1 Human-System Lifecycle Reference Model v0i

1.1 HS.1 Life cycle involvement

1.1.1.1 Purpose and outcomes

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. 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.

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

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

1.1.2 HS.1.1 Human-system issues in conception

1.1.2.1 Purpose and outcomes

The purpose of the *Human 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. 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.

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

5) 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

6) evolving and future stakeholder, organisation, social and legislative requirements are described in the system strategy

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

8) the organisation takes future acquisition strategy into account when defining organisational change

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

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

1.1.4.1 Purpose and outcomes

The purpose of the *Human 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. 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.

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

13) the product system is adapted to meet the requirements of individual implementations

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

15) the HS issues of introduction and rollout are addressed

16) critical HS criteria are part of the acceptance of the delivered product system

This is achieved through performance of the following practices:

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

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

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

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

— 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

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

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

1.1.5.1 Purpose and outcomes

The purpose of the *Human 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. 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.

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

17) safe operational and health and safety procedures are complied with

18) the long-term use of the product system is monitored in relation to the design intent

19) the competencies required to utilise and support the product system are identified and evolved over time

20) user and maintainer requirements for support are met by the product system

This is achieved through performance of the following practices:

— HS.1.4.BP1 Produce personnel strategy

— HS.1.4.BP2 Deliver training and workshops to users and support staff

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

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

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

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

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

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

1.1.6 HS.1.5 Human-system issues in retirement

1.1.6.1 Purpose and outcomes

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. 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.

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

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

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

23) there are debriefing and retrospective analysis to identify the requirements for the replacement version

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

This is achieved through performance of the following practices:

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

— 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

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

1.2 HS.2 Integrate human factors

1.2.1.1 Purpose and outcomes

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

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

25) HS issues are addressed by the organisation

26) HS life cycle processes are enacted

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

1.2.2 HS.2.1 Human-system issues in business strategy

1.2.2.1 Purpose and outcomes

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

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

27) the usability of the organisation's product systems in the market/work place is at competitive level

28) a corporate vision of usability as an asset is established

29) there is senior management support for the improvement of infrastructure related to product system usability

This is achieved through performance of the following practices:

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

— HS.2.1.BP2 Set usability objectives for product systems

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

— HS.2.1.BP4 Develop user-centred infrastructure

— HS.2.1.BP5 Management relate HS issues to business benefits

1.2.3 HS.2.2 Human-system issues in quality management

1.2.3.1 Purpose and outcomes

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

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

30) there is a policy for HS life cycle processes

31) suitable tools and methods are used to address HS issues

32) HS competencies are made available

This is achieved through performance of the following practices:

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

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

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

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

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

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

1.2.4.1 Purpose and outcomes

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

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

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

34) criteria derived from HF data are used for acquisition

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

36) HS practice and capability is reviewed in order to build organisational knowledge

This is achieved through performance of the following practices.

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

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

— HS.2.3.BP3 Assess and improve HS capability in processes which affect usability

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

1.2.5 HS.2.4 Management of human-system issues

1.2.5.1 Purpose and outcomes

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

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

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

38) resources and staff are adequate to address HS issues

39) the life cycle plan adapts to emerging HS issues

40) there is sufficient iteration in the life cycle to achieve product system usability

This is achieved through performance of the following practices:

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

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

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

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

1.2.6.1 Purpose and outcomes

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. 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.

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

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

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

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

This is achieved through performance of the following practices.

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

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

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

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

1.2.7 HS.2.6 User involvement

1.2.7.1 Purpose and outcomes

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. 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).

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

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

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

46) user involvement is widespread and effective

47) the resulting changes to the product system are reported back to the users

This is achieved through performance of the following practices:

— HS.2.6.BP1 Advocate the user perspective

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

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

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

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

1.2.8 HS.2.7 Usability engineering integration

1.2.8.1 Purpose and outcomes

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

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

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

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

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

This is achieved through performance of the following practices:

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

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

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

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

— HS.2.7.BP5 Identify emerging HS issues

1.2.9 HS.2.8 Develop and re-use HF data

The purpose of the *develop and re-use HF data process* is to develop, maintain and provide HF data and standards to the organisation. The benefits include: HF data are used consistently.

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

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

52) New or revised HF data are produced as required

53) Validated HF standards are promulgated

This is achieved through performance of the following practices:

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

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

— HS.2.8 BP3 Produce coherent data standards and formats

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

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

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

1.3 HS.3 Usability engineering

1.3.1.1 Purpose and outcomes

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. 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.

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

54) the product system meets user needs in its context of use

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

56) the user effectiveness, efficiency and satisfaction with the product system are known

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

1.3.2 HS.3.1 Context of use

1.3.2.1 Purpose and outcomes

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.

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

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

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

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

This is achieved through performance of the following practices:

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

— HS.3.1.BP2 Analyse the tasks and worksystem

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

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

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

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

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

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

1.3.3 HS.3.2 User requirements

1.3.3.1 Purpose and outcomes

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

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

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

61) the requirements of the users of the product system are defined

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

63) user requirements are addressed in the product system design

This is achieved through performance of the following practices:

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

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

— HS.3.2.BP3 Analyse the user requirements

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

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

1.3.4 HS.3.3 Produce design solutions

1.3.4.1 Purpose and outcomes

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

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

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

65) usability is traded-off against other design criteria

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

67) User input (direct and/or as feedback from evaluations) is incorporated in the design

This is achieved through performance of the following practices:

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

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

— 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

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

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

1.3.5 HS.3.4 Human Factors evaluation

1.3.5.1 Purpose and outcomes

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.

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

68) formative evaluation provides design information, new risks and issues

69) summative evaluation demonstrates the fulfilment of user requirements

70) the organisation has information on which to base a decision regarding one or more HS issues

This is achieved through performance of the following practices:

— HS.3.4.BP1 Plan the evaluation

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

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

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

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