Formative Evaluation of the JISC VRE Programme

First Progress Report

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February 2006

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Executive Summary

This report
This is the first progress report of the formative evaluation of the JISC's Virtual Research Environments (VRE) Programme. The formative evaluation supports the implementation of the VRE programme and projects, helping ensure that the intended goals are achieved.

This report presents analysis and feedback on the early stages of the implementation of the programme with the intention of addressing the four tasks that guide the evaluation, namely:

- To assess how effectively the selected projects are meeting the aims of the programme
- To identify common themes between projects where these exist
- To identity gaps in the work currently being undertaken
- To contribute to raising awareness of the programme and stimulating discussion on Virtual Research Environments in the community.

In view of the ongoing discussions about the specification of a follow-on VRE 2 programme, this report also looks ahead to identify the lessons that can be learnt from developments to date.

VRE programme aims and objectives
The main objectives of the VRE programme as they have emerged in practice are to:

- Gain an increased understanding of the requirements of VREs to support decision making on future activities in this area
- Production of tangible products and/or demonstrators of usable services & tools
- Begin moving technologies into the wider community
- Begin to change behaviours and cultures

These objectives firmly establish the VRE programme as a development programme supported by some specific research activities.

The formative evaluation
The activities of the formative evaluation are organised in three phases to (broadly) reflect the three-year structure of the VRE Programme.[1] Phase 1 has recently been completed and covered the period August to December 2005: this was essentially a familiarisation, mapping and needs analysis phase. Phase 2 began in January 2006 and will continue through to October 2006: this is a phase of practical project support on user feedback, evaluation, community engagement, institutional embedding and exit and sustainability issues. Phase 3 will extend from November 2006 through to November 2007: this will concentrate on examining overall programme impact. *Although subject to possible revision, impacts are likely to be systematically examined through case study work.*

[1] Whilst the VRE Programme runs from April 2004 to October 2007, the projects funded by it have a duration of between one and three years, with anticipated completion dates of between March 2006 and October 2007.

Mapping project activities against programme aims
Overall there is a strong alignment between the activities funded and the programme's aims as set out in the relevant programme documentation: that is, tools and techniques for VREs which are *appropriate; interoperable; distributed; extensible; end usable; open standard; secure; customisable*; and *add value*.

An emergent understanding of VREs
As the programme has progressed, understanding of what VREs could be has broadened and deepened (as indeed was a key original aim of the programme), particularly as regards *facilitating collaboration between researchers* and *managing the whole research process.* However what the VRE(s) is/are is by no means settled, but what is much clearer now is that the VRE programme is, and has to be, about ways (institutionalised socio-technical systems) for 'doing' research and not just about technical architectures or frameworks.

Programme characteristics
VRE programme projects overwhelmingly focus on tools or platforms directly designed to facilitate collaboration between researchers. We can distinguish four (overlapping) aspects of projects:

- Projects focusing on particular academic domains,
- Projects producing different technologies,
- Projects targeting particular stages in the R&D cycle and
- Projects modifying whole scholarly practices.

Perhaps unsurprisingly given the intrinsic research focus of the programme, typical project participants tend to come from the leading research universities and 5* departments.

Emerging issues
Most of the projects in the VRE programme do not address a full development cycle making it difficult to know how putative user communities will respond to VRE technologies, whether and how they will use them, and what functionalities are important to them. There are some weaknesses in user evaluation of demonstrators and prototypes, and limited piloting in the programme. Whilst the allocation of funding within the programme into smaller lots may not have been conducive for the completion of whole development cycles, the extent to which full development cycles – from the establishment of user needs through to user testing and some form of piloting - are completed and the learning that flows from this will be important to ultimate programme success.

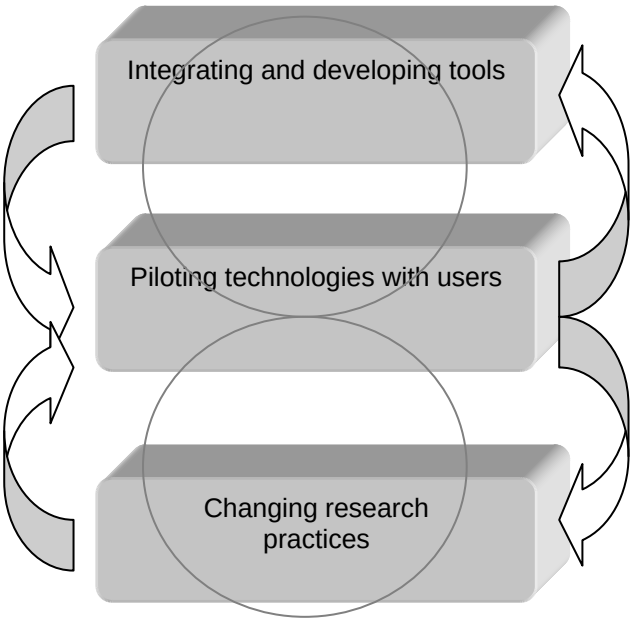
Formative evaluation support
Formative evaluation support to projects has therefore been designed to address the above issues. The core focus of the evaluation support will be on providing tailored support on a one-to-one basis to VRE projects: particularly on issues of user involvement, strategies to engage the wider scholarly community and sustainability. The formative evaluation is also supporting cross-project exchange, as well as providing feedback on programme steering

and development via the programme management and the programme Advisory Board.

Project weaknesses
In our experience of JISC research and technology development programmes over the years, projects which come forward from the community tend to be weak on expertise in user involvement and user engagement, systems design methodologies as well as evaluation and require help with these. The current VRE programme is no exception to this.

'VRE 2'
These weaknesses, added to the overarching need for projects which complete full technology development cycles using methods of rapid prototyping with short development cycles, have particular implications for thinking about the content, commissioning of projects as well as support and management of 'VRE 2'. The following figure – developed in discussion with the programme managers - illustrates the type of integrated model for programme design and project selection that the evaluation work so far indicates would be most appropriate for 'VRE 2':

Figure: Suggested integrated structure for VRE 2 Programme and projects



1 Introduction

This is the first progress report of the formative evaluation of the JISC's Virtual Research Environments (VRE) Programme. The VRE Programme started in April 2004 in order to explore how technologies and infrastructures developed for virtual learning environments can be exploited for the research community. The programme funds 15 projects that are to explore elements of a VRE by deploying large-scale VRE demonstrators, identify functionalities of a VRE or develop demonstrators. The formative evaluation is supporting the implementation of the VRE programme and projects helping ensure that the intended goals are achieved.

This report presents analysis and feedback on the early stages of the implementation of the programme with the intention of addressing the four tasks that guide the evaluation, namely:

- To assess how effectively the selected projects are meeting the aims of the programme
- To identify common themes between projects where these exist
- To identity gaps in the work currently being undertaken
- To contribute to raising awareness of the programme and stimulating discussion on Virtual Research Environments in the community.

In view of the ongoing discussions about the specification of a follow-on VRE 2 programme, the report also looks ahead to identify the lessons that can be learnt from developments to date.

The report is structured as follows. **Chapter 2** provides an analysis of the policy background against which the VRE Programme has been conceptualised and initiated, both in the UK and worldwide. It introduces the aims and objectives of the programme and presents the scope and activities of the formative evaluation. **Chapter 3** gives a brief overview of project activities and outputs to date before analysing their match with programme aims. **Chapter 4** introduces the emerging understanding of VREs. **Chapter 5** explores key programme characteristics as expressed by the type of projects funded and type of participating institutions while **Chapter 6** analyses the emerging issues and implications from this analysis and relates these to the programme support that will be offered as part of the formative evaluation over the coming months. It also draws some conclusions on the focus and formulation of the VRE 2 Programme. **Chapter 7**, finally, makes some general recommendations for the development of the VRE programme and VRE 2.

2 The JISC VRE Programme: genesis and development

2.1 Policy context and origin of the VRE Programme

Nationally and internationally the last few years have seen the emergence of initiatives aimed at exploiting the opportunities of high performance computing and the Internet for advancing scientific research, knowledge creation and use. These efforts to create e-infrastructures, promote e-science and develop virtual research environments are not only a function of the rapid technological progress in the field of computing made in the last decade or so, but crucially also a function of their socio-economic implications. Three key policy drivers are pushing forward developments in this area:

- *The recognition that open access to research publications and data is essential in a knowledge-based society.* The OECD acknowledges, for instance, that open access improves the quality of research, facilitates training and maximises the value of publicly funded research.[2] The importance of the Internet to open access to information, as well as the necessary conditions for realising this, have also been highlighted by several initiatives and declarations on open access to academic research publications emerging from within the scientific community since the early 2000s.[3]
- *The complexity of policy issues confronting governments in the 21st century.* In a globalised world, many socio-economic and ecological problems originating at the national level transcend national boundaries to have a global impact. Cause and effect, as well as implications for actions, become more difficult to discern. Multidisciplinary research involving increasingly global collaborations of scientists and the sharing of resources become more important.
- *Deluge of data.* Technological progress allows for the collection and storage of vast quantities of data in both the natural and social sciences. This requires huge computational power to manage and exploit data in the new research paradigm.[4]

Further, the Science and Innovation investment framework 2004-2014, produced jointly by the Treasury, the DTI and the DfES, suggests that: 'The nations that can thrive in a highly competitive global economy will be those that can compete on high technology and intellectual strength [...]'. For the UK, that according to a recent ranking has 24 Universities in the top 200

[2] OECD (2004) Declaration on access to research data from public funding, http://www.oecd.org/document/0,2340,en_2649_34487_25998799_1_1_1_1,00.html

[3] The Budapest Open Access Initiative aims to make research articles in all academic fields freely available on the internet (http://www.soros.org/openaccess/). Other initiatives include the Bethesda Statement on Open Access Publishing (http://www.earlham.edu/~peters/fos/bethesda.htm) and the ECHO Charter, which aims at defining the criteria for adequate exploitation of the new media's potential for archival preservation, scholarly and educational exploration, and the 2003 Berlin Declaration (http://www.zim.mpg.de/openaccess-berlin/berlin_declaration.pdf).

[4] See also: JISC (2005) *JISC Virtual Research Environments Programme*, Briefing Paper, June 2005

higher education institutions in the world[5], capitalising on this knowledge base is an important economic policy priority.

It is against this background that since the early 2000s a number of programmes were initiated, designed to capitalise on the opportunities offered by information and telecommunications technology for the (commercial) exploitation of knowledge.

The eScience Programme, launched by the UK government in 2000 and due to be reviewed in 2006, is the key catalyst for exploiting the opportunities that eInfrastructures present and also to establish the UK as a world leader in this field. With its focus on encouraging the development of eInfrastructures and the attempt to change research practices, it is not only expected to influence the way research is undertaken but also to contribute to business, government and society through new knowledge generated and new models of knowledge generation.

The idea of a VRE remains intrinsically linked with these developments. It complements eScience not only by extending the scope of potential users from mostly natural scientists to the social sciences and the arts and humanities but also by developing online tools, content and middleware within a coherent framework for all disciplines and all types of research.

2.2 The emergence of the VRE Programme

While it is unlikely that VREs would have become an issue without the prior rise to importance of eScience, the interest in the concept in the UK can also be traced back to the experience made with Problem Solving Environments (PSEs)[6] in the USA and Virtual Learning Environments (VLEs) in the UK. Among others, the VRE Programme sprang from an emergent awareness within the JISC Committee for the Support of Research that the technologies and infrastructures being developed for VLEs and within the digital libraries work had relevance for the research community which should be explored further.[7] This coincided with explorations by the grid community into the collaborative use of shared resources, studies on the lifecycle of scholarly communication and increased demand for collaboration tools such as shared diaries and file systems[8] ultimately created the momentum for the establishment of the VRE programme. £3.2 million, made available through the 2002 Comprehensive Spending Review, was subsequently earmarked for an exploratory programme on Virtual Research Environments.

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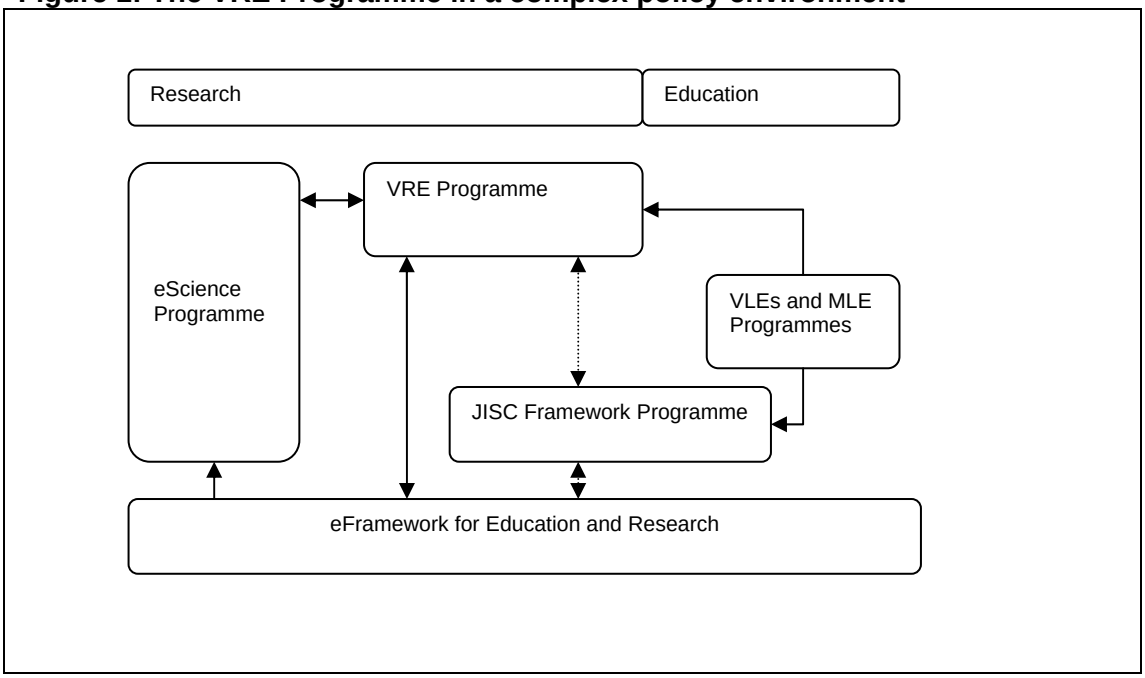
[5] Times Higher Education Supplement (2005) The world's top 200 Universities, 28.10.2005 http://www.thes.co.uk/statistics/international_comparisons/2005/top_unis.aspx?window_type=popup

[6] PSEs, which emerged in the 1990s at US universities, can perhaps be described as 'early VREs'. A PSE has been defined by Gallopoulos, Houstis and Rice (1994) as a "computer system that provides all the computational facilities needed to solve a target class of problems" (http://www-cgi.cs.purdue.edu/cgi-bin/acc/pses.cgi)

[7] Stakeholder Interview September 2005 and presentation by Alan Robiette at JISC VRE Programme Meeting 12 January 2005.

[8] Note of JISC Town Meeting on 'Developing Virtual Research Environments.

Figure 1: The VRE Programme in a complex policy environment



The scope and content of the VRE Programme were decisively shaped by the nine-member VRE working group[9] assembled in 2004. The group produced the 'Roadmap for a UK Virtual Research Environment'[10] which developed a 'wish-list' of capabilities of a VRE and drew up the key features of the soon-to-be-implemented programme (VRE definition, programme intention and approach). In carrying out this work, the VRE working group was able to draw on the outcomes of two workshops on the theme of 'Building Collaborative eResearch Environments', held in the first quarter of 2004, which brought together a range of people from different subject disciplines involved in the planning and implementation of research infrastructure developments. The workshops addressed technical, organisational and user questions and developed a set of recommendations of how the JISC could support the development of a VRE.

2.3 Aims and objectives

The aims of the VRE Programme, as expressed in the VRE Roadmap and the preceding workshop, are threefold:[11]

- To engage the research community in building and deploying Virtual Research Environments (VREs) based on currently available tools and frameworks;
- To provide a clear definition of what constitutes a VRE, its boundaries and how this function overlaps with other related technologies, e.g.

[9] Rob Allen, Alison Allden, David Boyd, Rob Crouchley, Nicole Harris, Liz Lyon, Alan Robiette, Dave de Roure, Scott Wilson.
[10] http://www.jisc.ac.uk/uploaded_documents/VRE%20roadmap%20v4.pdf
[11] See VRE Programme website: http://www.jisc.ac.uk/index.cfm?name=programme_vre and JISC Virtual Research Environments Programme Briefing paper of June 2005

Virtual Learning Environments, peer-to-peer applications and online collaboration software
- To raise awareness and stimulate discussion on VREs within the UK research community.

These aims are being implemented with the help of 15 projects funded under four thematic strands:

- *Strand I:* Larger scale projects to deploy VRE demonstrators based on existing frameworks, such as Sakai or OGCE (6 projects)
- *Strand II:* Projects to identify functionality (in the form of tools and services developed in other projects) which has not hitherto been integrated into the existing framework architectures and to add such functionality to address clear user requirements (2 projects)
- *Strand III:* Projects to develop and deploy lightweight, proof-of-concept VRE demonstrators appropriate to the needs and skills of specific communities (4 projects)
- *Strand IV:* Cross-strand (3 projects)

Table 1 below lists the projects funded under each strand:

Table 1: Projects funded under the four strands of the VRE programme

Strand	Projects
Strand I: Larger scale projects to deploy VRE demonstrators	• Sakai VRE for Educational Research • Sakai VRE Portal Demonstrator • A VRE to Support the Integrative Biology Research Consortium • EVIE: Embedding a VRE in an institutional environment • ELVI: Evaluation of a Large-scale VRE Implementation • Meeting Memory Technology Informing Collaboration (Memetic)
Strand II: Projects to identify functionality	• Implementing the Kepler Workflow Interface into the Cheshire Digital Library Framework (Cheshire 3) • CSAGE:
Strand III: Projects to develop and deploy lightweight, proof-of-concept VRE demonstrators	• CORE: Collaborative Orthopaedic Research Environment • Silchester Roman Town: A Virtual Research Community • GROWL: VRE Programming Toolkit & Applications • ISME: Integration & Steering of Multi-Site Experiments to Assemble Engineering Body Scans
Strand IV*:* Cross-strand	• VRE for the History of Political Discourse 1500-1800 • BVREH: Building A VRE for the Humanities • IUGO: Conference Information Integration Project

Source: VRE programme website www.jisc.ac.uk/vre

The approach chosen to achieve the programme aims is thus simultaneously top-down, represented by Strand 1 projects, and bottom-up, represented by Strand 3 projects.

While the aims of the programme were relatively clear from the beginning, the programme objectives as outlined in the VRE Programme Plan were quite broad. What they seemed to initially not portray was a sense of what the concrete and overall outcomes from the funded activities might be, that is, how the Programme aims were going to be supported. This presents difficulties not only because it becomes more difficult to assess whether the Programme was successful or not; it also presented the additional difficulty of obscuring what kind of programme the VRE programme is - oriented more towards research or more towards development?

It is fair to say that an added difficulty is the subject matter of research collaboration in itself which does not lend itself easily to the modelling of activities and processes on which concrete objectives for VREs could be build. Unlike the creation of VLEs and MLEs, for instance, the creation of VREs cannot draw on clearly definable tasks or a clear set and scope of activities. Research is a lot less structured than (formal) learning. What it means to do research, to do it collaboratively, the different tasks involved and how these can be supported electronically was by no means well understood and continues to be subject to further investigation from researchers participating in the programme and others.

The process of implementing the VRE programme is thus becoming in itself an important process of clarifying and making explicit the views of programme management, stakeholders and project teams about programme objectives. In the course of this process, a number of key objectives have crystallised so far. These are presented in Box 1 below:

Box 1: VRE Main Programme objectives

- Gain an increased understanding of the requirements of VREs to support decision making on future activities in this area
- Production of tangible products and/or demonstrators of usable services & tools
- Begin moving technologies into the wider community
- Begin to change behaviours and cultures

An additional objective of exploring the commonalities between technologies to support research, learning and administration has also been identified but it is not widely seen as a ‘main’ objective.

These objectives also clarify the nature of the VRE programme: they firmly establish it as a development programme (whilst also incorporating some of the research necessary to shed greater light on this cutting edge area). As Figure 2 overleaf illustrates, each of these objectives also supports one or several of the Programme's aims. In doing so the internal consistency of the Programme is maintained.

2.4 The Formative Evaluation of the VRE Programme: scope and activities to date

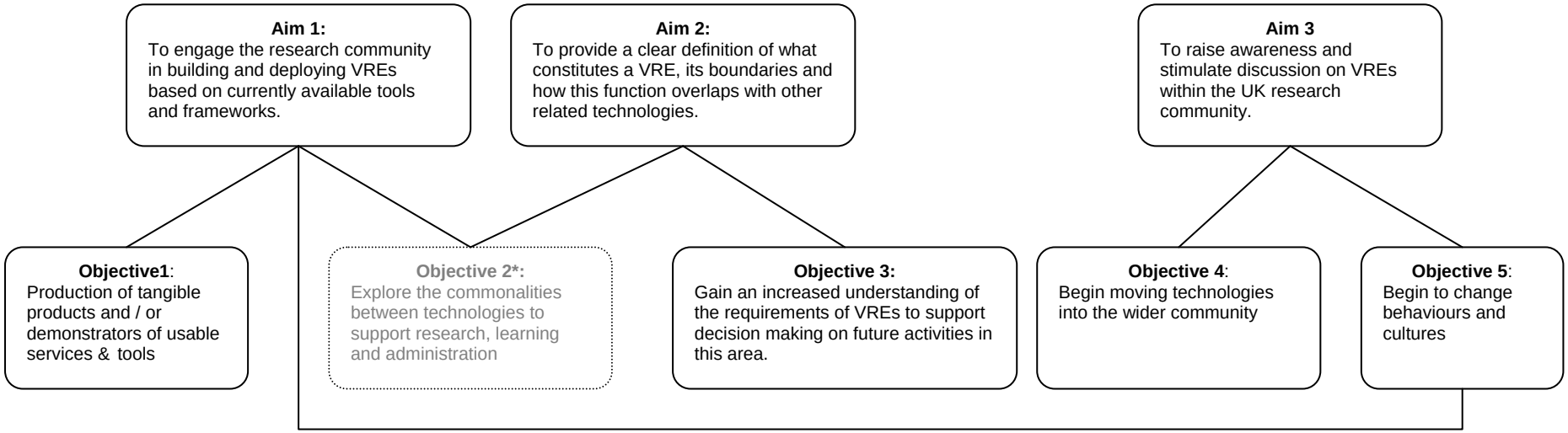
As part of the VRE Programme, the JISC commissioned a formative evaluation to accompany its implementation. The formative evaluation has four broad aims:

- Assess how effectively the selected projects are meeting the aims of the programme;
- Identify common themes between projects where these exist;
- Identify gaps in the work currently being undertaken;
- Contribute to raising awareness of the programme and stimulating discussion on Virtual Research Environments in the community.

In the course of the first four months of the formative evaluation funding was released for a successor to the VRE Programme, subsequently named 'VRE 2'. In addition to the four aims outlined above, the formative evaluation will also have an input into developing the focus of this successor programme.

The activities of the formative evaluation are organised in three phases to (broadly) reflect the duration of the VRE Programme. Phase 1 has recently been completed and covered the period August to December 2005: this was essentially a familiarisation, mapping and needs analysis phase. Phase 2 began in January 2006 and will continue through to October 2006: this is a phase of practical project support on user feedback, evaluation, community engagement, institutional embedding and exit and sustainability issues.

Figure 2: VRE Programme aims and objectives



**Note: Objective 2 is not a main objective of the VRE Programme.*

Phase 3 will extend from November 2006 through to November 2007: it will concentrate on examining overall programme impact, mainly it is thought through case study work, though this may be subject to revision. Activities in each phase are timed to fit into the VRE projects' lifecycles and also take into account their different completion dates.

Phase 1 activities focused on the mapping of the programme and its context in order to build up knowledge about the programme and help formulate activities for the subsequent phases. Specifically, the following five activities were carried out:

- Interviews with Programme stakeholders in order to capture their understanding and anticipation of the VRE programme.
- A review of programme documents and key literature from the UK and abroad on recent trends and developments related to the creation of virtual research environments, eScience and the use of technology for research purposes more generally in order to put the VRE programme into a broader context and delineate it from terms such as eScience.
- The production of a policy map (reflected in this report) analysing project documents in order to provide an overview of how well programme and project aspirations match.
- Visits to all 15 projects funded by the VRE programme in the course of October and November 2005 in order to gain a first-hand and in-depth knowledge of their work, approaches to it and any difficulties they may be facing.
- Based on the insight gained during the initial project visits, the development of activities to be carried out jointly with the projects in order to support their work as well as the contribution it makes to programme aims and objectives.

This report draws on the knowledge gained during the first phase of the evaluation, beginning with a brief overview of project activities and their match with key programme features. Activities planned and envisaged for phases 2 and 3 of the formative evaluation are outlined in **Chapter 6** of this report.

3 Mapping project activities against programme aims

If the VRE programme is to achieve its aims and objectives, it is important that the projects through which it is implemented are contributing through their intentions (and actions) to these aims and objectives. This chapter therefore presents an initial synthetic analysis of how intended activities under the VRE Programme are matching its aims and objectives.

This exploration is undertaken with the help of the policy map methodology. Policy maps compare project content against the overarching aims and objectives of a programme. While some basic information about project activities (progress, difficulties, etc.) is provided, the main focus of a policy map is on fit and alignment. The key question that we seek to address here is whether the sum of the VRE projects – as they were originally conceptualised – are intending to develop something which can be described as a VRE as it was characterised in the early documentation of the Programme? While it is too early to come to an assessment of whether the VRE programme is delivering what it set out to deliver, this method gives an early indication of how far activities carried out under the VRE programme are supporting its aims and objectives.

This approach has been chosen because thinking about VREs is at the cutting edge of conceptualising new socio-technical systems (new ways of working) in the world of higher education and scholarly research, and therefore entails fundamental insecurities about the character and purpose of VREs (that is to say there are both "known unknowns, and unknown unknowns" at issue here). Against this background, the initial analysis offered in this chapter simply wishes to examine whether or not there is a good alignment between what projects are *intending* to do and the ideal or prescribed characteristics or capabilities of a VRE *as originally envisaged*. It should be noted that this work is based on a review of early programme and project documents only[12]; information gleaned from project visits and interviews has not been included. This is to allow us to measure stated aims and objectives at the stage of application. Following this analysis a brief review of actual project activities and outputs as of November 2005 is provided.

3.1 Alignment of project intentions with Programme aims

How well then do the intended aims and activities of the 15 VRE projects match up with the aims of the VRE Programme? Whilst the programme has three overall aims (see Chapter 2 above), we would argue that a key aim is 'to provide a clear definition of what constitutes a VRE, its boundaries and how this function overlaps with other related technologies'. As a framework for thinking about VREs, nine core characteristics of VREs are mentioned in relevant programme documentation.[13]

[12] In particular, project proposals and first progress reports were examined.
[13] E.g. the VRE Roadmap, the JISC Developing Virtual Research Environments Circular, VRE Programme plan and others.

According to these documents, a VRE should be:

- *Appropriate*: the VRE should be relevant to the support of basic research processes and collaborative research;
- *Interoperable*: be compatible with other widely used and deployed systems and link into existing tools, services and resources;
- *Distributed*: be based on loosely-coupled, distributed, interoperable tools rather than monolithic pieces of software;
- *Extensible*: be extensible with enhanced or new tools by any developer;
- *End usable*: be seamless to end users and maximise ease of use, meet user requirements and allow for multiple modes of access;
- *Open standards compliant*: be open compliant wherever possible; adopt and use appropriate open standards wherever possible;
- *Secure*: be secure and trustworthy;
- *Customisable*: support the tailoring of the environment by individuals or groups to reflect their interests and preferences.
- *Added value*: is able to demonstrate added value with respect to existing workbenches, toolsets, portals etc.

In the absence of a universally accepted definition of what VREs are at this early stage of the development, it is alignment of project *intentions* as expressed in application documents and progress reports with these nine core characteristics that this policy map sets out to analyse. To this end, we have devised a scoring system from 0 (not identifiable) to 3 (perfect alignment). It should be noted that this is not a marking system for projects' performance. Rather, the scoring system is essentially a qualitative analysis of intended activities as displayed in early project documents that is expressed quantitatively (i.e. the data thus produced are meaningful, in the sense of providing a good indication of the match of intended activities with programme aims and objectives, but not necessarily always precise). For this reason, individual scores are not reproduced here and the precision of specific percentages should not be exaggerated in interpreting the data presented. Rather, the focus of the section is on highlighting some of the headline messages coming out of this analysis. The sections below thus outline how well according to this analysis project intentions support the key programme aim.

3.1.1 Overall a strong alignment …

Using this method of analysis highlights clearly the overall strong alignment between the projects' intended activities and the nine core VRE characteristics. Projects with overall the strongest alignment to programme objectives, as discernable from their early documentation, were the GROWL and EVIE projects. Generally, however, the match of activities to core characteristics is particularly strong in three key areas for the Programme and VREs more generally:

- Activities carried out under the VRE Programme are **highly appropriate**, that is, relevant to the support of basic research

processes and collaborative research. The intended activities focus on providing electronic solutions to key tasks carried out by academic researchers. The OGHAM project is a good example for this as it is strong on both supporting basic research processes in the field of archaeology (among others by electronically supporting the collection of data at the Silchester Roman Town archaeological site and their subsequent management), facilitating research collaboration (by allowing geographically and institutionally dispersed experts to 'visit' the site via their computers, view artefacts thus permitting them to contribute to their interpretation, for instance through real-time online conferences) and supporting the management the resulting data. In doing so the project 'synchronises the three processes of gathering information, co-ordinating expertise, and managing the resulting body of data'.[14]

- The intended research and development work under the VRE Programme also provides **significant added value** with regard to existing tools, workbenches, portals etc. This is expressed in the plans to either develop new tools or to extend or integrate existing ones, facilitate access to them and / or find new uses for them. The GROWL project, for instance, facilitates the uptake of Grid-based computing for scientists in both the natural and social sciences. It aims to produce a lightweight client-side connection toolkit to the Grid for 'naïve users' in both natural and social science fields who employ applications such as STATA and SPSS, making it easier for them to link in transparently (through "libraries") to the grid and distributed data sets including heritage applications.

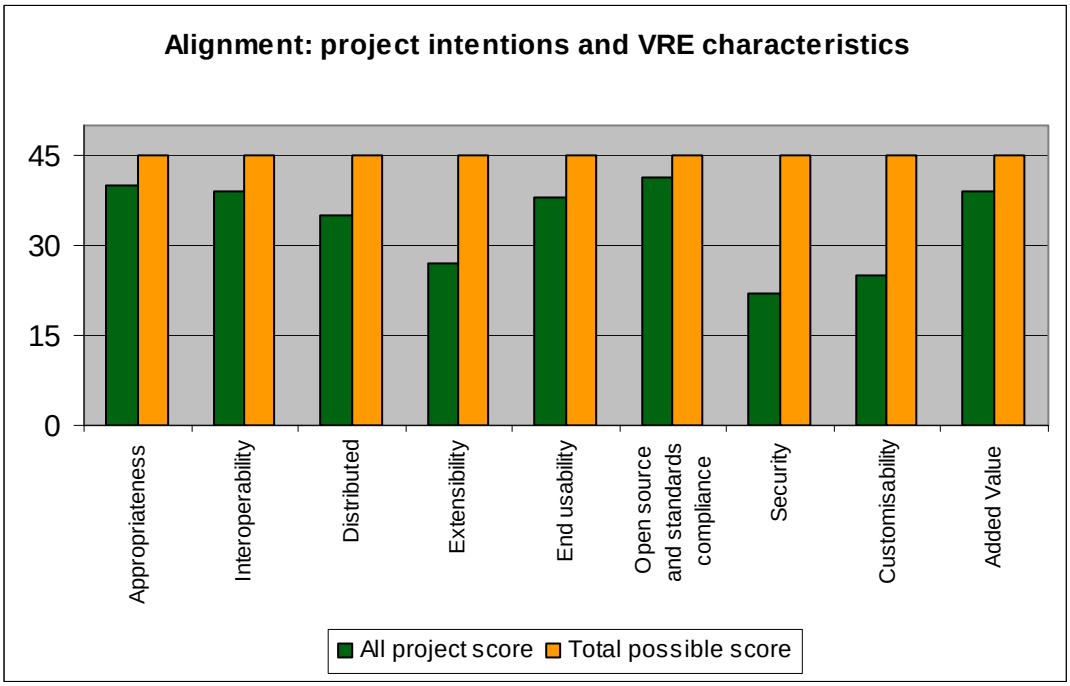
- Finally, projects also place **great importance on open source and standards compliance**. In fact, this is the VRE feature with the strongest match to planned activities highlighting and reflecting the importance attributed to these criteria both by the JISC and the projects funded.

Whilst activities carried out under the VRE Programme are thus highly appropriate, provide significant added value and are committed to open source and standards compliance, occasionally intended activities might have gone further, for instance in supporting collaborative research: some of the tools developed might lead to research collaboration further down the line but not necessarily at the first point of their use. The issue of end usability of the tools developed is a further area where early project documentation appeared to leave open some questions, in particular with regards to the extent of the planned end user testing of any technologies developed and how easily some of the technologies developed might be able to be taken up by the wider research community.

However, overall there is a strong match between intended activities and programme aims. This indicates that with their combined activities projects

[14] http://www.jisc.ac.uk/index.cfm?name=vre_silchester

will drive forward thinking about VREs and their concrete manifestations significantly.



3.1.2 … while some VRE characteristics feature less strongly

While the match of project intentions with VRE features as foreseen by Programme level documentation is thus strong in areas such as appropriateness, open standards compliance and added value, the match of intended activities with other VRE features appears to be weaker. This is particularly the case in areas of security, customisability and extensibility:

- There appears to be only a weak match between activities carried out under the Programme and the desire for a VRE to be **secure and trustworthy**. In a significant number of cases, it is difficult to identify the response to security because the issue is not sufficiently discussed to enable the reader to draw conclusions on whether and how the issues is dealt with in project activities.[15]

- Customisability, understood to mean 'tailoring of the environment by individuals or groups to reflect their interests and preferences', is also an area where activities appear to be not as aligned with programme objectives. Understanding customisability as meaning 'flexibly employable tools', as the above definition suggests, indicates that there are degrees of customisability within the VRE programme. Some of the tools and technologies developed under the Programme appear to be

[15] This may reflect the current transition between Athens and Shibboleth nationally and institutions' coming to terms with questions issues of identity management. Both of these trends may have contributed to the VRE Projects underplaying the issue of security.

highly flexible (for instance some of the tools developed for data retrieval) as the same tools allow researchers from different disciplines to run queries related to their specific fields of expertise. Some of the work that is being done at an institutional level also aims to cater the different needs of researchers in different disciplines. Yet, other tools and technologies appear to have a more limited capacity for customisation. This may be because the (sequence of) research activities supported by the VRE technologies adopted are highly specific, applying primarily to a particular academic discipline and a particular strand of investigation within it. It may also be because the research activities they primarily support are so generic that by their very nature the scope for customisation is limited. Where larger systems are being developed, customisation also depends on the selection of tools to be integrated into them and their individual qualities. Finally, the overall alignment of activities to programme aims also appears to be affected because in a number of cases this preliminary assessment of the degree of customisability of the tools developed could not be made because the project plans made the development of technologies dependent on a preceding research phase.

- Even though a large number of tools and instruments developed are clearly **extensible,** in some cases project documentation left open how extensible the systems or tools to be developed were going to be, either due to the nature or sequence of planned activities. Whilst the overall strong adherence to standards and development of open source code signals a fundamental ability of the tools and systems to be extended, some variations in the degree of extensibility thus appear to be built into the Programme.

While overall the intended activities under the VRE Programme are thus supporting the aims of the programme, it would thus appear that the issue of security in particular might require further in-depth exploration. For instance, as the emerging security frameworks such as WS-Security and Shibboleth are subject to other JISC development programmes, an area for future work might be how VREs might best adopt these frameworks once they are stable and widely deployed.

3.2 Project activities and outputs to date

While project intentions thus show a high degree of overlap with the programme's aim of defining what constitutes a VRE, achieving it depends on the execution of projects in line with these intentions.

Some projects reported delays in the start-up of their work (often the result of recruitment problems) though any time lost could mostly be made up. As regards the implementation of project activities in accordance with the original proposed ideas, however, only one project (Cheshire 3) reported significant changes. The project's change of direction was due to the assessment that the Sakai platform originally envisaged as the basis for its work was unsuited to achieve the project's aims. It now uses a different environment (Kepler) to develop workflows enabling the integration of Cheshire 3 and Sakai as well as an interaction with the Kepler environment.

Until July 2005, much of activity of the 15 VRE projects from the start of their work through to July 2005 was focused on what might be called preparatory activities and initial development work. Most projects across all four strands devoted some time early in the project to project management tasks. Depending on the project's requirements, this involved staff recruitment and / or training, finalising the project plan, developing project websites and installing the necessary hardware. The preparatory activities also included background research or other activities laying the foundation for later work packages such as user requirements studies or the installation of required hard- and software.

Very few projects have not been able to progress beyond this initial preparatory work. Even though they started work at different times and work to different schedules, most projects were able to report on initial developmental work by July 2005. This included the population of databases, the writing of code, the production of corresponding manuals and the production of functioning demonstrators.

Even though it is still early, some projects had already begun disseminating information about their approach and work by July 2005, either by writing articles for publication in academic journals or by participating in conferences and producing papers for these occasions.

As a result of these activities, the following types of outputs had been produced by July 2005:

- Project websites
- User requirement analyses
- VRE tools
- Other software
- Conference papers

4 An emergent understanding of VREs

While the origin of the VRE Programme shows clear conceptual links between VREs, eScience and and other developments , narrowing down what VREs are and what they are meant to do has proved difficult. It is a new concept which has to be imbued with meaning by the actors involved in its use. Indeed, it is one of the aims of the programme 'to provide a clear definition of what constitutes a VRE, its boundaries and how this function overlaps with other related technologies'.

Therefore it is not surprising that the initial ideas about VREs are still in the process of being produced and refined. The VRE Roadmap, for instance, defines a VRE as a 'set of applications, services and resources integrated by a standards-based, service-oriented framework which will be populated by the research and IT communities working in partnership'.[16] More specifically, a 'VRE will provide a framework of resources to support the underlying processes of research on both small and large scales'.[17]

Noticeable by its absence in these definitions is any specific (or at least explicit) notions of what VREs are for and who they are for.

Other early attempts at defining VREs chose to delineate it from VLEs which adds a useful dimension to the above attempt. Thus, while VLEs which are geared towards learning resources, VREs develop research capability . In this view a VRE provides an access point (for instance through a web portal or other form of access) to all the services that researchers may need, for instance visualisation, databases, collaborative working etc. Though VREs and VLEs have different functions, it is also becoming clear that the two need to be interoperable.

This view, and the nine characteristics of a VRE listed in core programme documents, is further enhanced by examining the views of the researchers involved in the current VRE programme. These signal a strong perception that VREs are about facilitating *collaboration between researchers*. This may involve sharing data, documents and resources, exchanging views and ideas and communicating more generally. At the same time, VREs are about *managing research* at both pre-project stage – when it could help the formation of partnerships, the identification of funding or the writing of bids - and during the implementation of projects when they can help the planning process as well as offer support throughout the research life cycle (experiments, data gathering, data analysis, research report writing, publications).

[16] JCSR VRE Working Group (2004) Roadmap for a UK Virtual Research Environment, p. 3 http://www.jisc.ac.uk/uploaded_documents/VRE%20roadmap%20v4.pdf
[17] JISC Briefing Paper June 2005

VREs thus address key scholarly needs such as accessing and sharing resources, examining literature, making connections and communicating.[18] Crucially, VREs combine these functions in a single portal, framework or infrastructure to create a single point for accessing different (automated) tools to support research. These tools should be interoperable and need to be able to interact with each other – and also with the physical environment (such as libraries). They also need to be able to be tailored to different disciplines and scholarly practices. Eventually, it will thus be possible to create a personally customised space geared to individual strategies, needs and research patterns.

With these features VREs provide added value to the research process by increasing efficiencies of 'synchronous' collaboration (for instance through speeding up research, integrating research and publication processes, improving research management), cross-linking tools, facilitating analysis and interpretation of large datasets while also facilitating asynchronous collaboration between researchers (for instance through the recording and playback of meetings, conference discussions and others).

The views of the VRE programme project teams also help to gain a better understanding of who VREs are for. VREs are likely to be used by researchers at all levels (from junior researcher to senior professor), as well as non-researchers such as administrators, in the natural sciences and the social sciences as well as the arts and humanities equally. However, different users will have different access rights. VREs may be a "bolt-on" to Universities with user authentications being managed centrally. In addition there may be subject-based VREs likely to be managed decentrally.

Even though the VRE Programme is only in its first year of implementation, we can already observe that the understanding of actors within it of what VREs are has developed. It is starting to become clearer what and who VREs are for and what their added value is. In particular, the above discussion shows that VREs are about technologies: tools with a concrete function that helps researchers investigate, analyse, plan and communicate. Rather than the more abstract terms such as architecture or framework, a VRE could thus be thought about as a workbench which includes collaborative tools and a shared workspace for carrying out research, or indeed more generally as Michael Fraser of Oxford University has put it:

> '*a set of online tools, systems and processes interoperating to facilitate or enhance the research process within and without institutional boundaries'*

[18] Indeed, the Compendium mindmapping tool integrated by the MEMETIC project, for instance, is able to support exactly these aspects of the research lifecycle, as is demonstrated in a recent longitudinal study (Selvin, AM and Buckingham Shum, SJ (2005) "Hypermedia as a productivity tool for doctoral research" New Review of Hypermedia and Multimedia, 11 (1), 91-101; pre-print: http://kmi.open.ac.uk/publications/pdf/kmi-tr-05-8.pdf).

5 Programme characteristics

While mapping project intentions against programme aims has given an initial impression of what the VRE programme is, and has allowed us to start thinking about how well intended activities are meeting programme aims, an identification of common themes and potential gaps requires a deeper analysis of the programme's characteristics. This chapter sets out to explore this by looking at:

- The role of research collaboration
- The type of projects funded and
- The type of participating institutions

5.1 The role of research collaboration in the Programme

As the objective to make VREs 'relevant to basic research processes and *collaborative research*' shows, facilitating the collaboration between researchers by providing them with the relevant electronic tools is an important element of the VRE Programme. Indeed, this view is shared by programme stakeholders and project teams alike.[19]

Clearly, research collaboration can mean many things. It can involve different configurations of researchers on a formal or informal basis: several individuals within one research group in the same department, researchers in different departments at the same institution, researchers at different research institutions both nationally and internationally, collaboration between academic and non-academic researchers are but a few of the different possible configurations.

At the same time, research collaboration can revolve around a number of different tasks, such as collection and / or analysis of data, production of a research paper or, indeed, managing research collaborations. Research collaboration is also bound to vary with the nature of the research and the discipline in which it is carried out. Studies on the subject have, for instance, shown that collaboration is more common in experimental work than theoretical work as the economic benefits and the need for a more formal division of labour are clearer.[20] There are also differences between applied and experimental research in terms of the likelihood of collaboration and, no doubt, between different disciplines and their particular intellectual and praxis traditions.

What this brief reflection indicates is that research collaboration is clearly a complex and multi-faceted process, and electronic tools and instruments designed to support it will need to cater for this complexity.

Indeed, the VRE Programme, and the tools to support research collaborations as part of it, recognise this. Not only is the bulk of the tools developed clearly

[19] Stakeholder interviews August 2005 and project visits.
[20] Katz and Martin (1997)

aimed at supporting – and facilitating - the collaboration between researchers independent of academic discipline, signalling that what is being supported are basic research processes common across domains. As the classification of projects by discipline in section 5.2 below shows, most of the tools developed under the VRE Programme can be applied across different academic disciplines. A good example for this is the integrated meeting replay tool developed by the Memetic project which allows for the recording, annotation and (asynchronous) playback of meetings held over the Access Grid (and also contains some further meeting management and support tools) that are clearly useful in any discipline. Another example for the flexibility of the developed tools is the work of the Cheshire 3 project which abstracts individual workflow components to a set of generic, re-usable tasks.

The tools developed also facilitate research collaboration at different institutional configurations: activities carried out under the programme explore the possibilities of electronic support for research processes at both an intra-institutional level and an inter-institutional level (the work of the IBVRE project is a good example for this, supporting the work of an international group of biology researchers). It is equally clear, however, that due to the nature of research tasks addressed, and the (electronic) method of supporting them, the boundaries for the application of these tools blur: in principle, the tools and instruments can be used at any institutional configuration where research collaboration takes place.

While thus overall within the VRE Programme there is a strong focus on supporting research collaboration as a primary objective of activities, in the case of some of the tools this may be a secondary function of the tools only (though by no means excluded). We can assume, for instance, that the process of retrieving conference outputs – considerably facilitated by the IUGO project – is likely to be primarily the activity of an individual (though of course producing it in the first place – and potentially the subsequent process of using it for research purposes – is an important collaborative activity). The 3D visualisation tool developed by the CSAGE project clearly has the potential to enhance such a collaborative process of data analysis by improving the ‘presence’ of data displayed thereby enhancing the analytical process for groups of researchers, though research collaboration is not a necessary precondition for a demonstration of the value of the tool.

Activities under the VRE Programme thus bridge the importance attributed to collaboration by the programme actors with the wider aims of the project of building and deploying VREs and defining what they are.

5.2 Types of projects funded

On the basis of the project documentation and the visits carried out as part of the first phase of this evaluation, we can distinguish three major aspects of projects funded by the VRE Programme:

- Projects focusing on particular academic domains
- Projects focusing on particular technologies
- Projects piloting new ways of professional practice

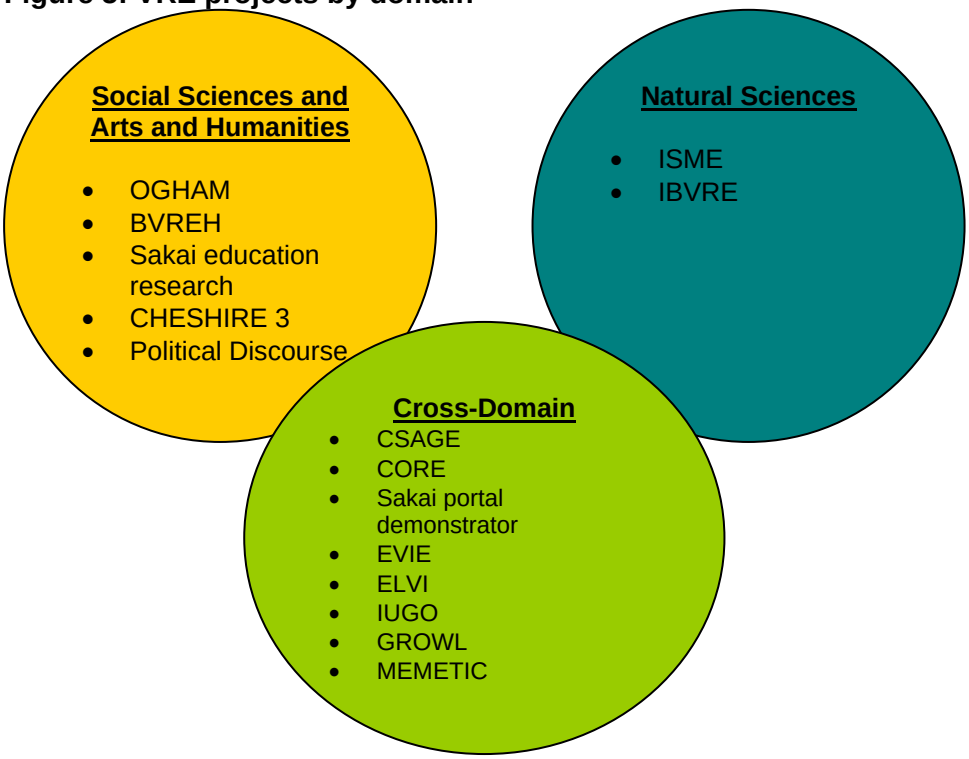
5.2.1 Projects in different domains

The VRE projects can be grouped into three distinct domain clusters:

- Projects working on domain-specific solutions for the arts and humanities or social sciences
- Projects working on domain-specific solutions for the natural sciences
- Projects working on tools and applications that can be used across academic disciplines.

Figure 5 below shows the projects fall into each of these clusters. More than half of the projects develop solutions that can be applied across domains, reflecting the intention expressed in Programme documents that VREs should support research processes across all disciplines. It is also interesting that projects in the social sciences and arts and humanities form the second largest group while those projects specifically addressing the natural sciences are comparatively under-represented. Considering that the social sciences and arts and humanities are generally regarded as lagging behind the natural sciences in the adoption of VRE technologies, this is an important step to achieve the aims of the programme of providing a clear definition of what constitutes a VRE and of raising awareness of VREs more widely within the UK research community.

Figure 5: VRE projects by domain



5.2.2 Projects focusing on particular technologies[21]

If it is the aim of the VRE programme to gain an understanding of what VREs are and to contribute to building one, it is important that the tools, instruments or approaches developed as part of the programme offer a good spread and cover key aspects of the research process in addition to being able to be used across different domains.

There is some debate – within the VRE programme and in the wider research community – what the research lifecycle is, i.e. what it is that researchers do when they research (and in fact projects such as BVREH have made it one of their objectives to identify the research lifecycle for the humanities, for example). One key question, which has also implications for the activities carried out as part of the VRE programme, is whether there is one generic research lifecycle or whether it is impossible to generalise on this question.

It is clear that research practices vary greatly between researchers and also between disciplines: the process of 'doing research' is intrinsically flexible and context dependent. Proposing a detailed model of what 'doing research' involves can therefore be unhelpful. At the same time, however, it is possible to distinguish - at a higher level of abstraction - a number of stages of the research process are universal, applying across all disciplines. They include:

- Data production

[21] Throughout the report the word 'technology' is used in a wide sense to encompass both the social and the technical sides of the research process (i.e. technologies as 'socio-technical systems' in jargon). This distinguishes it from the word 'tool' which is used to more narrowly describe an electronic device which performs a particular task.

- Data retrieval
- Data analysis
- Production of research outputs (academic papers or other publications)
- Communication

An additional set of activities are an increasingly important element of the research life cycle in higher education institutions:

- Identifying and applying for funding
- Finding partners
- Research administration and management.

An analysis of the work of the projects highlights that such major stages of the research life cycle are being addressed by the VRE projects. Importantly for the creation of a virtual research *environment*, most projects seek to develop technologies for two or more of these research activities (see Table 3 overleaf).

A number of different solutions are being developed to facilitate the task of data retrieval. GROWL's lightweight middleware for Grid-based computing, for instance, facilitates access to large datasets – including heritage applications - by linking different databases hosted in different locations while at the same time providing tools for their analysis. In doing so it transfers the 'classic' applications of supercomputing and eScience to data-intensive branches of the social sciences. CHESHIRE 3 also combines the retrieval of data from different databases with tools for analysis, but crucially working towards improving the design and re-usability performance of workflow systems. IUGO offers a solution for improved access to a range of outputs produced at conferences (papers as well as video recordings, blogs and other outputs).

Table 3: Research processes addressed by VRE projects

Research process	VRE Project addressing it	What / how it is addressed
Data production	OGHAM	Speedy collection of archaeological data through OHGAM website and their integration into IADB.
	CORE	Collection and collation of data on orthopaedic procedures (experiment database)
	ISME	Remote steering of experiments via the Access Grid
	GROWL	Facilities to easily integrate with simulation and modelling codes (e.g. for bio-informatics, physics and chemistry).
Data retrieval	GROWL	Production of middleware linking several databases and enabling retrieval of that information via the grid.
	Cheshire 3	Systematic retrieval of information from the Cheshire 3 database (and others) with Kepler workflow tools
	IUGO	Retrieval of written, visual and oral data produced for and at conferences
	Sakai portal demonstrator	Develops a "resource discovery tool" for search of Sakai resources. Grid tools now built into

Research process	VRE Project addressing it	What / how it is addressed
		Sakai also enable the control of modelling and simulation and transfer of data from other sources.
	Sakai education research	*Sakai* tools for capture of the datasets and reports as well as their dissemination
	Political discourse	SAKAI platform to provide access to relevant databases
	EVIE	Search and retrieval functionality to be integrated into VRE and resource discovery mechanisms
	ELVI	Access to the central publications repository for adding/editing an individual's research output, an 'Expertise' search and retrieval tool interrogating staff data at the University, a 'Business' search and retrieval tool interrogating legacy data at the University
Data analysis	GROWL	GROWL supports the use of complex statistical modelling techniques by linking relevant programmes to the grid and distributed datasets.
	Cheshire 3	Data analysis tools are included in the VRE system being built.
	IBVRE	Repository of experiments for reproduction identified as high priority
	Political discourse	Joint annotation of documents and document sharing
	OGHAM	Remote accessibility of website allows non-Reading archaeologists to comment.
	CSAGE	3D visualisation of data over the Access Grid.
	CORE	Architecture contains analysis service Software for virtual online seminars is being developed.
	ISME	Collaborative workspace allows joint analysis of experimental data
	ELVI	Four different versions of 'Research Activity' showing comprehensive research metrics across the University, 'Financial monitoring' permitting users to assess the status of their externally funded projects, 'RAE Validation' tools for the ranking and annotating of publications as well as Unit of Assessment assignments.
Producing research outputs	Cheshire 3	Version management, annotation of sources and written work
	IBVRE	Document creation tool
	CORE	Documentation generation tool
	EVIE	Web-based document creation
Communication	SAKAI portal demonstrator	A number of communication tools for the SAKAI platform: • A blogging tools is about to be released to the Sakai user base. • Audio tool: Sakai users can communicate via VOIP • Whiteboard • Shared display tool
	IBVRE	• Audio link identified as high priority for day-to-day discussions

Research process	VRE Project addressing it	What / how it is addressed
		• Capturing and storing collaborative discussions identified as useful for training
	Political discourse	• Visual communication via the AG • Discussion board in SAKAI platform
	Memetic	AG meetings and their (asynchronous) replay
	CORE	Communication tools included in the architecture
	Ogham	Software for virtual online seminars is being developed.
	ISME	AG serves as communication tool between researcher and supervisor
	EVIE	Integration of blogging tools, wikis, email, forums/threaded discussion tools into institutional portal.
	ELVI	Targeted alerts, bulletin boards with threaded discussion, integrated email, calendars and shared bookmarks.
Research administration and (project) management	IBVRE	• Project wiki • Issue tracking • Document creation
	Memetic	Compendium tool for mapping and linking (i) multimedia information, (ii) interpretations and (iii) meeting discussions.
	CORE	Personal workspaces for the repository of experimental data and papers produced
	ISME	Shared workspace for experiment management
	ELVI	Development of an institutional portal with tools such as eStaff profile, expertise search, funding opportunities, project tasks, project finances and “my research profile”. 'Research Opportunities' tool presenting targeted funding information based on the user's interests from researchresearch.com Access to shared file-stores, the various national and international electronic grant submission systems, and the University's costing tool (pFACT).
	Sakai Portal Demonstrator	Demonstrator used for project administration with separate areas for technical board, steering committee, operations board, etc.
	EVIE	Calendaring and bookmarking tools for groups and individuals as well as funding alerts. Web-based document creation tool can also be used for administration purposes.

Source: Information provided in project applications, progress reviews, meeting notes (as of November 2005)

Communication and research administration are important in any research project but gain rapidly in relevance where several researchers collaborate.

Communication tools, in particular those facilitating visual communication between researchers, and the integration and linking of research management tools are therefore also being worked on by VRE projects such as MEMETIC, Sakai portal demonstrator and others. The creation of visual

communication tools, frequently involving the Access Grid, is being explored.[22] Writing tools such as wikis of blogs are also being developed.

A number of projects also tackle issues of research administration and management, issues of growing complexity the more researchers participate. The IBVRE project, for instance, integrates a range of project management tools to facilitate collaboration within the international Integrative Biology project. These include project wikis and issue tracking tools. Interestingly, in some instances the use for research administration has even become an 'unintended consequence' of the development and deployment of a VRE tool. Thus, at least half of the projects using the Sakai portal demonstrator are currently using it for project administration (with separate areas for technical board, steering committee, operations board etc) – a use that was unforeseen when the project was originally conceptualised which signals a demand for such tools among researchers.

What this approach to analysing activities carried out under the VRE Programme highlights is that the tools developed have a shared purpose: they are technologies for 'doing things' – data capture and manipulation, management, etc. – that, is, technologies that have a concrete practical purpose.

5.2.3 Projects piloting new ways of professional practice

In developing the technologies to facilitate collaborative research, some projects have the potential to have a profound impact on the professional practice of university-based researchers. One outstanding example for this is OGHAM. By finding a new way in which to transmit information from an archaeological dig to a common database of artefacts and enabling remote access to it, the lead time to the production of research papers is potentially dramatically reduced. Similarly, the 3D visualisation of research data enabled by the portable viewer developed by CSAGE has – as part of a wide set of tools, the potential to fundamentally change the way in which complex data is interpreted.

5.2.4 Common themes

The analysis of the types of projects being funded also points towards some some common themes between the VRE projects in terms of approach, activities and impact:

- Projects using the Access Grid
- Projects using the Sakai platform
- Projects piloting new ways of professional practice
- Projects seeking community involvement and feedback
- Projects working towards a VRE architecture
- Projects involving one institution and working towards the institutional embedding of the VRE developed.

[22] Here it should be noted that work carried out by the CCLRC in Warrington has recently shown that the Access Grid and portal technologies do not easily work together. Current thinking is that the technologies will need to be merged in the future.

5.2.5 Some emerging gaps

Whilst the VRE programme thus covers the major research domains, and indeed pays relatively greater attention to the hitherto 'lagging' social sciences and arts and humanities subject areas, and major research tasks, there is also an emerging indication that some activities are better catered for than others.[23] Some of the activities that are less well catered for include, for instance:

- Tools for the 'pre-research' stage, such as finding funding and partners and tools to facilitate the joint preparation of bids.
- Lower tech' tools for audio and visual communication that can be integrated into a VRE[24]
- Peer review tools
- Integrated audio tools

At the Programme meeting in January 2006, projects identified a number of specific tools that might usefully be developed. Amongst others, these include:

- Collaborative document writing tools[25]
- E-Administration (e.g. project management) and the seamless interaction between administration and research
- Multivalent browser and a broader user community for this
- Text manipulation tools
- Heterogeneous devices and invisibility
- Portals
- (comparing tools to each other)

As work on VREs progresses, increasing the quality of existing tools and integrating them is likely to gain in importance. Further, once VREs become commonplace at UK higher education institutions, the maintenance, change management (and deployment) of VREs themselves.

5.3 Type of participating institution

Finally, the character of the VRE Programme is influenced by the types of research institution participating in it. Four types of institutions are involved in the VRE Programme:

- Academic departments of UK higher education institutions
- Specialist institutes located at, and affiliated with, UK Higher Education Institutions

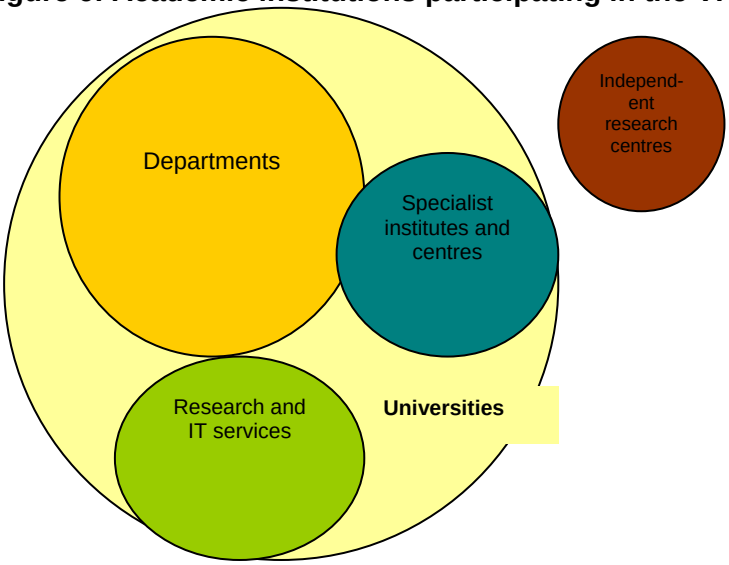
[23] The following list can only be indicative in the absence of a large-scale user needs analysis in addition to the work carried out by individual projects or a better understanding of the research process.

[24] One of the tools that is available is a lightweight version of Memetic's video conferencing and replay tool which is available through a web browser.

[25] During the second VRE Programme meeting some initial steps were taken to define relevant requirements further.

- Research and IT services at UK Universities
- Independent Research Centres

Figure 6: Academic institutions participating in the VRE Programme



As Table 5 shows, the participating HEI departments are all leading research departments. In the 2001 RAE, the vast majority received either a 5 or a 5* rating. Moreover, four of the HEIs involved are in the top 50 universities in the world. The VRE programme is therefore dominated by leading research institutions, an observation further cemented by the additional involvement of leading independent research centres. No commercial companies or higher education institutions located outside the UK are involved in the VRE programme.

Table 5: Participating institutions and their ranking in the UK and the world

	University	World ranking 2005*	Department	Research ranking (2001)**
Russell Group Universities	Oxford University	4	Classics Centre	5*
	University of Manchester	35	Manchester Computing	5*
			Manchester Material Science Centre	5*
	University of Southampton	n/a	School of Electronics and Computer Science	5*
	University of Edinburgh	30	School of Informatics	5*
	Bristol University	49	Institute for Learning and Research Technology	n/a
	Liverpool University	119	Special Collections and Archives, Sydney Jones Library	n/a
	University of Leeds	103	Library Services	n/a
	University of Nottingham	97	Research Support and Commercialisation Office	n/a
	Oxford University	4	Computing Services	n/a
Non-Russell Institutions	University of Reading	n/a	Department of Archaeology	5*
	University of Hull	n/a	Department of History	5
	University of East Anglia	n/a	Department of History	5*
	Open University	n/a	Knowledge Media Institute	4
	Lancaster University	n/a	Centre for eScience	n/a
			CARET – Centre for Applied Research in Educational Technology	n/a

			CCLRC - Council for the Central Laboratory of the Research Councils	n/a

** Source: Times Higher Education Supplement, 28.10.2005, http://www.thes.co.uk/statistics/international_comparisons/2005/top_unis.aspx?window_type=popup*
*** Source: www.hero.ac.uk/**rae**/*

5.4 Relation to software development stages

Technology development, in particular for the development of new software, can follow a number of different models. Commonly, however, this tends to entail the basic steps of the long established 'waterfall model' which sees software development as flowing through the phases of:

- Research to establish user needs (requiremens analysis).
- Conceptualisation of a system that meets these needs (design)
- Development of demonstrators or prototypes (implementation)
- Testing or evaluation of the prototype by users and feedback (validation)
- Piloting in some real world setting (integration)
- Maintenance

However, the simple linearity of the waterfall model itself has long been replaced by more sophisticated variants - variously described as 'V's', 'spirals', and 'rapid prototyping'. These stress the necessarily iterative and recursive nature of the steps in successful software development. The idea behind these iterative models is to develop a software system incrementally, allowing the developer to take advantage of what was being learnt during the development of earlier, incremental, deliverable versions of the system. Learning comes from both the development and use of the system, where possible. Key steps in the process were to start with a simple implementation of a subset of the software requirements and iteratively enhance the evolving sequence of versions until the full system is implemented. At each iteration, design modifications are made and new functional capabilities are added. Again, the idea is to release the software several times to the users, each time with more functionality.

Whilst these approaches are the basis of much conventional systems development, they have come under criticism as being too predictive and not adaptable enough. It is increasingly recognised that more flexible approaches to software development are invaluable for reducing the risk of software development and facilitating the integration of new tools with existing systems. Contrary to conventional models, agile software development stresses short software development cycles of two weeks to two months with a preference for shorter cycles (each a 'mini' software project of their own including the necessary tasks of planning, requirements analysis, design, coding, testing, and documentation) and real-time communication within the development team which – at a minimum – should include the developers and their

customers. Working software in use is seen as the primary measure of success.[26]

However it is questionable whether this contrast between the 'conventional' and the 'agile' is really anything more than another expression of the basic choice in any innovation strategy: to put something out there and see what happens and react accordingly, or to try to anticipate reactions, design accordingly and test carefully. This is a choice which has be to be determined not in principle but pragmatically in accordance with context.

Reflecting on activities carried out under the VRE programme in the light of these three major methods of software development, the following observations can be made:

- Within the VRE Programme there does not appear to be a dominant philosophy underlying the collective software development activities. Some appear to be following a conventional model, others a more agile methodology. Despite different approaches, there are similarities for instance as regards the approach to involving end-users and piloting.

- All projects have user evaluation phases built into their project plans laying the foundation for a usability testing of the system in development. However, user involvement appears to not always been given a similarly higher priority to the development work; few projects have real end-users on their project teams. Whilst the 'client' as user is frequently recognised as including technologically unaware or uninterested academics, user involvement often (and perhaps necessarily) focuses on those that are technologically 'savvy'. Indeed, reaching out to a broader range of potential users emerges as one of the key opportunities for future activities within the VRE programme.

- With a number of exceptions, the tools developed are not always piloted within the lifespan of the project. The conclusion is thus that the full software development cycle is not always completed. In an area where the 'problems' to which tools respond, end users and systems and technologies themselves are (still) in a continuing state of being defined, this is perhaps an opportunity missed: it stands to reason that only the wider availability of these new technologies will reveal which functions are used – and how.

The danger here is of projects which are 'neither fish nor fowl', that are neither structured nor systematic in their development processes but are not agile either because they have no immediate connection with use or uptake.

[26] Key principles of agile software development are outlined in the 'Manifesto for Agile Software Development" which can be found at http://agilemanifesto.org/

6 Emerging issues and implications

This analysis of the VRE programme from various angles raises a number of issues that have implications for the running of the programme and for the formative evaluation. These are discussed below. This section also presents the key recommendations to programme management that come out of the first phase of this formative evaluation and presents the actions planned as part of the formative evaluation.

6.1 Emerging issues

Work carried out as part of the VRE programme is at the cutting edge of conceptualising how research could be done in the near future. As concepts and technologies are not yet fixed, the VRE programme is therefore breaking new ground in a number of ways and presents an opportunity to make a significant contribution not only to shaping this new field but also to contributing to the way technology is 'fixed' in this area. The focus on interoperability and the use of open standards is an important precondition for achieving this.

At the same time, however, it is clear that the technologies developed under the VRE programme face a number of big questions exactly because it is at the cutting edge of application of technology and professional practice. These stretch from legal to cultural issues and also concern the wider response of the research community to the technologies and their implications for professional practice.

For instance, legal and cultural processes are lagging behind the aims and objectives of the programme as well as the technologies developed. The legal implications of filming and recording at conferences, for instance, and making this material available to non-participants (as envisaged by the IUGO project) are as of yet unclear.[27] Equally, there are intellectual property rights implications when ideas and research findings are shared over the Access Grid without appropriate security measures as discussions are susceptible to being listened in to. These are important issues as they are potential barriers to the deployment and take-up of VRE technologies.

Further, even though collaboration does exist among academic researchers (and studies as the one mentioned before are beginning to explore this phenomenon in greater detail), culturally, the practice of collaboration is not deeply enshrined in academic research practice where professional success and prestige – and the method of measuring it through the Research Assessment Exercise - is deeply individualised. All of this means that an eventual widespread use of VRE technologies could have a 'shadow side' for the research community. Rather than fostering collaboration between individual academics these technologies might affect behaviour negatively

[27] And these questions are of course themselves subject to investigation by the IUGO project itself.

resulting in less sharing of information rather than more especially among researchers within the same academic department if this is perceived to improve the relative competitive position. This is a possible development in particular in disciplines where the generation of primary data (for instance, in the field of anthropology) – rather than their interpretation (for instance, in the field of archaeology) – is the 'scarce resource'.

Against this background, we do not yet know how user communities will respond to the widespread adoption of VRE technologies, whether and how they will use it and what functionalities are important to them. Due to its character as primarily a development programme (though also involving some specific research), the VRE programme is therefore an unprecedented opportunity to increase knowledge about these issues due to its focus on development, in particular if user communities are given as much an opportunity as possible to become involved in the development of the technologies.

6.2 Implications for the VRE programme

In view of the uncertainties in relation to the acceptability of VREs and the adoption of its tools by researchers, the VRE programme is an opportunity to better understand the key issues relating to its implementation such as IPR, privacy, user acceptance, reactions to the technologies and others. Indeed, it is an opportunity to tease out user behaviour and changes to behaviour related to technologies. A key role of the formative evaluation over the coming months will therefore be to offer support and advice, where needed, to engage with users of diverse abilities in order to gauge their views and feed these back into the project.

The wider implication for the VRE programme more generally is that it cannot be understood as a research programme. As the scope of the projects' work suggests, it should be understood as a development programme which aims at producing tangible technologies (ways of doing things). It will be important that these outputs are produced as part of a full development cycle (using, for instance an iterative development methodology) and that activities carried out in and across both VRE programmes complete as much as possible of this full development cycle. As this is currently not always the case, the main focus of the formative evaluation in 2006 will therefore be working with the VRE projects to help them work towards a more complete action research cycle.

6.3 Implications for evaluation support

Against the background of the issues raised in this report, and reflecting discussions with programme management, evaluation support in the period January to October 2006 and beyond will concentrate on the following areas:

- One-to-one work with VRE projects
- Encouragement and facilitation of cross-project discussion at January and July programme meetings
- Continuing input into the development of VRE2
- Case studies of impact and good practice

6.3.1 One-to-one work with VRE projects

The core focus of the evaluation support will be on providing tailored support on a one-to-one basis to VRE projects. With the majority of VRE projects it was agreed during the initial visits to carry out one or two one-to-one interventions. These can be grouped into the following sets of activities:

- Technical assistance on the design of research tools for running user surveys
- Interventions to improve user engagements in projects entailing a wide spectrum of actions from workshops on user engagement techniques
- The facilitation of usability sessions to helping projects to engage with the wider user community.
- Support and advice on developing a sustainability strategy.
- Critical reflection

A detailed break-down of the interventions agreed with or proposed to the projects is listed in Table 6 overleaf.

Letters outlining the type of interventions agreed during the initial meetings with the VRE projects between October and November 2005 were written and sent out to the project managers. In the course of February and March these were followed up with phone calls to the project managers to agree on the timing of these interventions. Work with individual projects has already begun (attendance and support provided for the Memetic project during their user engagement workshop) and is expected to be mostly completed by summer 2006. In a small number of cases it has already been agreed that the planned interventions will need to take place in autumn of 2006 or later in order to fit into the project timetable.

6.3.2 Facilitation of cross-project discussion

During the initial visits to projects a clear interest in, and need for, an ongoing exchange about their work and the creation of VREs more generally was expressed. To meet this demand, the programme meeting in January 2006 provided space for the projects to discuss four sets of issues that had emerged as particularly pressing during our discussions an the analysis thereof:

- Technical issues
- User issues
- Domain specific issues
- Generic issues

The aim of these workshops was not only to provide a space for a cross-project exchange on these issues, but also to encourage the groups of individuals / project representatives to develop an agenda for collaborative work. All groups achieved this objective and will give an update on their work at the next Programme meeting in July 2006.

Table 6: JISC VRE Formative Evaluation – Support work with projects

	Project Specific	All Projects	Group of Projects, case study
EVIE	*No project-specific work needed*.	Active participation in Jan '06 meeting and work – follow on July meeting	**'Case' of emergent VRE architecture**
IBVRE	• Participatory review proposed • Potentially user evaluation support		**Institutional embedding 'Case' (Oxford projects)**
IUGO	Facilitating (design, facilitation, debrief) user validation session		
BVREH	• Workshop to review user plan. • Workshop to look at communication/dissemination to wide community (participatory review)	Workshop on user involvement and feedback Follow on July programme meeting	**Institutional embedding 'Case' (Oxford projects)** **Community involvement and Feedback 'Case'**
Sakai Portal Demonstrator	Workshop on user involvement & dissemination: concepts and specifics (participatory review) (joint with GROWL)	Workshop on User involvement and Feedback	**Institutional embedding 'Case' (Oxford projects)** **'Case' of emergent VRE architecture** **Sakai Case**
GROWL	Workshop on user involvement & dissemination: concepts and specifics (joint with Sakai Portal Demonstrator)	Workshop on User involvement and Feedback Follow on July programme meeting	
Cheshire 3	Usability evaluation – hands on experimentation and focus groups (design, facilitate, debrief)		**'Case' of emergent VRE architecture**
ELVI	*No project-specific work needed*.		**'Case' of emergent VRE architecture**
Political Discourse	Introducing systematic reflective practice (EIAG; AR cycle; capturing, debriefing, recording)	Access Grid Critical Review July programme meeting	**Community of Practice 'Case'** **Access Grid Usability 'Case'**
Memetic	Workshop on user involvement and feedback	Access Grid Critical Review July programme meeting	**Access Grid Usability 'Case'**
CSAGE	*No project-specific work needed* .	Access Grid Critical Review July programme meeting	**Access Grid Usability 'Case'**
Sakai Education Research	Work with Steering Committee on success/dissemination/embedding	Sakai Critical Review	**Sakai 'Case'**
CORE	Evaluation of impact and general structural reflection		**Community of Practice 'Case'** **Access Grid Usability 'Case'** **'Case' of emergent VRE architecture**
OGHAM	User community feedback and awareness raising event	Workshop on User involvement and Feedback Follow on July programme meeting	**Community involvement and Feedback 'Case'**
ISME	Systematic reflection offered (as Political Discourse & CORE) User community involvement (as Ogham & BVREH)	Access Grid Critical Review Workshop on User involvement and Feedback	**Access Grid Usability 'Case'** **'Case' of emergent VRE architecture**

It is currently envisaged that the July 2006 meeting should capitalise on the momentum created in January and build on it. Thus, in addition to this feedback from cross-project activities, evaluation support at the second programme meeting in 2006 will encourage the formation of additional working groups based on key themes emerging from the analysis of project visits undertaken in 2005:

- User involvement and feedback (techniques and methods)
- Critical review of the Access Grid
- Critical review of the Sakai platform

The projects that might be involved in these discussions are indicated in Table 6.

An additional work group comprised of arts and humanities projects may be established. Each of these work groups will involve several, but not all, of the current VRE projects. The discussions will take the form of a plenary session (or the similar but less conventional goldfish method), engaging not only the projects concerned but also the remaining VRE projects.

6.3.3 Evaluation support in 2006/07

While the focus of the evaluation support for much of 2006 (the second phase of the formative evaluation) is on providing one-on-one support for VRE projects, phase 3 – extending from the end of 2006 through to 2007 - will focus on the development of a set of case studies analysing and highlighting examples of good practice. It is currently envisaged that six case studies will be elaborated:

- Institutional embedding of VREs
- An emergent VRE architecture
- Access Grid usability
- Communities of practice
- The case of Sakai as a VRE platform
- Gaining community involvement and feedback

Each case study will include several VRE projects and will gain their input.

In addition to this case study work, it is envisaged that programme management support will be ongoing and continue in 2007.

7 Wider recommendations: 'VRE 2'

Some of the issues highlighted above are also important for the formulation of the 'VRE 2' programme currently in preparation.

7.1 Implications for the design of the VRE 2 Programme

The learning from the current VRE Programme suggests that it would be important for projects funded under the VRE2 Programme to complete a full development cycle (and thus enable the Programme to do so as well). Piloting should therefore be at the centre of VRE2, a feature that has already been identified and built into the design of the VRE2 Programme by the JISC. In this context it would be useful to understand piloting as giving individuals, projects or institutions the opportunity for a longer-term field-testing of the technologies.

Ideally, the piloting of VRE technologies under VRE 2 would involve those technologies produced under the current VRE programme. This would not preclude the funding of projects developing new technologies. However, where new technologies are proposed, applications should include a piloting phase as defined above. Larger scale testbeds bringing together several of the existing projects could address this in the VRE 2 programme.

Where the development of new technologies is proposed, it would be important for the underlying philosophy to reflect software design principles with a systematic methodology. Such a philosophy might draw on JISC's policy on code development which stresses iterative development, using code repositories (subversion), commenting and documenting code. The workshop on participatory and co-design at the Oxford Programme meeting might also offer useful guidance.[28]

[28] A copy of this can be found on the VRE website: http://www.jisc.ac.uk/index.cfm?name=programme_vre. The JISC funded FREMA project uses Unified Modelling Language (UML) techniques for the design of web services and might be helpful as a reference point in an area where there is no general methodology as of yet (www.frema.ecs.soton.ac.uk)

Overall, the selection of projects for VRE 2 might thus be distributed across the following matrix:

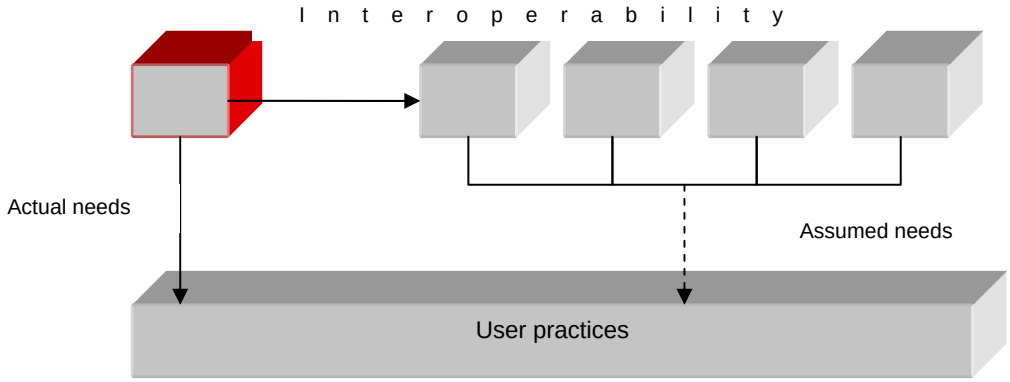
Table 7: Project selection matrix for VRE 2

	Institutional	Project	Discipline
Technical development			
Socio-technical development (SSDM)			
User engagement / evaluation			

It is important that new tools link in with those developed under the current programme. Thus, where the development of new tools is being proposed, these might either focus on research activities not covered by the current projects, or on integrating or developing existing tools further, also in view of improving their quality.

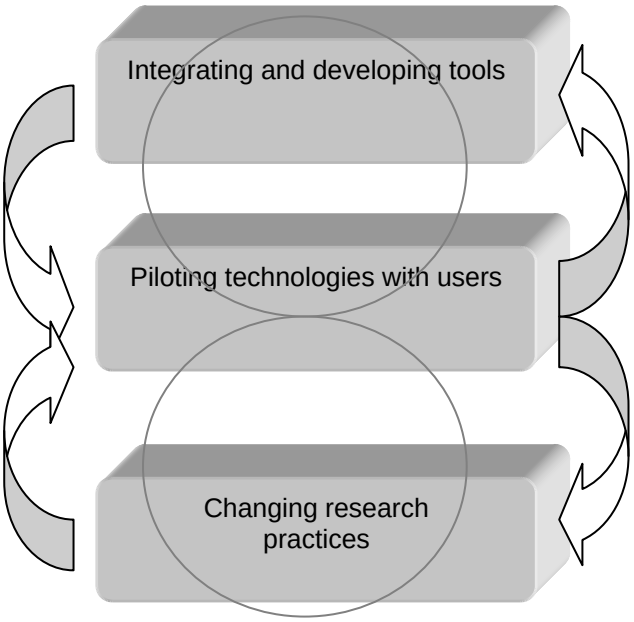
The development of any new tools is likely to benefit from being in close touch with user practices in order to ensure actual needs are met. Rather than a top-down model of developing a VRE, this would reflect a two-pronged strategy whereby the development of technologies is guided by proven needs of researchers. This would still allow for the development of tools based on assumed research needs, but would inform those better and allow for a feedback loop to user practices as illustrated in Figure 7 below.

Figure 7: VRE development based on user needs



This approach would result in an underlying structure for the VRE 2 where tool development and integration, piloting and the learning from and informing of research practices all influence each other. This is illustrated in Figure 8 overleaf.

Figure 8: Suggested integrated structure for VRE 2 Programme and projects



7.2 Improve the strategic management of the programme

To maximise the return on investment, it is important that the strategic management of the VRE programme is improved. In particular this should involve a stronger role of the Advisory Board in the ongoing steering of the programme.

In our experience of JISC research and technology development programmes over the years, projects which come forward from the community are almost inevitably weak on expertise in user involvement and user engagement; systematic development methodologies; and evaluation, and require help with these. The VRE programme is no exception to this.

To maximise impact it would therefore be important for the VRE2 programme to focus on funding projects that complete whole development cycles or which relate to projects which are completing whole development cycles, and it will be important to bring this across to projects. An open day might be helpful to provide relevant advice on this to potential applicants. It is also essential that projects are given sufficient lead time to prepare quality bids and assemble capable teams.

7.2.1 Develop a comprehensive communication strategy

A comprehensive communication strategy to promote the VRE programme and provide information about it would not only bind together the community of VRE practitioners in the UK but also raise awareness of the programme amongst a broader audience. Social marketing principles could underpin the communication strategy for the VRE programme and its successor. It is essential that any written communication material developed as part of this

strategy – be it newsletters, blogs or other – is wherever possible written in a language that is not too technical but addresses key issues in an easily accessible manner to widen audiences.

7.2.2 Adapting the programme to changing realities at UK higher education institutions

To maintain intellectual leadership and increase the probabilities of contributing to a technology fix in the area of VREs, it will be increasingly important to establish links between various initiatives taking place in the UK and also to better link up with work carried out on the EU level.

Serious thought will also have to be given to the funding model underpinning the VRE programme. Universities are increasingly cost-sensitive as higher education funding declines and they are expected to raise more and more third stream funding. In this new reality applying for funding that does not cover overheads will become increasingly difficult and could eventually impact on the quality of participating institutions.

Annex: Overview of VRE projects[29]

Strand	Project name	Participating institutions	Main activities, aims and objectives
Strand 1: Larger scale projects to deploy VRE demonstrators based on existing frameworks, such as Sakai or OGCE	Sakai VRE for Educational Research http://www.caret.cam.ac.uk/projects/jiscvre.html	• CARET – Centre for Applied Research in Education Technologies, University of Cambridge	The SAKAI VRE for Educational Research project plans to extend the Sakai platform for large-scale, distributed social science projects. The aims of this project are to examine the cross-disciplinary needs requirements of ESRC social scientists on the Teaching, Learning, Research Programme (TLRP) and to evaluate how SAKAI meets these users' needs. Specific sets of open-source tools have been developed by CARET and prototyped with this user community. The project will migrate these tools to the SAKAI platform offering a single point of access for users. Upon completion, the project expects to have shared with the UK higher education research community a detailed analysis of how the collaboration (and other) tools of the Sakai project can support and enhance collaborative research projects in the social sciences.
	Sakai VRE Portal Demonstrator http://tyne.dl.ac.uk/Sakai/	• Lancaster University, Centre for eScience • Oxford University, Computing Services • Council for the Central Laboratory of the Research Councils (CCLRC) • University of Portsmouth Distributed Systems Group	This project extends the Sakai open source and open standards portal framework. It will host a number of integrated tools and robust distributed services and become the principal user interface for a fully-functional demonstrator of a Virtual Research Environment (VRE). To accomplish this, the project has sought widespread community input to expose existing tools and services as Java portlets, SOAP-based or peer-to-peer Web services for use within the VRE. Using this approach, the project is creating a long-lasting, maintainable and extensible VRE demonstrator which will provide both reliable collaboration tools, together with a powerful distributed research toolset.

[29] The VRE Programme website (http://www.jisc.ac.uk/index.cfm?name=programme_vre) contains more detailed descriptions of each of the projects funded.

Strand	Project name	Participating institutions	Main activities, aims and objectives
			Some of the VRE tools and services to be exposed are UK adaptations of those directly available from Sakai and OGCE, the US NMI portal. Others are to be achieved in association with a UK community of VRE users. These are now being trialled by approx 200 users in 20 projects.
	A VRE to Support the Integrative Biology Research Consortium (IBVRE) http://www.vre.ox.ac.uk/ibvre/	• Oxford University, Computing Services • Oxford University, Computing Laboratory	IBVRE is working on extending the platform of a large-scale international e-science project (the Integrative Biology: IB project) to provide collaborative research and research management support tools and services through a single portal in order to support the entire research process of the IB project. The main aims and objectives are to provide a single point of access/integrated environment which will support the research process in the widest sense (i.e. activities such as identifying research areas and funding sources, building and managing projects/consortia, real-time communication, disseminating results, and learning and teaching support tools). The tools are designed to function in an integrated manner rather than in a typical portal where they may interact independently. As a result of the project's workpractice study the scope of the project's work has significantly tightened to focus initially on high priority requirements (such as supporting day-to-day activities) rather than activities that occur only once in a funding/research cycle.
	EVIE: Integration and deployment of existing components within a portal framework http://www.leeds.ac.uk/evie/	• ·University of Leeds, Brotherton Library • University of Leeds, Learning Development Unit • University of Leeds, Information Systems Services	Researchers in all disciplines are increasingly expecting to be able to undertake a variety of research-associated tasks online, from collaborating internationally to information-seeking in electronic libraries. Tools enabling these activities are already available, but are provided through discrete bespoke interfaces with few links between. This creates a number of challenges for researchers: needing

Strand	Project name	Participating institutions	Main activities, aims and objectives
		• British Library	multiple methods of authentication and authorisation; finding information; and sharing information between applications. Against this background, the EVIE project will test integration and deployment of key existing software components within a portal framework. Thus bringing together disparate resources and systems in a single environment, allowing end-users to utilise them in an integrated fashion. The portal will also provide a customised, personalisable framework for the VRE. Customisation allows delivery of content to users based on their roles. Personalisation enables users to tailor content to their own specific needs. Providing VRE services through a portal will also simplify authentication and authorisation processes.
	ELVI: Evaluation of a Large-scale VRE Implementation http://www.nottingham.ac.uk/research-systems	• Nottingham University, Information Services	This project will produce and demonstrate a practical framework for the effective deployment of a generic VRE in an higher education environment, identify and demonstrate the components of a generic VRE that have the most impact and/or are of the most value to the end-users, identify and demonstrate practical solutions for the development and deployment of those components. The Findings will be of interest to any Higher Education Institution considering implementing a portal solution.
	Meeting Memory Technology Informing Collaboration (Memetic) http://www.memetic-vre.net/	• University of Manchester, Manchester Computing • Open University, Knowledge Media Institute • University of Edinburgh, School of Informatics • University of Southampton, School of Electronics and	Meetings pervade the life of almost all researchers. Increasingly, these take the form of telephone and videoconferencing amongst geographically dispersed colleagues. Supporting distributed meetings that are as productive as face-to-face meetings is a primary challenge for research and development in this field. It is this challenge that MEMETIC addresses, while aiming to also specifically support asynchronous collaboration on the

Strand	Project name	Participating institutions	Main activities, aims and objectives
		Computer Science	Access Grid. In particular, the project extends the functionality of the Access Grid with advanced meeting support and information management tools – an integrated Meeting Replay – by integrating an Access Grid recorder (Arena), dialogue mapping tool (Compendium), and desktop streaming application (ScreenStreamer) within a navigable, annotatable meeting replay interface. This environment is being deployed as a prototype VRE with end-user communities in order to test, evaluate and discover further user requirements.
Strand 2: Projects to identify functionality which has not hitherto been integrated into existing framework architectures and to add such functionality to address clear user requirements.	Implementing the Kepler Workflow Interface into the Cheshire Digital Library Framework (Cheshire 3) http://vre.liv.ac.uk/	• University of Liverpool, Sydney Jones Library (Special Collections and Archives)	The project seeks to develop and implement the Kepler/Ptolemy scientific workflow system as an interface to the Cheshire 3 digital library framework. The aim is to enable researchers in both the humanities and scientific disciplines to use the Kepler/Cheshire software to conduct analyses and perform distributed processing in several different software and hardware environments; and to coordinate the export and import of data from one environment to another. The project intends to use the Kepler/Cheshire interface to provide researchers with capabilities ranging from discovering information to publishing results, thus comprising a Virtual Research Environment. In particular, it intends to work with the Arts and Humanities Data Service to develop a number of transactional services for the humanities.
	CSAGE: Collaborative Stereoscopic Access Grid Environment for Experimentation within the Arts & Humanities http://www.kato.mvc.mcc.ac.uk/rss-wiki/SAGE	• University of Manchester, Manchester Computing • ·University of Southampton, School of Electronics and Computer Science	Key parts of the project are the construction and use of semi-immersive stereoscopic facilities to create an increased level of 'presence' within the Access Grid environment and the recording of the performance, in the same format, within a framework playable by a larger community base as and when required. The project has two

Strand	Project name	Participating institutions	Main activities, aims and objectives
			main objectives; the first part building a portable hardware and software extension to the Access Grid for full-sized stereo viewing, and a second part to construct a lightweight framework for storing and editing the performances. A second phase is the promotion and publicity of the use of portable stereoscopic systems (GeoWalls) and the application within the Access Grid environment. To this end loaner systems are with the Universities of Manchester and Southampton and a purpose built server is permanently available. The VRE server aimed at experimental testing is constructed to house complete environments as well as hosting related utilities.

Strand	Project name	Participating institutions	Main activities, aims and objectives
Strand 3: Projects to develop and deploy lightweight, proof-of-concept VRE demonstrators appropriate to the needs and skills of specific communities	CORE: Collaborative Orthopaedic Research Environment http://www.core.ecs.soton.ac.uk/	• University of Southampton, School of Electronics and Computer Science	The Collaborative Orthopaedic Research Environment (CORE) is a 24-month project that will develop and deploy a Web services based Virtual Research Environment (VRE) demonstrator; to enable researches to design experiments collaboratively, collect the results and disseminate the findings. In the context of orthopaedics, experiments can be multi-centred clinical trials that involve analysis of large data sets. The documentation needs to be written collaboratively and the experiments will need to be managed and co-ordinated for a geographically disperse set of researchers. The CORE project will develop a Grid/Web services based VRE demonstrator for the benefit of the Higher Education and Further Education communities. The project aims to provide integrated computer support across the research and educational cycles, because these activities are intrinsically coupled as a part of the requirements of the surgeon's *Continuing Professional Development*. The CORE will allow surgeons to: create technical material (including non research material for education), analyse data (from their own trials or data entered from journals), investigate hypotheses (from their own work or as meta or thematic reviews), discuss the finding from their or others work, and prepare and submit articles for review.
	Silchester Roman Town: A Virtual Research Community (OGHAM) http://www.silchester.reading.ac.uk/vre/	• University of Reading, Department of Archaeology • York Archaeological Trust	The Silchester Roman Town archaeological excavation is one of the largest Roman sites in the UK. The annual excavation period at Silchester comprises eight weeks of intensive data gathering in a tight timeframe and with limited personnel. The site's excavation team has recognised the need for a more fluid and accessible network of human expertise. Many of the experts are geographically dispersed, both from each other, from the site, and from

Strand	Project name	Participating institutions	Main activities, aims and objectives
			relevant information held elsewhere. This makes the exchange of ideas and interpretations, which are critical to the research process, very cumbersome; a major problem long recognised in field archaeology. This project will provide the basis for a virtual solution to it. The overall aim is to develop a system to facilitate rapidly developing and iterative archaeological research by synchronising the three processes of gathering information, co-ordinating expertise, and managing the resulting body of data.
	GROWL: VRE Programming Toolkit & Applications http://www.growl.org.uk/	• Council for the Central Laboratory of the Research Councils (CCLRC), Daresbury Laboratory • University of Cambridge, Bioinformatics • Lancaster University, Statistical Computing	This project addresses the uptake of Grid-based computing and distributed data management by focussing on issues which may hinder or facilitate end-user application development. It builds upon the existing prototype GROWL library to produce a truly lightweight extensible toolkit which complements other solutions. What is required is something that is easily installable but with extensible access mechanisms for Grid resources. It should obviate the problems associated with institutional firewalls for Grid protocols by implementing a client-side (polling based) strategy. It is an alternative to a Grid portal, but can share the same underlying services via an internal Web service interface layer and therefore is a possible interface to the facilities in a Virtual Research Environment. Using C, it is possible to interface easily to ``heritage'' scientific applications written in C or Fortran. It is also possible, with a little additional work, to create wrappers to interface to Perl, R or other popular environments such as Python. It should be possible to install the GROWL library quickly on a variety of client workstations running Linux or a similar UNIX-like operating system with a minimum of additional software.
	ISME: Integration & Steering of Multi-Site	• University of Manchester,	Taken together, modern instruments in the laboratory and

Strand	Project name	Participating institutions	Main activities, aims and objectives
	Experiments to Assemble Engineering Body Scans http://pw63.mt.umist.ac.uk/isme/sites/index.htm	Manchester Material Science Centre • University of Cardiff • CCLRC, Daresbury Laboratory	international central facilities can build up a detailed, multi-faceted picture of the structure and behaviour of engineering components. At present, stitching together this information is a time consuming post mortem process, limiting the extent to which true interactive enquiry-based experiments can be undertaken. Software tools for fusing the acquired data have already been developed as part of a completed EPSRC research programme, but the interrogation and visualisation of the assembled database can only be done at a single location. The ISME project will construct, refine and deploy a prototype Virtual Research Environment (VRE) to enable teams of material scientists, academic and industrial engineers and instrument scientists to work together in undertaking, compiling, analysing, interrogating and visualising multiple experiments on components of high complexity at different sites.

Strand	Project name	Participating institutions	Main activities, aims and objectives
Strand 4: Cross-strand	VRE for the History of Political Discourse 1500-1800 http://www.uea.ac.uk/his/research/projects/vre/	• University of East Anglia, Department of History • University of Hull, Department of History	The project aims to develop a virtual research and research skills development environment, capable of expansion and of facilitating multiple participation in the rapidly evolving field of the history of political discourse. The environment includes the technical and cultural support necessary to deliver substantial and transferable value from the project. The project offers an opportunity to bring into being an exemplar for the humanities approximating to the more advanced collaboration models available in the sciences. Over the three years of funding, the project will: • Set up and pilot the postgraduate research and teaching programme • Explore the potential of the 'Access Grid', as a potential platform for collaboration. • Ensure that open and transferable technical platforms are in place for access to resources, virtual research environments, academic interchanges and publications. • Deliver a set of software tools where required, guidelines and support tools to the community on an open source basis. • Deliver a series of virtual and actual seminars, symposia and conferences led by both academics and research students • Roll out the programme to a number of other HE institutions in the UK by the end of the programme. • Produce reports analysing the technical and pedagogic outcomes and their implications for other VRE projects especially in the humanities.
	BVREH: Building A VRE for the Humanities http://bvreh.humanities.ox.ac.uk/	• University of Oxford, Classics Centre	Humanities researchers are increasingly drawing on networked resources to carry out their research activities. Whilst there is support for the creation and deployment of VRE tools, progress and awareness of collaborative

Strand	Project name	Participating institutions	Main activities, aims and objectives
			research activity has been less marked in the Humanities than in other disciplines. The aim of the BVREH project is to identify areas in which electronic research tools would be beneficial, both for researchers at Oxford and in a wider context. To this end, a detailed survey of research activities across the humanities division is carried out, forming the basis for the selection of a number of demonstrator applications. These 'demonstrators' or tools will allow the project to provide researchers with tangible ideas of how their needs might be addressed and will facilitate a phase of interactive user testing.
	IUGO: Conference Information Integration Project http://iugo.ilrt.bris.ac.uk/	• University of Bristol, Institute for Learning and Research Technology	Conferences, workshops and seminars are vitally important for disseminating research findings and are also places for networking, building relationships and collaborating. Increasingly, the new knowledge generated at these events is being captured (videos, blogs, recording of Internet Relay Chats). This project aims to develop a proof of concept system to enable the integration of web-based content (and references to non web-based content) related to individual conferences and individual sessions within conferences and make this content available via a single point of access. This will allow researchers easy-to-use access to information produced for and at conferences. Another objective is to investigate the feasibility and wider issues (such as economic, legal, ethical, social and political issues) involved in developing such a system on a national or international scale.