The Improvement of Human-Centred Processes - facing the challenge and reaping the benefit of ISO 13407

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Human-centred design processes for interactive systems are defined in ISO 13407 and the associated ISO TR 18529. The publication of these standards represents a maturing of the discipline of user-centred design. The systems development community see that (at last) Human Factors has processes which can be managed and integrated with existing project processes. This internationally-agreed set of human-centred design processes provides a definition of the capability that an organisation must possess in order to implement user-centred design effectively. It can also be used to assess the extent to which a particular development project employs user-centred design. As such, it presents a challenge to the Human Factors community, and indeed a definition of good practice may even be regarded by some as an unwelcome constraint. This paper presents the background to the process-level definition of user-centred design and describes how it relates to current practice. The challenges, benefits and use of a defined human-centred design process are presented. The implications for Human Factors and other disciplines are discussed. In four Annexes the process terminology and the contents of ISO 13407 and ISO TR 18529 are described in more detail, and three examples are given (in Annex 4) of using this process improvement approach to improve the actual design methods in three organisations.

KEYWORDS: User-centred design, ISO 13407, Human-centred design, ISO TR 18529, process improvement, process capability assessment

1. Introduction

This paper discusses the development of standards for user-centred design and the implications of their application. It is included in this special issue of IJHCS to show how far the infrastructure for a user-centred approach to system development has progressed and to describe the impact on, and opportunities for, the Human Factors community. The paper discusses the outcomes and challenges of the process standard for user-centred design, ISO 13407:1999 *Human-centred design processes for interactive systems* and the associated ISO TR 18529:2000 *Human-centred lifecycle process descriptions*

Section 2 relates usability to project risk and introduces the purpose and vocabulary of process improvement. Section 3 introduces the two ISO documents that define the human-centred design process and briefly presents the history of their development and their influence on other ISO process standards. Section 4 examines the difference between current practice in usability engineering and the human-centred design process defined in ISO 13407. Section 5 relates a process-level definition of human-centred design to user-centred design activities on a particular project. The benefits of, and rationale for, the emergence of standard

process-level models of good practice in business and system development are discussed. Section 6 presents the challenges to the system development and Human Factors communities that result from ISO 13407. Section 7 presents the opportunities arising from ISO 13407. Finally, the implications for systems development, Human Factors and Human Computer Interaction (HCI), and applied research are reviewed.

In this paper 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 (HCD) is used to refer to the particular design process defined in ISO 13407 and ISO TR 18529.

2. Determinants of Usability and their use in Assurance

2.1 DETERMINANTS OF USABILITY

Taking a user centred approach to design can reduce development times and rework for new versions, improve the productivity of users, and reduce training, documentation and support costs (Bevan, 2001a). ISO 9241-11 defines usability in terms of effectiveness, efficiency and satisfaction. ISO 9126-1 makes effectiveness, efficiency, safety and satisfaction (there called **quality in use**) the main goal of systems development. Attributes of the product such as understandability, learnability and operability contribute to usability. As usability becomes widely recognised as a requirement for products, purchasers and users increasingly need some guarantee that the claims for the usability of a product are valid.

Six approaches to the assurance of usability have been described by Daly-Jones *et al.* (1997), Bevan *et al* (1998), Earthy (1998a,b) and EUSC (1998). Bevan (2001b) describes the international standards that relate to each approach. From a practical point of view each approach can have a role to play in providing assurance of the usability of a product or system. As such, the approaches may be seen as components of a managed assurance scheme. For any business a combination of components will be required to give the required degree of assurance that product quality targets as regards usability are valid and achievable. Table 1 summarises each component, their purpose and makes comments on practical application.

Table 1. Components of a managed assurance scheme

Component	What	Purpose(s)	Comment
Product Attributes	Assessing whether a product conforms to ergonomic guidelines e.g. many parts of ISO 9241	Used at end of a development phase to verify successful completion Used at end of project as part of certification May be diagnostic, i.e. provide advice on re-design of the product Conformance to the principles of ISO 9241 meets the software ergonomics requirements of 90/270, the VDU Directive	Retrospective analysis Specific to a product or version of a product Difficult to relate to context of use Does not assess consequence of defects
User Performance and Satisfaction	Measuring the usability of a product e.g. ISO 9241 Part 11	Used at end of a development cycle for validation Used at end of project as part of acceptance Can be used to assess suitability of a product to be acquired May be combined with diagnostic feedback, i.e. provide advice on re-design of the product	Retrospective analysis Specific to a version of a product Only valid for the context used for measurement Does not diagnose cause of defects Thorough assessment may be costly

Component	What	Purpose(s)	Comment
Process Certification	Assessing whether a user-centred development process was used e.g. Bevan *et al* (1998)	Increased confidence for purchaser Feedback for developer Interpretation of ISO 13407 for generic products Project process definition Applies to a single product or a product line Depends on developer having an identifiable process	Retrospective analysis Specific to a product or product line
Organisational Human-Centredness	Assessing the maturity of human-centredness of an organisation e.g. Human Centredness Scale (Earthy, 1998b)	Initial assessment of client Awareness-raising for Maturity and Usability Model for management/attitude change Extra scale for software/system process assessments Source of practices for software/system assessments	Not precise about how to bring about improvements
Technical Competence	Accrediting the ability of an organisation to act as a provider of usability services e.g. Bevan *et al* (1998), MErgS, EurErgs	Accreditation of usability consultants Subcontractor qualification Design of training Organisational development Staff development Professional qualification	Sensitive to staffing Limited applicability Does not address product development
Process Capability	Assessing the capability of an organisation to perform user-centred activities e.g. ISO TR 18529	Assessment of a baseline of user-centred processes Assessment for accreditation of user-centred processes Elaboration of ISO 13407 Education in what needs to be done in user-centred design Model for process improvement Industry reference model	Organisational commitment required Novel extension to process assessment

2.2 DECIDING BEST COMBINATION OF COMPONENTS TO ASSURE USABILITY

This section reviews general approaches to the assessment of these six components in Table 1 with respect to usability. The question for the Human Factors practitioner is, which combination gives the best management of project risk?

Traditional assurance of **product attributes** takes a product and tests it against an agreed standard (e.g. Microsoft Windows™ look and feel). Evaluations based on fixed performance or feature attributes become progressively less useful with product complexity. This is especially limiting with information technology (IT) systems and quality attributes as complex as usability. Product inspection can find some possible causes of usability problems, but cannot assess their consequences.

Assurance of **user performance and satisfaction** (e.g. "a specified group of secretaries shall be able to complete an expenses form with no errors in under an hour") forms a necessary element in usability assurance. However, the specification of valid performance metrics and test conditions may not be possible until well after a project has started. Whilst forming part of product assurance, this element contributes to risk management only late in the project and cannot be used for selecting a supplier or assessing project risk at the early stages.

Process Certification can only be carried out retrospectively. For this reason it is of most value (a) to potential purchasers and users of a certified product and (b) as evidence that a contract requirement to apply a process standard has been met. Because process-oriented product certification schemes test a more stable set of criteria than product assessments they are more often applied to product lines rather than single types or versions. In an attempt to facilitate a use of process assessment for product lines, Davies and Brady (2000) have proposed the concept of 'project capabilities' for use in one-off and small batch complex products or new product lines. The project capability concept addresses the activities of bid preparation and project execution, and is in many ways more akin to process capability (see below) than process certification.

All the more traditional components of assurance (i.e. Product Attributes, User Performance and Process Certification) evolved when the project drivers of cost and timeliness were much less demanding. Concurrent engineering (where project phases are to a greater or lesser extent overlapped), which evolved to meet more stringent cost and time requirements, creates a new problem in that projects need to take account of changes in user requirements, context of use and base technology during design and development. The value of traditional assurance schemes is reduced and those responsible for assurance need to find ways of predicting product quality. These are discussed below.

Generic approaches to maturity based on Crosby (1978), such as **Organisational Human-Centredness** (Ehrlich & Rohn, 1994; Flanaghan, 1996; Earthy, 1998b), identify potential risks but are not particularly precise about specific solutions. **Technical Competence** in the relevant discipline is of course relevant (eg. professional qualifications such as MErgS - Member of the Ergonomics Society - and EurErgs - European Ergonomist), but in all but the smallest projects factors such as team dynamics, and project context, will have a more significant impact on product attributes than individual contributions alone.

Process Capability (Humphrey, 1989) is unique in offering (a) a prediction of the ability of a business to deliver a product that meets a required level of performance, (b) an indication of the factors that hinder this ability, and (c) the means of addressing such shortcomings. These strengths have led to the widespread adoption of process capability as an element in the assurance of timely and effective software delivery. This paper describes the development and application of process capability in the assurance of usability.

ISO TR 15504 *Software process assessment* defines a **process** as: a set of interrelated resources and activities that transform inputs into outputs. Processes are defined at the level of *what* is done to develop and operate a system (Annex 3 contains examples of human-centred processes). Processes are specified through methods, techniques, work instructions, etc. A process has a purpose and fulfils a business requirement. A disciplined evaluation of an organisation's processes against a reference model of good practice is called **process assessment**. Processes are assessed against a "capability scale", an ordinal scale that defines the extent to which the process is implemented and controlled. Process assessments generally focus on identifying improvement priorities (i.e. a formative evaluation), but can be summative against a required capability level. Action taken to change an organisation's processes so that they meet the organisation's business needs and achieve its business goals more effectively is called **process improvement**. Process improvement is an iterative activity that starts with an assessment of current capability. The cycle of assessment and improvement can be tailored to business need in a structured manner. Annex 1 discusses the topic further. Process reference models have been defined for particular applications and industries and international standards exist, for example ISO TR 15504 for software development. This paper uses terms from the process modelling community, which are defined in Annex 1.

3. History of the development of a user-centred design model

Towards the end of the development of ISO 9241 *Ergonomic requirements for office work with visual display terminals*, the working groups developing this product standard identified a need for a separate, high-level document that explained the human factors activities performed during the design of interactive systems. Taking the approach to user-centred design originating in Norman and Draper (1986), ISO TC159/SC4 *Ergonomics of human-system interaction* tasked a working group under the leadership of Tom Stewart with the development of guidance for project managers. This was published as ISO 13407:1999 *Human-centred design processes for interactive systems*. ISO 13407 lists the following principles for human-centred design:

- the active involvement of users and a clear understanding of user and task requirements
- an appropriate allocation of function between users and technology
- the iteration of design solutions
- multi-disciplinary design.

It specifies the following activities:

- planning of the human-centred design process
- specification of the user and organisational requirements
- understanding and specification of the context of use
- production of design solutions
- evaluation of designs against requirements.

As the work on ISO 13407 progressed, a formal liaison was established with ISO/IEC JTC1/SC7 *Software Ergonomics*, the committee leading the development of process models and process assessment methods for systems and software lifecycles. This liaison, and work on the EC INUSE project (Earthy, 1996), identified the need for a structured presentation of user-centred design activities for use in process assessment.

A range of assessment models had been developed for user-centred design, including HumanWare (Taylor *et al*, 1998), Usability Management Maturity (Flanaghan, 1996), User-Centred Design Maturity (Eason and Harker, 1997) and Total Systems Maturity (Sherwood-Jones, 1995). The processes in all of these models formed inputs to the Usability Maturity Model (Earthy, 1998a,b). The Usability Maturity Model in turn formed the basis for ISO TR 18529:2000 *Human-centred lifecycle process descriptions*, intended to be used in conjunction with ISO 13407 (see Annex 2). ISO TR 18529 contains descriptions of human-centred processes structured for use in process assessment (see Annex 3).

Both ISO 13407 and ISO TR 18529 achieved unanimous approval from the parent technical committee, TC159 *Ergonomics*. Although neither document mandates the performance of specified processes, the unanimous agreement of the international standards community on a definition of practice that is published world-wide presents a very strong case for the approach recommended in the Standard and its associated Technical Report.

ISO TR 18529 complies with the requirements of ISO TR 15504 *Software process assessment* (to be ISO 15504 *Process assessment*) for process assessment models. It can also be mapped onto the Capability Maturity Model (CMM) (see Annex 1) via the Usability Maturity Model. This compatibility allows the results of an assessment of human-centred process capability to be integrated with other compliant process capability assessments. The ability to integrate with other assessments is emerging as an important factor in process assessment (Hamilton and Cutler, 2000). The reason is partially related to credibility, but is largely financial. No business has an unlimited budget for process improvement, and separate assessments against a range of incompatible models looks disorganised, will split the assessment budget, create a problem in prioritising the findings and make the design of a harmonised improvement programme more difficult. An increasing number of specialist

disciplines are taking advantage of the power of process improvement, therefore, and defining compatible capability models to exploit it.

Kuutti *et al* (1998) describe a successful trial of the Usability Maturity Model in the office products sector. Annex 4 summarises the application of model-based process improvement by Taylor *et al* (1998) to user-centred design for high-technology products, and outlines usability capability assessments by Bevan and Ryan (2000) and Bevan and Bogomolni (2000).

Jokela (2000) reviewed a number of usability capability models. He concluded that the Usability Maturity Model was the best choice, but noted that the management aspects should be further expanded. Whilst emphasising the usefulness of assessment, he pointed out the need for other assurance elements - particularly technical competence, usability in business strategy, and organisational culture in user centred design.

In Japan there is recognition that usability and accessibility are attributes of product quality that define an organisation's image (National/Panasonic, 1999). ISO 13407 is seen as an industry-wide tool for the improvement of product quality (Hirasawa, 2000) where it complements the requirement to operate processes transparent to the organisation, the client and any user of a product. Indeed Japan is the first country to develop textbooks that explain ISO 13407 (Kurosu *et al.*, *in press*) and define compliant methods (Hirasawa, *in press*).

Subsequent to the publication of ISO 13407 and ISO TR 18529, the SC7 *Software Engineering* standard ISO 12207 *Software lifecycle processes* has been amended to include a usability process based on ISO TR 18529, and ISO 15288 *System lifecycle processes* has used the TC159 liaison to take account of Human Factors issues in system development and operation.

The contents list of ISO 13407 is reproduced in Annex 2. Annex 3 lists the human-centred design processes described in ISO TR 18529. Bevan (2001b) describes the range and content of international standards related to usability and user-centred design, and describes how to acquire international standards.

4. Scope of processes required to provide usability assurance

The ISO human-centred design process standards take a broader approach to usability than is common in much commercial practice. Usability is often seen as primarily concerned with the ease of use of the user interface (for example Nielsen 1993, Mayhew 1999). ISO 9241-11 *Ergonomic requirements for office work with visual display terminals - Guidance on usability* takes a much broader approach, defining usability as: *The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.* ISO 13407 also takes this broad approach to usability and describes how it can be incorporated into the development process.

In this view usability is the extent to which the product meets user needs, and includes issues such as appropriate functionality, compatibility and reliability. The conceptual model used to present the functions contributes about 60% of the ease of use whereas the details of the look and feel contributes only 10% (IBM, 1992). Activities concerning the identification and specification of functions to support user tasks should therefore, from an end user point of view, be part of the whole user-centred design process.

The main differences between ISO TR 18529 and previous approaches are described in Table 2. The human-centred design processes are summarised in Annex 3.

Table 2. Differences between ISO TR 18529 and usability engineering approaches to usability

Process Number	Title	Difference
HCD.1 HCD.2	System strategy Plan and manage HCD	These organisational processes have not traditionally been considered within the scope of usability and are only partially covered in ISO 13407. However, experience has shown (Clegg et al, 1997) that organisational commitment is essential to the successful implementation of user-centred design, and the activities listed under HCD.1 "Ensure HCD content in system strategy" and HCD.2 "Plan and manage the HCD process" detail how this can be achieved.
HCD.7	Introduce and operate the system	Activities such as determining the impact on the organisation and users, customisation, training and support are essential for successful implementation, but have rarely been considered within the scope of usability, and indeed are not included in ISO 13407.
HCD.3	Specify user and organisational requirements	Usability requirements activities are often limited to the user interface (Nielsen 1993, Mayhew 1999), while ISO 13407 and ISO TR 18529 are concerned with human requirements for the whole system.
HCD.5	Produce design solutions	Two of the recommended activities contributing to design are missing from many usability engineering methodologies, but central to Ergonomics and Human Factors: allocation of function and a definition of the overall experience of use of the system.
HCD.4 HCD.6	Understand context of use Evaluate designs against requirements	This is a central area of concern for usability engineering, although the standards are more explicit about the need to verify that the context used for evaluation is sufficiently close to the intended context of use. Context of use is completely missing from traditional systems and software engineering.

ISO TR 18529 thus provides a more comprehensive basis for process improvement than is available from other sources. One function of HCD.2 is to ensure that these management activities are integrated with the management of other user-centred design activities. A challenge to usability professionals is that the ISO TR 18529 addresses areas such as user training and system implementation, which often fall under different management from that responsible for system development.

5. The relationship of ISO 13407 and ISO TR 18529 to projects, lifecycles and methodologies

5.1 LEVELS OF SPECIFICATION OF USER-CENTRED DESIGN ACTIVITY

User-centred design activity can be specified or described at a number of levels; each level has its own purposes and needs to relate to the other levels for the purposes of managing, performing and reviewing a project. ISO TR 18529 is an example of a set of **process statements**. It describes **what** is done to make a system lifecycle human-centred. Process statements are typically terse, rigorous and implementation-free. They are aimed at the specialised audience of process assessors and implementers, but are also widely used when planning a project. The detail of **how** this is done depends on the business and project context. **Contextualised process statements** are embodied in methodologies and lifecycles and present detailed guidance on how to do user-centred design, typically in the form of a large text book. We have distinguished between generic methods, typically in the form of books by consultants, and corporate methods, typically in the form of a company handbook. **Project instantiation**, in the form of a project plan, sets out the activities to be performed on a particular project. **Project enactment** - what is actually done on a day to day basis - comprises the application of specific resources, such as tools and techniques. Table 3 summarises these different forms of specification with examples.

Table 3. Process standards in relation to other forms of specifying project activity

Form of specification	Format requirements	User	Usability examples	General examples
Process statement	Outcome, goals, activities, work products	Assessor, process implementer, planner	ISO TR 18529	ISO 12207, 15288, EFQM (1999)
Contextualised process statement - generic	Activities, inputs, outputs	Project manager	UPA lifecycle (Ross *et al*, 2000), CCTA (2000)	Software Engineering, SSADM, Yourdon
Contextualised process statement - corporate	Activities, inputs, outputs	Project manager	Philips HumanWare (Taylor *et al*, 1998)	IBM's project lifecycle
Project instantiation	Activities, dependencies, resources, timing	Project manager	Usability Plan	Project Plan
Project enactment	Activities, tools, resources, procedures, inputs, outputs	Specialist	Stakeholder workshop, Task Analysis, Prototyping	Systems Analysis, HAZOP, Factory Testing

UPA = Usability Professionals Association
SSADM = Structured Systems Analysis & Design Methodology
HAZOP = HAZard and OPerability study

Table 3 can be seen as a hierarchy of abstraction in the description of user-centred design. It should be noted that only at the level of process statement is there an explicit statement of the desired outcome or the purpose of the activity. The implicit nature of goals in most activity specifications drives project staff towards *goal-oriented* behaviour (cf. Roth *et al*, 1987), where following a course of activity is deemed to lead to a successful outcome, rather than *goal-directed* behaviour that uses procedures as resources to achieve an explicit goal. This problem is exacerbated within specialist engineering activities, such as usability engineering, with the result that unsuitable input to design and development is provided at the wrong time. Hakiel (1997a) attributes the problem to poor communication arising from a mismatch between the goals of specialist engineers (i.e. to apply and develop their expertise) and the goals of project managers (i.e. to complete the project to requirement within resources). He concludes that to ensure appropriate input on usability the project plan should explicitly include the required human or usage centred activities. The authors contend that a clear statement of outcomes assists in the definition and monitoring of this plan. The remainder of this section discusses aspects of using activity specification at each level of abstraction. It is argued that problems arise when models of user-centred design (and other business activities) are specified at a level of abstraction lower than a process model.

5.2 USER-CENTRED DESIGN ACTIVITY AS PROCESS

Regarding **process statements,** ISO 13407 and ISO TR 18529 summarise good practice for each human-centred design process in the lifecycle. An example of a business-level process model is the European Foundation for Quality Management Excellence Model (EFQM, 1999). This is a non-prescriptive framework of enablers and outcomes, which is used for benchmarking organisational capability by means of a process maturity scale. The interest in developing statements of good practice in a wide range of domains has thus moved, from prescriptive descriptions of **how** to do work, to the level of the process statement which defines **what** to do and leaves the contextualisation to the organisation managing the work. In the context of business activity, Hammer (1996) points out "*The difference between task and process is the difference between part and whole. A task is a unit of work, a business activity normally performed by one person. A process, in contrast, is a related group of tasks that*

together create a result of value to a customer....The problems that afflict modern organisations are not task problems. They are process problems. The reason we are slow to deliver results is not that our people are performing their individual tasks slowly and inefficiently... We are slow because some of our people are performing tasks that need not be done at all to achieve the desired result and because we encounter agonising delays in getting the work from the person who does one task to the person who does the next one." The authors of this paper contend that Hammer's view applies equally well to the practice of specifying user-centred design through methodology rather than at the level of process. The TRUMP project (Bevan and Bogomolni 2000, Bevan and Ryan 2000) is an example of the direct application of a process-level model of user-centred design to projects without use of an intervening methodology or lifecycle.

Taking this issue from a sociological point of view Holti (1993) examines the lessons from the era of methods in software engineering and concludes that the growing organisational preference for process has two roots:

1. that process specification is at the most suitable level for management understanding,
2. processes can be customised (using tools and even methodologies) to suit business needs.

The growing industrial interest in process has resulted in the development of a range of standards for good practice which are eventually expected to define the requirements for world trade (Arnold, 1998), not least through their use as a specification of technical practice for ISO 9001 and ISO 9004.

5.3 USER-CENTRED DESIGN AS METHODOLOGY

Contextualised process statements written as generic methodologies are difficult to adapt to a particular project or business context. The experience of two of the authors of this paper in using contextualised process statements is that the handbooks of guidance for methodologies, whilst comprehensive, have inadequate rules for tailoring to a specific project. This means that there is no basis for determining whether or not the method has been followed. Even the life cycle published by the Usability Professionals Association (UPA) (Ross et al, 2000) identifies 39 steps and 10 deliverables, but does not indicate to whom they will be delivered or why (or how this might be achieved in the case of a web development with a 3 month time scale). Further, such guidance is bounded, but with no definition of engineering context. This means that interfacing to other project activities is very difficult to effect. Carr and Whytock (1995) reviewed a large number of software methodologies and human factors methodologies and found almost no guidance given in any of them as to how the two disciplines should interact. Whilst this finding may reflect badly on software engineering, it is inexcusable in a discipline that preaches user-centredness and advocates the provision of information in a form that people can use.

The contextualised process statements developed for a corporate life-cycle tend to be easier to apply and are likely to be more integrated with project processes. However, they represent very significant investments (both initially, and then as a continuing investment in maintenance and company training) and are options only for very large organisations.

5.4 USER-CENTRED DESIGN AS PROJECT PLAN

Project instantiation sets out the required activities within practical constraints. The project plan for a specific product will contain goals and outcomes relating to system delivery, risk exposure and finance. Usability resources and activities must therefore be selected for their contribution to product delivery and sale, and reduced corporate risk in both the vendor and

purchaser organisations (for example, certainty of delivery deadlines, product acceptance, less rework for new versions).

Project managers typically need only to know how the deliverables from user centred tasks relate to other project deliverables and not, necessarily, the means by which they are produced Hakiel (1997b). This implies a shift away from the traditional specification of tasks in terms of delivery dates, document names and standard procedures, towards task specification in terms of the service provided to the project (for example, not a document name but the presentation format required for results, not standard procedure but options for techniques against available resource, and not delivery dates but deadlines linked to project need).

The particular methods to be used might be known at the time that the initial plan is formulated, or they may be chosen as the plan is executed. Hakiel (1997a) has pointed out that, either way, methods are not an integral part of the execution of the plan but tools to be used in its successful implementation (although the plan may specify particular methods to be used should particular project circumstances arise).

5.5 USER-CENTRED DESIGN AS TOOLS AND TECHNIQUES

Project enactment statements (HCI and Human Factors techniques) are invaluable toolboxes to the specialist practitioner and, in many cases, to the novice. However, they are far too detailed and technocentric to be comprehended by the management of a project enterprise before resources are committed or scheduled. Guidance on timing and scoping of the use of these technical project resources is difficult to convey, and during training such guidance is generally provided for use in an ideal world rather than a real one. Requiring that particular techniques are carried out on a project offers no assurance of usability, or of use of the results of the activity by those responsible for constructing the product.

6. The challenges presented by ISO 13407 and ISO TR 18529

The introduction of new standards for the conduct of user-centred design presents a challenge to those associated with the subject, including practitioners, trainers and specialists. It demands that we 'raise our game'.

6.1 CHALLENGES FOR DESIGNERS AND FOR TRAINING CURRICULA

ISO 13407 is a clear, succinct (26-page) description of internationally-endorsed best practice. The implications of the introduction of ISO 13407 and ISO TR 18529 are profound, and potentially include liability issues. Designers who cannot trace their design processes to ISO 13407 are potentially at risk since a legal defence for using an approach other than the one that has been internationally discussed, agreed, unanimously voted and published world wide is difficult at best. The status of ISO 13407 as an EN (European standard) also has implications in Europe. The European Display Screen Equipment Directive (European Commission, 1990) requires that the “principles of software ergonomics” are applied in the development of software. When seeking a definition of principles it is hard to argue against an international standard.

The ability to measure the extent to which good practice is being followed (using ISO TR 18529) has further implications:

1. it is likely to promote uptake of user-centred design, on the principle of "what gets measured gets done"

2. it raises the competitive stakes by enabling suppliers in competitive markets to provide validated product endorsement based on process metrics.

The curricula for courses in Design, Systems and Software Engineering, Human Factors and HCI need to take account of the existence of an authoritative standard for human-centred design. However, HCI training material that gives due recognition to the European Display Screen Equipment Directive (European Commission, 1990) such as in Hill (1995) is the exception rather than the rule. Indeed, a recent UK Government publication on 'best practice' in user-centred design (CCTA, 2000), which ignores both the Directive and resulting legislation, and the standards under discussion here, and those in Bevan (2001b), may well be putting both readers and its authors in harm's way.

6.2 CHALLENGES FOR HCI SPECIALISTS AND CONSULTANTS

Human-centred process assessment is a tool that can be used to demonstrate the validity and value of the Human Factors/HCI 'panacea'. The introduction of ISO 13407 and ISO TR 18529 enables the mainstream engineering community to critique HCI specialists in the way that specialists have critiqued the engineering designers. "*Software designers are rightly saying to us 'Well OK, if we get it so wrong you come and tell us in easy, understandable ways how to get it right. And prove to us that your poultices, potions and pink pills are really potent and successful, and above all easy for us to swallow and use.' That's the challenge in HCI today*" (Shackel *in* Earthy *et al*, 1998). The authors claim that the ability to assess capability in the performance of user-centred design provides a significant part of the evidence called for by Shackel. Through a suitable combination of the process and product assessments described in Table 1, it is now possible to assess the value (for example, the effectiveness) of each and every HF/HCI tool, methodology and lifecycle. It is also possible to deduce the competence of practitioners. The improvement of human-centred processes is a mechanism through which Human Factors/HCI can be made to work.

The expression of user-centred design in engineering terms and its presentation as an International Standard also has implications for the discipline's self-perception and for its presentation to others. It is no longer possible to claim user interface design or user-centred design as an obscure specialism. The discipline can legitimately claim to be 'normal business' for software or system engineering. Whilst a successful outcome may depend on an experienced usability professional, the definition of success is in terms of the process rather than expertise. Thus, the Technical Competence approach, achieving individual success by dint of great consulting expertise and detailed product knowledge (Mauro, 1994), or by the use of guerrilla tactics (Nielsen, 1993), can be recognised and assessed but is also seen as a low level of process maturity.

7. Opportunities offered to the HF/HCI community by ISO 13407 and ISO TR 18529

The introduction of these process standards presents a number of opportunities to the Human Factors and Human Computer Interaction community by creating the potential for new alliances.

7.1 ALLIANCES WITH SOFTWARE PROCUREMENT

Process models offer the potential to change the custom software business model by forming an alliance with the customer. There is a sector of the software supply industry that depends on poor usability for economic survival. The strategy is to bid at below cost for fixed-price competitively-tendered supply against a contracted set of requirements, to deliver a system

that meets the requirements (and so obtain payment) but which is unusable, thus leading to large quantities of profitable post-design support. The inclusion of compliance with ISO 13407 in the contract, with the use of ISO TR 18529 for assessment purposes, frustrates this strategy in a way that methodologies, guidelines, handbooks, or expert consultants cannot. Post award-of-contract, the use of process assessment and process improvement can complement mandated deliverables as management tools and financial incentives.

7.2 ALLIANCES WITH SOFTWARE MANAGEMENT AND DESIGN

Software and System Engineering have made a similar move from method to process, e.g. from SSADM and Information Engineering to the development of standards such as ISO 15504, the Software Engineering Institute's Capability Maturity Model (CMM), ISO 12207 and ISO 15288. The development of a process model for user-centred design that is compatible with engineering models and quality standards enables usability professionals to form new alliances (with quality managers, process architects and Software Process Improvement initiatives), and to take advantage of accepted initiatives for process improvement. For example, ISO 9001:2000 includes a requirement for continuous improvement of selected processes. The availability of a process model for human-centred design eases its inclusion in the scope of continuous improvement. Similar benefits can be obtained from a process model compatible with CMM and ISO 15504.

It is also important to note that globalisation and international collaboration are forcing convergence on single standards, in contrast to the profusion of methodology guides and standards promoted in the 1980's. ISO 13407 fits into this new class of standards. As the new version of ISO 12207 (incorporating a usability process based on ISO TR 18529) and ISO 15288 (incorporating Human Factors issues) emerge, there will be further benefits to be obtained.

Section 5 outlined the considerable academic and corporate interest in understanding how to make structured Process Improvement work at a business level and in the fields of software and system engineering. The proportion of ‘grey’ references in this paper is an indication that research into user-centred process has, so far, been led from industry rather than the Human Sciences. However, the human sciences can make contributions at both the cognitive and organisational levels (Clegg, 1996):

- the usability of Process Improvement in general: the HCI community has much to contribute to understanding Process Improvement for processes beyond those that deliver usability,
- the social and human science aspects of organisational change have yet to be investigated fully in the context of process maturity,
- the context of application of process models: the limits to existing process models need to be understood, for example how variables in users, tasks, technology affect the ease of achievement of process outcomes.

Jokela (2000) has started to investigate the basis for conducting assessment and Process Improvement, with consideration given to non-process perspectives.

7.3 ALLIANCES WITH BUSINESS AND QUALITY METRICS

An alliance can be made between usability engineering and business-level metrics. For example, in Europe the European Foundation for Quality Management (EFQM, 1999) has a business excellence model that is becoming widely adopted for organisational benchmarking (equivalent models are used in the US and Japan). The approach and content of the EFQM are compatible with ISO TR 18529, offering the opportunity for usability process metrics to

be included at corporate level. The World Wide Web has changed the importance of usability for many organisations. As Nielsen (1999) has pointed out "*In product design and software design, customers pay first and experience usability later. On the web, users experience usability first and pay later.*" Business therefore becomes critically dependent on usability. As a result, the component of the EFQM related to customer results becomes largely concerned with user-centred design. ISO TR 18529 offers a way to assess the likelihood of achieving usability in a manner that is compatible with EFQM in the context of e-commerce.

7.4 ALLIANCES WITH GOVERNMENT AND CITIZENSHIP

The increasing role of evaluation against performance measures in the public sector (Chelimsky & Shadish, 1997) offers both an opportunity and a challenge to usability professionals. For example, the UK Government now sets targets beyond regularity and propriety in the investment of public monies and requires demonstration of effectiveness of public IT systems from the citizen's point of view. The ability to measure the extent to which user needs are being addressed has the potential to deliver a powerful metric at programme level, with overtones of citizenship and accessibility for all, particularly in the domain of e-government.

8. The implications of ISO 13407 and ISO TR 18529

ISO 13407 and ISO TR 18529 present a definition of user-centred design expressed in the language of its user - the system designer. This definition can be integrated with definitions of software engineering and system engineering. This represents a quantum step forward for Human Factors and HCI.

The immediate implication of these standards is that software engineers, system engineers and usability professionals have a professional responsibility to adopt this definition of good practice as their baseline. This has cultural implications both for the technical focus of engineers and for the research focus of usability professionals. It also demands that earlier definitions of HCI (in terms of methods such as formal analysis, user interface design, usability testing or as specialist consultancy) are recognised as 'steps on the way' and consigned to history. The implications for teaching and training are similar; software engineers and human factors students need to be taught about these standards, why they are useful and how to do work which complies with them.

Usability is being pushed to centre stage in the marketplace. The usability of web applications and generic IT products has become the subject of commercial importance. The move to electronic service delivery by governments makes ease of access and understanding important aspects of citizenship (PIU, 2000). User-centred design has now reached a level of definition that allows Human Factors and HCI to meet these challenges, i.e. there is an engineering statement of best practice against which its capability can be assessed. This statement is a powerful tool to introduce and train user centred design in organisations (through assessments).

The implication for applied research is a need for re-definition of focus and direction to support effective practice in a new framework:

- Standards clarify what is known and what is still to be developed. Standardisation brings research into user-centred design under version control. ISO 13407 and ISO TR 18529 provide the framework for how user-centred design is to be practised. Methodologies and lifecycles should be defined in terms of their relationship to these international standards. Successive versions of standards incorporate changes in practice emerging from their application. In the case of user-centred design this is likely to be in areas such as

improved efficiency or issues relating to scope of application. Standardisation should not be taken to imply the end of research in user-centred design. For example, Malcolm Mills speaking at the Human Factors Integration Symposium (Mills, 1999) highlighted the relative lack of predictive capability in HCI and a need to lessen its dependence on an iterative lifecycle.

- The development of process metrics. Process assessment in general is in its infancy regarding the value and meaning of the results of a process assessment. Research is required into the type and interpretation of the measures that can be made of a process, the establishment of benchmarks and, in the longer term, normalised assessment tools.
- The context of use of HCI. Usability engineering is not just about the user interface and does not work in isolation. Research is required into the most effective means of integrating user-centred design processes and techniques with other systems disciplines. Sociologically, research is required into barriers to the uptake of user-centred approaches within technically-driven engineering disciplines.

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International standards are available from national standards bodies or from International Organisation for Standardisation, Geneva, Switzerland.

Annex 1: Terminology of process description, assessment and improvement

A technical or management task that contributes to the creation of the output (work products) of a process or enhances the capability of a process is called an **activity** or a **practice**. The elements of the format used to describe processes in ISO 15504 are listed below. These have been followed in ISO TR 18529 *Human-centred lifecycle process descriptions*:

- **Process number** - for precise reference
- **Process name** - summary of the process
- **Purpose of process** - what is done by the process
- **Outcome** - why it is done, the result of successful application of a process
- **Practices** - what is done to fulfill the purpose
  - Practice number - for precise reference
  - Practice name - summary of the practice
  - Description of practice - what task is performed

- **Work products** - the items used and produced by the process including the following: pieces of information, documents, hardware, software, training courses, awareness in individuals.

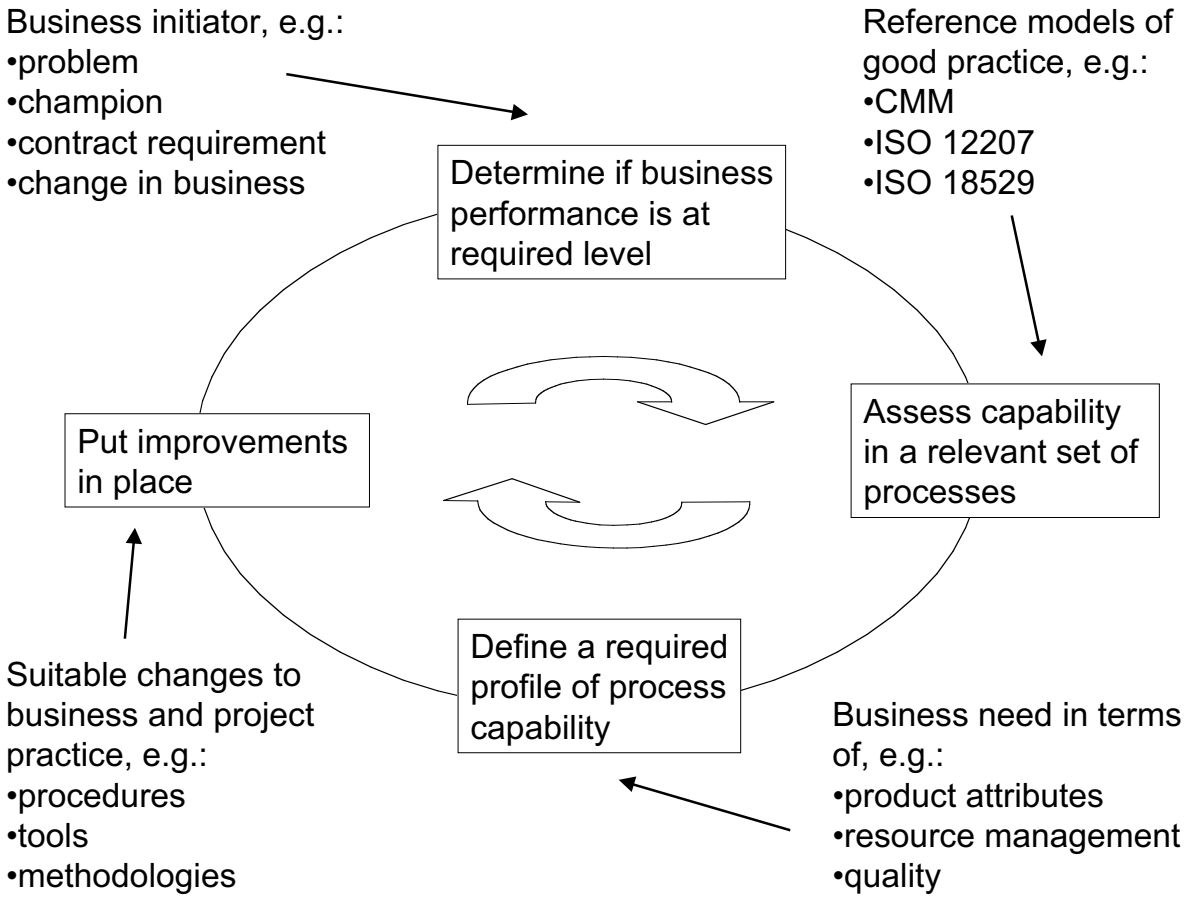
A disciplined evaluation of an organisation's processes against a model is called **process assessment**. Process assessments generally focus on identifying improvement priorities (i.e. a formative evaluation). Action taken to change an organisation's processes so that they meet the organisation's business needs and achieve its business goals more effectively is called **process improvement**. Process assessment and improvement are described in more detail below. Process assessment seeks firstly to establish whether processes are performed successfully and secondly the degree to which processes are under control. A scale of **capability** is used in this assessment. A capability scale is an ordinal scale of types of control. The most common scale (used in both the Capability Maturity Model, CMM, Paulk *et al*, 1993) and ISO 15504) uses six levels to assess process capability:

0 no achievement of results from a processes or processes (level 0),
1 performance in an *ad hoc* manner (level 1),
2 monitoring of time and product quality (level 2),
3 use of defined corporate procedures and infrastructure (level 3),
4 use of statistical control (level 4)
5 optimisation of each process to meet current and future business needs (level 5).

A process assessment will examine the evidence for the performance of practices and the existence and quality of work products. However, the final decision as to the degree of performance of a project is based on the degree to which the outcomes are achieved.

Process improvement is an iterative activity. Figure 1 summarises the processes implemented in the examples in Annex 4 and presents them as a cycle comprising the following stages: review of business need, selection of relevant reference processes, assessment of current capability, definition of required performance, deciding how to make up any shortfall (and how to preserve good practice), and organisational change. Assessment of current capability is made by examining one or more projects, ideally covering a range of lifecycle stages (from initiation to completion).

Figure 1. The process improvement process



The guiding objective in process improvement is benefit to business. Fayad and Laitinen (1997) illustrate the risks and costs of unplanned process improvement. Approaches to planned process improvement are proposed by Zultner (1993), who describes a procedure for selecting the processes to be improved based on product attributes, and by Keen (1997), who describes a procedure for selecting the processes to be improved based on business goals. The examples of the implications of ISO12207 and ISO 15288 given in section 6 illustrate the range of possible business drivers for process improvement. Whatever approach is used, cost-benefit depends on fitting the approach used to the organisation's process needs, and some form of assessment of current practice is always necessary in order to identify strengths and weaknesses. This assessment need not be very rigorous or cover a wide range of processes. Table 4 describes approaches to assessment and the benefits given to particular types of organisation.

Table 4. Uses of process assessment

		Type of organisation				
		Contract orientation	**Service orientation**	**Quality orientation**	**Enterprise/ Partnership**	**Description of the approach in use by organisations**
Approach used	**Certificate**	Preferred	Used		Used	Achievement of a target level of organisational capability for a generic set of processes. (The most traditional approach, e.g. CMM)
	Risk assessment	Used			Preferred	Capability in a set of processes relevant to risks of a particular mission or project.
	Profile		Preferred	Used		Capability rating in a wide range of processes. Give general picture against which to improve.
	Workshop			Preferred		Informal examination of a project or organisational unit against the requirements of a process model.
	Rationale for organisat-ions to use this approach	Certificates provide a testimonial of capability. Risk assessments are used by clients. Contracts are placed subject to specified improvements	The most common use is for benchmarking against other organisations. Certificates have a built-in reference. Profiles are more diagnostic and derived from business goals.	An organisat-ional focus on process improvement is commonly found in generic product development, especially in Japan. Capability may be assessed informally.	Organisations combining to develop or operate a system need a clear understanding of weakness in key areas. This includes the customer and user organisation.	

Whichever approach to assessment is to be used, it needs to be tailored and focused for efficiency. In practice, the efficiency of any approach to process assessment depends on designing the assessment to examine only the processes which are related to the selected drivers for process improvement. Examples of drivers are risks related to a particular contract, competitor capability, and defects which occur across versions or lines of products. With more formal assessments this tailoring takes place prior to assessment. Workshop-style assessment can be more flexible and tailoring may take place within the workshop itself.

Annex 2: Features of ISO 13407

This annex contains a summary of ISO 13407:1999 *Human-centred design processes for interactive systems* and presents its contents list.

Table 5. Overview of ISO 13407

Title	**ISO 13407** ***Human-centred design processes for interactive systems***
Date	July 1999
Scope	Guidance on human-centred design activities throughout the life cycle of interactive computer-based systems.

Contents	The rationale for a user-centred design process. A description of the four core principles of human-centred design. Planning of the user-centred design process. Description of the four activities which should take place during a system development process. A listing of current process and product standards for user-centred design.
Purpose	ISO 13407 aims to help those responsible for managing hardware and software design processes to identify and plan effective and timely user-centred design activities. It complements existing design approaches and methods.
Audience	Those managing the design process. All parties involved in human-centred system development, including the end-users of systems are expected to find the standard relevant.
Requirements	Any development process which claims to have met the recommendations in ISO 13407 shall specify the procedures used, information collected and use made of the results.

The clauses of the standard are as follows:

Introduction
1 Scope
2 Terms and definitions
3 Structure of this International Standard
4 Rationale for adopting a human-centred design process
5 Principles of human-centred design
- 5.1 General
- 5.2 The active involvement of users and a clear understanding of user and task requirements
- 5.3 An appropriate allocation of function between user and technology
- 5.4 Iteration of design solutions
- 5.5 Multi-disciplinary design

6 Planning the human-centred design process
7 Human-centred design activities
- 7.1 General
- 7.2 Understand and specify the context of use
- 7.3 Specify the user and organisational requirements
- 7.4 Produce design solutions
- 7.5 Evaluate designs against requirements

8 Conformance

Annex A (informative) Guidance on other relevant standards
Annex B (informative) Example of a structure for a usability evaluation report
Annex C (informative) Sample procedure for demonstrating conformance to this International Standard
Bibliography

Annex 3: ISO TR 18529 Processes for human-centred design

This annex presents a summary of ISO TR 18529:2000 *Human-centred lifecycle process descriptions*, and partial descriptions of the Human-Centred Design (HCD) processes contained therein.

Table 6. Overview of ISO TR 18529

Title	**ISO TR 18529 *Human-centred lifecycle process descriptions***
Date	April 2000
Scope	A formalised model based on the human-centred processes described in ISO 13407 *Human-centred design processes for interactive systems*.
Contents	Structured descriptions of the processes which comprise a human-centred approach and lists their components, outcomes and the information used and produced. The processes in the model are described in the format defined in ISO TR 15504 *Software process assessment*.
Purpose	The model is intended for use in the specification, assessment and improvement of the user-centred processes in system development and system operation. The Technical Report is intended to act as an annex to ISO 13407 for use by process assessors.
Audience	Those who are involved in the design, use and assessment of lifecycle processes for system, hardware and software. Human Factors and HCI practitioners involved in the development of products or systems are identified as secondary users and beneficiaries of this document.
Requirements	The TR is not normative but contains an annex which describe the requirements placed on derived assessment models by ISO 15504, the software equivalent of ISO TR 18529.

HCD processes address the consideration of end-users and other stakeholders in the specification, development and operation of a system. The processes always relate to the worksystem under development, not just the details of the hardware and software. The processes account for human-centred activities throughout the life of a system. Each process description is presented in the form: Process number, Heading, Purpose, list of Outcomes, list of Practice headings. The use of each part of the description is summarised in Annex 1 of this paper. Practices are enacted through the use of methods, techniques and tools. Particular human-centred methods, techniques and tools are not described in ISO TR 18529. However, some explanatory notes to the practices illustrate the requirements of methods, techniques and tools. Table 7 (taken from Earthy, 1998a) summarises the processes and practices in ISO 18529 and the following text details each Human-Centred Design process and its outcomes and practices.

Table 7. Human-Centred Design processes in ISO 18529

Human-centred system development

HCD 1	HCD 2	HCD 3	HCD 4	HCD 5	HCD 6	HCD 7
Ensure HCD content in systems strategy	**Plan and manage the HCD process**	**Specify stakeholder and organisational requirements**	**Understand and specify the context of use**	**Produce design solutions**	**Evaluate designs against requirements**	**Introduce and operate the system**
represent stakeholders	consult stakeholders	clarify system goals	identify user's tasks	allocate functions	specify context of evaluation	manage change
collect market intelligence	plan user involvement	analyse stakeholders	identify user attributes	produce task model	evaluate for requirements	determine impact
define and plan system strategy	select human-centred methods	assess H&S risk	identify organisational environment	explore system design	evaluate to improve design	customisation and local design
collect market feedback	ensure a human-centred approach	define system	identify technical environment	develop design solutions	evaluate against system requirements	deliver user training
analyse user trends	plan HCD activities manage HC activities	generate requirements	identify physical environment	specify system and use	evaluate against required practice	support users
	champion HC approach	set quality in use objectives		develop prototypes	evaluate in use	conformance to ergonomic legislation
	support HCD			develop user training		
				develop user support		

HCD.1 ENSURE HCD CONTENT IN SYSTEM STRATEGY

The purpose of the process *Ensure HCD content in system strategy* is to establish and maintain a focus on stakeholder and user issues in each part of the organisation which deals with system markets, concept, development and support. As a result of successful implementation of this process:

- marketing will take account of usability, ergonomics and socio-technical issues
- systems will be targeted to meet users' needs and expectations
- planners will consider stakeholder and organisation requirements in setting out systems strategy
- the system will be more responsive to changes in its users (their needs, tasks, context etc.)
- the enterprise will be more responsive to changes in its users
- the system is less likely to be rejected by the market.

This process comprises the following practices:

- Represent the end-user
- Collect market intelligence
- Define and plan a system strategy
- Collect market feedback
- Analyse trends in users

HCD.2 PLAN AND MANAGE THE HCD PROCESS

The purpose of the process *Plan and manage the human-centred design* is to specify how the human-centred activities fit into the whole system lifecycle process and the enterprise. As a result of successful implementation of this process:

- the project plan will allow for iteration and incorporation of user feedback

- resources will be allocated for effective communication between the design team participants
- potential conflicts and trade-offs between human-centred and other issues will be reconciled
- human-centred processes will be incorporated into quality systems, procedures and standards
- human-centred issues will be supported and promoted within the organisation.

This process comprises the following practices:

- Consult stakeholders
- Identify and plan user involvement
- Select human-centred methods and techniques
- Ensure a human-centred approach within the project team
- Plan human-centred design activities
- Manage human-centred activities
- Champion human-centred approach
- Provide support for human-centred design

HCD.3 SPECIFY THE STAKEHOLDER AND ORGANISATIONAL REQUIREMENTS

The purpose of the process *Specify the stakeholder and organisational requirements* is to establish the requirements of the organisation and other interested parties for the system. This process takes full account of the needs, competencies and working environment of each relevant stakeholder in the system. As a result of successful implementation of the process, the following will be defined:

- required performance of new system against operational and functional objectives
- relevant statutory or legislative requirements
- co-operation and communication between users and other relevant parties
- the users' jobs (including the allocation of tasks, users' comfort, safety, health and motivation)
- task performance of the user with the system
- work design, and organisational practices and structure
- feasibility of operation and maintenance
- objectives for the operation and/or use of the software and hardware components of the system.

This process comprises the following practices:

- Clarify and document system goals
- Define stakeholders
- Assess risk to stakeholders
- Define the system
- Generate the stakeholder and organisational requirements
- Set quality in use objectives

HCD.4 UNDERSTAND AND SPECIFY THE CONTEXT OF USE

The purpose of the process *Understand and specify the context of use* is to identify, clarify and record the characteristics of the stakeholders, their tasks and the organisational and physical environment in which the system will operate. As a result of successful implementation of this process the following will be defined:

- the characteristics of the intended users
- the tasks the users are to perform
- the organisation and environment in which the system is used.

This process comprises the following practices:

- Identify and document user's tasks
- Identify and document significant user attributes

- Identify and document organisational environment
- Identify and document technical environment
- Identify and document physical environment

HCD.5 PRODUCE DESIGN SOLUTIONS

The purpose of the process *Produce design solutions* is to create potential design solutions by drawing on established state-of-the-art practice, the experience and knowledge of the participants and the results of the context of use analysis. As a result of successful implementation of the process:

- the whole socio-technical system in which any technical components operate will be considered in the design
- user characteristics and needs will be taken into account in the purchasing of system components
- user characteristics and needs will be taken into account in the design of the system
- existing knowledge of best practice from socio-technical systems engineering, ergonomics, psychology, cognitive science and other relevant disciplines will be integrated into the system
- communication between stakeholders in the system will be improved because the design decisions will be more explicit
- the development team will be able to explore several design concepts before they settle on one
- stakeholder and end-user feedback will be incorporated in the design early in the development process
- it will be possible to evaluate several iterations of a design and alternative designs
- the interface between the user and the software, hardware and organisational components of the system will be designed
- user training and support will be developed.

This process comprises the following practices:

- Allocate functions
- Produce composite task model
- Explore system design
- Use existing knowledge to develop design solutions
- Specify system
- Develop prototypes
- Develop user training
- Develop user support

HCD.6 EVALUATE DESIGNS AGAINST REQUIREMENTS

The purpose of the process *Evaluate designs against requirements* is to collect feedback on the developing design. This feedback will be collected from end users and other representative sources. As a result of successful implementation of this process:

- feedback will be provided to improve the design
- there will be an assessment of whether stakeholder and organisational objectives have been achieved or not
- long-term use of the system will be monitored.

In the case of evaluation to identify improvements to the system (formative evaluation), successful implementation of the process will reflect:

- potential problems and scope for improvements in: the technology, supporting material, organisational or physical environment and the training
- which design option best fits the functional and user requirements
- feedback and further requirements from the users.

In the case of evaluation to assess whether objectives have been met (summative evaluation), successful implementation of the process will demonstrate:

- how well the system meets its organisational goals
- that a particular design meets the human-centred requirements

- conformity to international, national and/or statutory requirements.

This process comprises the following practices:

- Specify and validate context of evaluation
- Evaluate early prototypes in order to define the requirements for the system
- Evaluate prototypes in order to improve the design
- Evaluate the system in order to check that the system requirements have been met
- Evaluate the system in order to check that the required practice has been followed
- Evaluate the system in use in order to ensure that it continues to meet organisational and user needs

HCD.7 INTRODUCE AND OPERATE THE SYSTEM

The purpose of the process *Introduce and operate the system* is to establish the human-system aspects of the support and implementation of the system. As a result of successful implementation of this process:

- the needs of the stakeholders of the system will be communicated to the project
- the management of change, including the responsibilities of users and developers, will be specified
- the support requirements of end-users, maintainers and other stakeholders will be addressed
- there will be compliance to health and safety procedures
- local customisation of the system will be supported
- user reactions will be collected and the resulting changes to the system reported back to stakeholders.

This process comprises the following practices:

- Management of change
- Determine impact on organisation and stakeholders
- Customisation and local design
- Deliver user training
- Support users in planned activities
- Ensure conformance to workplace ergonomic legislation

Annex 4: Examples of the improvement of user-centred processes

A4.1 FORMAL ASSESSMENT AGAINST THE USABILITY MATURITY MODEL

The UK Inland Revenue in conjunction with software supplier EDS (Bevan and Ryan, 2000) used formal assessment against the Usability Maturity Model to obtain a thorough assessment of the extent to which the partnership was making use of user-centred techniques, and to provide a basis for improvement.

4.1.1 Procedure

A conventional software process assessment procedure based on ISO TR 15504 *Software process assessment* was used to assess the extent to which (a) the objectives in the Usability Maturity Model were achieved and (b) the defined practices were used. A formal assessment lasting one week was carried out by two assessors, assisted by two usability specialists who identified opportunities for process improvement. A total of 13 stakeholders associated with the trial project at different levels were interviewed in twelve 3-hour sessions.

Twelve months later when the improvements had been made, a second similar assessment was carried out to see whether the improvement objectives had been achieved.

4.1.2 Result

The assessment produced a detailed profile of capability in the human-centred processes and rich information about where improvements would be beneficial. At a feedback meeting on the last day of the assessment it provided the basis for an agreed set of improvement activities.

When the results of the second assessment were presented to a meeting of senior stakeholders, the benefits were sufficient for the meeting to authorise incorporation of most of the new user-centred design methods into the organisations' documented processes. The meeting also suggested that regular usability maturity assessments should be arranged to monitor improvement.

A4.2 INFORMAL ASSESSMENT AGAINST THE USABILITY MATURITY MODEL

The Usability Maturity Model was used by Israel Aircraft Industries (a) to obtain an understanding of the extent to which the organisation was making use of user-centred techniques, and (b) to provide a basis for improvement (Bevan and Bogomolni, 2000).

4.2.1 Procedure

The activities in the Usability Maturity Model were used as a good practice checklist for a day of interviews. The process improvement specialist rated each activity as not performed, largely performed or managed, based on a short discussion with one or two developers or managers who were most knowledgeable in each area.

Further short interviews were held 16 months later after improvements had been made.

4.2.2 Result

Although some ratings may not have been completely representative, they were sufficient to provide the basis for an agreed programme of improvement. As the process improvement specialist who had been carrying out the improvements also carried out the second interviews, it was easy to agree on the extent of the improvement with the organisation in less than two hours.

A4.3 INFORMAL ASSESSMENT AGAINST THE HUMANWARE MODEL

The HumanWare model was used by Philips (Taylor *et al*, 1998) when this large consumer and high technology product manufacturer identified the need to raise the corporate profile of user issues and integration of user-centred design, especially in the organisation's marketing function.

4.3.1 Procedure

Philips Corporate Design worked with the Carnegie Mellon University Software Engineering Institute (inventors of the Capability Maturity Model) to define a set of processes for the user-centred design of generic products, for a user-centred approach to marketing, and for management processes specific to the use of information about users within a design project. The model is used as the basis of an annual workshop for each project. The workshop is facilitated by someone familiar with Human Factors and the process model. It is not an assessment, although the project may take an informal record of good and bad points about its performance of the processes. The result is the actions taken by the attendees for the coming year. Many actions relate to timeliness or effectiveness of project communications regarding user requirements and usability issues.

4.3.2 Result

The result is integration of user-centred design into project activity with an improved user experience for the purchasers and/or users of Philips products. There is a corporate standard approach to user-centred design that is tailored and owned by each project and reviewed on a regular basis.