Criteria for selecting methods in user-centred design

Nigel Bevan

Professional Usability Services
12 King Edwards Gardens, London W3 9RG, UK
mail@nigelbevan.com
www.nigelbevan.com

ABSTRACT

The ISO TR 16982 technical report which provides guidance on the use of usability methods is being revised as ISO 9241-230. This paper describes the procedure currently being suggested for selecting user-centred design methods. The best practices in ISO PAS 18152 are prioritised based on the assessed benefits and risks, then the most appropriate methods to achieve the best practices are identified.

SELECTING USER-CENTRED DESIGN METHODS

Previous approaches to methods selection have focussed on the strengths and weaknesses of individual methods (e.g. [3]), and their cost benefits (e.g [1]). However the reason for using usability methods is to make specific contributions to user-centred design. As Wixon [6] says, "the goal is to produce, in the quickest time, a successful product that meets specifications with the fewest resources, while minimizing risk". "In the world of usability work on real products embedded in a corporate and business framework, we must focus on factors of success, such as how effectively the method introduces usability improvements into the product."

The approach suggested in this paper is to first identify the necessary user centred design activities, then select the most appropriate methods based on the design and organisational context.

The proposed steps needed to select user-centred methods for a project are:

1. Identify which categories of human-system (HS) best practice activities in Annex A can increase business benefits or reduce project risks.

   For any category of system development activity in column 1 of Annex A, the UCD professional can reference the best practice activities in column 2 (and read the explanation of them in ISO PAS 18152 if necessary). They can then use Annex C to help judge to what extent carrying out or not carrying out these activities will influence the final usability of the product, and hence result in potential business benefits from improved usability, or in project risks from inadequate usability [2].

2. For the selected categories of best practice activities choose the most appropriate methods:

   a) To what extent will each possible method listed in column 3 of Annex A achieve the best practices?

      NOTE   This relies on the expertise of the UCD professional supported by the documentation of the methods, such as that being developed by the Usability Body of Knowledge [5].

   b) How cost effective is each possible method likely to be?

      The most cost-effective methods can be selected by using Annex B to identify the method types, and then taking account of the associated strengths, weakness and constraints of each method type (examples of which are given in Annex D):

      - Constraints: time, cost, skills available, access to stakeholders and other users (Tables 4, 5 and 8 from 16982).

      - The nature of the task: complexity, amount of training required, consequences of errors, time pressure (Table 6 from 16982).

      - The nature of the product: whether new, complexity (Table 7 from 16982).

      - Context of use: range of contexts, how well understood (Table 9, to be done).

The selection of appropriate methods can be carried out as part of project planning, and may also be reviewed prior to each system development activity.

As the development of ISO 9241-230 is in the early stages, feedback on this proposed approach s welcomed.

REFERENCES

[1]   Bevan, N. (2005). Cost benefits framework and case studies. In: Bias, R.G. & Mayhew, D.J. (eds) (2005). Cost-Justifying Usability: An Update for the Internet Age. Morgan Kaufmann.

[2]   Bevan, N. (2008) Reducing risk through Human Centred Design. Proceedings of I-USED 2008, Pisa, September 2008.

[3]   ISO TR 16982 (2002). Usability methods supporting human-centred design

[4]   ISO PAS 18152 (2003). A specification for the process assessment of human-system issues.

[5]   UPA (2009) Usability Body of Knowledge. www.usabilitybok.org

[6]   Wixon, D. (2003) Evaluating usability methods: why the current literature fails the practitioner. Interactions, 10 (4) pp. 28-34.

Annex A. Examples of methods that can be used to support HS best practices

Activity category	Best practices for risk mitigation	UCD methods and techniques
1. Envisioning opportunities	•Identify expected context of use of systems [forthcoming needs, trends and expectations]. •Analyze the system concept [to clarify objectives, their viability and risks].	-Future workshop -Preliminary field visit -Focus groups -Photo surveys -Simulations of future use environments -In-depth analysis of work and lifestyles
2. System scoping	•Describe the objectives which the user or user organization wants to achieve through use of the system.	-Participatory workshops -Field observations and ethnography -Consult stakeholders -Human factors analysis
	•Define the scope of the context of use for the system.	-Context of use analysis
3. Understanding needs a) Context of use	•Identify and analyze the roles of each group of stakeholders likely to be affected by the system. •Describe the characteristics of the users. •Describe the cultural environment/ organizational/ management regime. •Describe the characteristics of any equipment external to the system and the working environment. •Describe the location, workplace equipment and ambient conditions. •Decide the goals, behaviours and tasks of the organization that influence human resources •Present context and human resources options and constraints to the project stakeholders.	-Success critical stakeholder identification -Field Observations and ethnography -Participatory workshop -Work context analysis -Context of use analysis -Event data analysis -Participatory workshops -Contextual enquiry
b) Tasks	•Analyze the tasks and worksystem.	-Task analysis -Cognitive task analysis -Work context analysis
c) Usability needs	•Perform research into required system usability.	-Investigate required system usability -Usability benchmarking -Heuristic/expert evaluation
d) Design options	•Generate design options for each aspect of the system related to its use and its effect on stakeholders. •Produce user-centred solutions for each design option.	-Early prototyping & usability evaluation -Develop simulations -Parallel design (tiger testing)
4. Requirements a) Context requirements	•Analyze the implications of the context of use. •Present context of use issues to project stakeholders for use in the development or operation of the system.	-Define the intended context of use including boundaries
b) Infrastructure requirements	•Identify, specify and produce the infrastructure for the system. •Build required competencies into training and awareness programs. •Define the global numbers, skills and supporting equipment needed to achieve those tasks.	-Identify staffing requirements and any training or support needed to ensure that users achieve acceptable performance
c) User requirements	•Set and agree the expected behaviour and performance of the system with respect to the user. •Develop an explicit statement of the user requirements for the system. •Analyze the user requirements. •Generate and agree on measurable criteria for the system in its intended context of use.	-Scenarios -Personas -Storyboards -Establish performance and satisfaction goals for specific scenarios of use -Define detailed user interface requirements -Prioritize requirements (eg QFD)
5. Architecting solutions a) System architecting	•Generate design options for each aspect of the system related to its use and its effect on stakeholders. •Produce user-centred solutions for each design option. •Design for customization. •Develop simulation or trial implementation of key aspects of the system for the purposes of testing with users. •Distribute functions between the human, machine and organizational elements of the system best able to fulfil each function. •Develop a practical model of the user's work from the requirements, context of use, allocation of function and design constraints for the system. •Produce designs for the user-related elements of the system that take account of the user requirements, context of use and HF data. •Produce a description of how the system will be used.	*-Function allocation* -Generate design options -Develop prototypes -Develop simulations
b) Human elements	•Decide the goals, behaviours and tasks of the organization [that influence human resources] •Define the global numbers, skills and supporting equipment needed to achieve those tasks. •Identify current tasking/duty •Analyze gap between existing and future provision •Identify skill requirements for each role	-Work domain analysis -Task analysis -Participatory design -Workload assessment -Human performance model -Design for alertness -Plan staffing

	•Predict staff wastage between present and future. •Calculate the available staffing, taking account of working hours, attainable effort and non-availability factor •Identify and allocate the functions to be performed Functional decomposition and allocation of function. •Specify and produce job designs and competence/ skills required to be delivered •Calculate the required number of personnel. •Generate costed options for delivery of training and/or redeployment •Evolve options and constraints into an optimal [training] implementation plan (4.3.5) •Define how users will be re-allocated, dismissed, or transferred to other duties. •Predict staff wastage between present and future. •Calculate the available staffing, taking account of working hours, attainable effort and nonavailability factor. •Compare to define gap and communicate requirement to design of staffing solutions.	
c) Hardware elements	See a) System architecting.	-Prototyping and usability evaluation -Physical ergonomics -Participatory design
d) Software elements	See a) System architecting.	-User interface guidelines and standards -Prototyping and usability evaluation -Participatory design
6. Life-cycle planning a) Planning	•Develop a plan to achieve and maintain usability throughout the life of the system. •Identify the specialist skills required and plan how to provide them.	-Plan to achieve and maintain usability -Plan use of HSI data to mitigate risks
b) Risks	•Plan and manage use of HF data to mitigate risks related to HS issues. •Evaluate the current severity of emerging threats to system usability and other HS risks and the effectiveness of mitigation measures. •Take effective mitigation to address risks to system usability.	-HSI program risk analysis
c) User involvement	•Identify the HS issues and aspects of the system that require user input. •Define a strategy and plan for user involvement. •Select and use the most effective method to elicit user input. •Customize tools and methods as necessary for particular projects/stages. •Seek and exploit expert guidance and advice on HS issues.	-Identify HSI issues and aspects of the system requiring user input -Develop a plan for user involvement -Select and use the most effective methods -Customize tools and methods as necessary
d) Acquisition	•Take account of stakeholder and user issues in acquisition activities.	-Common Industry Format
e) Human resources	•Implement the HR strategy that gives the organisation a mechanism for implementing and recording lessons learnt •Enable and encourage people and teams to work together to deliver the organization's objectives. •Create capability to meet system requirements in the future (conduct succession planning) •Develop and trial training solution to representative users. •Deliver final training solutions to designated staff according to agreed timetable. •Provide means for user feedback [on human issues].	
7. Evaluation a) Risks	•Assess the health and well-being risks to the users of the system. •Assess the risks to the community and environment arising from human error in the use of the system. •Evaluate the current severity of emerging threats to system usability and other HS risks and the effectiveness of mitigation measures. •Assess the risks of not involving end users in each evaluation.	-Risk analysis (process and product)
b) Plan and execute	•Collect user input on the usability of the developing system. •Revise design and safety features using feedback from evaluations. •Plan the evaluation. •Identify and analyze the conditions under which a system is to be tested or otherwise evaluated. •Check that the system is fit for evaluation. •Carry out and analyze the evaluation according to the evaluation plan. •Understand and act on the results of the evaluation.	-Obtain user feedback on usability -Use models and simulation
c) Validation	•Test that the system meets the requirements of the users, the tasks and the environment, as defined in its specification. •Assess the extent to which usability criteria and other HS requirements are likely to be met by the proposed design.	-Compare with requirements -Common Industry Format for usability reports -Performance measurement
d) HSI knowledge	•Review the system for adherence to applicable human science knowledge, style guides, standards, guidelines, regulations and legislation.	
e) Staffing	•Decide how many people are needed to fulfill the strategy and what ranges of competence they need.	*HR*

	•Develop and trial training solution to representative users. •Conduct assessments of usability [relating to HR]. •Interpret the findings •Validate the data. •Check that the data are being used.	
8. Negotiating commitments a) business case	•Contribute to the business case for the system. •Include HS review and sign-off in all reviews and decisions	-Program risk analysis
b) requirements	•Analyze the user requirements. •Present these requirements to project stakeholders for use in the development and operation of the system. •Identify any staffing gap and communicate requirement to design of staffing solutions.	-Value-based practices and principles (identify success critical stakeholder requirements) -Common Industry Specification for Usability Requirements -Environment/organization assessment
9. Development and evolution	•Maintain contact with users and the client organization throughout the definition, development and introduction of a system. •Evolve options and constraints into an implementation strategy covering technical, integration, and planning and manning issues. •	-Risk analysis (process and product) -User feedback on usability -Use models and simulation -Guidelines: Common Industry Format for usability reports -Performance measurement
10. Monitoring and control	•Analyze feedback on the system during delivery and inform the organization of emerging issues. •Manage the life cycle plan to address HS issues. •Take effective mitigation to address risks to system usability. •Take account of user input and inform users. •Identify emerging HS issues. •Understand and act on the results of the evaluation. •Produce and promulgate a validated statement of staffing shortfall by number and range of competence.	-Organizational and environmental context analysis -Risk Analysis -User feedback -Work context analysis
11. Operations and retirement a) Operations	•Analyze feedback on the system during delivery and inform the organization of emerging issues. •Produce personnel strategy. •Review the system for adherence to applicable human science knowledge, style guides, standards, guidelines, regulations and legislation. •Deliver training and other forms of awareness-raising to users and support staff. •Assess the effect of change on the usability of the system. •Review the health and well-being risks to the users of the system. •Review the risks to the community and environment arising from human error in the use of the system. •Take action on issues arising from in-service assessment. •Perform research to refine and consolidate operation and support strategy for the system.	-Work context analysis -Organizational and environmental context analysis
b) Retirement	•Collect and analyze in-service reports to generate updates or lessons learnt for the next version of the system. •Identify risks and health and safety issues associated with removal from service and destruction of the system. •Define how users will be re-allocated, dismissed, or transferred to other duties. •Plan break-up of social structures. •Debriefing and retrospective analysis for replacement system.	
12. Organizational capability improvement a) HSI capability data collection, analysis, and improvement	•Identify and use the most suitable data formats for exchanging HF data. •Have a policy for HF data management. •Perform research to develop HF data as required. •Produce coherent data standards and formats. •Define rules for the management of data. •Develop and maintain adequate data search methods. •Feedback into future HR procurement, training and delivery strategies.	-Assess and improve HSI capability
b) Organizational skill/career and infrastructure development planning and execution	•Define usability as a competitive asset •Set usability, health and safety objectives for systems •Follow competitive situation in the market place •Develop user-centred infrastructure. •Relate HS issues to business benefits. •Establish and communicate a policy for human-centeredness. •Include HR and user-centred elements in support and control procedures. •Define and maintain HCD and HR infrastructure and resources. •Increase and maintain awareness of usability. •Develop or provide staff with suitable HS skills. •Take account of HS issues in financial management •Assess and improve HS capability in processes that affect usability, health and	-Develop and maintain HSI infrastructure and resources -Identify required HSI skills -Provide staff with HSI skills -Establish and communicate a policy on HSI -Maintain an awareness of usability

	safety. •Develop a common terminology for HS issues with the organization. •Facilitate personal and technical interactions related to HS issues. •Feedback into future HR procurement, training and delivery strategies. •Create capability to meet system requirements in the future (conduct succession planning) •Identify any opportunities for redeployment. •Develop a strategy for [HR] data gathering	

ANNEX B. METHOD TYPES

This table (in its final version) will cross-reference the methods and techniques in Annex A to the different method types in the columns of the tables in Annex D, thus enabling the criteria in Annex D to be applied to the methods and techniques in Annex A.

Usability methods and techniques	Observation of users	Performance-related measurements	Critical-incident analysis	Questionnaires	Interviews	Thinking aloud	Collaborative design and evaluation	Creativity methods	Document-based methods	Model-based methods	Expert evaluation	Automated evaluation
Assess and improve HSI capability												
Cognitive task analysis												
Common Industry Format for usability reports												
Common Industry Specification for Usability Requirements												
Compare with requirements												
Consult stakeholders												
Context of use analysis												
Contextual enquiry												
Customize tools and methods as necessary												
Define detailed user interface requirements												
Define the intended context of use including boundaries												
Design for alertness												
Develop a plan for user involvement												
Develop and maintain HSI infrastructure and resources												
Develop prototypes												
Develop simulations												
Early prototyping and usability evaluation												
Environment/organization assessment												
Establish and communicate a policy on HSI												
Establish performance and satisfaction goals for specific scenarios of use												
Event data analysis												
Field observations and ethnography												
Focus groups												
Function allocation												
Future workshop												
Generate design options												
Guidelines: Common Industry Format for usability reports												
Heuristic/expert evaluation												
HR												
HSI program risk analysis												
Human factors analysis												
Human performance model												

Method										
Identify HSI issues and aspects of the system requiring user input										
Identify required HSI skills										
Identify staffing requirements and any training or support needed to ensure that users achieve acceptable performance										
In-depth analysis of work and lifestyles										
Investigate required system usability										
Maintain an awareness of usability										
Obtain user feedback on usability										
Organizational and environmental context analysis										
Parallel design (tiger testing)										
Participatory design										
Participatory workshop										
Performance measurement										
Personas										
Photo surveys										
Physical ergonomics										
Plan staffing										
Plan to achieve and maintain usability										
Plan use of HSI data to mitigate risks										
Preliminary field visit										
Prioritize requirements (eg QFD)										
Program risk analysis										
Prototyping and usability evaluation										
Provide staff with HSI skills										
Risk analysis (process and product)										
Scenarios										
Select and use the most effective methods										
Simulations of future working environments										
Storyboards										
Success critical stakeholder identification										
Task analysis										
Usability benchmarking										
Use models and simulation										
User feedback										
User feedback on usability										
User interface guidelines and standards										
Value-based practices and principles (identify success critical stakeholder requirements)										
Work context analysis										
Workload assessment										

ANNEX C: BUSINESS BENEFITS AND PROJECT RISKS

Developing a product with increased usability can provide business benefits (Table C1, column 1). Conversely, developing a product with inadequate usability can risk not achieving stated project objectives (Table C1, column 2).

The ultimate goal of system development is to produce a system that satisfies the needs of its operational stakeholders (including users, operators, administrators, maintainers and the general public) within acceptable levels of the resources of its development stakeholders (including funders, acquirers, developers and suppliers). Operational stakeholders need a system that is effective, efficient and satisfying. Developing and delivering systems that satisfy all of these success-critical stakeholders usually requires managing a complex set of risks such as usage uncertainties, schedule uncertainties, supply issues, requirements changes, and uncertainties associated with technology maturity and technical design.

The additional expenditure needed for human centred activities is often difficult to justify because the budget holder for project development often may not personally gain from the potential business benefits such as increased sales or reduced whole life costs. Project managers may therefore be more influenced by the risks of not achieving stated project objectives. It is thus useful to understand both the potential cost benefits of usability and the associated risks when justifying resources for usability.

Table C1. Benefits and risks associated with usability

Business benefit	Risk
A. Reduced development costs	**A: Increased development costs to produce an acceptable system**
• Detecting and fixing usability problems early in the development process	• Not detecting and fixing usability problems early in the development process
• Reducing the cost of future redesign or radical change of the architecture to make future versions of the product more usable	• Increasing the cost of future redesign or radical change of the architecture to make future versions of the product more usable
• Reduced costs due to only necessary functionality	• Increased costs due to unnecessary functionality
• Reduced costs due to minimising documentation	• Increased costs due to additional documentation
• Reducing the risk of product failure	• Product fails
B: Web site usability: improved web sales	**B: Web site usability: poor web sales**
• Users more frequently find products that they want to purchase	• Users cannot find products that they want to purchase
• Users more easily find additional information (e.g. delivery, return and warranty information)	• Users cannot find additional information (e.g. delivery, return and warranty information)
• Satisfied users are more likely to make repeat purchases	• Dissatisfied users do not make repeat purchases
• Users trust the web site (with personal information and to operate correctly)	• Users do not trust the web site (with personal information and to operate correctly)
• Users recommend the web site to others	• Users do not recommend the web site to others
• Web site increases sales through other channels	• Web site fails to increase sales through other channels
• Reduced support costs	• Increased support costs
C: Product usability: improved product sales	**C: Product usability: poor product sales**
• Improve the competitive edge by marketing the products or services as easy to use	• Competitors gain advantage by marketing competitive products or services as easy to use
• Satisfied customers make repeat purchases or recommend the product to others	• Dissatisfied customers do not make repeat purchases or recommend the product to others
• Good ratings for usability in product reviews	• Poor ratings for usability in product reviews
• Improve the brand	• Brand damage
D: Improved productivity: benefits to purchasing organisation	**D: Poor productivity: risks to purchasing organisation**
• Faster learning and better retention of information	• Slower learning and poorer retention of information
• Reduced task time and increased productivity	• Increased task time and reduced productivity
• Reduced employee errors that have to be corrected later	• Increased employee errors that have to be corrected later
• Reduced employee errors that impact on the quality of service	• Increased employee errors that impact on the quality of service
• Reduced staff turnover as a result of higher satisfaction and motivation	• Increased staff turnover as a result of lower satisfaction and motivation
• Reduced time spent by other staff providing assistance when users encounter difficulties	• Increased time spent by other staff providing assistance when users encounter difficulties
E: Reduced support and maintenance costs	**E: Increased support and maintenance costs**
• Reduced support and help line costs	• Increased support and help line costs
• Reduced costs of training	• Increased costs of training
• Reduced maintenance costs	• Increased maintenance costs

ANNEX D. EXAMPLES OF CRITERIA FOR METHOD SELECTION, FROM ISO TR 16982

Legend	
++	Recommended;
+	Appropriate;
When the cell is empty	Neutral;
−	Not recommended;
NA	Not applicable (NA).

Table 4 — The constraints of the environment on the project

Project characteristics	Methods											
	Observation of users	Performance-related measurements	Critical incidents analysis	Questionnaires	Interviews	Thinking aloud	Collaborative design and evaluation	Creativity methods	Document-based methods	Model-based methods	Expert evaluation	Automated evaluation
Very tight time-scale		−	−	−		−	−		+	−	++	+
Cost/price control		−	−		−	−		−	++	−	+	
High quality level of the product to be delivered as the dominant requirement	++	++	+	++	++	+	+	+	+	+	+	+
Need for an early information/feed-back/diagnosis	+		+	++		+	+				+	
highly evolving specifications	+	+	+	+	+	+	++	+				

Table 5 — Methods related to the user characteristics

User characteristics	Methods											
	Observation of users	Performance-related measurements	Critical incidents analysis	Questionnaires	Interviews	Thinking aloud	Collaborative design and evaluation	Creativity methods	Document-based methods	Model-based methods	Expert evaluation	Automated evaluation
Cannot be involved/accessed	NA	NA	NA	NA	NA	NA	NA	NA	+	+	+	+
Can be involved/accessed	++	++	+	++	++	+	++	+	+	+	+	+
Have a significant disability	++	+	+	+	++	+	++	+	+	−	+	−