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A HUMAN-COMPUTER INTERACTION PRINCIPLES BASED FRAMEWORK TO ASSESS THE USER PERCEPTION OF WEB BASED VIRTUAL RESEARCH ENVIRONMENTS

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Abstract. Due to various challenges and opportunities such as globalisation of research agenda and advancements in information and communication technologies, research collaborations (both international and national) have become popular during the last decade more than ever before. Within this context, the concept of Virtual Research Environments(VRE) is an emerging concept looking at addressing the complex challenges associated with conducting collaborative research. Even though concept of VRE is at its infancy, it is important to assess user perception about those, both to establish its success of uptake and future development strategies. However, to date, there is no formal method established to evaluate VREs .This paper reports a strategy adopted within an international collaborative research project (EURASIA) to evaluate its custom built VRE, VEBER, using the well known Computer Human Interaction principles.

KEYWORDS: Research Collaborations; Virtual Research Environments; HCI; User evaluations

1. BACKGROUND

The notion of collaborative research has been a growing subject of discussion during the last few decades (Subramanyam, 1983; Katz and Martin, 1997; Smith and Katz, 2000; Laudel, 2002). As with any other collaboration, management of collaborative research projects demands extensive resources and proper infrastructure. With the advancements of modern information and communication technologies, the internet in particular, the possibilities of meeting such demands has increased significantly. Accordingly, the concept of Virtual Research Environments (VREs) has gained the popularity among researchers as a tool to manage collaborative research projects (Yang and Allan, 2007; Singh, 2008). A VRE in its simplest form, is a set of web applications developed to manage collaborative research activities across distance. It helps researchers to manage a complex range of tasks involved in carrying out collaborative research (Down, 2008).

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Current academic discussions on VREs seem to be heavily focused on technological aspects. The majority of current literature on VREs discusses how modern technologies can be used to develop VREs to establish the resource base and the infrastructure to conduct collaborative research (for example see: Fraser, 2005; Yang and Allan, 2006; Yang and Allan, 2007; Singh, 2008). To ensure proper take up of the VRE concept within research communities, it is essential to assess whether VREs cater for the actual needs of their users. Despite increased number of research papers related to VREs published recently, the issue of user satisfaction has not been addressed adequately in current literature. Accordingly, the research presented within this paper aimed at addressing this gap by developing and testing a framework to assess VREs from user's point of view. Achieving this aim, this paper discusses the development of a framework to assess a custom built VRE, the Virtual Environment for Built Environment Research - VEBER developed as a part of the collaborative research project, EURopean and ASian Infrastructure Advantage – EURASIA. Further, the paper presents the outcomes of the assessment of VEBER conducted using the developed assessment framework. The paper is structured as follows.

Firstly, the paper reviews current literature on the challenges faced by collaborative research projects and the use of VREs as a mean of overcoming those challenges. Secondly, it discusses the common methodologies used in developing VREs and their short comings. Thirdly, the user expectations of VREs are discussed while establishing the main elements to determine user satisfactions of VREs. Fourthly, the main elements of VRE user satisfaction assessment framework is discussed followed by the methodology adopted in EURASIA to assess its custom built VRE. Finally the results of the VEBER user evaluation is discussed as a mean of testing the framework developed.

2. RESEARCH COLLABORATIONS AND USE OF VIRTUAL RESEARCH ENVIRONMENTS

Laudel (2002) states that, "A research collaboration is a system of conducting research activities by several actors related in a functional way and coordinated to attain a research goal corresponding with these actors' research goals or interests". In practice sense, research collaborations can be viewed as a system to functionally relate a group of researchers together to conduct research which brings in mutually beneficial outcomes to all. The main feature of collaborative research is its broad boundary, which often extends beyond the geographical barriers. Modern research collaborations often involve partnerships among research groups from various geographical locations who are seeking solutions for globally applicable research issues.

In addition to the drive created by globally applicable research issues, collaborative research initiatives seem to have been influenced by numerous other social, economical and political factors. For an example, the European Commission has been the main driver of collaborative research in Europe. Within its successive Framework Programmes (FP), the average number of organisations per project doubled from framework 5 (7.2) to framework 6 (15.1) (Katsouyanni, 2008). As Katz and Martin (1997) highlight, this strategy of the funding organisations may have been influenced by potential benefits, such as the possibility of reducing research costs through resource pooling, and less international travel. International research collaborations have the potential of utilising local resources within respective countries for research activities such as data collection in various locales, which would have involved international travel if a single organisation was to conduct the same research. On the other hand, this approach may have been influenced by the revised agendas and objectives of the funding organisations to reflect international associations, and a change of global priority issues, such as climate change and disaster management.

Moreover, the ever increasing demand for diversified expertise within a single research project has also made research collaborations popular both among researchers and funding organisations. This is especially true for multidisciplinary research projects, where the project activities demand expertise from more than one field or domain. In these circumstances, research collaboration between multidisciplinary parties have been shown to be more productive than employing experts from different disciplines to the project (Stokes and Hartley, 1989). Katz and Martin (1997), further highlight that the fall-in-real-term cost of communication is a major influential factor for research collaborations. Indeed, the introduction of World Wide Web, email and other related technologies have drastically reduced the costs of long distance communication and information sharing capabilities, enabling functional relationships among researchers to work within a research project.

3. VIRTUAL RESEARCH ENVIRONMENTS

VREs are a relatively new application area of modern web technologies and has largely arisen through a series of research projects funded by the UK Joint Information Systems Committee (JISC), starting in 2004. According to JISC, VREs aim at helping "researchers in all disciplines manage the increasingly complex range of tasks involved in carrying out research". In its current form, a VRE can be broadly classified as a group of web applications. Within a collaborative research project, researchers from different geographical locations can use a web browser in their personal computers to interact with other partner researchers through a VRE.

Current literature discusses various technologies used for the development of VREs. Most of the VREs that have been developed to date have taken existing applications of a similar nature, such as Virtual Learning Environments (VLE), to use as its foundation (for example see: Adler et al., 2004; Yang and Allan, 2006; Yang and Allan, 2007; Singh, 2008). Consequently, the development of VREs has been technology driven, rather than demand driven. As discussed in the "ICT productivity paradox" (see: Solow, 1987), this may lead to a state where the VREs are not sufficiently end user (researcher) focused. It was identified by the authors that an investigation was needed to ensure that current VREs address the demands of collaborative research projects and its users. In order to achieve this, the framework described in the remainder of this paper is developed to assess user perspectives of VREs.

3.1. The structure of a VRE

Derived from the above discussion, the following figure illustrates a typical structure of a VRE.

As shown in the Figure 1 below, a VRE integrates various research partners who are

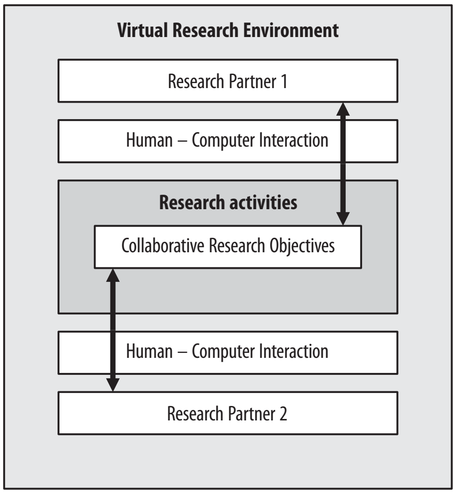

Figure 1. The structure of a typical VRE

often geographically separated through a human-computer interface. All the partners are seeking to achieve a common set of research objectives by completing various research activities. The VRE links the partners to the research objectives through a human computer interface and helps partners to achieve the common objectives of the research collaboration. Accordingly within this structure, two main items emerge as key elements of a VRE; the human - computer interface and the functionalities embedded to achieve success factors of collaborative research. The next two sections explore these two areas to identify their position in evaluating VREs from user a perspective.

4. HUMAN-COMPUTER INTERACTION (HCI)

Dix et al. (1992) defines Human Computer Interaction as "discipline concerned with design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them." As the above definition emphasises, the main focus of HCI is to study the interactions and the relationships between the users (humans) and computers. In the past, HCI has focused mainly on interfacing issues such as designing user friendly graphical user interfaces (GUIs) for computer programmes. At this stage, the "I" of HCI represent "Interface" and it was only in 90's this was switched from "Interface" to "Interaction" to represent the expanding range of digital technologies (Hinze-Hoare, 2007). However, in modern context, HCI is more than about interfacing issues and concentrate on issues which are more than "screen-deep" (Computer Science and Telecommunications Board, National Research Council, 1997). Reflecting of this, Myers (1998) states areas such as Gesture recognition, Multi-media, Virtual reality and 3-D technologies as upcoming areas of modern HCI research.

Helander et al. (1997) view HCI is a multidisciplinary field expanding its usability in many areas where human-computer interactions are valued. Hinze-Hoare (2007) reaffirms this multidisciplinary nature of HCI as he indicates, "HCI has become an umbrella term for number of disciplines, including theories of education, psychology, collaboration efficiency and ergonomics".

As interface issues were better understood and resolved, the focus of the HCI started to shift beyond these issues. As Fischer (1993) explains at latter stages, HCI research objectives were concerned with tasks, shared understanding and explanations, justifications, and argumentation about actions, and not just with interfaces. In the modern context, Fischer (2001) explains that some of the aspects of modern HCI are derived from the need and desire to provide better support for human-computer collaboration. Collaboration in this context is defined as "a process in which two or more agents work together to achieve shared goals" (Terveen, 1995). Accordingly, it can be ascertained that some fundamental issues identified within research collaborations such as shared goals and shared research contexts can be assessed within the realm on HCI.

According to the above discussion, within the context of evaluating a VRE, the HCI plays a dual role. Not only the concept of "interfacing" embedded within HCI determines how VREs perform as a web-application, but also it concerns the element of "collaboration" provides a valuable insight how VREs needs to perform as a collaborative framework. Next section elaborates on this aspect further, by examining the success factors of research collaborations and the role of HCI in assessing those factors.

5. SUCCESS FACTORS OF RESEARCH COLLABORATIONS

The second key element of the VRE structure described is section 3 is the capabilities (functionalities embedded) of VREs to achieve success factors of collaborative research. It has been noted that the way in which collaborative research projects are managed is the key to their success (Barnes et al., 2006). This view has been echoed in literature highlighting success factors for collaborative research. As a part of a thorough literature review and series of case studies, Barnes et al. (2006) categorise success factors for collaborative research mainly into two groups; universal success factors and project management related success factors. Universal success factors include mutual trust, commitment, good personal relationships, continuity, flexibility, and leadership, while project management success factors include items such as clearly defined objectives, clearly defined responsibilities, a mutually agreed project plan, realistic aims, adequate resources, defined project milestones, a simple collaborative agreement, regular progress monitoring, effective communication etc. These factors were commonly recognised by other researchers as well. For example, almost a decade before Barnes et al. (2006), Dodgson (1996) and Davenport et al. (1998) have identified a similar list of critical success factors and some of these factors have been discussed in length in literature to establish its validity. For example Dodgson (1996) discusses "trust" in research collaborations in detail. He explains, that "contractual trust" is beneficial to the research collaborations, where all the parties trust that each of the parties will adhere to agreements and promises. Often, funding organisations require the parties to have explicit partnership agreements to ensure this critical success factor exists within the research collaborations they are funding. In addition, "competence trust" and "goodwill trust" drive the research collaborations towards success by assuring the abilities of partners to each other and by creating mutual respect to each other respectively (Dodgson, 1996).

Success factors for collaborative research discussed in the literature seem to highlight a few common themes. For the purpose of this research, the success factors identified in literature are categorised into four focused elements, as shown in Table 1.

From the sections 4 and 5 above, it can be ascertain that the success of VREs are largely depend on two factors:

1. The quality of the VRE from its Human – Computer interface perspective.
2. The functionalities embedded within VREs to achieve success factors of collaborative research.

Accordingly, it can be argued that if the user perceptions are measured from the above explained parameters, it gives a fair indication of the success of a VRE. Based on this argument, a framework was developed by the authors to evaluate VREs and was tested within an international research collaboration setting. The details of this setting are explained within the next section.

6. THE EURASIA PROJECT

The European Commission funded EURopean and ASian Infrastructure Advantage (EURASIA) is an international collaborative research project. Five multinational project partners are working in collaboration within this project; three European higher education institutes and two Sri Lankan higher education institutes. The three European partners are located within United Kingdom, Estonia and Lithuania. All the partners are leading higher education institutions that produce construction specialists within their respective countries.

Table 1. Success factors of research collaborations

Focus element	Success factors	Reference
Trust	Mutual respect and trust among partners, Good personal relationships, Simple collaborative agreement, Clear and honest understanding of each other's abilities.	(Dodgson, 1996; Davenport et al., 1998; Mora-Valentin et al., 2004; Barnes et al., 2006; Mann, 2006)
Commitment ability and leadership	Top managerial commitment from all parties, Active participation on project team by all the parties, Adequate resources, specialist and complementary knowledge and expertise of partners, One agreed project leader with required authorities.	(Davenport et al., 1998; Barnes et al., 2006; Weck, 2006)
Transparency and clarity	Common goals with no hidden agendas, Clear understanding of each partner's responsibilities and tasks, Clearly defined objectives, Clearly defined responsibilities, Mutually agreed project plan, Realistic aims, Defined project milestones, Focused project scope.	(Davenport et al., 1998; Mora-Valentin et al., 2004; Barnes et al., 2006; Weck, 2006)
Communication and monitoring	Effective communication, communication and regular contacts with partners, Regular progress monitoring, and Ensuring collaborators deliver, Monitoring project's progress against agreed milestones.	(Davenport et al., 1998; Mora-Valentin et al., 2004; Barnes et al., 2006; Weck, 2006)

EURASIA focused on capacity building of higher education institutions within the context of disaster management, infrastructure management and facilities management related disciplines. Accordingly, the main aim of the EURASIA project is to foster cooperation in higher education institutions in both Europe and Asia, improve reciprocal understanding of cultures, exchange best practice and strengthen mutual awareness of programs specifically related to disaster recovery management and capacity building. The specific objective of the project is to enhance the capacity of the partner institutions for training, teaching and research activities required for the creation and long-term management of public and commercial facilities and elements of infrastructure associated with post-tsunami activities in Sri Lanka. The project set out to achieve this by: developing and improving the Sri Lankan and EU's staff and postgraduate students' professional and research skills associated with the creation and management of facilities and infrastructure; utilising the teaching experience of the EU University partners to develop a curriculum on the creation and long term management of public and commercial facilities and elements of infrastructure; improving and consolidating academic networks by encouraging systematic exchanges so as to establish a sustainable link between EU and Sri Lankan partner Universities; developing joint institutional systems and procedures for the provision and monitoring of training, teaching and research activities associated with the creation and management of facilities and infrastructure; providing career development opportunities to junior staff through postgraduate study and training programmes with partner Universities; and, disseminating knowledge and interpreting information through joint publications and by conducting lectures, seminars, workshops and conferences.

To achieve these aims and objectives, the partners identified a need to establish a collaborative research environment. Further the multinational, geographically dispersed nature of the partner institutions, demanded this research environment to offer capabilities beyond traditional collaborative working environments. In order to achieve this, it was decided that a Virtual Environment for Built Environment Researchers (VEBER) would be developed.

7. THE VIRTUAL ENVIRONMENT FOR BUILT ENVIRONMENT RESEARCH

As with many other VREs (for example see: Adler et al., 2004; Yang and Allan, 2006; Yang and Allan, 2007; Singh, 2008) VEBER was based on an open source distributed toolset, known as Moodle (www.moodle.org). Moodle was originally developed as a Virtual Learning Environment (VLE). Its use as a VLE has been discussed extensively within current literature and often commended (see for example: Jones and Conole, 2006; Sclater et al., 2006; Eales, 2007). VEBER was developed by taking this toolset as the foundation and by adding and altering functionalities required for a virtual research environment. Moodle is technically a dynamic data driven web application written in PHP and supports a number of different Database Management Systems (DBMSs) as the backend. For the purpose of VEBER, MySQL was selected.

7.1. The VEBER development process

The development process of VEBER was started by identifying the required functionalities of VEBER to be functional as Virtual Research Environment. These functionalities were mainly identified through brainstorming sessions conducted during the EURASIA project planning stage. These requirements have been identified and incorporated to the VEBER development plan in the following manner.

- Collaboration and Communication support: Traditional communication modes are less capable of meeting the demands of multiple partner institutions and therefore a set of communication tools is to be embedded in VEBER such as announcements, discussions, group email facilities, forums and chat.
- Information Handling and Exchange support: A file hosting tool provides a robust platform for information and document handling and exchange. VEBER is to be equipped with file hosting and sharing mechanisms preferably with a common document repository and a private workspace to keep and share private and confidential documents securely.
- Project Management support: Administration across partners are to be supported with shared project calendars, tasks management tools and project monitoring tools.
- Data Collection and Dissemination support: To overcome potential geographical barriers, the VEBER is to be equipped with data collection tools such as online survey tools and online workshop tools.
- Research Training support: VEBER is to be further equipped with learning material repositories, library services and a like.

One of the main challenges of the development process at this stage was to map these requirements with existing web technological capabilities. At this point various collaborative frameworks such as Virtual Learning Environments and Content management systems were evaluated to identify a base framework to support the above identified functional requirements. This analysis provided the basis to select Moodle as a suitable candidate to upon which to build VEBER.

The next development step was the technical process of identifying the resource requirements in terms of hardware and Software. The main requirement was to purchase a suitable web server along with proper network infrastructure. A detailed hardware requirement assessment was conducted to identify the suitable hardware profile of the server to be purchased.

In addition, the following items and services have been used during the development process:

1. 1 Gigabit Ethernet port with a fixed Internet Protocol (IP) address to provide the server with a fast connection to the internet.
2. A domain registration (http://veber.buhu.salford.ac.uk) and appropriate Domain Name Service (DNS) entries to access the server over the internet. A dedicated email address for the project was also created at this point (eurasia@salford.ac.uk).
3. IP level firewall protection to minimize possible malicious attacks to the server.

This was followed by the installation of appropriate software for the server and configuration to ensure optimum performance levels and maximum security. Microsoft Windows Server 2003 was selected as the operating systems for the server and inbuilt Internet Information Service (IIS) has been used as the web server software to host VEBER as a web application.

Moodle installation was the next step. Moodle was available to download free of charge from http://www.moodle.org and has been released under the General Public License (GPL) which allows use and modification of the programme to suit the requirements of the user. As PHP and MySQL are prerequisites for the installation of Moodle, those were obtained (under GPL) and installed in the server prior installing the Moodle.

After installing and testing Moodle, it was modified to create the desired environment and functionalities of the proposed VRE. There were two main structural changes to be implemented.

1. With its basic installation Moodle uses a specific vocabulary to project its role as a VLE. For an example, all the core functionalities of the basic Moodle installation is centred around the terms such as “teachers” and “students”. To be able to use the core functionalities of the Moodle in a virtual research environment, this vocabulary needed to be changed to reflect the context of a VRE. Moodle uses “language files” (a set of PHP files carrying definitions to map Moodle core Constants to language strings) to define its “vocabulary”. A separate “language file” was created for the VEBER, creating structural changes such as re-defining the words such as “teachers”, “students” and alike to be “research facilitators” and “research assistants”.
2. The second structural change was related to the organisational unit. In the original Moodle installation the main operational unit was a “course” organising all the roles and activities within that. Moodle further has the ability to incorporate “meta courses” which are essentially containers within which more than one course can be hosted (An analogy to in face to face learning environment would be several courses within a school). To cater for the requirements of the VEBER, this organisational unit has to be completely restructured. This was achieved by customising the core Moodle code. The “research project” was identified as the main organisational unit of the VEBER, while defining a superior and an inferior organisational units to support the “research project”. The superior organisational unit is a container named “research project categories” within which several “research projects” can be hosted, and the inferior organisational unit is named as “work packages” where within a research project several work packages can be defined.

Having completed the initial setup, VEBER was functional for the last three years. During that period, this has been used as the main administrative hub of the EURASIA project.

Based on the arguments presented within the previous sections, VEBER has undergone two user evaluations during its lifespan. These evaluations were conducted using a questionnaire administered through VEBER itself, with the participation of all the project partners. The questionnaire was designed based on the principles discussed above and aimed at evaluating the two parameters described in the sections 3 and 4.

8. VEBER ASSESSMENT FRAMEWORK (QUESTIONNAIRE) DEVELOPMENT

The first step of the questionnaire development was to identify main theories of the HCI which help the assessment of user perception about VEBER as a VRE. Within this context, Hinze-Hoare (2006) presents a comprehensive evaluation of various theories of HCI discussed within literature. Having conducted a frequency analysis of main theories identified within literature, Hinze-Hoare (2006) have noted 8 main HCI principles as most significant. Those principles are as follows:

1. Familiarity.
2. Consistency.
3. Forward Error Recovery.
4. Substitutivity.
5. Dialogue Initiative.
6. Task Migratablility.
7. Responsiveness.

When developing the VEBER assessment framework, these principles were considered as the basis. However, some of the principles identified by Hinze-Hoare (2006) could be interpreted with similar meanings within the scope of VEBER. Thus, some of those principles were considered in combination as highlighted within section 8.1 to 8.4.

Different questions posed within the developed questionnaire targeting each of the above principles, and user perceptions about VEBER was each of the above principles were measured through the evaluation of answers. Each of the above principles is discussed with regards to VEBER within the next sub sections.

8.1. Familiarity and consistency

Hinze-Hoare (2006) describes "Familiarity" as "the degree to which the user's own real world personal experience and knowledge can be drawn upon to provide an insight into the workings of the new system". Familiarity within the context of HCI is a measure of ability of the user to use his / her previous experience to operate the new system. With high level of familiarity, it is perceived to be possible greatly cuts down the learning time and the amount of new knowledge that needs to be gained to operate the system being introduced. Familiarity has been identified by many authors as a key principle of HCI. Indeed Hinze-Hoare (2006) highlights the fact that this was the most quoted principle amongst all HCI authors he evaluated. However, Hinze-Hoare (2006) noted that the term "Familiarity" is referred to by various authors under different terms (e.g. guessability – Jordan et al., 1991; reduction of cognitive load – Schneiderman, 1998).

Dix et al. (1992) defines "consistency" as the likeness in behaviour arising from similar situations or similar task objectives. Accordingly, this term can be interpreted with a very similar meaning to "familiarity", within the scope of a VRE. In fact, Hinze-Hoare (2006) stresses the point that familiarity can be considered as "consistency with respect to personal experience". Accordingly, within the scope of the VEBER evaluation questionnaire, both these principles were considered as a single element and were measured through the following question:

Q3. In your experience how do you rate the learning process of VEBER?

8.2. Forward error recovery

This concerns error recovering aspects of the interaction system. As Hinze-Hoare (2006) highlights, there are two aspects to error recovery; forward and backward. Forward error recovery involves the prevention of errors. Backward error recovery concerns the easy reversal of erroneous actions. Accordingly, forward error recovery is connected to fault tolerance, reliability and dependability (Hinze-Hoare, 2006).

This was tested by two questions.

Q8. If you made a mistake when you are using VEBER how easy/difficult is to recover from the mistake?

Q9. Do the error messages provided by the VEBER give you sufficient and accurate information on how to fix problems that you may have encountered when using VEBER?

8.3. Substitutivity and dialog initiative

Both substitutivity and dialog initiative concerns user interactions aspects of the system. In particular, substitutivity concerns performing the same action within the system in different ways according to the personal preference, whereas dialogue initiative concerns the ability of the user to create dialogs with the system concerned. For example a user might wish to enter values in either inches or centimetres, or he may wish to open a program with the mouse or with the keyboard. As Hinze-Hoare (2006) stresses substitutivity enhances overall flexibility if the HCI structure of the system, where as dialog initiative leads the system towards an unambiguous dialogue between the user and the system interface.

Within the VEBER evaluation questionnaire, following question measured the user perception of the VEBER users regarding substitutivity and dialog initiative.

Q7. How easy is it for you to find information in VEBER?

8.4. Task migratablility, responsiveness and customisability

These HCI principles concern the control for executing tasks with the system. Migratablility determines how flexible the system in determining the scope of performing various tasks by various parties. Within the context of VRE, this can be exemplified by a scenario where, the capabilities of the VRE need to cater for reallocating various research tasks between partners. For an example, if a data collection task initiated by one partner needs to be taken over by another partner at a later stage, how flexible the system in facilitating this, could be a good example of the task migratability of the VRE concerned.

As Hinze-Hoare (2006) highlights, responsiveness measures the rate of communication between the user and the system. It covers measures such areas as simple response time of the web interface. For instance if a web based VRE takes i minute to respond to a simple click on a link will lead to user frustration. Hinze-Hoare (2006) notes this as Raskin (2000)'s second law of the computer interface; "a computer shall not waste your time...". Customisability is ability of the user to modify the interface. Hinze-Hoare (2006) describes this as adaptability and allows different users to adapt the interface according to their own level and style of interaction. Within the scope of a web based VRE elements such as accessibility issues cover user this aspect.

Within the VEBER evaluation questionnaire, following question measured the above described HCI principles.

Q4. Are the information/guides provided within the "VEBER user guides" clear?

Q5. Is the organization of information on the VEBER screens clear?

Q6. Is the interface of VEBER pleasant?

Having addressed the user perceptions about the VEBER based on HCI principles, the second section of the questionnaire was designed to capture user perception about how well the VEBER managed to provide functionalities to achieve critical success factors of collaborative research. The critical success factors of collaborative research which are considered within the scope of the VEBER is discussed user the section 5 of this paper. Accordingly, following questions were posed within the questionnaire to evaluate this aspect:

Q10. Do you find VEBER useful in administrating research projects through the tools provided (Calendar, task assignments, User management, etc.) within VEBER?

Q11. Do you find yourself in control of the work when you are using VEBER?

Q12. Do you find the tools available within VEBER for resource management (Links to relevant literature, Image databases, User guide databases are useful for your research work?

Q13. Do you find the tools available within VEBER for data collection and analysis?

Q14. Do you find the tools available within VEBER for communication and collaboration (forums, news sections, chat facilities, etc) are useful for your research work?

Q15. Do you find the tools available within VEBER for document management (file manager, ability to upload and store files, ability to share files with other selected members?

Having complied the questionnaire as described above, two annual user evaluations were conducted using VEBER. Annex 1 provides the completed questionnaire developed for this purpose using the methodology explained within this paper.

9. CONCLUSION AND THE WAY FORWARD

HCI principles have provided a sound theoretical foundation to build the above described framework to evaluate the user perception about VREs. As the VREs are developed with the intention of addressing the challenges faced by the collaborative research activities though a Human-Computer interaction centred approach, the use of HCI principles as the basis for this framework is justifiable. Further, the framework described above needs validation through a different approach to measure its success within a operational setting. The authors have started the testing this framework within large VRE created to facilitate a large collaborative research space created integrating two leading higher education institutions; one from the Europe and the other from Asia. It is intended that this framework is to use as the main mechanism to evaluate user perceptions about the VRE within that initiative to validate the framework.

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SANTRAUKA

ŽMOGAUS IR KOMPIUTERIO SĄVEIKOS PRINCIPAIS PAGRĮSTA SISTEMA, VERTINANTI VARTOTOJŲ INTERNETINĖS VIRTUALIOSIOS TYRIMŲ APLINKOS SUVOKIMĄ

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Įvairiausi iššūkiai ir galimybės, tokios kaip planuojamų mokslinių tyrimų globalizacija ir informacijos bei komunikacijos technologijų pažanga, pastarąjį dešimtmetį lėmė didesnį nei bet kada tiriamojo bendradarbiavimo (ir tarptautinio, ir nacionalinio) populiarumą. Šiame kontekste virtualiosios mokslinių tyrimų aplinkos (VMTA) sąvoka – tai gimstanti sąvoka, kuria siekiama imtis sudėtingų iššūkių, susijusių su tiriamuoju bendradarbiavimu. Nors VMTA sąvoka kol kas žengia pirmuosius žingsnius, svarbu įvertinti, kaip vartotojai ją suvokia, siekdami nustatyti, kaip jai seksis prigyti, ir būsimąsias plėtros strategijas. Tačiau formalaus metodo VMTA vertinti kol kas nėra. Šiame darbe pristatoma strategija, taikyta tarptautiniame mokslinių tyrimų bendradarbiavimo projekte (EURASIA), nes norima įvertinti specialiai tam sukurtą VMTA, pavadintą VEBER, naudojant gerai žinomus kompiuterio ir žmogaus sąveikos principus.

APPENDIX 1

VEBER EVALUATION QUESTIONNAIRE ANALYSIS

1. What is your overall view about the role of a Virtual Research Environment to address the research needs of Built Environment?
2. How do you rate VEBER as a virtual research environment?
3. How many times have you experienced VEBER down times since January 2006
4. In your experience how easy was it to learn VEBER?
5. Are the information / guides provided within the "VEBER user guides" clear?
6. Is the organization of information on the VEBER screens clear?
7. Is the interface of VEBER pleasant?
8. How easy is it for you to find information in VEBER?
9. If you made a mistake when you are using VEBER how easy /difficult is to recover from the mistake?
10. Do the error messages provided by the VEBER give you sufficient and accurate information on how to fix problems that you may have encountered when using VEBER?
11. Do you find VEBER useful in administrating research projects through the tools provided (Calendar, task assignments, User management, etc.) within VEBER?
12. Do you find yourself in control of the work when you are using VEBER?
13. Do you find the tools available within VEBER for resource management (Links to relevant literature, Image databases, User guide databases are useful for your research work?
14. Do you find the tools available within VEBER for data collection and analysis (questionnaires, surveys, etc) are useful for your research work?
15. Do you find the tools available within VEBER for communication and collaboration (forums, news sections, chat facilities, etc) are useful for your research work?
16. Do you find the tools available within VEBER for document management (file manager, ability to upload and store files, ability to share files with other selected members, etc) are useful for your research work?
17. Please list three (3) things that you would like to see in the future updates of VEBER
18. Please list three (3) things that you like about VEBER
19. Please list three (3) things that you don't like about VEBER