Sharing experiences with using next generation knowledge portals for advancing web communities

Nik Bessis*

School of Computing and Maths,
University of Derby,
Kedleston Road, Derby, DE22 1GB, UK
Fax: +441332597741
E-mail: n.bessis@derby.ac.uk
and
Department of Computer Science and Technology,
University of Bedfordshire,
Park Square, LU1 3JU, Luton, UK
Fax: +441582489212
E-mail: nik.bessis@beds.ac.uk
*Corresponding author

Alfredo Gaitan

Division of Psychology,
University of Bedfordshire,
Park Square, LU1 3JU, Luton, UK
Fax: +441582489212
E-mail: alfredo.gaitan@beds.ac.uk

Mitul Shukla and Zhihua Lai

Department of Computer Science and Technology,
University of Bedfordshire,
Park Square, LU1 3JU, Luton, UK
Fax: +441582489212
E-mail: mitul.shukla@beds.ac.uk
E-mail: zhihua.lai@beds.ac.uk

Abstract: In this article, we discuss the development of two repositories of shared knowledge using intra- and inter-tagging functionality. The functionality enables web user communities to upload, search, navigate through and tag multiple documents in multiple ways at a macro and micro level. Users can tag the whole document as well as parts there-in, as they deem appropriate. Our development process employed a unique, specifically designed community user needs approach (CUNA) to allow elicitation of diverse user communities needs. This included an iterative, rapid application development approach, which in turn, allowed lessons learned from the testing phase to be implemented in the following building phase. Results from in-house testing and an independent consultancy suggest that the web communities perceive the portals as beneficial not just during the project lifecycle but quite likely in future ventures.

Keywords: virtual communities; communities of practice; community user needs approach; CUNA; open architecture; knowledge management systems; knowledge transfer; repositories of shared knowledge; content management systems; intra and inter tagging functionality; web-based communities.

Reference to this paper should be made as follows: Bessis, N., Gaitan, A., Shukla, M. and Lai, Z. (2011) 'Sharing experiences with using next generation knowledge portals for advancing web communities', *Int. J. Web Based Communities*, Vol. 7, No. 3, pp.256–275.

Biographical notes: Nik Bessis is the Head of Distributed and Intelligent Systems Research Group and a Full Professor of Computer Science in the School of Computer Science and Maths, University of Derby, UK. He is also associated with the Department of Computer Science and Technology at the University of Bedfordshire, UK. His research interest is the analysis, research, and delivery of user-led developments with regard to data integration, annotation, and data push in distributed environments. These have a particular focus on the use of next generation and grid technologies for the benefit of various virtual organisational settings. He is involved in and leading a number of funded projects in these areas. He has published numerous papers and articles in international conferences and journals, served as a reviewer, program committee member, session chair, associate editor, conference chair, editor of two books and an Editor-in-Chief of the *International Journal of Distributed Systems and Technologies (IJDST)*.

Alfredo Gaitan is currently a Senior Lecturer in the Division of Psychology at the University of Bedfordshire, UK. His main research interests include community member knowledge transfer, transitions and processes of personal change and construction of social identities. He has been involved in a number of funded projects in these areas. He has published numerous papers and articles in international conferences and journals. He served as a reviewer and a committee member.

Mitul Shukla is currently a PhD candidate in the Institute for Research in Applicable Computing at the University of Bedfordshire, UK. His main research interests are Second Life, Web 2.0 and social networking. He has served as a reviewer and worked for funded projects as a Researcher.

Zhihua Lai is a Postdoctoral Researcher in the Institute for Research in Applicable Computing at the University of Bedfordshire, UK. His research interests are intelligent ray launching for outdoor and indoor coverage prediction and the development of parallel algorithms suitable for grid deployments. He has produced a number of programmes for funded projects in these areas.

1 Introduction

The article discusses collective experiences learnt when developing various knowledge portals for a variety of web communities. These were the main outcomes from the Manchester Digital Development Agency, UK Arts Council funded Ambition project and the UK Joint Information Systems Committee (JISC) funded Users and Innovation (U&I) programme in which the authors have been heavily involved.

The article's main goal is multi-fold: firstly, to offer a background synopsis of the user communities involved, their goals and expectations; secondly, to briefly present an overview of our unique community user needs approach (CUNA); thirdly, to analyse findings leading to the production of an underlying model as the basis of the development of relevant portal prototypes; fourthly, provide descriptions of the prototypes' functionality and implementation and essentially how the technology works and the way that user communities could use it. Finally, we conclude by describing our testing and evaluation strategy and a discussion of the results derived there from.

2 Background synopsis

Two overarching web communities were the recipients of the technology that was developed.

The first user community (UC1) involved a group of arts organisations taking part in a UK Arts Council funded project. More information about the project is available from the Ambition website (2009). The main scope of this project was to address issues related to the lack of information and communication technology (ICT) inclusion in arts and cultural organisations; specifically in the areas of formal strategic documentation, budgets and capacity planning, and organisational development thinking. Thus, there was a need to enable UK arts and cultural organisations developing the effective use of current digital technology in their business and artistic pursuits improving their offer and competitiveness in a 21st century market (Bessis et al., 2008). A group of fifteen organisations (varied from one to more than ten users in each organisation) based in the North West and East of England participated in the project. These were divided into Tier 1 and Tier 2 groups, with seven and eight organisations in each, respectively. Our contribution was to build a web knowledge portal to aid knowledge transfer from within the community.

The second user community (UC2) comprised of participants of the JISC funded U&I programme. More information about the Emerge project is available from Roberts (2008). The project set out to support the creation of a sustainable community of practice around user engagement (UE) for the exploitation of new and emerging technologies, such as social software and pervasive computing in higher education establishments. One of the purposes for the UC2 formation was that rather than issuing a call for project proposals, the funders issued a call for groups to join a 'community of practice' who would work in wider collaboration facilitated by a support project to understand the processes of UE, undertake UE activities with various other communities, and work together through a peer review process to develop proposals into a call for projects to develop innovative, user-centred learning technologies and practices (Emerge Final Draft Report, 2009). Thus, the main aim was to build, maintain and sustain a community of practice to help develop and promote a consistent approach to the development of the next generation learning, teaching, research and administration environments. A key component of this approach was to encourage the adoption of a UE process and enable its use by the developers of the next generation of web-based (Web 2.0) services. Our contribution here was to develop a web-based knowledge base portal, which will ensure knowledge transfer across the involved community members. The community was made up of 22 funded projects (varying from one to more than ten users per funded project) based within various higher education institutions throughout England.

Although the two user communities (UC1 and UC2) differ in the domain of their application, there were certain elements that they both had in common. For example, both communities were comprised of distinct independent groups of practitioners who were involved in going through a learning experience and in which their involvement and practice had produced experiential knowledge of their processes and outputs. Due to the nature of their dispersed characteristics both of these communities required a web-based knowledge sharing tool for much the same reasons as Hildrech et al. (2000) describe, that is to: "… improve organisational performance by maintaining implicit knowledge, helping the spread of new ideas and solutions, acting as a focus for innovation and driving organisational strategy".

2.1 Virtual, web communities and next generation KSPs

De Vries and Kommers (2004) state that virtual communities permit users with common interests to keep in touch with each other, which in turn, lead to fostering social cohesion and make possible the interaction between members via the means of a virtual space. Similar references are also available from Rodrigues et al. (2004). Santos and Boticario (2008) describe web-based communities as online meeting places where groups of people do not physically meet but communicate their ideas and feelings on shared topics of interests using the collaborative services (or social software) offered by the web to regulate the activities of the participants. They also state that the second generation of web-based services (called Web 2.0), let people collaborate and share information online in new ways, leading to the so-called Community 2.0.

Our strategy for UC1 and UC2 was to use open source environments offering adaptable core services for uploading, searching, tagging, bookmarking and blogging, making the most of the Web 2.0 technologies available, as well as, extending tagging functionalities (Yusef and Herrero-Solana, 2006) to facilitate specific needs acknowledged from these communities. Our goal was also to develop new technologies and/or solutions, which explored next generation technologies and social networking such as medium rich content inter and intra tagging. Thus, our main task was to experiment with developing and testing UC tailored repositories of shared knowledge using advanced technologies and concepts. In brief, this paper aims to discuss findings with regard to the experiences learnt from two real world 'user communities forming' exercises when developing their knowledge sharing virtual portals.

3 Methodological approach

In order to develop the portals, user needs analyses with each community were conducted. These allowed us to become better informed about objectives, choices and implementation strategies for the prototype development. We also took the view that such a knowledge-sharing portal would have to tell the stories of the communities as they changed in time as well as describe how and why they did so. To achieve this, we employed a specifically designed CUNA in both UC1 and UC2; this is described next.

3.1 An overview of the CUNA

In this article, we coin the contextual term of a CUNA. Its origins come from JISC in 2006. They described the need for a user and innovation development model (UIDM) as a consistent approach towards software development in virtual environments (Capital Programme Briefing Papers, 2006). In particular, the UIDM was created on the basis of experiences with the JISC virtual research environments (VRE) programme and was designed as a set of guiding principles to ensure the inclusion of UE in the whole design and development process.

Fowler and Scott (2007) point out that user centred design (UCD) is not new and many methodologies already exist. They point out that the key concept to most UCD methods, including UIDM, is about engaging users in the design, development and deployment of systems, which in turn, should ensure the creation of usable services. They also point out that a service must not only be easy to use but also useful. A useful service contains functionality that matches the users' needs or is 'fit-for-purpose'. The goal of any developer is therefore to design, develop and deploy a service that is both usable and useful – such services have a high utility or value to users. Thus, any UCD method must meet these requirements, and most do, albeit in different ways. Several similarities between UIDM and life-cycle design models are noted; see Table 1.

Table 1 The relationship between the lifecycle model and the UIDM

Life-cycle	*UIDM*
Understanding the users, domain and processes	*Understanding the users (and domain)*
Design	Transition and decision
Iterative design (scope, contents, functionality, and user interface)	Scoping, build or buy decisions
Iterative refinement of (paper) prototypes via formative evaluation	
Technical design	Technical development
Detailed system design including service design	Analysis and design (analysis-level system class structure, detailed system design class structure, coding, testing, implementation, rollout)
Implementation, testing, rollout	Enhancing user acceptance and support
Evaluation of the rolled out system is not done here, instead the lifecycle method loops aforementioned steps as needed	Change management, including communication, training, help, summative user acceptance testing

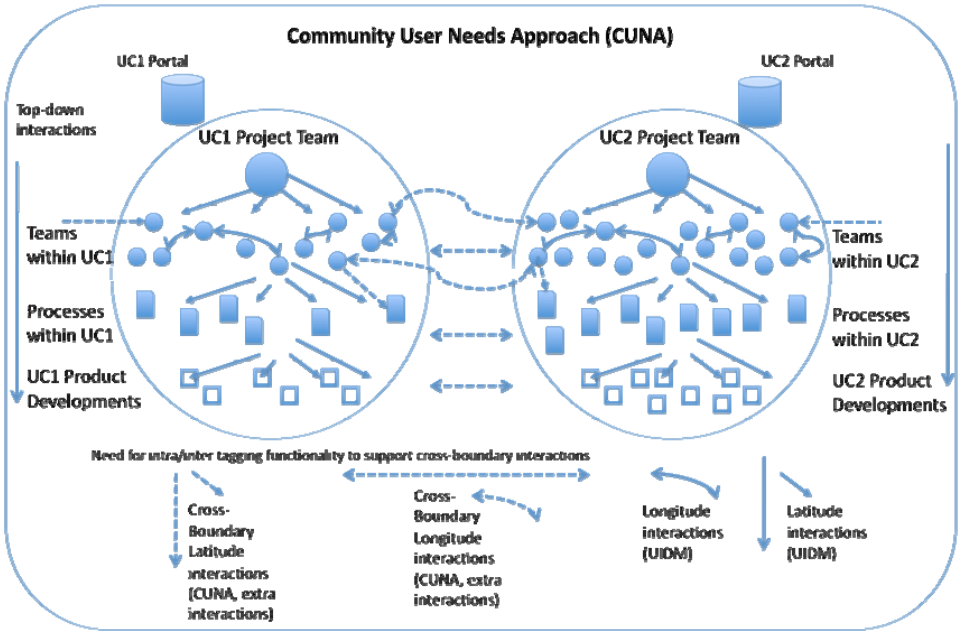
Source: Adapted from JISC (2009)

The UC2 project team (Roberts, 2008) took the view that the application of the UIDM differs from other models. The team hypothesised that by using fully networked community development processes the quality of projects might be improved. In particular, UIDM has been seen as an adaptable framework to the community development, where developing projects in a context where there is awareness of the wider activity in a field and an understanding of the alignments and gaps in that field will

lead to better projects being developed. By using UIDM in UC1, our approach has been transformed to a CUNA.

The application of UIDM within a UC supports the longitude and latitude interactions of that concerned UC only. That is to say, the application of UIDM in either UC1 or UC2 limits the UC activity to the specific isolated virtual community setting. In this paper, we refer to the opportunity that the application of UIDM crossing multiple UC boundaries would further assist the augmentation of individual community developments. This is by stressing further the longitude and latitude levels of interactions (i.e., awareness and activities in a field) within and outside the concerned user community (-ies). We therefore coin the term of CUNA as the application of UIDM in multiple UCs (UC1, UC2, … UCn) that undertake a number of relevant developments in a given timeframe. Figure 1 illustrates the benefits of the application of UIDM in both UC1 and UC2 settings, as well as depicting the overarching nature of CUNA. Solid arrows denote the latitude interactions between UC teams, solid bi-directional lines denote the potential UIDM-based longitude interactions between a UC teams and finally, dashed bi-directional arrows illustrate the potential cross-boundary longitude and latitude interactions. The uniqueness of crossing multiple UC boundaries triggers the need for the development of open source next generation knowledge sharing portals (KSPs) that incorporate intra and inter tagging functionality.

Figure 1 The relationship between the UIDM and CUNA (see online version for colours)



3.2 Application of the CUNA

The specifically designed CUNA is a new deployed approach (to the knowledge of the authors). It is considered unique due to utilisation of a mixture of techniques to suit diversified participant types within more than one user communities. It is an

interdisciplinary approach involving expertise from various disciplines within the project teams. It synthesises a number of participatory design, social network and content analysis and rapid application development activities into various development stages. The process was drawn from a body of user experience and aimed to be an iterative approach as a whole, since it was re-cycled throughout and in each development stage using Web 2.0 and next generation technologies.

The implementation of the approach began with an initial consultation with a small group of diverse communities about their experiences and expectations in relation to their specific ventures as well as to their overarching funded project streams. In turn, this has contributed to the identification of the content, structure, use and technical merits of the knowledge portal to be produced at a following stage during the project lifecycle. In addition, it has contributed in realising the applicability of CUNA in different community settings. The activities carried out by our team included:

- CUNA
- production of underlying models
- knowledge portals development
- user testing of the knowledge portal.

In particular, focus groups, blog entries, emails, telephone interviews and site visits were employed involving various levels of stakeholder. The aim of these techniques was to create a baseline understanding of how the participants perceived themselves and their peers and their organisations in terms of experiential and learning change as well as the influence and use of ICT (UC1) and UE techniques (UC2) within their settings. Thus, the elicitation techniques were employed in a manner inviting participants to consider experiences in the past, present and future. The elicitation was carried out with regard to the work experiences of participants. Participants were also provided with the opportunity to discuss these matters in an informal peer group setting. These were particularly useful in assessing mutual engagement as the basis for relationships within the user community.

Participants of UC1 were exposed to a case study describing the use of ICT by an arts organisation. This focus group approach enabled us to collect information regarding ICT perceived usefulness in terms of what aspects of the case study participants found of interest to themselves, as well as what they felt may have been lacking. This was useful in feedback to NMP, a consultancy whose task was to produce an initial batch of six case studies, which were to form the basis for us to observe the manner in which it would be beneficial for arts organisations and trigger them to prepare and publish their own stories and case studies using next generation technologies. Seven organisations, as a sample from the arts/cultural community, were invited to participate in blogging about their experiences in the project. Participants were encouraged through emails to write about specific themes. They were also given the option to write about any other relevant topic related to or stemming from participation in the project. The blogs were set up to be confidential; only the participants and the project team had access to the content contained in them. It was hoped that through this means participants would reflectively express their views about what was happening in their organisations. Telephone interviews and site visits to consultants and organisations were conducted. The site visits consisted of an interview-based approach in order to elicit a perceptual timeline of experiences and hopes for the project. Both enquiries helped identify general as well as

specific positive and negative experiences. Blog entries, interviews and site visits were also seen as an opportunity to engage in dialogue between the research team and the participants to discuss the process of knowledge transfer/generation. The topics of such exchanges include interpretations emerging from activities undertaken, as well as new insights by both the research team and participants.

The UC2 project team as a whole consciously adopted a model of blended support for community development (Emerge Final Draft Report, 2009). This included face-to-face and online events, opportunities for asynchronous and synchronous communication, and interaction for both formal and informal discourse. These allowed participants to have the opportunity to describe their funded project proposals and demonstrate that they had undertaken some kind of stakeholder or user analysis at the initial planning stage in order to understand the problem they were trying to address and define the kind of solution they wanted to develop. Online presentations and follow-up visits were also used. In these, all participants were provided with access to a UE guide and a model, which they could use as a method to employ and thus, to demonstrate UE in their forthcoming project activities. External project partners provided the UC2 with online discussion groups, online workshops (via Elluminate), surveys and blog facilities, which allowed us to analyse collected data as an informal method to elicit UC2 experiences with regard to the adaption of the UE model. In particular, project partners used Elgg as its primary platform, with support from various other Web 2.0 technologies, including a Wiki and a Moodle installation. In turn, these were also seen as an ongoing opportunity to engage in dialogue between the whole research project team and the participants. Participants were also encouraged to report back their ongoing experiences and stories (with regard to the UE adaption) in the form of case studies. A series of telephone and appreciative inquiry interviews with 22 members from 11 project communities were conducted (by the whole project team) to review community operations and experiences of members, and make recommendations for the further operation and development of the community.

3.3 Findings from the CUNA

A grounded theory (Glaser and Strauss, 1967) approach was adapted to analyse the output from participants.

An important aspect of the results collated from the content analyses were that participants wanted online stories (compiled in the form of case studies) to contain navigation to other relevant stories, within the same or different case studies. Further, participants expressed views on specific aspects of the organisation, the nature of their job, what they thought and felt, and the work environment (social and physical). To achieve this, content analysis of nine case studies was undertaken; the overarching aim was to identify key categories and produce taxonomy of types of information that would inform the design of the KSP. The taxonomy served two related purposes; it allowed for the tracking and analysis of how users tag and search information within the printed version of the case studies, and; it helped to provide guidelines for users on how to tag and search information. Each case study was inductively analysed in terms of structure and content (types of statements) being made as well as supporting categorisations. Content analysis was also used with the data collected in the focus groups described earlier. The participants perceptions of organisational change and learning were identified, as well as, their experiences of using/adopting ICT (UC1) or UE (UC2).

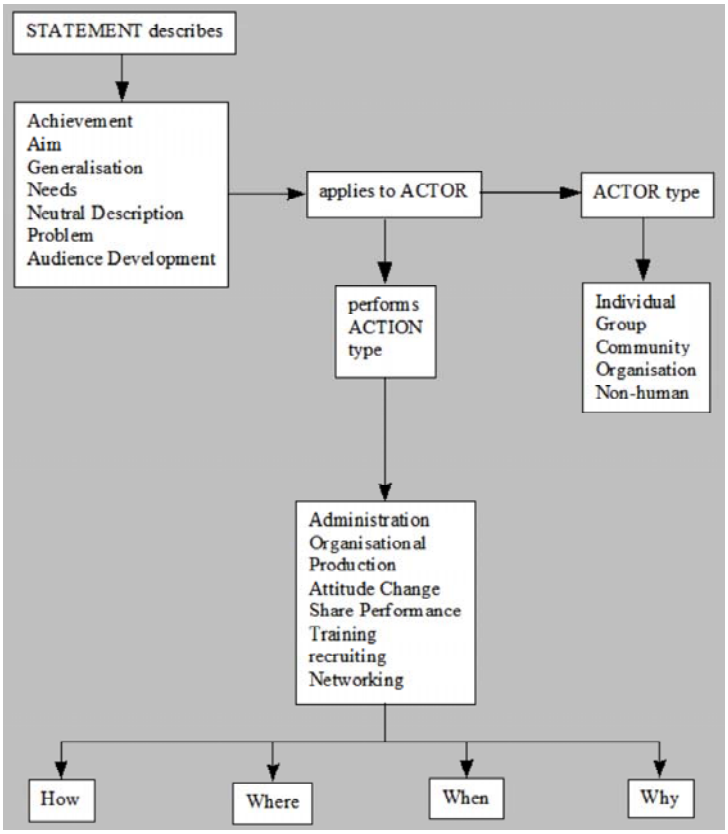
Several conclusions from these pilot activities were highlighted, including that the case study: was of the right length; contained the right kind of information; could have contained more detail on specific problems encountered (difficulties) and how they were overcome, as well as on types of technology used, finances, time and staff development; should have information on a combination of areas affecting the project (financial, technical, organisational, etc.), rather than only on one of these; should be made available online to allow navigation to other case studies and relevant online material. A glossary and the availability of navigation within the document itself were also mentioned as important. The *structure* of a generic case study is made up of the following components: title, subtitle, headers, heading, subheading, body, box heading, box, quote, footer, logo, photo header and photo/image. Seven main *content* categories emerged from the analysis: 'achievement', 'aim', 'generalisation', 'needs', 'neutral description', 'problem', and 'development'.

Deeper analysis from data collected from the UC1, revealed that half of the statements contained in the case studies described achievements, suggesting that this is the main purpose of a case study. Against our expectations (Bessis et al., 2009a), other key categories were almost absent, for example statements describing the needs of the organisation (1.6%), problems (5.6%) and audience development (0.2%). Statements describing neutral aspects (i.e., mostly headings, questions asked by the interviewer, or incidental information) constituted 21.3% of the total number of statements coded. Further analysis showed that there were five types of actors: (the general) community, (specific) group(s), individuals, non-human (e.g., a studio, technology) and organisations. The majority of actors mentioned in the case studies (75.6%) are organisations (predominantly the arts organisation) and the next most common type of actor was group. Eight types of action were identified from the statements: administrative, attitude change, networking, organisational, production, recruiting, shared performance and training. The two most frequent types of action linked to achievements were organisational (33.5%) and production (34.5%). Unfortunately, a similar deeper analysis from data collected from UC2 was not possible, due to the diverse range of projects involved.

3.4 The underlying model

Based on these, an underlying model (Bessis et al., 2008) about how users could interact with the portal has been ascertained. This model – as shown in Figure 2 – had two purposes, the first was to direct us on how to tag the stories/case studies on the portal and the second was to assess whether our tagging was consistent with how users were tagging their content at a later stage. The premise for its use is based on the reasoning that users from the either user community may not necessarily use the knowledge engine (KE) technology simply because it is available but rather a 'push-pull' strategy maybe required. The content analysis revealed that statements could be matched to seven basic descriptions (see 'STATEMENT describes'). These descriptions were applied to 'actors', an 'Actor' could be described as any one of five 'ACTOR types'. Further analysis showed that 'Actors' would perform an 'action', 'action types' were categorised into eight distinct categories. These 'action types' were often further described in the content and a finer granularity of description could be given in our model with regards to the 'how', 'where', 'when' and 'why' of a given 'action'.

Figure 2 The underlying model for the portal



4 Portal prototype development

A rapid application development with three main iteration phases was used. The prototype involved Joomla, an open-source content management system. It was chosen as the base middleware to use for both the production of the web-based portal and its embedded 'KE' functions. Various versions of the portal have been developed (starting with UC1), which led to the development of a portal for each of the two user communities (UC1 and UC2). The UC2 required added functionality and this is the one which it is mainly described here.

The first iteration of the portal had a number of issues identified by us as well as from feedback from the UC1 funders. These issues were essentially broken into two differing aspects by the team, layout/design and functionality. Functionality issues were all resolved during the second iteration, as outlined below:

- removal of administrator login access
- additional details about the UC1 project
- login procedure explanation

- text in KE differing in format
- renaming of certain buttons/tabs
- character set issues in KE
- capacity to delete uploaded files
- PDF section removal
- toggle group tagging.

The UC2 partner team also requested the inclusion of sub-categories and the ability for inter/intra tagging on visual material, which was implemented during the third iteration phase. Specific Macintosh compatibility issues were highlighted and relevant 'fixes' implemented. Full functionality for both UC1 and UC2 portals including their embedded next generation KE has been attained in early 2008.

4.1 Prototype principles

The 'KE' is the next generation element embedded in the portals. There were three main principles behind the portal development, namely:

- transforming user community members from an individual perspective to the awareness of how a community perceives, processes and evolves a subject matter under enquiry
- encouraging users to get into collaborative activities (joint ventures) by offering them the functionality and the ability to contribute to the evolution of how a subject of interest is perceived, processed and evolved by the wider community
- providing a mechanism that enables the annotation of differing perspectives to be applied to the same subject matter.

In turn, these have been addressed via our next generation technology portal engine, which allows multiple users to inter/intra tag instances of the subject matter under enquiry. The 'KE' uses next generation technologies features including intra and inter document tagging in an innovative way and, as far as our research has been able to ascertain, this method is currently unique. There are however certain conceptual similarities to our intra and inter tagging functionality of photographs on Facebook, therefore there is a possibility that other systems on perhaps private domains may exist. Content annotation and/or tagging as a technology is fairly well used and understood, however the 'KE' differs from these systems by enabling multiple users to tag specific documents as well as specific parts and components therein. In particular, the use of user-generated tagging of documents parts allows for the most specific and relevant content to be identified and consumed by practitioners as opposed to software (search engines) or documents at a macro level (del.icio.us).

4.2 KSP prototype functionality

The portal has several distinct sections that comprise the user experience. Particular sections of note are: the KE, in-built blogging, discussion or forum pages and incoming

RSS feeds. Apart from the KE, all remaining sections use standard solutions that are either built into the Joomla middleware or are available for it as extensions. Partial descriptions of this work are available in Bessis et al. (2009b).

4.2.1 Content classification and discovery (inter and intra tagging functionality) in the KE

The KE allows the use of two levels of classification, categories and sub-categories. Categories work at a macro level and are used to cluster similar content material. Sub-categories however work at the micro level within each category and can be helpful in disambiguating potentially large clusters of uploaded material in a given category.

However, the most important and unique feature available through the KE is the use of inter and intra tagging functionality (see Figure 3). The facility is only available for text documents with the .txt extension and for audiovisual clips and for image files such as jpeg, gif and png formats. Intra-tagging is essentially the user being able to select an area of interest within a document and label it from their perspective (subjective approach). This means that multiple users could tag the same elements within a given document using a variety of tag labels and thus make the content discoverable from multiple perspectives, as well as demonstrate a more objective view of the content classification type. In brief, intra-tagging refers to the user functionality of navigating from one tag to the next relevant tag within the same file or document. Similarly, inter-tagging refers to the user functionality of navigating from one tag to the next relevant tag in the next relevant file or document. Thus, the functionality of the portal thereby allows for the browsing and navigation between documents and the searching of specific components within a given document (intra tagging) as well as to other documents (inter tagging) that contain that specific tag. The use of user-generated tagging of documents makes the KE unique as opposed to existing functionalities. Tags can be assigned to any volume of text or visual in a document, for example a word, a sentence, a paragraph or an image part.

Figure 3 Intra and inter tagging functionality

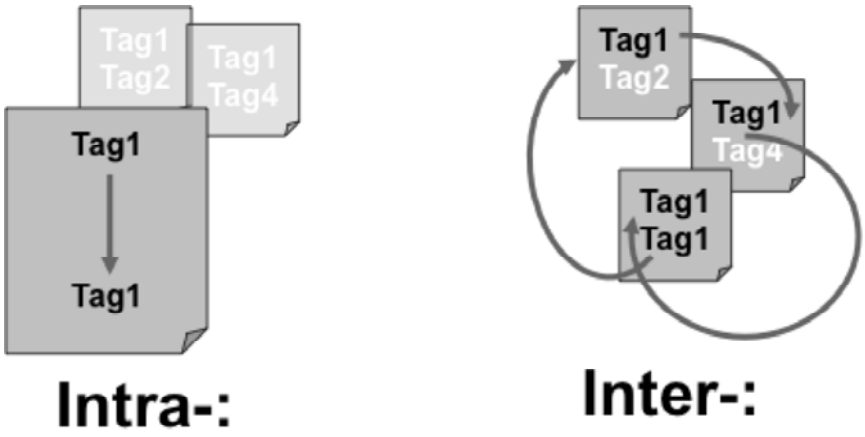


Figure 4 The inter and intra tagging algorithm in the form of a pseudo-code

```
Function InterTag(document, tagarea, metadata) return boolean
{
        switch (document.type)
        {
                text:
                        insert_to_table(document.id, tagarea.textstart, tagarea.textend, metadata);
                        return (true);
                video:
                audio:
                        insert_to_table(document.id, tagarea.timestart, tagarea.timeend, metadata);
                        return (true);
                pictures:
                        start = (tagarea.tagrectange.y1 – 1) * document.imagewidth + tagarea.tagrectange.x1;
                        end = (tagarea.tagrectange.y2 – 1) * document.imagewidth + tagarea.tagrectange.x2;
                        insert_to_table(document.id, start, end, metadata);
                        return (true);
                word:
                pdf:
                        if (installed(plugin[document]))
                        {
                                return (InterTag(plugin[document].process(document), tagarea, metadata));
                        }
                        else
                        {
                                text = extract(document);
                                pictures = extract(document);
                                audio = extract(document);
                                newdocument = link(text, pictures, audio);
                                return (InterTag(newdocument, tagarea, metadata));
                        }
                default:
                        return (throw "unsupported type");
        }
}

Function IntraTag(keywords, tag, document) return string
{
        results = perform_search(keywords);
        if (tag == document.lasttag)
        {
                return IntraTag(keywords, tag, results.nextdocument(document));
        }
        return (document.nexttag(tag.currentpos));
}
```

For the implementation of the inter and intra tagging functionalities, we took the following steps.

First, we stored data in an InterTag table encompassing four columns, namely, file-path (id), start-position, end-position, and meta-data. For video/audio sources, start and end positions note the start and end time of the clip. For texts, these values denote the part of texts to be tagged. For pictures, users can tag an area of interest using the rectangular selection tool. The upper-left and lower-right coordinates are ($x1$, $y1$) and ($x2$, $y2$) respectively. The start and end positions can thus be represented by S = y1 * Image.Width + $x1$; $E = y2$ * Image.Width + $x2$, respectively. To improve the performance of tag discovery, the InterTag table uses the meta-data column for indexing purposes.

Secondly, tags were linked using the standard keyword approach. For example, users can assign one or more keywords to any document. Our rationale here was to produce

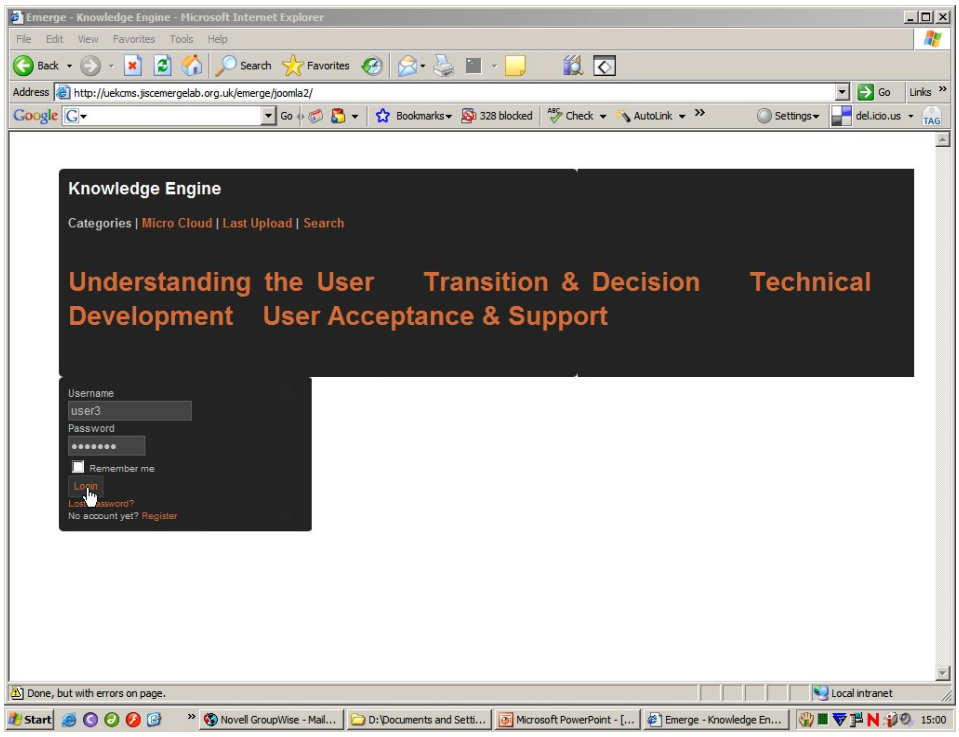
functionality allowing the navigation from one tag to the next relevant one, where tags may be located within the same or another document. This has been accomplished by first storing the search query in the current session when the search is performed. When users view a particular document, the document identifier (id) is recorded. Using a standard search engine feature, we automatically fetch the id of the next document that also satisfies the original search query. HTML tags in the form of links are generated automatically during runtime. This enables the navigation from one document to another via the last tag of the current document and the first tag of the next document. The functionality applies to various document formats including text, picture and audio-visual clip. Again, to improve the performance, the search field column is used for indexing purposes.

The inter and intra tagging functionalities in form of an algorithm expressed in pseudo code can be seen in Figure 4.

4.2.2 Using the KSP

Once logged into the system a user can browse content using the categories, sub-categories or the tag cloud. There are several options available (see Figure 5). Essentially the screen is broken up into two areas, the top navigation bar and the categories. The top navigation bar is comprised of: my files, upload, preferences, categories, micro cloud, last upload, search and search history.

Figure 5 The KSP Prototype web page (see online version for colours)



The 'My Files' section comprises a record of existing files that have been uploaded by a user and a number of options are available, arranged horizontally, with each file dependant upon its type. All files can have supplementary files added to them here. Each file also has the capacity to be viewed or listed and also to be downloaded in pdf format.

On the top navigation bar, there is an option for the user to 'Upload' files. Once a file has been uploaded the user is required to give the file a title and description, as well as allocate a category and relevant sub-category. The user can also allow other users to tag the file. Next, the user can tag their document. The user can for example select an area of an image by creating a marquee over the appropriate area and then ascribing a tag to that marquee area by using the add tag button. With text, the process is similar, text needs to be highlighted/selected and then a tag can be ascribed using the add tag button towards the bottom of the screen.

The 'preferences' function provides the user with choices relevant to how they would like text and tags to be rendered by the browser. This includes text size, foreground and background colour of tags in a document as well as foreground and background colour of text in a document. The 'last upload' function supplies a list of the latest uploaded files by the entire community. The 'search' function enable the user to search for content based on a given keyword, tag or phrase. Finally, the 'search history' function enables a more streamlined workflow by allowing a user to display a list of their most recent searches.

4.3 KSP prototype testing and evaluation

Testing of the portal was an essential process during all iteration phases and was undertaken by specific, discrete groups. In particular, user testing required a number of user roles to be looked at, such as expert or non-expert users; additionally a user guide was created for use with worksheets during the testing. Functional testing had been carried out as an ongoing process in-house during all iteration phases however both formative and summative user testing was an eminently sensible process to undertake to investigate the usability and functionality of the final portal prototype. A major factor here was to get feedback and opinions from people who had not been involved in the development of the project and were viewing the site for the first time.

Table 2 UC1 formative results

No.	*Error description*	*Occurrence (out of 10)*
1	Confusion with homepage navigation	3
2	Confusion with knowledge sharing portal navigation	3
3	Confusion with site terminology	5
4	Failure to save tags/site failure	4
5	Issue/boredom with repetition of tagging	2
6	Difficulty in macro tagging	1
7	Difficulty in micro tagging	4
8	Uncertainty about capitalisation of tags	2
9	Confusion with search facility	2
10	Difficulty with tag browsing	5

Specifically in UC1, three groups assessing specific areas carried out the testing, these include: three expert specialists from the arts professional domain, 15 software-technical experts from the computing domain and finally, 20 ordinary non-regular users. Arts professionals assessed the general functionality of the KSP by logging in to the system and carrying out specific tasks, such as: testing the upload feature, testing the tagging features, testing the tag cloud and search features, and assessing whether the KSP facilitates an impact value towards their work. Software testers tested specific functionality of the portal for errors, again by logging into the system and carrying out pre-determined tasks in a similar fashion to the arts professionals. Finally, non-regular users looked specifically at content and usability and testing as the previous two groups. All testers were given essentially the same tasks to conduct with the aim of: logging in to the system, testing the KSP upload, testing the KSP tagging, testing the KSP tag cloud and search, and assessing whether the KSP facilitates or helps the user with their work. Testing was carried out on both PC and Macintosh platforms with both internet explorer and Firefox browsers on each. Table 2 illustrates primary issues identified during the second iteration phase, which has been dealt with to the satisfaction of UC members during the third iteration phase. In particular, a number of changes were requested from the UC1 for the third iteration, including a definitive set of Macro tags (to be called categories), the ability for users to request only a new category and some minor functionality/usability issues to be addressed such as implementing a breadcrumb navigation trail. Final feedback in late 2008 from UC1 funders and members through site visit interviews confirmed that the technology was relatively easy to use and overall has validated its purpose (Bessis et al., 2009a).

Since the software-technical experts from the computing domain and non-regular users had already tested it, the portal was also presented to fifteen UC2 expert specialists during an online conference using the Elluminate online collaboration tool. The audience were given a presentation on how the portal and KE operate and the types of functionality they have. This was followed by a brief exercise in using the portal and its embedded KE. After the exercise, participants reflected on their experience during the exercise and sought some further clarification on either functionality or scope of the KE portal. Members of the audience expressed that there was an amount of similarity with regards to the intra-tagging principle being offered by the KE and by the online service offered by Diigo (http://www.diigo.com). One essential point came up during this discussion and that was the issue of rights access and who should have it. Basically there were two schools of thought on the issue, one was that only selected members from the U&I support team should have rights to upload and tag material, while the other line of thinking was that everyone in the U&I community should be able to upload and tag material. The case for only selected members being able to upload and tag was essentially that a certain level of quality of service could thereby be maintained. The selected team would be instructed as to aesthetic content parameters and could ensure that these were adhered to when the wider UC2 fed material to them. The alternative viewpoint was that the whole UC2 should have rights to upload and tag material as they saw fit. Early in 2009, the UC2 was offered the opportunity to run a questionnaire that was actioned by Glenaffric ltd, an independent consultancy, to evaluate the project as a whole. Four questions from the survey were directly concerned with the KSP and its usage.

Table 3 UC2 summative results

If an archive of user engagement project experiences from the users and innovation programme were established, how likely would you to be contribute to it? (n = 20)		
No response	3	15%
Possibly	5	25%
Quite likely	5	25%
Very likely	2	10%
Definitely	5	25%
What file types might you contribute? (n = 38, multiple responses allowed)		
Text	16	42%
Image	6	16%
Audio	5	13%
Video	8	21%
Spreadsheet	3	8%
What type of functionality would you like the archive to have? (n = 56, multiple responses allowed)		
File upload	14	25%
Blogging	6	11%
Tagging	9	16%
Tag cloud	5	9%
Wiki	8	14%
Flickr	4	7%
RSS aggregation	2	4%
RSS feed	6	11%
Calendar	1	2%
Microblogging	1	2%
If such an archive existed, would you be likely to: (n = 20)		
No response	3	
Refer to it before the end of your project		
Unlikely	4	20%
Possibly	3	15%
Quite	2	10%
Very	3	15%
Definitely	5	25%
Refer to it in the future projects		
Possibly	5	25%
Quite	2	10%
Very	6	30%
Definitely	4	20%
Possibly	3	15%
Quite	2	10%
Very	6	30%
Definitely	6	30%

Specifically, from the twenty UC2 responses, 35–55% of them would be likely to contribute to the portal, the most likely file type to be uploaded would be textual (42%), that uploading and tagging files was seen as the most important functionality for this kind of repository, that 35–45% of respondents would refer to it during the course of their current projects and finally that the majority of respondents (60%) would be most likely to use the portal as a resource in future projects. Therefore, it is concluded that UC2 perceived the portal and its KE as beneficial not just during this project lifecycle but quite likely in future projects as well. Table 3 shows these results.

4.4 Wider community feedback and future developments

Apart from demonstration of these works to UC1 and UC2 members, partial formative and summative from these studies have been formally presented in the IADIS Web-Based Communities 2008 and 2009 conferences. Feedback from the audience was very encouraging.

Currently UC1 is looking at making the KE available to the wider UK arts and cultural organisations community via the UK Arts Council national website. In contrast, UC2 has decided not to make the KE available to the UC2 wider community. This is partly due to the discontinuation of funding in the U&I programme and thus, there was considered little benefit in maintaining and sustaining the technical infrastructure.

The basic premise to future proofing the KE is through the addition of an XML conversion module. By converting files to XML before or during the upload step tagging of more file types becomes possible. By using XML-based files on the KE, the portal would be capable of accepting numerous file types for various and multiple purposes. Additionally the use of XML can facilitate the use of embedded URLs from within a given tagged document. For example, by pulling in XML data for the KE, the portal should be able to produce facilitation for a number of applications serving differing needs. Facilitation for applications could range across a data site, a mashup, or a data integrator to name but a few.

There is also current interest from the wider community to further explore the functionality of assigning inter and intra tagging in video and audio parts. Recently, we receive an interest from external parties to build a grid technology-based information environment to support the academic dance community. This is considered a grant challenge and we are currently looking for funding opportunities to support this joint endeavour. This will investigate and develop an e-infrastructure provision that will specifically support and enable practice-led dance researchers to work together both physically and virtually to organise, share and search data and to disseminate their activities and outputs more effectively. The central means for capturing, managing, analysing, sharing, preserving, curating and re-using practice-led dance research and scholarship is through visual rather than textual means. Moreover, practice-led dance research creates large amounts of video (and audio) data which needs to be preserved in order that it can be searchable and (re)usable. This therefore, needs to detailed meta-data associated with it. Currently it is not easy to search the content of video data, searches utilise meta-data and annotations to videos. We believe that we can develop a video-mining plug-in within motion capture (for example), which is able to recognise key movements within the video streams and mark them in a map. The development will also require the production of an unsupervised discovery of patterns in audio-visual content generated from the data stream source.

5 Conclusions

In this article, we have describe experiences learnt from the development of two repositories of shared knowledge using next generation technologies such as intra and inter tagging functionality. The portal acts as a means to allow two dispersed UCs to publish, browse and search for relevant information, including audiovisual material, through a web interface. A unique, specifically designed CUNA to allow elicitation of diversified needs from two UCs has been employed. The portal was previewed by members of the UC with further changes and enhancements being made to the KE before it was scrutinised by the wider UC for further development. Feedback obtained from the UC1 funders and members confirmed that the portal has validated its purpose. While UC2 has decided not to make the portal available (due to discontinuation in the funding stream), a questionnaire by an independent consultancy demonstrate that UC2 members perceive the portal as beneficial not just during this project lifecycle but also quiet likely in future ventures.

Acknowledgements

These works were supported by MDDA, the Arts Council and JISC.

References

Ambition (2009) *About*, available at http://www.getambition.com/about/.

Bessis, N., Gaitan, A. and Shukla, M. (2009a) *Achiever Final Report*, University of Bedfordshire.

Bessis, N., Shukla, M. and Lai, Z. (2009b) 'Sharing experiences using Web 2.0 and knowledge portals for advancing web communities', *Proceedings of the IADIS International Conference on Web-Based Communities*, pp.43-50.

Bessis, N., Gaitan, A., Shukla, M. and Stephens, J. (2008) 'Using next generation service oriented technologies to assess cultural handling of information communication technology', *Proceedings of the IADIS International Conference on Web-Based Communities*, pp.261–266.

Capital Programme Briefing Papers (2006) *Users and Innovation Development Model,* available at http://www.jisc.ac.uk/media/documents/programmes/capital/user_and_innovation_development_model_briefing.pdf

De Vries, S. and Kommers, P. (2004) 'Online knowledge communities: future trends and research issues', *International Journal of Web-Based Communities*, Vol. 1, No. 1, pp.115–123.

Fowler, C. and Scott, J. (2007) *The User Innovation and Development Model Guide*, available at http://vle.jiscemerge.org.uk/mod/resource/view.php?inpopup=true&id=100.

Glaser, B.G. and Strauss, A.L. (1967) 'The discovery of grounded theory', *Strategies for Qualitative Research*, Aldine, Chicago.

Hildrech, P., Kimble, C. and Wright, P. (2000) 'Communities of practice in the distributed international environment', *Journal of Knowledge Management*, Vol. 4, No. 1, pp.27–37.

JISC (2009) *Synthesis and Evaluation of Reference Model Projects: Lifecycle method in relation to the UIDM*, available at http://misc.jisc.ac.uk/refmodels/analysis_and_synthesis/methods_UIDM.html.

Roberts, G. (2008) *JISC Development Programmes: Project Document Plan*, available at http://www.jisc.ac.uk/media/documents/programmes/usersandinnovation/emergeprojectplan.pdf.

Roberts, G. (2009) 'Emerge project: support, synthesis and benefits realisation for the users and innovation programme', *JISC*, Final Report DRAFT', available at http://www.jiscemerge.org.uk.

Rodrigues, S., Oliveira, J. and de Souza, J.M. (2004) 'Competence mining for virtual scientific community creation', *International Journal of Web-Based Communities*, Vol. 1, No. 1, pp.90–102.

Santos, O.C. and Boticario, J.G. (2008) 'Requirements for building accessible web-based communities for people with functional diversity', *International Journal of Web-Based Communities*, Vol. 4, No. 1 pp.52–65.

Yusef, H. and Herrero-Solana, M.V. (2006) 'Improving tag-clouds as visual information retrieval interfaces', *Proceedings of the International Conference on Multidisciplinary Information Sciences and Technologies*, available at http://www.nosolousabilidad.com/hassan/improving_tagclouds.pdf.