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Ergonomics of human-system interaction — Specification for the process assessment of human-system issues

Ergonomie de l'interaction homme-système — Spécification pour l'évaluation de processus des aspects homme-système

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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 2.

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 other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

— an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;

— an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

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

ISO/PAS 18152 was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 4, *Ergonomics of human-system interaction*. It extends and formalises the user-centred processes difined in ISO 13407. It is presented in a similar form to the process definitions for sofware development defined in ISO/IEC 15504 developed by ISO/IEC JTC 1/SC 7.

This edition elaborates on ISO/TR 18529.

Introduction

This specification presents a view of system life cycle processes with an emphasis on the identification and handling of issues related to people (users and other stakeholders). It is intended for use in process assessment. The specification describes a set of processes that address issues associated with humans throughout the life cycle of a system.

Process models offer:

a) the potential to analyse the ability of an organization to deliver and/or maintain a system that meets a required level of performance,

b) a description of the factors that hinder this ability, and

c) the means of addressing such shortcomings and mitigating risk.

These have led to the widespread adoption of process modelling and assessment as an element in the assurance of timely and effective system delivery. Processes are defined at the level of what is done to develop and operate a system or organization. Process reference models have been defined for particular applications and industries. International Standard process models are being developed by ISO and ISO/IEC JTC 1. This specification provides a bridge between standardization in the area of Ergonomics (by ISO TC159) and the life cycle standardization being carried out by ISO/IEC JTC 1 *Information technology*, SC 7, *Software engineering*.

ISO/PAS 18152 makes the contents of ISO 13407 accessible to process assessors and to those familiar with, or involved in, process modelling. ISO/PAS 18152 extends the range of processes in ISO 13407 to cover the integration of human-centred design with project and organizational processes and makes a clearer separation between human-centred processes and human-centred design in the system life cycle. A mapping between ISO/PAS 18152 and ISO 13407 is provided in Annex G.

ISO/PAS 18152 informs the developers and users of process models who want to integrate Ergonomics/Human Factors processes in system, hardware and software life cycles in order to assure system usability, health and safety.

The processes in ISO/PAS 18152 (the Human-System process model, or HS model) present a collation of good practice in ergonomics/human factors, user/human-centred design and human factors integration across a range of industries worldwide. These processes are performed by a range of staff and with different degrees of rigour depending on the industrial sector, the type of system, its purpose or use and the need for an assured level of usability.

ISO/PAS 18152 has been developed with the following objectives in mind

— To provide the means of assessing and mitigating risks arising from human-system issues that will affect usability through the life cycle, both at transition points between life cycle stages and during each stage.

— To provide a description of human-system processes for use in project planning and for inter-disciplinary communication.

— As a basis for understanding and cooperation during the tendering process and for human-system capability evaluation to support contract award, either in a stand-alone manner or in conjunction with a software or system capability evaluation.

— To provide a basis for structured human-system process improvement by supplier, customer or employer organizations.

Ergonomics of human-system interaction — Specification for the process assessment of human-system issues

1 Scope

This Publicly Available Specification presents a human-systems (HS) model for use in ISO/IEC 15504-conformant assessment of the maturity of an organization in performing the processes that make a system usable, healthy and safe. It describes processes that address human-system issues and the outcomes of these processes. It details the practices and work products associated with achieving the outcomes of each process.

The model describes processes for specifying and evaluating usability, health and safety, but it does not address all processes relating to their achievement.

The model will always be tailored to the specific organizational and system context prior to use in assessment. Annex D provides advice on tailoring process models for a range of uses.

The HS model does not define the roles or competencies of staff who perform HS processes.

This specification is intended for use by process assessors and those developing process assessment models and tools. It may be informative for those responsible for human factors activities and human factors specialists. The latter groups of readers should familiarise themselves with the vocabulary of process modelling and process assessment prior to reading this specification. The Bibliography lists informative standards and texts.

This specification should be used in conjunction with ISO 13407 and ISO/IEC 15504. The latter standard provides the framework in which the process descriptions in this specification may be used. This specification defines an additional category of processes for use with other process standards, for example ISO/IEC 12207 and ISO/IEC 15288.

NOTE 1   Readers of this specification are expected to be familiar with ISO 13407 and ISO/IEC 15504.

This specification can be applied to the specification, design, assessment and operation of manned or embedded systems, hardware and software. The model can be applied to generic systems (for example consumer products), bespoke systems (for example control or defence systems) and systems which continuously change to meet changes in the business or user environment (for example management information systems). However, it will need to be tailored for each application.

NOTE 2   Copyright release for the process descriptions: Users of this specification may freely reproduce the process descriptions contained in Clause 7 and Annex A of this specification as part of any Process Assessment Model, or as part of any demonstration of compatibility with this specification, so that it can be used for its intended purpose.

2 Conformance

Those wishing to claim that derived process assessment models are conformant to this specification shall meet the conformance requirements of ISO/IEC 15504-2:2003, subclause 6.3. An example of such a conformance statement is provided by the attestation of conformance in Annex I of this specification.

3 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 6385:—[1]), *Ergonomic principles in the design of work systems*

ISO/IEC 9126-1:2001, *Software engineering — Product quality — Part 1: Quality model*

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 15288:2002, *Systems engineering — System life cycle processes*

ISO/IEC 15504-2:2003, *Process assessment — Part 2: Performing an assessment*

ISO/IEC 15504 (all parts) *Software engineering — Process assessment*

4 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6385, ISO 9241-11, ISO 13407, ISO/IEC TR 15504-9, ISO/IEC 9126-1 and ISO/IEC 15288 apply. The terms most relevant to this specification are given below.

4.1
(process) capability
ability of a process to achieve a required goal

[ISO/IEC TR 15504-9:1998]

NOTE 1   This usage differs from human capability, military capability and operational capability. To avoid confusion, these alternative usages are avoided in this specification.

NOTE 2   The capability levels used in ISO/IEC 15504-2 are included in Annex E.

4.2
context of use
users, tasks, equipment (hardware, software and materials), and the physical and social environments in which a system is used

[ISO 9241-11:1998]

4.3
enabling system
system that complements the system of interest during its life-cycle stages, but does not contribute directly to its functionality

NOTE 1   For example, when the system enters the production stage of the life cycle, an (enabling) production system is required.

NOTE 2   Each enabling system has a life cycle of its own. This specification is applicable to each enabling system when, in its own right, it is treated as the system of interest.

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1)   To be published. (Revision of ISO 6385:1981)

4.4
enterprise

that part of an organization with responsibility to acquire and to supply products and/or services according to agreements

[ISO/IEC 15288:2002]

NOTE   An organization may be involved in several enterprises and an enterprise may involve one or more organizations.

4.5
ergonomics
human factors

study of human capabilities and limitations, human interaction with technologies and environments, and the application of this knowledge to products, processes and environments

NOTE   The new word "Ergonomics" was originally created from a combination of the Greek words "ergos" and "nomos" to mean literally "laws of work".

4.6
formative evaluation

evaluation designed and used to improve the object of evaluation, especially when it is still being developed

[The Program Evaluation Standards, second edition]

4.7
HF data

information about users and other stakeholders that is generated and maintained by the Human Sciences

NOTE   This includes, for example, anthropometric data, health and safety data, psychometric measurements, ergonomics standards, accessibility standards, and expert knowledge in all human sciences (e.g. psychology, sociology, medicine, human computer interaction, behavioural science, anthropology, management science, education, personnel and staffing management), and codifications of this information and knowledge (e.g. international standards, legislative requirements, existing patents, good practice, style guides and project standards).

4.8
human-centred design
user-centred design

an approach to design that is characterised by the active involvement of users, a clear understanding of user and task requirements, an appropriate allocation of function between users and technology, iterations of design solutions, and multi-disciplinary design

[ISO 13407:1999, subclause 5.1]

NOTE   Usability engineering is often used as a substitute for human-centred design. However applying usability engineering methods does not necessarily prescribe the active user involvement that is the essence of human-centred design. In addition, usability engineering often over-emphasises the role of evaluation methods. Human-centred design, on the other hand, refers to the process of analysing context of use, eliciting user requirements, producing design solutions and evaluating the design against the requirements, all in an iterative fashion.

4.9
human factors integration

a systematic approach to the identification, tracking and resolution of human-system issues in order to ensure the balanced development of both the technological and human aspects of operational capability

NOTE 1   The aim is to ensure that project decisions are properly informed by adequate information about the human-related issues, and that relevant project decisions take proper account of HF data.

NOTE 2   Adapted from UK MoD *Human Factors Integration — An Introductory Guide*, 2000).

4.10
human-system issue
an issue (for example, a need, want, constraint, limit, concern, barrier, factor or consideration) relating to the people (users and other stakeholders) and their involvement in, or interaction with, a system at any time in the life cycle of that system. The domains in which HS issues may arise are listed in B.6.

4.11
life cycle
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

NOTE   Adapted from definitions in IEC 61508, ISO 13407 and ISO/IEC 12207.

4.12
(base) practice
a technical or management activity that contributes to the creation of the output (i.e. work products, see Annex A) of a process or enhances the capability of a process

[ISO/IEC TR 15504-9:1998]

4.13
process
a set of interrelated activities, which transform inputs into outputs

[ISO 8402:1994]

4.14
process assessment
a disciplined evaluation of an organization's processes against a model

[ISO/IEC TR 15504-9:1998]

4.15
process category
a set of processes addressing the same general area of activity

[ISO/IEC TR 15504-9:1998]

4.16
process improvement
action taken to change an organization's processes so that they meet the organization's business needs and achieve its business goals more effectively

[ISO/IEC TR 15504-9:1998]

4.17
project
an endeavour with defined start and finish dates undertaken to create a product or service in accordance with specified resources and requirements

[ISO/IEC 15288:2002]

NOTE   The term 'project' is not intended to be exclusive to the development of a system. Projects include long-term activities related to a system, such as training, maintenance and support.

4.18
prototype
refers to any artefact created for the purpose of demonstration to users in order to elicit or test user feedback

NOTE 1   This includes *inter alia* demonstrators, mock-ups, paper prototypes, simulations, role-plays, dummy systems or documents, scenarios.

NOTE 2   Adapted from ISO 13407.

4.19
stakeholder
an interested party having a right, share or claim in the system or in its possession of qualities that meet that party's needs and/or expectations

EXAMPLE   The user, the customer, the employer, developers, regulatory bodies, maintenance staff, support desk. "The employer" includes those responsible for providing the personnel for a system (e.g. staffing planners, training organization).

NOTE   The term "project stakeholder" is used in this specification to refer to the members of an organization who have a stake in a project. This includes, for example, the project manager, task leaders, technical staff, administrative staff, and quality assurance.

4.20
summative evaluation
evaluation designed to present conclusions about the merit or worth of the object of evaluation and recommendations about whether it should be retained, altered or eliminated

[The Program Evaluation Standards, second edition]

4.21
system
a combination of interacting elements organized to achieve one or more stated purposes

[ISO/IEC 15288:2002]

NOTE 1   A system may be considered as a product or as the services it provides.

NOTE 2   A system includes the workplace, physical equipment, computer software, documentation, manuals, human tasks and organizational or management procedures. When these are combined with users and operated, the result is a work system *q.v.* ISO 6385 gives guidance on the design and operation of work systems.

4.22
task
an activity required to achieve an intended outcome of a work system

NOTE 1   Adapted from ISO 6385:—[1].

NOTE 2   Task is not used to describe a project activity, the term 'practice' *q.v.* is used for this type of activity.

4.23
user
individual interacting with the system [ISO 13407:1999]

NOTE   The user organization can also be considered as a user of the system.

4.24
usability
extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use [ISO 9241-11:1998]

4.25
work product
an artefact associated with the execution of a process

[ISO/IEC TR 15504-9:1998]

NOTE   A work product might be used, produced or changed by a process.

4.26
work system
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 6385:1981]

5   Symbols (and abbreviated terms)

BP   Base Practice

HCD   Human-Centred Design

HF   Human Factors

HFI   Human Factors Integration

HR   Human Resources

HS   Human-System

6   Content and format of the model

6.1   Use of ISO/PAS 18152

The HS model presents a particular view of system processes that emphasises the treatment of HS issues in the system life cycle and its processes. The human-system process category consists of a set of processes that address issues associated with people throughout the system life cycle. The HS processes contribute to the achievement of usability, health and safety for the intended users of a system throughout its life.

Clause 7 presents three sets of process descriptions. Each description presents the purpose of the process, what will be achieved if it is performed (the outcomes) and lists the practices by which these outcomes are achieved. Notes on each practice and a list of the work products used by and produced by the process are provided in Annex A.

Informative annexes are provided to this specification. Annex A provides descriptive notes on the processes and practices in Clause 7, and lists of work products for each process. It may be used as an assessment model. Annex B describes the technical components of the model, the relationship between the processes in the model, the lifecycle and the organization, and places it in context to assessment and process standards and HFI. Annex C presents an additional set of processes relating to human resources activities and system usability. Annex D describes the use of the HS model in process definition, improvement and assessment. Annex E describes the ISO/IEC 15504 capability scale and indicates the practices in the HS model which are evidence of maturity greater than level 1. Annex F indicates the interrelationship between the processes and work products in the HS model. Annexes G and H present mappings between the HS model and ISO process models for HCD and the system life cycle. Annex I is an ISO/IEC 15504 conformance statement for the HS model.

6.2 Format of the HS model

The HS model presented in this specification uses the format common to process assessment models. Process assessment models describe the processes that give an organization the best opportunity to achieve defined technical goals. The processes in this model are described in the format used in ISO/IEC 15504. Each process is described with a reference number of the form HS.n.m and a unique title. "HS" indicates that the process is from the HS model, "n" is the view (i.e. super process) reference and "m" is the unique process number. The purpose of each process is described, along with a note indicating the benefits of enactment of the process. The list of outcomes indicates the significant, assessable results of the achievement of the process. A list of the activities (practices) by which the purpose is achieved is also included. These are uniquely numbered by extension of the process reference and a sequential number commencing with the identifier "BP". Process models do not indicate roles associated with the enactment of processes. Enactment of HS processes is not specifically associated with any roles, specialisms or professions.

Table 1 lists the processes belonging to the human-system process category with a type and a reference. The reference provides a link to the subclauses of Clause 7 that describe the processes, and to the annexes that provide further details. These annexes are described in 6.1. Annexes B and F provide details of the links between the processes in the HS model. Processes are likely to be instantiated and enacted several times in a life cycle and in several parts of an organization. This is in part a result of the hierarchical reduction of a system into sub-systems and implementable elements, each of which will be defined, developed and maintained by the enactment of the relevant processes, and in part the result of iterative development or continuous improvement of the system. Processes are performed whenever the preconditions for enactment (i.e. need for the outcomes) occur. The duration and degree of rigour employed in the enactment of a process depends on context and requirements.

This specification uses the concept of stage enabling systems presented in ISO/IEC 15288 as a basis for HS.1, the life-cycle involvement process. ISO/IEC 15288 describes each stage in the life cycle of a system of interest as a process. This specification adopts this concept and describes the HS elements of these processes.

Table 1 classifies the processes in the model using the process description provided in ISO/IEC 15504. This defines three types (basic, extended and new) and 2 levels (process and component). For this process specification, these combine in relation to ISO 13407 as follows:

a) Basic Process — identical in intent to a process in ISO 13407.

b) Extended Process — expansion of a process in ISO 13407.

c) New Process — outside the scope of ISO 13407.

d) Component Process — a group of one or more ISO 13407 activities from the same process.

e) Extended Component Process — one or more of ISO 13407 activities from the same process, with additional material. This would normally be a component process of an extended process.

f) New Component Process — one or more component processes outside the scope of ISO 13407. These would normally be component processes of a new or extended process.

Table 1 — Human-system life cycle processes

Reference Number. Overview of process		
Process Name	**Ref. No.**	**Type of process**
HS.1 This process anticipates the particular HS issues at specific stages of the life cycle. It makes the system life cycle efficient by addressing people in the stage enabling systems for the system of interest.		
NOTE These processes are in general grouped according to the example stages provided in Annex B of ISO/IEC 15288 *q.v.* However, in order to create meaningful groups of HS activities, the utilisation stage is split between the early stages (installation and transition to use) and the mainstream use of the system (operation and support of the system).		
Life cycle involvement	HS.1	Extended
Human-system issues in conception	HS.1.1	New component
Human-system issues in development	HS.1.2	Extended component
Human-system issues in production and utilisation	HS.1.3	New component
Human-system issues in utilisation and support	HS.1.4	Extended component
Human-system issues in retirement	HS.1.5	New component
HS.2 This process ensures that HS issues are addressed by the appropriate stakeholders. It reduces life cycle costs by ensuring that design for people is used within the organization.		
Integrate human factors	HS.2	Extended
Human-system issues in business strategy	HS.2.1	New component
Human-system issues in quality management	HS.2.2	New component
Human-system issues in authorisation and control	HS.2.3	Extended component
Management of human-system issues	HS.2.4	Extended component
HF data in trade-off and risk mitigation	HS.2.5	New component
User involvement	HS.2.6	Extended component
Human-system integration	HS.2.7	Extended component
Develop and re-use HF data	HS.2.8	New component
HS.3 This process enables user-centred technical activity to be focused appropriately. It contributes to a better system by designing for people who use the system of interest in its context of use.		
Human-centred design	HS.3	Basic
Context of use	HS.3.1	Component
User requirements	HS.3.2	Component
Produce design solutions	HS.3.3	Component
Evaluation of use	HS.3.4	Component
HS.4 This process provides the means to resolve issues by means of the human part of the system, rather than the equipment-centred part. It ensures the continued delivery of the correct number of competent people required to use the most suitable equipment.		
NOTE This process has not been reviewed to the same standard as HS.1-3. It is therefore presented in Annex C rather than in the main text of the standard.		
Human resources	HS.4	New
Human resources strategy	HS.4.1	New component
Define standard competencies and identify gaps	HS.4.2	New component
Design staffing solution and delivery plan	HS.4.3	New component
Evaluate system solutions and obtain feedback	HS.4.4	New component

7 Human-system process category (HS)

7.1 HS.1 Life cycle involvement

The purpose of the *Life cycle involvement process* is to consider the interests and needs of the individuals and/or groups that will work with the system.

NOTE   The benefits include: the usability of a system is given specific attention; user satisfaction with, and acceptance of, the system are enhanced; working conditions for users are improved; support and training costs are reduced; users can be made to feel more empowered and motivated to learn; the through-life costs of the system are minimised and overall system effectiveness maximised; the system adapts to changing user needs; organizational change, including the responsibilities of users and developers, is addressed.

As a result of successful implementation of this process, the following outcomes are achieved:

1) projects meet and anticipate the issues and risks arising from human-system interaction;

2) the system has a life cycle, phase planning and resourcing designed to combat HF risks in a cost-effective manner;

3) the needs of the stakeholders in the system are communicated to the organization;

4) HS processes are applied when required in the life cycle.

This is achieved through performance of the following sub-processes.

7.1.1 HS.1.1 Human-system issues in conception

The purpose of the *Human issues in conception process* is to establish a focus on user issues in each part of the organization which deals with the strategy, markets, options and overall planning for a proposed system.

NOTE   The benefits include: system whole-life costing including personnel costs and soft costs such as training and reorganization; the assessment of future system performance takes human and organizational performance into account; systems are less likely to encounter problems with operational acceptance or when fielded; the human aspects of system cost and effectiveness are included in the business case for the system.

As a result of successful implementation of this process, the following outcomes are achieved:

1) HS risks and the impact on the stakeholders, existing systems and the working environment are considered in the development and assessment of the system concept;

2) evolving and future stakeholder, organization, social and legislative requirements are described in the system strategy;

3) marketing strategy takes account of HS issues to define systems which meet users' and employer's needs and expectations;

4) the organization takes future acquisition strategy into account when defining organizational change.

This is achieved through performance of the following practices:

— HS.1.1.BP1   Identify expected context of use of systems.

— HS.1.1.BP2   Analyse the system concept.

— HS.1.1.BP3   Describe the objectives which the user or user organization wants to achieve through use of the system.