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Collaboration between universities and enterprises in the Knowledge Age

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Abstract

This paper suggests that a radical review is required of the way in which universities carry out their research and teaching roles. Political and economic factors are forcing change and the classical role of universities for delivering knowledge to customers is being challenged both in research and in the way teaching and learning take place.

In this new context, information and communication technologies allow an alternative approach to be taken. In this approach it is argued that the delivery of content should no longer play a major role; remote access to digital libraries and learning support through tele-tutoring are becoming increasingly common. The new role relates to supporting the *process* of knowledge exchange and acquisition rather than the delivery of *content*.

This paper is not concerned with creating virtual campuses to support traditional courses based on formal knowledge. Rather it reports on some experimental activities in which students learn through participation in research in naturalistic settings. It is further suggested that enterprises can come to see universities as partners in learning and research activities to the benefit of both parties. The use of information and communication technologies play a key role in making it possible to support the exchange of informal, context-related knowledge.

1.   INTRODUCTION

Opportunities which are offered by new information and communication technologies, among other factors, are stimulating a re-analysis of the role and operation of many organisations as well as in making adaptation to new demands easier. Universities are not uninvolved in this process and could/should be at the forefront of innovations which have their origin in changing perceptions on the nature of knowledge. Classically, universities have been centres for the creation and diffusion of knowledge through their prime functions as institutions for research and teaching. However, it is becoming necessary to review that role, and particularly the processes involved, as the way in which 'knowledge' is viewed is changing and new forms of knowledge become tradable commodities.

New perspectives are emerging from psychological and linguistics research which place increasing attention on the socio-historic, cultural, distributed and contextual nature of cognition (Nardi, 1996). Without being pedantic it is helpful to be reminded of the definitions of data and information which played an important part in defining computer science in the 1960's (IFIP, 1970). To build upon and extend those definitions, one may view:

- *data*: as the syntactic codes on which machines operate;
- *information*: as the addition of semantics which humans apply to (processed) data in context;
- *knowledge*: as the ability to apply information to solve particular problems; and
- *intelligence*: as the experience which allows the appropriate choice of knowledge to invoke at a particular time.

It is important to realise that, once past the level of data, *context* is a critical factor in the processes central to those concepts.

The primary form of 'knowledge' with which universities have been engaged is what might be termed formal or scientific; this is the 'knowledge' which they themselves have played a big part in creating and it is that *content* on which they have built the curricula which are currently being taught. The use of telecommunications to create virtual campuses for the diffusion of such content with access to various sources world-wide and a certain amount of assistance and tutoring through the same networks, is being explored in many universities. But is this the whole future?

As suggested above, context is critical to considerations of information and knowledge. It is even suggested that all knowledge is socially-shared and cannot exist within an individual person. These notions lead to a belief that it is *knowledge in context* which is taking on increasing importance and that apprenticeship should come back to take a leading part in education and training*. The key point is that

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*For example, in France some universities are engaged in serious debate with communities outside their doors about 'alternance' (courses split between university and industry) and the publications of Céreq (whose quarterly newsletter has an English version) are heavily biased towards continuous training in

this demand for education and training is not only for formal knowledge but for the tacit, experiential, often pragmatic knowledge of the workplace - professional and artisan.

The point of great importance to realise is that universities have no *ownership* of this form of knowledge; it cannot be 'taught' in the traditional way. This paper explores an alternative role for universities which involves both their teaching and research activities and their increasing reliance on industry and other outside communities. But, first it is important to review the nature of the professional knowledge which is becoming increasingly valued.

2.   PROFESSIONAL KNOWLEDGE

In the natural course of work, knowledge is used and exchanged in formal settings and in chance encounters. Its focus is the identification and resolution of practical problems and it draws on both scientific, established knowledge and that which is derived from working practices and experience. The problems are often ill-defined and yet decisions have to be made.

This knowledge is part of the practices of large numbers of people working in a wide variety of contexts. Solutions to problems are not always clear-cut and the consequences of actions may have broad implications and side-effects. Context is central to a large proportion of the knowledge which is used and optimal solutions are required since there may not be a unique 'correct' solution.

Extensive applied knowledge of this type, together with flexible and efficient ways to exchange this knowledge within communities of practice, are crucial in successful organisations. Clearly, the most effective organisations are those which capitalise upon the knowledge which resides within them, that is, within the workforce of that organisation. Each person may need the knowledge of others in order to work effectively and the way that knowledge can be accessed and shared becomes a critical factor in operational efficiency. In the same way, this type of knowledge and practice, and the processes of its exchange or sharing, should also be an important part of the education of future professionals. For this reason universities should have a goal of facilitating the acquisition of these processes.

In the workplace, exchanges of knowledge relate to the task in hand and problems to be solved. Face-to-face communications are very rich both in terms of the knowledge exchanged and in the potential for social cohesion. But, such encounters are not always possible or easy and, what is more, little or no trace of the interaction is left behind for future reference - even the records of formal meetings are scant in depth and rationale. This is often referred to as a lack of organisational memory:

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companies (see http://www.cereq.fr). Also, in Germany formal knowledge provided by educational institutions greatly emphasises learning in applied fields during specific periods of time, especially in professional training and in universities.

" . . . The problem is not a scarcity of documents and artefacts for organizational memory, but rather the quality, content, and organization of this material. For example, an effective organizational memory would be able to answer such often asked questions as 'Why did we do this?' and 'How did such and such come to be the case?' Rarely is this possible now." (Conklin, 1992, p. 133)

Conklin goes on to suggest the need for a process-orientation which has three technological elements: hypertext, groupware and rhetorical method. *The key to making good use of such tools is that they should not require extra, specific effort but must 'tap into' the existing flow of information in the organisation.* There is a requirement for organisational change but also there is a synergy between this memory requirement and other emphases on quality, customer service and other process-orientated approaches which are already gaining ground in the organisation of enterprises.

This section has tried to illustrate the nature of knowledge which is important in enterprises who increasingly believe that their competitiveness depends upon ways in which they can capitalise on the knowledge held by individuals in their organisation* and which needs to be made accessible to others. An important distiction is made in this paper between:

- *scientifically validated information* which is made available through somewhat restricted though well-recognised channels of education, training and professional practice;
- *information of a less formal nature,* which is often tacit, the validity of which is less clear but which is needed and used within communities of practice.

and, further, there is a need for:

- the *flexible, timely sharing of knowledge*, from both an academic and a professional perspective.

It is on the last two points that this paper focuses in examining new roles for universities both in the processes of research and the processes which can support learning.

3.   RESEARCH

While universities have traditionally seen research as an activity aimed at the creation of knowledge 'for its own sake', there are some signs (for better or worse) that two major trends are influencing the nature and processes of university research. One of these is political/financial as governments (in Europe and the UK, at least) are seeking ways to reduce public funding of research and engender an enterprise or free-market culture into university research as has been encouraged in

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*An interesting review of organisational memory with extensive references is given in a paper by Bannon and Kuutti (1996).

industry with the removal of barriers to transnational trading (for example, in the telecommunications and civil airline markets) and globalisation (Sigurdson & Tallving, 1997). In parallel with this, there has been a move towards government support for 'strategic' research. One example of this occurs in a UK Government paper (HMSO, 1986) where a strategic research area is defined in terms of social, economic and scientific timeliness as being "an area which promises significant advances in the medium term and will generate new knowledge . . . which must offer clear opportunities for economic exploitation." More recently such a position was restated when Newby (1992) introduced the Corporate Plan (1992-97) of the Economic and Social Research Council (ESRC) in the UK.

The (implied) outcome of such a policy is that industry should fund applied research and universities themselves need to generate their own funds for basic research. This seems also to be the policy of the European Commission. In order that universities meet this challenge, collaboration with industry and other 'users' of research outcomes is essential. In this context:

> "A critical role in defining the agenda for research is held by those whose professional work could be influenced by the outcomes of research. Such stakeholders are the practitioners who carry the professional responsibility of advancing their field by the adoption or adaptation of the outcomes of research and the products of development.
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> Once research moves beyond the quest for basic knowledge, that is it moves towards the applicable, even the medium term strategic, its value lies in the exploitation [by those affected by research] of its outcomes. It will usually be the case that such outcomes bring about pressure for change; but there is a natural human reaction to oppose change as the *status quo* is usually less threatening than the unknown.
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> If this premiss is accepted, the fear of the unknown needs to be minimised and one way to achieve this is to ensure that those implicated are a part of the rationale for undertaking the research, that is for defining the research agenda and for being full participants in the research process itself. . . .
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> Furthermore, they also become stakeholders in the process of research - they come to 'own' the outcomes and, hence, are more likely to be willing and able to capitalise upon them."
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> (Lewis, 1992, p. 159)

All of these directions of research point to the increasing importance of closer partnerships between universities and enterprises. Of course, there has been much collaboration in the past but now the links are essential - at least from the perspective of universities. So, if this is a major need, what role might communication technology play in satisfying that need, at least in some part?

The core action in a university-enterprise partnership is undertaken by a number of individuals who form a distributed community. This community has its rationale and coherence through the set of *common intentions* (goals) which have been established through negotiation. The subsequent, specific activities may take place over months or years. Throughout that period, there needs to be an adequate level

of communication between the participants and, due to their distributed nature, this is hard to sustain amongst individuals who have many demands on their time *and* who may be separated by significant distances.

Research with such communities indicates that a significant proportion of the necessary communication can be provided by the use of quite modest telecommunication channels. To facilitate this process, however, different functions and characteristics of media have to be researched and their potential made clear in order that they may be used in the most efficient way[*].

4.   LEARNING

The use of communication technology provides opportunities for universities to enhance their educational offer. For example, they may take steps to:
- use the campus network to allow traditional students better access to resources (including tutors);
- widen the accessibility of existing courses to off-campus students (including those in other countries);

As has been suggested earlier, in thinking about learning, it is necessary to identify the form of knowledge which is to be 'learnt'. In the classical case, universities have been engaged in offering opportunities for the learning of formalised ('scientific') knowledge; the learners have come to universities with the *intention* of learning some fairly well prescribed formal knowledge.

The two steps suggested above address the classical diffusion of knowledge but, as illustrated earlier, there is another equally important form of knowledge, that which is grounded in practice and professional activity. It is often informal, tacit and is developing continually in all working communities through the experience and the exchange of information among professionals. University staff have no exclusive or even particular insight into such knowledge but they are under pressure to facilitate the *process* of the exchange of this knowledge as well as more formalised knowledge. To this end information technology may be a communication medium which could help. There are a number of ways in which such mechanisms could work:
- by the creation of *discussion networks* between academic and professional tutors or workers in industry (linked perhaps to collaborative research or practicum programmes) which existing students could observe as a way to become, as Lave and Wenger (1991) would suggest, 'legitimate peripheral' participants;
- to provide a context for those seeking continuing learning to set the agenda for 'learning' in such a way that learning becomes predominantly a *process of*

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[*]The Virtual Mobility and Distributed Laboratories project, supported by DGXII of the European Commission, examined such issues (Heeren & Lewis, 1997). The final report may be found at: http://www.lancs.ac.uk/users/ktru/vmdl.htm

> *knowledge exchange* with peers (tutors providing process rather than content contributions);
- to create *explicit 'courses'* which engage students in action-research projects with industrial partners which might facilitate initial contacts with enterprises making the shift from academic to work cultures smoother.

Some tentative trials with the latter mechanism have taken place and others are planned. These will now be discussed.

5. LEARNING THROUGH ACTION-RESEARCH

Information and communication technology may have a crucial role in integrating perspectives on knowledge and the issues facing universities and enterprises in the current socio-economic climate which have been outlined above. Is it possible with the aid of ICT for universities to address both their research and teaching roles by combining these two key functions?

One model for exploring this possibility has been tried on a small scale at the University of Twente in a course module for final year undergraduate students.

5.1 Nieuwe Media en Media Management

The course description included the following perspective:

> "In a society which, it is claimed, is increasingly dependent on information, cognitive processes which transform information into knowledge must become a major concern. This course explores, reviews and compares the ways that communication technology can be used to support distributed groups of workers and learners in the transition from information to knowledge. It blurs the distinction between 'work' and learning' by drawing on mainly professional communities in which the distinction hardly exists. It considers the individual and organisational dimensions of work in communities in which interaction between members is wholly or partly dependent on a range of electronic communication media. It looks at ways in which professional knowledge, often tacit and informal, may be elicited and shared during the process of which action organisational memory is significantly enhanced."

The key element of the course was an action-research project in which groups of four students visited a local company and negotiated with that company to define a research question which related to communication patterns in the company; they then devised a semi-structured interview schedule or questionnaire to use with members of the organisation and wrote a report which identified particular problematic communication mechanisms. There were four face-to-face seminars during the course which lasted three months (part-time) and during the other times the students interacted electronically with local tutors and another (the course leader) who was in another university. The advantages seen in such an approach were:

- the students experienced setting up and undertaking an action-research project as a team;
- they also experienced support from a remote tutor communicating electronically with them;
- the company benefited from an outside analysis of its ways of working;
- there was reinforcement of the collaboration between the university and the enterprises with the potential for future partnerships;
- the outcomes contributed additional, much needed, naturalistic case study data about ways in which knowledge is shared in organisations.

Student reactions

Following the course, the students were asked to provide feedback on a number of issues related to the way the course ran and if and how how they saw benefits in the approach taken. Some of the questions and the feedback illustrate a number of the issues that require further attention.

- *were the face-to-face seminars of the right form? too many new concepts?*

Feedback from the students generally indicates that they can cope with a wide array of new concepts as long as the seminars are highly structured and allow them to track their own progress in the work they are doing:

> ". . . What I missed was the structure. Some 'syllabus' with an overview of the course (why is what subject taken into account..) and the most important articles neatly organised would have been really good. Sometimes I missed a real thread. It is nice to know what subjects are treated when and why."

Some students also demanded more active participation:

> "The course could have benefited from more interactivity during classes. If there would have been some challenging statements, more discussion would have taken place. In that way it could have become clearer what the goals of the course were, and maybe an interesting goal could have been negotiated."

- *was the on-line support adequate? could it have been more helpful?*

It was generally felt to be adequate.

> "It was adequate. Better not to write very often and give useful information, than writing for instance every day while there is nothing to say."

There was a suggestion to make all email interaction 'public'; a possibility which, however, was rejected by the group when offered at the beginning of the course:

> ". . . My suggestion: organise a mailinglist for the course and see to it all the online communication is done through this mailinglist. Since most TO-ISM students read their email you 'force' them to read the mailinglist communication. . . . "

- *should the local tutors have done more; if 'yes' is that role (time allocation/ availability) one that the remote tutor should have taken on more? how?*

Naturally, there was a view that tutors could always do more but an important point related to a clearly defined role.

> ". . . I don't know what their role should be exactly, but I think that their role has to be clear and mutually distinct. . . . . Like the students had a monitor in

their group, the professors could have the roles 'lecturer, organisational manager and technical manager' or something like that."

- *did all the students read the group email? how could you be better motivated?*

The technical aspects of using email were not a problem and students used it habitually. However, it is necessary to define the purposes of the exchange quite explicitly for the students (even though this seemed clear to the tutors).

" . . . I think the only way to get students communicating on-line is through email. They read it anyway. WWW is less frequently visited - messages do not get to their address. . . ."

"I checked email every day, but we didn't use it very much within our group. Sometimes to make appointments. But we saw each other regularly and then we discussed every thing face-to-face."

"I usually read my email two or three times a day, during the course maybe a little more. Roughly stated short-term goals could have made the interaction . . . more frequent and clearer."

- *how did you find the experience of working on a project in a team?*

The students had previous experience of groupwork and expressed their frustration as some members did not take an active role. On the positive side, they felt it was useful to share ideas but at times it was difficult to keep everyone informed of how personal tasks were progressing .

" . . . one of the frustrations in groupwork among students, is that every member is equal and in many cases no one has or takes responsibility. Group members should therefore been assigned to a specific role with specific responsibilities. Assigning monitoring tasks to one of the group members is a good start, though."

- *should the research question be defined by the tutors or is this a part of the research design which needs to be negotiated with members of the company;*

The students generally thought it was a significant part of their work but would have appreciated more clear information on the overall goals as well as better information given to the organisations in the way of what could be expected of them.

"It took quite a long time to specify the question. But it wouldn't have been useful to have it specified. It took a long time, because we needed certain information about the company that was difficult to get and we also had to change our research question a couple of times after having talked to the company manager and having received new information."

- *should more pressure (formality) have been used during the course?*

They generally appreciated the opportunity of self-guidance but also thought some more structure at the beginning would have been useful.

" . . . You don't have to give 'ready-made' instructions as what to do. A little 'self-guidance' can be expected from students I guess. A more clear statement of goals and a clear 'framework' of the course would have been very welcome though."

And yet:

"It was quite clear from the beginning. It would have been helpful if we had
received more suggestions along the way."

* *do we need more or fewer face-to-face sessions?*

Although some felt that more face-to-face sessions would have been useful, they
were able to get all the help they needed:

"No. More and better on-line communication!"

"Officially there should have been more I think. But we had in between a
few times a meeting with our local tutor and also some informal talks where
we posed some questions."

Some other suggestions were offered, one of which related to experience on
another course which used the Web:

"Even in this well-designed and frequently updated environment it was
sometimes hard to keep track of the goals and plans for the course. But the
web-site was the central 'face' of the course, it gave some handhold in the
virtual community. During the MMMT course there were a lot of
misconceptions and misunderstandings on planning and delivering of
products. When this information would have been available on a web-site, it
could still be flexible, but also be available clearly stated on the screen."

Overall, difficulties with the kind of open work which was required were also
expressed. These issues could perhaps be dealt with in other versions of the course
but some may have to do with a dramatic change in the nature of the tasks which
are required as students face open, naturalistic problems and may thus need
significant changes in their perspective of the processes of learning, always a
difficult goal.

"I don't think any of the groups had a well defined idea of what they were
doing exactly. This was partly due to the assignment being so broad. I
sensed that the groups really had problems narrowing the assignment down
to one problem in the company that could be dealt with within the confines
of this course. Too much time was spent on getting to know the company
and trying to find out whether they really DID have a problem. For instance
with TSM we had the impression that everything was going as good as it
could be in these times of rapid changes."

Tutor observations

Some of these difficulties were foreseen by the tutors before the start of the course.
Their reflection on students' feedback is that it highlighted a number of key issues,
some of which could apply to a more traditional group project run with regular
face-to-face sessions. However, the remote tutoring aspect meant that these issues
became more pronounced. The main tension which existed lay in the desire, on the
one hand, to 'force' the students to be autonomous in their actions whilst, on the
other hand, providing adequate guidance. There also seems to be a tension between
the complexities and ambiguities of the functioning of the enter-prise "in the real
world", the ingrained habits of working on the part of students and the time limit of
the course. However, clarity of purpose, the establishment of a shared
understanding of the goals of the activity, and, closely linked to that, explicit

expectations and role of both tutors and students could have helped. Both these dimensions require particular attention in the distance tutoring context. As one tutor said:

"... I think that a little more structure in the course and a clearer goal orientation, as well as a better role division between us, would have been appreciated".

It was also felt these demands could have been 'forced' or more strongly demanded by the students during the course. However:

"... anyway, all by all it was a good experience. It is clear that all of us (including the students) have still to learn a lot about how to deal effectively and efficiently with the opportunities of new pedagogical approaches ..."

One important perspective, that of the organisations studied was missing from this preliminary study. If this mechanism is to be used to promote university-enterprise collaboration, future work must ensure that these views are elicited.

5.2 Universidad Autonoma de Madrid

A second experiment with a similar philosophy, which will build upon the insights gained in Twente, will take place at Universidad Autonoma de Madrid (UAM) in a course for doctoral students.

Course structure

The course will be part-time over three months and there will be four course elements plus the main action-research project itself. The course elements have been selected to be directly related to the carrying out of the specific form of action-research envisaged.

- *Introduction to communications technology*

It will involve aspects of the design and practical use of computer conferencing, email, Internet. intranet systems, www etc. This will be essentially practical and the tools used will be used later in the course for interaction within the teams and in interaction of members with tutors.

- *Research methods*

The focus will again be practical and relate directly to the needs of the action-research case study which will be undertaken. This means it will cover issues related to elicitation of knowledge and perceptions of people working in organisations. Elements will be: the formulation of the research question; forms of data elicitation - semi-structured interview schedules; questionnaires; data analysis and reporting.

- *Structures, communication and knowledge exchange in organisations*

Patterns of communication, legitimacy of information, accessibility, decision making processes, power, control, management structure, collaboration, competition, capitalising on knowledge, learning organisations.

- *Social and cognitive processes of learning*

Cooperation and collaboration, communication as a key learning process, communication channels, knowledge creation, sharing knowledge in groups, working and learning, activity theory, social structures and processes.

Methodology
The basic structure of each module will be a half-day seminar/workshop run by one or more of the tutors followed by tele-tutoring support. Each module will be assessed by a team report on an assignment. The assignment will be written to ensure that the team draws on the 'introductory' seminar/workshop and on a supplied list of associated reports, papers, books etc. The teams will be set up and the assignments designed so that the work of writing the report can be divided up - for example one member focuses on a specific part of the literature and they work together to create the final collective document. Tutors will interact with the students by tele-conference during this work - commenting on drafts, suggesting lines of thinking, etc. All this work has the aim of preparing the students for their case study investigation during which tutors will provide tele-tutoring support by commenting on drafts (e.g. of the research question; of the data elicitation methodology; of the elements of the final report; etc.)

General goals
The activity is aimed at providing a significant experience of team working for the students whilst at the same time involving them in research related to working in teams and associated issues in a real-world context. Their research should enable them to uncover the explicit and implicit communication channels and structures in organisations. From this they may ask such questions as whether those channels and structures support the sharing of professional and operational knowledge in the organisation and pose the question as to whether alternative channels (using electronic communications for example) and an alternative management structure could impact positively on the effectiveness, efficiency, culture, morale and competitivity of the organisation.

    Following an effective analysis and report, the students (in partnership with the organisation) could plan, implement and evaluate an innovation in the organisation. This could become a follow-up 'course' as part of a doctoral thesis or a further diploma. This would require a fully developed evaluation and framework for the management of change to support such extension work.

6.   CONCLUSIONS

The aim of this paper has been to explore alternative approaches to the ways in which universities can fulfil their role in research as well as in teaching and learning, and to suggest ways of collaboration between universities and enterprises. It is suggested that the distinction between learning and research is one which can impose artificial boundaries to activities especially when the emphasis is on tacit, craft knowledge rather than on formal 'scientific' knowledge. The work is on-going and aims to assess the conditions under which ICT can provide support for the sharing of professional and craft knowledge, that is continual apprenticeship, both in working and learning contexts. It also stimulates an analysis of the

cognitive processes involved in learning and working and the extent to which research activities are similar to learning and need to be grounded in a social and cultural context.

Experiences of the action-research approach to learning so far seem to open new and interesting perspectives. However, it is also important to note that major difficulties appear: students may ask for more structure than is possible under these naturalistic conditions and this way of learning may be fraught with uncertainties, mistakes and ambiguities. There are also serious difficulties in convincing enterprises of the benefits of this collaboration. In summary, it can be concluded that more experience in the design of courses of this kind is needed.

But, to end positively, communications technologies do seem to open up exciting opportunities to bridge the gap between academic and professional knowledge, something which is currently highly valued.

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8.   BIOGRAPHIES

Robert Lewis has been engaged in research into the uses of information and communication technologies to support learning and knowledge exchange more generally. Recent research, some of it supported by the European Commission, has focused on the sharing of tacit, informal knowledge in communities of professional practice. He has been the Editor of the *Journal of Computer Assisted Learning* since its foundation in 1984 and has edited many IFIP proceedings.

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