variable

a Blank cells in the matrix indicate that a particular cell value is either not relevant or there is insufficient evidence to specify a value.

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Price based on 12 pages