HFI CMM Study
Process risk assessors version of HSL model

HFI CMM Study - Work Package 3

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1 Summary

A process assessment model that emphasises the human-system aspects of the lifecycle.

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2 Contents

3 Foreword

3.1 HFICMM requirements for an HSL model for use in "full-scale" assessments

3.1.1 Where risks are high or there is a large investment at risk there is a requirement to carry out a thorough review of process risks and/or process capability in all relevant area of an organisation or a project.

3.1.2 In the work plan for HFICMM the defined best outcome for the "full-scale" assessment against the HSL model was for it to be completely integrated into the way DERA/QinetiQ Knowledge and Information Systems (KIS) does process assessment. The project achieved this integration by production of a process model compliant with the requirements of ISO/IEC 15504 *Process Assessment*.

3.1.3 Therefore "full-scale" assessment is addressed by provision of a suitably formatted version of the HSL model to KIS and providing them training and expert assistance in interpreting the HFI issues of particular projects.

3.2 Structure of this note

3.2.1 This document contains the HSL model in a format suitable for use by process assessors. The main difference from the document submitted to ISO as a Publicly Available Specification is the combination of the detail of the assessment model (practices and work products) with the process descriptions. No other significant changes have been made to the content or structure of the Specification.

3.3 HFICMM project foreword to the proposed ISO Publicly Available Specification for HSL processes

3.3.1 This document is part of a process assessment scheme developed for reducing project risk. The work was conducted as UK MoD Corporate Research under TG5 RO2 and was performed in conjunction with DERA CHS as part of contract (Ref. CHS CU005-0000001056) to serve as the basis for Human Factors Integration Capability Maturity Assessment. This version of the table also lists the QIU process references to allow reference back into that earlier draft of the model. Although the template used marks this document as copyright to ISO the copyright of this version resides with Lloyd's Register of Shipping. Copyright will pass to ISO if the NWI vote accepts this document as a CD.

4 Introduction

4.1 Background

4.1.1 This specification presents a view of the system life cycle 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 and improvement. This specification describes the set of processes required to address issues associated with humans throughout the system life cycle.

4.1.2 Process models offer:

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

2/ a description of the factors that hinder this ability, and

3/ the means of addressing such shortcomings.

4.1.3 These facilities has 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 organisation. Process reference models have been defined for particular applications and industries and international standards are being developed by ISO and ISO/IEC/JTC1. This specification provides a bridge between standardization in the area of Ergonomics (by ISO TC159) and the life cycle standardization being carried out by ISO/IEC JTC1/SC7 Software engineering.

4.1.4 This specification presents a definition of the processes necessary for the achievement of usability and lists their outcomes. The intention is to inform the developers and users of process models who want to integrate Human Factors processes in system, hardware and software life cycles in order to assure system usability. Usability is a through-life measure strongly correlated with system operability, safety, cost effectiveness and fitness for purpose. It is defined in ISO 9241 part 11 as a measure comprising system effectiveness, efficiency and the satisfaction of users working with a system. The equivalent concept of quality in use is defined in ISO/IEC 9126-1 as a measure of software quality comprising the effectiveness, productivity, safety and satisfaction of users working with a system.

4.1.5 The processes in this specification (the Human-System Life cycle process model, or HSL model) present collated good practice in human factors, user centred design and human factors integration across a range of industries world-wide. 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. The HSL model does not define the roles or competencies of these staff. The HSL model defines processes for specifying and evaluating usability, but it does not address all processes relating to its achievement. For example, response times, fault tolerance or physical robustness.

4.1.6 This specification has been developed with the following objectives in mind:

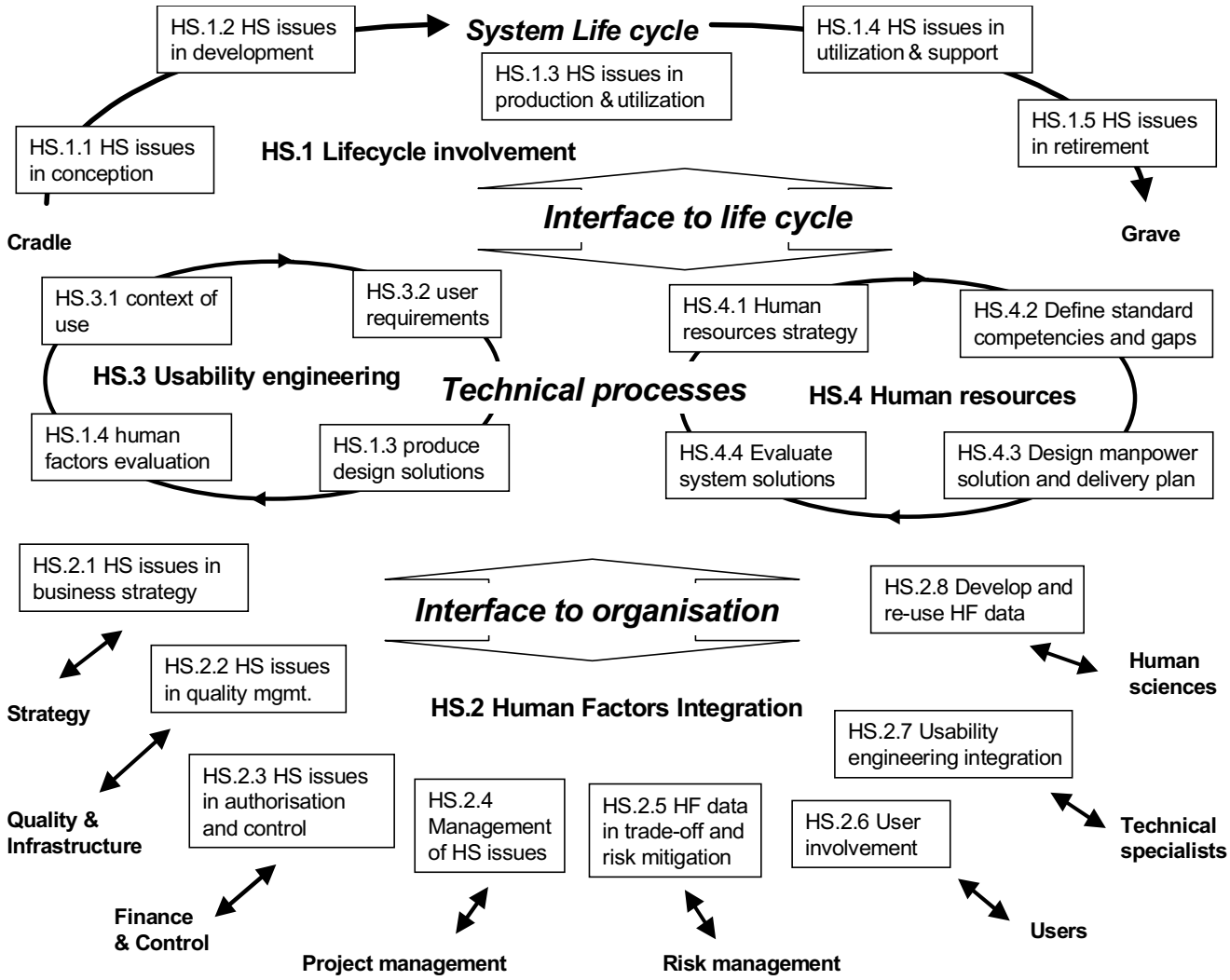
- To provide the means of assessing and mitigating risks arising from human-system issues that will affect usability through the life cycle, both at transition points between life cycle stages and during each stage.
- To provide a basis for structured human-system process improvement by supplier, customer or employer organisations.
- To provide a succinct description of human-system processes for use in project planning and for inter-disciplinary communication.
- A basis for understanding and co-operation 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.

4.1.7 This specification may assist those involved in the specification, design, assessment and operation of manned or embedded systems, hardware and software. The model may 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).

4.1.8 Only a small portion of the processes which affect the usability of a system are performed by human science specialists. However, human sciences specialists (for example, ergonomists, trainers, psychologists, medical experts, usability engineers) may find the HSL model useful as a means of presenting the activities required when projects or companies address human-system issues or need to develop products with an assured degree of usability. A process model is a means of discussing and planning the work required in order to take account of human sciences input in system development and operation. Process models are widely understood in the systems and software development communities. The ability to describe human sciences methods and techniques, and their inputs and outputs, in the language used by systems and software engineers and their managers simplifies the adoption and implementation of user centred design.

4.1.9 The human-system life cycle process 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 (these stages are often performed concurrently and by more than one organisation) the relevant life cycle involvement process is performed in order to identify the human-system issues for the system. These issues are investigated using the usability engineering and human resources processes. The input for, and the results from, these processes are acquired, and fed back to the organisation, through the integrate human factors processes. Figure 1 shows the relationship between these processes and the system life cycle and the organisation(s) involved. It is not a life cycle.

Figure 1 — Human-system processes in the system life cycle and organisation



4.2 Scope

4.2.1 This specification is intended to assist in the development of product systems which have assured usability. This specification presents a model for use in the assessment and improvement of the maturity of an organisation in performing the processes that make a product system effective, efficient and satisfying in use. It describes the processes which lead to a usable product system and their outcomes. It details the practices and work products associated with achieving the outcomes of each process.

4.2.2 The human-system life cycle process model has a focus on product systems, but includes processes related to the specification, recruitment, development and deployment of the humans who use a product system to achieve mission goals.

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

4.2.4 Users of this specification should be familiar with ISO 13407 *Human-centred design processes for interactive systems* and ISO/IEC 15504 *Process assessment*. The latter standard (which is currently available as an ISO/IEC technical report) provides the background to process modelling and assessment. It also provides the framework in which the process descriptions in This specification may be used. This specification defines an additional category of processes for use with other process standards, for example ISO/IEC 12207, ISO/IEC 15288 and ISO/IEC 15504. Readers who wish to gain an overview should study Annex B which describes the purpose of this specification and places it in context with other process standards and human factors integration activities.

4.2.5 Section 6 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 also provided.

4.2.6 Informative annexes are provided to this specification. Annex A lists the work products defined in ISO TR 15504 part 5 and describes extra work products related to HS processes. Annex B describes the technical components of the model, its relationship to core HCD, assessment and process standards and HFI. Annex C describes the ISO/IEC 15504 maturity scale and indicates which of the practices in the HSL model are evidence of maturity greater than level 1. Annex D describes the use of the HSL model in process assessment. Annex E indicates the interrelationship between the processes and work products in the HSL model. Annexes F to J present mappings between the HSL model and process models for HCD, process assessment and the system life cycle. Annex K is a 15504 conformance statement for the HSL model.

4.3 Normative standards

4.3.1 The following standards contain provisions which, through reference in this text constitute provisions of this specification. At the time of publication, the editions indicated were valid. All standards are subject to revision, and readers are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

- ISO/IEC/WD 15504-2: *Process assessment - Performing an assessment*
- ISO/IEC CD 15288 *System life cycle processes*

4.4 Terms and definitions

4.4.1 For the purposes of this specification, the terms and definitions given in ISO 6385:1981, *Ergonomic principles in the design of work systems*, ISO 9241 part 11 *Guidance on usability*, ISO 13407:1999, *Human-centred design processes for interactive systems*, ISO/IEC TR 15504:1998 part 9, *Software process assessment - vocabulary*, ISO/IEC 9126-1:2001 *Software product quality - quality model* and ISO/IEC CD 15288 *System life cycle processes* apply. The terms most relevant to this specification are given below.

(process) **Capability** The ability of a process to achieve a required goal. (ISO/IEC TR 15504 part 9). Note that this differs from human capability, military capability and operational capability. To avoid confusion these usages are avoided in this specification.

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

Enabling system A system that complements the product system q.v. during its life cycle stages, but does not contribute directly to its functionality. (ISO/IEC CD3 15288) (For example, when the product system enters the production stage of the life cycle, an (enabling) production system is required.) (Each enabling system has a life cycle of its own. This Specification is applicable to each enabling system when, in its own right, it is treated as the system of interest.)

Enterprise One or more organizations with a set of goals and objectives to offer products and/or services. (ISO/IEC CD3 15288) (An organization may be involved in several enterprises and an enterprise may involve one or more organizations.)

Ergonomics The study of human capabilities and limitations, human interaction with technologies and environments, and the application of this knowledge to products, processes and environments. (ISO 6385:2000). (The new word "Ergonomics" was originally created from a combination of the Greek words "ergos" and "nomos" to mean literally "laws of work".)

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)

HF data Information about users and other stakeholders that is generated and maintained by the Human Sciences. This includes, for example, anthopometric data, health and safety data, psychometric measurements, ergonomics 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)

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

Human/user-centred design In this document the term "user centred design" is used to refer in a general sense to a design process that takes account of the users of a system. The term "human-centred design" is used to refer to the particular design process defined in ISO 13407 and ISO TR 18529 Human-centred life cycle processes.

Human factors integration A systematic approach to the identification, tracking and resolution of human-related issues in order to ensure the balanced development of both the technological and human aspects of capability. 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 human related information (UK MoD An Introduction to HFI Management, 2000).

Human-system issue An issue (for example, a need, want, constraint, limit, concern, 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.

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. (from definitions in IEC 61508, ISO 13407 and ISO/IEC WD 15288)

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

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

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

Process category A set of processes addressing the same general area of activity. (ISO/IEC TR 15504 part 9) (ISO/IEC/IEC TR 15504 addresses Software process assessment in five general areas of activity: customer-supplier, engineering, support, management, and organisation.)

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

Product system A type of system q.v. In This specification the term "product system" is used to indicate the system of interest, i.e. the system that is under development or in operation. Any product system will have a number of enabling systems q.v. which are developed in concert with the product system. This specification also applies to the life cycle of enabling systems, these systems in turn become the product system when This specification is applied to them. Other systems form part of the context of use of the product system, or system of interest. (A product system includes the workplace, physical equipment, computer software, documentation, manuals, human tasks and organisational or management procedures. When these are combined with users and operated the result is a work system. ISO 6385 gives guidance on the design and operation of work systems.)

Project stakeholder A type of Stakeholder q.v. This term is used in This specification to refer to the members of an organisation who have a stake in a project. This includes, for example, the project manager, task leaders, technical staff, administrative staff, quality assurance.

Project An undertaking with pre-specified objectives, magnitude and duration. (ISO 2382-20) (The term 'project' is not intended to be exclusive to the development of a product system. Projects include long-term activities related to a product system, such as training, maintenance and support.)

Prototype Refers to any artefact created for the purpose of demonstration to users in order to elicit or test user feedback. This includes inter alia demonstrators, mock-ups, paper prototypes, simulations, role-plays, dummy systems or documents, scenarios. (extension of ISO 13407)

Stakeholder An interested party having a right, share or claim in the system or in its possession of qualities that meet that party's needs and/or expectations. (ISO/IEC CD3 15288) For 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 organisation).

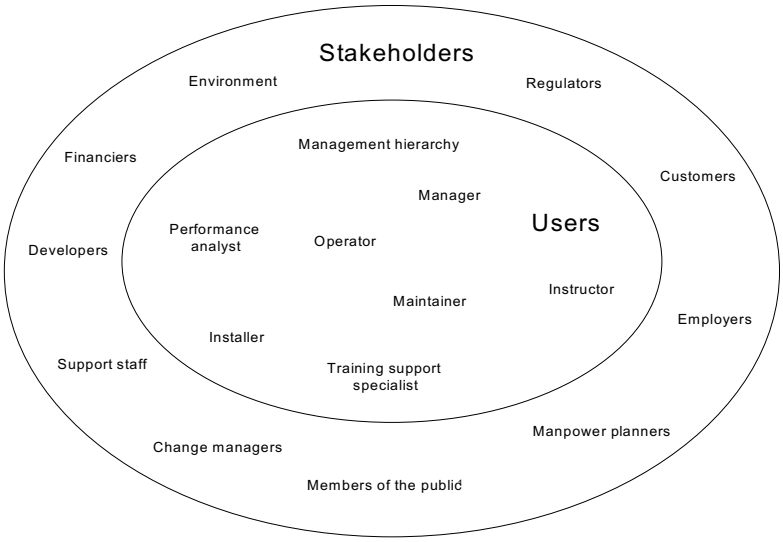
Summative evaluation Evaluation designed to present conclusions about the merit or worth of the object of evaluation and recommendations about whether it should be retained, altered or eliminated. (The Program Evaluation Standards, second edition)

System A discrete, distinguishable entity with a physical existence and a defined purpose completely composed of integrated and interacting elements, each of which does not individually comply with the overall purpose. (ISO/IEC WD5 15288)

Task An activity required to achieve an intended outcome of a worksystem (ISO/PDR 6385:1988). (Task is not used to describe a project activity, the term 'practice' q.v. is used for this type of activity.)

User Individual interacting with the system (ISO 13407). The relationship between stakeholders and users is shown in Figure 2. Examples of users and stakeholders are included in this figure.

Figure 2 — Stakeholders and Users



1 Members of the public are always stakeholders and may be users.

Usability The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in specified context of use. (ISO 9241 part 11) (For software systems usability is defined as “quality in use” and stated in terms of required levels of user effectiveness, productivity, safety and satisfaction for the system or its component parts in the context of particular tasks based on performance requirements. (ISO/IEC 9126:1999 Software product quality - quality model). The term “safety” as used in ISO/IEC 9126 and in this Specification includes user’s and other stakeholder’s health and well-being.)

Work Product An artefact associated with the execution of a process. (ISO/IEC TR 15504 part 9) (A work product might be used, produced or changed by a process.)

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

4.5 Symbols and abbreviations

BP Base Practice

HC Human-Centred

HCD Human-Centred Design

HF Human Factors

HFI Human Factors Integration

HR Human Resources

HS Human-System

HSL Human-System Life cycle

5 Components and format of the model

5.1 Reference component of the model

5.1.1 The human-system process category consists of the set of processes required to address issues associated with people throughout the system life cycle. These are the processes that ensure that a product system achieves effectiveness, efficiency and satisfaction for all of its intended users throughout its life. The HSL model presents a particular view of system processes that emphasises the treatment of HS issues in the system life cycle and its processes as described in, for example ISO/IEC 15504-5, ISO/IEC 15288 or ISO/IEC 12207.

5.2 Format of the model

5.2.1 The HSL model presented in this specification uses the format common to process assessment models. Process assessment models describe the processes that give an organisation the best opportunity to achieve defined technical goals. The processes in this model are described in the format used in ISO/IEC 15504 *Process assessment*. For easy reference the maturity levels used in ISO/IEC 15504-2 *Performing an assessment* are included in an annex. 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 HSL 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 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.

5.3 Processes in the model

5.3.1 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 sub-clauses of section 6 that describe the processes, their purpose, outcome and practices, and to the annexes that provide further details. These annexes are described in section 4.2. Section 4.1 to this specification and Annex E provide details of the links between the processes in the HSL model. Life cycle processes are likely to be instantiated and enacted several times in a life cycle and in several parts of an organisation. 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 product 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.

5.3.2 Table 1 classifies the processes in the model using the process description provided in ISO/IEC 15504. There are five types of process. 3 top-level (basic, extended and new) and 2 second-level (component and extended component), and these are as follows:

- Basic Process - identical in intent to a process in ISO 13407

- Extended Process - expansion of a process in ISO 13407
- New Process - outside the scope of ISO 13407
- Component Process - a group of one or more ISO 13407 activities from the same process
- 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.
- 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**	***QIU ref. (temp)***[1]
HS.1 The "long-term usability" view of the system life cycle. Making the system life cycle efficient by addressing people in the stage enabling systems for the product system. (These processes are in general grouped according to the example stages provided in Annex B of ISO/IEC CD 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 product system (operation and support of the product system).)			
Life cycle involvement	HS.1	Extended	*QIU.3*
Human-system issues in conception	HS.1.1	New component	*QIU.3.1*
Human-system issues in development	HS.1.2	Extended component	*QIU.3.2*
Human-system issues in production and utilisation	HS.1.3	New component	*QIU.3.3*
Human-system issues in utilisation and support	HS.1.4	Extended component	*QIU.3.4*
Human-system issues in retirement	HS.1.5	New component	*QIU.3.5*
HS.2 The "take account of usability engineering" view of the system life cycle. Reducing life cycle costs by ensuring that design for people is used within the organisation.			
Integrate human factors	HS.2	Extended	*QIU.1*
Human-system issues in business strategy	HS.2.1	New component	*QIU.1.7*
Human-system issues in quality management	HS.2.2	New component	*QIU.1.6*
Human-system issues in authorisation and control	HS.2.3	Extended component	*QIU.1.4*
Management of human-system issues	HS.2.4	Extended component	*QIU.1.5*
HF data in trade-off and risk mitigation	HS.2.5	New component	*QIU.1.3*
User involvement	HS.2.6	Extended component	*QIU.1.2*
Usability engineering integration	HS.2.7	Extended component	*QIU.1.1*
Develop and re-use HF data	HS.2.8	New component	-
HS.3 The "user centred design" view of the life cycle. Making a better product system by designing for people who use the system of interest in its context of use.			
Usability engineering	HS.3	Basic	*QIU.2*
Context of use	HS.3.1	Component	*QIU.2.1*
User requirements	HS.3.2	Component	*QIU.2.2*
Produce design solutions	HS.3.3	Component	*QIU.2.3*
Human Factors evaluation	HS.3.4	Component	*QIU.2.4*
HS.4 The "putting the man in front of the machine" view of the life cycle. The continued delivery of the correct number of competent people required to use the most suitable equipment. (This process has not been reviewed to the same standard as HS.1-3.)			
Human resources	HS.4	New	*QIU.4*
Human resources strategy	HS.4.1	New component	*QIU.4.1*
Define standard competencies and identify gaps	HS.4.2	New component	*QIU.4.2*
Design staffing solution and delivery plan	HS.4.3	New component	*QIU.4.3*
Evaluate system solutions and obtain feedback	HS.4.4	New component	*QIU.4.4*

[1]. This column is temporary. It provides a cross reference back to a previous version of the model for information.

5.4 Assessment component of the model

5.4.1 An assessment model is embedded in the reference model. This lists practices and work products and also provides elaborations and examples related to the HS processes and practices that may be informative for assessors. These elaborations

may be of use as a component of the body of knowledge underpinning the enactment of HS processes.

5.4.2 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:

1/ review the process, its outcomes and practices;

2/ review the project/organisation activities which fulfil the purpose and outcomes for a particular product system or business objective;

3/ consider the outcomes, practices and notes in that context.

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

5.4.4 For convenience in use all the information for a process is presented on either one or two pages.

5.5 Description of practices

5.5.1 Each process description includes a table that lists the practices which are performed in order to fulfil the purpose and achieve the outcomes in succinct single phrases or sentences. Expansions, examples and explanations of processes and practices are provided in informative text within the tables. 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.

5.5.2 Interpretations of this standard developed for particular assessments or sectors of industry may include additional notes which elaborate and interpret the practice for the type of product systems developed and operated in that sector.

5.6 Work products

5.6.1 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 HSL processes the achievement of a maturity level of 1 Performed is in part accomplished by changing the work products produced by the assessed process using 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. The source and numbering system for the work products and a description and checklist of the likely content for the work products is provided in Annex A.

5.6.2 The inter-process mapping tables in Annex E should be used in order to check that all work products are identified for each process. Many HS processes derive information or depend on the achievement of outcomes in other HS processes. The links between

processes are presented in Annex E. Whenever a process uses another process to achieve its outcomes the work products from the used process(es) may also be relevant. Annex E also summarises the relationship between HS processes and work products.

5.6.3 Example: HS.1 lists the work products from enabling systems related to stage aspects of the product system and core technical product system work products are listed in HS.3.

5.6.4 The practice descriptions 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 the last section of Annex C.

6 HS Human-system process category

6.1 HS.1 Life cycle involvement

6.1.1 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 product system.

6.1.2 Benefits of life cycle involvement include: the usability of a product system is given specific attention; user satisfaction with, and acceptance of, the product 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 product system are minimised and overall system effectiveness maximised; the product system adapts to changing user needs; organisational change, including the responsibilities of users and developers, is addressed.

6.1.3 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 product 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 product system are communicated to the organisation
- 4) HS processes are applied when required in the life cycle.

Notes on the process	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 usability engineering (HS.3). Life cycle involvement covers 'edge of system' issues, non-technical issues and through-life issues. These processes use the HS.3 (usability engineering) 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 product system. Stage enabling systems do not start and stop with product system milestones or project approval. The product system is the result of the operational stage in the life in a succession of stage enabling systems that are themselves product 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: 1/ some elements of a product system may be being delivered whilst others are still at the concept stage; 2/ a product system which is frequently revised may have versions in delivery and concept stage; 3/ some aspects of the delivery stage of a product 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.

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

6.1.5 Human-system issues in conception

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

6.1.7 The benefits include: system whole life costing include personnel costs and soft costs such as training and reorganisation; the assessment of future system performance takes human and organisational 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 product system.

6.1.8 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, organisation, 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 organisation takes future acquisition strategy into account when defining organisational change

6.1.9 This is achieved through performance of the following practices:

Notes process> **v practice**	The organisation here is the user organisation. For a generic product an individual user may be the user organisation. The organisation which is developing a product system may perform this process either independently from or in collaboration with the user organisation. For generic systems this process addresses HS issues in market research.
HS.1.1.BP1 Identify expected context of use of product systems	Perform studies of potential user groups in order to forecast forthcoming needs for product systems and new users or user organisations. 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 product 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 product 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 organisational impact of the product system to be introduced. Explore options for user effectiveness and user comprehension of the product system. For example, conduct an Early Human Factors Analysis.
HS.1.1.BP3 Describe the objectives which the user or user organisation wants to achieve through use of the product system	For a generic product the only user may be the end user of the system. For a larger or more complex system there will be more stakeholders and a user organisation, 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.
HS.1.1.BP4 Identify and analyse the roles of each group of stakeholders likely to be affected by the product system	Describe the potential user populations, their characteristics, and the staffing and personnel constraints and requirements imposed on/by the product system. Assess the significance and relevance of the product 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.
HS.1.1.BP5 Perform research into required product system usability	Benchmark equivalent systems using relevant criteria, for example usability, safety. Test the usability of product system elements, competing or alternative systems and/or system concepts. Use prototypes to stimulate stakeholder input to product 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	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 product 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 product 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)

6.1.10 HS.1.2 Human-system issues in development

6.1.11 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 product system and its elements.

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

6.1.13 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 product 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

6.1.14 This is achieved through performance of the following practices:

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.
HS.1.2.BP1 Generate design options for each aspect of the product system related to its use and its effect on stakeholders	There will be a shift between use of representations at system level and building elements at detailed/low level. Analyse the goals and tasks of the user in relation to the product system design in order to specify the user's demands on the user interface. As system requirements decomposition proceeds, so 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 and health and safety requirements will be provided. Identify, specify and produce the manning plans and personnel solutions for the product system. Propose staffing solutions for which equipment options are required. Include the manning necessary to provide training, support and safety. Ensure that the product 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 product 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 product system for the purposes of testing with users	Make design solution(s) more concrete using, for example, simulations, models, mock-ups. Prototypes include sufficient of the product system to test safeguards and safety of operations. Prototypes can be developed at any time in the life cycle.
HS.1.2.BP5 Collect user input on the usability of the developing product system	Use real tasks. Assess the prototypes against usability and/or operational criteria and collect user comments. 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.
HS.1.2.BP6 Assess the health and well-being risks to the users of the product system	Relate this to the overall risk assessment for the product 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 product system	Relate this to the overall risk assessment for the product system. Risks arising from malevolent use can also be assessed.

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

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

6.1.16 The purpose of the *Human-system issues in production and utilization* process is to maintain contact between the product system development enterprise, users and the client organisation throughout the implementation, introduction and validation of a product system.

6.1.17 The benefits include: the fit between the product system, its operational goals and the user requirements is assessed; the HR issues of re-organisation and training are aligned with product system introduction; the product system is incorporated into the organisation, e.g. with the safety management system, system support organisation, quality management system, training, recruitment and staff development processes; the delivered product system conforms to international, national and/or statutory requirements; the costs, time scales and resources required to put the product system into service are fully understood.

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

- 1) the product 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 product system

6.1.19 This is achieved through performance of the following practices:

Notes process> **v practice**	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 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 product system.
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 product system. The costs of transition to a new system may be high and need to be taken into account. For many types of product system a formal evaluation of health hazards and safety will be needed.
HS.1.3.BP2 Identify, specify and produce the infrastructure for the product system	Training and support are elements of the infrastructure of a product system. The development and provision of training is a well-established activity. Training is developed in parallel with design. Identify, specify and produce the training required to enable users to perform tasks effectively using the new product system. Training includes, in the case of a large safety-related system any requirements for user evacuation and recovery. Development of support is a well-established activity. Support is developed in parallel with design. Procedures are developed iteratively.
HS.1.3.BP3 Maintain contact with users and the client organisation throughout the definition, development and introduction of a product system	This activity facilitates, oversees and ensures that HS aspects are given sufficient attention during product system implementation. This may include re-organisation of job design and working practices. For example, group/teamwork, training, new business processes, reporting responsibilities.
HS.1.3.BP4 Build required competencies into training and awareness programmes	Competencies include not only operational but also maintenance and support personnel.

HS.1.3.BP5 Test that the product 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. Evaluation includes the data, procedures and tasks that appear in maintenance manuals and operating manuals. Check product systems for adherence to applicable human science knowledge, style guides, standards, guidelines, and legislation. Health hazards depend on the context of use and may be re-assessed if the operation of the product system is changed.
HS.1.3.BP6 Analyse feedback on the product system during delivery and inform the organisation 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)

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

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

6.1.22 The benefits include: product systems are more responsive to changes in users (for example, their needs, tasks, context); the product system is more responsive to changes in its stakeholders.

6.1.23 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 product system is monitored in relation to the design intent
- 3) the competencies required to utilise and support the product system are identified and evolved over time
- 4) user and maintainer requirements for support are met by the product system

6.1.24 This is achieved through performance of the following practices:

Notes process> v practice	This process may be enacted in part by the enterprise developing the product system and in part by the organisation which operates the product system. The context of use may change during the life of a product system. Periodic re-assessment may be required. For generic products this process addresses the provision of support to users.
HS.1.4.BP1 Produce personnel strategy	Develop staffing and recruitment options that are co-ordinated with maintenance, equipment, capability, service delivery options. Use life cycle cost accounting in order to assess the cost of personnel options. Apply organisation-level human resources strategy to acquisition. Present product system staffing concepts for operation and support (e.g. for senior management approval). Includes consideration of the resourcing of the product system through recruitment, staff development and training.
HS.1.4.BP2 Review the product 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 product system is utilised.
HS.1.3.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. A training needs analysis is the starting point. Delivery of training and workshops to users and maintainers to meet identified training needs carries on throughout the utilization of the product 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 product system	Assess the effect of: — new elements or sub-systems on the usability of the product system — major changes on the usability of the product system — changes in the context of use on usability of the product system. Changes to the context of use may occur in: — users (e.g. their skills and training for user organisations, 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, organisational and work structure, legislation, social and political issues). — Health hazards are re-assessed if the operation of the product system is changed.

HS.1.4.BP5 Review the health and well-being risks to the users of the product system	Relate this to the overall risk assessment for the product 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 product system	Relate this to the overall risk assessment for the product 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 product system	This is based on feedback about the product system in use from users and potential future users. This activity may also relate to organisational learning and process improvement.
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 product system. Continuous improvement in the operation of the product 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) 1.4/2.1 training strategy/plan (88) 2.5 training material (90) 1.3 HF standards and regulations (116) 2.5 HF data (112) 3.3 service level measure (42) 3.3 risk measure (40)	3.2 field measure (42) 1.4 improvement opportunity (26) 3.3 risk measure (40) 3.3 service level measure (42) 1.2 Customer support procedure (82) 3.2 customer satisfaction survey +(85) 3.2 problem report records (84) 3.4 customer satisfaction data +(86) 3.2 customer request record (83)

6.1.25 HS.1.5 Human-system issues in retirement

6.1.26 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 product system.

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

6.1.28 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 product system
- 2) the re-allocation, departure from employment and/or transfer of users is defined and actioned
- 3) there are debriefing and retrospective analysis to identify the requirements for the replacement version
- 4) the safety and health and safety hazards to workers, users and the general public are monitored.

6.1.29 This is achieved through performance of the following practices:

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 product 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 product 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 product system	
HS.1.5.BP3 Define how users will be re-allocated, dismissed, transferred to other duties.	
HS.1.5.BP4 Plan break-up of social structures	For product 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.

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

6.2 HS.2 Integrate human factors

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

6.2.2 The benefits include: human-centred design is applied in the product system life cycle; the product 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 product system.

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

- 1) HS issues are addressed by the organisation
- 2) HS life cycle processes are enacted

Notes on the process	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, clauses: 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 product system. See Annex B.8 for the background to the related term "Human Factors Integration".

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

6.2.5 HS.2.1 Human-system issues in business strategy

6.2.6 The purpose of the *Human-system issues in business strategy* process is to take account of product system usability in an organisation's business strategy.

6.2.7 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.

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

- 1) the usability of the organisation's product systems in the market/work place is at competitive level
- 2) a corporate vision of usability as an asset is established
- 3) there is senior management support for the improvement of infrastructure related to product system usability

6.2.9 This is achieved through performance of the following practices:

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 organisations. In the case of an supplier the focus will be on the HS of products in concept and development with an emphasis on usability. In the case of a user organisation 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 objectives for product systems	This means that business management sets demands on usability for product 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 product systems compares to that of competitors and they: a) define and maintain a position relative to the market place 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 organisation.
HS.2.1.BP5 Management relate HS to business benefits	EXAMPLE – Establish through-life cost accounting in order to assess the cost benefits of a user centred approach.

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

6.2.10 HS.2.2 Human-system issues in quality management

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

6.2.12 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.

6.2.13 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

6.2.14 This is achieved through performance of the following practices:

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 organisation. (for example through maintenance of an HS issues register). This process is the HS life cycle application of a generic process. When using This 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 organisation. 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 human issues in the management of projects and the organisation. Whilst the focus is on the human issues associated with the product system and the user organisation the development and production environments within the organisation 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 product system life cycle not the products of the development process (i.e. system documentation and utilization and support procedures). HS process is 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 organisation.
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 human factors evaluations. This normally involves training and other promotional activities and is typically performed by the HCD team. This can be achieved by, 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 co-ordination will be required.

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

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

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

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

6.2.18 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 product system and its elements
- 4) HS practice and capability is reviewed in order to build organisational knowledge

6.2.19 This is achieved through performance of the following practices.

Notes process> v practice	
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 organisation purchasing processes in general. For example, contracts management and purchasing, and provide and review HS requirements in invitations and tenders. In this case the 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 supplier towards addressing HS issues in the 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 which affect usability	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 product system. Assessment of both the product system development enterprise and the user organisation may be required. This process assessment is for the purpose of mitigating project risk regarding usability. 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 assessments questions asked b) look for required knowledge to understand and sign.

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

6.2.20 HS.2.4 Management of human-system issues

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

6.2.22 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 product system usability

6.2.23 This is achieved through performance of the following practices:

Notes process> v practice	This process is the HS life cycle application of a generic process. When using This 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, clause 5 *Planning the human-centred process*.
HS.2.4.BP1 Develop a plan to achieve and maintain usability throughout life	The plan specifies how and when HS activities integrate into the overall product system life cycle and how input from HS processes (based, for example, on those given in This specification) is used in the life cycle. Plans that address HS issues make allowance for iteration where necessary, they includes long term monitoring of the use of the product 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 organisational goals for the product system. Define reporting lines between personnel addressing HS issues in different parts of the organisation 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 to the life cycle methodology being followed for the product 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 product 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.2.4.BP3 Manage 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) 1.3 life cycle model (2) 2.1 schedule (5) 1.3 coding standard (10) 1.1 personnel policy (15) 2.1 project plan (17) 3.3 quality criteria (27)	2.1 project plan (17) 1.3 HS issue/project interface +(8) 1.2 job procedure, practice (4) 2.1 schedule (5) 2.1 work breakdown structure (6) 1.3 interface (8) 3.3 quality criteria (27) 3.2 corrective action (logs, plans, minutes) (97)

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

6.2.25 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.

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

6.2.27 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 product 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 product system usability

6.2.28 This is achieved through performance of the following practices.

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 product system effectiveness implications of a change in equipment usability in a manner that addresses the emergent properties of the product system.
HS.2.5.BP3 Evaluate the current severity of emerging threats to product 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.
HS.2.5.BP4 Take effective mitigation to address risks to product 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 product 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 test results (62) 3.2 problem report records (84) 3.4 customer satisfaction data (86) 3.2 change request (94) 3.2 assessment/audit records (29) 3.3 risk measure (40) 3.4 context of use analysis (111) 2.5 HF data (112)	3.2 risk analysis record/report (22) 1.4/2.1 risk management strategy/plan (23) 1.4 improvement opportunity (26) 3.3 risk measure (40) 3.2 change request (94) 3.2 corrective action (logs, plans, minutes) (97)

6.2.29 HS.2.6 User involvement

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

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

6.2.32 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 product system are reported back to the users

6.2.33 This is achieved through performance of the following practices:

Notes process> **v practice**	New systems often affect more people than is obvious at first. System output frequently crosses departmental and organisational boundaries. The real 'end user' may even be a member of the public. It is important then to recognise that the full range of users and other stakeholders are involved in the development process. These may 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 organisation who will purchase and use the new system. Users include maintainers.
HS.2.6.BP1 Advocate the user perspective	The user advocate reminds the staff in the product system development enterprise that the product system is intended for use by real people and has to achieve usability. Need management support to get this actioned. Identify human-system issues and aspects of the product system that require user input. 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. Identify certain individuals as key user representatives or user champions who are known to the development team.
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, users 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 product 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, 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.
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 product 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.

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 organisation 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 product 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. There should be 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.

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

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6.2.34 HS.2.7 Usability engineering integration

6.2.35 The purpose of the *Usability engineering integration* process is the facilitation of information exchange and communication regarding HS issues.

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

6.2.37 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 product 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

6.2.38 This is achieved through performance of the following practices:

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 product system design process are fed into the usability engineering process.
HS.2.7.BP1 Develop a common terminology for HS issues with the organisation	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 organisational 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 organisational maturity with respect to HS issues in the project and the organisation. 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 organisation. 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 product 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, 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 job procedure, practice (4) 2.1 schedule (5) 2.1 work breakdown structure (6) 1.3 interface (8) 1.3 coding standard (10)	1.2 communication mechanism (87) 1.4 Improvement opportunity (26) 1.3 interface (8) 1.3 coding standard (10)

6.2.39 HS.2.8 Develop and re-use HF data

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

6.2.41 The benefits include: HF data are used consistently.

6.2.42 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

6.2.43 This is achieved through performance of the following practices:

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 HAZOPs.
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	
HS.2.8 BP3 Produce coherent data standards and formats	
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 organisational learning regarding HS processes. EXAMPLE – Maintenance of a "Lessons learnt" database.
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	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, 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 organisational maturity in addressing HS issues.

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

6.3 HS.3 Usability engineering

6.3.1 The purpose of the *Usability engineering* process is to apply HS processes and HF data as appropriate in order to ensure the usability of the product system throughout its life cycle.

6.3.2 The benefits include: human characteristics will be taken into account in product 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 product system are addressed; safety risks occurring as a result of the product system functioning and being used and misused in a reasonably foreseeable manner are addressed; where appropriate special needs are explicitly considered.

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

- 1) the product 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 product system are known

Notes on the process	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 product systems are validated.

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

6.3.5 HS.3.1 Context of use

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

6.3.7 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 product system, including the factors that affect the performance of users, is described
- 3) the HS implications for the product system arising from the context of use are included in the product system constraints and requirements

6.3.8 This is achieved through performance of the following practices:

Notes process> v practice	This process is directly related to ISO 13407 clause 7.2 *Understand and specify the context of use*.
HS.3.1.BP1 Define the scope of the context of use for the product system	The scope is typically derived from the product system goals, the complexity of the working environment and the general type of product system. The scope will be determined by the granularity of the product 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 required detailed understanding of mission types and through-life accommodation requirements. There may be more than one context of use for a product 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 organisational activities (not in terms of equipment functions or features). Describe the activities (tasks) that users perform to achieve the intended user or organisational goals for the product system. Task descriptions will change during the life of the product system as the use of the product 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, anthopometrics, psychosocial issues, level of experience with job tasks and with systems equipment, motivations in using the system, priorities.
HS.3.1.BP4 Describe the cultural environment/organisational/management regime	Describe the real operational environment and the way that this shapes the role of the product system. Describe the worksystem as an entity and provide a context description for both the product system and the worksystem. The description may include *inter alia* the social and organisational milieu, management structure, communications and organisational practices, legislation.
HS.3.1.BP5 Describe the characteristics of any equipment external to the product 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.
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 product 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 product 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 product system concept, requirements, design and operation of the product 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 use of the product system.
HS.3.1.BP8 Present these issues to project stakeholders for use in the development or operation of the product 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 organisations, designer, evaluator, owner) needs to be able to gain enough information about the context of use to develop a design or evaluation which meets the product system requirements.

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

6.3.9 HS.3.2 User requirements

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

6.3.11 The benefits include: definition of the issues, constraints and opportunities related to human involvement with the product system (including: product 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 product system; setting of priorities for the requirements.

6.3.12 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 product 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 product system design

6.3.13 This is achieved through performance of the following practices:

Notes process> v practice	This process is directly related to ISO 13407 clause 7.3 *Specify user and organisational requirements*. User requirements include: ergonomics, user interface, workplace, habitation, training, support, procedures, jobs, recruitment, staffing structures.
HS.3.2.BP1 Set and agree the expected behaviour and performance of the product system with respect to the user	The user organisation may be considered as a single user. In the case of a generic product a single user may also be the user organisation. This can be stated in terms of the "total experience" of the users and/or the user organisation with the product system. The total experience covers critical aspects of a user's relationship with the product 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 product 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. 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 product system	The generation of the requirements of the user and the user organisation fits within with overall systems requirements capture activities. The requirements of the user and the user organisation define a large part of the operational and performance requirements for the product 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 product 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 worksystem. This may involve the development of a series of possible task allocations between the product 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.

HS.3.2.BP4 Generate and agree on measurable criteria for the product system in its intended context of use	Criteria are aligned to the acquisition boundaries and scope of supply for the product 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 organisation. There are criteria at all levels of system de-composition. These are elaborated in ISO/IEC 9126:2001 *Software product quality - quality model*. They range from the performance of the whole worksystem through to the detail of the user interface properties of the system. Examples of a usability criterion be “Use a roller ball interface device to select the correct item from a list within 3 seconds”, or "enter all data without any errors in 5 minutes". User interface properties include external attributes of the system such as learnability and consistency. ISO/IEC 9126 parts 2&3 provide a suitable list for software systems. Measurable criteria may be limited to some part of the product 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 product system criteria may be jointly owned by groups of users and stakeholders.
HS.3.2.BP5 Present these requirements to project stakeholders for use in the development and operation of the product 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 level of the system hierarchy. It is traditional to label these as “non functional” in order to clarify their relationship to particular elements of the product 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 document 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 document 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)

6.3.14 HS.3.3 Produce design solutions

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

6.3.16 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 product system (for example, jobs, roles, documentation, staffing) are designed
- 4) User input (direct and/or as feedback from evaluations) is incorporated in the design

6.3.17 This is achieved through performance of the following practices:

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 this will either be acquired or the shortfall will be managed as an HS issue. This process is directly related to ISO 13407 clause 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 organisational elements of the product system best able to fulfil each function	Analyse the context of use (especially the task information) and the required functions and performance of the product 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 product 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, organisational, 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 product system	Take context of use description and product 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 product 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 organisation. Communicate emerging design constraints 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 to the design engineers; system usage tasks 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 product system will be used	A description of the usage of the product system facilitates integrated development of the elements of a system by providing a link between technical, documentation, support, training and other elements of the product 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 product system, new HF data related to the use of the product system, 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 undressed issues for the product system.
Work products into process	**Work products out of process**

2.2 requirements specification (52) 2.5 context of use statement (110) 3.4 context of use analysis (111) 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)	2.3 system design/architecture (53) 1.3 interface (8) 1.3 coding standard (10)

6.3.18 HS.3.4 Human Factors evaluation

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

6.3.20 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 organisation has information on which to base a decision regarding one or more HS issues

6.3.21 This is achieved through performance of the following practices:

Notes process> **v practice**	This process is directly related to ISO 13407 clause 7.5 *Evaluate designs against requirements*. ISO/IEC 14598-3 Software product evaluation - Process for developers 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 *Product quality - Quality in use metrics* 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 product system, but may sometimes be carried out by human factors experts. The involvement of users is 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, 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 product 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 product system is fit for evaluation	Examine the components of the supplied product 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 organisational 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 product 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 the how parts of an organisation may make use of the results. In most cases the results will lead to a revision of the product 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)

6.4 HS.4 Human resources process

6.4.1 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.

6.4.2 The benefits include: the physical and cognitive capabilities required to be able to train for, operate, maintain and sustain the product 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 product system are defined and optimised; the HR strategy for the organisation adapts to changes in organisational needs and technical and operational context.

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

- 1) the users of the product system are stipulated, deployed and maintained within a given social environment throughout the life of the product system
- 2) the desired outcomes for the organisation are defined and promulgated
- 3) the operational, technical and organisational requirements of the systems employed by the organisation are used in staff development
- 4) individual and collective training requirements are reconciled with system requirements and desired outcome.

Notes on the process	A significant component of system usability is the result of the organisation acquiring the "right" people to use the system. This is most effectively done by recognising that the people "bits" process should run alongside or superordinate to system acquisition. Both people and system should be acquired in a planned process. These are the processes carried out by the user organisation in order to "fit the man to the machine". These processes are iterative.

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

6.4.5 HS.4.1 Human resources strategy

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

6.4.7 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 product 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 organisation.

6.4.8 This is achieved through performance of the following practices:

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, training development. Users may include teams. Skills means Knowledge, Skills and Attributes.	
HS.4.1.BP1 Decide the goals, behaviours and tasks of the organisation		
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 the HR strategy that gives the organisation a mechanism for implementing and recording lessons learnt		
HS.4.1.BP5 Feedback into future HR procurement, training and delivery strategies		
HS.4.1.BP6 Enable and encourage people and teams to work together to deliver the organisation's objectives		
Work products into process	**Work products out of process**	
	1.3 interface (8) 1.1 goal (12) 1.1 vision (13)	

6.4.9 HS.4.2 Define standard competencies and identify gaps

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

6.4.11 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 product 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.

6.4.12 This is achieved through performance of the following practices:

Notes process> **v practice**	Assess user goals and tasks towards overall product 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 as so they need tools/product systems to enable them to achieve these goal, hence they invest. Overall product 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	
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	

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)

6.4.13 HS.4.3 Design staffing solution and delivery plan

6.4.14 The purpose of the *Human resources evaluation* process is to deliver individual and collective training solutions reconciled to system requirements and desired outcomes.

6.4.15 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 task are commensurate with training and the skill set; user understanding of equipment capability is consistent with the goals of the organisation.

6.4.16 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 product system are integrated into staff development.

6.4.17 This is achieved through performance of the following practices:

Notes process> **v practice**	The HR process reminds the organisation that the product system will have to be manned, resourced, supported and maintained by an organisation. Staff will have to be developed to meet these roles. The staff using the system will need to work to any employment regulations, working hours restrictions and within an incentives framework. The organisation can also be reminded that the product system will eventually be disposed of and that this will involve human action.

6.4.18 HS.4.4 Evaluate product system solutions and obtain feedback

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

6.4.20 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.

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

- 1) the strengths and limitations of operation with the product system are described
- 2) contribution to product system operation and support provided locally by informal means are identified
- 3) operational data to support the safety management system are obtained

6.4.22 This is achieved through performance of the following practices:

Notes process> v practice	
HS.4.5.BP1 Develop a strategy for data gathering	
HS.4.5.BP2 Provide means for user feedback	
HS.4.5.BP3 Conduct assessments of usability	
HS.4.5.BP4 Interpret the findings	
HS.4.5.BP5 Validate the data	
HS.4.5.BP6 Check that the data are being used	

Work products into process	**Work products out of process**
1.1 goal (12) 2.5 staffed system (114) 2.5 users (115)	3.4 analysis result (21) 3.2 assessment /audit record (29) 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)

7 Annex A Work Products

7.1.1 Table A.1 presents the work product descriptions from the ISO/IEC TR 15504-5 Exemplar assessment model 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 defines the following numbering scheme for the classification of types of work product:

7.1.2 1. **Organisation** divided into: 1.1 policy, 1.2 procedure, 1.3 standard, 1.4 strategy

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

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

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

7.1.6 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 HSL model. Only six extended work products are defined for the HSL model (numbers 110 to 116). Most of the HS processes (the HSL 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.

7.1.7 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 15504-5.

7.1.8 Sector specific interpretations of this Specification may sub-divide and extend the work products and use the titles in common use in that sector. Sector specific interpretations of this Specification may include additional notes which elaborate and interpret work products for the type of product systems developed and operated in that sector. ISO 13407 describes a set of information types used and produced during user centred design.

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

Table A.1 — Work product characteristics

ID	Class	WP Type	WP Characteristics
1	1.2	Software development	-Identification of the approach/method used to develop software -Identification of the life cycle model (for example, waterfall, spiral, serial build) used to develop

ID	Class	WP Type	WP Characteristics
		methodology	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 uniquely identified -Each task 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
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 critical timing dependencies or sequence ordering
9	1.3	Standard	-Identification of who/what they apply to -Each requirement unique -Each requirement 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,	-Identifies the objective to be achieved -Identifies who is expected to achieve the goal -Identifies any incremental supporting goals -Identifies any conditions/ constraints

ID	Class	WP Type	WP Characteristics
		process)	-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
13	1.1	Vision	-Provides information on the overall strategy for the organizational unit, organization, or business -Is authorized at the highest level -Defines the main objectives to be achieved
14	1.1	Policy	-Authorized -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.
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

ID	Class	WP Type	WP Characteristics
			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
23	1.4/2.1	Risk management strategy / plan + (59)	-Project risks identified and prioritized -Mechanism to track the risk -Threshold criteria to identify when corrective action 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

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
36	3.3	Measure (general 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

ID	Class	WP Type	WP Characteristics
			-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)
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 -interfaces 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
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 resubmitted of the response -requirements with regard to the format of response

ID	Class	WP Type	WP Characteristics
48	1	Supplier proposal response (Response to RFPs)	-Defines the suppliers proposed solution -Defines the suppliers proposed delivery schedule -Identifies the coverage identification of 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.
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

ID	Class	WP Type	WP Characteristics
			-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
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 the design for each required system component consideration is given to things like: -memory/capacity requirements -hardware interfaces requirements -user interfaces requirements -external system interface requirements -performance requirements -commands 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
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

ID	Class	WP Type	WP Characteristics
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 installation activities at customers site were performed correctly -Identifies how to validate 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
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
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 -up-loading to appropriate software to (for example) files, folders, libraries.

ID	Class	WP Type	WP Characteristics
			-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 -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 customers 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

ID	Class	WP Type	WP Characteristics
			-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)
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) 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
88	1.4/2.1	Training strategy/plan + (16)	-Defines current staff capabilities -Defines the skills required -Outlines course available to achieve training goal

ID	Class	WP Type	WP Characteristics
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 -Courses 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 -Workstations requirements -Supporting software -Tools -Communication equipment -Disaster recovery plan
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

ID	Class	WP Type	WP Characteristics
			-The characteristics of the users -The social and cultural environment, organisational/management regime -The characteristics of equipment external to the product 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 product 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 fuller list of relevant entities in the user's environment)
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. (see the definition of users for the likely range of user roles)
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.

8 Annex B Purpose, structure and use of the human-system life cycle processes

8.1 Use of the model

8.1.1 This specification is intended to assist those who wish to make their system development process and its associated support processes more user centred, and to include knowledge from the human sciences in system design. It presents a definition of the processes that deliver usability. It lists their components, outcomes and the information used and produced.

8.1.2 This specification is intended for use by those developing life cycle process models. It provides a reference set of descriptions of HS processes for this purpose and requirements for conformant assessment models. This specification does not place further requirements on those developing process models. ISO/IEC TR 15504 *Software process assessment*, on which the format of the descriptions is based, gives further advice on the development of models for process assessment. Annex C of this specification contains an informative interpretation of the relevant clauses of ISO/IEC 15504 which may be used in the qualification of process assessment models which claim compatibility with the processes described in this specification.

8.2 Basis of the model

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

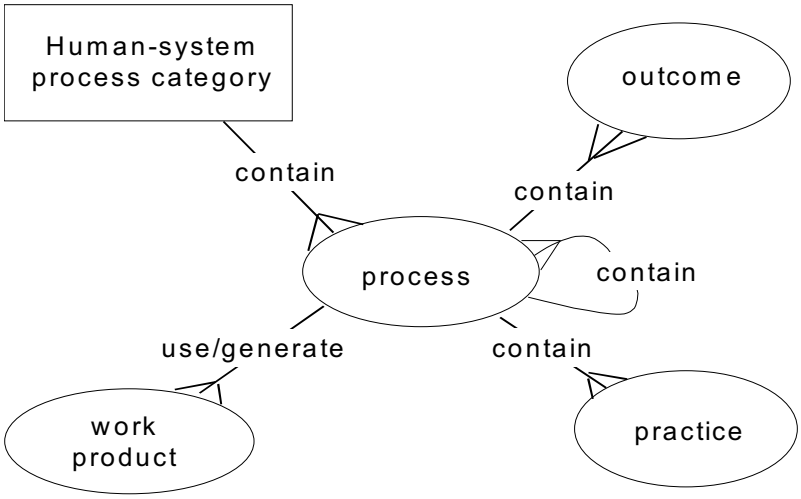
8.2.2 Processes should not be confused with the stages of a life cycle. Processes are enacted at more than one stage in the life cycle, and it may be useful to think of them as essentially continuous through the life cycle. The emphasis between the outcomes of a process will vary depending on the stage 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.

8.2.3 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.

8.3 Structure of the model

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

Figure B.1 — Entity relationship diagram of the model



8.3.2 The 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 TR 15504 Software process assessment or ISO/IEC 15288 System life cycle processes. This is mainly because of the number and variety of process models, but also to make more clear the treatment of the human factor in product systems and its implications for system life cycles. The model conforms to and extends ISO 13407 Human-centred design processes for interactive systems. 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.

8.4 Elements of the model

8.4.1 This 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 has 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).

8.4.2 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 single, generic sentence or phrases which are 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.

8.4.3 The processes in the model are linked as indicated in Annex F and, since user centred life cycles are iterative, they are likely to be instantiated more than once.

8.4.4 The core process is user centred design. HS.3 Usability engineering is where the work of user centred design is done. This comprises four types of technical activity. These processes generate information to inform the design and operation of a system.

8.4.5 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 organisation.

8.4.6 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.

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

8.4.8 User centred design is not performed in isolation. Human-system life cycle 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 organisation. HS.2 deals with how and when to call up and resource of 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 organisation which perform the various processes. HS.2.1 is performed at, or on behalf of senior levels in an organisation 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.

8.4.9 The allocation of HSL 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 product system being developed; the interface to organisational support depends on the organisation's maturity with respect to HS issues.

8.4.10 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. Figure 1 (in the Introduction to this standard) attempts to convey the cyclical nature of the HSL processes and their linking for a product system.

8.4.11 The main technical processes during system development are HS.3 which 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 product system development enterprise and those of the client user organisation. HS.2 & HS.4 also connect HF into the higher management and organisational processes within an organisation. 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 & HS.1.4 are concerned with the use of the system. They connect the human resources and usability engineering processes to the support phase of the system life cycle.

8.4.12 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.

8.5 Relationship between this model and ISO 13407

8.5.1 ISO 13407 Human-centred design processes for interactive systems is the standard produced by ISO TC159/SC4/WG6 that explains the benefits achieved by making the interactive systems life cycle more user centred. It introduces and describes the required processes. The life cycle process model presented in This specification is a structured, formalised and extended definition of the human-centred processes described in ISO 13407. This specification is intended to make the contents of ISO 13407 accessible to process assessment and improvement specialists and to those familiar with or involved in process modelling. This specification extends the range of processes in ISO 13407 to cover the integration of human-centred design with project and organisational processes and makes a clearer separation between human-centred processes and human-centred design in the system life cycle. A mapping between this specification and ISO 13407 is provided in Annex F.

8.6 Relationship between this model and ISO/IEC 15504

8.6.1 ISO/IEC 15504 Process assessment presents a standard for process capability determination. It defines a normative approach to the assessment of process maturity. The processes presented in This specification conform to ISO/IEC 15504 requirements for variant processes. A mapping between the processes in ISO/IEC 15504 and this specification is provided in Annex H.

8.6.2 Those familiar with process maturity models will observe that the HSL model differs from generic models in that some processes are enacted at particular stages in a life cycle and there is a requirement for the life cycle to have certain attributes, such as the ability to iterate (particularly during the design of the system). These requirements arise from the technical necessities of a life cycle which takes account of stakeholder and organisational requirements. Early in system development these requirements cannot be specified fully for a system throughout its entire life. 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.

8.6.3 ISO/IEC 15504 describes two types of practice base and management. The majority of processes in this 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 the last section of annex C.

8.7 Relationship between this model and ISO/IEC 15288

8.7.1 ISO/IEC 15288 System life cycle processes presents a standard for the processes required to develop systems. This specification contains a formal description of HSL processes and adds processes that may be used to extend the requirements 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 specification and ISO/IEC 15288 is provided in Annex I.

8.8 B.8 Relationship of this model to military and industrial guidance on Human Factors Integration

8.8.1 There is a considerable body of HF and HS-related guidance that has been produced for military and industry applications. The US Department of Defense has a set of

guidance documents relating to their MANPRINT and HSI initiatives. The UK MOD 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 HSL 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.

8.8.2 The process model complements the HFI domains. The process model describes what is to be done, while the domains describe the scope of application. The HFI domains are as follows:

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

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

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

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

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

8.8.8 **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.

8.8.9 **Survivability** Enhancement of the service survivability of all personnel regardless of military skills of location.

9 Annex C ISO/IEC 15504 Capability attributes and practices

9.1 A scale of process capability

9.1.1 This section presents an overview of the ISO/IEC 15504 model for the management and organisational quality activities which are carried out in the enactment of any technical process, for example those given in the body of this standard. The model has six levels of capability:

- Level 0 Incomplete
- Level 1 Performed
- Level 2 Managed
- Level 3 Established
- Level 4 Predictable
- Level 5 Optimising

9.1.2 At level 0, the organisation is not able to carry out the process. At level 1, individuals carry out processes. At level 2, the quality, time and resource requirements for the process are known and l R, t g ' J M K M

9.2 Level 0: Incomplete process

9.2.1 The process is not implemented, or fails to achieve its process outcomes. There are no attributes at this level.

9.3 Level 1: Performed process

9.3.1 The implemented process achieves its process outcomes. The following attributes of the process demonstrate the achievement of this level:

9.3.2 PA1.1 Process performance attribute

9.3.3 The extent to which the process achieves its outcomes by transforming input work products to output work products. The outcomes related to this attribute are the definition of the scope of work and work products, and the production of relevant work products. The related management practices to achieve this process attribute are:

9.3.4 MP1.1.1 Identify input and output work products.

9.3.5 MP1.1.2 Ensure that the scope of work is identified

9.3.6 MP1.1.3 Ensure that base practices are implemented

9.3.7 Integration attribute

9.3.8 Integration of processes is not addressed in existing maturity scales. However, it is an important issue for process assessment and may be included informally. There are at least two ways to assess if processes integrate:

- delivery did you do the delivery process and was there change?
- or receipt did you get the information and make changes?

9.3.9 The use of the plan-do-check-act cycle as the basis for drafting the base practices in the HSL model implies that to achieve level 1 a process has to integrate with the processes that bring about changes based on the work products provided by the practice.

9.4 Level 2: Managed process

9.4.1 The Performed process delivers work products of expected quality within defined time-scales and resource needs. The following attributes of the process demonstrate the achievement of this level:

9.4.2 PA2.1 Performance management attribute

9.4.3 The extent to which the process is managed to produce work products within stated time and resource requirements. The outcomes related to this attribute are identification of objectives for the performance of the work, assignment of responsibility and authority, and management to meet the defined performance objectives. The related management practices are:

9.4.4 MP2.1.1 Identify the objectives

9.4.5 MP2.1.2 Plan the performance of the process

9.4.6 MP2.1.3 Plan and assign the responsibility and authority

9.4.7 MP2.1.4 Manage the execution of the activities

9.4.8 PA2.2 Work product management attribute

9.4.9 The extent to which work products are documented and controlled to meet their functional and non-functional requirements. The outcomes related to this attribute are definition of the requirements for work products, the definition of the quality of work products, the interrelationships of the work products, configuration management of work products verification and rework of work products. The related management practices are:

9.4.10 MP2.2.1 Identify requirements

9.4.11 MP2.2.2 Manage the documentation, configuration management, and change control of the work products.

9.4.12 MP2.2.3 Identify and define work product dependencies

9.4.13 MP2.2.4 Manage the quality of work products

9.5 Level 3: Established process

9.5.1 The extent to which the Managed process deploys a defined process based upon good software engineering principles and capable of achieving its process outcomes. The following attributes of the process demonstrate the achievement of this level:

9.5.2 PA3.1 Process definition attribute

9.5.3 The extent to which the process contributes to the defined business goals of the organisation through definition of a standard process. The outcomes related to this attribute are definition and tailoring of a standard process, use of defined process documentation, understanding of process behaviour, refinement of the standard process based on understanding. The related management practices are:

9.5.4 MP3.1.1 Identify the standard process

9.5.5 MP3.1.2 Implement and/or tailor the standard process

9.5.6 MP3.1.3 Gather process performance data

9.5.7 MP3.1.4 Establish and refine the understanding of process behaviour

9.5.8 MP3.1.4 Refine the standard process

9.5.9 PA3.2 Process resource attribute

9.5.10 The extent to which the process contributes effectively to the defined business goals of the organisation through use of suitable, skilled human resources and process infrastructure. The outcomes related to this attribute are defined roles, responsibilities and competencies, defined process infrastructure and provision of defined resources to

a process. The related management practices are:

9.5.11 MP3.2.1 Identify and document the roles, responsibilities and competencies

9.5.12 MP3.2.2 Identify and document process infrastructure requirements

9.5.13 MP3.2.3 Provide allocate and use the resources

9.5.14 MP3.2.4 Provide allocate and use an adequate process infrastructure

9.6 Level 4: Predictable process

9.6.1 The Established process is performed consistently within defined control limits to achieve its outcomes. The following attributes of the process demonstrate the achievement of this level:

9.6.2 PA4.1 Measurement attribute

9.6.3 The extent to which goals and measures are used to ensure that implementation of the process contributes to the achievement of the goals. The outcomes related to this attribute are alignment of metrics with business goals, quantitative monitoring, analysis of performance trends, measurement and maintenance of organisational process capability. The related management practices are:

9.6.4 MP4.1.1 Identify product and process goals and measures

9.6.5 MP4.1.2 Collect the specified product and process measures

9.6.6 MP4.1.3 Analyse trends in the performance of the process

9.6.7 MP4.1.4 Measure the process capability

9.6.8 PA4.2 Process control attribute

9.6.9 The extent to which reliable achievement of the defined process goals is achieved through collection and analysis of measures to control and correct the performance of the process. The outcomes related to this attribute are identification of analysis and control techniques, maintenance of process performance within measured limits, quantitative management. The related management practices are:

9.6.10 MP4.2.1 Identify suitable measurement techniques

9.6.11 MP4.2.2 Collect measures and identify process control parameters

9.6.12 MP4.2.3 Control the process performance using the analysis measures

9.7 Level 5: Optimising process

9.7.1 The Predictable process now dynamically changes and adapts to meet relevant current and projected business goals effectively. The following attributes of the process demonstrate the achievement of this level:

9.7.2 PA5.1 Process change attribute

9.7.3 The extent to which the business goals of the organisation are achieved through changes in the definition, management and performance of the process. The outcomes related to this attribute are impact assessment of process changes, process change management, effectiveness of change evaluated. The related management practices are:

9.7.4 MP5.1.1 Identify and approve changes to the standard process definition

9.7.5 MP5.1.2 Assess the impact of all proposed changes

9.7.6 MP5.1.3 Define an implementation strategy for the approved change

9.7.7 MP5.1.4 Implement the approved changes

9.7.8 MP5.1.5 Evaluate the effectiveness of process change

9.7.9 PA5.2 Continuous improvement attribute

9.7.10 The extent to which continuous improvement in the fulfilment of the defined business goals of the organisation is ensured through changes to the process. The outcomes related to this attribute are that process improvement goals support business goals, sources of problems are identified, opportunities are identified, process improvement goals will be established across the organisation. The related management practices are:

9.7.11 MP5.2.1 Define the process improvement goals for the process

9.7.12 MP5.2.2 Analyse the source of real and potential problems in the current process

9.7.13 MP5.2.3 Implement changes to selected areas of the tailored process according to the implementation strategy

9.7.14 MP5.2.4 Validate the effectiveness of process change

9.8 Maturity of HSL processes and practices

9.8.1 Some of the processes within the model contain practices that require or imply a level of process maturity above level 1. These are listed below.

Process	Practice	Practice name	Level	Notes
HS.2.1 HS issues in business strategy	all		4	Alignment of metrics to business goals is part of the evidence for a predictable process.
HS.2.2 HS issues in quality management	HS.2.2.BP2	Include human-centred elements in support and control procedures	2 or 3	This process as a whole could apply at a project level (where HS processes come under project quality management and procedures) or at an organisational level where HS processes would be explicitly incorporated into the organisation's procedures.
	HS.2.2.BP4	Define and maintain HCD infrastructure and resources.	3	Full achievement of this practice is an indicator that the process is established.
	HS.2.2.BP5	Develop or provide staff with suitable HF and HCD skills	3	Full achievement of this practice is an indicator that the process is established.
HS.2.3 HS issues in authorisation and control	HS.2.3.BP3	Assess and improve HS capability in processes which affect usability	4	Assessment of process capability is part of the evidence for a predictable process.

HS.2.4 Management of HS issues	all		2	Full achievement of all practices is an indicator of managed HSL processes.
HS.2.5 HF data in trade-off and risk mitigation	HS.2.5.BP4	Take effective mitigation to address risks to usability	4 or 5	Evaluation of the effectiveness of the use of HF data in achieving organisational goals is a level 4 activity. Adaptation of HS processes based on identified threats is a level 5 maturity activity.
HS.2.7 Usability engineering integration	HS.2.7.BP3	Identify and use the most suitable data formats for exchanging HF data	3	Full achievement of this practice is an indicator that the process is established.

10 Annex D Use of the human-system life cycle processes

10.1 Use of the model in process definition

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

10.1.2 The recommended approach is for the organisation to set up a process to define its needs for such a life cycle. The outcomes of the processes in this model (and other models) are compared with the needs for this life cycle. The processes in this specification can be used as input at this stage. The first part of each of the process descriptions given in section 6 describes the outcomes of the process.

10.1.3 The next step is to define a life cycle which implements and integrates the practices to the required level to achieve the business purposes of the organisation, department or project. The practices and work products from each process are given in tables for each process in section 6. The lists of work products assist in the definition of the life cycle.

10.1.4 More detailed information on many of the practices is provided in ISO 13407 Human-centred design processes for interactive systems. Advice on the particular methods which implement the practices is available from textbooks and human factors service providers.

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

10.2 Use of the HSL model in process improvement

10.2.1 The HS processes, the practices and the work products provide a description of how organisations carry out activities which take account of user issues. Part 2 of ISO/IEC 15504 Process assessment presents a number of levels of maturity with regard to these processes. These are presented in Annex C of this specification. These descriptions can be used in setting the agenda and goals for improvement of human-centredness in systems development. The management practices provide a description of what is required in order to take the next step in increasing the maturity of the organisation with respect to its human-centredness.

10.2.2 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 organisation to define a desired profile of performance in human-system processes based on their business need. The scope of initial and monitoring assessments is then designed to match that profile.

10.3 Use of the HSL model in process assessment

10.3.1 Scoping the use of the HSL model

10.3.2 This specification presents a hierarchical, three-process model in which the activities carried out to promote, support, manage and integrate HS processes (HS.2) are described in a layered fashion from the management of human factors data and the day to day facilitation by the person responsible for the usability of a product through ensuring that users are involved through ensuring that the risks from and to the use of the product system are made obvious through the consideration of HS issues in sign-off and approvals, through management of HS processes for a project through to the support/infrastructure activities for HS processes to usability in the organisation's business strategy level. Activities to perform HCD and HR are in technical groups (HS.3 & 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 represent the key issues to ask projects. Each of these processes addresses a particular issue or view on the handling of HS issues. One or more of these viewpoints may be paid specific attention when tailoring the model for a particular assessment. HS.2 assessments may be applied to the facilitation of any specialist engineering activity in the system life cycle.

10.3.3 The model is efficient to use in assessment since an organisation can be interviewed without completely contextualising the usability and HS issues in terms of a project. This is based on assessor experience that interviews with process owners, managers and technical staff tend to range across projects to make comparisons for clarity. This presents a recording problem, but 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 organisation). 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 product system project concentrates on one process, depending on where it is in the life cycle. It would of course be possible to investigate all 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 increase its coverage very considerably.

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

10.3.5 Process assessment procedure

10.3.6 The model presented in This specification can be used in the assessment of an organisation’s capability to carry out the HS processes described in the model. The intended assessment process is that defined in ISO/IEC 15504 Process assessment. The reader is referred to ISO/IEC 15504-2 Performing an assessment for details of the qualification of assessors, quality processes associated and other groups associated with assessments.

10.3.7 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 which is likely to be observed. The processes selected are be representative of the activities carried out by the organisation. 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 organisation for the purpose of process risk assessment or

process improvement. The benefit to the organisation is only realised if the model is tailored to suit the purposes of the assessee. Processes and practices are selected for assessment if the organisation wishes to know how well that particular activity is carried out. If it is not important to the business that a particular process is performed well then there is no need to assess it.

10.3.8 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 which it considers necessary are performed to the level it requires. In this case the processes to be covered are defined by the client.

10.3.9 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 organisation.

10.3.10 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 performance of the management practices in ISO/IEC 15504 *Process assessment*. These management practices are summarised in Annex C. Annex A provides descriptions of HS work products which might be requested as evidence of the performance of the practices.

10.3.11 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.

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

10.3.13 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.

10.3.14 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.

10.3.15 Rate each practice for each interviewee on a scale of N to F where:

- N Not achieved: There is no evidence of achievement of the defined practice.
- P Partially achieved: There is some achievement of the defined practice.

- L Largely achieved: There is significant achievement of the defined practice.

- F Fully achieved: There is full achievement of the defined practice.

10.3.16 It is advisable to use a pre-prepared paper form or a computer-based tool to calculate the rating of each process in the organisation 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 organisation. 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.

10.3.17 HS processes plus other models

10.3.18 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 organisation or department which develops or supports systems that gain business benefit from meeting the needs of their users.

10.3.19 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 human factors expert 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 that some of the practices in HS.3.3 & 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 & HS.3.2 are enacted during the support of a system.

10.3.20 Use of the model in informal assessment

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

10.3.22 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 management practices are performed is retained, but the scoring need not be introduced or, if it is, the assessment as to whether attributes are performed 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.

10.3.23 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 so as to promote awareness and organisational learning. In informal assessment a group may assess itself and retain the results for comparison with their next discussion or project; improvement actions can still be planned and responsibility for making changes

can be assigned.

10.3.24 Use of the model in process risk assessment

10.3.25 In the case of risk assessment the preparation is as described above, 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.

11 Annex E Mapping between processes in This specification

11.1 Dot diagram mapping between HSL processes

11.1.1 This diagram indicates the links between processes in the HSL model. Three types of relationship are indicated: **G**roup (where a group of processes are likely to be performed in concert, **U**ses (where one process requires the enactment of another), and **S**imilarity (where a process is similar to another process in either type or outcome). Two levels of demand are indicated. UPPERCASE indicates a strong (necessity) link. lowercase indicates a weak (optional or partial) link. The diagram is intended to be read from left to right, i.e. the relationship is from the process in the vertical list of process names to the process listed across the top of the table.

HS.1 Life cycle involvement	**HS.2 Integrate human factors**	**HS.3 Usability engineering**	**HS.4 Human resources**
HS.1.1 HS issues in conception HS.1.2 HS issues in development HS.1.3 HS issues in production and utilization HS.1.4 HS issues in utilization and support HS.1.5 HS issues in retirement	HS.2.1 HS issues in business strategy HS.2.2 HS issues in quality management HS.2.3 HS issues in authorisation and control HS.2.4 Management of HS issues HS.2.5 HF data in trade-off and risk mitigation HS.2.6 User involvement HS.2.7 Usability engineering integration HS.2.8 Develop and re-use HF data	HS.3.1 Context of use HS.3.2 User requirements HS.3.3 Produce design solutions HS.3.4 Human Factors evaluation	HS.4.1 Human resources strategy HS.4.2 Define standard competencies and identify gaps HS.4.3 Design staffing solution and delivery plan HS.4.4 Evaluate product system solutions and obtain feedback

V HS HS >	**1**	**.1**	**.2**	**.3**	**.4**	**.5**	**2**	**.1**	**.2**	**.3**	**.4**	**.5**	**.6**	**.7**	**.8**	**3**	**.1**	**.2**	**.3**	**.4**
1 Life cycle																				
1.1					**u**	**u**		**U**				**u**	**U**		**u**		**U**	**U**	**U**	**U**
1.2									**U**	**u**	**U**	**U**	**U**	**u**	**u**		**u**	**u**	**U**	**U**
1.3											**U**	**U**	**U**				**u**	**u**	**u**	**U**
1.4								**u**		**u**		**U**	**U**		**u**		**u**	**u**	**u**	**U**
1.5										**u**	**u**	**U**	**U**		**U**		**u**	**U**	**u**	**U**
2 Integrate HF																				
2.1		**u**			**u**									**u**	**u**		**u**			**U**
2.2						**U**		**u**		**u**	**u**				**u**					
2.3		**U**						**U**			**u**	**U**		**u**	**u**		**u**	**u**		**U**
2.4								**U**	**u**				**u**		**u**					
2.5								**u**			**u**		**U**	**u**	**u**		**u**	**u**		**U**
2.6									**u**					**u**						
2.7								**u**	**u**		**u**				**U**		**u**	**u**	**u**	**u**
2.8			**u**		**u**	**u**			**u**				**U**				**U**	**u**	**u**	**U**
3 Usability engineering																				
3.1									**u**				**U**	**u**	**u**					
3.2									**u**		**u**		**U**	**u**	**U**					**u**
3.3									**u**			**u**	**U**	**u**	**U**		**u**			**u**
3.4									**u**		**u**		**U**	**u**	**U**		**u**			
4 Human resources																				
4.1		**G**							**s**											
4.2			**G**															**S**		
4.3				**G**	**G**	**G**												**s**	**S**	
4.4				**G**	**G**								**U**							**U**

11.2 Dot diagram mapping between HSL processes and work products

11.2.1 This diagram summarises the use and production of work products by processes in the HSL model. Four types of relationship are indicated: **C**reate, **R**ead or use, **U**pdate, detail or extend, **D**elete (not used in this version). Combinations are indicated by use of more than one code. Alternatives are indicated by a slash (/) between the codes.

HS.1 Life cycle involvement	**HS.2 Integrate human factors**	**HS.3 Usability engineering**	**HS.4 Human resources**
HS.1.1 HS issues in conception HS.1.2 HS issues in development HS.1.3 HS issues in production and utilization HS.1.4 HS issues in utilization and support HS.1.5 HS issues in retirement	HS.2.1 HS issues in business strategy HS.2.2 HS issues in quality management HS.2.3 HS issues in authorisation and control HS.2.4 Management of HS issues HS.2.5 HF data in trade-off and risk mitigation HS.2.6 User involvement HS.2.7 Usability engineering integration HS.2.8 Develop and re-use HF data	HS.3.1 Context of use HS.3.2 User requirements HS.3.3 Produce design solutions HS.3.4 Human Factors evaluation	HS.4.1 Human resources strategy HS.4.2 Define standard competencies and identify gaps HS.4.3 Design staffing solution and delivery plan HS.4.4 Evaluate product system solutions and obtain feedback

WP ID	**HS.1 Life cycle involvement**					**HS.2 Integrate Human Factors**								**HS.3 Usability engineering**				**HS.4 Human Resources**			
	.1	**.2**	**.3**	**.4**	**.5**	**.1**	**.2**	**.3**	**.4**	**.5**	**.6**	**.7**	**.8**	**.1**	**.2**	**.3**	**.4**	**.1**	**.2**	**.3**	**.4**
1	**U**						**R**														
2							**C**		**R**			**R**									
4									**C**			**R**									
5									**C U**			**R**									
6									**C**			**R**									
7													**C U**								
8									**C**			**C U**				**C**		**C**		**C**	
9							**R**						**r**								
10							**U**		**R**			**U**				**U**					
12	**R**	**R**	**R**	**R**	**R**	**C**		**R**										**C**	**R**		**R**
13						**C**	**R**											**C**	**R**		
14							**C**	**R**	**R**												
15	**C**						**U**		**U**										**C**	**R**	
16																					
17									**R U**												
21			**C**	**C**	**C**						**C**				**C**	**R**	**C**		**C**		**C**
22										**U**	**C**										
23										**U/ c**											
24							**U**														
26	**C**	**C**	**C**	**C**	**C**		**C**					**C**									
27							**C**	**R**	**U**						**U**		**R**				
29								**C**													**C**
30											**C**										
31											**C**										
36																					
40				**U**						**C U**			**C**								

HS.1 Life cycle involvement	HS.2 Integrate human factors	HS.3 Usability engineering	HS.4 Human resources
HS.1.1 HS issues in conception HS.1.2 HS issues in development HS.1.3 HS issues in production and utilization HS.1.4 HS issues in utilization and support HS.1.5 HS issues in retirement	HS.2.1 HS issues in business strategy HS.2.2 HS issues in quality management HS.2.3 HS issues in authorisation and control HS.2.4 Management of HS issues HS.2.5 HF data in trade-off and risk mitigation HS.2.6 User involvement HS.2.7 Usability engineering integration HS.2.8 Develop and re-use HF data	HS.3.1 Context of use HS.3.2 User requirements HS.3.3 Produce design solutions HS.3.4 Human Factors evaluation	HS.4.1 Human resources strategy HS.4.2 Define standard competencies and identify gaps HS.4.3 Design staffing solution and delivery plan HS.4.4 Evaluate product system solutions and obtain feedback

WP ID	HS.1 Life cycle involvement					HS.2 Integrate Human Factors								HS.3 Usability engineering				HS.4 Human Resources			
	.1	.2	.3	.4	.5	.1	.2	.3	.4	.5	.6	.7	.8	.1	.2	.3	.4	.1	.2	.3	.4
41			C	C																	
42		C		U																	
43	C					R															
44	R U														R						
45	U/ c																				
46	C U					R															
47								U C													
48								R													
49								R													
51								U C													
52		U												R	C	R	R				
53		U														C	R				
59																	U/ c				C
60																	C				C
61																	C				C
62																R	C				C
68			C																		
69			C																		
73		C	R											R							
74			C																		
75			C																		
81			C																		
82				C																	
83	R			C																	
84		R	C	C																	
85			C	C																	
86			C	C	R																
87												C									
88			C	R																C	
89				U										R						C	
90			C																		
94										U											
97									C	C											

HS.1 Life cycle involvement	HS.2 Integrate human factors	HS.3 Usability engineering	HS.4 Human resources
HS.1.1 HS issues in conception HS.1.2 HS issues in development HS.1.3 HS issues in production and utilization HS.1.4 HS issues in utilization and support HS.1.5 HS issues in retirement	HS.2.1 HS issues in business strategy HS.2.2 HS issues in quality management HS.2.3 HS issues in authorisation and control HS.2.4 Management of HS issues HS.2.5 HF data in trade-off and risk mitigation HS.2.6 User involvement HS.2.7 Usability engineering integration HS.2.8 Develop and re-use HF data	HS.3.1 Context of use HS.3.2 User requirements HS.3.3 Produce design solutions HS.3.4 Human Factors evaluation	HS.4.1 Human resources strategy HS.4.2 Define standard competencies and identify gaps HS.4.3 Design staffing solution and delivery plan HS.4.4 Evaluate product system solutions and obtain feedback

WP ID	HS.1 Life cycle involvement					HS.2 Integrate Human Factors								HS.3 Usability engineering				HS.4 Human Resources			
	.1	.2	.3	.4	.5	.1	.2	.3	.4	.5	.6	.7	.8	.1	.2	.3	.4	.1	.2	.3	.4
104		C					U														
107		C																			
108														R					C	U	
109								C													
110											R			C	R	R	R U				
111	C									R				C	R	R	R				
112	R									R			C U		R	R	R				
113			C																		
114																				C	U
115											R									C	U
116													C U	R							

12 Annex F Mapping to ISO 13407 *Human-centred design processes for interactive systems*

12.1 Dot diagram mapping clauses in ISO 13407 to HSL processes

12.1.1 The viewpoint presented in HS.4 is not explicitly addressed by ISO 13407.

HS.1 Life cycle involvement	**HS.2 Integrate human factors**	**HS.3 Usability engineering**
HS.1.1 HS issues in conception HS.1.2 HS issues in development HS.1.3 HS issues in production and utilization HS.1.4 HS issues in utilization and support HS.1.5 HS issues in retirement	HS.2.1 HS issues in business strategy HS.2.2 HS issues in quality management HS.2.3 HS issues in authorisation and control HS.2.4 Management of HS issues HS.2.5 HF data in trade-off and risk mitigation HS.2.6 User involvement HS.2.7 Usability engineering integration HS.2.8 Develop and re-use HF data	HS.3.1 Context of use HS.3.2 User requirements HS.3.3 Produce design solutions HS.3.4 Human Factors evaluation

V 13407 HS >	**1**	**.1**	**.2**	**.3**	**.4**	**.5**	**2**	**.1**	**.2**	**.3**	**.4**	**.5**	**.6**	**.7**	**.8**	**3**	**.1**	**.2**	**.3**	**.4**
5 Principles of HCD																				
5.2 involvement of users													•							
5.3 allocation of function																			•	
5.4 iteration											•									
5.5 multi-disciplinary teams											•									
6 Planning HCD process											•									
7 HCD activities																				
7.2 understand context		•															•			
7.3 specify requirements		•	•															•		
7.4 design solutions			•										•						•	
7.5 evaluate designs			•	•	•															•

13 Annex G Mapping to ISO TR 18529 *Human-centred life cycle process descriptions*

13.1 Dot diagram mapping clauses in ISO 18529 to HSL processes

13.1.1 The viewpoint presented in HS.4 is not explicitly addressed by ISO 18529.

HS.1 Life cycle involvement	**HS.2 Integrate human factors**	**HS.3 Usability engineering**
HS.1.1 HS issues in conception	HS.2.1 HS issues in business strategy	HS.3.1 Context of use
HS.1.2 HS issues in development	HS.2.2 HS issues in quality management	HS.3.2 User requirements
HS.1.3 HS issues in production and utilization	HS.2.3 HS issues in authorisation and control	HS.3.3 Produce design solutions
	HS.2.4 Management of HS issues	HS.3.4 Human Factors evaluation
HS.1.4 HS issues in utilization and support	HS.2.5 HF data in trade-off and risk mitigation	
	HS.2.6 User involvement	
HS.1.5 HS issues in retirement	HS.2.7 Usability engineering integration	
	HS.2.8 Develop and re-use HF data	

v 18529 HS >	**1**	**.1**	**.2**	**.3**	**.4**	**.5**	**2**	**.1**	**.2**	**.3**	**.4**	**.5**	**.6**	**.7**	**.8**	**3**	**.1**	**.2**	**.3**	**.4**
HCD1		•			•			•												
HCD2									•		•		•							
HCD3		•	•															•		
HCD4																	•			
HCD5			•																•	
HCD6		•	•	•	•															•
HCD7		•			•															

14 Annex H Mapping to the ISO/IEC TR 15504 *Software process assessment process model*

14.1 Dot diagram mapping clauses in ISO/IEC TR 15504 Part 2 and amendment to HSL processes

14.1.1 This diagram indicates affinities between the processes in the HSL model and the processes in the exemplar software life cycle process model in ISO/IEC TR 15504. It should not be taken to imply a one-to-one mapping between the processes in the two models. This is in part because of the need to contextualise processes within an organisation and a project and in part because the models address different aspects of systems. The diagram is intended to suggest a starting point for development of a joint model for a particular assessment or organisation. Depending on the importance of HS issues in a particular application more or less HS processes than those indicated may be relevant. An affinity in general means that the process described is the most relevant to address the HS issues that should be addressed as part of enactment of the ISO/IEC 15504 process. A dot indicates an affinity. A dot in braces indicates a possible relationship. Some affinities would only be relevant when assessing for levels of maturity above level 1.

14.1.2 The viewpoint presented in HS.4 is not explicitly addressed by ISO/IEC 15504.

HS.1 Life cycle involvement	**HS.2 Integrate human factors**	**HS.3 Usability engineering**
HS.1.1 HS issues in conception HS.1.2 HS issues in development HS.1.3 HS issues in production and utilization HS.1.4 HS issues in utilization and support HS.1.5 HS issues in retirement	HS.2.1 HS issues in business strategy HS.2.2 HS issues in quality management HS.2.3 HS issues in authorisation and control HS.2.4 Management of HS issues HS.2.5 HF data in trade-off and risk mitigation HS.2.6 User involvement HS.2.7 Usability engineering integration HS.2.8 Develop and re-use HF data	HS.3.1 Context of use HS.3.2 User requirements HS.3.3 Produce design solutions HS.3.4 Human Factors evaluation

v 15504 HS >	**1**	**.1**	**.2**	**.3**	**.4**	**.5**	**2**	**.1**	**.2**	**.3**	**.4**	**.5**	**.6**	**.7**	**.8**	**3**	**.1**	**.2**	**.3**	**.4**
ACQ acquirer category																				
ACQ.1 policy								•												
ACQ.2 strategy								•												
ACQ.3 benefits					•															
ACQ.4 technical reqts.		(•)							•											
ACQ.5 leg and admin reqts.		(•)								•										
ACQ.6 financial reqts.										•										
ACQ.7 project reqts.			(•)								•									
ACQ.8 request proposals			(•)							•								•		
ACQ.9 supplier qualif.			(•)							•										
ACQ.10 proposal evaln.			(•)							•										
ACQ.11 contract estab.			(•)							•										
ACQ.12 supplier monitoring			(•)	(•)						•										•

HS.1 Life cycle involvement	HS.2 Integrate human factors	HS.3 Usability engineering
HS.1.1 HS issues in conception	HS.2.1 HS issues in business strategy	HS.3.1 Context of use
HS.1.2 HS issues in development	HS.2.2 HS issues in quality management	HS.3.2 User requirements
HS.1.3 HS issues in production and utilization	HS.2.3 HS issues in authorisation and control	HS.3.3 Produce design solutions
HS.1.4 HS issues in utilization and support	HS.2.4 Management of HS issues	HS.3.4 Human Factors evaluation
HS.1.5 HS issues in retirement	HS.2.5 HF data in trade-off and risk mitigation	
	HS.2.6 User involvement	
	HS.2.7 Usability engineering integration	
	HS.2.8 Develop and re-use HF data	

v 15504 HS >	**1**	**.1**	**.2**	**.3**	**.4**	**.5**	**2**	**.1**	**.2**	**.3**	**.4**	**.5**	**.6**	**.7**	**.8**	**3**	**.1**	**.2**	**.3**	**.4**
ACQ.13 acceptance				(•)						•										•
ACQ.14 contract closure				(•)						•										
ACQ.15 supplier relations.										•			•	•						
ACQ.16 user relationship			(•)	(•)						•			•	•						
ACQ.17 financial mgmt.			(•)	(•)						•										
CUS customer/supplier																				
CUS.1 acquisition (obs.)																				
CUS.2 supply			•							•										
CUS.3 requirements elicitn		•								•										
CUS.4 operate																				
CUS.4.1 operational use				•						•										
CUS.4.2 customer support				•						•										
ENG engineering																				
ENG.1 development			•	•																
ENG.1.1 sys reqts analysis and design																	•	•	•	
ENG.1.2 s/w reqts analysis																			•	
ENG.1.3 s/w design																			•	
ENG.1.4 s/w construction																				
ENG.1.5 s/w integration																				
ENG.1.6 s/w testing																				•
ENG.1.7 sys int. & testing				•																•
ENG.2 sys & s/w maint.					•	•														
SUP support					•															
SUP.1 documentation									•					•						
SUP.2 config. mgmt.																				
SUP.3 quality assurance											•									•
SUP.4 verification																				•
SUP.5 validation																				•
SUP.6 joint review													•							
SUP.7 audit									•											

HS.1 Life cycle involvement	HS.2 Integrate human factors	HS.3 Usability engineering
HS.1.1 HS issues in conception	HS.2.1 HS issues in business strategy	HS.3.1 Context of use
HS.1.2 HS issues in development	HS.2.2 HS issues in quality management	HS.3.2 User requirements
HS.1.3 HS issues in production and utilization	HS.2.3 HS issues in authorisation and control	HS.3.3 Produce design solutions
HS.1.4 HS issues in utilization and support	HS.2.4 Management of HS issues	HS.3.4 Human Factors evaluation
HS.1.5 HS issues in retirement	HS.2.5 HF data in trade-off and risk mitigation	
	HS.2.6 User involvement	
	HS.2.7 Usability engineering integration	
	HS.2.8 Develop and re-use HF data	

v 15504 HS >	**1**	**.1**	**.2**	**.3**	**.4**	**.5**	**2**	**.1**	**.2**	**.3**	**.4**	**.5**	**.6**	**.7**	**.8**	**3**	**.1**	**.2**	**.3**	**.4**
SUP.8 problem resolution											•	•								
MAN management																				
MAN.1 proc. management											•									
MAN.2 project management											•									
MAN.3 quality management											•									
MAN.4 risk management												•								
ORG organizational																				
ORG.1 org. alignment									•											
ORG.2 improvement																				
ORG.2.1 prc. establishment									•											
ORG.2.2 proc. assessment										•										
ORG.2.3 proc. improvement														•						
ORG.3 HR management									•											
ORG.4 infrastructure									•											
ORG.5 measurement																				•
ORG.6 reuse									•											

15 Annex I Mapping to ISO/IEC CD3 15288 *System life cycle processes*

15.1 Dot diagram mapping clauses in ISO/IEC CD3 15288 to HSL processes

15.1.1 This diagram indicates affinities between the processes in the HSL model and the processes in the system life cycle process model in ISO/IEC CD3 15288. It should not be taken to imply a one-to-one mapping between the processes in the two models. This is in part because of the need to contextualise processes within an organisation and a project and in part because the models address different aspects of systems. The diagram is intended to suggest a starting point for development of a joint model for a particular assessment or organisation. Depending on the importance of HS issues in a particular application more or less HS processes than those indicated may be relevant. An affinity in general means that the process described is the most relevant to address the HS issues that should be addressed as part of enactment of the ISO/IEC 15288 process. A dot indicates an affinity. A dot in braces indicates a possible relationship. Some affinities would only be relevant when assessing for levels of maturity above level 1.

15.1.2 The viewpoint presented in HS.4 is not explicitly addressed by ISO/IEC 15288.

HS.1 Life cycle involvement	**HS.2 Integrate human factors**	**HS.3 Usability engineering**
HS.1.1 HS issues in conception	HS.2.1 HS issues in business strategy	HS.3.1 Context of use
HS.1.2 HS issues in development	HS.2.2 HS issues in quality management	HS.3.2 User requirements
HS.1.3 HS issues in production and utilization	HS.2.3 HS issues in authorisation and control	HS.3.3 Produce design solutions
	HS.2.4 Management of HS issues	HS.3.4 Human Factors evaluation
HS.1.4 HS issues in utilization and support	HS.2.5 HF data in trade-off and risk mitigation	
	HS.2.6 User involvement	
HS.1.5 HS issues in retirement	HS.2.7 Usability engineering integration	
	HS.2.8 Develop and re-use HF data	

v 15288 HS >	**1**	**.1**	**.2**	**.3**	**.4**	**.5**	**2**	**.1**	**.2**	**.3**	**.4**	**.5**	**.6**	**.7**	**.8**	**3**	**.1**	**.2**	**.3**	**.4**
5.1 agreement																				
5.1.1 acquisition										•										
5.1.2 supply										•										
5.2 enterprise mgmt.																				
5.2.1 enterprise mgmt.								•	•											
5.2.2 investment mgmt.										•										
5.2.3 sys lifecycle prc. mgmt									•											
5.2.4 resource mgmt.									•											
5.3 project management																				
5.3.1 planning											•									
5.3.2 assessment											•									
5.3.3 control											•									
5.3.4 decision making											•	•								
5.3.5 risk management												•								
5.3.6 configuration mgmt.																				

HS.1 Life cycle involvement	HS.2 Integrate human factors	HS.3 Usability engineering
HS.1.1 HS issues in conception	HS.2.1 HS issues in business strategy	HS.3.1 Context of use
HS.1.2 HS issues in development	HS.2.2 HS issues in quality management	HS.3.2 User requirements
HS.1.3 HS issues in production and utilization	HS.2.3 HS issues in authorisation and control	HS.3.3 Produce design solutions
HS.1.4 HS issues in utilization and support	HS.2.4 Management of HS issues	HS.3.4 Human Factors evaluation
HS.1.5 HS issues in retirement	HS.2.5 HF data in trade-off and risk mitigation	
	HS.2.6 User involvement	
	HS.2.7 Usability engineering integration	
	HS.2.8 Develop and re-use HF data	

v 15288 HS >	**1**	**.1**	**.2**	**.3**	**.4**	**.5**	**2**	**.1**	**.2**	**.3**	**.4**	**.5**	**.6**	**.7**	**.8**	**3**	**.1**	**.2**	**.3**	**.4**
5.3.7 Information mgmt.															•					
5.4 technical																				
5.4.1 stakeholder reqts dfn.																	•	•		
5.4.2 reqts. analysis																		•		
5.4.3 architectural design																			•	
5.4.4 implementation																	•	•	•	•
5.4.5 integration																				
5.4.6 verification																				•
5.4.7 transition				(•)	(•)															
5.4.8 validation																				•
5.4.9 operation																	•	•		•
5.4.10 maintenance																			•	
5.4.10 disposal																				
B Life cycle stages																				
B.1 Concept stage		•																		
B.2 Development stage			•																	
B.3 Production stage				•																
B.4 Utilization stage				•	•															
B.5 Support stage					•															
B.6 Retirement stage						•														

16 Annex J Mapping to the Software Engineering Institute Capability Maturity Model (CMM)

16.1 Dot diagram mapping clauses in CMM to HSL processes

16.1.1 This diagram indicates affinities between the processes in the HSL model and the processes in the CMM. It should not be taken to imply a one-to-one mapping between the processes in the two models. This is in part because of the need to contextualise processes within an organisation and a project and in part because the models address different aspects of systems. The diagram is intended to suggest a starting point for development of a joint model for a particular assessment or organisation. Depending on the importance of HS issues in a particular application more or less HS processes than those indicated may be relevant. An affinity in general means that the process described is the most relevant to address the HS issues that should be addressed as part of enactment of the KPA. A dot indicates an affinity. A dot in braces indicates a possible relationship.

16.1.2 The viewpoint presented in HS.4 is not explicitly addressed by the CMM.

HS.1 Life cycle involvement	**HS.2 Integrate human factors**	**HS.3 Usability engineering**
HS.1.1 HS issues in conception	HS.2.1 HS issues in business strategy	HS.3.1 Context of use
HS.1.2 HS issues in development	HS.2.2 HS issues in quality management	HS.3.2 User requirements
HS.1.3 HS issues in production and utilization	HS.2.3 HS issues in authorisation and control	HS.3.3 Produce design solutions
	HS.2.4 Management of HS issues	HS.3.4 Human Factors evaluation
HS.1.4 HS issues in utilization and support	HS.2.5 HF data in trade-off and risk mitigation	
	HS.2.6 User involvement	
HS.1.5 HS issues in retirement	HS.2.7 Usability engineering integration	
	HS.2.8 Develop and re-use HF data	

v CMM KPA HS >	**1**	**.1**	**.2**	**.3**	**.4**	**.5**	**2**	**.1**	**.2**	**.3**	**.4**	**.5**	**.6**	**.7**	**.8**	**3**	**.1**	**.2**	**.3**	**.4**
Level 2																				
requirements management																		•		
s/w project planning											•									
s/w proj tracking & oversight											•									
s/w subcontract mgmt										•										
s/w quality assurance																				•
s/w configuration mgmt																				
Level 3																				
organizational process focus									(•)											
organizational process defn									•											
training programme									•											
integrated s/w mgmt														•						
s/w product engineering																	•	•	•	•
inter-group co-ordination														•						
peer reviews													•							
Level 4																				

HS.1 Life cycle involvement	HS.2 Integrate human factors	HS.3 Usability engineering
HS.1.1 HS issues in conception	HS.2.1 HS issues in business strategy	HS.3.1 Context of use
HS.1.2 HS issues in development	HS.2.2 HS issues in quality management	HS.3.2 User requirements
HS.1.3 HS issues in production and utilization	HS.2.3 HS issues in authorisation and control	HS.3.3 Produce design solutions
HS.1.4 HS issues in utilization and support	HS.2.4 Management of HS issues	HS.3.4 Human Factors evaluation
HS.1.5 HS issues in retirement	HS.2.5 HF data in trade-off and risk mitigation	
	HS.2.6 User involvement	
	HS.2.7 Usability engineering integration	
	HS.2.8 Develop and re-use HF data	

v CMM KPA HS >	**1**	**.1**	**.2**	**.3**	**.4**	**.5**	**2**	**.1**	**.2**	**.3**	**.4**	**.5**	**.6**	**.7**	**.8**	**3**	**.1**	**.2**	**.3**	**.4**
quantitative process mgmt																				•
s/w quality mgmt									•											
Level 5																				
defect prevention																				
technology change mgmt									•											
process change mgmt									•											

17 Annex K Conformance to ISO/IEC 15504 *Process assessment*

17.1 Introduction

17.1.1 ISO/IEC 15504 part 2 places conformance requirements on process reference and assessment models. The following sections quote the requirements for process and assessment models and present how these are met by this specification. In each of the following clauses the italicised text presents the requirement and the normal text presents the attestation of compliance for this specification.

17.2 Requirements for Process Reference Models

17.2.1 A process reference model shall contain:

- *a) A declaration of the scope of the process reference model.* This is provided in section 4.2.
- *b) Descriptions of the processes within the scope of the process reference model, as required by clause 6.4 of ISO/IEC 15504 part 2.* This is provided in section 6 of this specification.
- *c) A description of the relationship between the process reference model and the context in which it is used.* This is provided in section 4, Annex B and Annex D.
- *d) A description of the relationship between the processes defined within the process reference model.* This is provided in section 5.3 and Annex E.

17.2.2 *The process reference model shall document the measures taken to ensure consensus within the community of interest of the model. If no measures are taken, a statement to this effect shall be documented.* The reference model is based on ISO 13407, ISO TR 18529 and HFI. The development of the first draft of the model was iterative and involved international trial and review by experts in a range of relevant disciplines. The model has been developed through the ISO review process by TC159 Ergonomics / SC4 Human system interaction.

17.2.3 *The process reference model shall document the relationship between the model and relevant International Standards, including ISO/IEC 12207 and/or ISO/IEC 15288. If there is no relationship, a statement to this effect shall be documented.* A mapping to the ISO/IEC TR 15504 examplar model, which is based on and explicitly related to ISO/IEC 12207 is provided in Annex H. This specification expands the usability process in ISO/IEC 12207 Amd 1. A mapping to ISO/IEC CD3 15288 is provided in Annex J.

17.2.4 *The processes defined within a process reference model shall have uniqueness of definition and identification.* The processes in this specification are numbered according to the scheme used in ISO/IEC TR 15504. The numbering is made unique by use of the prefix “HS”.

17.2.5 *Any elements contained in the process reference model over and above those listed in this clause shall be considered to be informative.* The process descriptions in section 6 of this specification include lists of base practices for information.

17.2.6 Process Descriptions

17.2.7 *The fundamental elements of a process reference model are the set of descriptions of the processes within the scope of the model. These process descriptions shall meet the following requirements:*

- *a) A process shall be described in terms of its Purpose and Outcomes.*
- *b) In any description the set of process outcomes shall be necessary and sufficient to achieve the purpose of the process.*
- *c) Process descriptions shall be such that no aspects of the measurement framework as described in clause 4 of ISO/IEC 15504 part 2 beyond level 1 are contained or implied.*

17.2.8 These requirements are met by the process descriptions in section 6. Some practices of some processes may contribute to measurement of levels of capability above level 1. These practices are indicated in Annex D section 9.8. However, the overall achievement of the relevant processes does not depend on these higher levels of capability.

17.3 Assessment Models

17.3.1 Introduction

17.3.2 *This clause of ISO/IEC 15504-2 sets out the requirements that must be met by process models used to support assessment. Any such assessment model shall be based upon a suitable reference source of process definitions –a Process Reference Model. This clause defines the requirements to be met by an assessment model in order to claim conformance through its relationship with a specific Process Reference Model. The requirements for conformance of the assessment model enable comparison of outputs from assessments based upon the same Process Reference Model, using different assessment models.* Section 6 of this specification includes an assessment model for the HSL reference model contained in section 6.

17.3.3 Model purpose

17.3.4 *A model shall be based on good engineering and process management principles and be suitable for the purpose of assessing process capability.* The model is closely derived from ISO/IEC 15504 and its development took account of advice from experts in process assessment.

17.3.5 Model scope

17.3.6 *A model shall encompass all, or a non-empty subset, of the set of processes of the specified Process Reference Model.* All processes in section 6 are included.

17.3.7 *A model shall address all, or a continuous subset, of the levels (starting at level 1) of the measurement framework for process capability for all of the processes within its scope. It would be permissible for a model, for example, to address solely level 1, or to address levels 1, 2 and 3, but it would not be permissible to address levels 2 and 3 without level 1. The model is for level 1 assessment of technical performance.* Above this level the ISO/IEC 15504 process capability measures are to be applied.

17.3.8 *A model shall declare its scope of coverage in the terms of both the selected reference model, the selected processes from the reference model, and the capability levels*

selected from the measurement framework. This text makes the declaration. The coverage is indicated by the text of section 4.2, section 5.3 and Annex C.

17.3.9 Model elements and indicators

17.3.10 *A model shall be based on a set of elements that explicitly address the purposes, as defined in the selected reference model, of all the processes within the scope of the model, and that demonstrate the achievement of the process attributes within the capability level scope of the model.* Base practices through which the purpose is achieved and the process performed are described for each process.

17.3.11 *The detailed elements of the model shall constitute a set of indicators of process performance that focus attention on the effective implementation of the processes in the scope of the model, through their work products.* Work products are listed for each process.

17.3.12 *The detailed elements of the model shall constitute a set of indicators of process capability that focus attention on the process management practices that realise the process attributes within the scope of the model.* This is addressed by use of the ISO/IEC 15504 scale.

17.3.13 Mapping

17.3.14 *A model shall provide an explicit mapping from the fundamental elements of the model to the processes of the selected reference model and to the relevant process attributes of the measurement framework. The mapping shall be complete, clear and unambiguous and shall substantiate the declaration of the scope of coverage.* The mapping is achieved by use of the ISO/IEC 15504 process capability numbering scheme.

17.3.15 *The mapping shall include the mapping of the indicators of process performance within the model to the purposes and outcomes of the processes in the specified reference model. The mapping shall include the mapping of the indicators of process capability within the model to the definitions of the process attributes (including all of the results of achievement of the process attributes) in the measurement framework. The mapping requirement enables assessment models that are structurally different to be related to the reference model.* The mapping is achieved for level 1 by use of the ISO/IEC 15504 numbering scheme. Above level 1 the ISO/IEC 15504 process capability scale applies.

17.3.16 Translation

17.3.17 *An assessment model shall provide a formal and verifiable mechanism for converting data collected against the model into a set of process attribute ratings for each process selected from the specified reference model directly or indirectly assessed as defined in Clause 6 of this part of ISO/IEC 15504.* This specification is intended for use with the ISO/IEC 15504 process capability scale.

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19 Version control information

Contents	HFICMM project and reviewers up to April 2001
Format	Brian Sherwood-Jones, 2001-03
Last editor	Jonathan Earthy, 2001-06-28
Version	1 (HSL model assessment version V1.doc)
Format	HFICMM internal report format
Material incorporated	All of final HSL model
Editor's notes	
General	This document attempts to present the activities requried to address human-system issues without accusations of solutioneering by the human sciences. This approach is required because of the strong opposition to what is seen as "empire building" on the part of the human sciences by other disciplines that have a legitimate claim to address particular human-system issues. In order to progress towards the dependable production of effective systems tolerance is requried from all disciplines. It is hoped that this document is read and appreciated for the general good it is trying to achieve in the complicated, broad inter-disciplinary area of endeavour in which we try to relate people to technology.
Editorial	May be opportunities for more aggressive language simplification.
Technical	ISO 15288 has been revised and now contains a Quality Managment process.