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CONFERENCE REPORT

DAVIDE BOLCHINI & DANIEL FELIX & FRANCA GARZOTTO & MILES
MACLEOD & ELKE-M. MELCHIOR*

USER-CENTRED PRODUCT CREATION WORKSHOPS
FEUP (FACULDADE DE ENGENHARIA DA UNIVERSIDADE DO PORTO), POR-
TUGAL, 11-12 JUNE 2001, POLITECNICO DI MILANO, ITALY,
10-12 OCTOBER 2001

User validation is a crucial part of projects which develop new solutions in electronic publishing.

While verification tests if an electronic product is free of bugs, validation tests if the product meets the requirements of its intended users. Yet many projects find it difficult to integrate suitable approaches to user validation. They miss the opportunities to understand the needs of users early in design and development process, to adapt the product to user needs and to assure that their product will be accepted in the market.

The VNET5 project

The EU funded project VNET5¹ (IST-2000-25465) aims at advancing the level of user-centred product creation in electronic publishing projects involved in IST programme.

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¹VNET5 is thematic network founded by the European Commission. Project official web site: www.vnet5.org

In order to fulfill its challenging goal, the VNET5 consortium² is committed to hold a set of workshops to raise the awareness by IST projects about the relevance features of user-centredness and for delivering hands-on coaching on approaches, assessed methods and techniques for an effective usability evaluation.

Since the beginning of VNET5 project (February 2001), two workshops has been recently held; the first at the Faculdade de Engenharia da Universidade do Porto (11-12 June 2001) and the second at the Politecnico di Milano (10-12 October 2001). At both workshops, industrials and researchers from more than fifteen IST projects involved in electronic publishing attended and actively partecipated to the events. Some participants were representatives of projects which had yet not started any validation activity and did not know how to approach the problem. Others came to the workshops because had already defined their validation plan but they need help in how to implement it.

The structure of the three-days workshops is the following: a full day plenary session covers the rationale for being user centred, the benefits and costs, and why projects usually fail. Then, major steps in the user-centred product creation process are illustrated and methods of how to manage them are proposed. The second day of the workshops is devoted to an overview of methods and tecniques for requirements analysis, of the distinctive features of evaluation approaches based on inspection methods ad user testing, and of key principles and methods for evaluating user satisfaction. On the third day, the participants could choose to attend hands-on sessions about two of the proposed methods for user validation (requirement analysis, inspection methods, user testing or user satisfaction). During the whole workshops, very rich and in-depth content was delivered and each partner of VNET5 consortium held the sessions sharing know-how and personal experience with the participants. A conclusion session was held for gathering feedback from the participants and for discussing the ways for possible integration of different methods.

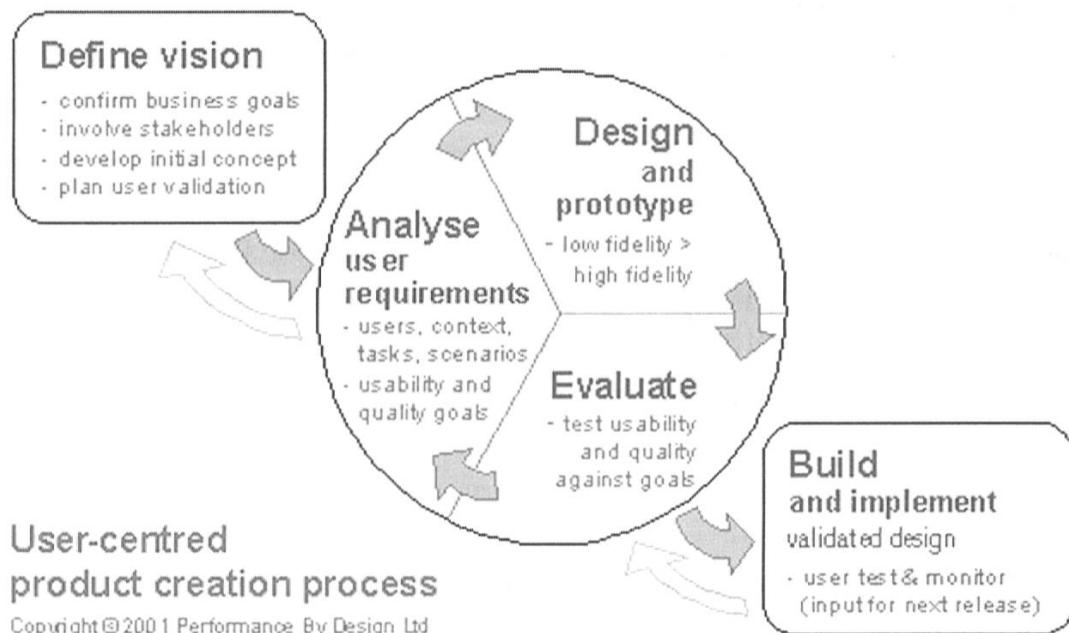
²VNET5 consortium is made of two industrial partners and four university partners: Acit GmbH (www.acit.net) - who is leading house of the project - , Performance by Design Ldt (www.performance-by-design.com), Tec Lab at the University of Lugano (www.lu.unisi.ch/tec-lab), The ergonomics and Technology group at the ETH (www.ihb.bepr.ethz.ch/e-t), HOC at Politecnico di Milano (www.hoc.elet.polimi.it) and the Dept. of Human Science and Design at the Technical University Of Sofia (www.hsd.tu-sofia.acad.bg).

The goal of this report is to present the key topics discussed during the workshops especially the ones concerning the usability evaluation methods.

The foundations of user-centred product creation³

The plenary sessions of the workshops was devoted to a rich overview of the issue of user-centredness. Elke Melchior⁴ and Miles Macleod⁵, senior consultants in interaction and user-centred design, illustrated the need of carrying out a set of consistent interrelated activities for gaining electronic products that will meet customer's needs.

The diagram below, held as the essential roadmap for the whole workshops, summarises the key stages in the process of user-centred design:



³A rich set of extensive resources supporting user-centred development are available on one of the web sites affiliated to the VNET5 project: www.acit.net/vnet. The site has been conceived, designed and managed by Tom Bösser and Elke Melchior, leading a number of projects in electronic publishing usability industry.

⁴Within VNET5 consortium, Elke Melchior and Tom Bösser represent Acit - Advanced Concepts for Interactive Technology GmbH (www.acit.net), a consulting company with long standing competence in user evaluation of technical systems with emphasis on the productivity for the owner and quality of user experience.

⁵Within VNET5 consortium, Miles Macleod represents Performance By Design Ltd (www.performance-by-design.com), a UK-based consultancy helping organisations improve performance. It offers deep expertise in the business application of user-centred design and usability evaluation.

It is essential that the whole process is carried out in iteration in order to be flexible in adjusting the outcome of each activity with the changing requirements coming in from the previous one. For each activity area, a set of assessed methods and techniques have been introduced to the participants.

It was firstly pointed out that a clear user-centred vision is an essential foundation for success because it enables sponsors and development teams to achieve a shared understanding of project objectives and of how the product will meet the needs of its users. Moreover, it enables the project to focus on delivering things that will succeed in the marketplace.

Relevance of requirements analysis was issued, stating that the scope of user requirements analysis is to gather relevant information about user needs, and to exploit this information in order to give proper and effective guidance to design. It requires an accurate selection of tools and techniques because errors encountered and not detected at this stage may lead to expensive system failures later. A reasoned overview of the key techniques for user requirement elicitation and definition was illustrated. As far as design concerns, guidelines and general principles for effective user-centred approach to design was presented and discussed. Strongly intertwined with these topics, a very valuable activity in the whole iterative user-centred process is the usability evaluation. That issue could be considered the core topic of the workshops and seems worthy to be reported.

Usability evaluation

Usability evaluation is concerned with finding out (or predicting) how well users can use something, what they think about it, and what the major problems are, with the aim of improving design. Usability evaluation is essential for assuring quality of use:

- How effectively and efficiently intended users can achieve particular goals using a product or prototype?
- How satisfied they are with it?
- How well it meets specific requirements (e.g appeal, engagement, learnability, error avoidance, etc.)?

There is great diversity of methods for evaluating usability. VNET5 coaching workshops focused on a subset of these methods, chosen because they are practical and valuable for use in product creation:

- Inspection methods, where a usability expert apply heuristics to assess the features of a design for their contribution to usability (enabling judgments about usability from early in design)
- User testing, based on observation of the use of systems or prototypes by a sample of users (in lab or field), to assess quality of use and identify usabiliy breakdowns.
- User satisfaction methods, which employ interviews or questionnaires to gain insights into what users think of a product, identify areas of difficulty and assess satisfaction.

Following sections will highlight the relevant each usability evaluation approach⁶ which was presented by VNET5 consortium and discussed with the participants.

Inspection methods⁷

Franca Garzotto, Isabella Rega, Nicoletta Di Blas⁸ and Davide Bolchini⁹ introduced the audience to the distinctive features of inspection methods. Inspection methods are a set of methods based on having evaluators only examine a software product without involving end users.

Basically, the inspector first of all figures out a model of the application in order to state its general high-level architecture in terms of navigational access paths, structure of information and main functionalities offered. Then the inspector performs a set of predefined inspection tasks on the applications in order to assess its various features and detect possible usability deficiencies. Usability inspection methods are very efficient with a high benefit-cost ratio.

Among the most adopted inspection methods used by industry, the followings were discussed:

⁶The approach for user-centred creation presented at VNET5 workshops claims to be not method-specific, i.e. try to provide the audience with an as much as possible comprehensive overview of the assessed strategies in each field.

⁷One of the most trusted resource - although quite old - for evaluation methods based on inspection is Nielsen, J., Mack, R.L., *Usability Inspection methods*, Wiley & Sons, 1994.

⁸The HOC - Hypermedia Open Centre group at Politecnico di Milano is active in research and competence development in usability inspection methods and human-centred development of hypermedia systems.

⁹Within VNET5 consortium, Davide Bolchini, Paolo Paolini and Lorenzo Cantoni represents the TEC lab - Technology Enhanced Communication Laboratory of the University of Lugano. The lab has developed valuable expertise in user-centre evaluation methods for web applications, especially for usability content analysis.

Heuristic Evaluation¹⁰

An heuristic evaluation is based on a set of proven and assessed usability principles that guides the inspection. According to these principles, the inspector systematically performs a set of activities on the application in order to assess if usability and interaction breakdowns arise. General usability principles include: visibility of system status, user control and freedom, consistency and standards, recognition rather than recall, help and documentation and many others.

At the end of the inspection activity, a list of usability problems is detected and guidelines for the next design iteration are provided. Heuristic evaluation is the most used method in usability inspection.

Cognitive Walkthrough

A walkthrough is a storyboarding of a relevant fragment of the application. In this method the inspection team is composed by communication engineers and designers who focus on the evaluation of the ease of learning of a user interface by exploration. An interface design is evaluated in the context of one or more specific user tasks. The inspectors consider the actions needed to accomplish this task. Usability problems detected during the cognitive walkthrough will be collected.

Pluralistic Walkthrough

The inspection team is composed by representative users, product developers and usability experts. All participants in the walkthrough are confronted with hard-copy panels of screens in the order these would appear in a real application according to a given scenario of use. For each hard-copy all participants describe as detailed as possible the actions they would take in executing the task described in the scenario. Then the contributions from everyone will be discussed and results are delivered. However, most of them have a number of drawbacks:

¹⁰ Especially devoted to heuristic evaluation for web based application is one of the richest illustration of heuristic and guidelines for usability in Nielsen, J., *Designing web usability*, New Riders, 2000.

- They focus on “surface-oriented” features of the graphical interface. Only few of them address the usability of the application “structure”, i.e., on the organisation of both information elements and functionality.
- They depend on the individual know-how, skills and judgement of inspectors, making inspection a subjective process - a kind of “art”. Domain and application specific experience may surely improve the evaluators’ performance. Unfortunately, usability specialists often lack domain expertise, and domain specialists are rarely experienced in usability engineering.

SUE: Systematic Usability Evaluation¹¹

To overcome this problem for hypermedia applications, the SUE (Systematic Usability Evaluation) heuristic inspection method introduces the use of evaluation patterns, called Abstract Tasks, for guiding the inspector. Abstract Tasks precisely describe which hypermedia “objects” (i.e., functionality, information structures, or interface elements) to focus upon and which actions to perform on them in order to analyse their usability.

SUE proposes a set of very detailed usability criteria and associate them to the various tasks. These criteria are obtained by refining general usability principles with respect to the specific context of hypermedia applications. Abstract Tasks provide a precise guide about which actions to undertake on which application constituents during evaluations. Usability attributes provide detailed reference criteria against which to judge the inspection findings.

As a consequence, inexperienced evaluators, with lack of expertise in usability and/or hypermedia, are able to provide good results. SUE adopts a design model (e.g. HDM – Hypermedia Design Model) for describing the application and steering the evaluation process. The inspection process starts with the evaluator describing the application through the primitives and the terminology of the design model. Such a terminology is the same

¹¹ For valuable references about SUE systematic methodology for hypermedia evaluation, see: Costabile, M.F., Garzotto, F., Matera, M., & Paolini., P., Abstract Tasks and Concrete Tasks for the Evaluation of Multimedia Applications, Proceedings of the ACM CHI'98, Los Angeles, CA, April 1998. Costabile, M.F., & Matera, M., Evaluating WINP interface through the SUE approach, Proceedings of IEEE ICIAP'99, Los Alamitos (CA): IEEE Computer Society. Garzotto, F., & Matera, M., A Systematic Method for Hypermedia Usability Inspection. The New Review of Hypermedia and Multimedia, 1997, 3, 39-65.

used for formulating both usability criteria on which the evaluation process is based, and the activities defined in the Abstract Tasks.

As a natural consequence, evaluators will also use such terms for naming objects and describing critical situations while reporting troubles, so attaining more precision and standardization in documenting the evaluation outcome.

Content inspection¹²

Too often the focus of inspection concerns dimensions (navigation, functionalities, interactions) which turn out to be just a support of a precious dimension often neglected: the content. Infact, for information intensive interactive products, the approach to inspection can also adopt methods for content analysis and communicability evaluation.

The objective of content analysis is twofold:

- inspecting the quality of content allows detecting quality breakdowns in the communication
- content evaluation methods suggest guidelines for designing usable content.

Therefore, especially when dealing with content, the inspector has to take into account that addressee as the starting point and the target of the whole communication effort. Content should not be primarily intended in its technical sense (e.g. image size, length of pages, colour of icons), but it should be addressed as a designed set of ideas and messages conveyed through structured interactive possibilities.

The conceptual tools for inspecting the content of an interactive application (especially a hypermedia application) are general criteria that guide the inspector during the analysis of the actual content of the application. The set of content usability principles include: relevance, accuracy, currency, objectivity, authority, coverage and many others.

¹² For relevant references in content evaluation approaches and criteria see: J. Alexander e M. Tate, *Web wisdom: how to create and evaluate information quality on the web*, Mahwah, NJ (1999); M. Eppler, The concept of information quality: an interdisciplinary evaluation of recent information quality frameworks, «Studies in Communication Sciences», 2 (2001); L. Cantoni, Paolo Paolini, *Hypermedia Analysis: Some Insights from Semiotics and Ancient Rhetoric*, «Studies in Communication Sciences», 1 (2001); Cantoni, L., Bolchini, D, Usability content analysis for web sites, Tools By Tec-lab, <www.lu.unisi.ch/tec-lab/editorial_reports/tec-lab_content_analysis_april2001.PDF>

After the presentation of what inspection is and what the most used inspection methods are, a specific practical session was held. Several examples of systematic heuristic evaluation inspection were performed together with the participants on a number of hypermedia applications. The hand-on inspection activities mainly focused on navigation and content analysis.

User testing

Daniel Felix¹³, usability consultant and researcher, illustrated and discussed the evaluation method called “user testing” or “usability testing”. Usability testing consists of observing typical present or future users working through a set of tasks and it enables to identify weaknesses as well as positive aspects of any device or software application. Valuable insights are collected for a focused and cost effective optimisation of the product under scrutiny.

Several forms of user testing are possible. The most structured and standardized procedure is the *usability lab*, to which was dedicated and in-depth presentation during the workshop.

In a usability lab, subjects are observed while performing predetermined tasks.

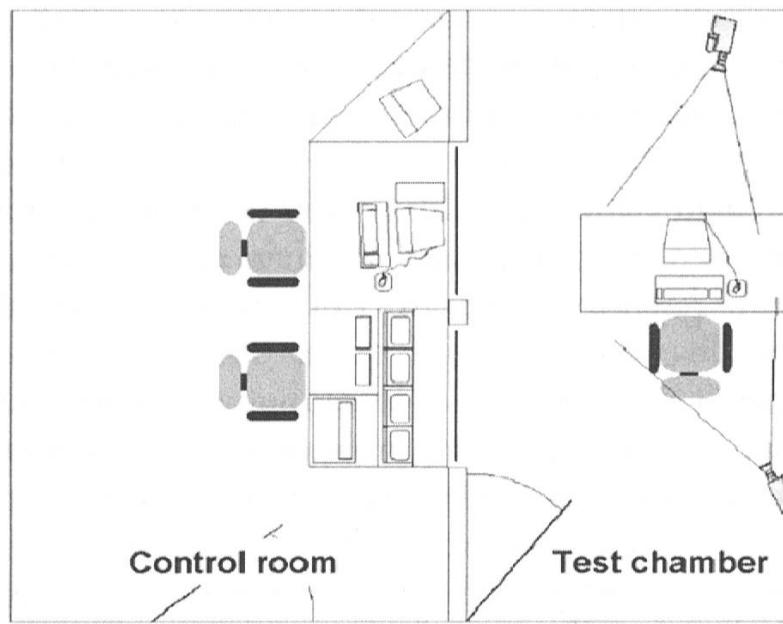


Figure: Set-up of a Usability-lab

¹³ Within VNET5 consortium, Daniel Felix represents the Ergonomics and Technology Group at ETH Zuerich. The research and consultancy group runs a usability lab, and has developed in-depth experience in evaluation of interactive systems.

mined tasks on the interactive system to be tested. The test session is recorded on videotape, in order to facilitate detailed step-by-step analysis. The important components of the Usability-lab are:

- Test chamber (soundproof) in which the subjects perform the tasks
- Video cameras which record the subjects during the test session
- Control room from where the observers keep an eye on the performance and reactions of the subject

The test chamber is equipped with two video cameras and a microphone. A one-way mirror window separates the control room from the test chamber. Thus the subjects can be observed without getting distracted by the observers. Generally, a Usability-test is divided into three phases:

Planning. Subjects for the test are recruited and pre-test is planned to fit the typical user profile(s). Then realistic scenario (list of tasks) are defined and pre- and post-test questionnaires are prepared.

Testing. After the pre-test is performed, subjects are introduced to the procedures of the Usability-test. It is essential to convey to the users that not they are being tested, but the product (users *will help to test* the product). Afterwards, product and the scenario are presented and the test is run. Subjects are interviewed right after the test (supervisor and subject) and a post-test discussion in the control room (all participants) with optional reiteration of single steps and video confrontation is held. Afterwards a discussion of the preliminary results is made by experts only.

Reporting. Inherent usability problems and inconsistencies according to post-test questionnaires, interviews and expert discussions are identified. According to the pooling of the raw data gathered during the test, preliminary results are compiled.

Questionnaires and recorded observations are analyzed; suggestions are prepared for optimisation / improvements. The report is then edited and results are discussed with the client / within the expert group.

It is essential to select subjects who fit the user profile defined in the project. A minimal number of five users per clearly distinguishable user group is highly recommended. It is strongly suggested that all key areas of a project participate at least partly in the observation. Even if some observation training is needed to accomplish meaningful results, it has been shown to be helpful if many team members know the user reaction to the system from own experience.

In order to assure smooth procedures during the testing, sufficient time must be allocated per subject. Users should normally not be observed over a period longer than one hour, in order to keep tiring to a minimum (exception: if fatigue is a key area of concern for the product). After the presentation of the evaluation approach based on user testing, a specific practical session was held. A hypermedia application was tested with the help of several participants who played the role of test users. Discussion followed the testing and results were commented.

Combining inspection with user testing

An interesting issue arose during the workshops, was the disposition of inspection methods and user testing to be integrated effectively. The two families of approaches come from very different usability consultant traditions. While inspection is based on a in-depth and systematic analysis of the application performed by usability experts, user testing founds its strength on setting the actual users as the measure of usability. Some benefits and drawbacks for each approaches are worth to be reported.

Usually inspection methods detect crucial usability breakdowns concerning both the general architecture of the application (navigation, structure of the information, content accessibility, state visibility) and detailed deficiencies concerning the interface appearance (visual consistency, self-evidency, ...). In fact, the inspector usually builds up a model of the application that allows the analysis to be more focused and comprehensive on all application dimensions. What actually a pure inspection method is missing is the verification of the usability relevance of the deficiencies detected against the experience of the real users of the application.

On the other hand, user testing detects a list of usability bugs on the basis of actual problems encountered by sample users. The main benefit is that the application is tested against a “real” scenario of use which likely resembles the context in which the application will be actually used after deployment. One main drawback of this approach is that sample users usually detect surface usability problems (especially concerning precise points of the interface or of functionalities) and express general considerations about the look&feel of the application. That is due to the fact that first and foremost during test there is no time for systematic analysis on all the diverse aspects of the applications. Secondly, users cannot have the same in-depth insight and a comprehensive view on the application that

an expert inspector usually achieves. such results can give good suggestions for re-designing interface elements (in terms of graphics and lay-out) and interaction possibilities but provide poor suggestions for hard re-design of architectural dimensions (structure of content, access and navigation).

Performing a user testing is very risky to take non-representative sample users and to judge the usability against their test experience. Moreover, in a test environment, performing fictitious tasks can easily bring the test users to feel not actually involved and committed in the situation. That – together with the feeling of being constantly observed - could bring to biased testing results.

A proper combination of inspection methods and user testing open new directions in the research towards effective usability evaluation and can bring fruitful results. As the discussion pointed out, a combined approach devised at least two possible evaluation scenarios:

- Performing systematic inspection as a previous activity to user testing. Reasoned usability breakdowns detected during inspection are input for the preparation of a more focused user testing. Thus, the usability test will verify the role and weight that the detected usability problems will have within the user experience.
- Performing user testing as a previous activity to inspection. A first set of usability deficiencies found out by a usability test can help inspector to focus the systematic analysis on the parts and dimensions of the application relevant for the user experience, then saving time and effort in the inspection.

In practice, an iteration of inspection and user testing is going to turn out to be an effective exploitation of both devised solutions.

Evaluating user satisfaction

Miles Macleod illustrated and discussed the founding concepts, main methods and tools for evaluating user satisfaction. The plenary and the practical sessions were focused on providing useful guidelines for conducting user satisfaction evaluation and helping the participants in getting valuable results within the constraints of their project.

Evaluation of user satisfaction aims to discover what people think and feel about using a product, to assess the perceived quality of use. It is

based on asking people to share their experiences and opinions, usually in a structured way by responding to specific spoken or written questions. Evaluating user satisfaction may involve drawing out insights by facilitating commentary or discussion on the experience of using something. There are well established techniques for eliciting user views, identifying issues, and measuring user satisfaction.

Ask the right people

The single most important thing about evaluating user satisfaction is that if you ask the wrong people, you get invalid answers. It can be completely misleading to discover that the designer's friends, family and work-colleagues are highly satisfied with a product. Or that the 0.1% of users who filled in a feedback form disliked it. You must find a representative sample of users, with sufficient sample size and diversity to cover significant minorities.

Focus groups

Focus group techniques are powerful for developing concepts and assessing first impressions, early in product development. Group discussion is facilitated around predefined topics. Focus groups can be used to discover 'gut reactions' to concepts, elicit expected user requirements, uncover prejudices and to draw out insights into what people think of an existing product. Their disadvantage in evaluating new designs is that they typically involve speculation about the use of future designs, rather than the real experience of trying out prototypes.

User Interviews

User interviews can explore people's opinions of products, their preferences, experiences, areas of difficulty, patterns of use, reasons for not using, and suggestions for improvement. Hence interviewing is a key technique at all stages of development. Interview data can be quantitative (counts of responses), or qualitative (insights into issues and motivations). Interviews are highly effective in evaluating usability when used to debrief users after user testing, to explore the experiences that lay behind what was observed.

It is advisable to work with other stakeholders when designing ques-

tions. Use closed questions for quantifiable data, and open questions (to be asked flexibly) to elicit deeper views where required. It is important to ask the right things at the right moment, and to avoid leading questions.

Interviews should take place somewhere convenient for the interviewee, preferably where they have used the product or prototype, to remind them what they have experienced and allow them to demonstrate. Good engagement and listening skills are required. People often take a while to say what they really think, so the interviewer must not try to fill silences, but should wait for full responses.

Questionnaires

Questionnaires can ask much the same things as interviews, but have to get good valid answers without the benefit of an interviewer's skills. Hence the question order, wording and administration instructions are critically important. Many questionnaires fail to get good responses simply because they look too long and seem confusing. Keep them short and well structured, and give simple clear instructions. To make it possible to analyse responses from multiple users, questionnaires should have sufficient simple closed questions, where users can

- state if they agree / are undecided / disagree
- state a degree of agreement or preference
- choose one or more items from a list.

Subjective, free text answers can give good insights, but are more difficult to analyse and tend to draw fewer responses.

Psychometric questionnaires measure user satisfaction, with demonstrable validity and reliability. They compare user responses to a tried-and-tested set of questions, against a database of responses to the same questions from many other users of similar products. They require rigorously methodical use and analysis. Commercial examples include: SUMI (the Software Usability Measurement Inventory, sumi.ucc.ie) and WAMMI (the Website Analysis and Measurement Inventory, www.wammi.com).

Closing remarks

The more the VNET5 project goes along, the more the workshops seem to outline a consistent and well-formed shape that can communicate valuable approaches to user validation and succeeds in helping the electronic publishing projects planning and completing effectively their user-centred development process. Moreover, among VNET5 consortium an increasing sharing of views and experiences is leading to see fruitful integrations between methods and approaches that could wrongly appear different and incompatible. The general feedback from the participants was very good especially for the hands-on sessions, where the presented methods were put into practice. Discussions with them also allowed VNET5 leaders to tune and refine the presentation of the approaches for the next workshop, which will be held at the University of Lugano.

