JISC 3D Visualisation in the Arts Network (3DVisA)

Anna Bentkowska-Kafel
anna.bentkowska@kcl.ac.uk

Needs of the 3D Visualisation Community

3DVisA REPORT

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1.1. Introduction

This report by the JISC 3D Visualisation in the Arts Network (3DVisA) is concerned with views of individuals and institutions that shape the use and development of computer-based 3D visualisation in the Arts and Humanities in UK Higher Education. Reported here are the wide-ranging needs of this community in the context of today's interdisciplinary and international research culture. A number of ways of addressing the identified needs are also suggested.

The author considers herself a member of this community and writes from the position of an insider, seeking to answer three main questions:

Who are we?

What do we need?

Where to look for support?

Here are three examples of concerns expressed by the Arts and Humanities researchers interested in the application of 3D computer graphics:

Need 1

An American academic is planning a new visualisation project. She intends to construct computer models of key medieval monuments in England, which contain both Romanesque and Gothic building phases. Her aim is to analyse how such complex architectural structures evolved. To ensure that she does not duplicate anyone else's efforts, she would like to find out whether the monuments she has in mind have been the subject of similar visualisation projects and who, if anyone, is doing this type of work in the UK. Her query, originally emailed to English Heritage, eventually reached the author of this report. The message had a long trail of earlier correspondence, indicating that her email had been forwarded to several people, all willing but unable to answer her enquiry satisfactorily.[1]

Need 2

While the American academic referred to above, has considerable modelling experience, a King's College undergraduate student is lacking exactly that skill and is looking for hands-on training with 3D StudioMax. He has this software installed on his computer and would like to use it to model a Roman amphitheatre, whose remains have survived in the City of

[1] Source: Email communication with ABK, 16-28 February 2006.

London. He would like to be put in touch with 3D modellers specialising in heritage visualisation.[2]

Need 3

A Senior Lecturer in medieval history at the University of East Anglia studies wax seals. He has access to original objects but also relies on photographs for analysis and comparison. He wonders whether his sphragistical research would be better served by digital 3D images. When looking at the objects and their photographs with a magnifying glass, he finds that the level of detail is unsatisfactory. He would welcome methods better suited the detailed scrutiny needed. He is also interested in imaging techniques that would enable him to look at a seal from a variety of angles and in raking light, so that the relief and inscriptions could possibly be easier to decipher. His computing skills are basic and he is not sure what technology can offer.[3]

These are just three of many enquires communicated to the author. All are concerned with just one area of 3D visualisation, namely digital representation of heritage, yet demonstrate a variety of needs on different levels of academic research which, in order to be met, require different actions. Other areas of Arts and Humanities share some of the same concerns while also have other needs.

The principal aims of this report are to:

1. Portray the Arts and Humanities 3D visualisation community;

2. Identify the needs of this community;

3. Identify the support required to meet the identified visualisation needs in the best possible way.

4. Provide a document which would encourage consultation and initiate follow-up actions that are required to meet current and future needs of the Arts and Humanities 3D visualisation community in the UK.

[2] Source: Face-to-face communication, 25 October 2006.
[3] Source: Face-to-face communication, 21 April 2006.

1.2. Background

This chapter describes the brief for this report. It also outlines relevant earlier research that provides useful material for comparison, indicating common trends in ICT-based scholarship, teaching and education.

The need for this report has been identified and proposed in the 3DVisA Project Plan, which was accepted by JISC prior to the start of the project on 1 May 2006. The project plan stipulated that this report should identify the needs of the 3D visualisation community. The findings were to be communicated to the 3DVisA team and submitted to the 3DVisA Steering Group by 1 November 2006. These objectives have evolved since, taking into account new developments in the Network activities. Time was needed for 3DVisA to gain recognition and establish itself as an academic forum for debating issues in 3D visualisation before it was possible to lend a trustworthy 'ear' for listening to complex professional concerns. A number of pro-active initiatives helped to reach out to the community. Activities organised by 3DVisA and the participation by its team in events organised by other bodies, enabled the network to develop and widen its contacts. Widespread contacts, representing the community stakeholders at large, conditioned the research leading to this report. Within six months this approach started to bring slow but steady feedback, which is included in this report. It was also decided that the report should be made available not just to the 3DVisA Steering Group (which has not yet been appointed at the time of writing) but to a wider audience for consultation. It is therefore being published on the 3DVisA website (www.viznet.ac.uk/3dvisa).

This report is an outcome of what seems to be the first in-depth investigation focused solely on the needs of the 3D visualisation community. However, a number of earlier surveys, carried out in the UK and elsewhere, looked at the needs of Arts and Humanities researchers using advanced ICT. Some of these initiatives have provided an opportunity for practitioners of 3D visualisation to have their views represented. Select outcomes of these past investigations have informed the research leading towards this report. Although dissimilar in scope, the following earlier investigations were found of particular relevance:

- 2005 AHDS Visual Arts Survey: *The Digital Picture: a Future for Digital Images in UK Arts Education*.[4]

  This study focused on the needs of the users, creators and custodians of digital images within visual arts domains. It was conducted by the Arts and Humanities Data Service, Visual Arts, and sought 'to establish a national overview of issues, and potential solutions, relating to the use and impact of digital images within visual arts, higher education institutes and

[4] Pringle, M. *et al.* (2006), *The Digital Picture: a Future for Digital Images in UK Arts Education,* Report published by the Arts and Humanities Data Service (AHDS) Visual Arts, available at http://thedigitalpicture.ac.uk/documents/pdf/digital_picture_final_report.pdf.

associated organizations.' Although the survey was concerned primarily with still, two-dimensional images, it allowed for articulating the specific needs of those working with 3D computer graphics; it seems no such comments had been communicated. Highly relevant to the concerns of the 3D visualisation community is the discussion of the complex cultural change brought about by digital technologies; the concern for potential loss of traditional skills and resources; and the complex and notoriously little understood issues of Intellectual Property (IP) rights.

This survey was commissioned by the Images Working Group 1 of the Joint Information Systems Committee. It was initiated in 2004 and the final report was completed in May 2006. Data were collected through 502 questionnaires, targeted interviews and the community-wide consultation carried out online at the project's website, www.thedigitalpicture.ac.uk, as well as at workshops and expert seminars attended by 257 people. The survey team involved all AHDS Visual Arts staff. It was managed by Polly Christie under the directorship of Dr Mike Pringle. The cost of the project was £17,000.

- 2005-2006 ILRT Bristol Survey: *Gathering Evidence. Current ICT Use and Future Needs for Arts and Humanities Researchers*[5]

  The aim of this important survey was to inform the Fundamental Review of the Arts and Humanities Research Council ICT Strategy Programme. It was led by Dr Lesley Huxley and carried out by the Institute for Learning and Research Technology (ILRT) at the University of Bristol. The survey looked at what was then current use of ICT in research by 449 Arts and Humanities scholars and students in UK Higher Education. The focus was on researchers' access to digital tools and resources, including the creation of such resources. One question was concerned with the importance of electronic resources based on modelling techniques and geospatial data. The results were indicative of the negligible use of those: **79 per cent of respondents said that 3D resources are not important** for their research; **86 per cent of respondents considered geospatial data not important**. Also investigated where the ways in which digital technologies have changed the methods and dissemination of research and its sustainability. The results were compared with data from two surveys carried out by the Office for Humanities Communication in 1985 and 1991/2 respectively, thus tracing trends over a period of twenty years.

[5] L. Huxley, C. Mullings, T. Hodos and D. Jones, *Gathering Evidence. Current ICT Use and Future Needs for Arts and Humanities Researchers,* University of Bristol, Final Report, September 2006, http://www.ahrcict.rdg.ac.uk/activities/strategy_projects/reports/bristol/gathering_evidence_final.pdf. Since April 2007, this survey has been used as a model by the Australian Academy of the Humanities for collecting data about the use of ICT amongst arts and humanities researchers in Australia; the data will inform Academy policy, and its advice to government on humanities research infrastructure (see https://www.surveymonkey.com/s.aspx?sm=H2Y6januxt3P_2fGeGfRjqWA_3d_3d).

The survey concluded that 61 per cent humanities researchers work alone on small-scale projects (NB the majority of respondents were students); that traditional, non-electronic methods of conducting and disseminating research are more popular than digital methodologies; that the use of ICT is an age-related issue; that the word of mouth, rather then institutionalised support, is the most common way for researchers to keep up-to-date with ICT; that ICT methodologies are best established in archaeology, which is also a discipline with the lowest level of unfunded research (alongside anthropology).

This survey was conducted by a team of four researchers working part-time over a period of one year, and was supported by AHRC grant of £39,148.

- 2007 AHDS AHRC Survey: *The Hunt for Submarines in Classical Art: Mappings between scientific invention and artistic inspiration*.[6]

  Building on the considerable experience of the AHDS team and earlier research into ICT in the Arts and Humanities, this survey looked at the use of ICT by artists, art historians and art-practice-based researchers. Needs were identified, quantified and compared with the existing provision of digital tools (software, technologies). Visualisation, particularly three-dimensional modelling, was identified as one of the specific needs of this community. The report concluded that **existing technologies for 3D data capture and modelling** not only meet this need, but **are underused**. This was expressed by the ratio of the visualisation needs to visualisation tools, given as 5:9, and compared with the unsatisfactory ratio of the demand for access to digital resources to access technologies, given as 34:3 (see diagram on p. 25). This survey was conducted at the University College for the Creative Arts, Furnham, in 2004-2007 at a cost of £61,829. It was managed by Polly Cristie under the directorship of Mike Pringle and carried out by Dr Rupert Shepherd.

The above surveys demonstrate general trends and common problems in the use of advanced ICT by Arts and Humanities researchers. Issues such as access, dissemination and sustainability of research outcomes, are common to most areas of digital scholarship and will be discussed in the context of 3D technologies. The references to the following report should be noted:

- 2006 DPC Report, *Mind the Gap. Assessing digital preservation needs in the UK.*[7]

[6] Pringle, M. and Shepherd, R. (2007), *The Hunt for Submarines in Classical Art: Mappings between scientific invention and artistic inspiration*, Report published by AHDS Visual Arts, Funded by the Arts & Humanities Research Council, available at http://www.ahrcict.rdg.ac.uk/activities/strategy_projects/reports/vads/vast_full_report.pdf.

[7] Waller, M. and Sharpe, R. (2006), *Mind the Gap. Assessing digital preservation needs in the UK,* A report published by the Digital Preservation Coalition, York, available at http://www.dpconline.org/graphics/reports/mindthegap.html.

The Digital Preservation Coalition (DPC) commissioned Tessella Support Services Plc to conduct this report to raise the awareness of the importance of the long-term access to digital information and to assess digital preservation needs across sectors. The title 'gap' refers to the gap between the current provision and preservation practice within the UK and the needs of organisations. Practical, technological and legal considerations remain relevant for 3D data. The report concluded that less than 20 per cent of UK organisations had a strategy in place to deal with the risk of loss or degradation to their digital resources and that the permanent loss of digital data is commonplace. The 3DVisA survey of 3D visualisation projects has confirmed that this situation is also common for 3D products of these projects.

The report was a result of three years of preparation and research. Data gathering included a questionnaire sent to over 900 professionals (which resulted in over 10 per cent response, considered good). The report has identified 18 needs with recommendations.

Considering the rapid pace of technological advances and the ever new demands this imposes on the provision of ICT and its support, the focus of this research has been on the findings of most recent surveys. However, lessons may also be learned from earlier initiatives aiming at supporting the 3D visualisation community.

- The Advisory Group on Computer Graphics (AGOCG) was established in 1989 as a joint initiative by the UK University Funding Council's Information Systems Committee and the Science Engineering Council (SERC).[8] The aim of AGOCG, which ceased in 1998, was to advise UK Higher Education on computer graphics, visualisation, multimedia and virtual environments, by providing 'a single national focus' on these technologies. It is an interesting precedent to what the UK Visualization Support Network (VizNET) has been doing since 2006.[9] It was also a JISC initiative, and involved some of the same researchers who are active in VizNet. One of the objectives of AGOCG was 'to stimulate and support the effective use of computer-based visualization'. During its ten-year lifespan a wealth of training materials, technical reports and academic papers, as well as advisory material in support of national frameworks and strategies in the field have been produced. They are still available archived on the AGOCG website (which is no longer actively maintained). A number of surveys conducted by AGOCG are relevant to this study; in particular the *Survey of Virtual Reality Activity in the United Kingdom,* published in 1995

[8] See the Advisory Group on Computer Graphics (AGOCG) website at www.agocg.ac.uk.
[9] For more information about VizNet and 3DVisA see www.viznet.ac.uk and www.viznet.ac.uk/3dvisa respectively.

and 1999 respectively.[10] Some of the needs of the visualisation community identified by AGOCG and actions required for promoting visualisation activities in the UK remain the same and are referred to in this report.

AGOCG is a telling case concerning the long-term support for computer-based visualisation research in the UK. Why were they unable to continue? Are there any lessons to be learned by support services existing today?

[10] Howard, T., Hubbold, R., Murta, A. and West, A. (1995) *Survey of Virtual Reality Activity in the United Kingdom,* Prepared for the Advisory Group on Computer Graphics (AGCG) by Advanced Interfaces Group (AIG), Department of Computer Science, University of Manchester, p. 11; available in PDF at http://www.agocg.ac.uk/reports/virtual/vr95/vr95.pdf (also in HTML).

Howard, T., Hubbold, R., Murta, A. and West, A. (1999) *Survey of Virtual Reality Activity in the United Kingdom,* Prepared for the Advisory Group on Computer Graphics (AGCG) by Advanced Interfaces Group (AIG), Department of Computer Science, University of Manchester; available in PDF at http://www.agocg.ac.uk/reports/virtual/27/27.pdf (also in HTML).

1.3. Approach

As indicated in the discussion of the background to this project (1.2), this report is informed by earlier studies concerned with advanced ICT in research, teaching and educational practices in the Arts and Humanities. In preparation for this report, and concurrently with other activities, 3DVisA has undertaken new research.

- Soliciting views of 3D practitioners

  In the summer of 2006, 3DVisA carried out a survey of 3D visualisation projects in the Arts and Humanities, which resulted in a report and an online *Index of 3D Projects*.[11] One hundred projects were investigated in the first instance and more have been added since. This research looked at the aims of projects across a variety of subjects; the technology and methodologies employed; the background and expertise of the contributors; sources of funding; 3D digital products such as computer models, graphics and motion capture data; dissemination and sustainability of outcomes, and the relationships between similar projects. A purpose-designed questionnaire was circulated to selected leading investigators. This activity provided an opportunity to solicit the views of those engaged in 3D visualisation about community-wide issues. Three questions (Nos. 29-30) were asked in anticipation of this Report:

  - What areas of your research benefit from the application of 3D visualisation?
  - What challenges do you face in the use of 3D visualisation?
  - What kind of support for 3D visualisation users would you like to see put in place?

  This questionnaire was sent only to those invited to contribute to the 3DVisA *Index of 3D Projects*. Another questionnaire was therefore made available online for anyone willing to comment on the visualisation needs. The questionnaire was posted on the VISA-3D List, hosted by JISC (at http://www.jiscmail.ac.uk/lists/visa-3d.html) and advertised in the 3DVisA Bulletin and through other free academic channels. The number of responses received to both questionnaires was negligible; too small to consider a quantitative analysis. Communication via telephone or face-to-face was by far the preferred mode of communicating the needs. The comments received are referred to throughout this Report.

[11] Bentkowska-Kafel, A. (2006), *3DVisA Survey of 3D Projects*, an unpublished report available from 3DVisA. The 3DVisA *Index of 3D Projects* is an evolving resource available at www.viznet.ac.uk/3dvisa.

The 3DVisA survey of 3D visualisation projects has confirmed that successes and failures of past projects tended to depend not solely on technological solutions, but also on people-related issues: leadership and management, team work and communication, vision and purpose.

3D visualisation methods have implications that go far beyond technological innovation in research and educational practices. The discussion of issues specific to the use of such methods in the Arts and Humanities requires much broader socio-cultural context. A growing body of literature reflects the complexity of this debate. Such literature has been consulted and referred to where relevant.

- Reaching out to the undecided, the fearful and the apprehensive

The 3DVisA survey of 3D projects, understandably, involved the practitioners of 3D visualisation. The experience of earlier research into factors conditioning the uptake of ICT in research, teaching and learning across Visual Culture studies, suggests that views of non-users are critical for developing strategies for promoting such technologies. This Report communicates the needs of members of the community who are indifferent, fearful or openly apprehensive of the use 3D visualisation in the Arts and Humanities. It was felt that such views should not be ignored, but examined carefully as they may help to refine the goals and strategies of 3D visualisation. It is accepted in Social Sciences that the identity of a community is shaped by the outsiders' relationships towards it (the 'otherness'). An identity of a group is therefore a construct: it does not come naturally, but is shaped by judgements and actions that are reactions to opinions and attitudes of others.

- Methodology

The qualitative methodology adopted for this research has been that of observation and targeted direct communication (face-to-face, telephone and email) with members of the 3D community. It is believed that the comments received reflect genuine concerns of the 3D visualisation community. This report draws extensively on these comments, which has been edited where anonymity was requested. Where permission has been granted, the comments are cited verbatim. This report is also supported by a considerable additional analysis of earlier studies and new research.

Some needs of the 3D visualisation community are common to the Arts and Humanities in general, and many of these have been identified in earlier studies. None of the methodologies proposed or used by these earlier studies

served as a direct model for this research.[12] The authors of the *Hunt for Submarines* report have approached the needs of researchers from a primarily technological perspective, i.e. by grouping identified needs according to computing criteria, and listed them as follows: Interfaces, Capture, Modelling, Image processing; Video; Visualisation; Processor power; Storage; Display. Additional categories of needs are concerned with: collaboration; image collections; access; categorisation/ordering and finding images.[13]

As quantitative methods – the predominant approach in earlier studies with similar objectives – were beyond the means of 3DVisA, this Report draws upon established theories and communitarian practices developed in Social Sciences and Anthropology in recent decades.[14] The emphasis is on the response from educational and research communities to the ever greater use of digital technologies in communication and human interactions.

One of the lessons one may learn from the earlier surveys is that qualitative research based on questionnaire may be problematic in the Arts and Humanities communities: the results do not need to be representative in order to be meaningful; a single voice can make a real difference to future developments. This contradicts the rationale of qualitative methods. It is not possible to say to what extent individual comments included in this Report are representative of a wider demand. Some comments refer to needs which are contradictory, yet both positions should be addressed.

Questionnaire-based methods are time and labour intensive to conduct and the response is often disappointing. A low response rate is caused by general 'questionnaire fatigue', as well as the questions often considered to be too generic to adequately reflect upon specialist areas of study.[15] Therefore, all

[12] Pringle, M. (2005), 'The Bigger Picture – A method for Identifying Community Needs', *Electronic Imaging and the Visual Arts (EVA) Conference Proceedings,* University College, London, 25-29 July 2005, eds. Hemsley, J. et al., ISBN 0-9543146-6-2, pp. 32.1-32.10.

[13] Pringle, M. and Shepherd, R. (2007), *The Hunt for Submarines in Classical Art: Mappings between scientific invention and artistic inspiration*, Report published by AHDS Visual Arts, Funded by the Arts & Humanities Research Council, available at http://www.ahrcict.rdg.ac.uk/activities/strategy_projects/reports/vads/vast_full_report.pdf.

[14] For an introduction to the community theory from educational perspective and bibliography see Smith, M. K. (2001) 'Community' in *The Encyclopedia of Informal Education*, http://www.infed.org/community/community.htm.

[15] The schedule for the ILRT Bristol survey of 2005-2006, *Current ICT Use and Future Needs of Arts and Humanities Researchers,* had to be extended because of 'difficulty in reaching the target audience, slow response, and respondents' inconsistent interpretation of the questions which varied depending on experience.' The investigators concluded: 'Response to the initial survey invitation was slow, requiring extension of the deadline, but with active support from our Steering Group, finally achieved just under 500 responses [ABK: Actual figure: 449]. Students represented around a quarter of the responses. One of the main difficulties was finding appropriate routes to reach A&H researchers and in establishing the target population in UK HE.' Source: AHRC ICT Strategy Projects, http://www.ahrcict.rdg.ac.uk/activities/strategy_projects/huxley2.htm.

surveys listed in Chapter 1.2. used selective interviews as a follow-up method. The author participated in three of these surveys, acting as respondent and interviewee. This experience was helpful in conducting the present research.

The cost of AHDS and IRLT surveys that employed such methods recently has been indicated in Chapter 1.2. 3DVisA has not budgeted for the use of qualitative methods.

- Scope

  Only the needs which have been communicated to the author are discussed. The discourse is therefore that of reporting, rather than deductive assumption. There may be other concerns not covered here because of lack of supporting evidence. Views were solicited across Arts and Humanities disciplines, research and pedagogical interests, and levels of computing skills. Paradoxically, disciplines where the use of 3D visualisation is routine (e.g. architectural practice, film studies) are poorly represented here. The low response from these practitioners and researchers may be explained by the fact that where 3D technologies are well established, the mechanisms for addressing new needs are already in place. The voice tends to be stronger when comments concern problems. Demands for support identified here range from individual to community-wide issues. Some require straightforward actions, others call for considerable changes in legislation and policies on a national level, and major shifts in attitudes. Where more research is needed, follow-up actions have been suggested.

- Timescale

  The research leading to this report was conducted over a period of six months, from June to November 2006, on a part-time basis and concurrently with other activities. The Report was drafted in January-April 2007 and revised in July 2007 to include new research and signal the changes in the administrative structure of the UK institutions that are responsible for supporting research and education in the UK. The effects of these changes are yet to be seen.

1.4. Acknowledgements

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2.1. Naming the 3D Visualisation Community

This report assumes the existence of a 3D visualisation community in the UK. Its size is difficult to determine, yet impacts directly on the level of support required. Equally important in this respect is the academic and professional profile of the community members. In this section an attempt is being made to portray the constituent groups of the 3D visualisation community in the UK and demonstrate its diversity.

What follows, is informed by the belief that strengthening this particular community is beneficial not only to its members, but also the wider academic community and society at large, both in the UK and worldwide.

"Words have meanings: some words, however, also have a 'feel'. The word 'community' is one of them. It feels good: whatever the word 'community' may mean, it is good 'to have a community', to be in a community." – the philosopher and sociologist, Z. Bauman argues.[16]

The 3D visualisation community consists of four main interest groups representing varying level of familiarity with 3D visualisation:

A. Creators;
B. Facilitators;
C. Users;
D. Outsiders.

The constituent groups of the 3D visualisation community in the UK may at present be described as follows:

Group A: Creators of 3D Visualisations

These are developers of 3D visualisations. They include specialists of two different backgrounds: 3D technology specialists whose work involves programming, software, hardware and other 3D digital tools; as well as non-technical contributors (academics and practice-based researchers), whose knowledge of the subject is critical for the creation of 3D products. A number of such closely working teams have been established in the UK.

- Academic 3D visualisation centres

  Academic centres specialising in 3D visualisation are located within the UK Higher and Further Education institutions: within Arts and Media schools,

[16] Z. Bauman: *Community. Seeking Safety in an Insecure World*, Cambridge UK: Polity, 2001, p. 1.

Built Environment and Archaeology, educational technology departments, as well as Computer Science and other scientific departments.

Amongst the pioneers still active today, since 1992, is the Centre for Advanced Studies in Architecture, based at the University of Bath.[17] A team of five academics consists of architectural historians and architectural computing experts. They lead research students (four in 2005-206). The team undertakes historical studies of art and architecture. These studies are frequently supported by photogrammetric surveys and historical reconstructions in the form of computer models, the products of which have accompanied major art exhibitions and book publication. Projects involving 3D simulation of urban environments have also been commissioned by local authorities and commercial organisations (CASA's first commission was for a computer model of Bath received from the retailer J. Sainsbury plc).

CASA has a clear subject focus. This is characteristic of a number of centres, enabling the team to build upon its own expertise and experience of technology. The King's Visualisation Lab (formerly the Visualisation Unit of the Warwick University Theatre Studies Department) has also established a reputation in one specialist area, namely theatre studies.[18] KVL supports historical research with digital visualisation of theatre spaces and, more recently, 3D motion-capture to record movements of performers and experiment with placing characters in virtual theatres.

The number of research staff in academic visualisation centres varies. Like CASA, the KVL has a core staff of five (two subject specialists and three technology experts), the Centre for Advanced Spatial Analysis (CASA) of the University College London is a team of some forty researchers (incl. staff and Ph.D. students). [19]

Academic scientific centres with 3D visualisation expertise frequently apply this technology to the arts. This interest may be marginal and not reflected in the name of the centre. The Department of Geomatic Engineering at the

[17] For information about the Centre for Advanced Studies in Architecture, University of Bath, and a list of completed projects see the CASA website at www.casa.ac.uk. Details of select CASA projects are included in the *3DVisA Index of 3D Projects*; see for example The Alberti Project at http://3dvisa.cch.kcl.ac.uk/project22.html, and El Templo Mayor del Tenochtitlan, Mexico at http://3dvisa.cch.kcl.ac.uk/project59.html**.**

[18] For information about King's Visualisation Lab, see the KVL website, http://www.kvl.cch.kcl.ac.uk/. Details of select CASA projects are included in the *3DVisA Index of 3D Projects*; see for example The Theatre of Pompey the Great, Rome, http://3dvisa.cch.kcl.ac.uk/project81.html, and *How Kew Grew,* http://3dvisa.cch.kcl.ac.uk/project30.html.

[19] For information about the Centre for Advanced Spatial Analysis (CASA), University College London see the CASA website at http://www.casa.ucl.ac.uk/index.asp. Details of select CASA projects are included in the *3DVisA Index of 3D Projects*; for useful links for the Virtual London project see http://3dvisa.cch.kcl.ac.uk/project94.html.

University College London has teamed with museums on a number of occasions, and applied photogrammetry and 3D laser scanning to artefacts. The 3D AURA project (Accurate and Reliable 3D data applied to Artefacts), for example, involved the British Museum, Victoria and Albert Museum and the UCL Petrie Museum, alongside learning technology experts from Birkbeck London Knowledge Lab, the UCL Bartlett School of Architecture and others.[20]

New visualisation research centres dedicated to the visual and performing arts have been established in recent years within Media, Art and Design departments. The Visualisation Research Unit (VRU) opened in 2004 at the Birmingham Institute of Art and Design of the University of Central England. The Unit is dedicated to the use of digital media, including motion capture and high performance computing.[21]

A new kind of creative industries centres, combining academic research with industry standard technology and market forces, is emerging within the UK HE. The unprecedented scale of investment is a true boost to creative application of 3D technologies and academic research. An example can be found at the London Metropolitan University's Sir John Cass Department of Art, Media and Design, where a new centre, Metropolitan Works, has been established (to be completed in 2008) with an investment of over £2.5 million for equipment and workspaces alone. Metropolitan Works helps 'designers, artists and manufacturers develop ideas and bring new products to the market place through access to digital manufacturing, workshops, knowledge transfer, advice, courses and exhibitions.'[22] The Centre has already been active in research and teaching, exhibitions and other events open to the public, including 'taster' days in CAD, rapid prototyping and Computer Numerically Controlled Routing (CNR) during the London Design Festival 2006.

Metropolitan Works, an academic research centre with a strong industrial focus, is representative of the new involvement of industry in teaching arts and design on the postgraduate level. The Royal College of Art also maintains strong links with business, engineering and manufacturing industry through their Innovation Programme, the Materials and Design Exchange (MADE) and industry's support for postgraduate research. Audi, Phillips, Thorn and other leading manufacturers, for example, have been involved in

[20] Information kindly provided by Dr Stuart Robson, Department of Geomatic Engineering, University College London.

[21] For more information see the VRU webpages hosted by the UCE Birmingham Institute of Art and Design at http://www.biad.uce.ac.uk/vru/index.php.

[22] Source: the Metropolitan Works Creative Industries Centre website, http://www.metropolitanworks.org/about.php. For an example of the use of CNC routing, rapid prototyping and other 3D technologies in product design, see the Osteon chair by Assa Assauch, *3DVisA Index of 3D Projects: Product Design,* http://3dvisa.cch.kcl.ac.uk/project28.html.

the RCA Helen Hamlyn Research Associates Programme in product design.[23]

- Industrial and commercial visualisation technology centres

  The collaboration with industry and commercial sectors goes back to the very beginnings of 3D visualisation research in the Arts and Humanities in the UK. Early projects in the 1980s involved collaboration of HE with the computer industry. One of the earliest computer reconstructions of a historic building was created by scientists at the IBM UK Scientific Centre at Hursley Park, Winchester.[24] The WINSOM software designed for this purpose found other applications. The software package, Plant Design Management System (PDMS), developed by nuclear and other industries, was used by Lancaster University Archaeological Unit (LUAU) and English Heritage to develop a computer model of Furness Abbey in Cumbria.[25] Although application of visualisation to the Arts and Humanities no longer depends on such specialist computer programs and infrastructure, the collaboration between researchers working for large computer companies with Arts and Humanities academics continues and now frequently involves innovative conceptual work. Antonio Criminisi of Microsoft Research Ltd., Cambridge, UK and other scientists worked with Professor of Art History at Oxford University, Martin Kemp, on new techniques for extrapolation and visualisation of 3D data from paintings.[26]

  The contribution of smaller commercial computing and media companies to visualisation projects in the Arts and Humanities is substantial. A London-based company, Armadillo Systems works with the British Library and the Wellcome Library for whom they have developed and maintain the highly successful technology, called Turning the Pages™ 3D, which enables viewing virtual models of old manuscripts and rare books interactively online.[27]

Some individuals working for small commercial companies also teach at universities, as visiting lecturers, and participate in academic research projects, bridging business with academic interests. Warren Fearn is the owner and creative director for WAK Studios, a 3D animation company in South Yorkshire and a part-time teacher at York St John University, York in the design

[23] See *Human Frame,* exh. cat., Helen Hamlyn Research Associates Programme 2006, Royal College of Art, London, 23-27 September 2006, available at http://www.hhrc.rca.ac.uk/archive/hhrc/resources/publications/RA/ra_cat2006.pdf

[24] See **'**Old Minster, Winchester, Hampshire, UK'**,** *3DVisA Index of 3D Projects: Archaeology,* http://3dvisa.cch.kcl.ac.uk/project12.html.

[25] See **'**Furness Abbey, Cumbria, UK'**,** *3DVisA Index of 3D Projects: Architectural and Urban Studies,* http://3dvisa.cch.kcl.ac.uk/project23.html.

[26] See 'Exploring the Paintings Third Dimension'**,** *3DVisA Index of 3D Projects: Art History and Conservation: Painting***,** http://3dvisa.cch.kcl.ac.uk/project73.html.

[27] See 'Turning the Pages'**,** *3DVisA Index of 3D Projects: Palaeography and Manuscript Studies***,** http://3dvisa.cch.kcl.ac.uk/project19.html.

department, where he is also undertaking a Ph.D.[28] Rotography Ltd. is a small media company specialising in panoramic imaging, including virtual rotographs of 3D models for tourism and the heritage industries. Its Director, David Clarke has been involved with the University of Huddersfield.[29] By the same token, academics set up their own businesses, which provides them with facilities needed to pursue their academic interests.

- Professional and educational visualisation centres

  Expert centres of 3D visualisation are also located within educational institutions outside HE. Heritage conservation is one of the areas where research and application of 3D technology is advancing at a considerable pace. Among the leaders is the National Museums Liverpool specialist centre, Conservation Technologies, based at the National Conservation Centre.[30] Their work involves documentation and physical conservation of artefacts and architecture, supported by 3D laser scanning and modelling, and other digital techniques. Conservation Technologies are also running courses for heritage professionals and are actively involved in research (conference papers, publications etc).

- Independent researchers

  ICT-based research projects in the Arts and Humanities increasingly rely on independent experts and support staff. Employed for the duration of the project, they constitute a modern equivalent of medieval migrant master craftsmen, who move from job to job, from one employer to another, often changing location. This has implications for all involved, impacting on careers, administration and sustainability of research.

  The needs of individuals who are not on long-term institutional contracts should also be addressed as they make an important contribution to the advance of 3D visualisation, particularly in creative arts.

  A number of such practice-based researchers – fine and performing artists, architects and designers – have both subject knowledge and computing skills at the level enabling independent work on visualisation. They rarely have access to the same level of funding, technological infrastructure, and logistics as those available to colleagues at the HE institutions. They often have to make a much stronger case for their work to receive support.

[28] WAK Studios website is at www.wakstudios.co.uk.
[29] An example is the cooperation between Dr S. Ward of the Huddersfield University and Rotography Ltd. (http://www.rotography.com/index.php), on the EPSCR-funded project, *3D Panoramic Image Capture and Virtual Environment Construction,* completed in July 2004.
[30] For an example of 3D laser scanning and modelling in conservation of sculpture, see 'Statue of Buddha, National Museums Liverpool, UK', *3DVisA Index of 3D Projects: Art History and Conservation - Sculpture,* http://3dvisa.cch.kcl.ac.uk/project98.html. The Conservation Technologies website is at http://www.liverpoolmuseums.org.uk/conservation/technologies/.

> *'Things are getting better now, but when I started as a media artist only a few years ago, it was really difficult to persuade the Arts Council that an artist needs a high-powered computer.'*

Formal qualifications of such hybrid practice-based researchers vary. Many, possibly a majority of older researchers involved in 3D visualisation, have formal qualifications in one subject (either in the Arts and Humanities or computer science) and acquired knowledge of the second discipline through practice. Some have degrees in two or more disciplines.

> *"**Forget left and right brain theory**, and give serious attention to whole brain ability. Ph.D. student Daniel Keefe is that new breed of visionary inventor that embraces art and science simultaneously. Equally comfortable with algorithms and art, Dan is developing software for tangible tools in the Cave in the Computer Science Dept. at Brown University, while simultaneously working on his own art and collaborating with artists and illustrators at the Rhode Island School of Design."* [Emphasis ABK][31]

The number of individuals able to conduct academic research in the Arts and Humanities by supporting it with 3D visualisation programming and tools, without resorting to the experience of others, is growing. This is a result of courses offered on every level of education, as well as ever easier access to computer visualisation tools in general.

Group B: Facilitators of 3D visualisation

This group makes 3D visualisation happen and develop. Facilitators include: national and international policy makers and policy advisors; funding bodies; advisory services; support networks such as the AHRC Methods Network, JISC VizNET and 3DVisA; distributors and custodians of 3D visualisation research outcomes and products.

Facilitators are not necessarily 3D visualisation experts. The practitioners of 3D visualisation have expressed a concern that, regrettably, research proposals are occasionally evaluated by reviewers with limited knowledge and experience of this technology; stressing the need for addressing this problem.

[31] [NN], *Established Artist Introduces Emerging Artist (EA2)*, A SIGGRAPH initiative at http://arts.siggraph.org.

Group C: Users of 3D visualisation

Even in today's highly visual culture familiarity with 3D visualisation is not synonymous with active use and understanding of visualisation tools and products. Many of us are familiar with special 3D graphic effects in films, advertising and other forms of popular culture, but have no understanding how these are created.

Active and frequent use of 3D tools and products does not imply their understanding. People in their millions play computer games, thousands explore Google Earth and examine rare books with the Turning the Pages™ software, without in-depth knowledge of the technology involved in the creation of these virtual spaces and its objects. However, those exposed to such tools are likely to see their potential relevance to their work. This is where the guidance is much needed, i.e. readily available information from a trustworthy source and examples of good practice, which may help in turning an observation into a research method.

It is believed that the knowledge of technology makes better users. The creators of 3D visualisation are certainly the most knowledgeable users of its products. However, the variety of 3D technologies, techniques and applications is such that a specialist in one area of visualisation may not be familiar with another.

Researchers on the same team, but of different background, may have different understanding and therefore expectations of the technology they use; they ask different questions and expect different answers. Crucially, they see the quality of 3D visualisation differently. This was a message communicated over and over again by the contributors to the projects surveyed by 3DVisA, thus identifying the need for a consensus of understanding research objectives within a project team.

Group D. Outsiders: Sympathisers of 3D visualisation in the Arts and Humanities

The term 'outsiders' is used for convenience to describe those who do not belong to the 3D visualisation community in Higher and Further Education, but may potentially establish such links in the future.

This group includes what is probably a majority of Arts and Humanities researchers: those with no particular interest and direct exposure to 3D visualisation, but potentially sympathetic to 3D visualisation. They need to gain experience and knowledge of this method before they consider using 3D tools or resources in any significant way.

Sympathisers also include those with keen interest in 3D visualisation, who currently have no direct links with academic research in the Arts and Humanities.

The discussion of the future of 3D visualisation should take into consideration present needs of those who are likely to become 3D practitioners in a few years time. These are today's children with natural ease of computing and enthusiasm for virtual environments. This familiarity and skills may influence their choice of education in the future.

The Lewisham City Learning Centre in London runs a pilot project in 3D visualisation, which enables children in secondary education to develop extra-curriculum skills in this area.[32] The new BTEC Advanced Certificate in 3D Animation is the first course of its kind in the UK that gives students a thorough grounding in 3D modelling and animation using software standard in film and game industries. Coupled to this is the fact that now schools are for the first time in a position where both the hardware and software prices for delivering 3D education are within reach.' [33] Two schools, John Kellys' Girls Technology College in Neasdon and Dr Challenors Boys Grammar School in Amersham, participated in 2005-2006. 3DVisA was contacted by the director of the Kingwood City Learning Centre, London, also involved in the pilot. At present this course does not attract UCAS points, the need for which was strongly advocated.[34]

At the other extreme of computing expertise are professional digital media practitioners in commercial and industrial sectors. Some have been mentioned in relation to the academic collaborative practice, but there are also areas outside the interests of the Arts and Humanities. Military, industrial and medical computing set the pace of technological innovation and constantly seeks to push the barriers beyond current practice. It has always been an indicator of possible future directions in other areas of computing, including imaging. Work of these sectors needs to be watched closely for possible new collaboration opportunities, as well as general indication of the future trends and needs, including the provision of software and computing infrastructure for the academic sector.

Outsiders: Opponents and the Indifferent

[32] 'BTEC 3D', *3DVisA Index of 3D Projects: Art and Media Education,* http://3dvisa.cch.kcl.ac.uk/project99.html.
[33] [N.N.], *Education for the Creative Industries. 3D Education in the Secondary Curriculum,* Lewisham City Learning Centre, http://www.lewisham-clc.org.uk/?_id=285.
[34] A UK system of entry points to full-time undergraduate courses. Applications are processed by the Universities and Colleges Admission Service (UCAS), www.ucas.com.

Technology and computer-based methods tend to generate strong views, both positive (even enthusiastic) and negative (even hostile). 3D visualisation is not a universally accepted subject and methodology in the Arts and Humanities; it has many critics and opponents. It is important to listen to well-informed criticism. Negative views of 3D visualisation help to refine its understanding and advance 3D techniques.

It is also important to be conscious of those who are indifferent to 3D visualisation and prone to shift to one position or the other. No method should be forced, but may be encouraged through explanation and exposure. All 'outsiders' constitute the recruitment base for new members of the 3D visualisation community.

Conclusion

3D visualisation work is not confined to specialist subjects within Arts and Humanities, nor even research centres. The territory on which the 3D visualisation community operates is broad. It is one of those communities whose boundaries 'may be thought of, rather, as existing in the minds of the beholders'.[35] The Center for New Media at the University of California at Berkeley, much engaged in 3D visualisation, introduces itself on the Centre's webpage as 'a network of brains and bodies' which 'brings together humanists, technologists, designers, social scientists, and artists who are passionately engaged in the creation and critical study of New Media'.[36] CHArt (Computers and the History of Art) promotes itself as 'an independent group of like-minded computer enthusiasts who have interest in the use of digital technology for the study and preservation of works of art and visual culture'.[37]

The interest in digital technology that enables spatial visualisation of data is what identifies the 3D visualisation community. Although far from common, this interest is international.

Is it possible to estimate the size of the 3D visualisation community in the UK?

Figures indicative of the size and subject affiliation of the academic 3D visualisation community in the UK are fragmentary; reliable figures are not readily available. HEFCE statistics for the 132 higher education institutions in the UK do not provide such details.[38] An attempt was made in 2006-2007 to

[35] Cohen, A. P. (1985), *The Symbolic Construction of Community*, London: Tavistock, p. 12.
[36] Source: Center for New Media, University of California at Berkeley, http://cnm.berkeley.edu/people/index.php, (5 July 2006).
[37] CHArt, Computers and the History of Art, www.chart.ac.uk, (5 July 2006).
[38] See figures for UK universities and further education establishments available at the HEFCE website, http://www.hefce.ac.uk/unicoll/.

estimate the size of the UK visual arts community.[39] Only some members of this group have an interest in 3D graphics. 3DVisA is compiling a directory of active academic centres specialising in 3D visualisation and individual researchers. More work is needed to make this resource comprehensive and up to date.

The 3D visualisation community is certainly growing. This is a reflection of the greater awareness of 3D visualisation methods, as well as the general trend of advanced ICT methods becoming increasingly popular. Recent surveys conducted under the auspices of AHRC and AHDS (see 1.2.) indicate that nationally, the proportion of those in HE using advanced ICT methods in research and teaching represents a minority, with those employing 3D computer graphics being only a fraction of this minority group. This trend seems to be also characteristic to the United States. The report on the *Summit on Digital Tools for the Humanities,* held in September 2005 at Charlottesville, Virginia, expresses 'the consensus of participants that **only about six per cent** of humanist scholars go beyond general purpose information technology and use digital resources and more complex digital tools in their scholarship' [ABK emphasis].[40] It can be estimated that the users of 3D and 4D visualisations constitute only a fraction of these six per cent (no figures are given).

Although the current uptake of 3D technologies in the Arts and Humanities is low, the significance of this community should not be measured by the popularity of the methods employed, but rather evaluated on the merits of its contribution to the arts, humanities scholarship and education in general.

[39] Pringle, M. and Shepherd, R. (2007), *The Hunt for Submarines in Classical Art: Mappings between scientific invention and artistic inspiration*, Report published by AHDS Visual Arts, Funded by the Arts & Humanities Research Council, pp. 5-8; available at http://www.ahrcict.rdg.ac.uk/activities/strategy_projects/reports/vads/vast_full_report.pdf.
[40] [N.N.], *Summit on Digital Tools for the Humanities. Report on Summit Accomplishments,* Charlottesville, Virginia, U.S.A., p. 4.

2.2. Community Building Tools

It has been proposed in Social Sciences that modern Communitarianism is intrinsically related to two opposing forces of enforcement and shared agreement.[41] On the one hand members of a community are expected to act in a certain way and express common views and interests; this requires the power of enforcement. On the other hand, as Bauman argues, the ethical foundation of a community of individuals may only be established through sharing. The reality of competitive academic life echoes this dichotomy of the interest of an individual and communal sharing.

The 3D visualisation community is a community with a shared interest in digital technology. It will grow in strength if this interest is sustained, fed on new ideas and opportunities, and broaden. The community building tools that reflect the dichotomy of enforcement and shared agreement, proposed by Bauman, are those of enforced institutionalisation on the one hand, and communication (collaboration) based on voluntary participation on the other. Both may be present in a variety of forms: the traditional top-down organisation of academic activities and established, discrete conventions of individual disciplines, are increasingly complemented by bottom-up initiatives and convention-free methodologies.

The practitioners of 3D visualisation in the UK belong to a global community. This community continues to grow owing to an ever wider network of professional contacts and collaboration on national and international levels.

- The need for a sustained programme of national and international conferences

  Conferences and seminars have been the main platform for exchange of knowledge and expertise in ICT-based research. Live events of this kind allow for debate, stimulate ideas, encourage new contacts and collaboration, and disseminate research. A number of international and national conferences in the field did come and go; others have established themselves as institutions in their own rights. Science and technology is a focus for IEEE conferences in Computer Vision[42]*;* the SIGGRAPH Conference on Computer Graphics and Interactive Techniques (37th in 2007)[43]; the Information Visualisation Conference (11th in 2007)[44], and

[41] Bauman, Z. (1997), *Communitarianism in Postmodernity and its Discontents*, New York: New York University Press; Bauman, Z. (2001), *Community. Seeking Safety in an Insecure World*, Cambridge UK: Polity, p. 172. See also Shaun Best's review of both titles at http://shaunbest.tripod.com/index.html.

[42] The American Institute of Electrical and Electronics Engineers, Inc. sponsors some 300 conferences annually, www.ieee.org/web/conferences/home/index.html.

[43] The Special Interest Group on Graphics and Interactive Techniques (SIGGRAPH), www.siggrah.org.

many others. 3D visualisation features strongly in the programmes of interdisciplinary conferences in the area of Media and Visual Culture such as CHArt (23rd in 2007)[45], EVA (some 80 conferences and seminars to date)[46], VAST Symposium in Virtual Reality, Archaeology and Cultural Heritage (7th event in 2006).[47] These present the science of visualisation to a non-technical audience in a more approachable way.

Conference presentations are one of the best ways of keeping up with the latest technological developments and pilot applications, ahead of publication of research. (More in Chapter 3.5.2. Funding).

- The need for making conferences and other academic events widely accessible

  Conference fees are prohibitive. The high cost makes attendance impossible for many who should participate. These events should be made free to participants whenever possible. Alternative ways of funding such events, including systems in other countries, should be looked at and emulated. (See also Chapter 3.5.2.)

- The need to facilitate participation in virtual conferencing

  The unprecedented ease of electronic communication made it common for researchers to work together without being together or even knowing each other personally. The possibilities offered by Collaborative Virtual Environments (CVE), Access Grid and similar technologies are now allowing for remote participation in seminars and conferences. These facilities need to be made more widely available, so it is eventually possible for more conferences to offer virtual access to those who are not able to attend.

  Virtual conferencing is particularly beneficial for collaborations involving digital material, including 3D visualisation. Participants may work together on the same computer model or other digital data in real time. This possibility has been demonstrated on many occasions, at Imperial College London using the inSORS Grid, in 2006, and elsewhere, but there is little evidence of this practice in the Arts and Humanities.

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[44] 11th Information Visualisation Conference, 3-6 July 2007 at ETH, Zurich, Switzerland.
[45] Computers and the History of Art (CHArt), www.chart.ac.uk.
[46] *Electronic Imaging and the Visual Arts (EVA)* international conferences, www.eva-conferences.com.
[47] VAST Symposium in Virtual Reality, Archaeology and Cultural Heritage, 7th annual conference organised jointly with the ICOMOS International Committee for Architectural Photogrammetry (CIPA); and a VAST seminar co-located with IEEE).

- The need to raise awareness of industry events and encourage participation

  There is much benefit to be drawn by Arts and Humanities academics and students from attending industry events, such as computing technology exhibitions and fairs. These are rarely advertised to the academic sector. Although driven by market forces, some offer seminars, demonstrations and tutorials, enabling participants to gain knowledge of technology and techniques first hand, talk to experts and obtain advice. The annual Nikon fair at the London Olympia may not seem of much relevance to the Arts and Humanities research, yet offers a programme of seminars and professional advice on computer graphics, colour science and digital imaging on every level of expertise. The event is free.

- The need to support small-scale events and informal meetings that raise awareness of 3D visualisation

  Large-scale international conferences should not distract from the importance of seminars in small groups, allowing for presentation of work-in-progress and informal discussion of research amongst peers. The ignorance of work undertaken by colleagues is not unusual among academics. Research projects may convene regular staff meetings but sometimes do not allow or budget for internal scholarly seminars. Where programme of such seminars is in place, it is found beneficial for better understanding of research issues. In the case of 3D visualisation, such events provide an opportunity for its demonstration. Colleagues not on the 3D project have an opportunity to experience this technology first hand, at source and benefit from an informed commentary.

- The need to review the top-down organisation structures within academic research

  Academic and educational institutions have no longer hegemony over access to information, provision of knowledge and research tools. Google, Wikipedia, YouTube, Bittorrent, Napster, MySpace and other Web 2:0 initiatives force institutions to rethink their role as providers of information and educational instructors.

  The aim of the Participatory Culture Foundation (PCF) is to ‘eliminate gatekeepers’ and ‘make mass media more open and accessible for everyone’. The Foundation provides open-source technology for video production and offers a step-by-step guide for ‘every stage of video

production – from filming, to editing, encoding, publishing, and promotion.'[48]

How will academic institutions respond to the bottom-up instruction currently available from a variety of sources? Will they resist or embrace this shift?

Will young people choose an academic course (and the dept package which goes with it) to learn 3D visualisation or rather join the Google Earth community to draw instruction from the Google SketchUp 3D modelling software? The program is offered in two versions, for casual and professional use; the former is free.[49]

- The need for a wider recognition of the validity of bottom-up developments

By launching Photosynth software in its trial, pre-beta version, Microsoft Live Labs pre-empted the competition, but have also demonstrated Microsoft's recognition of the role of the user. 'We thought it important to get it out there early, though, because our roadmap is still wide open, and we know that **the best ideas for how this technology might be used may not come from us**.'[50]

In the summer of 2006 Ars Virtua, a media centre and gallery 'located entirely in the synthetic world of Second Life' announced a call for artists in residence, offering the applicants a possibility of exploring 'a new type of space that leverages the tension between 3D rendered game space and terrestrial reality, between simulated and simulation.'[51] This call and similar opportunities sent a shiver down the spine of museum curators. Although art galleries are not strangers to online community-based projects, this call, like similar initiatives, signalled the loss of control and influence over the curation of art. The independent foundation, Eduserv was quick to follow with the announcement of grants available to educational projects in Second Life.[52]

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[48] The Participatory Culture Foundation a non-profit organisation based in Worcester, MA USA, and staff in other parts of the world. Edited citation sources: http://participatoryculture.org/ and http://www.getmiro.com/create/.

[49] Google SketchUp. Model your world. Dream. Design. Communicate, at http://sketchup.google.com/.

[50] Source: Microsoft Live Labs Photosynth, http://labs.live.com/photosynth/sysreq.htm?collection=sanmarco/index1.sxs

[51] I'm grateful to Linda Spurdle of Birmingham Museums and Art Gallery, for drawing my attention to this call. See her message posted on 5th December 2006 to the Museum Computer Group List at mcg@jiscmail.ac.uk. Citation after and further details are at http://arsvirtua.com/residence/.

[52] Eduserv (http://www.eduserv.org.uk) is a self-funding educational charity registered in England. Eduserv raises funds through such services as *Athens*, which facilitates access to online

> *'This morning I was asked to set up a Facebook account for our organization […] I believe that my superiors wish to use Facebook to attract a younger audience and raise our profile with more web-savvy people as a step towards the online PCF in a few years time.'*[53]

This comment from a member of the museum staff is yet another sign that the recognition of bottom-up initiatives is already present in the world of art and education. There is a demand (alongside considerable criticism) for these popular initiatives to be embedded more firmly in the academic institutional structures and strategies of UK higher education.

resources, and the software licensing scheme, *Chest*. There is more about the Eduserv grants in the Chapter 3.3.2. Funding.

[53] A comment by David Salmon, posted to the Museum Computer Group List (www.jiscmail.ac.uk/mcg), 2 July 2007.

3.1. Climate/Culture/Policies

Is the UK a good place for conducting research supported by 3D visualisation?

This chapter assesses the climate for conducting Arts and Humanities research, based on advanced ICT, by looking at the existing policies and strategies at governmental and university levels. These policies and resulting actions impact on the support researchers receive for conducting and innovating research. A wider community of creators and users of 3D resources are also affected. Areas which would benefit from further attention are identified.

- Research Councils: Arts and Humanities Research Council (AHRC)

It is only in April 2005 that the Arts and Humanities Research Board (AHRB) was elevated to the role of research council (AHRC) thus becoming the seventh research council in the UK. "The decision to create AHRC underlines the importance of high-quality research in the arts and humanities for the cultural, creative and economic life of the nation."[54]

While this is a welcome recognition, the administrative positioning of the AHRC as a public body of the Office of **Science** and Innovation, within the Department of **Trade and Industry** [emphasis ABK] seems – at least semantically – to contradict the AHRC status of an independent, non-departmental public body dedicated solely to the Arts and Humanities. The decision of 28 June 2007 to create a new Department for Innovation, Universities and Skills (DIUS) has made the division of governmental responsibilities more transparent. 'The new Department will deliver the Government's long-term vision to make Britain one of the best places in the world for science, research and innovation.'[55]

The Office of Science and Innovation is responsible for UK Science Policy and for allocating funds to research through the Research Councils. The annual investment in research of around £2.8 billion is shared by seven Research Councils: Biotechnology and Biological Sciences; Engineering and Physical Sciences (EPSRC); Economic and Social Research; Medical research, Natural Environment research, and Science and Technology Facilities; and AHRC.[56] The AHRC annual budget is less than 3 per cent of this sum and amounts to around £75 million (or approximately 95 million according to some sources). By comparison 'EPSRC invests around £740 million a year in research and postgraduate training'.[57] The ARHC makes approximately 700 research awards

[54] Source: http://www.rcuk.ac.uk/links/ahrc.htm.
[55] Source: http://www.dius.gov.uk/functions.htm.
[56] Source: www.rcuk.ac.uk/default.htm.
[57] AHRC Press Release 25.05.2007, available at http://www.ahrc.ac.uk/news/news_pr/2007/AHRC_EPSRC_appoint_director_UK_Science_Heritage_Research_Programme.asp.

and around 1,500 postgraduate awards. However, owing to the technological and interdisciplinary nature of computer-based 3D visualisation, humanities research has benefited in this area from the support of scientific councils.

The AHRC has developed an ICT in the Arts and Humanities Research Programme, which concentrates on three major review activities concerned with e-infrastructure, sustainability of digital resources and evidence of value of ICT in the Arts and Humanities research.[58] Research based on 3D visualisation is represented by a King's College London project, *Making Space.*[59] The support offered to this project indicates that the importance of 3D-based research has been recognised by AHRC. Earlier initiatives from AHRC concerned with virtual research environments and e-publishing have demonstrated the same commitment. However, the popular perception within the Arts and Humanities academics and students is of the support being inadequate to the existing needs.

The Arts and Humanities researchers envy the scientists the privileged position the latter enjoy. This feeling is particularly strong among postgraduate students. New initiatives supporting science are perceived as generous and abounding, one of the most recent being the Science and Technology Facilities Council, established by Royal Charter in 2007.[60] The opposite seems the case in many areas of the Arts and Humanities, where support and funding are regarded as patchy and insufficient for ensuring long-term and sustainable development. The case of AHRC and JISC both withdrawing their support from the Arts and Humanities Data Service beyond the spring of 2008 has stunned the community and was much protested.[61] The AHRC not continuing with the Methods Network beyond the spring of 2008 is also regarded as short-sighted.

The Arts and Humanities research normally follows - rather than champions - ICT policies and practices developed by scientific computing, and adapt them to the specific needs of the Arts and Humanities subjects. This tendency has been a result of Art and Humanities scholars being traditionally dependant on

[58] AHRC ICT in Arts and Humanities Research Programme, http://www.ahrcict.rdg.ac.uk/index.htm.

[59] *Making Space. A Methodology for tracking and documenting a Cognitive Process in 3-dimensional Visualisation-based Research.* An AHRC ICT project based at King's College London and led by Professor Richard Beacham. The aims of the project has been presented as follows: 'Our project will draw upon our extensive experience in diverse 3-dimensional (3D) based research to reflect and analyse how in individual projects we and others gathered and evaluated data and made choices when creating and contextualising our models and their functionalities. Secondly, it will develop the tools that will enable these experiences and analyses to be documented and then extended to provide the transparency necessary for 3D to be more widely used as a research methodology in a range of arts-based subject areas.' (Source: http://www.ahrcict.rdg.ac.uk/activities/strategy_projects/index.htm).

[60] For the mission of the Science and Technology Facilities Council see: www.scitech.ac.uk/Home.aspx.

[61] The protest was expressed in various forms, including an e-petition to the Prime Minister, submitted by Andrew Prescott (27 November 2007 deadline), see http://petitions.pm.gov.uk/AHDSfunding/.

technologies and computing infrastructure developed for non-humanities subjects. As e-science programmes for Arts and Humanities are on the increase, this dependence is being slowly transformed into mutually beneficial interaction. The following recent initiatives promoting technological innovation in research should be noted:

- *The **Science and Innovation Investment Framework 2004-2014*** outlines the Government's view of the long-term challenges facing UK science and innovation**.**[62] **It was p**ublished in 2004 by the Treasury, the Department of Trade and Industry (DTI) and the Department for Education and Skills **(**DfES), and revised periodically to reflect the ongoing consultation. In response to this Framework, a working group was formed by senior representatives from the Joint Information Systems Committee (JISC), the Research Councils, Research Information Network (RIN) and the British Library. The Report produced by this Working Group, entitled *Developing the UK's e-Infrastructure for Science and Innovation,* considers enabling creation of knowledge through research processes as a factor enabling creation of wealth. The Report accesses current provision of technology and presents **a vision for a national e-infrastructure.** The latter, it is argued, is **crucial for the future of** knowledge-based economy **and its engagement with industry and commerce**.[63] Such a national e-infrastructure should be common across research disciplines, across Government departments and across sectors. The relevance of this recommendation to the Arts and Humanities communities is unquestionable. A number of general points raised in the Report should also be noted. The awareness of social and behavioural barriers hindering technological progress is common across communities, and so are important findings concerning the role of virtual research environments; integration of e-research with physical research; global cross-referencing between data and software; metadata creation; repurposing of data, interoperability of resources, and the need for standards. These findings inform the presentation of the needs of the 3D visualisation community.

[62] *Science and Innovation Investment Framework 2004-2014***,** published by the HM Treasury *et al.,* 2004, is available online at www.hm-treasury.gov.uk/spending_review/spend_sr04/associated_documents/spending_sr04_science.cfm [11 June 2007].

[63] Emphasis ABK. Source: *Developing the UK's e-Infrastructure for Science and Innovation,* A report published by the Office of Science and Innovation e-Infrastructure Working Group, is available at www.nesc.ac.uk/documents/OSI/index.html. Also available are reports of six sub-working groups: *Data and Information Creation*, at www.nesc.ac.uk/documents/OSI/data.pdf; *Preservation and Curation*, at www.nesc.ac.uk/documents/OSI/preservation.pdf; *Search and Navigation*, at www.nesc.ac.uk/documents/OSI/search.pdf; *Virtual Research Communities*, at www.nesc.ac.uk/documents/OSI/vrc.pdf; *Compute, network and data storage*, at www.nesc.ac.uk/documents/OSI/compute.pdf; *Authentication, Authorisation, Accounting, Middleware and DRM*, at www.nesc.ac.uk/documents/OSI/aaa.pdf [11 June 2007].

- Need: To ensure that a national e-infrastructure identified in this *Framework,* and in the course of the follow-up consultation, accommodates the requirements of the ICT research in the Arts and Humanities, including those of the 3D visualisation community.

- The House of Commons' Education and Skills Committee has published three reports on the *UK e-University*.[64]

  The Report of February 2005 blames the failure of the UK e-University project, whose cost is given at £50 million, for 'its *demand-led* approach where a *supply-driven* approach was needed'. This may serve as a cautionary note to the user communities that are trying to shape ICT developments in HE.

- The Lords Science and Technology Select Committee Report on Science and Heritage (HL256), November 2006.[65]

  This report links economy, heritage and technology. Income from tourism is 4 per cent of the UK GDP. A view was expressed that tourists come to Britain not for the weather or food, but primarily for the heritage. It is, therefore, essential that the heritage of Britain is preserved for the future. Technology is playing an ever greater role in its conservation for the present and the future. Therefore, it was felt necessary to coin the term of **heritage technology** to reflect this change. Heritage Technology involves specialists from academic and commercial backgrounds, as well as, and increasingly, private and communal sectors; so it is much fragmented and would benefit from leadership. This report has therefore, identified

  - The need for a champion of heritage technology.

  The Government has responded to the House of Lords Report 256 welcoming its focus on, and vital new insights into 'the science behind the care and conservation of cultural heritage (…) that does not always receive the highest level of public attention'.[66] The Government has acknowledged that '**Under the current governance and funding structure the maintenance of the science base for conservation, and thus the long-term preservation of the United Kingdom's cultural heritage, are severely under threat. The**

[64] House of Commons' Education and Skills Committee, *UK e-University*, 2004-2005; 3rd Report February 2005, p. 3; available at http://www.publications.parliament.uk/pa/cm200405/cmselect/cmeduski/205/205.pdf.
[65] House of Lords Science and Technology Committee, 9th Report of Session 2005–06, *Science and Heritage. Report with Evidence,* 16 November 2006, available at www.publications.parliament.uk/pa/ld200506/ldselect/ldsctech/256/256.pdf.
[66] *Government Response to the House of Lords Science and Technology Select Committee Report on Science and Heritage (HL256) Presented to Parliament by the Secretary of State for Culture, Media and Sport by Command of Her Majesty*, January 2007, p.1; available at www.culture.gov.uk/NR/rdonlyres/56B4B774-3172-4881-AFC1-F5D172C26305/0/Cm7031.pdf.

Department for Culture, Media and Sport has hitherto failed to grasp the scale of this threat – indeed, probably does not know it exists. This must be put right.'[67]

In response to the recommendations of the HL Report 256, and the need for a 'champion' of heritage technology, the following actions have been taken:

The Arts and Humanities Research Council (AHRC) has been made responsible for scientific research in the field of cultural heritage. In May 2007, the AHRC, in conjunction with the Engineering and Physical Sciences Research Council (EPSRC), appointed Professor May Cassar of the UCL Bartlett School, as director of the new UK Science and Heritage Research Programme. The position is part-time for five years. 'The investment in the directorship will be around £1 million. The Director's role involves, among others, coordination between the research councils and other stakeholders; developing a programme specification in advance of the delivery of recommendation.'[68]

- The recognition of the need for a champion of heritage technology and the follow-up actions listed are much welcome. However, similar initiatives are needed to ensure adequate support to other areas of Arts and Humanities computing, including 3D visualisation in subjects other than cultural heritage.

Conclusion

The recognition by governmental and funding bodies of the needs of the Arts and Humanities researchers was slower and came about later than in other disciplines. Today, the climate for digital scholarship and application of advanced ICT methods in the Arts and Humanities, including 3D visualisation, is generally favourable in UK HE. AHRC has expressed the opinion that 'the UK may well be a world leader in the use of ICT for high-quality research'.[69] However, the support and level of funding in the Arts and Humanities lag behind those for science and engineering. While the role of the latter disciplines is unquestionable, there is no reason for the humanities to remain the poor relative. Despite a slow and uneven uptake of digital technology in some areas of the Arts and Humanities research, the discipline is no longer based on pen and paper. Specific individual needs of research that relies on the use of advanced technologies must be better understood and matched by a level of support that is already enjoyed by the scientists. The selected policies listed above are

[67] *Op. cit.,* Recommendation 1 (3.46).
[68] Sources: UCL Press Release 29.05.2007 available at http://www.ucl.ac.uk/news/news-articles/0705/07052901. AHRC Press Release 25.05.2007, available at http://www.ahrc.ac.uk/news/news_pr/2007/AHRC_EPSRC_appoint_director_UK_Science_Heritage_Research_Programme.asp
[69] The AHRC ICT Programme. Activities and Services. Anonymous review of activities at www.ahrcict.rdg.ac.uk/activities/review/index.html [11 June 2007].

indicative of positive new developments, but target specific areas of digital humanities and culture rather than be all inclusive. While the recognition of the role of heritage science is welcome, similar recognition is due, for example, to digital performing arts.

There is a need to develop and implement practical measures which will ensure that governmental policies are translated into a favourable research environment. At present many feel that policies remain statements of intention and have not been implemented in a satisfactory manner. Examples given included policies that encourage the use of digital research tools but are jeopardised by an old practice. Some of the most contentious issues are the terms and conditions of the use of digital images, still common amongst the custodians of picture libraries, which tend to hinder rather than facilitates ICT-based research: a manipulation of digital imagery (duplication, cropping, use of detail, etc.) that is a necessary part of the visualisation process, is still considered derogatory. Unless there is a real shift in attitudes and approach, policies and declarations of support alone will not change the present situation.

3.2.2. Know-How: Scholarship

'The model is thus a representation of the state of our knowledge (and, implicitly, of our ignorance)...' [70]

The computer model of the Old Minster in Winchester created in the early 1980s by IBM UK is believed to be one of the earliest applications of 3D modelling to visualisation of archaeological data in the UK.[71] The model of the church of St Laurence in Bradford, created in 2003 by a student reading for an M.Sc. in Archaeological Computing offered by the University of Southampton, is another example of virtual representation of Anglo-Saxon heritage.[72] Some twenty years apart, these two projects may be seen as milestones in the development of 3D visualisation as a tool of historical scholarship. The first project involved expert archaeologists who provided the data resulting from many years of excavation and analysis, and a team of scientists at a world-class research centre of a leading commercial computing company. They used purpose-designed software and all the computer power at their disposal. The second project was researched and the model created by a relatively inexperienced student researcher. He combined study of the subject with training in the use of digital tools, using off-the-shelf software and a personal computer.

This chapter enlists needs identified in the area of academic research and education. The discussion of issues in digital scholarship continues in Chapter 3.4, which deals with sustainable dissemination of research.

- The need for innovative research

  Although many areas of research have developed digital methodologies as standard the use of novel technology is proposed in project proposals. Digital technology is still regarded as an innovation factor in Arts and Humanities, and a potential guarantor of successful funding application. 3D computer graphics continue to fulfil this role despite a relatively short life-span of the products of this technology. The projects surveyed by 3DVisA demonstrate that, typically, innovative 3D products of visualisation become neglected as technology becomes obsolete. Very few 3D resources are maintained in the long term. It is therefore important for computer-based projects to rely on innovation that is independent of the current technology. Technology should support and advance an innovative research argument.

[70] Cited after the introduction to the *Rome Reborn* project, Institute for Advanced Technology in the Humanities (IATH), University of Virginia, US, http://www.romereborn.virginia.edu/ >About.
[71] See 'Old Minster, Winchester, Hampshire, UK', *3DVisA Index of 3D Projects*, http://3dvisa.cch.kcl.ac.uk/project12.html
[72] See 'Chapel of St Laurence, Bradford-on-Avon, Wiltshire, UK', *3DVisA Index of 3D Projects*, http://3dvisa.cch.kcl.ac.uk/project61.html

Innovation based on technology is usually short lived. If successful, it is quickly absorbed as a standard, mainstream practice. The use of 3D visualisation in architectural and design practice has become so commonplace that it is no longer talked about. If mentioned, it is rather because of an exception from this standard practice, as in the case of the architect Frank O. Ghery. Ghery is famously not using a computer when designing his iconic buildings whose construction, paradoxically, would not be possible without digitally controlled technologies.

- The need for transparent criteria for innovative research

A great deal of experimentation with technology is needed in order to test its suitability for the Arts and Humanities research. However, application of technology for technology sake is generally not a satisfactory research strategy. Innovation criteria for technology-based research should be defined independently from technology.

The AHRC ICT Programme, the function of which is to advise the AHRC on the strategy and agenda for the use of ICT in the Arts and Humanities research, calls for 'evidence of value of ICT' as an evaluation criterion.[73] Pioneering research is elitist and should not be measured quantitatively. 'For the most part this means providing qualitative rather than quantitative evidence of the value of ICT for arts and humanities research, since the value of research in general depends less on the size of its audience than on its significance to the academic community. In particular we need to show how ICT can lead to new kinds of knowledge, or to doing research better than through conventional methods.'[74]

- The need for creativity

The need for advancing creative practices in education and academic research through digital technology, particularly in the area of arts and design, has been identified and discussed in the report, *Beyond Productivity. Information Technology, Innovation and Creativity* (2003) commissioned by the National Research Council of the US National Academies. This report argues for a new domain of information technology and creative practices (ITCP). One of the recommendations for educators and academic administrators stresses the need for supporting 'curricula, especially at the undergraduate level, that provide the necessary disciplinary foundation for later specialization in ITCP.'[75]

[73] Source: AHRC ICT Programme. Review Activities at www.ahrcict.rdg.ac.uk/activities/review/index.htm.
[74] Op. cit. (no page no).
[75] Mitchell, J., Inouye, A.S. and Blumenthal, M.S. (2003), *Beyond Productivity. Information Technology, Innovation and Creativity,* Washington, D.C.: National Academies Press, p. 12.

Although primarily sought in visual and performing arts, creativity is needed in all areas of 3D visualisation. Criteria for evaluating creativity in fine and performing arts need to be different from other academic disciplines. The difference may be illustrated in the use of data, which might be manipulated in fine arts but should not in historical research. 3D visualisation extends the potential for creativity without compromising the strictness of academic argumentation. The creativity in digital scholarship may include new analytical tools, new interpretative methods, new ways of contextualisation and new forms of output and dissemination.

- The need for quality

> *'In looking on the web, I have seen some simple static models of English buildings but nothing very sophisticated.'* [76]

This comment, one of many received by 3DVisA, confirms that users of 3D visualisation products seek quality. The casual use of the term 'quality' is almost synonymous with 'good quality'. The understanding of quality differs greatly among the members of the 3D community. The best possible quality may only be demanded if and when the possibilities of technology are understood.

- The need for transparent criteria defining quality

There is no consensus on what constitutes good quality 3D visualisation. The judgement depends on the purpose of visualisation and the user's needs. In the academic context evaluation criteria are particularly important. The survey of 3D visualisation projects carried out by 3DvisA has indicated that evaluation criteria are difficult to establish when a focus for a 3D visualisation research project is not clear.

> *'I personally think the project is a bit too ambitious in its scope and the team is too big and too amorphous (lots of people from around various institutions) and we haven't accomplished anything…'* [77]

This comment is part of a personal evaluation of a major heritage visualisation project, which has failed to find a historical focus. By trying to be 'too many things to too many people', the project, therefore, was unable to determine an effective methodology, employ a specialist team, plan and organise work.

[76] Source: An email enquiry received by the author, 16 February 2006.
[77] An edited comment received by the author on 21 August 2006.

If 3D visualisation is to be considered a useful analytical, pedagogical or research tool, every project should define its objectives in a way that meets the established academic conventions as well as expectations of the subject community. This may be difficult, because digital material often offers new uses, which have not been anticipated. Even within a single visualisation field there are wide-ranging expectations. In heritage visualisation, for example, excellence may be sought in a variety of features, such as accurate structural reconstruction (geometry); perfect representation of appearances (photo-realism); simulation of sensual human experience of a physical environment, etc. A project may seek to respond to select criteria.

> *'What can or should be represented? What ought the relationship between reality and representation be? What is the relationship between cognition and emotion in artistic representations? In earlier periods, the limitations of computer processing speed and power rendered answers to such questions de facto or purely speculative; as the sophistication of digital representation increases, however, it is becoming clear that meaningful modern responses to these ancient philosophical questions must be based not upon computational, but formal and generic, criteria.'* [78]

- The need to draw inspiration and experience from interdisciplinary scholarship to broaden and enhance the understanding of 3D visualisation.

  Theoretical and practical concerns surrounding 3D visualisation are echoed by other disciplines. Intrinsic to 3D visualisation are issues about space, time, representation, realism, imitation, evocation, illusion, authenticity, identity, etc. These concepts have been subjects of considerable debate in a number of disciplines and have resulted in robust theoretical systems. Practitioners of 3D visualisation may not be aware of their existence, because their background is either in technology or another unrelated subject. The theoretical frameworks already established for other subjects may be applied to broaden the understanding of 3D visualisation.

- The need to continue to engage with other areas of digital scholarship and practice

  Scholarship in 3D visualisation relies on collaboration between specialists (see Chapter 3.3. Communication, Access and Exchange). However, a view was expressed that those engaged in 3D visualisation work in

[78] Source: Abstract of the talk by Tim Hill, Cambridge, 'Wiser than the Undeceived? Past Worlds as Virtual Worlds in the Electronic Media', Digital Classicist Seminar, 22 June 2007, Senate House, Malet Street, London WC1E 7HU.

isolation and miss out on initiatives, experience and developments in other areas of research (also of a non-digital nature) of potential benefit.

3D visualisation as a research methodology strives for recognition. New media art is in a similar position: ''If new media art wishes to be taken seriously then it is necessary to start to develop appropriately robust and convincing means by which it can be examined critically.'[79] A view was expressed that joint initiatives in these – currently separate – disciplines would be more effective.

- The need to ensure that scholars engaged in 3D visualisation have the same access to information, material and facilities as those who do not use digital methods.

  A number of respondents to the 3DVisA survey of the needs of the 3D visualisation community expressed the view that access to primary sources is often more difficult for those working with digital technologies. Restrictions apply to the use of archival material (e.g. architectural plans, historic photographs, art images, manuscripts) when requested for digitisation. The lack of understanding of the needs of digital scholarship and restrictive copyright are regarded as serious limitations.

- The need for the evidence of value of ICT-based research to include ethical considerations

Digital scholarship does not call for revaluation of traditional research ethics. Ethical research should be the only accepted norm. However, the emphasis on transparency and reliability of methods is needed in the light of the deceptive practice of manipulation of digital data.

[79] Gere, C. (2005), 'New Media Art', *The Art Book*, Vol. 12. 2, May, p. 6.

3.2.2. Know-How: Technology

Technology makes computer-based 3D visualisation possible. Technology is also the main cause of 3D research products becoming neglected and obsolete. The technological content of new research projects in the Arts and Humanities requires the same level of careful consideration as subject-related content.

The *3DVisA Index of 3D Project*s (http://3dvisa.cch.kcl.ac.uk/projectlist.html) has confirmed that 3D visualisation in the Arts and Humanities employs a wide range of digital technologies. Virtual Reality has been by far the most popular, but the use of other technologies is also on the increase. Tomography, motion capture and anthropometrics, haptic computing, photogrammetry, laser scanning and Artificial Life are just a few examples. All these technologies and computing in general are improving all the time, allowing researchers and practitioners to do more, to do better and to do easier than ever before. Whatever the rate of this progress, the *status quo* is never satisfying. The need for more computer power and better digital tools has been voiced by many contributors to the 3D visualisation projects, and those in the creative arts in particular. Specific demands for faster networks, increased processing power and more accurate and cheaper equipment for motion capture and more sophisticated tools for rendering textures have been expressed by a number of practitioners of 3D modelling.[80] Pushing the boundaries of existing technologies is common to digital research and education.

Technology is critical for the success of digital 3D visualisation, but is also a reason of its limitations and sometimes its failures.

> *Michael Greenhalgh on the VRLM models of Phimai Temple:*
>
> *'**The models provided are as good as the technology allows.** Constructing the Model is the most interesting [web]page, in that it demonstrates clearly the problems inherent in the technology - namely the simplification of forms and of textures, the repetition of both, and the overall unworldly look-and-feel (best seen in the comparison between the computer interior view and the photograph). The difficulties should not surprise us, since the process involves stripping down the real world to its computer-understandable components, and then rebuilding it in the machine, which is far from simple, and tedious, time-consuming and expensive to do to any level of accuracy. But to repeat, any shortcomings are not Professor Levy's fault, but endemic to such*

[80] I'm particularly grateful to Angela Geary, Daniela Sirbu and Michael Takeo Magruder for their comments. See the contributions of the first two researchers to the 3DVisA Discussion Forum, *3DVisA Bulletin,* Issues 2 and 3, March and September 2007 respectively, http://3dvisa.cch.kcl.ac.uk/bulletin.html

> *modelling. This might explain why the computer models on these (and plenty of other) pages are shown at such low resolution: seen in close-up the reconstructions would reveal themselves even more clearly to be lacking in both detail and accuracy.'* [81]

Computer-based 3D visualisation projects strive to use 'cutting-edge' technology. However, even the most advanced technology may not be the most effective way of addressing research questions raised by a project.

> *"Despite the extraordinary appearance of these pictures, and the potential that they show for these advanced imaging techniques, the scholars were dissatisfied with the results. […]The imagers were imaging at about 300 dpi, which the scholars found insufficient to their needs."* [82]

Both these comments indicate that there is

- The need for greater awareness of the complexity of interdisciplinary research enabled by digital technology.

  Arts and science have always communicated in the past, but this relationship was generally that of one-to-one (examples include painting and crystallography; x-ray imaging and restoration; microscopy and palaeography, etc). The impact of digital technology on a variety of disciplines in the Arts and Humanities has no precedent, and this relationship is often that of many-to-many, offering possibilities of new interdisciplinary methodologies to many subjects. Discrete disciplines which used to evolve independently are now open to exchange of knowledge and practice. A simple illustration of the conceptual shift enabled (or forced) by technology may be found in taxonomies of Arts and Humanities scholarship.

  The UK Arts and Humanities Data Service (AHDS) has developed services across the subjects traditionally classified as Archaeology; History; Literature, Languages and Linguistics; Performing Arts; and Visual Arts. Given more funding the services would have been extended to the Classics, Ancient History, Theology and Religious Studies, Philosophy as well as Law.[83] 3DVisA has in principle followed this model when compiling the *Index of 3D Project*s

[81] See 3DVisA Index of 3D Projects, http://3dvisa.cch.kcl.ac.uk/project11.html; citation after Greenhalgh, M. (2006), 'Temple Site at Phimai, Thailand', A Review, *3DVisA Bulletin*, Issue 1, September, http://3dvisa.cch.kcl.ac.uk/bulletin.html).
[82] Source: [N.N.], *The Archimedes Palimpsest Project,* The Walters Art Museum in Baltimore, Maryland, USA, http://www.archimedespalimpsest.org/imaging_initialtrials1.html.
[83] The Arts and Humanities Data Service (*AHDS) Annual Report 2004-2005,* p. 6, available at http://ahds.ac.uk/about/reports-and-policies/ahds-annual-report-2004-05.doc.

(http://3dvisa.cch.kcl.ac.uk/projectlist.html), but has also demonstrated that 3D visualisation calls for a more flexible and broader taxonomy (e.g. when 3D imaging techniques transform a documentation project concerned with a single artefact into a complex interdisciplinary study).

> *'… are there any real-life examples out there (in any field) where these tools have been successfully applied and proven?!'* [84]

- Arts and Humanities scholars need to gain a good understanding of technology in order to be able to formulate meaningful research questions and establish methodologies that are appropriate for their subject.

- Academic teachers need to understand 3D visualisation before they develop effective pedagogy in this area.

- Arts and Humanities students need to be exposed to a wide-range of applications before they employ this technology in their projects.

Computing skills and understanding of technology vary considerably among the 3D visualisation community. The needs of a professional programmer/modeller are diametrically different from a researcher with a keen interest in 3D visualisation but little or no practical skills. Such specialists are often on the same research team working on issues that require good communication based on mutual understanding of the methodology.

- There is a need for accessible specialist information and guidance for Arts and Humanities researchers, on every level of technology, that they may resort to when required.

  3DVisA has been approached on a number of occasions with a specific enquiry relating to the application of 3D visualisation to an area of Arts and Humanities research or practice. For example:

  > *3D from 2D*
  >
  > *'I have a preliminary question for you: can your 3D group help persons such as myself to create a groundplan (3D or otherwise) of the positions of a set of WWII buildings based only on information that exists in extant photographs of the demolished structures?'* [85]

[84] Source: A comment (unrelated to 3D visualisation) by James Morley sent to the Museums Computer Group, 11 July 2007, see MCG Archive at www.jiscmail.ac.ak/mcg.
[85] Source: An email enquiry received on 8 April 2007.

Imaging seals in 3D

What imaging techniques are available that would enable a sphragistical historian to look at a seal from a variety of angles and in raking light, so that the relief and inscriptions could possibly be easier to read and analyse? [86]

If the different technology-related needs listed above are to be addressed satisfactorily action on various levels of support is required (see 3.3.2. Support: Guidance). The needs at the basic level of 3D technology seem most acute. 3DVisA is undertaking a separate study in this area.

[86] See Need 3. 1.1. Introduction.

3.3. Communication, Access and Exchange

The focus in this chapter is on the need for good communication as a condition of widening the understanding of 3D visualisation in the Arts and Humanities. This understanding is needed in order to enable access to 3D visualisation skills and knowledge, and for ensuring the visibility and a wider dissemination of 3D scholarship and its products. The previous chapter 3.2.2 pointed out the dissatisfaction with technology when it does not meet the expectations of Arts and Humanities scholars. Scientists share the same frustration. The problem often lies in the lack of communication, especially at the planning stages of collaboration.

- The need for more effective communication of 3D visualisation issues.

  The understanding of 3D visualisation is a condition *sine qua non* of its advance. It needs to be communicated effectively in order to thrive. Successful collaboration is conditioned by good communication. Effective communication of the 3D research processes and outcomes remains problematic. The tendency has been to separate the subject-related content from technology.

  3D visualisation is frequently a complex intellectual and technological construct. Better understanding of 3D visualisation should begin at 'home'. It is a paradox of collaborative 3D projects that colleagues on the same team sometimes do not have a full understanding of their respective roles and contributions. This is particularly true of some subject-specialists' ignorance of, or unwillingness to acknowledge how technological processes contribute to the intellectual content of research.

  > *Professor of History about a postgraduate student modelling a historic building: He's merely putting my ideas in 3D.*

- The need to recognise that in academic 3D visualisation technological and subject-related content is equally important.

  > *An archaeologist about a computer model of a site he has excavated: I haven't learnt anything from the model that I hadn't already known.* [87]

  'The lips of a scholar praising a colleague are like a poisoned chalice smothered with honey', Victor Hugo famously said. Whatever the reasons of the above striking comments – a statement of fact, ignorance or arrogance – they are indicative of tensions between contributors. Such

[87] Source: Edited comments received on 11 July 2006 and 24 November 2006 respectively.

tensions impact negatively on teamwork; they might even jeopardise the project and sour future collaboration.

> *'At present, although humanities computing projects may involve large teams of personnel, they generally reflect the research vision of one or two scholars, other team members being responsible for data elaboration and technical development. Projects collaborative in the sense of allowing a wider group of researchers jointly to formulate new research questions are rare.* [88]

- The need to address 'two-cultures' concerns and promote positive aspects of interdisciplinary research.

  The debate over the breakdown of communication between the Sciences and Humanities has not abated since the issue was discussed by C. P. Snow in his influential article on 'two cultures', which was followed by an even more famous lecture delivered in 1959.[89] Nearly sixty years on and the divide is still present and much debated. Different understanding of technology may be a positive factor as long as it encourages new methodologies and knowledge. The already mentioned lack of communication between imaging scientists and subject specialists (see p. 43) is likely to be seen as a positive experience in the sense that it will allow the team to learn a lesson and opt for better solutions next time round. There is, however, a need to condemn negative attitudes that arise from prejudice and are manifestations of uninformed critique.

  Non-speaking-term relationships between Computer Science departments and Arts and Humanities academics could be regarded anecdotal if, regrettably, they were not true. This problem is not limited to the academic culture in the UK, but is more general.[90]

  This divide is strongly felt by many. Fora which offer a 'safe heaven' for communication of cross-disciplinary research should be encouraged and

[88] Source: [N.N.], A description of the workshop, *Sound and moving image*, organised by the Arts and Humanities E-Science Support Centre (AHESSC), Humanities Research Institute, University of Sheffield, 17 January 2007, http://www.ahessc.ac.uk/node/117.
[89] C.P. Snow, 'The Two Cultures', *New Statement,* 6 October 1956 and a Rede lecture delivered in the Senate House, Cambridge, UK, on 7 May 1959.
[90] See, for example, G. Sporton (2007), 'When Two Cultures Collide: e-Science, e-Art & Creativity', *Digital Humanities Quarterly*, Forthcoming July. Sporton's observations on this subject are recorded by G. Earl, (2007), in his review of the JISC Workshop, New Directions in e-Science and Visual Perceptions, EVA'07 Conference, London College of Communication, 11 July 2007, *3DVisA Bulletin,* forthcoming September, at www.viznet.ac.uk/3dvisa/bulletin.html.

supported. Such organisations as *Leonardo* (est. 1968)[91], CHArt (est. 1984)[92], and the more recent COSIGN (est. ?)[93] whose mission is to enable interdisciplinary understanding among humanities scholars, artists, scientists and technologists, demonstrate that 'two cultures' may be bridged by thoughtful patronage, with one culture being enriched by the other.

Research programmes developed by the Royal College of Art, such as the Helen Hamlyn Research Associates Programme and a series of events run under the Innovation label, are amongst the most successful initiatives bridging science with the arts and humanities. They offer a model to follow.

> *'Historically, knowledge transfer between academia and industry has been a difficult process.*
> *Academic timetables run differently from the financial year, expectations and outcomes can be mismatched, and each party can speak a different language to the other. All of this makes communication, much less collaboration, problematic to accomplish.*
> *The Helen Hamlyn Research Associates Programme is a deliberate response to bring two worlds together: it teams new Royal College of Art design graduates with business partners on year-long design research projects.'* [94]

- The need for well-informed criticism of 3D visualisation.

Scholarship thrives on well-informed criticism. Scholarship based on 3D visualisation has not yet developed review mechanisms whose authority would be widely recognised by the Arts and Humanities communities. Such mechanisms are well in place in scientific visualisation.

Critique of 3D visualisation should reach out to those who are indifferent or openly opposed to this technology and its products. Their participation in the debate should be encouraged.

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[91] *Leonardo*, an umbrella name for the International Society for the Arts, Sciences, and Technology (ISAST), the French Association Leonardo and a number of other organisations and networks, see www.leonardo.info and www.olats.org.
[92] Computers and the History of Art (CHArt) is an international organisation promoting the use of digital technologies in the study of visual arts, see www.chart.ac.uk.
[93] COSIGN is the name of cross-disciplinary conferences bringing together artists and scientists, co-founded by the experts on videogames, Andy Clarke and Grethe Mitchell.
[94] Source: *Human Frame,* exh. cat., Helen Hamlyn Research Associates Programme 2006, Royal College of Art, London, 23-27 September 2006, p. 8, available at http://www.hhrc.rca.ac.uk/archive/hhrc/resources/publications/RA/ra_cat2006.pdf. See also www.innovation.rca.ac.uk.

- The need to accept the validity of alternative methods.

  It would be naïve to think that it will ever be possible to make 3D technologies universally accepted. The promotion of these technologies should never discriminate against alternative methods.

- The need to enable access to research products of 3D visualisation and for making its outcomes more visible.

  Digital panoramic views produced for the benefit of property markets and tourism have become familiar features of these trades: one may examine the interior of a house before one even considers seeing it, or an hotel room before one chooses to book. It is far more difficult to familiarise oneself with visualisations which are products of academic or practice-based research.

  One needs to experience and examine a computer model first hand in order to comprehend it. One needs to interact with it in order to understand how it works. Such experiences are not readily available. Where does one turn to? Many computer models and other 3D visualisations created in recent years are now available online, normally in a surrogate and simplified form of a video movie. The video serves demonstration but cannot be used and interacted with in the same way as the full product. DVD has been used to document and disseminate the outcome of 3D visualisation offline. Grid technologies are enabling global communication of 3D visualisation in real-time, all being welcome replacements for earlier media.

  'Scholarship has no homeland, because man's knowledge spans the whole world'.
  Louis Pasteur

  The words of the nineteenth-century scientist resonate ever more strongly in the time of global communication. The role of virtual research environments and virtual research communities is often being emphasised as a factor stimulating research and innovation. Collaborative Virtual Environments (CVE) are particularly well suited for 3D visualisation research and practice, enabling the exchange and dissemination of knowledge across geographical borders and vernacular schools of thought. There is a need to recognise these technologies as viable communication and dissemination channels (see Chapter 3.4.3 Sustainable Dissemination).

  Access to such technologies may potentially respond to

- the need for a wider 'collaboration with other universities for development, testing, dissemination, and educational use of computer resources developed for a 3D project'.[95]

  Researchers actively involved in 3D visualisation need to do more to demonstrate this potential and push for developments and institutional support in this area.

- The need to protect individualism

  3D visualisation projects rely on collaboration. Large-scale, international collaboration in particular facilitates the use of standardised methods and technologies. This should not discourage from individualism, even uniqueness of approach which should be properly recognised, supported and protected. A system of awards should be established to recognise the individuality and originality in student projects, as well as projects developed by individual academics and independent scholars on short-term academic contracts.

[95] Source: A response to 3DVisA Survey, 23 June 2006.

3.4. Sustainable Dissemination

3D visualisation has been employed in the Arts and Humanities studies for well over three decades now. While the technological progress made over these years has been proven and is experienced by all computer users, the transferable knowledge and experience of 3D visualisation accumulated over these years are elusive. Unlike other areas of academic research, digital scholarship is – not without a reason – notorious for neglecting past achievements.

- The need for detailed and robust evidence of past achievements and up-to-date information on current work.

> *'We need to provide detailed and robust evidence about the achievements to date of the UK arts and humanities community in the use of ICT for high-quality research. The UK may well be a world leader in this respect, but the claim needs more substantiation.'* [96]

3DVisA has been approached on a number of occasions by 3D visualisation students and more experienced practitioners with requests for information on 'who has done or is doing similar kind of work'. The following message has been forwarded by a colleague at English Heritage:

> *'I am currently writing a grant for a project, which would involve fairly sophisticated modeling of key English monuments which contain both Romanesque and Gothic building phases. […] I wondered if English Heritage or anyone else you might know of is going this type of work?*
> *Any information you can offer about others doing this type of work would be greatly welcome.'* [97]

- There is a need for 3D visualisation-based research to follow a standard academic practice of acknowledging earlier research in the field.

In the paper-based research it is inconceivable for the author not to demonstrate his or her knowledge of earlier research in the same area. This is normally evidenced in the critical discussion of earlier findings and the bibliography. This has rarely been the case in research concerned with 3D computer-based visualisation, as if this medium allowed an exception. It is clear from the 3DVisA survey of 3D projects that researchers are either unfamiliar or unwilling to acknowledge earlier research of a similar

[96] Source: AHRC ICT Programme. Review Activities at www.ahrcict.rdg.ac.uk/activities/review/index.htm.
[97] Email message addressed to English Heritage, 16 February 2006, and forwarded to the author.

nature. Applications for funding of new projects strive to demonstrate the novelty of the proposal, often without referencing earlier work. Evaluators of applications should however be knowledgeable enough to recognise the lack of this information.

> *"I certainly don't want to duplicate anyone else's efforts, but if I do get the grant,* ***the models and information from my analysis*** *(which is centered around a particular question)* ***will be available to others, including English Heritage if it might be interested****." [Emphasis ABK]*[98]

- The need to make 3D products of research available to others should be coupled with the provision of a means for doing so. Dissemination is at present extremely difficult.

  At present, conferences are the main platform for exchange of knowledge and expertise in ICT-based research, but only a handful of these events publish the proceedings. 3D visualisation and other advanced ICT are fast evolving and print publication does not keep with this pace. Text illustrated with static images is still the predominant format for both online and paper-based publication. This format is not adequate to 3D visualisation as it does not fully represent its dynamics and interactivity and does not demonstrate the advantages and inherent problems of such applications.

  Research success is measured in the UK primarily by number of publications, not even their quality. Research Assessment Exercise (RAE) requires academics to submit qualifying titles of the articles and books they have published. A 3D computer model published in DVD format is not considered as qualifying 'output'. Examples of two recent visualisation projects available on DVDs, namely the virtual reconstruction of *Napoleon's Triumphal Route through Paris,* created by CASA of Bath for the National Maritime Museum, and *How Kew Grew* produced by King's Visualisation Lab for Kew Gardens, are not even available from the bookshops at the commissioning institutions. They do not have catalogue records at the British Library, nor an equivalent of ISBN which normally ensures bibliographic presence (therefore also distribution) of an academic title.

- The need to establish a widely recognised system for evaluation of 3D visualisation products as valid academic research output.

- The need to ensure long-term access to knowledge gained through the use of 3D digital tools.

[98] See note 2.

3D information presented and stored in electronic formats risks becoming obsolete if not pro-actively maintained and migrated to new media. Knowledge resulting from digital scholarship should be protected from obsolescence factors identified by the Digital Preservation Coalition.[99] With the exception of evolving educational resources, such as *Virtual Egypt* developed by the UCL CASA, very few projects surveyed by 3DVisA have been able to maintain usability and access to 3D computer models and other resources despite their content remaining meaningful and of potential use. The records of projects compiled by 3DVisA contain information, where available, about the current status of created 3D resources.

- The need for establishing a wide range of systems enabling sustainable dissemination of knowledge gained through 3D visualisation, including the need for electronic (rather than paper-based) publication of research outcomes, especially in a format which allows edits and further enhancement.

  The rationale for this need has been explained by John Pollini in the context of research into sculptural portraiture of Augustus. In a review of a book by Boschung on this subject, Pollini argues:

  > *'Because of the subjective nature of portrait studies and the constant addition of new archaeological material, no such work [**book**] can ever really be considered a definitive publication. Added to the corpus in the future will be sculptures like the relatively recently discovered marble portrait of Augustus from the theater at Troy, which could not be included in Boschung's work. Other pieces that have been little published in the past should also be included, like the sculpture in Lowther Castle in Lowther, England.*
  >
  > ***Given the rapid developments in new technologies, I can even see in the not too distant future computer databases replacing bound catalogues. In this way, all newly discovered and attributed portraits could be easily added to a corpus. Eventually, too, such a database would allow a researcher to rotate portraits at will on screen to facilitate three-dimensional comparison.'***[100] *[Emphases ABK]*

[99] Waller, M. and Sharpe, R. (2006), *Mind the Gap. Assessing digital preservation needs in the UK,* A report published by the Digital Preservation Coalition, York, p. 8, available at http://www.dpconline.org/graphics/reports/mindthegap.html.

[100] Source: John Pollini's review of the book, *Die Bildnisse des Augustus, Das romische Herrscherbild*, Berlin: Gebruder Mann Verlag, 1993, by Dietrich Boschung, *Art Bulletin*, December 1999, p. 22, available at http://www.findarticles.com/p/articles/mi_m0422/is_4_81/ai_58926051/pg_22 (14 Oct 2006).

> *'…a digital model can be easily updated to reflect corrections to the model or new archaeological discoveries'.*[101]

This argument, cited after the creators of the model of ancient Rome from the University of Virginia, US demonstrates awareness of this potential which is common among the practitioners of 3D visualisation, but not among wider community of scholars. A static presentation of research findings corresponding to their fixed status at a given time is practiced by a majority of scholars because of the requirements of RAE and other reasons. Knowledge is not static, it evolves continually. Electronic publications may reflect this evolution if means are provided for their maintenance and sustainability. This long-term custody of knowledge should be planned for at the inception of research projects. Such practice may be further encouraged by exemplary applications.

- The need for a specialist journal dedicated to 3D visualisation in the Arts and Humanities.

This need for a specialist, peer-reviewed journal has been identified by a respondent to the 3DVisA Questionnaire. Although an electronic format is advantageous to the interactive 3D graphics, a paper version would also be welcome. This approach has been adopted by the 3DVisA Bulletin. The article on haptic computing by Robert and Stephen Laycock, published in Issue 2, is illustrated with photographs in print version (ISSN 1751-8962) and the online version (ISSN 1751-8970) includes movies. The Bulletin could be developed into a fully fledged peer-reviewed publication. It seems that a similar initiative from the University of Virginia has not yet been realised:

> *'The leaders of the project [Rome Reborn] agree that they should shift their emphasis from creating digital models of specific monuments to vetting and publishing the models of other scholars. In this way, the vision of Rome Reborn can be realized more quickly as scholars around the world contribute their work as bricks in the larger edifice of the complete digital model of ancient Rome from the late Bronze Age to late antiquity. Studies are therefore underway about the feasibility of creating an online, peer-reviewed scholarly journal whose mission would be to make the model and related monographs available to students and scholars.'* [102]

[101] Cited from the introduction to the *Rome Reborn* project, University of Virginia, US (no date or author given), http://www.romereborn.virginia.edu/ >About.

[102] Cited after the project website, *Rome Reborn,* http://www.romereborn.virginia.edu/ >About >Detail.

- The need for developing a consensus and a transparent system for sharing knowledge enabled by digital 3D visualisation.

- The need for copyright which protects intellectual property, but does not restrict dissemination of research for academic and educational purposes.

> *'With the Shakespeare Electronic Archive, the English Department at MIT has created one of the most comprehensive drama sites worldwide, complementing the complete texts of Shakespeare's works with images and films. Copyright issues, however, restrict the full use of the virtual library to MIT students; select external users have access to most of its services by way of a password.'* [103]

A number of practitioners of 3D visualisation, especially those involved in computer games, have pointed out the often insurmountable problem of access and reuse of their own work. The terms of use of third-party material in academic studies and teaching is equally burdened with conditions which contradict the purpose of digital research. There needs to be a wider debate to enable a better understanding of issues relating to dissemination of research in this area.

[103] Source: Ravelhofer, B. (2002), 'Virtual Theatres', *Jahrbuch für Computerphilologie* (ISSN 1617-3465), 4, pp. 133-150. Also online at *Forum Computerphilologie*, http://computerphilologie.uni-muenchen.de/jg02/ravelhofer.html.

3.5.1. Support: Guidance

As demonstrated in the preceding chapters, the Arts and Humanities 3D visualisation community is a diverse group with wide-ranging interests, experience and expectations of 3D technologies. In order to respond to and meet the needs of this community in a satisfactory way a variety of actions at multiple levels of advice and support is required. This chapter comments on the current situation and lists some of the needs identified in the area of training and best practice guidance. It should be noted that the enabling of skills and exchange of knowledge is a subject of an independent report by 3DVisA (in progress).

- The need to make existing advice and guidance easier to locate.

  There is a wide range of advice and guidance available to those interested in 3D visualisation. This information is available through publications, online tutorials, academic and specialist courses, professional consultancy, industry training and from many other sources. The diversity and quality of provision are confusing; Art and Humanities academics and students find it difficult to locate the information about suitable source of advice and training (see examples listed in Introduction). Few prospective students of 3D visualisation will be aware of a fairly comprehensive list of relevant courses in the UK HE, which may be found on a website of a commercial supplier of 3D technology.[104]

  The offer of online, open-access training material is particularly rich, ranging from tutorials provided by software manufacturers[105] to learning resources created for a specific academic course. An interesting example of the latter is learning material in Computer Aided Architectural Design, 3D modelling and visualisation, a course run by the School of Architecture of the University of Virginia in Charlottesville.[106] This comprehensive resource includes handouts from hands-on training in surface and solid modelling, materials, rendering and lighting, as well as an archive of student projects 1994-2004 and a history of computer graphics.

- The need for independent advice on 3D visualisation.

[104] The website of a South Yorkshire company, *Design Academy*, based in High Melton offers a wide range of visualisation-related material and news items of interest to the UK research community; the colleges offering courses in this area are listed at http://www.design-academy.co.uk/education.htm.

[105] Examples include free software and self-paced tutorials in Autodesk Maya for engineering and design students available at http://students5.autodesk.com/?lbon=1, and the already mentioned on p. 28, SketchUp 3D modelling software from Google.

[106] Computer Aided Architectural Design, 3D modelling and visualisation, Course ARCH 541, School of Architecture of the University of Virginia, http://www.arch.virginia.edu/arch541/, Course instructors Earl Mark and Eric Field.

Much of the currently available advice is offered by those who profit from promoting the use of their own 3D visualisation software and hardware products. While this does not preclude the quality and reliability of information, there is a need for advice independent from commercial interests and delivered in a way that would imply academic credibility.

- The need for best practice guidance for academic use of 3D visualisation which is independent of current technologies.

  This approach is exemplified by the guide to Virtual Reality published by the Visual Arts Data Service in 2002.

  > '*Creating and Using Virtual Reality:*
  > *a Guide for the Arts and Humanities*
  >
  > *Creating and Using Virtual Reality is intended for those who are interested in how virtual reality can be used within the arts and humanities. This Guide to Good Practice concentrates on accessible desk-top virtual reality which may be distributed and viewed on-line via the World Wide Web. It is concerned with the variety of virtual reality models that may be produced and how to ensure that these can be delivered successfully to users and preserved for future reuse.*
  >
  > *This Guide introduces virtual reality by considering its history, philosophy and theory and discusses good practice in planning virtual reality projects. It does not attempt to cover all virtual reality technologies – this is a rapidly developing field and new methods are continually emerging.'* [107]

  Although Virtual Reality remains the most popular of 3D technologies, a wider range of guides to other 3D technologies available from the same source would be beneficial. The fact of such guides being available from an organisation with proven expertise in ICT applications to the Arts and Humanities would be comparable with the reputation of an academic publisher of repute, thus responding to the previous need for recommended sources of advice.

- There is a need for **continued** support and guidance.

  The support for UK ICT-based academic research in the Arts and Humanities is notorious of its short-term solutions. The unanimous outrage felt by the community at the closing down of the AHDS services was

[107] The guide was edited by edited by Kate Fernie and Julian D. Richards and is available at http://vads.ahds.ac.uk/guides/vr_guide/index.html. Also in book format published in 2003 by Oxbow Books.

concerned primarily with the lack of understanding of the nature of ICT-based research, and the potential loss of a one stop advisory service based on unique expertise. The loss of the convenience of depositing electronic data with AHDS was of secondary concern.

> *'The decision of the Arts and Humanities Research Council, the primary funding body for the humanities in the UK, to terminate funding of the Arts and Humanities Data Service (http://www.ahds.ac.uk/), the UK national service aiding the discovery, creation and preservation of digital resources in and for research, teaching and learning in the arts and humanities […]was taken in* ***the mistaken and ill-informed belief that each university is now capable of doing the work of the AHDS for itself, implying either (a) that perfect coordination will take care of itself, or (b) that arts and humanities data really don't matter in the long term****.'* [108] *[Emphasis ABK]*

AGOCG (see p. 8) and a number of other academic advisory services with the mission to support researchers engaged in visualisation are, like AHDS, amongst projects started in the past only to cease after a few years. Although new initiatives often involve some of the same experts, the notion of 'why bother if there is no future' is common. It takes time for an advisory service to establish its reputation among researchers. It is regrettable, once this reputation is established, not to allow a good support service to continue.

- The need to enable solutions to specific 3D visualisation problems.

Arts and Humanities researchers with no professional skills in 3D visualisation tend to seek an *ad hoc* solution to a one-off problem. Here is an example:

> *Simple Design Software to help visualise the effect of hanging pictures*
>
> *'My colleagues in Art are seeking a simple software package that would enable them to trial the look of combinations of pictures hung against a scaled representation of a gallery. Has anyone any suggestions of suitable packages?'* [109]

[108] Source: An introduction by Willard McCarty to an open letter to the Arts and Humanities Research Council, posted on 18 June 2007 to the Humanist Discussion Group, Vol. 21, No. 106, available at http://lists.village.virginia.edu/lists_archive/Humanist/v21/0104.html

[109] Source: A message from John Williams posted to the Museums Computer Group List, www.jiscmail.ac.uk/mcg, 23 Apr 2007.

- The need to widen access to the products of completed 3D visualisation projects for the purposes of study and training.

> *3D reconstruction IT displays in museums*
>
> *'I am enquiring as to whether anybody knows of any 3D reconstructed IT displays in a museum environment. At present I am planning to focus my dissertation on visitors experience of IT displays and require another case study. One of the displays I am interested in shows a site and its use/disuse over time and the other has a 3D reconstruction of a site and provides choices of narrative.'* [110]

Communication of 3D scholarship has already been partly covered in chapters 3.2 and 3.4. The focus here is on actions which are needed in order to make the products of 3D visualisation available to study for training purposes. The expertise gained in creating a 3D resource is transferable and may benefit others if made available.

A wide range of tutorials in 3D modelling for school use was built around the Canadian 3D Historical Cities Project.[111] This project has been run since 1997 by the Interactive Media Research Laboratory, being a partnership between the National Research Council, Canada's Digital Collections, and Canada's SchoolNet. Although developed specifically for this project, the tutorials may be used by anyone who finds them useful.

- The need for reliable, tried and tested advice on best practice.

> *'Dear list members can you help?*
>
> *I am currently trying to determine the 'best practice' approach to creating accessible audio and video content for the National Gallery's website.*
>
> *In my research I've come across all manner of interesting, vague or conflicting thoughts on this subject. I'd really welcome any advice you could offer, or experiences to learn from.*

[110] This enquiry by Josephine Walker was posted to the CHArt List, www.jiscmail.ac.uk/chart, on 17 Apr 2003. Replying, Martin Zumsteg of Easyknow, Switzerland, recommended his own 3D reconstruction of Sebastian Serlio's architecture available at http://www.easyknow.ch/serlio/.
[111] See 3D Virtual Cities Project (Canada), http://3dlearning.iit.nrc.ca/3DVirtualBuildings/Tutorial.html.

I am trying to determine:

-Which would be the most viable formats to use (e.g. Flash, Real Player, Windows Media Player, etc.).

-To better understand the pros and cons with each format.

-What level of accessibility is desirable and achievable within given resources.

-Any practical tips and tricks to achieving this. Many thanks' [112]

The above enquiry relates to online 3D visualisation with video and audio content and is indicative of the importance of peer advice. Reputable academic advisory services are still needed but have no longer the monopoly over the advice they offer. A researcher in need of advice is likely to turn for help to fellow members of an online community. The volume and quality of response to this particular query posted on a JISC mail list, also available to non-subscribers at any time, indicates the degree of help one may draw from such an open discussion.

- The need to support the knowledge of traditional research skills, alongside novel methods in 3D visualisation.

  The loss of traditional crafts, increasingly being replaced by computerised methods, is a common concern. The same concern applies to the loss of traditional research skills and basic research tools. ICT-based research tools and techniques should not be used and taught at the expense of manual skills and physical creative processes which are still beneficial for digital research. Otherwise, there is a risk of breeding designers unable to draw and actors relying on avatars acting in a virtual space.

- The need to support initiatives promoting high standards, reliability and transparency of 3D visualisation methods.

  The need to remind about the ethics of conducting and communicating digital research in areas which involve computer graphics is greater than ever. The ease of manipulation of digital information and the gravity of its

[112] Source: A message posted to the MCG List on 17 May 2007by Charlotte Sexton
Deputy Head New Media, National Gallery, London. See the archive at www.jiscmail.ac.uk/mcg.

potential abuse is possibly the single most distinct difference between the creative and scholarly use of digital media. The responsibility of making this distinction visible lies with those engaged in this kind of research. However, no support should be spared to allow researchers the time and resources needed to develop appropriate standards in this area.

3.5.2. Support: Funding

> *'We wish to enable researchers to respond to new trends and developments in their disciplines and in the research environment, and to pursue new fields of enquiry. Our funding arrangements nurture and respond to these as well as recognising established excellence.'*
>
> HEFCE mission statement [113]

How is 3D visualisation in the Arts and Humanities funded currently? What are the criteria for funding this highly specialised area of research, teaching and learning? 3DVisA has surveyed over one hundred 3D projects across the Arts and Humanities which demonstrated a wide range of sponsors from public and non-public sectors, including philanthropic and charitable organisations, on national and international levels. Examples given below are representative of the main sources of funding of academic 3D visualisation projects based in UK higher and further education. Some sponsors have been approached to comment on how applications for funding have changed over recent years; what are the criteria for their assessment and what actions should be taken to ensure that the Higher Education Funding Council for England (HEFCE) fulfils its mission in this area. This chapter communicates the situation observed and comments received.

> *'May I end my period as Chairman [of AHRC] by reminding us all that the arts and humanities are now a genuinely important part of the economy.'*
>
> Professor Sir Brian K. Follett [114]

- The need for wider recognition that successful academic research contributes to the economy of the UK, and for verbal declarations to be followed up with actions.

  The relatively more privileged position of research involving 3D heritage technology (see p. 34) is a result of this recognition. The same recognition is being slowly bestowed upon other areas of the Arts and Humanities research, but is yet to be confirmed through effective funding commitments. The shift in attitudes was demonstrated in the Government's recent response to the petition to keep the British Library free to users, which has acknowledged the role of 'a modern knowledge economy'.[115] The perception that not enough is

[113] Source: The Higher Education Funding Council for England (HEFCE) website at http://www.hefce.ac.uk/research/

[114] Source: Chairman's Statement, *The Arts and Humanities Research Council Annual Report and Accounts 2006-2007*, Presented to the House of Commons, Ordered by the House of Commons to be printed on 12 July 2007, p. 3.

[115] The Government response of 13 July 2007 to the e-petition to the Prime Minister to keep the British Library free of charge to users, http://www.pm.gov.uk/output/Page12213.asp.

being done to effectively support the Arts and Humanities researchers who rely on advanced digital technologies is widespread.

- The need for an effective and economical funding system.

  The current system of funding research projects, conference attendance, visiting lecturers and other activities is in some cases not economical. It is also burdened with excessive administration and additional costs. This needs to be simplified. It is not unusual for tax-payers money to be spent in a most inefficient way, for example when a grant comes from and ends up in the same kitty! An example of this practice was given of a researcher on an AHRC-funded project attending a conference sponsored by AHRC; the cost of his/her participation was ultimately paid to AHRC from AHRC funds. This is a wasteful practice which should stop.

- There is a need to ensure that top-rated research proposals are not denied funding. Mechanisms for prioritising such proposals in the subsequent rounds of grant distribution, through invited re-submission or other means, should be developed.

  Only a tiny proportion of grant applications are successful. The Arts and Humanities Research Council (AHRC) is a major funding body for UK researchers at and above the postgraduate level. In 2006-2007 AHRC supported some 550 research projects and around 1500 students working towards a Masters or doctoral degrees. This is less than one third of applications received; even those top-rated by the AHRC, do not receive support.[116] In the spring of 2007 the Eduserv Foundation released a call for four research proposals for developing an educational environment in the virtual computer world of Second Life (www.secondlife.com). 92 applications were received, 88 rejected in accordance with the conditions of this funding.[117] The process of submitting numerous applications for funding of a single project, and the necessity of resorting to piecemeal grants, is regarded as unproductive.

- The need to relieve researchers from grant hunting and other fundraising activities.

[116] The statistics pertaining to the distribution of awards by subject, and other figures, are available at http://www.ahrc.ac.uk/about/ke/evaluation/vitalstats/research_programme.asp for the research programme, and at http://www.ahrc.ac.uk/apply/postgraduate.asp for the postgraduate competition.

[117] For more details about the Eduserv 2007 research grants, see http://www.eduserv.org.uk, and Powell, A. (2007), 'Virtual Worlds, Real Learning?', *3DVisA Bulletin,* http://3dvisa.cch.kcl.ac.uk/bulletin.html, Forthcoming September.

Researchers should be doing what they are best qualified for, i.e. research. Good researchers are not necessarily good fundraisers. At present researchers are generally left to their own devices in securing external funding (which also supports the host institution). Access to funding is given to those who are prepared to break from research to spend time on keeping an eye on what grants are available, composing proposals and filling in lengthy application forms, the majority of which are unsuccessful. A number of research funding bodies are known for requesting a pre-application which, if successful, enables submission to be made in full. No reason is given for rejection of the pre-application, so there is, even no benefit of feedback.

Having secured funding, researchers are not able to commit themselves solely to working on the current project but begin to look for funding for the next project. All these activities take valuable time away from research. An urgent need for quality time dedicated strictly to research has been identified by many academics overloaded with administration of their own research.

- The need for staff time (own and others') that is required to plan and conduct projects (pilot and full-scale) properly.

Experienced researchers should, therefore, be relieved from fundraising for their own work and concentrate on actual research. The reputation built upon successes of earlier research may in many cases be sufficient guarantor for the institution to provide funds for a new project. Other evaluation mechanisms, including a peer review, traditionally used in the Arts and Humanities research, should be used and extended for monitoring quality. Provision of funding for younger scholars should be based on recommendations by their academic supervisors, as a kind of academic apprenticeship model. Post-doctorate schemes should be enhanced so that talented researchers having completed their Ph.D. may be offered the opportunity to stay with the institution and develop ideas while at this most creative phase of their academic career. The benefit of Intellectual Property for the host institution is likely to be considerable.

The need has been identified for extending the academic patronage of academic institutions and ownership of internal research.

- The need to widen and better the support for postgraduate students.

> *'There are around 30 Mphil/PhD students studying at CASA, [Centre for Advanced Spatial Analysis, UCL]. Most of these students are self-funded because scholarships are very competitive and difficult to obtain.'* [118]

[118] Centre for Advanced Spatial Analysis (CASA), University College London website (About), 26 July 2007.

The support offered to research students by AHRC meets the demand only partly. The British Academy does not fund postgraduate studentships and has no record of applications for postdoctoral fellowships in the area of 3D visualisation.

Schemes which allow visualisation projects to appoint a doctoral candidate have been proven beneficial to the project and career prospects of the individual concerned. Such schemes should be encouraged and made possible through adequate funding. A number of EU-funded collaborations have demonstrated the benefits of such an approach on both national and international levels. The *SCULPTEUR* project, for example, used a new technique for 3D modelling and retrieval of museum objects, based on an algorithm developed by Carlos Hernández Esteban as part of his doctoral research at the Ecole Nationale Supérieure des Télécommunications, Telecom Paris, one of the project partners that also involved the University of Southampton and UK museums.[119] Carlos is now a researcher with Cambridge Research Laboratory, Computer Vision Group, working in collaboration with the University of Cambridge and Toshiba Corporate R&D Center in Japan.

3DVisA has been approached on a number of occasions by postgraduate students seeking financial support for their research. Here is an example of an inquiry from an artist and Ph.D. candidate at the Nottingham Trent University School of Art and Design, engaged in a practice-as-research project inspired by the collection of clown artefacts and ephemera held at the Herbert Museum in Coventry.

> *I've been advised '[…] that your organisation may be interested in supporting postgraduate research in the form of digital resources […]. As to the format I am aiming to create for my PhD final submission, I am interested in bringing the practical project outcomes into a close dialogue with theoretical principles and analysis in the form of an interactive DVD Rom. 3D visualisation may offer the possibility for the user to experience the site of memory alongside performative and critical elements in a format that allows for an experience of process; reinforced by a sense of journey and encounter. […]*
>
> *I imagine that the wealth of documentary material and strong characterisations would benefit from interpretation or analysis in the form of a 3D visualisation.'* [120]

[119] See: SCULPTEUR (IST-2001-35372), *3DVisA Index of 3D Projects*: Museum Applications, http://3dvisa.cch.kcl.ac.uk/project86.html.
[120] Email message received 18 October 2006.

3DVisA was also contacted about a reverse situation, where funding has been made available to the researcher and there was a need to devise a project that would meet the funding criteria.

- The need to explore and make better use of funding from non-traditional Arts and Humanities sources.

  The former Department of Trade and Industry (DTI)[121] has funded or co-funded a number of successful projects in the area of the arts, including:

  > The 3D Direct Centre at the London College of Fashion, The University of the Arts London received funding of a total of nearly £400,000 in the period 1999-2006(?) from the Department of Trade and Industry, matched with funding from industrial partners and a consortium of retailers, to carry out research in fashion science (body scanning and measurements for *SizeUK* and other projects).[122]
  >
  > *Combining Laser Scanning with Photogrammetry,* a Knowledge Transfer Programme between the Department of Geomatic Engineering, University College London, the British Museum, the Victoria and Albert Museum, Plowman Craven and Associates and others.[123] The project involved a 3D photogrammetric survey of the Egyptian funerary chest of Irthorru (664 BC) in the British Museum and the modern glass chandelier by the artist Dale Chihuly in the V&A foyer.

This route of funding is generally little known to UK Arts and Humanities researchers as the tendency is to seek funding from the AHRC, British Academy, Leverhume Trust and other traditional sponsors of humanities research. Arts and Humanities researchers are sometimes co-opted to projects initiated by science and technology departments, but could play a more pro-active role in planning the governmental LINK programme and other collaborative award schemes.[124] Here the need for a champion of 3D visualisation should be emphasised once more.

[121] The Department for Business, Enterprise and Regulatory Reform has replaced the Department of Trade and Industry on 28 June 2007.
[122] For more information about the 3D Direct Centre (Centre for 3D Electronic Commerce) at the London College of Fashion, The University of the Arts London, see http://www.fashion.arts.ac.uk/5913.htm.
[123] Information kindly provided by Dr Stuart Robson, Department of Geomatic Engineering, University College London.
[124] Currently available schemes are listed on the Department for Business, Enterprise and Regulatory Reform website, at http://www.berr.gov.uk/innovation/technologystrategyboard/tsb/other_government_support/OGD/page28144.html#Sustainable%20Arable%20LINK%20Programme.

There is much resentment to commercialisation of research in the Arts and Humanities. Creative arts, such as product and textile design, are using this route to much benefit, but traditional academic humanities subjects are reluctant to embrace this approach. Positive outcomes of collaboration with industry and commerce should therefore be publicised. It was a commission from Sainsbury Plc[125] that started the University of Bath Centre for Advanced Studies in Architecture (CASA). Established in 1991, CASA has since established a reputation of a leading academic research centre in the area of urban and architectural visualisation of historic and modern subjects, and is supporting its work through academic and commercial channels.

- The need to make funding more effective by establishing sound criteria for assessment of grant applications and management of research projects involving 3D visualisation.

  This area is still considered new and marginal by funding institutions. No specific criteria have been developed for assessing research proposals. The British Academy has received applications for funding of research projects in this area but 'they were a tiny number and miniscule proportion of the total number of grants given by the Academy'.[126] There was therefore no immediate need to develop specific criteria for assessment. The same applies to the management of research projects by funding bodies: the criteria for evaluation of progress and outcomes are the same as for other ICT-rich disciplines. The lack of this understanding of the specific needs of 3D visualisation is of much concern to the researchers.

- The need for effective communication of research funding opportunities.

  In a world overloaded with information, it is easy to overlook information that may be vital for a career opportunity, as this observation illustrates:

  > After a lecture on educational merits of computer game environments, the speaker, a lecturer in Classics at the University of Essex, was asked what would be his dream educational project if money would be no object. My recollection of his reply is thus: *I should like to develop a learning environment in Second Life. The lack of basic research skills of my students is of great concern. I find it difficult to inspire students with reading lists, bibliographies and references. I think that if they could experiment with visual tools and create something of their own in Second Life, or a similar environment, they would demonstrate more interest in actual historical content.*

[125] For further details see 'The Model of Bath, UK', *3DVisA Index of 3D Projects*, http://3dvisa.cch.kcl.ac.uk/project66.html.
[126] Email correspondence of 9 August 2006.

> This lecturer missed the call from the Eduserv Foundation for the proposals for educational projects in *Second Life*, mentioned earlier, because he was not aware of this opportunity.

This situation is common. Funding opportunities are communicated through a variety of channels, typically online on the founder's website, through mailing lists, e-bulletins, as well as press and other media. There are too many channels of information for anyone to follow the announcements effectively. Some colleges have appointed a Research Grants Officer who monitors funding opportunities and communicates them to eligible academics in the form of a regular digest and in good time to meet the application deadline. This practice has been commended as effective especially where complemented by advice on application procedures. The services of such an officer enable academics to spend time on what they are remunerated for, i.e. research and teaching.

- The need to complement provision of funding with coordination of other research opportunities.

  Successful 3D visualisation has occasionally happened as if by chance. A long grant-application process and project planning may not always be necessary if other possibilities are being realised. 3DVisA has recorded a 3D visualisation project which originated from the need to test new 3D laser scanning equipment, practice techniques and skills. A suitable subject and site was found fairly locally. The survey and modelling of the medieval doorway at Prestbury, Cheshire conducted by the National Conservation Technologies, Liverpool, is the study case in question.[127] The *Corpus of Romanesque Sculpture in Britain and Ireland*, a British Academy project hosted by the Courtauld Institute of Art in London, has now added to its church record a reference to this model, and a demonstration of the model was included in the virtual exhibition of academic research projects curated in *Second Life* by Hugh Denard of the Centre in the Computing in the Humanities, King's College London. The role of 3DVisA was in making connection between the projects, researchers and resources.

As the role of institutionalised academic patronage changes, an opportunity arises to take up coordination of institutional and independent initiatives, which enhance the understanding, application and collaborative use and discussion of 3D visualisation in research and education.

[127] For further information and links see 'Romanesque Doorway at Prestbury, Cheshire', *3DVisA Index of 3D Projects*, at http://3dvisa.cch.kcl.ac.uk/project32.html.

A specific, frequently articulated need relates to the widening participation in fee-payable academic events.

- The need to extend existing support for conference delegates and in particular students.

  Conferences and other live academic events are an important forum for communication and exchange of knowledge, but the cost of attending conferences is prohibitive. Conferences bridging arts and technology are particularly expensive. A handful of students benefit from bursaries funded by various organisations (e.g. from the AHRC Methods Network). More support is needed to widen students' participation.

- The need to ensure future developments in 3D visualisation by supporting education at the primary and secondary level.

  Despite its problems and limitations, 3D visualisation is a technology of the future. Young people, in particular, approach 3D virtual environments with natural ease and creativity. They should be provided with every possible opportunity to develop their understanding and skills in this area in a way that may be beneficial to their education and future career prospects. It should be ensured that the existing courses attract academic credits and new courses are developed in preparation for further education at university level.

3.5.3. Special Needs

Digital technologies offer educational opportunities to people with physical and learning disabilities. 3D visualisation may enhance the scope and quality of teaching and learning and offer accessibility and inclusion. Unfortunately no comments were received regarding the needs in this important area. It is strongly recommended to carry out a separate study in consultation with students and teachers, specialist educational organisations such as the JISC-funded TechDis (www.techdis.ac.uk) and other learning technology specialists.

4. Summary Conclusions, Key Needs and Recommendations

'…if you would have the kindness to think of my needs.'
Antoine de Saint Exupéry, The Little Prince

[1] This report, by the JISC 3D Visualisation in the Arts Network (3DVisA), is concerned with views of individuals and institutions that shape the use and development of computer-based 3D visualisation in the Arts and Humanities in UK Higher Education. Relevant earlier studies, as well as new research undertaken by 3DVisA in 2006-2007 have informed this report.

[2] 3D visualisation has implications that go far beyond technological innovation in research and educational practices. The discussion of issues specific to the use of such methods in the Arts and Humanities requires much broader socio-cultural and economical contexts. A growing body of literature reflects the complexity of this debate.

[3] 3D visualisation is conceptually complex and methodologically diverse. Digital 3D visualisation is understood differently by different subject groups. Expectations of technology vary depending on the established academic and pedagogical conventions of the discipline. Archaeology, palaeography, and museum studies are amongst the disciplines which employ scientific visualisation for identification, authentication and dating of primary material, while in other areas of the Arts and Humanities the shift is towards creative applications and computational aesthetics. The interest in 3D technologies in the Arts and Humanities is generally driven by their potential in advancing the knowledge of the subject, or exploring the creative potential of the digital medium, rather than by other factors. The opportunities seem limited only by the willingness of researchers to investigate what is to be gained from 3D visualisation. This results in a diversity of needs, thus imposing considerable demands on those who may be able to meet these requirements, and cautioning against adopting 'one-fits-all' solutions.

[4] If one word could describe the most important need identified by the contributors to this study, it would be **RECOGNITION**. The urge for 3D visualisation to be recognised as a valid academic pursuit is overwhelming across the Arts and Humanities disciplines. Many other demands seem a consequence of this need. This need, however, is strongly felt by only one constituent group of the 3D community, those who are involved in 3D research and practice. They are at present a miniscule minority of UK academics; 3D environments thrive outside academia. If education and research into 3D visualisation are to be advanced for economic, educational and public benefits, an academic uptake on a much larger scale needs to be encouraged and facilitated.

[5] **Members of the 3D community** have been identified primarily as CREATORS and FACILITATORS: researchers, both subject- and technology specialists, who are actively engaged in the development and use of 3D visualisation[128]; those with casual or potential research and/or pedagogical interests in such applications but no direct involvement (both these groups include students); members of support and management agencies whose policies and strategies affect scholarship, facilitation and sustainability of 3D visualisation in the Arts and Humanities. On the opposite side of the academic spectrum, there are the 'OUTSIDERS'; they include academics and students who mistrust 3D visualisation, but may eventually recognise the potential of the method for their own research, if exposed to informed advice. 3D visualisation needs to be offered **a forum** where both sympathetic and negative views might be voiced and debated.[129]

[6] Research thrives in a **climate** favourable to the needs of researchers. Policies are needed to sustain research culture sympathetic to 3D visualisation. These are generally in place, and need to be developed further and implemented. The Lords Science and Technology Select Committee Report HL256 (2006) confirms the commitment at governmental level to promote heritage science, which includes 3D visualisation. The 3D visualisation community feels that the **existing policies** do not go far enough to represent, respond and enable the opportunities offered by other areas of visualisation in the Arts and Humanities. Policy makers do not have to have professional understanding of visualisation issues, but it is vital they are advised by experts. A permanent advisory body of repute should be established for advocacy of the needs of digital visualisation in the Arts and Humanities, to mirror the appointment, in May 2007, of a champion of heritage technology, i.e. Director of the new AHRC/EPSRC UK Science and Heritage Research Programme. The lack of communication distances policy makers and those to be served by policies. A number of practical measures will ensure that the UK higher education system – being predominantly hierarchical and static – is more favourable to unconventional research and teaching. Much greater openness to embedding bottom-up initiatives; changes to RAE submission and Intellectual Property laws, which would reflect the specifics of digital visualisation, are among a number of practical measures advocated by the contributors to this survey.

[7] A wide-spread and deep **understanding of 3D visualisation** as a valid research method in the Arts and Humanities is needed for its recognition. It is only then that 'opportunities and career advancement for all involved in

[128] The term 'clients' employed by others to describe the creators and users of 3D visualisation (and ICT in general) has been avoided here as it implies the need to pay in order to get access. It is believed here that access to 3D scholarship and resources should be free in academic and educational contexts.

[129] 3DVisA has adopted this approach for its Discussion Forum. Each issue of the *3DVisA Bulletin* (ISSN 1751-8962 Print, ISSN 1751-8970 Online) has published views representing opposite sides of an argument.

visualisation-based research may be enabled'.[130] There is a great need for more **exposure** to 3D visualisation which represents outcomes of academic research. Greater **visibility** of academic 3D visualisation would be beneficial to those already engaged in this field, stimulating debate and moving the discipline forward, as well as those who have not yet realised its potential. Academics involved in such projects should do more to make the outcomes of their research visible by enabling and encouraging access to actual digital products of 3D visualisation. **Evidence of quality research** and good practice, as well as access to 3D products of research are needed in order for 3D visualisation to gain a wider recognition as a viable methodology in research and education. At present access to actual 3D research products is extremely limited. There is no obvious place where such products could be viewed and tested. No service or venue ('reading room') is readily available where 3D resources could be experienced and studied first hand. Demonstration versions in the form of simplified surrogates (typically animated video) are available on the Internet (many of which do not work) and on DVDs (poorly distributed), but interactive **access** to the full products is only available to the very few. A wider update of 3D visualisation is not possible without direct exposure to 3D technologies and resources. Researchers need to know where such material is to be found before they consider applying similar methods and techniques in their own work. Familiarisation with 3D visualisation should begin at 'home'. 3D visualisation involves in most cases **collaboration and teamwork**. Colleagues on the same team, i.e. subject and technology specialists, should make an effort to gain a full understanding of their respective roles and contributions. The interdependence of these contributions should be defined at the inception of the project as part of the research aims and revised as the project progresses. This approach may clarify the intellectual ownership of research outcomes, which – as has been illustrated – is causing considerable tensions at present. In-house demonstration of visualisation at departmental seminars and school events should be considered as important as presentation to prestigious international audiences and grant-attracting events. A number of small-scale informal events have demonstrated that direct exposure to 3D visualisation with an opportunity to ask questions is all it takes to initiate an interest in this methodology. **Public exposure to 3D visualisation** should not be dominated by computer games for home use and advertising (even if of high educational value and technological quality), but boosted by educational events such as the British Museum and Silicon Graphics Inc. visualisation of an Egyptian mummy, showing scholarship and technology at their best.[131] Academic collaboration in this area should be encouraged. There should be a permanent educational display of 3D visualisation products and technologies at the National Media Museum or similar institution. Information about such products is far too often confined to ephemeral paper documentation and publications, mostly strictly scientific, which are not indexed or abstracted in bibliographies standard to the Humanities, and are therefore difficult to locate.

[130] Source: email correspondence, 13 July 2007.

[131] See 'Mummy. The Inside Story', *3DVisA Index of 3D Projects: Anthropology,* http://3dvisa.cch.kcl.ac.uk/project1.html.

3D visualisation in the Arts and Humanities does not yet have a dedicated specialist journal, the need for which has been identified alongside better access to electronic resources.

[8] Research Assessment Exercise panels evaluate quality of research using purpose-developed standards. In terms of originality, significance and rigour of research, the criteria of quality levels have been defined as 'world-leading' (4*), 'internationally excellent' (3*), 'recognised internationally' (2*)' and 'recognised nationally' (1*). Research may also fall under the 'unclassified quality' or 'work which does not meet the published definition of research for the purposes of this assessment'.[132] The exact meaning of these standards in relation to research involving 3D visualisation is not clear. It has been demonstrated that criteria for evaluating digital research should be independent of current technology, but there is no consensus what constitutes the evidence of value of 3D visualisation. Transparent criteria are also needed for the audit of research projects. It is for the individual subject communities to establish what RAE standards mean in their respective fields. In the case of heritage visualisation quality is commonly sought in the appearance (photo-realism) and functionality of computer models. There is a need to argue for the value of other cognitive processes facilitated by this method. Criticism is important and needs to be listened to as it helps in refining the methodology underpinning virtual 3D visualisation. The debate should be encouraged, facilitated and embedded in pedagogy of 3D visualisation in a way that does not discriminate contradictory arguments and alternative approaches.

[9] The ongoing debate on the academic and educational merits of 3D visualisation needs to be based on transparent arguments, the readiness to acknowledge the limitations of methods and technologies, and be supported by the **evidence of good practice**. If computer 3D visualisation is to be taken seriously then it is necessary to develop transparent, convincing and methodologically sound means by which it can be examined critically. Academic visualisation and heritage reconstruction in particular, need to be documented. 'It is crucial that an accurate record of the decision making process involved in any reconstruction is kept and is accessible in the future. [A record of treatment routinely created in the course of physical restoration of an artefact, and embedded in the object, may serve as a model approach.] The difficulties that 3D visualisations present are well documented. In particular, there is the fear that [historical] 3D visualisations are perceived as in some way more 'real' than a 2D representation or description. In fact, both 2D and 3D representations are impressions of what might have been, and both are therefore entirety subjective.'[133] These issues are being addressed by the London Charter.[134]

[132] Source: Research Assessment Exercise 2008 panel statements, http://www.rae.ac.uk/pubs/2006/01/.
[133] Lapensée, A. (2008), '3D Visualisation in Cultural Heritage. Using Laser Scanning in 3D Documentation and Digital Reconstruction', *3DVisA Bulletin,* 4, forthcoming March 2008.
[134] For the London Charter see www.londoncharter.org.

Similar initiatives aiming at transparency and reliability of 3D visualisation in other areas of Arts and Humanities need to be encouraged, facilitated and coordinated.

[10] While the insatiable demand for **the best possible e-infrastructure** is inherent to advanced ICT practice, 3D visualisation hardware and software is becoming ever easier to provide. Desk-top visualisation is now possible alongside highly-specialised and expensive laboratory-based and networked technologies. The needs of the Arts and Humanities visualisation need to be represented and accommodated in the national e-infrastructure framework (see 3.1) and other initiatives on a governmental and university level. The level and particulars of this provision should be identified by the academic 3D visualisation community. Schemes for sharing and transferring resources should be encouraged and facilitated; these are at present hindered by lack of information regarding availability and access, and often discouraged by terms and conditions of funding.

[11] Continuous and **reliable support** for 3D visualisation in the Arts and Humanities is regarded as a condition for its advancement. Short-term projects which are not allowed to evolve; piecemeal funding overburdened with bureaucracy; lack of consistency and continuity in the provision of resources and advisory services (*vide* AGOCG, AHDS) are all considered detrimental for the development of the discipline. In-depth understanding of diverse needs of the 3D visualisation community (of digital dance as much as architectural photogrammetry) is required from those responsible for offering advice and support. Good practice guidance should promote academic rigour, without restricting innovation and creativity of practice-based research. It has been pointed out that a vast, centralised advisory service to keep up to date with all visualisation technologies and their disciplinary and cross-disciplinary applications would be difficult to establish. However, only a funded advisory service could maintain knowledge of where such expertise is distributed, and facilitate access to it. It would be advantageous to the 3D visualisation community to model how some such knowledge-exchange mechanism could be made successful and sustainable.

[12] Arts and Humanities researchers interested in 3D visualisation, but with no technical skills, tend to seek solutions to an individual problem, as has been illustrated by a number of cases. The problem is usually too negligible for a scientist to be challenged intellectually, to engage and help. Access to **advice** on this low technological level is crucial if wider and deeper applications of 3D visualisation are to be expedited. Examples of good practice are vital. These will remain in short supply unless the lifespan of digital products of research is extended through active maintenance and sustainable **preservation**. The re-usability of 3D resources created in the course of visualisation projects should be encouraged and facilitated where appropriate. Excellent heritage visualisations were created by academics to accompany blockbuster exhibitions (*Aztecs*, Royal Academy, London, 2002-2003; *Stanley Spencer*, Tate Britain, 2001; *Nelson and*

Napoleon, National Maritime Museum, Greenwich, 2005, etc.), but little effort was made to make these available after these shows finished. This is not the case with exhibition catalogues and videos which are stocked by bookshops for much longer.

[13] Adequate **funding** is therefore needed, alongside well-planned and wide-reaching support. Funding is an area where expectations will always exceed the level of provision. The comments received suggest that the inefficient spending of existing funds and the under-use of resources is of a far greater concern to the community than the limited availability of grants. Ph.D. students are among those whose needs have been neglected, despite high levels of expertise and promising academic careers. A number of practical measures aiming at recognition of their work, enhanced support and long-term affiliation with academic hosts have been identified.

[14] Although the current uptake of 3D technologies in the Arts and Humanities is low, the significance of this community should not be measured by the popularity of the methods employed, but rather evaluated on the merits of its contribution to the arts, humanities scholarship and education, and social and economical life in general. 3D visualisation may remain a specialist academic pursuit, as well as a popular form of leisure. The openness to bottom-up developments initiated by online communities, and embedding such activities in academic curricula may bridge the two activities. 3D visualisation, among other digital technologies, may enhance the inclusion of people with special teaching and learning needs, if enabled by practical measures.

[15] It is believed that 'digital scholarship is the inevitable future of the humanities and social science'.[135] There is little evidence that the findings from earlier surveys into the ICT needs of the UK research community have been implemented. Some of the same concerns surface over and over again in the subsequent studies. More decisive actions leading to implementation of recommendations, some of which require little effort (UCAS points for a BTEC course in 3D visualisation; inclusion of digital content in the British Thesis Service records; fair use copyright in education, etc.), would empower the community and enable it to flourish.

[135] Our Cultural Commonwealth, The report of the American Council of Learned Societies' Commission on Cyberinfrastructure for Humanities and Social Sciences, ACLS Commission, July 2006 p. 48, available at www.acls.org/cyberinfrastructure/acls.ci.report.pdf.

List of Acronyms

3DVisA	JISC 3D Visualisation in the Arts Network, UK
AGOCG	Advisory Group on Computer Graphics, UK
AHDS	Arts and Humanities Data Service, UK
AHRC	Arts and Humanities Research Council, UK
CAD	Computer-Aided Design
CASA	Centre for the Advanced Study of Architecture, Department of Architecture and Civil Engineering, Bath University, UK
CASA	Centre for Advanced Spatial Analysis, University College London
CBIR	Content-based Image Retrieval
CCH	Centre for Computing in the Humanities, King's College London
CHArt	Computers and the History of Art
CNC	Computer Numerically Controlled (Routing)
CVE	Collaborative Virtual Environments
DPC	Digital Preservation Coalition, UK
EVA	Electronic Imaging and the Visual Arts (conference)
ICT	Information and Communication Technology
IP	Intellectual Property
ISAST	International Society for the Arts, Sciences, and Technology
ITCP	Information Technology and Creative Practices
JISC	Joint Information Systems Committee, UK
KCL	King's College London
KVL	King's Visualisation Lab, King's College, London
MADE	Materials and Design Exchange, Royal College of Art
PCF	Participatory Culture Foundation
PDMS	Plant Design Management System
RM	Rapid Manufacturing
SERC	Science Engineering Research Council
SGI	Silicon Graphics Inc.
SIGGRAPH	Special Interest Group for Computer Graphics, US
VR	Virtual Reality
UCE	University of Central England, Birmingham
UCL	University College London
URL	Unique Resource Locator
VRML	Virtual Reality Modelling Language
VRU	Visualisation Research Unit, Institute of Art and Design, UCE
VizNet	Visualization Network, UK
WINSOM	Winchester Solid Modeller
XML	Extensible Markup Language