DRAFT FOR DEVELOPMENT

DD ISO/PAS 18152:2003

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

ICS 13.180

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Comments arising from the use of this Draft for Development are requested so that UK experience can be reported to the international organization responsible for the Technical Specification. A review of this publication will be initiated not later than 3 years after its publication by the international organization so that a decision can be taken on its status at the end of its 3-year life. Notification of the start of the review period will be made in an announcement in the appropriate issue of *Update Standards*.

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Cross-references

The British Standards which implement international publications referred to in this document may be found in the BSI Catalogue under the section entitled "International Standards Correspondence Index", or by using the "Search" facility of the *BSI Electronic Catalogue* or of British Standards Online.

Summary of pages

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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;

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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.

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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.

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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.

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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)

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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).

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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

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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]

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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.

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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.

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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

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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.

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— HS.1.1.BP4 Identify and analyse the roles of each group of stakeholders likely to be affected by the system.

— HS.1.1.BP5 Perform research into required system usability.

— HS.1.1.BP6 Present context and human resources options and constraints to the project stakeholders.

— HS.1.1.BP7 Contribute to the business case for the system.

7.1.2 HS.1.2 Human-system issues in development

The purpose of the *Human-system issues in development process* is to present and represent the needs of the user in the specification, design and verification of the system and its elements.

NOTE The benefits include: potential user problems and scope for improvements in; the technology, supporting material, organizational or physical environment are identified and included in trade-off studies; the design option that best fits the functional and user and organizational requirements is evolved; the hazards to and from users are identified and mitigated.

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

1) design is based on trials of prototypes by potential users;

2) the principles of human-centred design are applied in the development of the system;

3) HS costs (e.g. personnel and training costs), effectiveness (e.g. human performance) and risks are known;

4) feedback and further requirements from the users are collected and used.

This is achieved through performance of the following practices:

— HS.1.2.BP1 Generate design options for each aspect of the system related to its use and its effect on stakeholders.

— HS.1.2.BP2 Produce user-centred solutions for each design option.

— HS.1.2.BP3 Design for customisation.

— HS.1.2.BP4 Develop simulation or trial implementation of key aspects of the system for the purposes of testing with users.

— HS.1.2.BP5 Collect user input on the usability of the developing system.

— HS.1.2.BP6 Assess the health and well-being risks to the users of the system.

— HS.1.2.BP7 Assess the risks to the community and environment arising from human error in the use of the system.

7.1.3 HS.1.3 Human-system issues in production and utilization

The purpose of the *Human issues in production and utilization process* is to facilitate, oversee and ensure that HS aspects are given sufficient attention throughout the implementation, introduction and validation of a system.

NOTE The benefits include: the fit between the system, its operational goals and the user requirements is assessed; the HR issues of re-organization and training are aligned with system introduction; the system is incorporated into the organization, e.g. with the safety management system, system support organization, quality management system, training,

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recruitment and staff development processes; the delivered system conforms to international, national and/or statutory requirements; the costs, time scales and resources required to put the system into service are fully understood.

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

1) the system is adapted to meet the requirements of individual implementations;

2) transition is made to new designs of jobs and new teamworking arrangements;

3) the HS issues of introduction and rollout are addressed;

4) critical HS criteria are part of the acceptance of the delivered system.

This is achieved through performance of the following practices:

— HS.1.3.BP1 Evolve options and constraints into an implementation strategy covering technical, integration, and planning and manning issues.

— HS.1.3.BP2 Identify, specify and produce the infrastructure for the system.

— HS.1.3.BP3 Maintain contact with users and the client organization throughout the definition, development and introduction of a system.

— HS.1.3.BP4 Build required competencies into training and awareness programmes.

— HS.1.3.BP5 Test that the system meets the requirements of the users, the tasks and the environment, as defined in its specification.

— HS.1.3.BP6 Analyse feedback on the system during delivery and inform the organization of emerging issues.

7.1.4 HS.1.4 Human-system issues in utilization and support

The purpose of the *Human issues in utilization and support process* is to monitor and advise the user organization on the user's response to operation, use, support and maintenance of the system.

NOTE The benefits include: the system is more responsive to changes in users (for example, their needs, tasks, context); the system is more responsive to changes in its stakeholders; system usability is maintained at required levels.

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

1) safe operational and health and safety procedures are complied with;

2) the long-term use of the system is monitored in relation to the design intent;

3) the competencies required to utilise and support the system are identified and evolved over time;

4) user and maintainer requirements for support are met by the system.

This is achieved through performance of the following practices:

— HS.1.4.BP1 Produce personnel strategy.

— HS.1.4.BP2 Deliver training and other forms of awareness-raising to users and support staff.

— HS.1.4.BP3 Review the system for adherence to applicable human science knowledge, style guides, standards, guidelines, regulations and legislation.

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— HS.1.4.BP4 Assess the effect of change on the usability of the system.

— HS.1.4.BP5 Review the health and well-being risks to the users of the system.

— HS.1.4.BP6 Review the risks to the community and environment arising from human error in the use of the system.

— HS.1.4.BP7 Take action on issues arising from in-service assessment.

— HS.1.4.BP8 Perform research to refine and consolidate operation and support strategy for the system.

7.1.5 HS.1.5 Human-system issues in retirement

The purpose of the *Human-system issues in retirement process* is to take account of user needs in the close down, removal from service, decommissioning and destruction of a system.

NOTE The benefits include: the HS risks, and health and safety issues associated with removal from service and destruction of the system are addressed; there is support for users during and after decommissioning.

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

1) user reactions and in-service data are used to define future versions of the system;

2) the re-allocation, departure from employment and/or transfer of users is defined and actioned;

3) user requirements for the replacement(s) of the system are identified;

4) the safety and health and safety hazards to workers, users and the general public are monitored.

This is achieved through performance of the following practices:

— HS.1.5.BP1 Collect and analyse in-service reports to generate updates or lessons learnt for the next version of the system.

— HS.1.5.BP2 Identify risks and health and safety issues associated with removal from service and destruction of the system.

— HS.1.5.BP3 Define how users will be re-allocated, dismissed, or transferred to other duties.

— HS.1.5.BP4 Plan break-up of social structures.

— HS.1.5.BP5 Debriefing and retrospective analysis for replacement system.

7.2 HS.2 Integrate human factors

The purpose of the *Integrate human factors process* is the satisfactory deployment of human-system processes for a system.

NOTE The benefits include: human-centred design is applied in the system life cycle; the system is responsive to the growing understanding of user needs; HF skills, methods and techniques are applied to support user-centred design and operation of the system.

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

1) HS issues are addressed by the organization;

2) HS life cycle processes are enacted.

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

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7.2.1 HS.2.1 Human-system issues in business strategy

The purpose of the *Human-system issues in business strategy process* is to take account of system usability, health and safety in an organization's business strategy.

NOTE The benefits include: senior management require that HS life cycle processes have a key role in product development projects; goals are set and resources are made available to address HS issues.

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

1) the usability of the organization's systems in the market/work place is at competitive level;

2) a corporate vision of usability, health and safety as assets is established;

3) there is senior management support for the improvement of infrastructure related to system usability, health and safety.

This is achieved through performance of the following practices:

— HS.2.1.BP1 Define usability as a competitive asset.

— HS.2.1.BP2 Set usability, health and safety objectives for systems.

— HS.2.1.BP3 Follow competitive situation in the market place.

— HS.2.1.BP4 Develop user-centred infrastructure.

— HS.2.1.BP5 Relate HS issues to business benefits.

7.2.2 HS.2.2 Human-system issues in quality management

The purpose of the *Human-system issues in quality management process* is to establish, promote and maintain an organizational infrastructure and staff for HS processes.

NOTE The benefits include: project stakeholders understand the design, project and business procedures related to HS issues; HS life cycle processes are incorporated into existing quality systems, procedures and standards.

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

1) there is a policy for HS life cycle processes;

2) suitable tools and methods are used to address HS issues;

3) HS competencies are made available.

This is achieved through performance of the following practices:

— HS.2.2.BP1 Establish and communicate a policy for human-centredness.

— HS.2.2.BP2 Include HR and user-centred elements in support and control procedures.

— HS.2.2.BP3 Define and maintain HCD and HR infrastructure and resources.

— HS.2.2.BP4 Increase and maintain awareness of usability.

— HS.2.2.BP5 Develop or provide staff with suitable HS skills.

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7.2.3 HS.2.3 Human-system issues in authorisation and control

The purpose of the *HS issues in authorisation and control process* is to take account of usability, health and safety in the acquisition, supply and operation of systems.

NOTE The benefits include: HS issues are supported and promoted within the various customer and supplier organizations.

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

1) human effectiveness, cost and risk analysis results are fed into the system investment process;

2) criteria derived from HF data are used for acquisition;

3) HS issues are part of official sign-off for the system and its elements;

4) HS practice and capability are reviewed in order to build organizational knowledge.

This is achieved through performance of the following practices.

— HS.2.3.BP1 Take account of stakeholder and user issues in acquisition activities.

— HS.2.3.BP2 Take account of HS issues in financial management.

— HS.2.3.BP3 Assess and improve HS capability in processes that affect usability, health and safety.

— HS.2.3.BP4 Include HS review and sign-off in all reviews and decisions.

7.2.4 HS.2.4 Management of human-system issues

The purpose of the *Management of HS issues process* is for the deployed HS processes to reflect the system needs and constraints.

NOTE The benefits include: cost-effective use of HS techniques and resources; life cycle and processes adapt to address HS issues.

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

1) life cycle planning documents include the work products from HS processes;

2) resources and staff are adequate to address HS issues;

3) the life cycle plan adapts to emerging HS issues;

4) there is sufficient iteration in the life cycle to achieve system usability.

This is achieved through performance of the following practices:

— HS.2.4.BP1 Develop a plan to achieve and maintain usability throughout the life of the system.

— HS.2.4.BP2 Identify the specialist skills required and plan how to provide them.

— HS.2.4.BP3 Manage the life cycle plan to address HS issues.

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7.2.5 HS.2.5 HF data in trade-off and risk mitigation

The purpose of the *HF data in trade-off and risk mitigation process* is to use HF data in trade-off and risk management studies in order to mitigate project risk.

NOTE The benefits include: project processes are designed and maintained to encompass HS risks; analyses of human performance, cost and risk are fed into system life-cycle processes.

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

1) the impacts of changes in human performance, cost and risk on overall system characteristics are identified;

2) potential conflicts between HS and other risks and issues are traded-off or otherwise reconciled;

3) project resource is allocated on the basis of an explicit assessment of threats to system usability.

This is achieved through performance of the following practices.

— HS.2.5.BP1 Plan and manage use of HF data to mitigate risks related to HS issues.

— HS.2.5.BP2 Assess the extent to which usability criteria and other HS requirements are likely to be met by the proposed design.

— HS.2.5.BP3 Evaluate the current severity of emerging threats to system usability and other HS risks and the effectiveness of mitigation measures.

— HS.2.5.BP4 Take effective mitigation to address risks to system usability.

7.2.6 HS.2.6 User involvement

The purpose of the *User involvement process* is to effectively involve and consult users on each significant aspect of the system in order to improve the usability, health and safety of the system or to enhance its performance.

NOTE The benefits include: communication between users and other stakeholders in the system is effective; users and stakeholders are aware of the HS risks and issues for the system usability and the changes made as a result of their input (or informed as to why changes will not be made).

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

1) the need for user involvement is identified and accepted by the project;

2) representative users are selected and made available in sufficient numbers and in a timely fashion;

3) user involvement is widespread and effective;

4) the resulting changes to the system are reported back to the users;

This is achieved through performance of the following practices:

— HS.2.6.BP1 Identify the HS issues and aspects of the system that require user input.

— HS.2.6.BP2 Assess the risks of not involving end users in each evaluation.

— HS.2.6.BP3 Define a strategy and plan for user involvement.

— HS.2.6.BP4 Select and use the most effective method to elicit user input.

— HS.2.6.BP5 Take account of user input and inform users.

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7.2.7 HS.2.7 Human-system integration

The purpose of the *human-system integration process* is the facilitation of information exchange and communication regarding HS issues.

NOTE The benefits include: HS processes and their products are taken account of in the development and operation of systems; communication between project stakeholders regarding human issues is effective; HS issues are supported and promoted within the various customer and supplier organizations; emerging HS issues are identified and trade-off against other system issues.

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

1) HF data are provided in suitable format(s) for use by project stakeholders;

2) potential risks arising from HS issues related to the system and its context are identified;

3) the methods and techniques used in the enactment of HS life cycle processes are matched to the needs of project stakeholders.

This is achieved through performance of the following practices:

— HS.2.7.BP1 Develop a common terminology for HS issues with the organization.

— HS.2.7.BP2 Facilitate personal and technical interactions related to HS issues.

— HS.2.7.BP3 Identify and use the most suitable data formats for exchanging HF data.

— HS.2.7.BP4 Customise tools and methods as necessary for particular projects/stages.

— HS.2.7.BP5 Identify emerging HS issues.

7.2.8 HS.2.8 Develop and re-use HF data

The purpose of the *develop and re-use HF data process* is to develop, maintain and provide HF data and standards to the organization.

NOTE The benefits include: HF data are used consistently.

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

1) Correct, adequate, timely and unambiguous HF data are made available;

2) New or revised HF data are produced as required;

3) Validated HF standards are promulgated.

This is achieved through performance of the following practices:

— HS.2.8 BP1 Have a policy for HF data management.

— HS.2.8.BP2 Perform research to develop HF data as required.

— HS.2.8 BP3 Produce coherent data standards and formats.

— HS.2.8 BP4 Define rules for the management of data.

— HS.2.8 BP5 Develop and maintain adequate data search methods.

— HS.2.8.BP6 Seek and exploit expert guidance and advice on HS issues.

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7.3 HS.3 Human-centred design

The purpose of the *Human-centred design process* is to apply HS processes and HF data as appropriate in order to ensure the usability of the system throughout its life cycle.

NOTE The benefits include: human characteristics will be taken into account in system definition, design, development and evaluation in order to optimise human/machine performance under operational conditions; short- or long-term hazards to health as a result of normal operation of the system are addressed; safety risks occurring as a result of the system functioning and being used and misused in a reasonably foreseeable manner are addressed, where appropriate special needs are explicitly considered.

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

1) the system meets user needs in its context of use;

2) possible adverse effects of use on human health, safety and performance are addressed;

3) the user effectiveness, efficiency and satisfaction with the system are known.

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

7.3.1 HS.3.1 Context of use

The purpose of the *Context of use process* is to establish, clarify and communicate the characteristics of the users, their tasks and the technical, organizational and physical environment in which the system will operate.

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

1) the characteristics of the intended users and their tasks, including user interaction with other users and other systems, are documented;

2) the real operational environment of the system, including the factors that affect the performance of users, is described;

3) the HS implications for the system arising from the context of use are included in the system constraints and requirements.

This is achieved through performance of the following practices:

— HS.3.1.BP1 Define the scope of the context of use for the system.

— HS.3.1.BP2 Analyse the tasks and worksystem.

— HS.3.1.BP3 Describe the characteristics of the users.

— HS.3.1.BP4 Describe the cultural environment/organizational/management regime.

— HS.3.1.BP5 Describe the characteristics of any equipment external to the system and the working environment.

— HS.3.1.BP6 Describe the location, workplace equipment and ambient conditions.

— HS.3.1.BP7 Analyse the implications of the context of use.

— HS.3.1.BP8 Present these issues to project stakeholders for use in the development or operation of the system.

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7.3.2 HS.3.2 User requirements

The purpose of the *User requirements process* is to establish, clarify and communicate the requirements of the users of the system.

NOTE The benefits include: definition of the issues, constraints and opportunities related to human involvement with the system (including: system performance and usability criteria, comfort, safety, health and motivation; worksystem and legislative issues, maintenance and support requirements); production of an estimate of what has not been specified; clarification of the constraints, opportunities and degree of flexibility required of the system; setting of priorities for the requirements.

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

1) relevant groups of users within the stakeholders, and their task needs, are identified and analysed;

2) the requirements of the users of the system are defined;

3) user criteria for the performance of the worksystem against operational and functional objectives are stated;

4) user requirements are addressed in the system design.

This is achieved through performance of the following practices:

— HS.3.2.BP1 Set and agree the expected behaviour and performance of the system with respect to the user.

— HS.3.2.BP2 Develop an explicit statement of the user requirements for the system.

— HS.3.2.BP3 Analyse the user requirements.

— HS.3.2.BP4 Generate and agree on measurable criteria for the system in its intended context of use.

— HS.3.2.BP5 Present these requirements to project stakeholders for use in the development and operation of the system.

7.3.3 HS.3.3 Produce design solutions

The purpose of the *Produce design solutions process* is for the design options for the product worksystem to take account of HF data.

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

1) HS issues are considered in the trade-off between design options;

2) usability is traded-off against other design criteria;

3) all user aspects of the system (for example, jobs, roles, documentation, staffing) are designed;

4) user input (direct and/or as feedback from evaluations) is incorporated in the design.

This is achieved through performance of the following practices:

— HS.3.3.BP1 Distribute functions between the human, machine and organizational elements of the system best able to fulfil each function.

— HS.3.3.BP2 Develop a practical model of the user's work from the requirements, context of use, allocation of function and design constraints for the system.

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— HS.3.3.BP3 Produce designs for the user-related elements of the system that take account of the user requirements, context of use and HF data.

— HS.3.3.BP4 Produce a description of how the system will be used.

— HS.3.3.BP5 Revise design and safety features using feedback from evaluations.

7.3.4 HS.3.4 Evaluation of use

The purpose of the *Evaluation of use process* is to collect and report feedback on the evaluation of the aspects of the system related to its use or users.

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

1) formative evaluation provides design information, new risks and issues;

2) summative evaluation demonstrates the fulfilment of user requirements;

3) the organization has information on which to base a decision regarding one or more HS issues;

4) the design is tested with real users.

This is achieved through performance of the following practices:

— HS.3.4.BP1 Plan the evaluation.

— HS.3.4.BP2 Identify and analyse the conditions under which a system is to be tested or otherwise evaluated.

— HS.3.4.BP3 Check that the system is fit for evaluation.

— HS.3.4.BP4 Carry out and analyse the evaluation according to the evaluation plan.

— HS.3.4.BP5 Understand and act on the results of the evaluation.

7.3.5 HS.4 Human resources

The specification, recruitment, development and deployment of the humans who use a system to achieve mission goals also have an effect on usability, health and safety. A fourth process is described in this specification to address this view on the system life cycle. The purpose of HS.4, the *Human resources process*, is for usability to be achieved in the most timely and cost-effective manner by provision of the correct number of competent users. This process has not been reviewed according to the same standard as HS.1-3. It is therefore presented in Annex C rather than in the main text of this specification.

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Annex A
(informative)

Example of an assessment model

A.1 Introduction

This Annex presents an assessment model for the process reference model described in Clause 7. It also contains elaborations and examples related to the HS processes and practices that may be informative for assessors. These elaborations also form part of the body of knowledge underpinning the enactment of HS processes.

To assess if the practices have been achieved in a particular case, the assessor is advised to apply the following contextualisation procedure. For each process the assessor and assessee:

a) review the process, its outcomes and practices;

b) review the project/organization activities that fulfil the purpose and outcomes for a particular system or business objective;

c) consider the outcomes, practices and notes in that context.

The existence and form of the related work products listed in this Annex will assist in this contextualisation. Advice on assessment is given in D.3.

A.2 Practices

Each process is described in terms of the practices which are performed in order to fulfil the purpose and achieve the outcomes. In Clause 7, the practices are succinctly stated in single phrases or sentences. Expansions, examples and explanations of processes and practices are provided in informative text within this Annex, Annex E and the tables in Annex F.

This approach is used in preference to the ISO/IEC 15504 “title, summary and explanation text” presentation of practices for three reasons. Firstly, during assessment there is frequent confusion between the inferred meaning of a short title and the detail of the clause. Secondly, it is difficult to summarise the full meaning of a practice in a sentence without omission of a relevant component. Thirdly, since all practices require interpretation in use, a brief summary with informative text to guide the assessor is more flexible than definitive text which attempts to address all applications of a practice.

Sector-specific interpretations of this specification may include additional notes which elaborate and interpret the practice for the type of systems developed and operated in that sector.

A.3 Elaboration of HS processes, practices and lists of work products

This clause contains a set of tables for use by assessors and as background information for any resulting process improvements. These tables elaborate the purpose, benefits and practices in the reference model contained in Clause 7. The information for each process is presented in one table. Many HS processes derive information or depend on the achievement of outcomes in other HS processes. The links between processes are presented in Table F.1 in Annex F.

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Each table relating to a sub-process (i.e. those numbered HS.m.n) lists a minimum set of work products for each process. As a result of using a Plan-Do-Check-Act structure for the definition of HS processes, the achievement of a maturity level of 1 Performed is in part accomplished by developing the work products produced by the assessed process to take account of relevant HS information (i.e. that described in the practices, processes used by the assessed process and the input work product characteristics). At higher levels of maturity, processes take account of (and produce more) quality, process control, management and measurement work products. A checklist of the likely work products for each process is provided in the tables in this clause and a description of the source and numbering system for these work products is provided in Clause A.4.

The inter-process mapping tables in Annex F should be used in order to check that all work products are identified for each process. For example, HS.1 lists the work products from enabling systems related to stage aspects of the system, but the core technical system work products are listed in HS.3. Whenever a process uses another process to achieve its outcomes (as indicated in Table F.1) the work products from the used process(es) may also be relevant. Table F.2 summarises the relationship between HS processes and work products.

The tables in this clause do not indicate if practices represent process maturity levels of greater than level 1 Performed. All processes may be fully achieved at level 1, but the few HS.2 practices that may (when fully performed) provide evidence of higher levels of capability are listed and discussed in Clause E.3.

Table A.1 — Life cycle involvement (HS.1)

Notes on the process	Human Factors in the Life Cycle — issues related to people in the stages and enabling systems for the system. The processes here are related to anticipating and tracking the particular needs of each stage in the life cycle. The intent is to improve the efficiency of the life cycle by timely resolution of human-system issues. Because the life cycle involvement processes address particular domain issues at each stage in the life cycle, the process descriptions tend to be specific about a broad range of HS issues. These processes trigger and contextualise the processes to integrate human factors (HS.2) and apply human-centred design (HS.3). Life cycle involvement covers ‘edge of system' issues, non-technical issues and through-life issues. These processes use the HS.3 (human-centred design) processes in order to achieve outcomes and the HS.2 (integrate human factors) processes to integrate HF data output into project stage outputs. Many of the processes described in HS.1 will be performed by the purchaser, not the supplier, of the system. Stage enabling systems do not start and stop with system milestones or project approval. The system is the result of the operational stage in the life, in a succession of stage enabling systems that are themselves systems in their own life cycle. Furthermore, because system life cycles tend to be to a greater or lesser degree, concurrent stage enabling systems tend to have long operational stages. Some examples: a) some elements of a system may be being delivered whilst others are still at the concept stage; b) a system which is frequently revised may have versions in delivery and concept stage; c) some aspects of the delivery stage of a system (such as change management) will need to be considered at the concept stage. For generic products, the HS.1 processes address product marketing, sales and service issues.

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Table A.2 — Human-system issues in conception (HS.1.1)

Notes process> **v practice**	The organization addressed in this process is the user organization. For a generic product (for example a mobile telephone), an individual user may be the user organization. The organization which is developing a system may perform this process either independently from, or in collaboration with, the user organization. For generic systems, this process addresses HS issues in market research.
HS.1.1.BP1 Identify expected context of use of systems	Perform studies of potential user groups in order to forecast forthcoming needs for systems and new users or user organizations. Elicit and take account of trends and expectations in society, for example in forthcoming legislation. Elicit staffing and personnel input regarding operation of future systems in their expected context. This activity is carried out as part of marketing or forecasting and is not necessarily related to a particular system. The future context is examined using techniques developed in product marketing. Examples are: photo surveys, focus groups with young people, simulations of future working environments, in-depth analysis of work and lifestyles.
HS.1.1.BP2 Analyse the system concept	This is first carried out very early in the life cycle. Analyse the significance of the difference between prototypes developed to demonstrate aspects of the concept and user needs. Analyse the good, bad and necessary aspects of existing systems. Assess the human and organizational impact of the system to be introduced. Explore options for user effectiveness and user comprehension of the system. For example, conduct an Early Human Factors Analysis.
HS.1.1.BP3 Describe the objectives which the user or user organization wants to achieve through use of the system	For a generic product, the only user may be the purchaser of the system. For a larger or more complex system, there will be more stakeholders and a user organization, but there are still different types of user with different contexts of use. Objectives are ideally set as measurable criteria. At an early stage, stakeholders other than users may also be involved. However, user involvement is a principle of ISO 13407.
HS.1.1.BP4 Identify and analyse the roles of each group of stakeholders likely to be affected by the system	Describe the potential user populations, their characteristics, and the staffing and personnel constraints and requirements imposed on/by the system. Assess the significance and relevance of the system to each group of users. Assess stability of stakeholder requirements. Document issues related to usability and emerging user needs. This will include reference to medical and performance standards, and competence levels, where appropriate. ISO 13407 lists typical stakeholders
HS.1.1.BP5 Perform research into required system usability	Benchmark equivalent systems using relevant criteria, for example usability, safety. Test the usability of components, competing or alternative systems and/or system concepts. Use prototypes to stimulate stakeholder input to system requirements. Research may be just a heuristic evaluation or other expert analysis.
HS.1.1.BP6 Present context and human resources options and constraints to the project stakeholders	Identify future people-supply issues. Requirements and constraints imposed by other systems within the context of use will need to be stated. Identify the relationships between system development options and training options. Health and Safety and Safety legislation will have the greatest effect. Environmental legislation may have an impact.
HS.1.1.BP7 Contribute to the business case for the system	This includes cost aspects, including “soft” costs of introduction, operation and disposal, human contributions to effectiveness, including human error and human resilience in recovering from system failures.

Work products into process	**Work products out of process**
2.2 product needs assessment (44) 1.1 system goal (12) 3.1/3.2 market analysis record/report (46) 2.5 HF data (112) 1.3 HF standards and regulations (116) 3.2 customer request record (83) 3.4 context of use analysis (111)	3.4 benchmark data (43) 2.2 product needs assessment (44) 3.1/3.2 market analysis record/report (46) 1.4/2.1 acquisition strategy/plan (45) 1.4 Improvement opportunities (26) 1.1 personnel policy (15)

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Table A.3 — Human-system issues in development (HS.1.2)

Notes process> v practice	This process addresses project life cycle issues. It deals with the use of HF data and interfaces regarding HS issues between people in the project with sets of interests and responsibilities. System design ideally includes design of the support of the system as a part of the system. This allows support to be included as a factor in trade-off studies.
HS.1.2.BP1 Generate design options for each aspect of the system related to its use and its effect on stakeholders	At a system level, abstract representations of behaviour and capability will be used. At a detailed/low level, the focus will be on components and their construction. Analyse the goals and tasks of the user in relation to the system design and total system performance in order to specify the user's demands on the user interface. As system-requirements decomposition proceeds, it will be necessary to state the staffing and personnel constraints on each sub-system or equipment. Cover or include any proposed changes in business processes, job design and tasks. The number of options and their level of definition relate, at a high level, to the stage of development. Depending on the make-up of the collective knowledge and experience in the multi-disciplinary design team, the involvement of human science specialists and user representatives may range from offering advice to a substantial portion of the analysis of options.
HS.1.2.BP2 Produce human-centred solutions for each design option	Take into account the proposed changes in business processes, job design and training. Identify how job cover, health and safety and accessibility requirements will be met. Identify, specify and produce the manning plans and personnel solutions for the system. Propose staffing solutions for which equipment options are required. Include the manning necessary to provide training, support and safety. Ensure that the system is compatible, with pre-existing systems and mechanisms. For example, procedures, sequences, documentation, maintenance policy, levels of maintenance, degree of operator maintenance.
HS.1.2.BP3 Design for customisation	Provide support for customisation of the system to meet local cultural or operational needs and for customisation and configuration to meet the needs of specific users. Provide details of customisation to configuration management.
HS.1.2.BP4 Develop simulation or trial implementation of key aspects of the system for the purposes of testing with users	Make design solution(s) more concrete using, for example, simulations, models, and mock-ups. Prototypes include sufficience of the system to test safeguards and safety of operations. Prototypes can be developed at any time in the life cycle, although some imagination may be required to realise abstract or ill-formed requirements in a form than can be tested. This practice is supported by selection and tracking of what is a key aspect. The aspects of a system that are key may change with time.
HS.1.2.BP5 Collect user input on the usability of the developing system	Use real tasks. Assess the prototypes against usability and/or operational criteria and collect feedback. Evaluate effectiveness of training and continuous support in producing effective users. Collect user comments. For some systems, the evaluation will include evaluation of safety and health hazards and unnecessary barriers to accessibility.
HS.1.2.BP6 Assess the health and well-being risks to the users of the system	Relate this to the overall risk assessment for the system. Risks to well-being of users covers stress and hazards to mental health.
HS.1.2.BP7 Assess the risks to the community and environment arising from human error in the use of the system	Relate this to the overall risk assessment for the system. Risks arising from malevolent use can also be assessed. Define a policy for the specification and treatment of human error in system risk assessment. EXAMPLES: inclusion of quantitative assessments of human error in risk probability calculations or a design assumption that humans will make errors.

Work products into process	**Work products out of process**
2.2 requirements specification (52) 2.3 system design/architecture (53) 2.5 HF data (112) 1.3 HF standards/regulations (116) 3.2 problem report record (84) 1.1 goals (12)	1.4 improvement opportunities (26) 2.2 requirements specification (52) 3.3 service level measure (42) 2.5 system components (73) 2.5 development environment (104)

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