TECHNICAL SPECIFICATION

ISO/TS 18152

First edition
2010-06-01

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

Reference number
ISO/TS 18152:2010(E)

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

COPYRIGHT PROTECTED DOCUMENT

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

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 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/TS 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 defined 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 first edition of ISO/TS 18152 cancels and replaces ISO/PAS 18152:2003 , of which it constitutes a minor revision.

Introduction

By the time ISO/PAS 18152 had reached the end of its six-year life it had proved to be a useful collection of information with a range of uses. For example, it is cited in ISO/IEC 15288 (the reference model for systems engineering) as the means to address human-system issues in the system lifecycle. However, there are a number of ongoing developments in other standards and related pre-standardization work in ISO/TC 159 and in other ISO technical committees that need to be completed before the material in this Technical Specification can be further developed into a standard or other ISO document. In order to ensure its continued availability within ISO until a project is started to develop a possible successor, it has been converted into this Technical Specification.

This Technical 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 Technical Specification provides a bridge between standardization in the area of Ergonomics (by ISO/TC 159) and the life cycle standardization being carried out by ISO/IEC JTC 1, *Information technology*, SC 7, *Software engineering*.

ISO/TS 18152 makes the contents of ISO 13407 accessible to process assessors and to those familiar with, or involved in, process modelling. ISO/TS 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/TS 18152 and ISO 13407 is provided in Annex G.

ISO/TS 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/TS 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/TS 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 Technical 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 Technical 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 Technical Specification. The Bibliography lists informative standards and texts.

This Technical Specification is intended to be used in conjunction with ISO 13407 and ISO/IEC 15504. The latter standard provides the framework in which the process descriptions in this Technical Specification may be used. This Technical 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 Technical Specification are expected to be familiar with ISO 13407 and ISO/IEC 15504.

The HS model can be applied to the specification, design, assessment and operation of manned or embedded systems, hardware and software. The HS 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 Technical Specification may freely reproduce the process descriptions contained in Clause 7 and Annex A as part of any Process Assessment Model, or as part of any demonstration of compatibility with this Technical 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 Technical Specification shall meet the conformance requirements of ISO/IEC 15504-2:2003, 6.3. An example of such a conformance statement is provided by the attestation of conformance in Annex I.

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, *Ergonomic principles in the design of work systems*

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

ISO 9241-11, *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, *Information technology — Process assessment — Part 2: Performing an assessment*

ISO/IEC TR 15504-9, *Information technology — Software process assessment — Part 9: Vocabulary*

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 and the following apply.

NOTE The terms most relevant to this Technical Specification are given here.

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 Technical 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 Technical Specification is applicable to each enabling system when, in its own right, it is treated as the system of interest.

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
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, 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
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
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

NOTE The domains in which HS issues can 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
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
set of interrelated activities, which transform inputs into outputs

[ISO 8402:1994]

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

[ISO/IEC TR 15504-9:1998]

4.15
process category
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
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
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
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 Technical 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
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
activity required to achieve an intended outcome of a work system

NOTE 1 Adapted from ISO 6385.

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
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
system comprising one or more workers and work equipment, acting together to perform the system function, in the work space, in the work environment, under the conditions imposed by the work tasks

[ISO 6385]

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 this Technical Specification

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 Technical 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 Technical 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 Technical 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 Technical 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 Technical 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.

— 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, 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.

— 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.

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.

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.

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.

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.

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.

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.

— 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 Technical 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 Technical Specification.

Annex A
(informative)

Exemplar 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 Technical 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.

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.

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)

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)

Table A.4 — Human-system issues in production and utilization (HS.1.3)

Notes process>	System approval/acceptance is part of this process. The employer has a key role in the successful implementation of a system. The employer will normally have responsibility for the change process including: making users aware of the change, defining new recruitment and training needs, agreeing an implementation strategy and timetable, and over-seeing the change. It is important that these issues are considered early on as they can have implications for which parts of the system are developed and implemented first, employment conditions, and user acceptance of the new system. This process addresses sales and supply for generic products. Market trials require some degree of utilization of the system.
v practice	The scope of adaptation for individual implementations may range from choosing between standard alternatives to significant redesign.
HS.1.3.BP1 Evolve options and constraints into an implementation strategy covering technical, integration, and planning and manning issues	Planning the availability of people at introduction and throughout the life cycle of the system. The strategy will include a suitable strategy for iteration, including training and maintenance; a time line and a kill line for the project; HF assessment and approval issues for the system. The costs of transition to a new system may be high and need to be taken into account. For many types of system, a formal evaluation of health hazards and safety will be needed.
HS.1.3.BP2 Identify, specify and produce the infrastructure for the system	Covers all HS components of the infrastructure. Training and support are elements of the infrastructure of a system. The development and provision of training is a well-established activity. Training is developed in parallel with design. A training-needs analysis is the starting point. Identify, specify and produce the training required to enable users to perform tasks effectively using the new system. In the case of a large safety-related system, training includes any requirements for user evacuation and recovery. Transfer of training may be an issue. Development of support is a well-established activity. Support is developed in parallel with design and is ideally a part of the designed system. Procedures are developed iteratively.
HS.1.3.BP3 Maintain contact with users and the client organization throughout the definition, development and introduction of a system	This activity maintains contact between the system development enterprise, users and the client organization during system implementation. This may include re-organization of job design and working practices. For example, group/teamwork, training, new business processes, reporting responsibilities. This activity continues as long as the system remains in service. Requirements for ongoing user support will evolve. Allocation of the design and provision between the supplier and user organization may be complex.
HS.1.3.BP4 Build required competencies into training and awareness programmes	Competencies include not only operational but also maintenance and support personnel. ISO/IEC 15288 considers training of operators to be the implementation of the human component of the system. This concept is useful in that it makes clear that training is not an afterthought but a critical element in the integration of the worksystem. This concept also clarifies why training and competence assessment programmes are critical to the safe operation of systems.
HS.1.3.BP5 Test that the system meets the requirements of the users, the tasks and the environment, as defined in its specification	For some systems the evaluation will include evaluation of safety and health hazards. Evaluation to check requirements can be done from early in the life cycle. The system to be tested includes the data, procedures and tasks that appear in maintenance manuals and operating manuals. Check systems for adherence to applicable human science knowledge, style guides, standards, guidelines, and legislation. Health hazards depend on the context of use and may need to be re-assessed if the operation of the system is changed.
HS.1.3.BP6 Analyse feedback on the system during delivery and inform the organization of emerging issues	Feedback may be collected using formal means such as surveys, and analysis of helpdesk calls and bug reports or using anecdotal reports, interviews and informal reports by users.

Work products into process	**Work products out of process**
1.1 goals (12) 2.5 system components (73) 1.2 customer support procedure (82)	1.4/2.1 installation strategy plans (74) 2.5 installation guide (75) 1.4/2.1 acceptance test strategy/plan (68) 1.4/2.1 release strategy/plan (69) 2.5 system (73) 2.5 user's environment (113) 1.4/2.1 training strategy/plan (88) 2.5 training material (90) 3.2 customer satisfaction survey (85) 3.4 customer satisfaction data (86) 1.4 improvement opportunities (26) 3.3 field measure (41) 3.2 problem report record (84) 3.4 acceptance record (81)

Table A.5 — Human-system issues in utilisation and support (HS.1.4)

Notes process> **v practice**	This process may be enacted in part by the enterprise developing the system and in part by the organization which operates the system. The context of use may change during the life of a system. Periodic re-assessment may be required in order to maintain optimum integration between the human and other components of the system. For generic products (for example, a digital television decoder), this process addresses the provision of support to users.
HS.1.4.BP1 Produce personnel strategy	Develop staffing and recruitment options that are coordinated with maintenance, equipment, capability, service delivery options. Use life-cycle cost accounting in order to assess the cost of personnel options. Apply organization-level human resources strategy to acquisition. Present system staffing concepts for operation and support (e.g. for senior management approval). Includes consideration of the resourcing of the system through recruitment, staff development and training.
HS.1.4.BP2 Review the system for adherence to applicable human science knowledge, style guides, standards, guidelines, regulations and legislation	Perform a post-installation study to validate the specification, monitoring of sickness records for health and safety problems. Perform a regular survey of workplaces, users and training programmes to ensure that the software, hardware and workplace meet the requirements of national legislation. There may be changes in regulations regarding Health and Safety. Maintenance of Health and Safety responsibility is a system task. It requires information, instructions and training. This training carries on as long as the system is utilised.
HS.1.4.BP3 Deliver training and workshops to users and maintainers	Training is delivered to meet identified training needs and facilitate the transition to new designs of jobs and new teamworking arrangements. Delivery of training and workshops to users and maintainers to meet identified training needs carries on throughout the utilization of the system. In general, basic training for system usage will be required. Ongoing training to promote user growth may also be provided.
HS.1.4.BP4 Assess the effect of change on the usability of the system	Assess the effect of: — new elements or sub-systems on the usability of the system — major changes on the usability of the system — changes in the context of use on usability of the system. Changes to the context of use may occur in — users (e.g. their skills and training for user organizations, as well as needs and desires for consumer products and personal expectations), — tasks (e.g. changes in type of work or volumes of work), — environment (e.g. changes in working and living environments, new technologies, organizational and work structure, legislation, social and political issues). Health hazards are re-assessed if the operation of the system is changed.
HS.1.4.BP5 Review 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.1.4.BP6 Review 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.
HS.1.4.BP7 Perform research to refine and consolidate operation and support strategy for the system	This is based on feedback about the system in use from users and potential future users. This activity may also relate to identification and retention of knowledge within the organization and process improvement.

Table A.5 (*continued*)

HS.1.4.BP8 Take action on issues arising from in-service assessment	Data from user audit and assessment feeds into actions to improve the system. Continuous improvement in the operation of the system may require support and advice on Human Factors, Safety and Health and Safety.

Work products into process	**Work products out of process**
1.1 operational goals +(12)	3.2 field measure (42)
1.4/2.1 training strategy/plan (88)	1.4 improvement opportunity (26)
2.5 training material (90)	3.3 risk measure (40)
1.3 HF standards and regulations (116)	3.3 service level measure (42)
2.5 HF data (112)	1.2 Customer support procedure (82)
3.3 service level measure (42)	3.2 customer satisfaction survey +(85)
3.3 risk measure (40)	3.2 problem report records (84)
	3.4 customer satisfaction data +(86)
	3.2 customer request record (83)

Table A.6 — Human-system issues in retirement (HS.1.5)

Notes process> **v practice**	The disposal system is conceived of at concept and can be in operation for a considerable part of the life of the system. Include personnel, competence and staffing comment in addition to “hard system” detail.
HS.1.5.BP1 Collect and analyse in-service reports to generate updates or lessons learnt for the next version of the system	Commission further investigations as required. The arbiter for analysis of feedback is coherence of outcomes. For some systems and (iterative/incremental) life cycles, this activity is driven from the concept stage. Feed to learning from experience and legacy migration.
HS.1.5.BP2 Identify risks and health and safety issues associated with removal from service and destruction of the system	There may be long-term health and safety, and accessibility issues associated with the use, operation or disposal of a system. Records may need to be kept and appropriate monitoring activities carried out on stakeholders.
HS.1.5.BP3 Define how users will be re-allocated, dismissed or transferred to other duties.	(no notes in this edition of ISO 18152)
HS.1.5.BP4 Plan break-up of social structures	For systems where the operators or users have had to undertake dangerous, stressful or antisocial tasks, some form of de-conditioning may be required.
HS.1.5.BP5 Debriefing and retrospective analysis for replacement system	Need to start early in order to get input to successor system. HS.1.5.BP1 is reactive; it depends on the emergence of issues in use. BP5 is proactive.

Work products into process	**Work products out of process**
1.1 goals (12)	1.4/2.1 (decommissioning) strategy/plan +(74)
3.4 customer satisfaction data (86)	2.5 decommissioning guide +(75)
1.3 HF/HR standards and regulations (116)	1.4/2.1 training strategy/plan (88)
2.5 HF data (112)	1.1 personnel policy (15)
3.2 personnel record (108)	1.4 improvement opportunity (26)
2.2 requirements specification (52)	3.2 personnel record (108)

Table A.7 — Integrate human factors (HS.2)

Notes on the process	Human Factors Integration — issues related to people in the system-of-interest. The processes here are concerned with strategy, procurement, planning. This process ensures that human-system issues are addressed by the appropriate stakeholders. It reduces life cycle costs by ensuring that "design for people" is used within the organization. This process describes the activities which those responsible for usability and HS issues perform on a successful project. The interface to systems engineering is moveable and depends on the staffing of the project and the proportions of technical and operational risk. This process is directly related to ISO 13407:1999, Clause 6 *Planning the HCD process*; 7.4.6 *Manage the iteration of design solutions*; 7.5.2 *Evaluation plan*. For defence or emergency services use, an additional purpose may be added: "The service survivability of all personnel regardless of skills or location will be enhanced". Special needs, age and impairment are addressed if they emerge as issues in the stakeholder and user needs analysis for the system. See B.6 for the background to the related term "Human Factors Integration".

Table A.8 — Human-system issues in business strategy (HS.2.1)

Notes process> v practice	This process describes those activities that are performed by the business management (and describes its commitment to usability). This process can be performed by business management within the supplier and user organizations. In the case of a supplier, the focus will be on the HS issues related to products in concept and development with an emphasis on usability. In the case of a user organization, the focus will be on products in service with an emphasis on staff and training.
HS.2.1.BP1 Define usability as a competitive asset	This means that business management understands usability and HS life cycle processes as part of the business strategy.
HS.2.1.BP2 Set usability, health and safety objectives for systems	This means that business management sets demands on usability for systems. EXAMPLE Development projects are rewarded for good usability. There may be broader HS issues than usability, but, at a validation level, the treatment of all HS issues is measured in terms of effectiveness, efficiency and satisfaction. Where there is a cluster of related projects, HS objectives can be developed for the cluster before the assignment of project-specific objectives.
HS.2.1.BP3 Follow competitive situation in the market place	This means that business management is interested in how the usability of their systems compares to that of competitors and they a) define and maintain a position relative to the market place, and b) are aware of the marketplace in order to make changes if necessary.
HS.2.1.BP4 Develop user-centred infrastructure	Senior management directly control the funds to maintain/improve user-centred design skills, resources, technology, awareness and culture in the organization.
HS.2.1.BP5 Relate HS issues to business benefits	EXAMPLE 1 Establish through-life cost accounting in order to assess the cost benefits of a user-centred approach. EXAMPLE 2 Consideration of accessibility and a barrier-free workplace/product may have a competitive advantage and give increased marketability and uptake.

Work products into process	**Work products out of process**
3.1/3.2 market analysis (46)	1.1 vision (13)
3.4 benchmark data (43)	1.1 goals (12)

Table A.9 — Human-system issues in quality management (HS.2.2)

Notes process> **v practice**	Include HS process elements in, for example, quality assurance, change control, risk management, process and method maintenance, resource management. Ensure that these are carried out as an integral part of the infrastructure management for the organization (for example through maintenance of an HS issues register). This process is the HS life cycle application of a generic process. When using this Technical Specification in conjunction with other process models, it may be appropriate to use a generic support process and still address the HS-specific concerns described here.
HS.2.2.BP1 Establish and communicate a policy for human-centredness	Promote and maintain a human-centred approach within the organization. Establish a multi-disciplinary culture in project teams. Maintain staff focus on a human-centred approach in activities which may have an impact on usability. Take specific account of HS issues in the management of projects and the organization. Whilst the focus is on the HS issues associated with the system and the user organization, the development and production environments within the organization will generate similar issues.
HS.2.2.BP2 Include HR and user-centred elements in support and control procedures	This practice addresses the processes and procedures related to the system life cycle, not the products of the development process (i.e. system documentation and utilization and support procedures). HS processes are included in corporate procedures and standards or guides. For example, quality assurance, change control, process and method maintenance, resource management. Ensure that these are carried out as an integral part of the infrastructure management for the organization.
HS.2.2.BP3 Define and maintain HCD and HR infrastructure and resources	Select HS processes, methods, tools and techniques in light of best practice, legislative requirement and industry norms. Revise HS processes, methods, tools and techniques in light of experience, technical development, client and legislative requirement and industry norms. Learn from the use of tools and methods to understand and improve the effectiveness of the HS process. Examples of infrastructure are tools, methods, guides, test facilities.
HS.2.2.BP4 Increase and maintain awareness of usability	Promote designer understanding of context of use. Promote designer involvement in HF evaluations. This normally involves training and other promotional activities. For example, formal training, case studies, championing, award schemes.
HS.2.2.BP5 Develop or provide staff with suitable HS skills	This may be accomplished through recruitment, training or retention of consultants. Professionally-recognised qualifications exist for most of the specialist skills. In all cases, some in-house coordination will be required.

Work products into process	**Work products out of process**
1.1 vision (13)	1.1 policy (14)
1.2 system development methodology (1)	1.1 quality statement/policy (24)
1.3 standards (9)	1.3 system life cycle model (2)
1.3 coding standards (10)	1.3 coding standards (10)
2.1 personnel policy (15)	2.1 personnel policy (15)
2.5 development environment (104)	1.4 improvement opportunity (26)
	3.3 quality criteria (27)
	2.5 development environment (104)

Table A.10 — Human-system issues in authorisation and control (HS.2.3)

Notes process> v practice	(no notes in this edition of ISO 18152)
HS.2.3.BP1 Take account of stakeholder and user issues in acquisition activities	This practice extends to provision of HF data and advice to the products system development enterprise and user organization's purchasing processes in general. EXAMPLE 1: contracts management and purchasing. EXAMPLE 2: provide and review HS requirements in invitations and tenders. In this case, the intended stakeholders include the stakeholders in any resulting projects. Involvement in the tendering and contract award process includes the provision of programmes of work, technical requirements, assessment of the capability of suppliers and approval/sign-off. Incentives may be provided in order to encourage a supplier towards addressing HS issues in contractual and commercial arrangements.
HS.2.3.BP2 Take account of HS issues in financial management	Provide and review HS aspects of investment appraisal, cost-effectiveness analysis, business case and high-level project metrics. Use through-life and other suitable total cost models as part of financial analysis.
HS.2.3.BP3 Assess and improve HS capability in processes that affect usability, health and safety	Carry out process assessments of the project stakeholders to identify strengths, weaknesses and opportunities for improvement of HS processes. All project stakeholders may have an influence on the usability of the system. Assessment of both the system development enterprise and the user organization may be required. This process assessment is for the purpose of mitigating project risk regarding usability, health and safety. Feedback may range from a formal certification of capability to a shortlist of major process risks.
HS.2.3.BP4 Include HS review and sign-off in all reviews and decisions	HS review will cover all relevant HS issues, such as usability, Health and Safety legislation, safety, manning, trainability. Follow and clarify project requirements for Design Authority and liability. Signatories and reviewers can be required to demonstrate required knowledge/necessary expertise. Review of this practice can be broken into: a) look for necessary skills in assessment questions asked; b) look for required knowledge to understand and sign.

Work products into process	**Work products out of process**
1.1 goals (12)	2.2 request for proposal (47)
2.1 supplier response to proposal (48)	3.2 contract review record (109)
3.2 subcontractor/supplier history record (49)	3.2 assessment/audit record (29)
3.2 contract (51)	3.2 contract (product or service) (51)
1.1 policy (14)	
3.3 quality criteria (27)	
2.2 request for proposals (47)	
3.2 contract (51)	

Table A.11 — Management of human-system issues (HS.2.4)

Notes process> **v practice**	This process is the HS life cycle application of a generic process. When using this Technical Specification in conjunction with other process models, it may be appropriate to use a generic management process and still address the HS-specific concerns described here. This process is directly related to ISO 13407:1999, Clause 5 *Planning the human-centred process*.
HS.2.4.BP1 Develop a plan to achieve and maintain usability throughout the life of the system	The plan specifies how and when HS activities integrate into the overall system life cycle and how input from HS processes (based, for example, on those given in this Technical Specification) is used in the life cycle. Plans that address HS issues make allowance for iteration where necessary, they include long-term monitoring of the use of the system and they identify the need for and cost of user involvement. The goals for the programme of work related to HS issues are derived from the overall organizational goals for the system. Define reporting lines between personnel addressing HS issues in different parts of the organization and life cycle. Resources need to be allocated for effective communication between project stakeholders. Plan HF data requirements. Decide which methods will be included, how they will link together in the life cycle and produce work packages. Define how these methods will interface with the life cycle methodology being followed for the system. Define outputs and criteria for success for each activity. Define milestones related to concrete stages and achievements. These are not necessarily payments.
HS.2.4.BP2 Identify the specialist skills required and plan how to provide them	A multi-disciplinary team is a means of providing the wide range of skills and viewpoints required to produce and maintain an operable system. Examples of the range of skills which may be required, depending on the system, include: operator, user, maintainer, purchaser, business analyst, trainers marketeer, visual designer, ergonomist, domain expert, technical author, ergonomist, human resources, health and safety, systems analyst, programmer, logistics. Although some HS processes may be conducted by Human Science specialists, most are performed as part of other roles. There is a need to identify someone with authority for HS activities. HS.4 addresses issues related to the provision of operators and users of systems. It could also be applied to the provision of staff for enabling systems.
HS.2.4.BP3 Manage the life cycle plan to address HS issues	Produce and review budgets relating to HS processes. Ensure that the consideration of HS issues does not add unnecessary overhead. Usability is a long-term issue and requires maintenance. Project managers ensure sufficient resource in concept and design to ensure consideration of whole-life issues in design, after that it is not the project manager's concern. However, usability needs to be maintained throughout life and resource will be required to support this. Identify resource for prioritisation and performance of corrective activity occurring as a result of in-service reporting of HF-related defects.

Work products into process	**Work products out of process**
1.1 policy (14)	2.1 project plan (17)
1.3 life cycle model (2)	1.2 job procedure, practice (4)
2.1 schedule (5)	2.1 schedule (5)
1.3 coding standard (10)	2.1 work breakdown structure (6)
1.1 personnel policy (15)	1.3 interface (8)
2.1 project plan (17)	3.3 quality criteria (27)
3.3 quality criteria (27)	3.2 corrective action (logs, plans, minutes) (97)

Table A.12 — Management of HF data in trade-off and risks mitigation (HS.2.5)

Notes process> v practice	Risk is uncertainty, it emerges and is mitigated, other factors are traded and managed from the start.
HS.2.5.BP1 Plan and manage use of HF data to mitigate risks related to HS issues	Define when information about usability is sufficient in any trade-off with other concerns (e.g. cost). Emphasise a management strategy which identifies and addresses risk. Prioritise resources to match risk and emerging HS issues. Drive risk assessment vs. HS issues by identifying the causes for change. For example, staffing levels and health and safety requirements arising from policy and business objective. HS risks such as personnel strategy and operability risks and project risks such as resource limitation will need to be differentiated.
HS.2.5.BP2 Assess the extent to which usability criteria and other HS requirements are likely to be met by the proposed design	Take account of the effect of the context of use including, for example, other equipment. This activity requires the wherewithal to translate between system, sub-system and equipment performance criteria, e.g. to assess the system effectiveness implications of a change in equipment usability in a manner that addresses the emergent properties of the system.
HS.2.5.BP3 Evaluate the current severity of emerging threats to system usability and other HS risks and the effectiveness of mitigation measures	This evaluation may be implemented by use of HS issues and risk management and/or the hazard log. HS risks include operational and life-cycle cost risks. For some types of system, there may be external limits to trade-off arising from, for example, employment law, health and safety considerations, accessibility requirements.
HS.2.5.BP4 Take effective mitigation to address risks to system usability	Mitigation may include changes to the contract and/or requirements. If these changes are not acknowledged and actioned, users will end up filling the gap between the needs and the delivered performance of the system. Take account of the tension between training costs, design costs and operational utilisation in trade studies. Assess the effect on the project plan.

Work products into process	**Work products out of process**
1.4/2.1 risk management strategy/plan (23)	3.2 risk analysis record/report (22)
3.2 test results (62)	1.4/2.1 risk management strategy/plan (23)
3.2 problem report records (84)	1.4 improvement opportunity (26)
3.4 customer satisfaction data (86)	3.3 risk measure (40)
3.2 change request (94)	3.2 change request (94)
3.2 assessment/audit records (29)	3.2 corrective action (logs, plans, minutes) (97)
3.3 risk measure (40)	
3.4 context of use analysis (111)	
2.5 HF data (112)	

Table A.13 — User involvement (HS.2.6)

Notes process> **v practice**	New systems often affect more people than is obvious at first. System output frequently crosses departmental and organizational boundaries. The real "end user" may even be a member of the public. It is important to recognise that the full range of users and other stakeholders are involved in the development process. Stakeholders typically include supervisors, managers, recipients of system output, and maintainers of the system. The term "user" refers to individuals who will use the system, rather than the organization who will purchase and use the new system. Users include maintainers. User involvement is a principle of ISO 13407.
HS.2.6.BP1 Identify human-system issues and aspects of the system that require user input	Advocate the user perspective by reminding the staff in the system development enterprise that the system is intended for use by real people and has to achieve usability. Management support is needed to get this actioned. The most important factor in successful user involvement is management support for a user presence within the design process and for the staff who will be facilitating it. Once management support has been agreed and communicated to the design team, the user perspective can then become influential in the design process.
HS.2.6.BP2 Assess the risks of not involving end-users in each evaluation	This activity is linked to the preparation of the project plan. This activity provides information related to the conditions of use which have to be tested in order to mitigate HS risks on the project. This activity should include review of the barriers to effective user involvement including: availability of users, staff development, length of involvement, user representatives loosing touch with the context of use.
HS.2.6.BP3 Define a strategy and plan for user involvement	This activity includes arranging for end-user involvement in the examination and definition of the system concept. The required representativeness of users is one of the factors in the strategy. For example, representing the breadth of the user group anthropometrically, intellectually or experientially is preferable to using experts (test pilots, for instance). Issues to be addressed include: criteria for recruitment, training, degree of involvement, type of involvement (stage and method), specific user responsibilities. A clear and recognised process allowing user representatives to highlight issues or areas where the development process is diverging from user requirements or where important user views are not being considered.
HS.2.6.BP4 Select and use the most effective method to elicit user input	Selection of the most effective method can address both the perspective of the users involved and the sort of information required. Define and maintain structures, mechanisms and procedures for the effective involvement and consultation of users on each aspect of the system development and implementation related to usability. Methods that allow users continuing, rather than one-shot, involvement are preferred. Take account of established good practice in team work and user involvement. For example, involve users in design activities, problem-solving groups, QA procedures. Suitably prepared representative users are always preferable to user representatives. However, under some circumstances, subject matter experts or other representatives may have to be used, for example, user advocates for accessibility or special needs. EXAMPLE Identify certain individuals as key user representatives or user champions who are known to the development team.
HS.2.6.BP5 Take account of user input and inform users	Direct user input and input derived from users or other HF sources may require interpretation and explanation. If this input is problematic to the organization, it will take some effort, championing and re-presentation in order for necessary changes to be made. This task is achieved if changes are made to the system in the light of user input or if a valid and justified technical reason for not making changes as a result of each component of user input is provided. Feedback is provided to users for a range of reasons, including information, buy-in and validation. An example of feedback is a user review or audit that focuses on user-requirement documents, system prototypes, or may involve face-to-face interviews with the development team.

Work products into process	**Work products out of process**
1.1 project plan (13)	3.2 risk analysis record report (22)
2.5 context of use statement (110)	3.4 analysis result (21)
2.2 product need assessment (44)	1.4/2.1 review strategy/plan (30)
1.4/2.1 test strategy/plan (59)	3.2 review record (31)
2.5 users (115)	
1.4/2.1 Risk management strategy (23)	

Table A.14 — Human-system integration (HS.2.7)

Notes process> **v practice**	Describe HS issues in a form suitable for comprehension by project stakeholders. Work towards a common description of the context of use and concept of operations. For example, operation concepts and scenarios, system requirements and function decompositions, flows and models from the system design process are fed into the human-centred design process.
HS.2.7.BP1 Develop a common terminology for HS issues with the organization	All project stakeholders develop a common language for HS issues. For example, speaking the same language as system designers, safety engineering and specialist engineering disciplines. Present the context of use in a comprehensible form with a description of the real operational environment and its implications. Work to promote a systems approach to engineering.
HS.2.7.BP2 Facilitate personal and technical interactions related to HS issues	Select working groups and interfaces, e.g. to training and personnel planning. Use documents and working groups to control interfaces between activities that address HS issues and other organizational activities. Use documents and working groups to control dependencies between activities that address HS issues and other project activities. For example, the interface between implementation and support or software and training.
HS.2.7.BP3 Identify and use the most suitable data formats for exchanging HF data	Define common data formats and exchange procedures. Present human aspects of the design in a form suitable for trade-off studies. For example, personnel costs or performance presented in a form that can be traded off against equipment costs or performance. Provide readily understood feedback from evaluations. Work towards a common method of working, e.g. common checklists, review formats, risk and issue management. Ensure that the context of use forms part of the information used by designers. For example, it is important to specify the user requirements in the user's language so that they can maintain a clear picture of how the future system will operate. This may involve producing descriptive overviews of the system to complement the formal requirements.
HS.2.7.BP4 Customise tools and methods as necessary for particular projects/stages	Match methods and techniques to the organizational maturity with respect to HS issues in the project and the organization. Match methods and techniques to the particular stage in the life cycle of the project. Make maximum use of the tools and methods in common use within the organization. For example, business process modelling and task analysis, common cost models, prototyping environments.
HS.2.7.BP5 Identify emerging HS issues	Review HS aspects of engineering changes, requirements changes and configuration changes. Work towards early identification of situations requiring trade-offs between disciplines or between specialist engineering and equipment design priorities (e.g. production cost and time scale). Impacts of human workload and performance on overall system performance and characteristics are identified to assist in trade-off of design options between disciplines. 'Specialist engineering' in this context is taken to include disciplines such as survivability, safety management, logistics, through life cost management, security, and value engineering. It is beneficial to work as a team with the Safety and Training officers (for example, to participate in HAZOPs). Send notice to all affected parties when a particular design feature is found to require particular training, support, documentation or procedures.

Work products into process	**Work products out of process**
1.3 life cycle model (2)	1.2 communication mechanism (87)
1.2 job procedure, practice (4)	1.4 Improvement opportunity (26)
2.1 schedule (5)	1.3 interface (8)
2.1 work breakdown structure (6)	1.3 coding standard (10)
1.3 interface (8)	
1.3 coding standard (10)	

Table A.15 — Develop and re-use HF data (HS.2.8)

Notes process> **v practice**	Provide HF data (e.g. information on human performance) to support equipment design and design review. Provide HF data for use by other disciplines, for example, the use of task analysis to support Hazard and Operability studies.
HS.2.8 BP1 Have a policy for HF data management	The policy can encourage all projects, studies and analyses to use HF data. HF data are developed through, for example, literature search, research and experiment
HS.2.8.BP2 Perform research to develop HF data as required	(no notes in this edition of ISO 18152)
HS.2.8 BP3 Produce coherent data standards and formats	(no notes in this edition of ISO 18152)
HS.2.8 BP4 Define rules for the management of data	This will include the commissioning of new research as required. This will include the capture of organizational learning regarding HS processes. EXAMPLE Maintenance of a “Lessons learnt” database.
HS.2.8 BP5 Develop and maintain adequate data search methods	(no notes in this edition of ISO 18152)
HS.2.8.BP6 Seek and exploit expert guidance and advice on HS issues	Guidance and advice will centre on Human Factors, Human Error and Health and Safety, but is likely to extend to, for example, training, staff issues, and recruitment. All stakeholders may require guidance and advice on HS issues. The form and timing of the provision of guidance and advice is influenced by the stage in the life cycle. If a significant amount of an HF specialist's time is spent in *ad hoc* performance of this activity, it is an indication of a low level of organizational maturity in addressing HS issues.

Work products into process	**Work products out of process**
1.3 HF data (112)	3.3 risk measure (40)
1.3 HF standards and regulations (116)	1.3 HF data (112)
1.3 standards (9)	1.3 HF standards and regulations (116)

Table A.16 — Human-centred design (HS.3)

Notes on the process	Human-centred design — design for people using the system of interest in the context of use. The processes here are technical, concerned with requirements, design and evaluation. This process enables user-centred technical activity to be focused on appropriately. It contributes to a "better" system by the inclusion of processes that deliver Quality In Use. These are the processes which are the focus of ISO 13407. They describe the core technical activities through which information regarding human usage is introduced to system design and operation, and systems are validated.

Table A.17 — Context of use (HS.3.1)

Notes process> v practice	This process is directly related to ISO 13407:1999, 7.2 *Understand and specify the context of use*.
HS.3.1.BP1 Define the scope of the context of use for the system	The scope is typically derived from the system goals, the complexity of the working environment and the general type of system. The scope will be determined by the granularity of the system (for example, a software application, a computer incorporating an application, or a network of computers), the range of tasks (for example cut and paste, text entry or document production) and the types of users and usage environments. For example, a system for use in an office may have a limited range of users and tasks in a defined physical environment, whereas a submarine will require detailed understanding of mission types and through-life accommodation requirements. There may be more than one context of use for a system, for example for a generic product (such as a wrist-watch), more than one user group or more than one user environment.
HS.3.1.BP2 Analyse the tasks and worksystem	Describe the tasks in terms of user and organizational activities (not in terms of equipment functions or features). Describe the activities (tasks) that users perform to achieve the intended user or organizational goals for the system. Task descriptions will change during the life of the system as the use of the system and the worksystem evolve. There can be goals at several levels in the system of interest (examples are use of directory function on a mobile telephone user interface before making a call or the operation of a digital watch while running for a train). The interaction of these levels requires analysis. Users may work for several people and within different systems at the same time. If, as a result, users perform tasks which contribute to goals for different systems in parallel, the interaction of, and the effect on, all of the systems needs to be taken into account. Task analyses can vary in rigour and degree of structure. For example, a task analysis may need to include estimates or measures of workload for use in staffing calculations or may simply be a short scenario outlining the typical use of a system.
HS.3.1.BP3 Describe the characteristics of the users	This may include *inter alia* knowledge, language, physical capabilities (including special needs), anthopometrics, psychosocial issues, and level of experience with job tasks and with systems equipment, motivations in using the system, priorities.
HS.3.1.BP4 Describe the cultural environment/ organizational/ management regime	Describe the real operational environment and the way that this shapes the role of the system. Describe the worksystem as an entity and provide a context description for both the system and the worksystem. The description may include *inter alia* the social and organizational milieu, management structure, communications and organizational practices or legislation.
HS.3.1.BP5 Describe the characteristics of any equipment external to the system and the working environment	Particular attention may be paid to the non-system equipment (COTS and given equipment, existing systems and technical infrastructure) with which the users will directly interact. For new systems, the equipment characteristics are dependent on the system design solutions and will not be known until relatively late in the life cycle.

Table A.17 (*continued*)

HS.3.1.BP6 Describe the location, workplace equipment and ambient conditions	For aspects of the environment that are given as fixed, specify their characteristics in a way that enables the design implications and HS issues to be identified. For aspects of the environment that are outside the scope of the system but which are variable, specify the desired characteristics, and identify any trade-offs. For aspects of the physical environment that are part of the system, identify the implications of the operating conditions. For example, lighting, noise levels, vibration, heat, hazards, dimensions of working and living space.
HS.3.1.BP7 Analyse the implications of the context of use	There will be an effect on the system concept, requirements, design and operation of the system. There may be issues related to problems with existing systems. There may be effects on the existing worksystem, for example the existing equipment and tasks. Identify and analyse the potential risks in the environment that may be made more hazardous or likely by using the system.
HS.3.1.BP8 Present these issues to project stakeholders for use in the development or operation of the system	The context of use is documented to the level of detail required by the particular stakeholder, project and stage in the life cycle. Each project stakeholder (for example, system developers, system owners and user organizations, designer, evaluator, and owner) needs to be able to gain enough information about the context of use to develop a design or evaluation which meets the system requirements.

Work products into process	**Work products out of process**
2.2 requirements specification (52)	2.5 context of use statement (110)
2.5 user environment (113)	3.4 context of use analysis (111)
2.5 users (115)	
3.2 personnel record (108)	
3.2 training record (90)	
1.1 goal (12)	
2.5 system (73)	

Table A.18 — User requirements (HS.3.2)

Notes process> **v practice**	This process is directly related to ISO 13407:1999, 7.3 *Specify the user and organizational requirements*. User requirements include: ergonomics, user interface, workplace, habitation, training, support, procedures, jobs, recruitment, and staffing structures.
HS.3.2.BP1 Set and agree the expected behaviour and performance of the system with respect to the user	The user organization may be considered as a single user. In the case of a generic product, a single user may also be the user organization. This can be stated in terms of the "total experience" of the users and/or the user organization with the system. The total experience covers critical aspects of a user's relationship with the system and its context of use from release on the market to disposal. Total experience is not the general previous life experience which the users have, but the particular experience that they are expected to have with the system. Defined use includes reasonably foreseeable misuse and potential for environmental damage. Total experience includes reconfiguration, maintenance and servicing. Materials-handling activities are included in this definition. Subsets of user roles and tasks may be examined, for example, unpacking and setting up a television using only the provided documentation, or escape from a submarine. Exclusion of potential user groups (for example those with disabilities) is explicit. It may be helpful to develop a series of standard tasks or usage scenarios that the system should support. These will be a useful reference for the system design team to work to, and for the users to check the prototype system against. The scenarios form a useful focus for communication between the two groups. Evaluation may be based on these scenarios.
HS.3.2.BP2 Develop an explicit statement of the user requirements for the system	The generation of the requirements of the user and the user organization fits within overall systems requirements capture activities. The requirements of the user and the user organization define a large part of the operational and performance requirements for the system. Statutory requirements regarding health, working environment and workload are taken into account. For example, see BS 8800, Occupational Health, Operations and Lifting Equipment regulations, Fire Precautions regulations. Requirements may be ranked, for example in order of importance. The generation of requirements is an interactive and often iterative process involving users and designers in collaboration. Successive iterations of the process help to establish the user-requirements aspects of the system requirements and design specifications at progressive levels of detail. The specification of user requirements includes evaluations in order to ascertain that requirements are correct and complete. The requirements for some types of systems are never static or fully defined.
HS.3.2.BP3 Analyse the user requirements	Analysis may include evaluation of prototypes with users, feasibility studies and trade-off studies. The assumptions made when making the trade-offs should be documented. These studies will include user productivity, effectiveness, safety and satisfaction. Analysis can include cost-benefits, prioritisation and identification of "show-stoppers" (issues that can result in system failure). Analyse technology and staffing options and their associated risks for the work system. This may involve the development of a series of possible task allocations between the system and different user roles, and getting user feedback on them. The results of the analysis or the need for detail may require that the statement of requirements is revisited.

Table A.18 (*continued*)

HS.3.2.BP4 Generate and agree on measurable criteria for the system in its intended context of use	Criteria are aligned to the acquisition boundaries and scope of supply for the system and its elements. The measures for criteria are defined within a context or for a range of contexts of use. Criteria are clear statements that can be judged to determine when the design achieves them or not. However, for some statements, these can be judged by inspection or by reference to a standard, rather than requiring them to be tested within user trials. Criteria may be set for both the user requirements and the effect on the organization. There are criteria at all levels of system decomposition. These are elaborated in ISO/IEC 9126-1:2001. They range from the performance of the whole work system (stated as quality in use) through to the detail of the user interface properties of the system. Examples of quantitative quality in use criteria are “Use a roller ball interface device to select the correct item from a list within 3 s”, or “enter all data without any errors in 5 min”. User interface properties include external attributes of the system such as learn ability and consistency. ISO/IEC 9126-2 and ISO 9126-3 provide a suitable list for software systems. Measurable criteria may be limited to some part of the system or the requirements, e.g. to signature tasks. For example, to handle specified levels of air traffic through specified airspace. For requirements relating to the functional performance of the whole of a complex (or large) system, the criteria may be jointly owned by more than one group of users and/or stakeholders. In cases where objective data cannot be collected or are not appropriate, subjective data may have to be used.
HS.3.2.BP5 Present these requirements to project stakeholders for use in the development and operation of the system	The record will include assumptions and constraints related to scope, users, context of use and usability criteria. Some requirements will not be functional at lower levels of the system hierarchy. It is traditional to label these as “non-functional” in order to clarify their relationship to particular elements of the system. The user requirements are likely to be information in project and system documents rather than a separate document. The format can be defined in collaboration with the relevant project stakeholders, including the users. The user requirements information should be produced in a clear and understandable format in order to promote communication between interested parties. It is important that clear communication channels are established so that feedback on the requirements can be collected. The producer of each requirement should be clearly referenced to ensure traceability and to facilitate change if required. Scenarios of use may be used to present user requirements. They have the benefits of being relatively easy to test and being easy for other project stakeholders to understand.

Work products into process	**Work products out of process**
2.2 product need assessment (44) 2.2 requirements specification (52) 2.5 HF data (112) 1.3 HF standards (116) 2.5 context of use (110) 3.4 context of use analysis (111) 1.1 goal (12) 3.3 quality criteria (27) 3.2 review record (31)	2.2 requirements specification (52) 2.3 analysis report (21) 3.3 quality criteria (27)

Table A.19 — Produce design solutions (HS.3.3)

Notes process> **v practice**	There may be many alternative design options, especially at early stages in the life cycle. In the event that gaps in HF data are identified, these data will either be acquired, or the shortfall will be managed as an HS issue. This process is directly related to ISO 13407:1999, 7.4 *Produce design solutions*. Designs include: user interfaces, workplace, training, support, procedures, jobs, recruitment, staffing structures, habitation.
HS.3.3.BP1 Distribute functions between the human, machine and organizational elements of the system best able to fulfil each function	Analyse the context of use (especially the task information) and the required functions and performance of the system in order to explicitly assign functions to the human, hardware, software or combinations thereof, with the goal of defining and allocating functions to the humans that are best suited to their capabilities and limitations. The allocation of functions may be dynamic. The aim is to optimise the performance of the overall system against the system goals. Allocation of function is not merely related to achieving performance against goals. The allocation has to be balanced against the cost of a particular implementation which ultimately will be stated in financial terms, but will also have implications in terms of workload/staffing and system capability implications. At high levels in the system hierarchy, functions may not be allocated to particular human, organizational, software or hardware elements, but to sub-systems which may be made up from more than one of these elements. Allocation of function occurs at all levels of design. In the absence of systems engineers, those responsible for HS issues often fulfil this role in the project team.
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	Take context of use description and system goals and operational requirements and produce task design which a) allows users to meet criteria within capabilities, and b) is the basis of the design of their jobs. The aim of this design activity is to specify an achievable set of user tasks. Task and job design uses and informs the trade-off between alternative designs. For example, work-intensive (“high driver”) tasks are identified and analysed with a view to improving users' efficiency and effectiveness when performing these tasks.
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	Depending on the type of system, the design specification can include, but is not limited to, at least one or all of the following: working environment, hardware, software, user documentation, user interface, packaging design, interface functionality, training, support and organization. Emerging design constraints are communicated to the relevant project stakeholders. In designing jobs, it is necessary to look at the complete set of the user's tasks, including tasks with existing systems that will be retained. Examples include: ergonomics according to the design engineers; system usage tasks according to the trainers, technical writers and procedure developers. Several design solutions may be produced for evaluation during the design process.
HS.3.3.BP4 Produce a description of how the system will be used	A description of the usage of the system facilitates integrated development of the elements of a system by providing a link between technical, documentation, support, training and other elements of the system.
HS.3.3.BP5 Revise design and safety features using feedback from evaluations	Evaluation is used to compare between alternative design solutions or to elicit information about a proposed design solution. The output from evaluation may include, for example, new or changed requirements for the system, new HF data related to the use of the system and detailed design information. Revisions are made where, for example, hazards raised as a consequence of evaluation findings are deemed unacceptable; where usability criteria are not met; when new HS issues emerge in the evaluation. Where evaluation forms part of a safety case, the results of the evaluation may form part of the file of un-addressed issues for the system.

Work products into process	**Work products out of process**
2.2 requirements specification (52)	2.2 requirements specification (52)
2.5 context of use statement (110)	2.3 system design/architecture (53)
3.4 context of use analysis (111)	1.3 interface (8)
1.3 coding standard (10)	1.3 coding standard (10)
3.4 analysis result (21)	
3.2 review record (31)	
3.2 test result (62)	
2.5 HF data (112)	
1.3 HF standards (116)	

Table A.20 — Evaluation of use (HS.3.4)

Notes process> **v practice**	This process is directly related to ISO 13407:1999, 7.5 *Evaluate designs against requirements*. ISO/IEC 14598-3 provides advice on the planning, performance and analysis of evaluations for software systems. The results of trials may be reported using the Common Industry Format for Usability Test Reports ISO/IEC DTR 9126-4:—[2)], Annex F.
HS.3.4.BP1 Plan the evaluation	The evaluation may be primarily formative (to identify problems, typically early in the life cycle) or summative (to assess whether requirements have been met, typically late in the life cycle). Identify the user requirements and/or risks that are to be assessed. Design the evaluation (including the involvement of any users). The plan may include the production or assembly of necessary equipment, prototypes, training and support material and staff, trials staff and recording equipment and media. Evaluation should, where possible, involve the intended users of the system, but may sometimes be carried out by human factors experts. For a design process to be human-centred, ISO 13407 recommends that at least the final testing should take place with real users. Procedures for the involvement of users are a part of the design of an evaluation. Formative Evaluation provides information for the requirements and design process. It tends to use fairly informal, open-ended, collaborative techniques (for example, paper prototyping, discussion-based reviews, and checklists). It is generally carried out early in the life cycle. Summative evaluation is carried out in order to assess if specified requirements have been satisfied. It is performed using relatively formal, closed methods. For example, assessment against specifications, standards or legislation.
HS.3.4.BP2 Identify and analyse the conditions under which a system is to be tested or otherwise evaluated	Analyse the relationship, and especially any potential discrepancies, between the context to be used for the evaluation (users, tasks and environment) and the intended context of use.
HS.3.4.BP3 Check that the system is fit for evaluation	Examine the components of the supplied system to determine whether it is in a state suitable for evaluation. The system to be evaluated may comprise any combination of physical equipment, computer software, documentation, training, human tasks and organizational or management procedures. The system to be evaluated can be very simple (such as a paper prototype), especially at early stages in the life cycle. For the system to be sufficient for evaluation later in the life cycle, components such as documentation and user training may be necessary.
HS.3.4.BP4 Carry out and analyse the evaluation according to the evaluation plan	Performance of the evaluation includes analysis of the results as defined in the evaluation plan. The consideration of options includes an assessment of whether user and operational objectives have been achieved or not.
HS.3.4.BP5 Understand and act on the results of the evaluation	The range of outcomes from an evaluation is wide. HS.1 describes how the results may be used depending on the stage in the life cycle and HS.2 describes how parts of an organization may make use of the results. In most cases, the results will lead to a revision of the system or its requirements.

Work products into process	**Work products out of process**
1.4/2.2 test strategy and plan (59)	1.4/2.1 test strategy and plan (59)
2.4/2.5 system (73)	3.2 test result (62)
2.5 context of use (110)	3.4 analysis report (21)
3.4 context of use analysis (111)	2.3 test script (60)
3.3 quality criteria (27)	2.3 test case (61)
3.2 review record (31)	2.5 HF data (112)
2.2 requirements specification (52)	2.5 context of use (110)
2.3 system design/architecture (53)	3.4 context of use analysis (111)

Table A.21 — Human resources (HS.4)

Notes on the process	Human Resources process — the provision of the correct number of competent staff. The processes here are concerned with selection and training, and harmonising organizational development and technological change. This process provides the means to resolve issues concerned with the "implementation" of the human part of the system, rather than the equipment-centred part. It ensures continued, timely delivery of the correct number of competent people required to use the most suitable equipment. A significant component of system usability is the result of the organization acquiring the "right" people to use the system. This is most effectively done by recognising that the "people bits" process should run alongside or super-ordinate to system acquisition. Both people and system should be acquired in a planned process. ISO/IEC 15288 goes further and considers people as a component of a system. These are the processes carried out by the user organization in order to "fit the man to the machine". These processes are iterative. The specific issue of the provision of skilled project staff is addressed in HS.2.4.BP2.

Table A.22 — Define and operate human resources strategy (HS.4.1)

Notes process> v practice	The staffing, recruitment, technical and operational strategies are interrelated. The trade-off between the requirements arising from each is dynamic. The ranking of importance between strategies is not fixed. HR strategy includes recruitment, selection, staffing planning, terms and conditions, and training development. Users may include teams. Skills mean Knowledge, Skills and Attributes.	
HS.4.1.BP1 Decide the goals, behaviours and tasks of the organization		(blank)
HS.4.1.BP2 Define the global numbers, skills and supporting equipment needed to achieve those tasks		(blank)
HS.4.1.BP3 Decide how many people are needed to fulfil the strategy and what ranges of competence they need		(blank)
HS.4.1.BP4 Implement the HR strategy that gives the organization a mechanism for implementing and recording lessons learnt		(blank)
HS.4.1.BP5 Feedback into future HR procurement, training and delivery strategies		(blank)
HS.4.1.BP6 Enable and encourage people and teams to work together to deliver the organization's objectives		(blank)
Work products into process	**Work products out of process**	
	1.3 interface (8) 1.1 goal (12) 1.1 vision (13)	

Table A.23 — Define standard competencies and identify gaps (HS.4.2)

Notes process> **v practice**	Assess user goals and tasks towards overall system effectiveness and hence identify equipment options to enable the user to realise these goals, i.e. fit the equipment to the use rather than expecting the user to fit the equipment. Users have goals and tasks to achieve, so they need tools/systems to enable them to achieve these goals, hence they invest. Overall system effectiveness is dependent on operator effectiveness, and so there is a need to address the operator's effectiveness. It is easy to manipulate the equipment but not the user's abilities.
HS.4.2.BP1 Identify current tasking/duty	(blank)
HS.4.2.BP2 Analyse gap between existing and future provision	(blank)
HS.4.2.BP3 Identify skill requirements for each role	(blank)
HS.4.2.BP4 Predict staff wastage between present and future	(blank)
HS.4.2.BP5 Calculate the available staffing, taking account of working hours, attainable effort and non-availability factor	(blank)
HS.4.2.BP6 Compare to define gap and communicate requirement to design of staffing solutions	(blank)
HS.4.2.BP7 Create capability to meet system requirements in the future (conduct succession planning)	(blank)
HS.4.2.BP8 Produce and promulgate a validated statement of shortfall by number and range of competence	(blank)

Work products into process	**Work products out of process**
1.1 goal (12) 1.1 vision (13)	1.1 personnel policy (15) 3.4 analysis result (21) 3.2 personnel record (108)

Table A.24 — Design staffing solution and delivery (HS.4.3)

Notes process> **v practice**	The HR process reminds the organization that the system will have to be manned, resourced, supported and maintained by an organization. Staff will have to be developed to meet these roles. The staff using the system will need to work to any applicable employment regulations, working hours restrictions and within an incentives framework. The organization can also be reminded that the system will eventually be disposed of and that this will involve human action.
HS.4.3.BP1 Identify and allocate the functions to be performed	Functional decomposition and allocation of function.
HS.4.3.BP2 Specify and produce job designs and competence/skills required to be delivered	(no notes in this version)
HS.4.3.BP3 Calculate the required number of personnel (number required)	(no notes in this version)
HS.4.3.BP4 Generate costed options for delivery of training and/or redeployment	(no notes in this version)
HS.4.3.BP5 Evolve options and constraints into an optimal implementation plan	(no notes in this version)
HS.4.3.BP6 Develop and trial training solution to representative users	Iterate until meets HS/usability criteria.
HS.4.3.BP7 Deliver final training solutions to designated staff according to agreed timetable	(no notes in this version)
HS.4.3.BP8 Identify any opportunities for redeployment	Costed options will include alternative staff provision or acquisition to deliver the required skill sets.

Work products into process	Work products out of process
1.1 personnel policy (15) 3.2 personnel record (108)	1.3 interface (8) 1.4/2.1 training strategy/plan (88) 3.2 training record (89) 3.2 personnel record (108) 2.5 staffed system (114) 2.5 users (115)

Table A.25 — Evaluate system solutions and obtain feedback (HS.4.4)

Notes process> v practice	This process in similar to HS.3.4 but provides feedback on HR issues rather than technical approval or information.
HS.4.4.BP1 Develop a strategy for data gathering	(no notes in this version)
HS.4.4.BP2 Provide means for user feedback	(no notes in this version)
HS.4.4.BP3 Conduct assessments of usability	This includes assessments of accessibility as required.
HS.4.4.BP4 Interpret the findings	(no notes in this version)
HS.4.4.BP5 Validate the data	(no notes in this version)
HS.4.4.BP6 Check that the data are being used	(no notes in this version)

Work products into process	**Work products out of process**
1.1 goal (12)	3.4 analysis result (21)
2.5 staffed system (114)	3.2 assessment/audit record (29)
2.5 users (115)	1.4/2.1 test strategy/plan (59)
	2.3 test script (60)
	2.3 test case (61)
	3.2 test result (62)
	2.5 staffed system (114)
	2.5 users (115)

A.4 Work products

Table A.26 presents the work product descriptions from ISO/IEC TR 15504-5 and includes the new work product types required to express and address HS issues in the life cycle. Annex C of ISO/IEC TR 15504-5:1999 defines the following numbering scheme for the classification of types of work product:

1. **Organization** divided into: 1.1 policies, 1.2 procedures, 1.3 standards, 1.4 strategies.

2. **Project** divided into: 2.1 plan, 2.2 requirement, 2.3 design, 2.4 implementation, 2.5 product, 2.6 interim deliverable.

3. **Records** divided into: 3.1 report, 3.2 record, 3.3 measure, 3.4 data.

These classes may be combined for descriptive effect. For example strategy/plan = 1.4/2.1.

Each work product in the lists has the following form <**type of work product**> <**name**> (<**reference number in ISO/IEC 15504**>). A **+** sign before the ISO/IEC 15504 reference number indicates that the work product is an extension of the basic type, either as described in ISO/IEC 15504 or for the HS model. Only six extended work products are defined for the HS model (numbers 110 to 116). Most of the HS processes (the HS model can be seen as a set of views on the system life cycle) extend the detail and scope of existing work products in areas relating to people and HS issues. The informative text associated with the practices may provide guidance on the expected additional contents or emphasis of the work product.

The work product descriptions in ISO/IEC TR 15504-5 refer to software rather than systems. However, at the level of abstraction used for most of the descriptions included in Table A.26, the majority of the descriptions apply to systems as well as software. Users of this document are recommended to make a general interpretation of the descriptions and to refer to descriptions in the latest version of ISO/IEC 15504.

Sector-specific interpretations of ISO/TS 18152 may subdivide and extend the work products and use the titles in common use in that sector. Sector-specific interpretations of this Technical Specification may include additional notes which elaborate and interpret work products for the type of systems developed and operated in that sector. ISO 13407 describes a set of information types used and produced during human-centred design.

Each project or organization will have its own names for particular products. The contents of a work product may be split between several project/organization products or several work products may be grouped into one project/organization work product. Prior to an assessment, the assessor and/or local contact for the assessment are advised to prepare a mapping between project/organization products and the work products listed in this Technical Specification.

Table A.26 — Work product (WP) characteristics

ID	Class	WP Type	WP Characteristics
1	1.2	Software development methodology	— Identification of the approach/method used to develop software — Identification of the life cycle model (for example, waterfall, spiral, serial build) used to develop software — Provides a high-level description of the process, activities, and controls
2	1.3	Life cycle model	— High level description of activities performed at each life cycle phase — Sequencing of the life cycle phases — Identification of critical life cycle phase dependencies — Identification of required inputs, outputs to each life cycle phase — Identification of the key decision points (milestones) model — Identification of the quality control points in the model
4	1.2	Job procedure, practice	— Each task to be performed is uniquely identified — Each task is sequenced by execution order — Coverage of support information (for example, commands and parameter settings) when required for operations — Establishes rules by which staff is expected to operate — Approved by authorised personnel
5	2.1	Schedule	— Identifies the tasks to be performed — Identifies the start and completion date for required tasks — Allows for the identification of critical tasks and task dependencies — Identifies task completion status, vs. planned date — Has a mapping to scheduled resource data
6	2.1	Work breakdown structure	— Defines tasks to be performed — Documents ownership for tasks — Documents critical dependencies between tasks — Documents inputs and output work products — Documents the critical dependencies between defined work products
7	2.5	Work product	Defines the attributes associated with an artefact from a process execution: — key elements to be represented in the work product — expected form, style — expected media (paper, electronic) and storage attributes defined

Table A.26 (*continued*)

ID	Class	WP Type	WP Characteristics
8	1.3	Interface	— Defines relationships between two products, process or process tasks — Defines criteria and format for what is common to both — Defines criteria for critical timing dependencies or sequence ordering
9	1.3	Standard	— Identification of who/what they apply to — Each requirement is unique — Each requirement is tagged with an identifier — Expectations for conformance are identified — Conformance to requirements can be demonstrated — Provisions for tailoring or exception to the requirements are included
10	1.3	Coding standard	Coverage for software includes, but is not limited to (as appropriate to the application): — data naming conventions — defines required languages, compilers, data base management systems, etc. — format of code, structure, comments required — standard data structures, types, classes — best practices Required usage of tools: — data dictionaries, associated CASE tools — compatibility requirement for existing software and/or hardware — security considerations — performance considerations — standard error messages, codes Interface standards: — human-machine interfaces — external system interfaces — peripheral equipment, hardware — storage and retrieval of source code and object modules — quality and reliability standards
12	1.1	Goal (business, quality, organizational, team, training, performance, process)	— Identifies the objective to be achieved — Identifies who is expected to achieve the goal — Identifies any incremental supporting goals — Identifies any conditions/constraints — Identifies the timeframe for achievement — Are reasonable and achievable within the resources allocated — Are current, established for current project, organization — Used to monitor progress — Are optimized to support known performance criteria, plans

Table A.26 (*continued*)

ID	Class	WP Type	WP Characteristics
13	1.1	Vision	— Provides information on the overall strategy for the organizational unit, organization, or business — Is authorised at the highest level — Defines the main objectives to be achieved
14	1.1	Policy	— Authorised — Available to all personnel impacted by the policy — Establishes practices/rules to be adhered to
15	1.1	Personnel policy + (14)	— Defines career opportunities for individuals in the organization — Defines team building strategy — Defines reward and recognition — Covers performance appraisal
16	2.1	Plan (General attributes applies to all plans) (i.e., Business, Organization, Project, Quality, Review, Test)	(as appropriate to the application and purpose): — Identification of the plan owner Includes: — The objective of what is to be accomplished — assumptions made — constraints — risks — tasks to be accomplished — schedules, milestones and target dates — critical dependencies — maintenance disposition for the plan — method/approach to accomplish plan Identifies: — task ownership — quality criteria — audit to be performed — required work products — Includes resources to accomplish plan objectives — time — staff — materials/equipment — budget — Includes contingency plan for non-completed tasks — Plan is approved.

Table A.26 (*continued*)

ID	Class	WP Type	WP Characteristics
17	2.1	Project plan + (16)	Defines: — work products to be developed — life cycle model and methodology to be used — customer requirements — tasks to be accomplished — task ownership — project resources — schedules, milestones and target dates — quality criteria Identifies: — critical dependencies — required work products — project risks and risk mitigation plan — contingency actions for non-completed tasks
21	3.4	Analysis result	— What was analysed — Who did the analysis The analysis criteria used: — selection criteria or prioritization scheme used — decision criteria — quality criteria Records the results: — what was decided/selected — reason for the selection — assumptions made — potential risks Aspects of correctness to analyse include: — completeness — understandability — testability — verifiability — feasibility — validity — consistency — adequacy of content.
22	3.2	Risk analysis record/report	— Identifies the risks analysed — Records the results of the analysis — potential ways to mitigate the risk — assumptions made — constraints

Table A.26 (*continued*)

ID	Class	WP Type	WP Characteristics
23	1.4/2.1	Risk management strategy / plan + (59)	— Project risks identified and prioritised — Mechanism to track the risk — Threshold criteria to identify when corrective action is required Proposed ways to mitigate risks: — work around — corrective actions activities/tasks — monitoring criteria — mechanisms to measure risk
24	1.1	Quality statement/ policy + (14)	— Statement is official, approved — States commitment to quality principles — Identifies who is expected to follow principles
26	1.4	Improvement opportunity	— Identifies what the problem is — Identifies what the cause of a problem is — Suggest what could be done to fix the problem — Identifies the value (expected benefit) in performing the improvement — Identifies the penalty for not making the improvement
27	3.3	Quality criteria	Defines expectations for quality: — Establishes what is an adequate work product (for example, required elements, completeness expected, accuracy) — Identifies what constitutes the completeness of the defined tasks — Establishes life cycle transition criteria and the entry and exit requirements for each process and/or activity defined — Establishes expected performance attributes — Establishes product reliability attributes
29	3.2	Assessment/ audit record	— States the purpose of assessment — Method used for assessment — Requirements used for the assessment — Assumptions and limitations Identifies the context and scope information required: — date of assessment — organizational unit assessed — sponsor information — assessment team — attendees — scope/coverage — assessees' information — assessment instrument (check-list, tool) used — Records the result — identifies the required corrective actions — improvement opportunities

Table A.26 (*continued*)

ID	Class	WP Type	WP Characteristics
30	1.4/2.1	Review strategy/plan + (16)	Defines: — what to be reviewed — roles and responsibilities of reviewers — criteria for review (check-lists, requirements, standards). — expected preparation time — schedule for reviews Identification of: — procedures for conducting review — review inputs and outputs — expertise expected at each review — review records to keep — review measurements to keep — resources, tools allocated to the review
31	3.2	Review record	Provides the context information about the review: — what was reviewed — lists reviewers who attended — status of the review Provides information about the coverage of the review: — check-lists — review criteria — requirements — compliance to standards Records information about the readiness for the review: — preparation time spent for the review — time spent in the review — reviewers, roles and expertise Identifies the required corrective actions: — risk identification — prioritized list of deviations and problems discovered — the actions, tasks to be performed to fix the problem — ownership for corrective action — status and target closure dates for identified problems

Table A.26 (*continued*)

ID	Class	WP Type	WP Characteristics
36	3.3	Measure (generally applies to all specific measures)	— Available to those with a need to know — Understood by those expected to use them — Provides value to the organization/project — Non-disruptive to the work flow Appropriate to the process, life cycle model, organization: — is accurate — source data is validated — results are validated to ensure accuracy — Has appropriate analysis and commentary to allow meaningful interpretation by users
40	3.3	Risk measure + (36)	— Identifies the probability of risk occurring — Establishes measures for each risk defined — Measures the change in the risk state
41	3.3	Field Measure + (36)	Measures attributes of the performance of system's operation at field locations, such as: — field defects — performance against defined service level measures — system ability to meet defined customer requirements — support time required — user complaints (may be third-party users) — customers' requests for help — performance trends — problem reports — enhancements requested
42	3.3	Service level measure + (36)	Real-time measure taken while a system is operational, it measures the system's performance or expected service level. Identifies things like: — capacity — throughput — operational performance — operational service — service outage time — up time — job run time
43	3.3	Benchmarking data + (36)	— Identifies key process / product / market need information to be benchmarked — Measurement reflects comparison of the current performance against some well-defined criteria or historical information (or benchmark)

Table A.26 (*continued*)

ID	Class	WP Type	WP Characteristics
44	2.2	Product need assessment	Coverage for key elements (as appropriate to the application): Definition of the need: — reason product is needed — features and functions desired — requirements to be satisfied Constraints: — cost limitations — date/schedule requirements — specific support software required — interface requirements — associated equipment or hardware required — regulatory standards and/or requirements — operational impacts — patent, copyright and licensing issues Business case: — expected benefit — expected cost (including projected installation, conversion and/or maintenance) vs. profit expectations — market window/target delivery dates
45	1.4/2.1	Acquisition strategy/plan + (16)	— Identifies what needs to be acquired Establishes the approach for acquiring the product or service; options might include: — off-the-shelf — develop internally — develop through contract — enhance existing software product — or combination of these — Establishes the evaluation criteria acceptance strategy — Identifies any constraints/risks
46	3.1/3.2	Market analysis record/report	Contains information about: — what was analysed — the selection criteria & prioritization scheme used — the analysis criteria used Records the results which identify the: — market opportunities and market window — business drivers — cost/benefit — potential customers and their profiles information — any assumptions made — alternate solutions considered and/or rejected — risks and/or constraints (regulatory issues) Defines the product offering and target release

Table A.26 (*continued*)

ID	Class	WP Type	WP Characteristics
47	2.2	Request for proposal (RFP) (Requester)	Reference to the requirements specifications Identifies desired characteristics, such as: — system architecture, configuration requirements or the requirements for service (for example, consultants, maintenance) — quality criteria or requirements — project schedule requirements. — expected delivery/service dates — cost/price expectations — regulatory standards/requirements Identifies submission constraints: — date for resubmission of the response — requirements with regard to the format of response
48	1	Supplier proposal response (Response to RFPs)	— Defines the suppliers' proposed solution — Defines the suppliers' proposed delivery schedule — Identifies the coverage identification of the initial proposal — identifies the requirements that would be satisfied — identifies the requirements that could not be satisfied, and provides a justification of variants — Defines the estimated price of proposed development, product, or service
49	3.2	Subcontractor or supplier history record	— List of potential subcontractor/suppliers — Qualification information — Identification of their qualifications — Past history information when it exists
51	3.2	Contract (product or service)	— Signed — Defines what is to be purchased/delivered — Identifies time frame for delivery or contracted service dates — Identifies monetary considerations — Identifies any warranty information — Identifies any copyright and licensing information — Identifies any customer-service requirements — References to any performance and quality expectations/constraints/monitoring — Standards and procedures to be used As appropriate to the contract, the following are considered: — references to any acceptance criteria — references to any special customer needs (for example, confidentiality requirements, security, hardware) — references to any change management and problem-resolution procedures — identifies any interfaces to independent agents and subcontractors — identifies customer's role in the development and maintenance process — identifies resources to be provided by the customer.

Table A.26 (*continued*)

ID	Class	WP Type	WP Characteristics
52	2.2	Requirement specification (internal or external) (Product, Service, Customer, System, Software, Documentation, Environment)	— Each requirement is identified — Each requirement is unique — Each requirement is verifiable or can be assessed — Includes statutory and regulatory requirements — Includes issues/requirements from (contract) review — Consideration is given to the following (as appropriate to the product or service and type of requirement) Products/Application requirements: — identify any required feature and functional characteristics — identify any necessary performance considerations/constraints — identify any necessary internal/external interface considerations/constraints — identify any required system characteristics/constraints — identify any human engineering considerations/constraints — identify any security considerations/constraints — identify any environmental considerations/constraints — identify any operational considerations/constraints — identify any maintenance considerations/constraints — identify any associated documentation considerations/constraints — identify any installation considerations/constraints — identify any support considerations/constraints — identify any design constraints — identify any safety/reliability considerations/constraints — identify any quality requirements/expectations — includes storage requirements (products) Service requirements: — identify any performance expectations — identify any time schedule/constraints — identify any tasks to be performed — identify any responsibilities — identify the method of communication, project reporting expected — identify any quality expectations/controls Document requirements: — purpose/objectives defined — proposed contents (coverage) defined — intended audience defined — identification of supported software release, system information — identification of associated software requirements and designs satisfied by document — identification of style, format, media standards expected — definition of the intended distribution requirement — includes storage requirements

Table A.26 (*continued*)

ID	Class	WP Type	WP Characteristics
53	2.3	System design/ architecture	— Provides an overview of all system design — Describes the interrelationship between system components — Describes the relationship between the system components and the software — Specifies that the design for each required system component consideration is given to things like: — memory/capacity requirements — hardware interface requirements — user interface requirements — external system interface requirements — performance requirements — command structures — security/data protection characteristics — system parameter settings — manual operations — reusable components — Mapping of requirements to system components
59	1.4/2.1	Test strategy/ plan (all test plans) + 16	— Identification of test purpose — Identification of the responsible test plan owner — Identifies the approach to performing the test — Identification of components to be tested — Identify aggregates and sequence for testing — Identify urgent release — Identification of required system configuration (for example, software, hardware, interface components) — Identification of the associated development owner for components to be tested — Identification of associated test scripts/test cases — Sequence ordering of how testing will be executed — Identification of requirements which will be validated by tests (i.e., customer requirement, regulatory requirements and system requirements) — Identification of the problem-reporting mechanism — Identification of the test tools and resources required (for example, test channels, analysers, test emulators) — Identification of the test schedule — Identification of the test completion criteria — Identification of audits to be performed — Official source libraries and versions of software defined

Table A.26 (*continued*)

ID	Class	WP Type	WP Characteristics
60	2.3	Test script	— Defines what is being tested — Defines the required system configuration for the test — Identifies all required software components — Identifies special initialisations, for example, parameter setting — Identifies the input date required — Sequences the ordering of the test cases — Defines the expected test results — Identifies what requirements were met by performing the test
61	2.3	Test case	— Provides executable set of test instructions — Purpose defined — Defines the expected test result — Mapped to test scripts, requirements
62	3.2	Test result	— Records results of testing — Identifies what components were tested — Identifies date test was executed — Status at completion of test (actual test results compared to predicted results in test plan(s)) — Record of test configuration at time of test — Record of trouble reports generated from testing
68	1.4/2.1	Acceptance test strategy/plan + (59)	— Identified activities to be performed to test “deliverable” end customer product — Identifies who has responsibility for performance of acceptance test activities (supplier or customer) — Identifies the system configuration requirements for site — Identifies the installation requirements for site — Provides a plan for validating the “delivered” software — Identifies how to validate whether installation activities at customer's site were performed correctly — Identifies how to validate whether the deliverables satisfied the customer requirements — Identifies associated test scripts/test cases — Identifies actions to be take upon acceptance of product — Refers to quality plan
69	1.4/2.1	Release strategy/ plan + (16)	— Identifies the functionality to be included in each release — Identifies the associated components required (for example, hardware, software, documentation) — Mapping of the customer requests, requirements satisfied to particular releases of the product

Table A.26 (*continued*)

ID	Class	WP Type	WP Characteristics
73	2.5	System	— All components of the product release are included — Any required hardware — Integrated software — Customer documentation Fully configured set of the “system components”: — parameters defined — commands defined — data loaded or converted
74	1.4/2.1	Installation strategy plan + (16)	— Identifies product deployment objectives — Identifies schedules for deployment activities — Identifies schedule constraints — Identifies impacted site locations — Identifies site environment configuration Identification of the required components for the installation with appropriate version information (consideration given to at least the following): — released software — type of media — required maintenance fixes — support software required (conversion programs, validation routines, associated system interfaces, data base management system) — required customer documentation — installation instructions Identification of required hardware and peripheral equipment Identification of supporting information or materials required: — parameter information — operation and maintenance information — pre-conversion information, materials or installed equipment Type of installation (new vs. conversion of existing system, maintenance) Identification of backup and recovery procedures Identification of customer contacts and technical support personnel Custody of master and backup copies Identification of go/no-go decision criteria Identification of verification process: — of required tasks to prepare deliverables required — of components required at site — of installation procedures — of pre-installation construction or conversion activities — of (for example) system integration, release builds Identification of customer acceptance requirements Identification of any copyright and licensing requirements Identification of any safety and security requirements

Table A.26 (*continued*)

ID	Class	WP Type	WP Characteristics
75	2.5	Installation guide	Coverage for key elements (as appropriate to the application): — Tasks for loading/installing product sequentially, order by execution requirements — downloading of software from delivery files — uploading of appropriate software to (for example) files, folders, libraries. — partial or upgrade installation instructions, where applicable — initialisation procedures — conversion procedures — customisation/configuration procedures — verification procedures — bring-up procedures — operations instructions Installation requirements identified: — associated hardware, software, customer documentation — conversion programs and instructions — initialisation programs, system generation information — components and descriptions — minimum configuration of hardware/software required — backup/recovery instructions — validation programs — configuration parameters (for example, size requirements, memory) — Customer/technical support contacts
81	3.2	Acceptance record	— Record of the receipt of the delivery — Identification of the date received — Identification of the delivered components — Records the verification of any customer acceptance criteria defined — Signed by receiving customer
82	1.2	Customer support procedure	Coverage for key elements (as appropriate to the product or contract): — Tasks to follow in providing support defined Defines the availability and coverage the support provided: — hot-line number — hours of availability — appropriate expertise — cost Defines a schema for classification of customer request and/or problems: — definition of request type — definition of priority/severity — definition of response time expectations, by type and severity Standards for what information to retain from a customer, such as: — company and location

Table A.26 (*continued*)

ID	Class	WP Type	WP Characteristics
82			— contact information details — description of the request — reference to supporting information sent (dumps, files) — customer system site configuration information (product, release, version, last update) — impacted system(s) — impact to operations of existing systems — criticality of the request — expected customer response/closure requirements — definition of customer escalation procedures Identification of customer support tools available and procedures for using them, such as: — mechanism used to record customer requests — status reports — systems available to reproduce problems — ability to reproduce customer's software environment — ability to reproduce problems — rest emulators — rest scripts — dial-in ports — dump analysis tools
83	3.2	Customer request record (internal or external)	Identifies request purpose, such as: — new development — enhancement — internal customer — operations — documentation — informational Identifies request status information, such as: — date opened — current status — date assigned and responsible owner — date verified — date closed Identifies priority/severity of the request Identifies customer information, such as: — company/person initiating the request — contact information and details — system site configuration information — impacted system(s) — impact to operations of existing systems — criticality of the request — expected customer response/closure requirements Identifies needed requirements/standards Identifies information sent with request (for example, RFPs, dumps)

Table A.26 (*continued*)

ID	Class	WP Type	WP Characteristics
84	3.2	Problem report record	— Identifies the name of submitted and associated contact details — Identifies system configuration information (such as: release versions, system software, hardware configuration) — Identifies the group/person(s) responsible for providing a fix — Includes a description of the problem — Identifies any associated support information (such as: dumps, files) — Identifies the severity of the problem (critical, major, minor...) — Identifies the status of the reported problem — Identifies the components of the product affected — Identifies the applicable software product release and version information — Identifies the date “opened” — Identifies the target release(s) the problem will be fixed in — Identifies the expected closure date — Identifies any associated problem reports, customer requests, duplicate problems, associated fixes — Identifies any closure criteria — Identifies re-inspection actions
85	3.2	Customer satisfaction survey	— Identification of customer and customer information — Date requested — Target date for responses — Identification of associated software and hardware configuration — Ability to record feedback
86	3.4	Customer satisfaction data	— Determines levels of customer satisfaction with software products and services Mechanism to collect data on customer satisfaction: — results of field performance data — results of customer satisfaction survey — interview notes — meeting minutes from customer meetings
87	1.2	Communication mechanism	A way to distribute information: — Clear description of what is being communicated — Ability to specify date information sent — Ability to distribute to all impacted Identification of the impact: (for example on: software, development, customer, organization) — Provides a clear identification as to who/what the message applies — Mechanism for recipient to respond when required (return information) — The distribution media used is accessible to all with a need to know — The distribution list is current and includes all with a need to know — Ability to specify target return date information

Table A.26 (*continued*)

ID	Class	WP Type	WP Characteristics
88	1.4/2.1	Training strategy/plan + (16)	— Defines current staff capabilities — Defines the skills required — Outlines course available to achieve training goal
89	3.2	Training record	— Record of employee's training — Identifies employee's name — Identifies any courses taken (date, hours, course title) Identifies current skills/capabilities/experience level, lists: — formal education — in-house training — mentoring — Identifies future training needs — Identifies current status of training requests
90	2.5	Training material	— Synchronised to current supported versions of the software — Updated and available for new releases — Coverage of system, application, operations, maintenance as appropriate to the application — Course listings and availability
94	3.2	Change request	— Identifies purpose of change — Identifies request status (new, accepted, rejected) — Identifies requester contact information — Impacted system(s) — Impact to operations of existing system(s) defined — Impact to associated documentation defined — Criticality of the request, date needed by
97	3.2	Corrective action (logs, plans, minutes)	— Identifies the initial problem — Identifies the ownership for completion of defined action — Defines a solution (series of actions to fix problem) — Identifies the open date and target closure date — Contains a status indicator — Indicates follow-up audit actions
104	2.5	Development environment	— Floor plan — Environmental safety considerations — Regulatory requirements — Contractual requirements — Security considerations — Facility configuration — Special environmental requirements (for example, air conditioning, raised floor, power) — Individual workspace needs defined — Workstation requirements — Supporting software — Tools — Communication equipment — Disaster recovery plan

Table A.26 (*continued*)

ID	Class	WP Type	WP Characteristics
107	2.5	System component	— Hardware components — Software components — Manual components — Customer documentation — Training materials
108	3.2	Personnel record	Relevant information about personnel including: — Name, address, date of birth, marital status — Grade, pay, appraisal history — Disciplinary history
109	3.2	Contract review record + (31)	— Scope of contract and requirements — Possible contingencies or risks — Alignment of the contract with the strategic business plan of the organization — Protection of proprietary information — Requirements which differ from those in the original documentation — Capability to meet contractual requirements — Responsibility for subcontracted work — Terminology — Customer ability to meet contractual obligations.
110	2.5	Context of use statement + (7)	— The scope of the statement — The worksystem and the tasks to be performed — The characteristics of the users — The social and cultural environment, organizational/management regime — The characteristics of equipment external to the system or the working environment — The location, workplace equipment and ambient conditions
111	3.4	Context of use analysis + (21)	Analysis relating the context of use to the system and its development constraints including any resulting HS issues or risks.
112	2.5	HF data + (7)	Information regarding a particular aspect of human performance or ability provided or developed by a human sciences specialist. (see the definition of HF data for more detail on likely contents)
113	2.5	User's environment + (104)	Characteristics as for development environment plus: — Location — Culture — Social environment. (see the definition of context of use for a more complete list of relevant entities in the user's environment)

Table A.26 (*continued*)

ID	Class	WP Type	WP Characteristics
114	2.5	Staffed system + (73)	Worksystem of hardware, software, users, documentation and procedures (see the definition of worksystem for more detail on the scope of a worksystem)
115	2.5	Users + (7)	Individuals with *inter alia* needs, wants, desires, physical capabilities, competencies. (examples of users are operators, installers, maintainers, managers, instructors, the management hierarchy, performance analysts and training support specialists)
116	1.3	HF standards and regulations + (9)	International, national, sector or corporate guidance on practice or parameters related to humans or human-system issues. International, national, sector or corporate statutory or legal requirements related to human-system issues.

Annex B
(informative)

Structure and context of the human-system model

B.1 Use of process models

Process models describe what processes *q.v.* ought to be carried out by an organization to achieve defined technical goals. The primary use of a process assessment model is to measure how well an organization carries out the processes covered by the model. However, such models can also be used as a description of what is required in order to design and develop effective organizational processes. For more information on this use of process models, reference may be made to ISO/IEC 15504.

Processes should not be confused with the stages of a life cycle. Processes are enacted at more than one stage in the life cycle, and it may be useful to think of them as essentially continuous throughout the life cycle. The emphasis between the outcomes of a process will vary depending on the stage at which it is performed. This variation in emphasis will in turn affect the conduct of the practices that comprise the process. The effect of stage and project context on the performance of processes and practices is one of the main differences between process models and methods/methodologies for system development.

NOTE ISO/IEC 15288 describes the relationship between the processes which bring about required outcomes in the life cycle and the stages in the life cycle through which the system progresses.

B.2 Structure of the HS model

The entity relationship diagram in Figure B.1 describes the formal components of the model presented in this Technical Specification. The diagram shows that the HS process category in the HS model contains a set of processes which themselves contain sub-processes. Each process has a set of outcomes, a set of practices and uses and produces a set of work products.

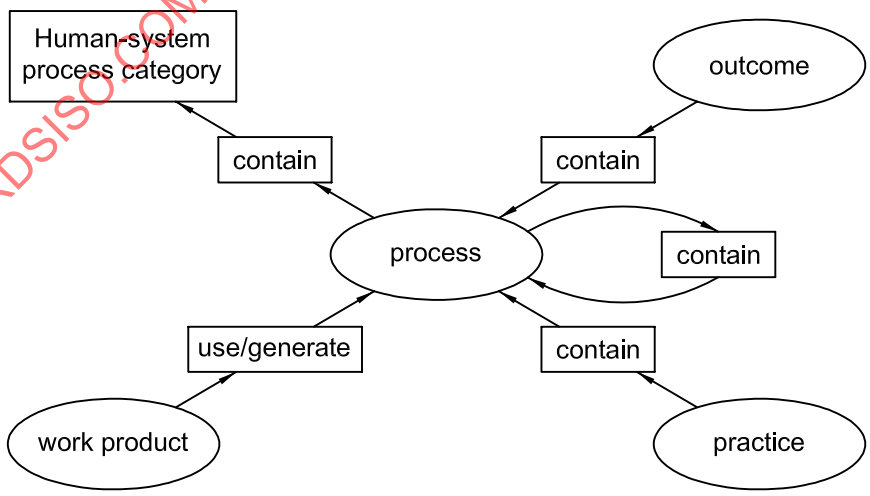

Figure B.1 — Entity relationship diagram of the model

The HS model has been developed as a stand-alone but compatible model, rather than being incorporated into one of the existing process models, such as the *Capability Maturity Model* (CMM), ISO/IEC 15288 or ISO/IEC 12207. This is mainly because of the number and variety of process models, but also to clarify the treatment of the human factor in systems and its implications for system life cycles. The model conforms to and extends ISO 13407. ISO 13407 explains the arguments for and purposes of human-centred design and describes the activities necessary to be user centred in the design process.

B.3 Elements and interrelationships in the HS model

The HS model is intended for use in stand-alone assessment of HS processes and also for assessments conducted in conjunction with software or systems engineering process assessment. The model describes what may need to be done in order to represent and include human-system issues during the life cycle. The contents of the model can be summarised as a four-level process hierarchy (process category, process, sub-process, practice).

The human-system process category consists of 21 sub-processes grouped under 4 super-processes. Each process is achieved by the performance of a set of practices. Each sub-process uses and generates a set of work products. The practices and work products for each process are described in Annex A. Practices are described in a single, generic sentence or phrase which is interpreted and elaborated by informative notes. Each set of practices loosely follows the Plan Do Check Act structure. Each process is therefore responsible for ensuring that its work products are delivered and used.

The HS model is applied throughout the life cycle of a system. It presents a set of complimentary views on life cycle processes that emphasise the treatment of human-system issues. At each stage in the life cycle (stages are often performed concurrently and by more than one organization) the relevant **life cycle involvement (HS.1)** process identifies the HS issues for the system of interest as it is realised through the operation of successive stage enabling systems. These issues are investigated using the **human-centred design (HS.3)** and **human resources (HS.4)** processes. The input for, and the results from, these processes are acquired and fed back to the organization through the **integrate human factors (HS.2)** processes.

Figure B.2 shows the relationship between these processes and the system life cycle and the organization(s) involved. It is not a life cycle. Figure B.2 attempts to convey the cyclical nature of the HS processes and their linking for a system. Whilst it is possible to draw a number of simple diagrams that demonstrate the iterative nature of a user-centred life cycle, iteration may take a range of forms depending on the type of system being developed and the market sector for which the system is intended.

The core process is user-centred design. HS.3 *Human-centred design* is where the work of describing and addressing requirements from the user's point of view is done. This comprises four types of technical activity. These processes generate information to inform the definition, design and operation of a system.

HS.4 *Human Resources* presents a similar set of four technical processes related to the definition, development and maintenance of staff competence and the match between the social and technical aspects of an organization.

User-centred design plays different roles and provides different information at each stage of the system life cycle. HS.1 *Life cycle involvement* covers particular domain issues at each stage in the life cycle. It contextualises the HS.2 and HS.3 processes. HS.1 covers “edge of system” issues, non-technical issues and through-life issues. HS.1 processes use HS.3 and HS.4 (technical processes) in order to achieve their outcomes.

NOTE This life cycle stage process approach to process description is also used in ISO/IEC 15288.

User-centred design is not performed in isolation. Human-system issue processes use information from and create information for other system life cycle processes. HS.2 *Integrate human factors* describes the facilitation activities that relate the consideration of human-system issues to the other activities performed in an organization. HS.2 deals with how and when to call up and resource HS.3 and to some extent HS.1 and HS.4. Just as there is a cycle implied by HS.3 and a set of stages within HS.1, HS.2 has an internal structure. This is related to the areas of the organization which perform the various processes. HS.2.1 is performed by, or on behalf of, the (senior) staff in an organization who address business strategy issues. HS.2.2 is performed by, or on behalf of, process, quality and training staff. HS.2.3 to HS.2.5 are performed by, or on

behalf of, staff supervising or managing the HS aspects of a project. HS.2.6 to HS.2.8 are technical and largely performed by those responsible for HS issues and usability.

The allocation of HS process to profession is also moveable. For example, the interface to systems engineering depends on the staffing of the project and the proportions of technical and operational risk; the interface to marketing depends on the type of system being developed; the interface to organizational support depends on the organization's maturity with respect to HS issues.

The main technical processes during system development are in HS.3. These are performed iteratively under the management of HS.2 and in a context set by HS.1 and HS.4. HS.2 is concerned with connecting the life cycle processes concerned with human issues to other processes in system development. HS.2 is concerned with harmonising the activities of the system development enterprise and those of the client user organization. HS.2 and HS.4 also connect HF into the higher management and organizational processes within an organization. HS.1 connects the HS life cycle to higher project processes and looks to the future of systems. HS.1 also sets boundaries and goals for projects, which then cycle through HS.3 & HS.4 and are implemented with HS.2. HS.1.3 and HS.1.4 are concerned with the use of the system. They connect the human resources and human-centred design processes to the support phase of the system life cycle.

All processes may not be enacted with full rigour at all stages in the life cycle. The character of a process (how it is enacted) may change depending on the stage in the life cycle and processes may be enacted more than once in any stage.

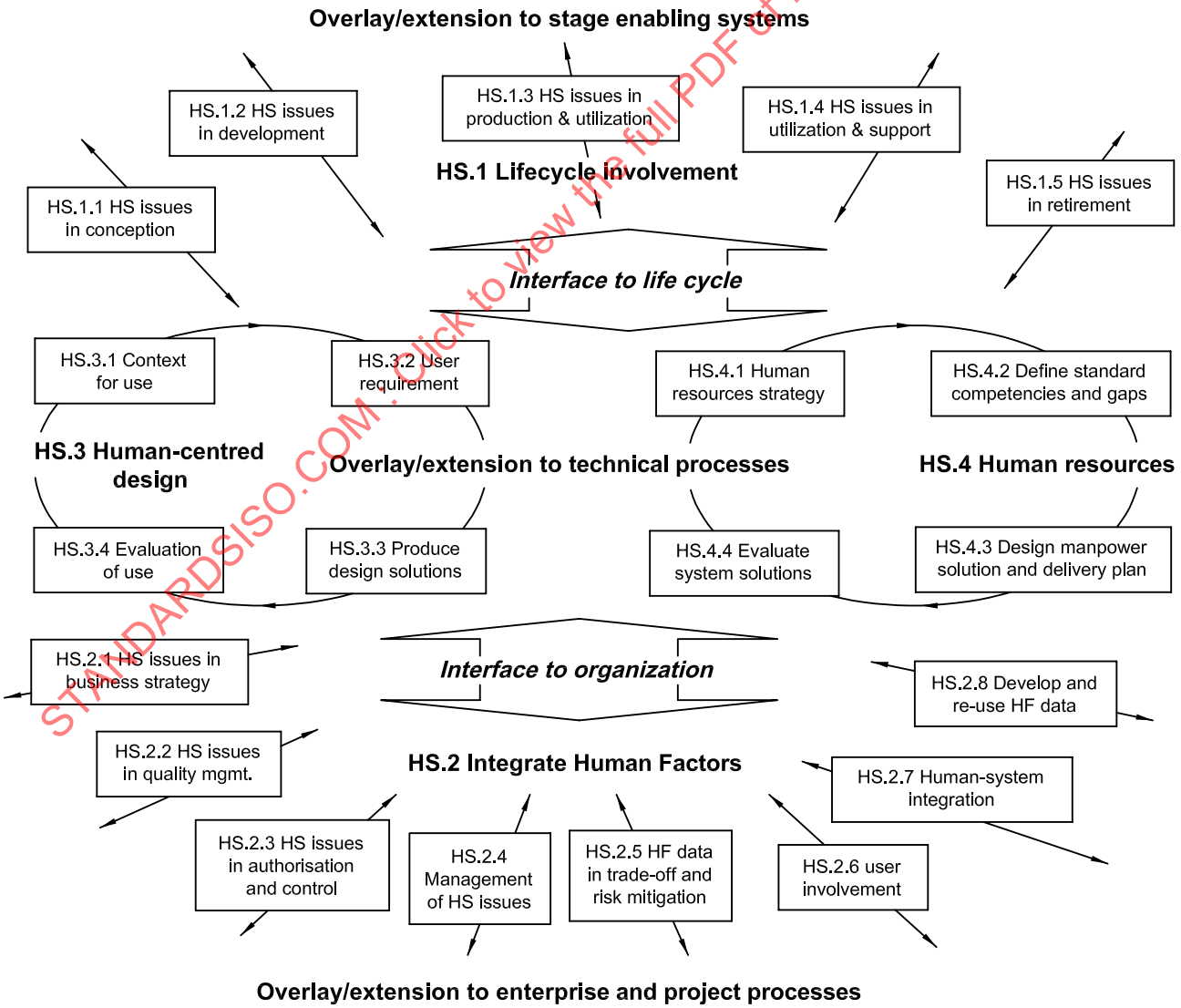

Figure B.2 — Human-system processes in the system life cycle and organization

B.4 Relationship between this model and ISO/IEC 15504

ISO/IEC 15504 is a presents a standard for process capability determination. It defines a normative approach to the assessment of process maturity. The processes presented in this Technical Specification conform to the requirements of ISO/IEC 15504 for variant processes.

Those familiar with process maturity models will observe that the HS model differs from generic models in that HS.1 processes are enacted at particular stages in the life cycle of the system of interest and there is a requirement for the life cycle to have certain attributes, such as the ability to iterate (particularly during the definition/design of the system). These requirements arise from the technical necessities of a life cycle which takes account of stakeholder and organizational requirements. Early in system development, these requirements cannot be specified fully for a system throughout its entire life and have to be re-visited as the system is detailed. This pragmatic consideration breaks one of the requirements of pure capability models in which all processes and practices can be enacted independently and continuously. However, users of this model will find that it supports a considerable degree of freedom in the selection and implementation of life cycles and practices, even within the limitations of this pragmatic consideration.

NOTE ISO/IEC 15504 describes two types of practice: *base* and *management*. The majority of processes in this Technical Specification are only base practices. However, this may not be entirely the case for HS.2, or the case when HS practices are used in other maturity models. This issue is explored in Clause E.3.

B.5 Relationship between this model and ISO/IEC 15288

ISO/IEC 15288 presents a standard for the processes required to develop systems. This Technical Specification provides an overlay or extension to these processes to address HS issues and adds processes that may be used to extend the requirement activities for consumer products, to support the implementation and operation of large management systems and for bespoke systems, i.e. systems for use by a well-defined set of stakeholders and users. A mapping between this Technical Specification and ISO/IEC 15288 is provided in Annex H.

B.6 Relationship of this model to guidance on Human Factors Integration

There is a considerable body of HF and HS-related guidance that has been produced for military and industry application of HF. The US Department of Defense has a set of guidance documents relating to their MANPRINT and Human Systems Integration initiatives. The UK Ministry of Defence and Defence Procurement Agency have mandatory and guidance documents supporting the Human Factors Integration (HFI) initiative. There is also a range of NATO publications. There are standards and guidance documents relating to merchant shipping, nuclear power generation, medical equipment, process control and other applications where HFI is appropriate (rather than the HCD processes in ISO 13407 for generic product development). The HS model complements these other sources of guidance by offering the following features:

— A basis for assessment and process improvement.

— Compatibility with other process models (e.g. software, systems) for the development of specific life cycles.

— A simple process model rather than the detailed guidance on methods provided in many of the existing guidance documents.

The HS process model complements the HFI domains. The HS model describes what is to be done, while the HFI domains describe the scope of application. The HFI domains can also be used as a checklist of areas in which HS issues might arise. The HFI domains are as follows:

— **Manpower** (staffing): The numbers of (military and) civilian personnel required and potentially available to operate, maintain, sustain and provide training for systems.

— **Personnel**: The physical and cognitive capabilities required to be able to train for, operate, maintain and sustain systems.

— **Training**: The instruction or education, and on-the-job or unit training required to provide personnel their essential job skills, knowledge, values and attitudes.

— **Human Factors Engineering**: The integration of human characteristics into system definition, design, development and evaluation to optimise human/machine performance under operational conditions.

— **Health Hazard Assessment**: Short- or long-term hazards to health as a result of normal operation of the system.

— **System Safety**: The process of applying human factors expertise to minimise safety risks occurring as a result of the system being operated or functioning in a normal or abnormal manner.

— **Survivability**: Enhancement of the service survivability of all personnel regardless of (military) skills or location.

B.7 Mapping to other process reference models

Annexes G and H provide mappings to the ISO and ISO/IEC process models close to the HS model. The HS model is intended for use with a wider range of existing and future process reference models. These models may be International or industry standards. Since it is not possible to update this Technical Specification as these models emerge or are revised, mappings to a range of process reference models are provided on the ISO/TC internet site in a sub-folder to the public information folder called “Directory of mappings for ISO/TR”. The URL is:

http://isotc.iso.ch/livelink/livelink?func=ll&objId=651393&objAction=browse&sort=name

You should click on the “Proceed to public areas” section when you get the ISO/TC log in page.

The initial set of mappings will include the CMM and ISO/IEC TR 15504-5.

Annex C
(informative)

Human resources process

C.1 HS.4 Human resources process

The purpose of 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.

NOTE The benefits include:

— the physical and cognitive capabilities required to be able to train for, operate, maintain and sustain the system are defined and made available;

— the instruction or education, and on-the-job or group training required to provide staff with their essential job skills, knowledge, values and attitudes are provided;

— the workload requirements for the operation, maintenance and support of, and training for, the system are defined and optimised;

— the HR strategy for the organization adapts to changes in organizational needs and technical and operational context.

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

1) the users of the system are stipulated, deployed and maintained within a given social environment throughout the life of the system;

2) the desired outcomes for the organization are defined and promulgated;

3) the operational, technical and organizational requirements of the systems employed by the organization are used in staff development;

4) individual and collective training requirements are reconciled with system requirements and desired outcome.

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

C.1.1 HS.4.1 Human resources strategy

The purpose of the *Human resources strategy process* is to derive and operate an HR strategy from the mission of the organization that includes a mechanism for implementing and recording the lessons learnt.

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

1) the right equipment is purchased;

2) the overall performance output of each system is consistent with required system capability;

3) future HR procurement, training and delivery strategies take account of feedback;

4) staff work together to achieve the objectives of the organization.

This is achieved through performance of the following practices:

— HS.4.1.BP1 Decide upon the goals, behaviours and tasks of the organization.

— HS.4.1.BP2 Define the global numbers, skills and supporting equipment needed to achieve those tasks.

— HS.4.1.BP3 Decide how many people are needed to fulfil the strategy and what ranges of competence they need.

— HS.4.1.BP4 Implement an HR strategy that gives the organization a mechanism for implementing and recording lessons learnt.

— HS.4.1.BP5 Feed findings back into future HR procurement, training and delivery strategies.

— HS.4.1.BP6 Enable and encourage people and teams to work together to deliver the organization's objectives.

C.1.2 HS.4.2 Define standard competencies and identify gaps

The purpose of the *Define standard competencies and identify gaps process* is to identify the changes to existing staffing and personnel resources, and skill demands imposed by the new system, and predict their availability over the life of the system.

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

1) existing and future human resources, explicitly identifying any shortfalls that may limit system usability, are clearly stated;

2) numbers and skills, and when they are required, are known;

3) there is a detailed and regular staffing and personnel audit;

This is achieved through performance of the following practices:

— HS.4.2.BP1 Identify current tasking/duty.

— HS.4.2.BP2 Analyse gap between existing and future provision.

— HS.4.2.BP3 Identify skill requirements for each role.

— HS.4.2.BP4 Predict staff wastage between present and future.

— HS.4.2.BP5 Calculate the available staffing, taking account of working hours, attainable effort and non-availability factor.

— HS.4.2.BP6 Compare to define gap and communicate requirement to design of staffing solutions.

— HS.4.2.BP7 Create capability to meet system requirements in the future (conduct succession planning).

— HS.4.2.BP8 Produce and promulgate a validated statement of shortfall by number and range of competence.

C.1.3 HS.4.3 Design staffing solution and delivery plan

The purpose of the *Design staffing solution and delivery plan process* is to deliver individual and collective training solutions reconciled to system requirements and desired outcomes.

NOTE The benefits of this process include: system performance falling into an agreed acceptable performance curve where costs of training and human error are taken into account; users have job satisfaction because tasks are commensurate with training and the skill set; user understanding of equipment capability is consistent with the goals of the organization.

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

1) sufficient, suitably capable users are deployed at the right time and in the right place to man and support the systems used;

2) the technical and operational requirements of the system are integrated into staff development.

This is achieved through performance of the following practices:

— HS.4.3.BP1 Identify and allocate the functions to be performed.

— HS.4.3.BP2 Specify and produce job designs and competence/skills required to be delivered.

— HS.4.3.BP3 Calculate the required number of personnel.

— HS.4.3.BP4 Generate costed options for delivery of training and/or redeployment.

— HS.4.3.BP5 Evolve options and constraints into an optimal implementation plan.

— HS.4.3.BP6 Develop and trial training solution with representative users.

— HS.4.3.BP7 Deliver final training solutions to designated staff according to agreed timetable.

— HS.4.3.BP8 Identify any opportunities for redeployment.

C.1.4 HS.4.4 Evaluate system solutions and obtain feedback

The purpose of the *Evaluate system solutions and obtain feedback process* is to provide data on system operation to improve staffing provision and deployment, system design and operational deployment.

NOTE The benefits of this process include: the identification of the HR implications of the shortfall in system usability; the identification of the strengths and shortfalls in training implementation; the achievement of system usability in minimum time and with minimum manning.

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

1) the strengths and limitations of operation with the system are described;

2) contribution to system operation and support provided locally by informal means are identified;

3) operational data to support the safety management system are obtained.

This is achieved through performance of the following practices:

— HS.4.4.BP1 Develop a strategy for data gathering.

— HS.4.4.BP2 Provide means for user feedback.

— HS.4.4.BP3 Conduct assessments of usability.

— HS.4.4.BP4 Interpret the findings.

— HS.4.4.BP5 Validate the data.

— HS.4.4.BP6 Check that the data are being used.

Annex D
(informative)

Use of the human-system life cycle processes

D.1 Use of the model in process definition

The HS model describes a set of processes and sub-processes that are helpful for addressing HS issues in the life cycle of a system. This makes it a useful resource for organizations (for example, enterprises, departments, projects) that are designing a system life cycle which needs to be user centred.

The recommended approach is for the organization to set up a procedure to define its needs for such a life cycle. The outcomes of the processes in ISO/TS 18152 (and other models) are compared with the needs for the organization's life cycle. The processes in this Technical Specification can be used as input at this stage. Each of the process descriptions given in Clause 7 lists the outcomes of the process.

The next step is to define a life cycle which implements and integrates the practices of the selected processes to the required level to achieve the business purposes of the organization, department or project. The practices are listed in Clause 7 and detailed in Annex A. Annex A also lists the work products from each process. The lists of work products assist in the definition of the life cycle.

More detailed information on many of the HS practices is provided in ISO 13407. Advice on the particular methods which implement the practices is available from textbooks and human factors service providers.

Sets of processes implemented within an organization can be seen as systems intended to be operated by staff in order to achieve organizational goals. The HS model may be informative in the design and maintenance of effective, human-centred organizational and project processes.

D.2 Use of the HS model in process improvement

The HS processes, the practices and the work products provide a description of how organizations carry out activities which take account of user issues. Part 2 of ISO/IEC 15504 presents a number of levels of maturity and associated attributes with regard to these processes. These are described in Annex E of this Technical Specification. These descriptions can be used in setting the agenda and goals for improvement of human-centredness in systems development. The capability attributes provide a description of what is required in order to take the next step in increasing the maturity of the organization with respect to control of its processes.

Assessments will be required to diagnose existing process capability and to monitor performance. However, the goal of process performance is business benefit, not a score or certificate. The best approach to assessment for the purpose of process improvement is for the organization to define a desired profile of performance in human-system processes based on its business needs. The scope of initial and monitoring assessments is then designed to match that profile.

D.3 Use of the HS model in process assessment

D.3.1 Scoping the use of the HS model

This Technical Specification presents a hierarchical, four-process model in which the activities carried out to promote, support, manage and integrate HS processes (HS.2) are described in a layered fashion, down from consideration of usability in the organization's business strategy to day-to-day management of HF data. Activities to perform HCD and HR are in technical groups (HS.3 and HS.4) as generally applicable processes with an implication of iterative application. Activities that address HS issues at each stage of the life cycle are in their own group (HS.1) and are the key issues to discuss with projects. Each process addresses a particular issue or view on the handling of HS issues. One or more of these views can be paid specific attention when tailoring the model for a particular assessment. HS.2 assessments may also be applied to the facilitation of any specialist engineering activity in the system life cycle.

The model is efficient to use in assessment since an organization can be examined without completely contextualising HCD and/or HS issues in terms of a project. Assessment practice shows that interviews with process owners, managers and technical staff tend to range across projects to make comparisons for clarity. Although presenting something of a problem for documenting the assessment, this gives high quality analytical output in an efficient manner. HS processes can be assessed at all levels by a series of cross-project interviews against HS.2 (still focusing on projects as examples, where appropriate). This covers, for example, business strategy and infrastructure assessments. HCD technical activities can be assessed separately against HS.3 with the staff concerned (who may not be employed by the same organization). HR and sociotechnical issues can be addressed through HS.4. The only interviews which need to be system-specific are those against HS.1 where the assessment of each system project concentrates on one process, depending on where it is in the life cycle. It is possible to investigate all life cycle stages up to the current stage with only a few more interviews (if staff are still available). Focused assessments of this form reduce the cost of an assessment and considerably increase its coverage.

For details of how to plan, staff, perform and report an assessment based on a process model, refer to the most recent versions of the parts of ISO/IEC 15504.

D.3.2 Process assessment procedure

The model presented in this Technical Specification can be used in the assessment of an organization's capability to carry out the HS processes described in the model. The intended assessment process is that defined in ISO/IEC 15504. The reader is referred to ISO/IEC 15504 for details of the qualification of assessors, assessment procedures associated and other issues.

The first step is the tailoring of the model for the assessment. This consists of selection of relevant processes and definition of the maximum capability that is likely to be observed. The processes selected should be representative of the activities carried out by the organization. The model is not sacrosanct and may be tailored as much as necessary. The purpose of assessment is usually to gain a clear picture of the processes in a particular organization for the purpose of process risk assessment or process improvement. The benefit to the organization is only realised if the model is tailored to suit the purposes of the assessee. Processes and practices are selected for assessment if the organization wishes to know how well that particular activity is carried out. If it is not important to the business that a particular process is particularly well performed then there is no need to assess it.

In a third-party assessment for the purposes of accreditation, the situation is different. A purchaser or other client is looking for evidence that the processes that it considers necessary are performed to the level it requires. In this case, the processes to be covered are defined by the client.

The next step is to select typical projects for assessment. For a thorough assessment, the range of projects are selected to be representative of the spread of work, size of project and diligence of the organization.

The assessment itself is achieved by interviewing selected staff. Firstly, to ascertain how many of the practices are performed for each process. Secondly, to ascertain how well these processes are implemented in terms of, for example, the capability attributes in ISO/IEC 15504. Annex A provides lists of HS work products which might be requested as evidence of the performance of the practices.

It is beneficial if the interviewees prepare for the assessment. They need to understand the model and why the assessment is being carried out. Some familiarity with process thinking is required. Evidence of the performance of practices is provided by the interviewees, probably in the form of the work products. ISO 13407 provides guidance on the provision of evidence for assessment of human-system processes.

The organization being assessed needs to understand and prepare for the assessment. In an ideal case, the relevant staff will have studied the process model and prepared a description of how the organization's processes and practices map onto the integration of human factors in the life cycle.

In general, interviews with a project manager and two or three members of project staff (the staff may be interviewed together) will be sufficient to give a reasonable impression of the level of maturity of each project.

In order to encourage openness and co-operation, the assessment of whether practices are performed or not is reasonably informal. It is best to ask the interviewee to describe how the process is carried out and to only ask specific questions about particular practices or deliverables if the description is unclear. At the end of the discussion, summarise the findings back to the interviewee in terms of what is and is not done and/or delivered. During an assessment of capability, it is advisable to start by getting the interviewee to describe how the process is managed, move on to asking specific questions about the lowest levels of maturity and move up the scale until it is obvious that the practices are not being achieved. It is not beneficial to go beyond this level. If interviewees are not well prepared or if time is short, the assessor may resort to asking direct questions.

Rate attributes (practice, outcome or other indicator) for each interviewee using the ordinal scale below:

— **N** Not achieved: There is little or no evidence of achievement of the defined attribute for the assessed process. (0-15 % achievement).

— **P** Partially achieved: There is some evidence of systematic approach to, and some achievement of, the defined attribute in the assessed process. Some aspects of achievement may be unpredictable. (> 15 % to 50 % achievement).

— **L** Largely achieved: There is evidence of a systematic approach to, and significant achievement of, the defined attribute in the assessed process. Performance of the assessed process may vary. (> 50 % to 85 % achievement).

— **F** Fully achieved: There is evidence of a complete and systematic approach to, and full achievement of, the defined attribute in the assessed process. No significant weaknesses exist in the performance of the assessed process. (> 85 % to 100 % achievement)

It is advisable to use a pre-prepared paper form or a computer-based tool to calculate the rating of each process in the organization with regard to performance of HS activities. The result of the assessment will form the basis of plans to review and/or improve HS lifecycle processes within the organization. There are no good or bad results from an assessment. The level of capability only needs to be good enough to allow the business to fulfil its objectives. The required profile of maturity (capability against process) will be defined by the client as part of process improvement (see Clause D.2).

D.3.3 HS processes plus other models

The processes for human factors integration presented in this model may be used to augment the set of processes in other process models. This augmentation is likely to be carried out when a capability assessment is being performed on an organization or department which develops or supports systems that gain business benefit from meeting the needs of their users. A range of mappings to other process standards is provided on the ISO web site. See Clause B.7 for details of access.

The HS processes are selected as part of the routine tailoring process that is carried out prior to an assessment. The processes are described in a standard format in order to make this process as easy as possible. It is advisable to take advice from a competent HFI practitioner when selecting processes to include in the assessment. HS.2 will almost certainly be required. Some questions on HS.3 and HS.4 will be required for most assessments, and for detailed process improvement these will be the main focus. HS.1.1 may be

more relevant to generic system development (such as domestic products) and HS.1.3 is more relevant to large systems (such as public-sector information systems). HS.1.1 may be more relevant early in the life cycle of a system, and note that some of the practices in HS.3.3 and HS.3.4 are also required very early in the development of a system. The iterative or continuous nature of most system life cycles means that HS.3.1 and HS.3.2 are enacted during the support of a system.

D.3.4 Use of the model in informal assessment

The assessment approach described above is rigorous and is intended to give reproducible results across a variety of organizations. In some cases, this degree of rigour and the associated formality are not appropriate.

The model can also be used in a more informal setting, such as a workshop or discussion group. A description of the development process and the discussion about whether or not the capability attributes are present is retained, but the scoring need not be introduced or, if it is, the assessment as to whether attributes are present or not would become a group decision. The result need not be recorded, but a general agreement is reached about the achieved level, the required level for the business or project, and the actions required to attain it.

A discussion group approach is intended to increase awareness amongst participants. Their discussion with each other in the assessment meeting may well be more valuable than recommendations given by improvement experts. Even where assessment is carried out by external assessors, an element of group discussion can be built in order to promote awareness and organizational learning. In informal assessment, a group may assess itself and retain the results for comparison with subsequent meetings or projects; improvement actions can still be planned and responsibility for making changes can be assigned.

D.3.5 Use of the model in process risk assessment

In the case of risk assessment, the preparation is as described in Clause D.3.2, but the assessment may not need to be as rigorous. The interviewees' description of the performance of the selected processes may be used as the starting point for immediate discussion on risks and their mitigation. Collation of individual responses into an overall risk report and risk mitigation plan is advised.