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User Requirement Study for a Virtual Research Environment

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User Requirement Study for a Virtual Research Environment

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Abstract

This report is a documentation of a user requirement study for Collaborative Orthopaedics Research Environment (CORE) project. The study assesses the needs of users, who are researchers and clinicians working in a bone laboratory, for a Virtual Research Environment (VRE). It was conducted through a consultation process that involved semi-structured interview technique. Requirements of users for a VRE and their corresponding recommendations are outlined according to the study's objectives.

1 Introduction

This study is a user requirement investigation for the, JISC funded project titled *Collaborative Orthopaedics Research Environment* (CORE) [3], which is a follow-up project to *Virtual Orthopaedic University* (VOEU) [2]. The VOEU provides an infrastructure that combines clinical, educational and research in one working environment. However, the architecture of VOEU is integrated and tightly coupled, making it difficult to expands as the user requirements change. In view of this, the CORE takes the foundation of *Virtual Research Environment* (VRE) in VOEU and re-builds it into a Grid/Web services based VRE using *Service Oriented Architecture* (SOA) [7].

The extent to which a VRE can be used by specific users to achieve specified goals with effectiveness, efficiency and satisfaction is largely driven by the requirements of the users. Hence, user requirements study plays an important role when developing a VRE. This study aims to assess the requirements of CORE VRE's end users, who are researchers and clinicians working in a bone laboratory. These users typify a group of e-scientists working on collaborated projects and a group of e-learners studying in joint-partnership institutions.

The VRE in CORE project will incorporate the basic science disciplines of molecular and tissue biology, engineering and computing with allied medical disciplines of pharmacology, prosthetics, trials managements and the clinical disciplines concentrating upon musculoskeletal applications in rheumatology and orthopaedics. This report describes the user requirements for such VRE in accordance with the objectives outlined in the following section. Recommendations for each objective are also included in this report to guide further development activities in the CORE project.

2 Objectives of the Study

The objectives of this user requirement study are as follows:

1. To identify the requirements of users for a VRE.
2. To discover developments that would enhance the planned functionalities in the CORE.
3. To assess the current practice of users in discovering, locating and using research findings (i.e. publications and experimental data) to inform the enhancement of such processes through the VRE.

3 Methodology

The resources available for this study lend itself to a semi-structured interviewing technique that is an adaptation of methods used by Wood [11] and Spradley [9]. The important principles underlying such interviewing technique, as identified by Wood, are mainly concerned with the nature of expert knowledge. End users of a VRE are usually experts in their research domain, which the VRE intended to support. There is a body of literature in cognitive psychology [8] on the nature of expertise that has implications for how one should work with experts to gain an understanding of the way they accomplish their work in a specialised domain.

Aspect of expertise which the authors find relevant to this study is the potential for experts to exercise translation competence. Interviewers are often novices in the investigated domain. In ethnographic research settings, translation competence [9] may occur when cultural experts translate their view of their cultural to an outsider. The more an expert translates for the convenience of an interviewer, the more the expert's view becomes oversimplified and distorted. In an effort to avoid the errors that might result from translation competence, Spradley advocates an approach to questioning in which the interviewer makes minimal assumptions about experts' knowledge, and which uses information they provide as the basis for further questioning [9].

In view of the translation competence problems, the authors conducted the interviews by first using very general probing techniques to persuade experts to talk freely about their domain in a global sense. Expert's language is recorded and then examined for category labels and other domain-specific linguistic cues. Domain-specific terms are then used by the authors to probe experts for additional, related information. For this reason, the interviewing technique described in this report is considered semi-structured rather than structured [5]. Instead of designing a priori set of questions to be asked in a specified order, the authors have various types of questions at their disposal to be used in opportunistic ways, depending on the demands of the situation.

As stated earlier in this report, end users in the CORE project typify e-Scientists and e-learners in their research environment; hence, five professionals who work as researchers in the computer science field and medical field were invited to take part in this study. The participants were chosen based on their expert knowledge in the research areas of digital library, information and learning technologies, and biomedical. Their expertise is appropriate in finding out the requirements involved with providing Grid/Web services that facilitate the sharing of resources (for the purpose of research and education) in data repositories and digital libraries.

Starting from the foundation of VRE in VOEU, a use case scenario (see Figure 1) was worked out to explore possible functionalities and application settings. The scenario described several concrete activities of a fictitious user like formalising trial protocol, selecting dataset, analysing dataset and discussing results.
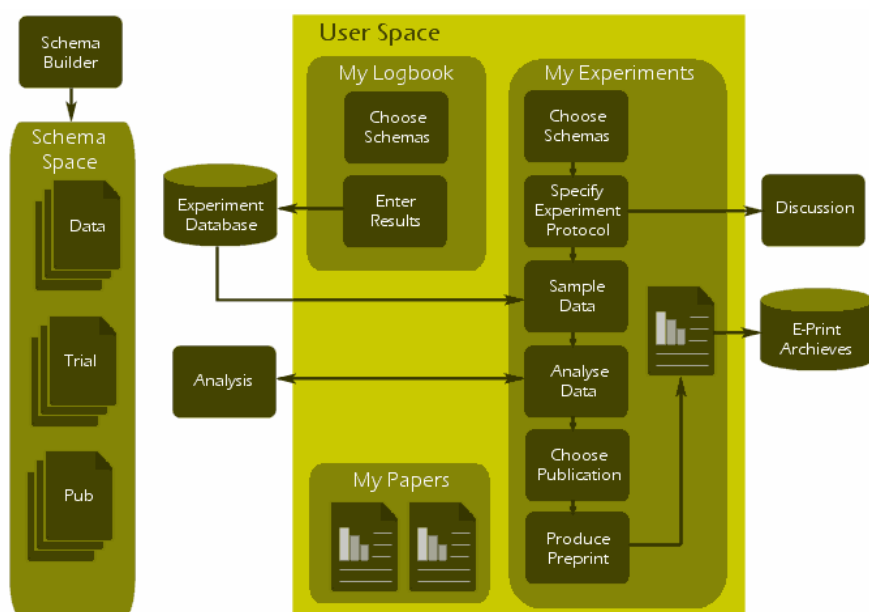

Figure 1: Workflow in the VRE framework

The authors approached each interviews by first giving a brief overview of the CORE project and the planned basic functionalities such as formalising trial protocol, storing and analysing data, submitting and reviewing articles, and discussing experiment findings in a forum. This is then followed by a presentation of the use case scenario described above. Each interview was generally an hour in duration, and permission was asked to tape recorded the interviews for later analysis and interpretation. The purpose of the interviews was to stimulate individual reflection upon experience and act as a starting point to engage participants in identifying their requirements for a VRE. Some key common questions were included in order to identify strategies to discover, locate and use research findings (see Appendix 1).

4   Major Findings

In general, the participants were very positive about the VRE and generated a lot of suggestions on how to enhance the functionalities of the planned VRE. This section maps out the major findings derived from the semi-structured interviews with the objectives listed in Section 2. Recommendations for each objective will also be included in this section. As well be evident, some of the recommendations overlap between the objectives, reinforcing the outcomes of the study.

4.1 Objective 1: To identify the requirements of users for a VRE

4.1.1 Requirements

- All participants agreed that any scientific effort will have diachronic features, i.e. collaborative research activities may extend through time, enabling the influence

of these activities to carry on beyond their timescale and disseminating research findings beyond the original boundaries of collaboration.

- One of the participants also identified that there is a loose coupling that exists between researchers as educators and their students, notability in the context of higher and further education. The findings of research activities can be used to educate the next generation of researchers.

- In view of the research activities, the idea of centralising and sharing relevant resources under a VRE is well accepted by all participants. This is because sharing of resources can keep others in the research community up-to-date with the current development.

- A participant sees digital library as an important medium for focusing various channels into a single portal. She also recognises the need for researchers to undertake experiments, deposit scientific data, and produce pre-prints using a VRE.

- There were mixed feelings about sharing resources among the participants. This was highlighted by the tension between the concept of sharing and feelings of ownership of the resources. Some participants welcomed the idea of sharing as it would make their life easier; while others see that it is pointless to share resources unless some form of rewards were involved. In one of the interviews, a participant implied that resources *per se* do not make scientific sense; it is what the researchers do with these resources and how they are beings used that adds scientific value to content materials.

- The VRE should be made easy to use for users who may not be computer literate, as pointed out by all participants. For example, if users are asked to fill up lots of required field (metadata) when depositing articles, they might become frustrated and give up on using the VRE.

- There is a very common comment made by majority of the participants, which indicates the requirement to contextualise resources within a research framework that is relevant to the subject discipline. It also means the importance of providing resources that are of easy access to the users and can be delivered to them regardless of their computer platforms. Some degree of personalisation or user profiling in order to narrow the users' inquiry on particular subjects seemed to be envisaged by all the participants.

- A participant from bone laboratory identifies the need to utilise Grid services in running simulations and analysing large scale experimental data.

4.1.2 Recommendation

- Sharing of research resources, i.e. scientific data and publications, appears to be an attractive idea; however issues of intellectual capital of both personally and institutionally must be addressed. For example, initiatives and support to enable resource sharing should be targeted at the institutional level.

- Portals build on the same technology used for Web sites, but enhanced the functionality and flexibility to cater for the demands of specific classes of user [1]. A useful definition from Andy Powell of UKLON is: "A portal is an online facility that provides a personalised, single point of access to resources that supports the end user in one or more tasks (i.e. discovery, learning and research)" [1]. Hence, a portal is an appropriate approach to construct a VRE. It can provide personalisation to users and allow them to access the VRE using Web browsers, which is platform independent.

- A clear priority requirement is the design of a user-oriented portal, aimed at the non-computer specialist, with accessible resources that are easy to browse, upload and download.
- Grid services make sense in running large scale analysis and simulation since they provide secure and managed access to distributed computational power. Hence Grid services should be included in the VRE as part of its functionalities to support research activities.

4.2 Objective 2: To discover developments that would enhance the planned functionalities in the CORE

4.2.1 Requirements

- During the interviews, participants were asked to identify what would enhance the use and access of a VRE. The major concern of the participants was how to integrate VRE into their working environment. For instance, problem could arise if users were asked to submit scientific data in XML format, which might be unfamiliar to them. Users are reluctant to change their work output formats, as experienced by most of the participants in their research projects.
- Participants in this study also express their need for interaction between users and VRE administrators. This means resources should be made dynamic and responsive, where users can add/remove links to resources in the VRE.
- Supporting storage and retrieval of raw scientific data was a welcomed thought to all participants. The participants agreed that only a small percentage of the data generated by many scientific experiments appears in, or referenced by, the published literature. Hence, providing links between raw scientific data and articles is a desirable feature that could enhance the functionalities of VRE. One participant added that not only data which show positive outcomes should be included in the VRE but those with negative results should also be made accessible.
- A participant felt that the process of formalising trial protocol should be made flexible. For instance, users should be allowed to choose trial protocols from a list of available options and only include those that are relevant to them in the trial procedures. Such approach will not only give users the flexibility in conducting their trials, but also at the same time offers them a chance to use protocols that might be unknown but yet useful to them.
- The ability to view a particular set of scientific data in various way, i.e. numerically or graphically, was another feature that majority of the participants felt was useful. For example, a biologist might want to visualise scientific data graphically while a mathematician would prefer to see the same set of data numerically.
- Populating the VRE with vast amount of resources is an essential requirement to attract users and promote its usage. A participant suggested that prototype systems should be built to collect and audit the data generated by scientific activities. These data can in turn be used to populate the VRE once it is constructed.

4.2.2 Recommendation

- Users have expectations of VRE, no only as a source of research resources, but also as a focus to share good practice. This can be done by providing examples of excellence with tools and templates.

- It is important to ensure that the portal involve potential users through the process of content development. A participatory based approach (resources developed, evaluated and tested by the community) should be considered.
- A loosely coupled architecture, i.e. one that based on SOA, should be used to build the VRE, as this allows the flexibility of adding, removing or modifying extra services when user requirements change.
- It appears that constructing a prototype system to collect and audit scientific data is beneficial. Hence such system should be taken into consideration when constructing the VRE.

4.3 Objective 3: To assess the current practice of users in discovering, locating and using research findings (i.e. publications and experimental data) to inform the enhancement of such processes through the VRE

4.3.1 Requirements

- Most of the participants claimed that Google search engine is the first place that they will be start looking for research materials. However, these participants felt uncomfortable about using some of the resources found this way due to unclear copyright and quality of these materials, or the links to the resources might be remove without notice.
- In a few occasions, participants reported to visit particular Web sites to locate resources. It appears that resources found this ways is somehow at random, which means that finding resources is not an easy task and very few knew about existing collections and supports services. This highlights the need to centralise resources via a portal.

4.3.2 Recommendation

- A strategy to manage the quality of resources should be devised to guarantee the flow of new materials. This could involve expert input and feedback on content renewal and, as suggested by participants in this study, peer review. On top of that, it is also important to derive a mechanism to maintain and check the resource links' integrity.
- It will be useful to be able to access the VRE (portal) from popular search engines such as Google. Metadata in the VRE should be utilised effectively so that research resources in the portal can be retrieved via search engines.

5 Conclusions

The current development of Web technologies increases the effectiveness of collaboration between scientists. Digital libraries lie in the heart of these technologies, acting as an information grid that consists of a collection of resources for learning and teaching, data repositories for research purposes, or as archives of diverse cultural heritage materials [6]. The VRE has been implemented as a Web-based environment for supporting a critical subset of the e-science cycle: the collation and analysis of experimental results, the organisation of internal project discussions, and the production of appropriate outline documents depending on the requirements of conferences and journals selected for dissemination [2].

It is essential to understand (through further research and evaluation) the users' experience and requirements for a VRE in order to promote its usage. This user requirement study has involved a total of five professionals contributing to the semi-structured interviews. Reactions toward the proposed VRE in the CORE project were on the whole positive and users generally agreed that there is need to centralised and shared research resources. In addition, the results from this study have reinforced the necessity of adopting portal technologies in developing the VRE demonstrator.

The valuable suggestions of all participants and outcomes of their interviews will be used to gain a thorough understanding of user requirements, which should be taken into consideration when designing the Grid/Web services based demonstrator in the CORE project.

6   Acknowledgements

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Appendix 1

The following are key common questions asked during the interviews:

- What are the requirements that you will envisaged in a VRE?

- In your opinion, what developments would enhance the planned functionalities of the planned VRE in CORE?

- What strategies do you use to discover and locate research materials?

- What collections, portals, services and networks are you aware of in the area of your research?

- How do you integrate discovered research resources, i.e. raw scientific data, into your research practice?

- What are the lessons learnt from your experience in projects that involve research resources sharing and discovery?