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# **Knowledge Resource Network (KRN) Project**



## **Final Report**

**July 2006**

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## **Introduction**

The Knowledge Resource Network (KRN) Project is a partnership between the Universities of Cambridge, Massachusetts Institute of Technology, and the Open University.

The project's aim was to further the exchange and reuse of teaching materials in higher education. The starting point was the set of graduate courses jointly developed by the University of Cambridge and Massachusetts Institute of Technology, designed to support the growth of enterprise cultures. With MIT's OpenCourseWare (Long 2002) as an example, our sponsors sought ways to share the materials developed with other universities. The intention was to collect, develop, and share the CMI teaching materials; to create a suite of tools and resources; and to record the development process in order to gain a better understanding of designing for reuse.

This report outlines the history and management structure of KRN, describes the various activities carried out over the life of the project, and reports research findings and outcomes. With a view to sustainability, it also gives details of future directions and extension work that have been identified by the project, together with plans for user engagement and community-building.

### **KRN Project Goals**

KRN activities were developed in pursuit of three principal goals:

- To collect all the teaching materials used in the CMI taught graduate programmes;
- To succeed in sharing MPhil value with other UK universities;
- To contribute to the overall mission of improving the UK enterprise culture.

In order to achieve these goals, it was recognized from an early stage that it was essential for the project to develop a research agenda, aimed at understanding the cultural and institutional issues involved in the reuse of learning materials. The intention was for this research agenda to be carried out in parallel to project development work, designing and re-shaping a series of KRN materials for reuse outside their original teaching contexts. The knowledge created by the KRN research agenda would then inform the creation of higher-level protocols and frameworks for the design and development of materials intended for reuse. In this way, the project could move beyond an understanding of individual, localised practice to a more generalisable or "best practice" model for higher education, with potential application beyond the Cambridge / CMI contexts. In line with CMI's focus on academic collaboration, fostering cooperation—between members of the KRN project team and between project partners—was seen as an essential element of the project. Great efforts were made to ensure that each strand of project activity would contain a collaborative dimension.



## **KRN Project Outputs**

KRN successfully created a range of project outputs. First among these is the KRN digital repository, based on the Open University's Knowledge Network software, which contains all the teaching materials from the CMI M.Phil programmes (over 1000 items, ranging from individual digital images to full sets of lecture notes). The process of collecting the materials and working with academic authors raised crucial issues of ownership and IPR, which it became essential to address in order to progress further. This led directly to the creation of the KRN Flagship Projects: six development projects drawn from the original materials in the repository, which were identified as being of particular academic and pedagogical interest. Each Flagship Project involved the creation of a partnership with another department or external institution committed to reusing the materials developed in collaboration with the KRN team and with the original CMI authors.

Through the medium of the Flagship Projects, KRN developed mechanisms to create sustainable partnerships between individuals and institutions who wish to share or co-develop teaching materials. This included the creation of an inter-institutional Memorandum of Understanding, which is being used by the Flagship Projects, and has been made available for use by other projects and institutions. The Flagship Projects adopted an innovative approach to legal issues, including intellectual property rights and copyright, based on the Creative Commons model.

As an alternative, complementary model to the Flagships, KRN focused on the notion of academic communities of practice as a means to foster the informal sharing of knowledge and professional expertise. In order to foster a community of practice around reuse, three major workshops were held, focusing on key questions of interest, including legal issues in e-learning systems, innovation in the field of electronic learning materials, and new and emergent pedagogies. The project also sponsored the creation of two more formal Communities of Practice in collaboration with professional academic societies, the Royal Academy of Engineering and the Institute of Physics.

Lastly, the project created a range of research outputs that includes data sets, research experience and methods—and particularly, knowledge of innovative teaching methods, including role plays and case studies.

## **Acknowledgments**

The KRN Project team would like to acknowledge the support and assistance provided by staff at the Centre for Applied Research in Educational Technologies (CARET) at the University of Cambridge, which hosted the KRN Project from January 2006 and provided essential facilities, resources, and guidance on project planning and research methods. We would particularly like to acknowledge the support of the Director of CARET, John Norman; the administrative team, Ms Stephanie Saunders and Ms Katy Cherry; the Evaluation Manager, Patrick Carmichael; and the CARET Project Manager, Emel Kus.

We would also like to acknowledge the work of Ms Sue Keppie, who provided administrative and research support to Steve Hurst while the project was managed from the Judge Business School (or, as it was then called, the Judge Institute of Management Studies) and during the handover period, as the project transferred to CARET.

This Report was edited by Catherine Howell, based on contributions by the following members of the KRN Project Team:

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## **Staffing and Project Management**

### **First Phase: June 2003 – January 2006**

The KRN Project was initiated in June 2003 by Prof. Joel Cutcher-Gershenfeld (MIT), Dr Bill Nuttall (University of Cambridge), and Dr James Aczel (Open University). Final budget was approved in early 2004. Dr Betty Barrett (Engineering Systems Learning Centre / MIT) joined the core team in summer 2003.

Project management for the initial phase of KRN passed through three stages. The first project manager was Shwen Gwee (graduate student in neuroscience, University of Cambridge), who worked on the project 1 day per week. Shwen was responsible for organizing the first KRN workshop in 2003.

Subsequently, joint project managers were appointed, one for the UK work (Steve Hurst, Judge Institute of Management Studies / University of Cambridge) and one for the USA (Abe Dane, MIT). Abe Dane left MIT/CMI early in 2005 to pursue a career in industry. Steve Hurst then assumed responsibility for the entire project, with support from project administrator Sue Keppie (Judge Institute of Management Studies / University of Cambridge).

Additional technical and research support staff from the Open University made significant contributions to the project; including William Woods, Hassan Sheikh, and Rob Hughes (Institute of Educational Technology / Open University).

The team managed internal and external communications by producing a monthly progress report, supported by a regular conference call schedule, and reporting to the CMI MPhil team at Jochen Runde's monthly meeting.

The project team also attended three face-to-face meetings. Two KRN meetings were held at MIT, in September 2004 (attended by Joel Cutcher-Gershenfeld, Betty Barrett, Abe Dane, Bill Nuttall and Steve Hurst) and in June 2005 (attendees: Joel Cutcher-Gershenfeld, Betty Barrett, and Steve Hurst). The team also held a meeting in Newton Longville in September 2005, prior to the KRN workshop at the Open University (attendees: Joel Cutcher-Gershenfeld, Betty Barrett, Bill Nuttall, Jochen Runde, James Aczel, John Norman, and Steve Hurst). This meeting confirmed the transfer of KRN to CARET and the start of its second phase.

**Second Phase: January – July 2006**

In January 2006, management of the KRN Project passed to the Centre for Applied Research in Educational Technologies at the University of Cambridge. Dr Catherine Howell assumed responsibility for project liaison, and was joined by Research Associates Matthew Riddle and Dr Lee Wilson. Professor Mary Thorpe (Open University) oversaw the work of the Open University's evaluation team during James Aczel's sabbatical leave. Steve Hurst was retained as a part-time project consultant, until July 2006. In June 2006 Matthew Riddle assumed a role as leading the development phase of the project through the KRN Flagship Projects.

CARET-based project staff continued to communicate with distributed members of the team via email, occasional face-to-face meetings, and teleconferences. A Wiki, published via the CARET intranet, was used by the team to document day-to-day project activity. Team members met regularly with CMI teaching and administrative staff, and also attended meetings of the CMI MPhil Working Party.

## **Motivation**

Education has always been fundamental to the Cambridge-MIT Institute's programme of activities. CMI activities collectively provided many avenues for the dissemination of knowledge from the academic research lab and lecture theatre through to industry practice and professional training. In particular, the six CMI M.Phil programmes (in Advanced Chemical Engineering Practice, BioScience Enterprise, Computational Biology, Engineering for Sustainable Development, Micro- and Nanotechnology Enterprise, and Technology Policy) provide a leading example of research-informed graduate education with a clear emphasis on professional training and the application of research knowledge to industry and "applied" settings.

In line with the CMI focus on Research, Industry and Competitiveness, there is an acknowledgement that, as social institutions, universities have a duty not only to create new knowledge, but to benefit the wider community by engaging in knowledge transfer. In particular, institutions may stand to gain much by creating processes to capture the knowledge that is created in teaching. How might CMI capture and enable exchange of the multi-disciplinary knowledge generated as part of the CMI M.Phil programmes? The KRN Project represents, in part, an attempt to answer that question.

KRN work sprang from an awareness that teaching practice in research-intensive universities has special, distinctive qualities. Students may have opportunities to learn a subject from the leading expert in that particular field; while researchers may also benefit from the fresh insights and creativity of students. However, staff engagement in, and awareness of, cutting-edge research practice may mean that the boundaries of a defined subject or teaching area are prone to change regularly, potentially resulting in an increased workload for teaching staff.

More particularly, at the universities of Cambridge and MIT, where small-group teaching plays a key role in pedagogy, teaching necessarily involves the creation of various forms of dialogue: between student and teacher, between teaching staff, and between student peers. The creation of these learning dialogues may be characterized as a form of emergent knowledge. Yet this knowledge is frequently not captured from year to year, or even from term to term. If the same member of teaching staff teaches a particular topic over several years, he or she accumulates a depth of professional experience in that specific area. Yet this deep level of pedagogical knowledge and expertise often remains with the individual, and may not be shared even with colleagues in "team-teaching" situations. Sharing materials and cooperative work are an established part of research practice in higher education, where collaboration is seen as delivering increased productivity as well as less tangible, but no less important, benefits to the institution, such as increased communication between staff. What then are the barriers to extending these practices and benefits to the domain of teaching and learning?

Part of the challenge for this project has been to discover, capture, and promote ways to make it easier to design materials that are suitable for reuse. The existing literature on digital repositories and Reuseable Learning Objects (RLOs) in higher education suggests that designing for reuse is prohibitively resource-intensive and inefficient. It is claimed, for instance, that “Universities tend to treat courseware development as a cottage industry and would benefit from using the models from industry” (Rada, 2001). How then might insights from industry improve the process of designing for reuse? What can be learned from other disciplines that practise reuse, such as software engineering?

The greatest potential gain from industry is thought to be in terms of streamlining the design process and avoiding duplication of effort. This is particularly relevant when it comes to making the initial argument for reuse, because it is known that creating learning materials fit for reuse costs more time and effort than creating materials to be used once. Indeed, it has been claimed that “in the context of Open Universities and eUniversities in Europe, we have experienced that the efforts required to reuse objects in most cases outweigh possible advantages .... This is especially true when the objects are developed in different institutions”. (Koper et al., 2004). The KRN research programme, based on in-depth, semi-structured interviews with staff and students, investigates these issues and captures perceived issues and barriers to reuse.

However, successful models for reuse do exist. At an informal level, teachers do share materials: from whole textbooks to individual PowerPoint slides. A succession of digital repository projects for education, including JORUM, has provided a variety of community-based models for reuse, and an increasing variety of educational design applications (such as RELOAD) allows staff to design and edit learning objects, and to create effective tasks and workflows. MIT’s OpenCourseWare provides a successful model for “designing for reuse”, based on high-quality, research-informed teaching materials. Open CourseWare is recognized as a world leader in open learning and promoting the reuse of educational materials, based on free exchange. All of these models form a useful starting point for tailoring our design approach to the UK domain. Our Flagship Projects approach is designed to build on these various initiatives, by implementing the findings of the research team in a series of focused development projects.

The project recognizes that human and organizational factors present significant barriers to reuse. “Beliefs regarding the perceived benefits of reuse and the perceived ease of use are contingent on the organizational actions regarding resources required to develop and market reuse” (Sherif & Vinze, 1999). Reuse thus depends on the existence of a supportive institutional culture. For reuse to thrive, the shared understanding has to be that it is important, that it is something that the institution values and rewards. The model of Communities of Practice was chosen to complement the KRN research and development initiatives, bringing two groups of academic staff from diverse institutions together, under the imprimatur of the relevant professional / learned societies (Royal Academy of Engineering and the Institute of Physics), to discuss issues around pedagogy and reuse within the emerging disciplines of Sustainable Engineering and the Built Environment and Complexity Science.



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## **Research and Evaluation Summary**

### **Introduction**

The following is a summary of the research programme that has been designed and implemented by the KRN team at CARET. The KRN project strategy has involved three distinct strands, fostering communities of practice, development, and research and evaluation. However, it should be stressed that the research activities feed into and inform all aspects of the project as it has been hosted at CARET. The approach that has been taken towards research is participatory, the assumption being that a strong research focus is necessary in order to fulfil the project aim of the development and dissemination of materials held in the repository. The KRN team has made significant headway into identifying the barriers and obstacles to reusing learning materials and the ways in which these learning materials are reused.

The focus of the first phase of the project was on the collation of materials to be stored in the repository. In order to circumvent issues surrounding IP and the ownership of materials, authors were given the guarantee that their materials could not be reused or developed without their explicit permission. After this initial stage of the collation of learning materials, the dissemination of materials was to take place through the generation of ‘communities of practice’ that materials might be fed into. As a first step in this second phase of the project at CARET, it seemed sensible to identify which authors might be willing to allow others to use their materials, and indeed, what themes these ‘communities’ might coalesce around.

Rather than take a unilateral decision as to the value of particular ‘learning objects’, the KRN team at CARET deemed it a necessary first step to try and identify which materials might have value and for whom. We wanted to know how and when reuse took place, between who, and why? What were the motivations for doing so? If reuse did take place, what kinds of things kinds of things were being reused? What was a ‘learning object’ from an author’s perspective? These questions were prompted by a review of literature surrounding the reuse of learning objects, and of other digital repositories. It seemed clear from this review that a focus on the materials in these projects had met with limited success in the fostering of reuse. We considered this to be an issue of fundamental importance. We took the further view that what we managed to achieve should be replicable outside of the context of the KRN project. That our findings should, if possible, provide a roadmap for reuse and collaboration between other partners and institutions, and that the findings and lessons learnt from KRN should not be lost.



## **Research Programme**

To date the following research activities have been carried out. The development strand of the project is due to run through to September, during which time further data will be gathered on the interaction with partners in the KRN project. At the moment it is planned that some of these materials that are in the process of being developed in collaboration with partners from other universities will be introduced into the curriculum of these institutions at the beginning of the academic year in October 2006. The opportunity to monitor this process has been included in the memorandum of agreement with prospective partners.

- To date we have conducted nineteen semi-structured interviews with fourteen authors of materials held on the repository. The interview schedules were open ended, the aim being to explore issues around the topic of reuse with the interviewees as they arose in the course of the discussion.
- In addition to the qualitative data gathered from the author interviews, we have carried out a number of semi-structured interviews with students on the CMI MPhil courses, with more planned over July and August.
- Classroom observations of particular learning materials being delivered have been conducted.
- We have conducted a content analysis of student reflections on their participation in one of the Flagship projects.
- Interviews with potential reuse partners in other institutions have been carried out. Further meetings are planned during the development stage of the project through to December that will add to the body of qualitative data.

This research has presented us with a wealth of qualitative data on the issues surrounding the reuse of learning materials. It quickly became obvious that an approach that focused upon people and not things was more likely to meet with success. We took the view that the focus upon the collation of ‘learning objects’ to some extent obscured the social production of ‘things’. The value of the materials to authors and the kinds of exchange relations in which such materials might be embedded have been identified as important matters that need to be addressed if collaboration is to take place. Other issues included trust, reciprocity, quality assurance and recognition. We identified that reuse of materials held in the repository was taking place outside of the confines of the KRN project, but that it was informal, and often ad hoc. On a practical level, sustainability was identified as a consideration for any potential collaborative interaction. This has influenced our approach to the promotion of reuse in the following ways.

- We have aimed to encourage the exchange of materials in a manner that is sustainable beyond the period of CMI funding.
- We have focused upon the mapping of existing social relationships in which the production and exchange of learning materials takes place using ethnographic methodologies and research processes.
- The focus has been on relationship building. We have shifted the emphasis on things, the ‘learning objects’ themselves, to the social relationships in which these



‘things’ are produced and embedded. Our aim has been to facilitate relationships and, where possible, to broker collaboration.

- The involvement of authors in a repository from the outset is important for its success. This has been an important aspect of the development phase of the project. Not only for the curation and subsequent development of materials, but from the perspective of fostering sustainable relationships between partners.
- Collaboration with KRN partners takes place under a creative commons licence, <http://creativecommons.org/licenses/by-nc-sa/2.5/>, that addresses the concerns of the authors and re-users of materials.

## Summary of Interview findings

The following is a brief summary of some of the findings that have informed our research and interactions with contributors to the repository, and in turn, our development approach to the Flagship Projects.

- As one author put it, “people work with people, not machines”. An object focused approach to building repositories is probably not going to work. Rather, the focus should be on building new interpersonal relationships, or strengthening and providing a framework for existing relationships, through which the exchange of materials might take place.
- Reuse would seem more likely to happen freely at the “cutting edge”. Currently in Nanotechnology materials are out of date if they two years old. Thus, materials held on a repository that are not constantly updated soon become less attractive to potential users.
- Reuse is often driven by limited resources. For example, collaboration with one of the potential KRN partners, Lancaster University, is seen to be motivated in part by a desire to access an extra resource stream. Yet the original instance of reuse, the course structure for the CMI Nanotechnology MPhil (upon which a similar course at Lancaster is based) hinged upon the social actors involved. It was through these relationships that reuse occurred.
- Sustainability is an important issue for reuse. If particular elements are to be used in a course, then it is important they will continue to be available, and that, for example, issues of licensing will not be a problem further down the line.
- Brand image does seem to be important. Issues of quality assurance are seen to have been addressed in part for some Flagship partners by the Cambridge/MIT reputation. They can state that they are working in conjunction with these institutions.

It seems that collaboration often takes place for the purposes of research, but not for the purposes of pedagogy, the sharing of experiences, materials, etc. Where reuse does take place, it is through established networks of personal relations. There are a number of issues that are neglected in an approach that focuses upon the materials abstracted from social relations.

- Trust was often mentioned as an issue for academic authors, and was necessary



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as the basis for the exchange of materials to take place.

- The value of material to authors was an important issue. Academics are, to some extent at least, what they write. Their worth is made visible by what they produce. This is the way that they act upon the world. It is therefore important that they maintain some connection to their materials.
- Originality was a major concern for some of the authors. They felt that they had to be seen to be feeding their own research into their teaching. This had some impact on the use of other peoples' materials in their teaching practices.
- Recognition for the production of work was often voiced as a reason for making things public. The reuse of teaching materials raised concerns over how materials might subsequently be used, and how they might be developed further.
- IP was, not surprisingly an issue. But not as much of one as we thought it might be initially. Issues over recognition, subsequent use of materials and quality assurance seemed to be of greater concern than in the majority of cases.
- Reciprocity was an issue. What is in it for the author to share their materials? If there was some benefit involved, for example, professional development, recognition from peers, helping a friend, exchange of materials or ideas with a colleague, and so on, all, to some degree, hinge upon reciprocal relations.
- The Research Assessment Exercise in the UK is also of concern in relation to the reuse of other peoples' materials, or the subsequent development of these. How, for example, might credit be given for the development of these materials in the RAE?

In relation to the KRN as a means to foster collaborative relations, authors identified the following mechanisms that they would like to see implemented in a digital repository of learning and teaching materials.

- Materials often require curation, and change rapidly. Without involvement from authors materials can not be updated, and are often quickly out of date.
- The text book publishing model is not entirely appropriate for repositories such as KRN as it does not facilitate the continual updating of materials as they are developed. It is synchronic, providing a snapshot of materials at a particular moment in time. A repository that is the focus for interactive relationships with students and colleagues should encompass mechanisms that enable the materials held on the repository to be continually updated by authors or collaborative partners that might modify the materials in some way.
- Domains of knowledge often overlap, and what may of interest to other parties are not always readily accessible through current means of searching the KRN repository. For example, one of the Flagship Projects partners, Brunel University, is collaborating in the development of a role play exercise from the Technology Policy module, yet they are a Centre for Public Health. It would be a great help if therefore the repository to be searched by topic.
- Peer Review. Authors are often in favour of the dissemination of their own materials, and those of others, but quality must be assured. Materials might be peer reviewed before submission. This might allay fear as to quality of materials, and elicit further interest in a repository as a source of materials. Issues of QA are addressed through working with colleagues, fellow

researchers, and so on. Materials, in the form of text books, are often reused, but there is a peer review process that ensures that a particular book is worthy of being published.

### **‘Communities of Practice’**

The theme for the KRN Workshop in September 2005, “Enabling Communities of Practice”, was chosen in light of the increasing evidence that technology is not the major barrier to sharing in higher education. Academic authorities and various academic technology programs and initiatives working on digital repositories and related areas were starting to point to the importance of cultural and institutional factors in ensuring user engagement and adoption.<sup>7</sup> Adopting Etienne Wenger’s concept of “Communities of Practice,” the KRN project attempted to foster and support two subject-based groups around subject areas of common interest to participants.<sup>8</sup> The intention was to seed the development of cross-disciplinary, cross-institutional peer networks through which sharing and reuse might take place on a less formal, more personal basis.

Two KRN Communities of Practice were established, to support the domains of Sustainability and the Built Environment, and Complexity Science. These particular subjects were chosen in order to test our hypothesis that academics working in newly-established, fast-moving subject fields may be more amenable to sharing pedagogical strategies and learning materials.

The Open University evaluation team, with oversight from Mary Thorpe and James Aczel, produced an Evaluation Plan for the KRN Communities of Practice (attached as Appendix 1 to this Report).<sup>9</sup>

### **Community of Practice on Sustainability and the Built Environment**

The first KRN Community of Practice was initiated in partnership with the Royal Academy of Engineering. With assistance from Dr Richard Fenner, course convenor

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<sup>7</sup> See, for example: The Academic ADL Co-Lab, “Content Repositories as e-Learning Tools: Community Building with Repository Services”, Paper developed with support from The William and Flora Hewlett Foundation, available online at:

[http://www.academiccolab.org/resources/Repositories\\_Tools.pdf](http://www.academiccolab.org/resources/Repositories_Tools.pdf)

Neil Ballantyne, “The Learning Exchange: Issues Emerging from the Large-Scale Roll-out of a Subject Specific Repository”, Cambridge eLearning Symposium, Cambridge UK, June 2006; Patrick Carmichael and Richard Proctor, “Research archiving, user engagement and the semantic web,” TLRP Annual Conference, Cardiff, November 2004, available online at:

<http://www.tlrp.org/dspace/handle/123456789/127>; George Roberts et. al., “Reflective learning, future thinking: digital repositories, e-portfolios, informal learning and ubiquitous computing”, White Paper, ALTA / SURF / ILTA Spring Conference Research Seminar, Dublin, 1 April 2005.

<sup>8</sup> Etienne Wenger, Richard McDermott, William Snyder (2002). *Cultivating Communities of Practice: A Guide to Managing Knowledge*. Boston, Mass.: Harvard Business School Press.

<sup>9</sup> At the time of writing this Report, the final Report from the Evaluators has not yet been received.

of the CMI MPhil Programme in Engineering for Sustainable Development, the project team compiled an invitation list of key academics, consultants, and engineering professionals working in the area of sustainability and the built environment. The original intention was to establish a Community of Practice on ‘Sustainability’; however, the decision was taken to broaden this topic to encompass the ‘Built Environment, as the RAE later decided they were going to establish their own CoP on Sustainability—a positive indication of the currency of this issue for the profession.

We were able to build on the work of the 2005 Workshop on “Innovations in the Reuse of Electronic Learning Materials: Enabling Communities of Practice”, which had already established some requirements for the creation of sustainable communities of practice. In light of that workshop’s emphasis on fostering communities as a way of promoting the sharing and exchange of learning materials, we selected the themes of engineering pedagogy and fostering innovation in engineering education as a ‘point of focus’ for the meeting.

The initial Community of Practice meeting was held at the Royal Academy of Engineering in London, UK, on 16 December 2005. It was attended by representatives from Cambridge (CARET and Engineering), CMI/MIT, the UK Government’s Department for the Built Environment, City University London, the University of Manchester, and the Royal Academy. David Foxley (RAE) hosted the meeting, and Betty Barrett acted as facilitator. David spoke on the work of the RAE in reforming the engineering curriculum, with particular reference to the Visiting Professors in Sustainability programme. Betty introduced MIT and CMI’s work on pedagogy and reuse. Catherine Howell introduced the KRN project.

The meeting identified three major challenges for educating future engineering professionals in the area of sustainability and the built environment:

- Sustainability is a complex, multidisciplinary area, and it requires a holistic approach to design. Building students’ design skills, and finding ways to engage them in the design process—particularly, increasing their involvement in the creation of design specifications—will be crucial to the profession’s ability to grow and develop engineers who can deal successfully with contemporary and future challenges to sustainability;
- Problem-solving skills are allied to design skills. Increasing the use of problem-based learning, as a way to boost students’ ability to deal with ‘real-world’ engineering issues and problems, is a positive way forward for engineering education. The use of role plays in engineering education is an area that merits further exploration;
- It will be necessary to establish further professional mechanisms to support the process of curriculum reform. We cannot rely solely on the Visiting Professorships scheme; we should diversify and ensure ‘sustainability’ for professional development channels.

KRN funded two follow-up activities for the Community. On 24 January 2006, Steve Hurst and Catherine Howell met with two academics from the University of Bath, Peter Mellett and David Hirst, who had been unable to attend the initial meeting, to discuss pedagogy, sustainability, and ways to involve Bath in the Community.

In February 2006, the CARET team set up an online worksite to support the Community, using the Sakai open-source VRLE (Virtual Learning and Research Environment). This was hosted at Cambridge, where the system is known locally as ‘CamTools’. Betty Barrett and Catherine Howell added seed content, and the site was launched via an email list, including all original invitees to the RAE meeting. Site members were invited to discuss issues of interest using the wiki tool, and to add themselves to an informal ‘yellow pages’-style people directory.

### **Community of Practice on Complexity**

Dr Bill Nuttall (CMI / University of Cambridge) led the organization of a meeting at the Institute of Physics, London UK, on 11 September 2006. Like Sustainability, the subject of Complexity is an emerging, interdisciplinary research area that will require a step-change in the conduct of research collaboration, bringing together research scientists from diverse disciplines and methodological traditions in order to solve new kinds of research problems. The field of Complexity is however currently less well-established than Sustainability. Hence, this initial meeting was more investigative in nature than the RAE meeting, the aim being to explore interest in establishing a possible Community of Practice on Complexity.

The meeting was hosted by Phillip Diamond (Institute), and chaired by Catherine Howell. It attracted sixteen researchers, from universities and research institutes around the UK (including British Antarctic Survey, Brunel University, Cranfield School of Management, Imperial College London, University of Cambridge, University of Exeter, University of Warwick). Professor Maya Paczuski, founder of the Complexity Group at the University of Calgary, was invited as principal guest speaker. Annette Bramley from the EPSRC (Engineering and Physical Sciences Research Council, one of the UK’s seven national funding councils) spoke about new funding streams for Complexity research. Bill Nuttall spoke about teaching issues and opportunities in the field of Complexity.

Key issues raised at the meeting included:

- Complexity is currently a highly ‘distributed’ research community. There are multiple groups and multiple professional gathering-points, but currently no ‘peak body’ for researchers in this area;
- Ways to bridge the gap between complexity researchers with a ‘hard’ scientific background (particularly, those working in physics), and the fresh problems that the social sciences can throw up; for example, in the area of healthcare provision;
- Opportunities to develop simulation-based teaching, encouraging students to work on problem-solving and modelling skills.



The group shared documents and notes from the meeting using the ‘Writely’ online document-sharing and editing tool (now acquired by Google, and incorporated into ‘Google Docs and Spreadsheets’).

Attendees agreed that the meeting had been useful and informative. Bill Nuttall was subsequently invited to participate in a planning committee for a major conference organised by British Antarctic Survey in Summer 2007.

### **Community of Practice on Nanotechnology**

The project took a somewhat different approach to the fostering of a third ‘community of practice’ with the Institute of Nanotechnology (IoN). During our discussions with authors and potential collaborative partners, we discovered a perceived need for a community focused around pedagogical issues in the field of nanotechnology. As part of our ongoing participatory research strategy, rather than attempting to initiate a new ‘community of practice’, our intention with the IoN was to build upon existing interactions. In line with our research agenda of first identifying existing interactions and patterns of reuse, we attempted to locate just where the boundaries of any potential community might lie. In addition, we wondered if it would be possible to capitalise upon these existing patterns of interaction and initiate an online virtual collaborative environment (VLE) without first hosting face-to-face meetings. While to date this has met with limited success, it has enabled the elicitation of data from those parties that are strongly opposed to reuse. We were aware of a bias in our findings due to those strongly in favour of repositories and exchange being more likely to interact with the CARET research team. The interaction with the IoN has then proved very positive in this respect.

### **Research Deliverables**

In the second phase of the KRN project as it has been hosted at CARET we have made considerable headway in the development of a ‘best practice’ protocol for the sharing and exchange of teaching and learning materials on an individual and institutional basis. In achieving the aim of the dissemination of materials from the CMI graduate courses to other institutions KRN has developed mechanisms to facilitate the sustainable development of institutional partnerships. The KRN project has generated qualitative data sets employing ethnographic methodologies, as well as survey data gathered from contributors to the repository. Class room observation of these materials being delivered has been captured on video for further analysis. These research outputs – the experiences, data sets, methodologies and mechanisms – form a valuable resource of materials on the facilitation of collaboration and exchange of teaching and learning materials in higher education. A number of papers have been prepared for publication in peer reviewed journals, and the aim is to feed the findings and experiences from KRN into other projects focused on the reuse of learning materials.



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## **Dissemination Activities**

### **Symposium**

**‘Next Generation Repositories: Lessons from KRN’, ALT-C 2006, Edinburgh, 5-7 September**

#### **Abstract**

There has been a significant effort in the area of digital repositories over the past 5 years in UK Higher Education. Those involved in establishing repositories face many technical, administrative, legal, procedural, cultural and institutional barriers for re-use of learning resources. This symposium will focus on how the next generation of repositories should approach these problems, presenting one such major project and the lessons learnt from it.

The Knowledge Resource Network (KRN) is a Cambridge-MIT Institute (CMI) project being run at the Centre for Applied Research in Educational Technologies (CARET) at the University of Cambridge, in collaboration with the Open University. The aims of project are to foster the exchange of innovative learning materials and to support the growth of ‘communities of practice’ in higher education. While the KRN began life as a digital repository, it is now in the process of transformation into a project about users and supporting user communities.

Three perspectives on the KRN project are examined in detail. The first provides the thesis: the historical setting for the debate, including the reasons for such a project, the goals for repositories in assisting academics with teaching and learning, why re-use should be promoted, and the most serious problems it faces.

The second provides the antithesis: that a conception of knowledge as an object shared across boundaries neglects interpersonal relations and ties. The fostering of reuse and collaboration is described in terms of the dynamics of these relationships. KRN is practically located in these networks of social agents. Ironically, a technological focus in learning design fails to account for this, and becomes a barrier to the utilisation of the possibilities of technological innovation.

The third suggests a synthesis: that further development of the learning resources for re-use must be undertaken in collaboration with authors. A strategy is proposed that involves the identification of high quality resources; the pedagogical principles and educational objectives of these resources; a rich description of how the resources were used, including key elements that make them work and any necessary technology and a plan for re-use, including a guide for those who might use them.

Each of the three position papers aims to stimulate discussion and engagement among symposium participants. The symposium will also draw on group expertise in order to generate a list of functional requirements for “next generation repositories”.



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Accordingly, there will be discussion time following each chaired presentation and the symposium will conclude with a facilitated interactive session in which participants will be invited to contribute use cases and scenarios.

### **Papers in preparation**

- **Aczel, J., Barrett, B., Riddle, M. & Wilson, L.** In preparation for submission to the Journal of Studies in Higher Education, ‘If you show me yours I’ll show you mine; some observations on the social dimensions of digital repositories’. This will combine both qualitative data from the programme of interviews conducted with KRN authors with the quantitative data from the OU survey to highlight some of the issues surrounding the uptake of learning object repositories and the reuse and exchange of teaching and learning materials.
- **Riddle, M. & Wilson, L.** In preparation for submission to the Journal of Learning, Media & Technology, ‘The Tanbark Principle: a path-finding approach to fostering the reuse of learning and teaching materials’. This article will detail the KRN project methodology for identifying existing pathways through which reuse and collaboration are taking place. This will involve modelling these relationships using social network and cultural domain analysis software.
- **Riddle, M. & Wilson, L.** In preparation. ‘What’s in a name? A critique of the concept of community as a means to engender knowledge transfer’.

### **Conference Papers**

- Catherine Howell presented two scenarios based on KRN, developed in collaboration with Steve Hurst, at “Next generation activity-based eLearning”, UNFOLD Community of Practice Workshop, 28-29 December 2005, Berlin.

**Abstract:** The first scenario presented the task of extracting a Learning Object from informally defined teaching of the provider, packaging this formally, and bringing it into use by an end user without necessitating the support of the provider. The challenges were to assemble a sufficient accurate definition of the LO where the provider is not an expert in Learning Design, and to simplify take-up of the LO, again with an end user who does not have Learning Design expertise. The second scenario presented a more concrete, discipline-based example, and described the task of packaging and sharing material designed to help students understand the value of sensitivity analysis.

- James Aczel, Betty Barrett, Joel Cutcher-Gershenfeld, Steven Hurst, and William Nuttall, ‘New Frontiers in the Exchange and Re-Use of Electronic Learning Materials: Lessons from the CMI Knowledge Resource Network’, presented 22/9/2005 at MPhil Conference.

## **Podcasts**

**Podcast 1: ‘Online Role-plays in Tertiary Education’, presentation to Data Club, CARET, University of Cambridge, 20 April 2006. Available online at:**  
<http://web.mac.com/zot/>

### **Abstract**

Role-play has long been used as an educational tool to provide learners with a way to understand the real world. Since the advent of the World Wide Web, online role-plays have become widely used in Australian tertiary institutions to provide students with authentic learning opportunities. This presentation profiles two examples of online role-plays developed at the University of Melbourne: DRALE Online, in which final year law students form legal teams in a dispute resolution process, and The Campaign, a role-play about journalists and political advisors following a political campaign. Data Club Series, CARET, University of Cambridge

**Podcast 2: ‘Rolerunner: Role-plays in the CMI M.Phil.’, presentation to Evaluation Group, CARET, University of Cambridge, 6 July 2006.**

### **Abstract**

The Knowledge Resource Network (KRN), sponsored by the Cambridge-MIT Institute (CMI), aims to make learning materials developed for the CMI M.Phil. courses available to other UK higher education institutions. The KRN Project identified a number of role-plays as exemplars for possible reuse. This presentation to the CARET Evaluation Group describes a qualitative research project to investigate the usage of these role-plays.

## **KRN Flagship Projects**

KRN Flagships are collaborative development projects sponsored by KRN to re-work and refine learning objects identified by the KRN Project as potentially valuable and transferable to other higher education settings. The ‘flagship’ philosophy is to select a small number of projects to be supported that will serve as models for reuse in the future.

The KRN Flagship Projects aims are, broadly, to share best practice in teaching and learning, to foster academic dialogue on relevant pedagogical issues, and to disseminate knowledge by developing materials from KRN more widely within UK Higher Education. KRN Flagship Projects will provide a focus for collaboration between Cambridge and other higher education institutions in order to develop existing materials for reuse. By fostering a small number of projects involving the adaptation of KRN materials, we aim to refine and publish a selected range of the KRN materials, and to catalyse further collaboration.



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**Selected Flagship Projects**

CMI Author(s): Bill Nuttall and Eileen Rubery  
CMI MPhil Programme: Technology Policy  
Materials: BSE Case Study  
Reuse Partner(s): Brunel University

CMI Author(s): Robert Doubleday and others  
CMI MPhil Programme: Micro- and Nanotechnology Enterprise, MOTI  
Materials: Social Dimensions of MNT Role Play and others  
Reuse Partner(s): Lancaster University

CMI Author(s): Stephen Eglon  
CMI MPhil Programme: Computational Biology  
Materials: Computational Neuroscience  
Reuse Partner(s): Engineering Department, University of Cambridge

CMI Author(s): Stephen Littlechild  
CMI MPhil Programme: Technology Policy  
Materials: Electricity Privatisation Case Study  
Reuse Partner(s): University of Cambridge

CMI Author(s): Peter Guthrie  
CMI MPhil Programme: Engineering for Sustainable Development  
Materials: Marchwood Role Play  
Reuse Partner(s): Lancaster University / RAE Community of Practice

CMI Author(s): Bill Nuttall  
CMI MPhil Programme: Technology Policy  
CMI Materials: Complexity Materials  
Reuse Partner(s): University of Cambridge / Institute of Physics

## Appendix 1: KRN CoP Evaluation Plan

Professor Mary Thorpe and Dr James Aczel  
KRN Evaluation Team  
Institute of Educational Technology, The Open University  
August 2005

### Aims

The evaluation focuses on the distinct groups of people associated with CMI and being supported by the KRN project, with a view to exploring how wider communities of practice (CoPs) associated with the groups can be supported by the reuse and sharing of educational materials and know-how.

- *Formative aim:* Obtain formative feedback from participants to help identify ways to improve support for the groups.
- *Summative aim:* Obtain summative evidence of the KRN project's impact.
- *Academic research aim:* Collect data to investigate the interaction and networking associated with the reuse and sharing of educational materials and know-how, and the relationships with Communities of Practice and other theories.

### Formative strand

#### Questions

- What are the groups wanting to do?
- What are the problems? How do they differ between disciplines?
- What strategies are being used to overcome these problems?
- What's helpful? What's not? What might help?

#### Methods

- Preliminary and mid-point interviews will elicit participants' answers to these questions.
- The *CMI Teaching Materials Survey* will investigate the extent to which those involved in some form of CMI-related teaching reuse and share their educational materials, and the relevant factors in such decisions.
- Data-logging will provide some evidence of activity, to alert the team to the need to try alternative strategies.

## Summative strand

### Questions

- What have the groups been doing?
- How are the materials used? Have they been improved in some way? How is this different to what might be done “normally”? What are the effects on workload?
- What evidence is there of benefits? (e.g. pedagogical effectiveness, efficiency, collaborative synergies, improved understanding, peer support)
- What evidence is there of drawbacks?
- How useful were the workshops?

### Methods

- The *CMI Teaching Materials Survey* will gather evidence about the extent to which CMI has encouraged reuse and sharing.
- A follow-up to the *CMI Teaching Materials Survey* will obtain evidence on changes in attitudes to reuse and sharing have changed as a consequence of the KRN CoP project.
- Interviews will elicit participants’ answers to these questions.
- Data-logging will provide some evidence of activity.

## Academic strand

### Questions

With particular reference to the reuse and sharing of educational materials and know-how...

- What are the contextual conditions under which relevant CoPs thrive or wither? (e.g. discipline, type of course or teaching, student demographics, financial constraints, prior experience of teachers)
- How do roles, behaviour, and language change over time?
- What are the roles of shared tools in supporting these kinds of CoPs?
- In what ways do practitioners benefit (or suffer) from participation in one or more of the relevant CoPs?
- Can interaction and support along the lines of the KRN CoP project change the way people engage in CoPs, or does such engagement have to be emergent?
- What issues are associated with different levels of granularity of learning objects and of teaching plans?

- What factors contribute to willingness to share and to willingness to reuse? Are one's own materials and those of one's department the main focus of attention?

## **Methods**

- Interviews will gather evidence in relation to these questions.
- Section D of the *CMI Teaching Materials Survey* allows us to consider relationships between information transmission and conceptual change approaches to teaching on the one hand, and attitudes to reuse and sharing on the other.
- Data logging provides evidence of kinds of activity over time.
- If any of the groups engage in electronic communication, permission will be sought to analyse the traces.

**Planned Timescale**

Month	Actions	Days <sup>10</sup>
June 2005	<ul style="list-style-type: none"> <li>• Planning: Agree aims and data collection methods</li> </ul>	5
July	<ul style="list-style-type: none"> <li>• Preliminary interviews: Elicit participants' views of what they are hoping to do</li> <li>• Set up appropriate data logging</li> <li>• <i>CMI Teaching Materials Survey</i></li> </ul>	10
August		
September	<ul style="list-style-type: none"> <li>• Analysis of survey</li> </ul>	5
October		
November		
December	<ul style="list-style-type: none"> <li>• Mid-point interviews: Elicit participants' views of how things are going, and perceptions of the workshops</li> <li>• Analysis of data logs</li> </ul>	10
January 2006	<ul style="list-style-type: none"> <li>• Interim report</li> </ul>	5
February		
March		
April	<ul style="list-style-type: none"> <li>• Final interviews: Elicit participants' views of how things have gone</li> <li>• Analysis of data logs</li> <li>• (By consent) Analysis of any electronic communications within the groups</li> </ul>	5
May		
June		
July	<ul style="list-style-type: none"> <li>• Final report</li> </ul>	10

It is also hoped that a journal paper will result from the final report, but the funds made available do not provide time for this.

<sup>10</sup> The figures in this column exclude James Aczel's time, and are approximate (given different salary levels for different roles)