TECHNICAL REPORT

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Ergonomics — Ergonomics of human-system interaction — Human-centred lifecycle process descriptions

Ergonomie — Ergonomie de l'interaction homme/système — Descriptions des processus cycle de vie centrées sur l'opérateur humain

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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is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.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 ISO/TR 18529 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TR 18529 was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 4, *Ergonomics of human-system interaction*, WG 6. It extends and formalises the human-centred processes defined in ISO 13407:1999, *Human-centred design processes for interactive systems*. It is presented in a similar form to the process definitions for software development defined in ISO/IEC TR 15504, *Information technology — Software process assessment*.

Introduction

This document is intended to assist those involved in the design, use and assessment of lifecycle processes for systems, hardware and software. It presents a definition of the processes which comprise a human-centred approach and lists their components, outcomes and the information used and produced. The intention is to inform the users of process models who want to take account of human-centred processes in system, hardware and software lifecycles.

ISO 13407 *Human-centred design processes for interactive systems* is the standard produced by ISO TC159/SC4/WG6 that explains the benefits achieved by making the interactive systems lifecycle more human centred, and the processes required to make a lifecycle human-centred. The human-centred lifecycle process model presented in this Technical Report is a structured and formalised definition of the human-centred processes described in ISO 13407. It is intended to make the contents of ISO 13407 accessible to process assessment and improvement specialists and to those familiar with or involved in process modelling.

The model presented in this document uses the format common to process assessment models. These models describe the processes which ought to be performed by an organisation to achieve defined technical goals. The processes in this model are described in the format defined in ISO/IEC TR 15504, *Information technology — Software process assessment*. Although the primary use of a process assessment model is for the measurement of how well an organisation carries out the processes covered by the model, such models can also be used as a description of what is required in order to design and develop effective organisational and project processes.

Human sciences experts (e.g. ergonomists, usability engineers etc.) may find the model useful as a means of presenting the activities required when projects or companies adopt a human-centred approach or need to develop products with an assured degree of quality in use. Process modelling and process definitions are means of discussing and planning the work required in order to take account of human sciences input in system development and operation. Process definitions are widely understood in the systems and software development communities. The ability to describe human sciences methods and techniques, and their inputs and outputs, in the language used by systems and software engineers and their managers simplifies the adoption and implementation of the human-centred approach.

Ergonomics — Ergonomics of human-system interaction — Human-centred lifecycle process descriptions

1 Scope

This Technical Report contains a formalised model based on the human-centred processes described in ISO 13407, *Human-centred design processes for interactive systems*. It should be used in the specification, assessment and improvement of the human-centred processes in system development and operation.

NOTE 1 The word formalised is used in the preceding paragraph to mean that the process descriptions in this document follow the format specified in ISO/IEC TR 15504, *Information technology — Software process assessment*. It should not be read as a claim that the model has any mathematical basis or rigour.

NOTE 2 The difference in coverage of the model and ISO 13407 is indicated in the relevant processes (HCD 1 clause 6.2 and HCD 7 Clause 6.8).

The scope of the model is based on that for ISO 13407 which has as its scope '*guidance on human-centred design activities throughout the life cycle of interactive computer-based systems.*' However, whilst the intended audience for ISO 13407 is given as '*those managing the design process*' this Technical Report is intended as guidance for those who are involved in the design, use and assessment of lifecycle processes for system, hardware and software.

Readers of this Technical Report are expected to be familiar with ISO 13407.

NOTE 3 Copyright release for the process descriptions: Users of this Technical Report may freely reproduce the process and work product descriptions contained in this document as part of any Assessment Model based on these descriptions, or as part of any demonstration of compatibility with the described processes, so that the descriptions can be used for their intended purpose.

2 Normative References

The following standards contain provisions which, through reference in this text (or the text of ISO 13407 which is normative on this standard) constitute provisions of this Technical Report. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Technical Report are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 6385:1981, *Ergonomic principles in the design of work systems*.

ISO 13407:1999, *Human-centred design processes for interactive systems*.

3 Definitions

For the purposes of this Technical Report, the terms and definitions given in ISO 6385:1981, *Ergonomic principles in the design of work systems*, ISO 9241-11:1998, *Ergonomic requirements for office work with visual display terminals (VDTS) — Part 11: Guidance on usability*, ISO 13407:1999, *Human-centred design processes for interactive systems,* ISO/IEC TR 15504-9:1998, *Information technology — Software process assessment — Part 9: Vocabulary*, ISO/IEC 9126-1, *Information technology — Software product quality — Part 1: Quality model* and

ISO/IEC 15288, *Information technology — System engineering — System life cycle processes* apply. The terms most relevant to this Report are given below.

(process) **Capability** The ability of a process to achieve a required goal (ISO/IEC TR 15504 part 9).

Context of use The users, tasks, equipment (hardware, software and materials), and the physical and social environments in which a system is used (ISO 9241 part 11).

Enterprise A business unit, company, corporation or other organisation engaged in trading a product or service. (ISO 15288)

Ergonomics Ergonomics produces and integrates knowledge from the human sciences to match jobs, systems, products and environments to the physical and mental abilities and limitations of people. In doing so it seeks to safeguard safety, health and well-being whilst optimising efficiency and performance (ISO/CD 6385).

Human/user-centred Approaches which have as their primary intention or focus the consideration of the interests or needs of the individuals and/or groups which will work with or use the output from a system. (developed from ISO 13407)

Lifecycle The stages and activities spanning the life of the system from the definition of its requirements to the termination of its use covering its conception, development, operation, maintenance support and disposal (derived from IEC 61508 and ISO 15288).

Organisational In making use of the definitions in these standards a potential conflict is created over the word 'organisational'. ISO/IEC TR 15504 uses the term 'organisational process category' to describe processes related to the maintenance of infrastructure and competence in the organisation which develops software. This document and ISO 13407 use the term 'organisational requirements' to refer to the needs of the client organisation. In this document 'organisational' should be taken to refer to the client, not the developer organisation. To avoid confusion the term 'enterprise' *q.v.* is used when referring to the organisation(s) which are developing a system for use by the client organisation. Apart from in this clause the term 'organisation' is used to refer to any other organisation, including the client organisation.

Practice A technical or management activity that contributes to the creation of the output (work products) of a process or enhances the capability of a process (ISO/IEC TR 15504 part 9).

Process A set of interrelated activities, which transform inputs into outputs (ISO 8402).

NOTE 1 In this model nearly the equivalent of a Capability Maturity Model key process area (KPA).

Process assessment A disciplined evaluation of an enterprise's software processes against a model (ISO/IEC TR 15504 part 9).

Process category A set of processes addressing the same general area of activity (ISO/IEC TR 15504 part 9).

Process improvement Action taken to change an enterprise's processes so that they meet the enerprise's business needs and achieve its business goals more effectively (ISO/IEC TR 15504 part 9).

Prototype Representation of all or part of a product or system that, although limited in some way, can be used for evaluation (ISO 13407).

Quality in use The capability of a (software product) to enable specified users to achieve specified goals with effectiveness, productivity, safety and satisfaction in specified environments (ISO 9126-1:1999) or contexts of use (ISO 9241 part 11).

Stakeholder Any individual who is affected by the output from, provides the input to, develops, maintains, uses or manages the use of a system (derived from ISO 15288).

NOTE 2 Stakeholders include all types of users and anyone else affected by the system. For example, the customer, regulatory bodies, maintenance staff, support desk, etc.

System A discrete, distinguishable entity with a physical existence and a defined purpose completely composed of integrated and interacting components, each of which does not individually comply with the overall purpose (ISO 15288).

NOTE 3 In this document the term system is used to describe a product *q.*v., implemented in any combination of physical equipment, computer software, documentation, human tasks and organisational or management procedures.

NOTE 4 The term 'system' is used in this document to mean large and small systems and also equipment and other products. A system can range from an entire outsourced information provision service, to a worksystem, to a consumer item such as a lawnmower.

Task Activities required to achieve a goal (ISO 9241 part 11).

User The individual interacting with the system (ISO 9241 part 10).

NOTE 5 A user is a stakeholder.

Usability The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in specified context of use (ISO 9241 part 11).

Worksystem The work system comprises a combination of people and working equipment, acting together in the work process, to perform the work task, at the work space, in the work environment, under the conditions imposed by the work task (ISO 6385).

(associated) **Work product** A document, piece of information, product or other item which acts as input to or output from a process (ISO/IEC TR 15504 part 9).

4 Abbreviations

HC Human-centred

HCD Human-centred design

UI User interface

5 Background to the human-centred process model

5.1 Use of the model

This document is intended to assist those who wish to make their system development process and its associated support processes more human-centred, and to include knowledge from the human sciences in system design. It presents a definition of the processes which comprise a human-centred approach. It lists their components, outcomes and the information used and produced.

This Technical Report should be used by those developing lifecycle process models. It provides a reference set of descriptions of human-centred processes for this purpose. This Technical Report does not place further requirements on those developing process models. However, ISO/IEC TR 15504, *Information technology — Software process assessment*, on which the format of the descriptions is based, gives further advice on the development of models for process assessment. Annex C of this Technical Report contains an informative interpretation of the relevant clauses of ISO/IEC TR 15504 which may be used in the qualification of process assessment models which claim compatibility with the processes described in this Technical Report.

5.2 Benefits of human-centredness in the lifecycle

ISO 13407, the standard for human-centred design processes for interactive systems, describes human-centred development as '*An approach to interactive system development that focuses specifically on making systems*

usable. It is a multi-disciplinary activity, which incorporates human factors and ergonomics knowledge and techniques. The application of human factors and ergonomics to interactive systems design enhances effectiveness and efficiency, improves human working conditions, and counteracts possible adverse effects of use on human health, safety and performance. Applying ergonomics to the design of systems involves taking account of human capabilities, skills, limitations and needs.'

It goes on to say that '*Human-centred systems empower users and motivate them to learn. The benefits can include increased productivity, enhanced quality of work, reductions in support and training costs and improved user health and safety. Although there is a substantial body of human factors and ergonomics knowledge about how such design processes can be organised and used effectively, much of this information is only well known by specialists in those fields. This International Standard aims to help those responsible for managing hardware and software design processes to identify and plan effective and timely human-centred design activities. It complements existing design approaches and methods.*'

As far as systems and software developers are concerned the use of a human-centred approach gives a more usable, trainable, and supportable product and greater client satisfaction. Human-centred design may reduce risk and can reduce health and safety risks associated with the operation of a system. In most sectors of industry predictable usability and training requirements are now expected attributes of an interactive system. Predictable support requirements allow the management of service costs. Human-centred processes require more investment in the early stages of the lifecycle, but have been found not only to reduce in-service costs but also to reduce development costs. In particular human-centred processes reduce the risk of unexpected changes in requirements and reduce re-work and installation costs. In the case of generic or off-the-shelf products usability and delight are now necessary requirements.

The goal of the human-centred approach is to ensure that the development, acquisition and operation of an interactive system take account of the needs of the user as well as the needs of the developer and owner. A human-centred approach takes account of the user's interaction with the components of the system and with other stakeholders. Human-centred processes allow developers and owners to analyse how the system will behave when it is in operation and to measure its quality in use. Human-centred processes take account of context of use, i.e. the complete environment in which the interactive system will be used. Human-centred processes address the total system within which software and hardware are components.

Human-centred approaches can also be used to design and improve processes within both the enterprise which is developing the system and the client organisation. A human-centred approach to process modelling and re-engineering addresses cultural issues and staff acceptance and engenders buy-in to new processes.

5.3 Rationale for the model

This model has been developed in response to a need to improve the performance of the human-centred part of system development and support projects. The model is intended to provide a basis for those planning the human-centred activities on a project and to assist those who wish to improve how well their enterprise performs human-centred activities. The model has been developed as a stand-alone model, not as part of one of the existing process models, such as ISO/IEC 12207, *Information technology — Software lifecycle processes*, the *Capability Maturity Model* (CMM) and the *System Engineering Capability Maturity Model* (SE-CMM) or ISO/IEC TR 15504, *Information technology — Software process assessment*. This is mainly because of the number and variety of process models, but also to make more clear the nature of human-centred activities and their implications for system lifecycles. The model conforms to and extends ISO 13407, *Human-centred design processes for interactive systems*. ISO 13407 explains the arguments for and purposes of a human-centred approach and describes the activities necessary to be human-centred in the design process.

5.4 Basis of the model

This model uses the format common to process assessment models. Such models describe what **processes** ought to be done by an enterprise to achieve defined technical goals. The processes in this model are described in the format defined in ISO/IEC TR 15504, *Information technology — Software process assessment*. The primary use of a process assessment model is for the measurement of how well an enterprise carries out the processes covered by the model. However, such models can also be used as a description of what is required in order to design and develop effective enterprise processes. For more information on this use of process models reference may be made to ISO/IEC TR 15504.

5.5 Structure of the model

The entity relationship diagram in Figure 1 describes the formal components of the model presented in this Technical Report.

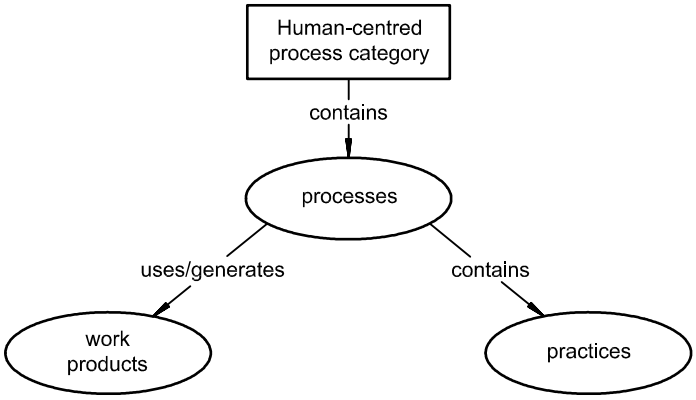

Figure 1 — Entity relationship diagram of the model

5.6 Elements of the model

The human-centred design process model consists of seven sets of practices. These practices describe what has to be done in order to represent and include the users of a system during the lifecycle as is emphasised in Figure 3. The contents of the model can be summarised as a process hierarchy as demonstrated in Figure 2.

Human-centred system development

HCD 1	HCD 2	HCD 3	HCD 4	HCD 5	HCD 6	HCD 7
Ensure HCD content in systems strategy	**Plan and manage the HCD process**	**Specify stakeholder and organisational requirements**	**Understand and specify the context of use**	**Produce design solutions**	**Evaluate designs against requirements**	**Introduce and operate the system**
represent stakeholders collect market intelligence define and plan system strategy collect market feedback analyse user trends	consult stakeholders plan user involvement select human-centred methods ensure a human-centred approach plan HCD activities manage HC activities champion HC approach support HCD	clarify system goals analyse stakeholders assess H&S risk define system generate requirements set quality in use objectives	identify user's tasks identify user attributes identify organisational environment identify technical environment identify physical environment	allocate functions produce task model explore system design develop design solutions specify system and use develop prototypes develop user training develop user support	specify context of evaluation evaluate for requirements evaluate to improve design evaluate against system requirements evaluate against required practice evaluate in use	manage change determine impact customisation and local design deliver user training support users conformance to ergonomic legislation

Figure 2 — Human-centred design processes and their practices

The processes in the model are linked and human-centred lifecycles are iterative.

Processes should not be confused with the stages of a lifecycle. Processes are enacted at more than one stage in the lifecycle. The need for, or emphasis between, the outcomes (i.e. the results of successful implementation and the work products) of a process will vary depending on the stage at which it is performed. This variation in emphasis will in turn affect the performance of the practices which comprise the process. The effect of stage and project context on the performance of processes and practices is one of the main differences between process models and methods/methodologies for system development.

NOTE 1 ISO 15288 describes the relationship between the processes which bring about required outcomes in the lifecycle and the stages in the lifecycle through which the system progresses.

Whilst it is possible to draw a number of simple diagrams which demonstrate the iterative nature of the human-centred lifecycle there are many different versions of lifecycles, depending on the type of system being developed and the market sector for which the system is intended. It is therefore difficult and may even be confusing to draw one simple diagram which demonstrates how processes are linked. Figure 3 attempts to convey the cyclical nature of the HCD processes and their linking. Human-centred processes are not performed in isolation. HCD processes use information from and create information for other system lifecycle processes.

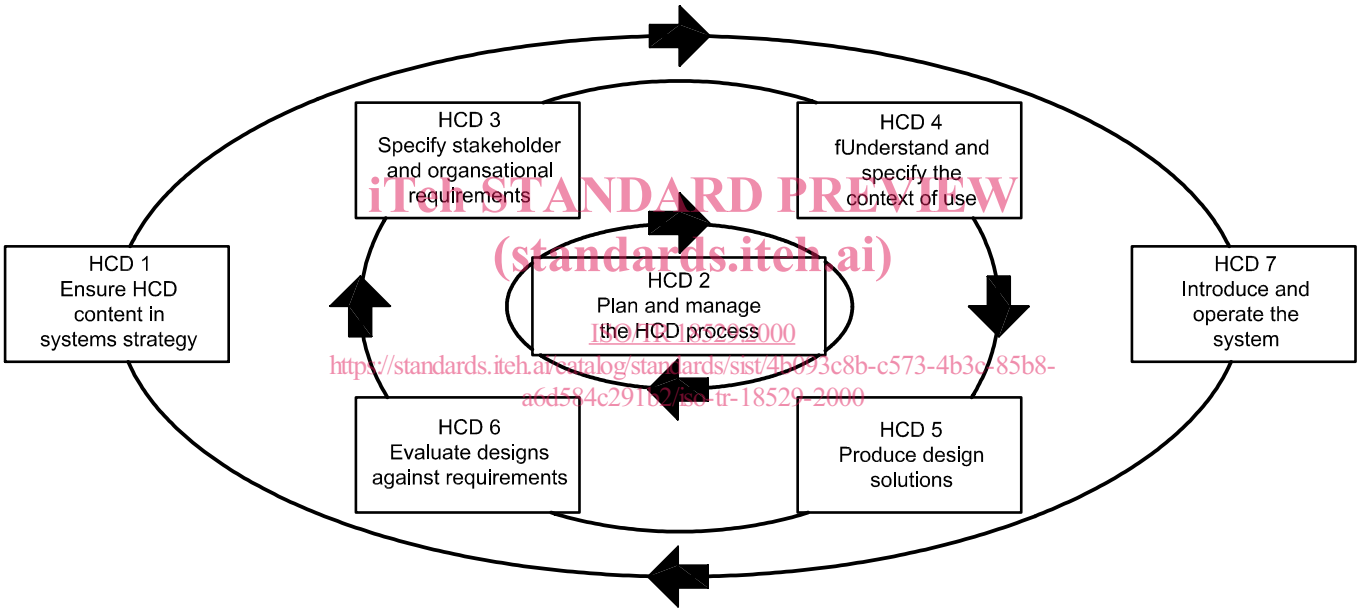

Figure 3 — Linking of Human-centred processes in the lifecycle

In general HCD 3-6 are more technical and form a tight loop at the core of the system development. This loop will be cycled several times during a typical development. HCD 2 covers management and control of human-centred activities. It uses information generated by the HCD 3-6 loop. HCD 2 connects the human-centred lifecycle to other processes in system development. HCD 1 connects the human-centred lifecycle to higher management processes and looks to the future of systems. HCD 1 sets boundaries and goals for projects which then cycle through HCD 3-6 and are implemented with HCD 7. HCD 7 is concerned with the use of the system. HCD 7 connects the HCD processes to the support phase of the system lifecycle. All processes may not be enacted with full rigour at all stages in the lifecycle. The character of process (how it is enacted) may change depending on the stage in the lifecycle.

NOTE 2 HCD 3 and 4 are closely related and there is a degree of overlap between the practices. See the note in clause 6.3.1 for more details.