Information Jockey: The Dubious Role of the 21st-century Academic

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This paper appeared in *Southern Review* 35.2 (2002)

Abstract. While the university has traditionally been our primary centre for the management of knowledge, a variety of factors are changing the processes associated with this function. This paper discusses the university's transition from industrial to information society by focusing on the four processes of knowledge advancement, transmission, preservation and diffusion and the way these processes are shaping (and being shaped by) current advancements in information technologies. Particular attention is given to the fact that many trends indicate a shift in the role of the academic towards a stronger focus on the consumption, recombination and dissemination of information rather than the reflection arguably required for the creation of new knowledge.

1 The University in Perpetual Crisis?

The 'network society' as defined by Manuel Castells (2000) is characterized by the pervasive expansion of the network (as opposed to the hierarchy) as an organisational principle throughout the social structure. Castells argues that this change in organisation has been underway for a while, and that it marks the transition from industrial to informational society. In Castells' model, a network is a set of 'nodes' (anything from government councils and universities to coca fields and mobile communications devices) interconnected via 'flows' that can for example be political, financial or knowledge-based in nature. Together, the nodes and flows define a network's topology. Castells' networks are highly dynamic and very flexible structures, characterised by their openness and their ability to adapt and expand. When flows change, nodes change roles. Castells also identifies 'switches', nodes that connect networks of different types, as having special significance as 'privileged instruments of power' (2000, p. 502).

The network society is a society in progress. At the moment, it is as yet unclear exactly what kind of society will emerge, although we do have an idea of its general characteristics. It is also unclear when (and to what extent) this society will stabilise, or even what defines stability for a society based on a structure whose hallmark is its ability to change. Many questions remain open, certainly politically and culturally, but most importantly as to the shape of the playing field emerging from the new organisational principles. Castells lists political, financial and knowledge flows as the most important in the current network society. The university has traditionally been our primary centre for the management of knowledge, so it seems the natural choice for a hub (or switch) in the knowledge network. However, the transition may not be quite as straightforward as one could be led to believe.

The present year is at the same time the 150th anniversary of John Henry Newman's classic discourse on the university as an institution (Newman 1852) and the tenth anniversary of Jaroslav Pelikan's reexamination of Newman's ideas (Pelikan 1992). In his book, Pelikan identifies four knowledge management roles played by the university and assigns them equal importance:

> [T]he advancement of knowledge through research, the transmission of knowledge through teaching, the preservation of knowledge in scholarly collections, and the diffusion of knowledge through publishing are the four legs of the university table, no one of which can stand for very long unless all are strong (1992, pp. 16–17).

For the purposes of this essay, I shall without further ado adopt Pelikan's model of the university as a four-legged table and use it as the basis for discussing some aspects of the transfer of the university into the information age. The university's role in the network society is of course dependent on its internal and external processes, and in this context the 'table legs' defined by Pelikan—knowledge advancement, transmission, preservation and diffusion—can be recast as the processes (internal and external) that allow the university to function as a node and to interface with other nodes in the knowledge network.

At the moment, it is rather uncertain how these processes will transfer into the network society. Advances in information technology are changing the technological basis for knowledge preservation and diffusion, and research into distance learning (which oddly enough has been called e-learning rather than e-ducation) aims to change also the way knowledge is transmitted. Hence, at least three of the university's four legs are being, if not exactly shaken, then at least rapidly reconfigured on the fly. Does this mean the table is rocking? It appears so, but it is worth noting that critical voices at various intervals since (and including) Newman (Newman 1852, Barnes 1970, Landow 1996) have declared the university as being either in danger or at least threatened, and called for reinvention or restructuring in order to assure continued survival. We should therefore be careful not to blow the whistle needlessly but keep in mind that rapid change is a natural characteristic of the network society and, despite its historical and intellectual weight, there is nothing odd or unnatural about changing the university. It is the right (even necessary) thing to do, and even if we get it right, the chances are we will be doing it with increasing frequency within the foreseeable future.

The opportunity and need to rethink and redefine the university's processes on the basis of new technologies is at the same time a difficult and exciting position, and also one that comes with a great deal of responsibility. In addition to the four knowledge processes, there are factors over which academics and administrators have little or no control. Financial and political flows influence the university, and even in terms of knowledge flows, other nodes in the network can now—thanks to advancements in information technology—perform processes akin to (and sometimes in direct competition with) those traditionally performed by the university. This essay will focus on a few aspects of each of the four processes involved in the knowledge flow as they apply to the university. The institution's interaction with other flows will be ignored to the extent that this is possible, and although this makes for a less complete treatment, it is necessary to limit the scope of the paper. (For a detailed and more

general discussion of cultural functions and practices and their digital manifestations, see Tan 2001).

As a preliminary note, it is worth pointing out that the university over the last thirty years or so has developed much like anything else in Western society to become broader and wider. There has been an increase in volume for all of the four processes, but particularly in knowledge transmission and advancement. There are more students than ever, and the number of subjects being taught and researched has increased. One of the new research areas, e-learning, even aims to sustain or accelerate the expansion in knowledge transmission to include students not physically present at the university to a scale not feasible with past distance learning technologies. This is a good example of the informational mode of development, characterised by Castells as 'the action of knowledge upon knowledge itself as the main source of productivity' (2000, p. 17).

2 Advancement: The Space and the Time

In his conclusion to *The Rise of the Network Society*, Castells notes that '[n]etworks are appropriate instruments for…a social organization aiming at the supersession of space and the annihilation of time' (2000, p. 502). The way we use the new technologies is changing the way we as individuals and as a society perceive and use space and time. Of course, everything we do depends on space and time, so these are significant changes that affect all spheres of our lives. As to the advancement of knowledge, two of the most profound changes in the way research is conducted have to do with space and time respectively. First, the supersession of space signals an important change in the structure of research communities. Second, the annihilation of time is changing the way we conduct research.

'Community' is a key word for research environments in several ways. We talk about 'the research community' as a large, somewhat amorphous and relatively abstract entity, and at the same time depend on stimulating interaction with our local, immediate peers (e.g., research groups) to achieve the day-to-day intellectual cross-fertilisation required to improve understanding and advance knowledge. We interact with the different communities in different ways: informally through meetings and spontaneous conversations with immediate colleagues and through formal channels of conferences and journals with the greater research community. Compared to the greater community, the local community is a distinctively non-competitive environment, a safe place to try out new ideas with little fear of ridicule or theft. This is not to say that intrigue and betrayal never occur within local environments, but personal bonds tend to foster a level of trust that makes the free exchange and cross-fertilisation possible. It is well known that the most successful research environments are those where ideas flow freely among members.

For research environments, one of the greatest changes brought on by new information technologies is related to changes in the structure and scope of communities. The new technologies—at the moment the web and the Internet—let academics with shared interests develop cross-institutional communities. It is beyond doubt that information technologies in this way are a blessing, because they allow geographically dispersed groups of people to communicate. The two immediate consequences of this type of community-making are that the flow of ideas is increased

in volume and that flows become more specialised, i.e., targeted towards narrower topics.

Howard Rheingold's 1994 book titled *The Virtual Community* brought virtual communities into the spotlight of mainstream media, but before that, academics had already been using the underlying technologies relatively quietly for more than a decade. It could perhaps even be argued that in academia there is a tradition for a previous generation of 'virtual communities' (e.g., some schools of thought) whose members have been separated in time rather than space. The preservation of knowledge (e.g., in the form of libraries) allowed such communities to 'exist' despite the temporal separation of some of the members. Where the library as a technology (in particular combined with the printing press) collapsed time, informational technologies are collapsing space to a degree we have not seen before.

The risk associated with the widespread adoption of spatially distributed and highly specialised academic communities is that it can lead to less contact between academics in the same institution much the same way that we as inhabitants of a given neighbourhood tend to have less contact (and less in common) with our neighbours than was the norm in the pre-information society. Perhaps, as network connectivity increases and technology affords us a better sense of *presence*, geographical communities will give way for virtual communities on an even greater scale. As pointed out by Landow, Newman's idea of the university assumes the existence of a *place*, a shared spatial context for academics and students (1852, p. 349). The power and popularity of virtual communities (academic and otherwise) indicate that the future university may not need to reside in a physical place as such. For the research community, the trust that has been traditionally been built through personal bonds and face-to-face communication in local communities will need to be built in different ways. One approach is to focus on increasing the degree of presence that can be projected and perceived in the virtual space. A study of trust-building in virtual teams conducted by Sirkka Javenpaa and colleagues (1998) has shown that even with current technologies, trust can in some circumstances be built rapidly among people who have never met each other physically. It is likely that technology offering an increased sense of presence will make this kind of trust-building easier.

Castells' notion of time being annihilated is a theme that has been raised often as one of the social impacts of information technology, most often in the form of *acceleration* (e.g., Gleick 1999, Virilio 2000, Eriksen 2001, Haahr 2001). The acceleration of the knowledge advancement process is carried by the imperative towards a higher volume of output over any given period of time. Knowledge advancement can be seen as a three-step feedback loop where researchers receive impressions, for example through journals, books and conferences (input); reflect and develop hypotheses and conduct experiments to support or explode them (process the input), and eventually document and diffuse the findings (output). Feedback loops such as these are found everywhere, and as discussed elsewhere (Haahr 2001), there is a strong trend in current society to focus on the input/output portions of these loops, rather than the reflection/processing portions. For the loop associated with knowledge advancement, all three steps are important: the input stage because good ideas require proper stimulation and meaningful analysis can only be performed on carefully collected data; the processing stage because this is where the insight and understanding takes place, where information is turned into knowledge; and the

output stage because this is where the findings are communicated to peers and students.

In general, the drive towards tightening feedback loops is related to our requirement for continual acceleration. In research, this phenomenon is often described as 'publish or perish', a *bon mot* used to describe the importance of publications for an academic's career. Academic merit is commonly measured by the number of publications appearing on one's CV, rather than the quality of each publication and its impact on the research community, and the length of a CV is often used as the main basis for tenure and promotion. Another approach is to measure academic merit by the number of references other people have made to one's work, but this is rarely done, and even this process is flawed, first because it favours research in 'popular' areas, and second because counting references in a global body of publications, where many are still published only in print and without a standardised reference format, is a difficult and time-consuming process. A comparison can be made with the current state of the art in Internet search engine technology, where the quality of a given web page is estimated as a function of the number of other pages linking to it, taking into account the perceived quality of those pages themselves. While this generally works well, it does tend to reinforce popular links and make it difficult to find little-known information.

Another word for knowledge advancement could be knowledge creation. A substantial portion of the work involved in research consists of mechanics, such as laboriously testing hypotheses or documenting findings, but there is also a kernel of creativity involved. The creative insights, the spontaneous leaps in understanding, happen in the reflection/processing portion of the feedback loop. While these leaps are among the most satisfying aspects of research, they are also among the most mysterious, perhaps because of our incomplete understanding of the mechanics of creativity. David Gelernter (1994) has made the observation that the human mind is more creative in a lowered, partially idle, state, such as while driving a car or showering, and James Gleick has pointed out that some of the greatest scientists, notably Charles Darwin and Albert Einstein, thought of themselves as slow thinkers (1999, p. 109). Hence, perhaps this type of creativity is a naturally slow process, one that tends not to accelerate well. The question then is how the acceleration of the feedback loop associated with knowledge advancement and the shifting of emphasis towards its input/output portion will influence the way we achieve leaps in understanding, the way we have original ideas. Will we learn to be creative in a new way, one that does not require slowness, or will we have fewer truly original insights? Because our traditional mode of creativity is slow and largely not understood, this is a decision we are essentially making in the dark.

In a recent paper Thomas Hylland Eriksen describes two modes of creativity. The first—exemplified by Salman Rushdie's novels—is based on multiplicity, diversity and hybridisation, and denotes the creative process of recombining existing material to create something new. This is a kind of creativity associated with the global network society and often with collaborative efforts. The other—exemplified by another author, V.S. Naipaul—is based on rootedness, coherence and a stronger, more Romantic belief in individual inspiration. This is a kind of creativity associated with the hierarchy as a structure and with pre-information society. The observations made by Eriksen and others seem to indicate a shift in creative mode. The type of creativity

favoured by the network society is that of multiplicity, and it is favoured at the expense of reflection.

How does this bode for the knowledge advancement process? Eriksen's two modes of creativity seem both to apply to the creative process associated with knowledge advancement. Research—the creation of knowledge—is in many ways the discovery and/or creation of new links between existing ideas in an attempt to achieve the occasional leap of increased understanding. Both modes are intuitive and both can lead to original work, as the comparison of the two authors' works obviously shows. The current trend, however, is towards a greater degree of attention to the former type of creativity at the expense of the latter. Assuming that this trend continues (and there is no reason to believe it should not), it seems that as researchers we will come to spend even more of our time recombining information and even less time reflecting. While the human brain has shown a great ability to adapt to changing environments, it is uncertain whether multiplicity as a creative method can lead to insights as revolutionary as those made by 'slow thinkers'. The network society has yet to produce discoveries of the order of those made by Einstein and Darwin.

3 Transmission: Scaling the University

For the individual embarking on a career, a university or college degree is more important than ever for that person's employment prospects. Hazel E. Barnes puts it very succinctly in her comparison of the university to the church: '[W]ithout the degree which serves as a baptismal certificate, few can be saved economically or socially' (1970, p. 20). The growth in student intake is driven by a demand for education and is in turn driving research into how university education can be made available to more. The introduction to this essay mentioned e-learning as an example of Castells' informational mode of development. In addition to that, e-learning is of course a pragmatic attempt to use information technologies to reach a greater portion of the population at a lower cost. Borrowing a term from distributed systems research, researchers in e-learning are hoping to *scale* the knowledge transmission process to a greater number of students than possible when all students reside in the same geographical location.

The increased interest from industry in employing people with college degrees has also had another consequence. There is widespread agreement among academics, especially in science and engineering, that a push has been felt from industry (and therefore also from many students) towards the adoption of curricula based more on specific rather than general skills. For industry, it seems easier to hire someone straight out of college, who already has a specific set of skills, rather than to hire someone with a general understanding of a domain and train her (or let her train herself). In my own field—that of information technology—the situation has been particularly difficult because of rapidly changing technologies. While the number of buzzwords appearing on, for example, the syllabus for an optional course affects many students' choices, such buzzwords tend to be replaced by new ones almost overnight. If the students focus on learning the actual technologies any given year, rather than achieving a good understanding of the underlying ideas, they will find it more difficult to pick up next year's fashions in technologies.

This trend can be interpreted using the tightening feedback loop as a model. Learning a vocational skill can be seen as the input portion of the loop, and achieving the

general understanding as the reflection/processing part. It takes less time to learn most specific skills than it takes to understand why a given skill is useful. The general shift in focus characteristic of the informational society means that we concentrate on the (relatively fast) input portion rather than (more time-consuming) reflection/processing portion. We tend to hunt for the specific, the single piece of knowledge that will fit exactly into our grand puzzle rather than achieving the general understanding that will make it possible to manufacture that piece ourselves.

Prominent sources such as John Henry Newman and Albert Einstein support the notion that the university should teach people the general ideas, the mindsets, rather than highly specific skills. Einstein puts it very plainly:

> I want to oppose the idea that the school has to teach directly that special knowledge and those accomplishments that one has to use later directly in life. The demands of life are much too manifold to let such a specialized training in school appear possible (1954, p. 69).

On the other hand, the same sources also argue that learning requires *doing*. Einstein also expresses the following view:

> Personalities are not formed by what is heard and said, but by labour and activity. The most important method accordingly always has consisted of that in which the pupil was urged to actual performance. This applies as well to the first attempts at writing of the primary boy as to the doctor's thesis on graduation from the university (1954, p. 65).

Einstein argues for a symbiotic relationship between understanding and doing, a middle ground of interaction between the general and the specific. Skills taught should not be targeted too highly towards specific vocations but at the same time need to be specialised to a degree where they can be put to actual use for further learning. The act of doing is central to the reflection/processing portion of the feedback loop associated with knowledge acquisition. As teachers, this is something we know instinctively, and we are therefore keen to equip our students with skills they can put to good use. If these actual skills can also be useful in acquiring a job afterwards, it seems we have hit two birds with the same stone because we will have saved the students some time. The risk of course is that it is easy to come to focus on the specific rather than the general and to add increasing amounts of specific material to the syllabi in an attempt to equip the students for any possible situation.

This leads us to what can be seen as a change in the way we encourage students to learn. By teaching a greater range of increasingly vocational skills at the cost of the general concepts, students are encouraged to learn by example, to perform the knowledge synthesis, the generalisation process, on their own. When we learn by example, achieving a good understanding of the underlying principles requires knowledge of more than one related vocational skill. For example, students of computer science typically learn a number of procedural programming languages over the first few years of study. This makes it easy for them to understand the procedural paradigm, which is the underlying principle for such languages. Borrowing another term from distributed systems research, a current trend in knowledge transmission is to *marshal out* the process of knowledge synthesis to the individual students to a greater extent than previously.

Oddly enough, this is exactly the way computer services are made to scale to (meaning to operate in scenarios with) large numbers of users. Such services (for example, a website) typically consist of a central server that performs some service (for example, providing information) for the clients (that is, the computers belonging to human users). By distributing as many tasks to the clients as possible, load is removed from the server, which in turn can accommodate more clients. Removing load from the server typically involves serving data to clients in a form that is raw, under the assumption that the clients can process the data themselves. For many such distributed applications, the system as a whole ends up performing more work than if the server had done everything, but one server can support more clients. The analogy does not hold completely but the similarity is striking. Teachers cannot digest the information for students, but a shift towards growing syllabi with more vocational content is certainly a shift towards transmitting knowledge in a form that is raw. Also, the inherent expectation of the students' ability to synthesise those skills into general knowledge on their own accord can be perceived as a way of reducing the load on academics and therefore as a way of making the university scale.

For an entire university degree, a distributed knowledge synthesis mode requires a significant number of skills to be taught. This also translates into growing syllabi and, combined with an active social life and possibly a part-time job to pay for tuition, explains why students are busy. In addition to being a way to scale knowledge transmission, this mode of learning is also symptomatic of the network society and of the idea of multiplicity as a creative mode. While distributed knowledge synthesis may prime our students for life in the network society, there is also the risk that excessive teaching will lead to information overload. Einstein writes:

> It is…vital…that independent critical thinking be developed in the young human being, a development that is greatly jeopardized by overburdening him with too much and too varied subjects…Overburdening necessarily leads to superficiality. Teaching should be such that what is offered is perceived as a valuable gift and not as a hard duty (1954, p. 72).

For academics, the risk is perhaps a little more subtle. Section 2 mentioned that when multiplicity is used as a creative method, the creative element is related to establishing links between concepts. Combined with a drastically scaled university and with growing syllabi featuring an increasing variety of subjects, the academic is at risk of becoming simply a conveyor of context and links to students. Even if as teacher, they retain their own (possibly multidisciplinary) selection of material, what remains of teaching is essentially juggling pieces of information for the students to synthesise into knowledge in the same way that a disc jockey juggles vinyl records or CDs to make their audience dance.

4 Diffusion: The Journal Reinvented

The previous two sections discussed some ways in which the processes of knowledge advancement and transmission were changed through the adoption of information technology. Pelikan's third process, knowledge diffusion, denotes the ways in which completed research is diffused to the research community at large, mainly via the publication of journals, books and conference proceedings. At the time of writing, the former is of particular interest, because a shift is starting to take place as to how knowledge is diffused. Academics are developing the electronic journal as a

reinvention of the traditional peer-reviewed journal in a form that is tailored for the network society. Because the present author is an editor of such a journal and has personal experience with its operation, the discussion here will focus on journals as means of knowledge diffusion, rather than books and conference proceedings.

The primary motivation for the reinvention of the journal at this particular point in time is an increasing discontent with the prices charged by publishers for journals. Academics generally submit their material and sign over the copyright to publishers free of charge due to the prestige associated with publication in peer-reviewed journals and the immediate relation between the career advancement opportunities and the length of one's CV. Academics also conduct the peer reviews for the publishers free of charge, and the publishers then print (and sometimes also typeset) the journals and sell them back to the academics' libraries. The reason this scheme has received a substantial amount of attention recently has mainly to do with dramatic increases in prices charged by publishers for this service, causing libraries, despite substantial budget increases, to reduce the number of titles purchased and thereby limit the scope of diffusion. As an example, serials unit costs in Australia increased by 474 per cent during 1986–98, and even though library expenditure on serials increased by 263 per cent during that same period, the increase in price led to a 37 per cent drop in the number of titles purchased (SPARC).

Academics have discovered that they can do every part of the publishing process themselves, and that the Internet provides sufficient infrastructure to operate and distribute a peer-reviewed academic journal electronically. This is an exciting trend worthy of attention. A particularly noteworthy case was when forty members of the editorial board from the *Machine Learning Journal*, published by Kluwer, collectively resigned in October 2001 and went on to found the *Journal of Machine Learning Research*, an electronically published journal also available in paper form from MIT Press and in direct competition with Kluwer's journal *(JMLR*). The main reason for this step, explained in a public letter from the resigning board members, was that, as authors, they felt the subscription fees imposed by Kluwer (US$1050 per year for institutions, $120 for individuals) prevented the journal from being distributed as widely as desirable.

There are other, perhaps less dramatic, examples of online journals, one of which is *Crossings: Electronic Journal of Art and Technology*. Published online by the University of Dublin, this multidisciplinary journal is peer-reviewed, archival and published four times a year. *Crossings* is modelled quite rigidly after traditional print journals: new issues appear at scheduled intervals, and once published, papers are only updated to correct minor errata. All papers received for publication are subjected to peer review by at least three members of the editorial board who perform this service free of charge. Because the journal is published only online (no print edition currently exists), distribution is virtually free, and the only considerable operating expense is related to staff required to edit and mark up the papers selected for publication. It costs less than €4500 to produce an issue of *Crossings*, an expense currently covered partly by the University of Dublin and partly through volunteer efforts.

Crossings relies on information technologies for all aspects of its operation. Nearly all correspondence with authors and reviewers takes place electronically, which results in a relatively low turn-around time: around eight weeks from initial paper submission to

final publication. Indexing and search facilities are provided free by the Google search engine through their 'University Search' programme, and readers can comment on papers online via the 'Loquacious' service provided (also free) by Philip Greenspun. Hence, in terms of software the journal is lightweight, meaning that any functionality that could be externalised—notably searching and indexing and the site collaboration features—are provided by third parties and not by the university. While this does decrease administration and maintenance overhead, it also means that there are portions of functionality over which the editors have no control. For example, if Greenspun were to discontinue the annotation service, the body of comments that users have made to the *Crossings* papers would not be available until a replacement service could be found. (They will not be lost; the editors keep backup copies on file.)

Modelling the journal very closely on the traditional journal form was a conscious decision intended to make *Crossings* easily identifiable as an academic publication. Potentially, however, the information technologies allow much greater flexibility and, once established, the journal's format may very well evolve over time. The idea of collecting papers into issues is convenient for printed journals that require physical distribution, but a modern electronic journal could easily publish papers incrementally. Also, the digital format allows a greater range of media to be published, for example audio, video and software—something of which the editors have yet to take advantage. Note that despite its electronic form, *Crossings* is also designed to be easily printable and generally accessible to people with disabilities, such as visual impairment.

The *Crossings* journal serves as an example of how an existing concept from knowledge diffusion—the academic journal—can be transferred from the hierarchical to the network society. It is beyond doubt that in the next few years we will see an increasing number of high-quality journals available online. At the moment, it is somewhat uncertain whether publication in an electronic journal carries the same merit as publication in a print journal. However, given the same rigidity in the peer review and editing processes, the level of quality achieved in both media will be identical, and any perceived discrepancy can therefore be expected to disappear over time.

5 Preservation: Storing for Good

The last of Pelikan's processes—the preservation of knowledge in scholarly collections—refers to the role traditionally served by university libraries. While the adoption of information technologies, such as those used for electronic journals, dramatically increases the scope of distribution at a negligible cost, these technologies do raise serious concerns for the future availability of the material. The attentive reader will have noticed that, whereas section 4 mentioned that *Crossings* is an archival journal, it conveniently left out any discussion of how archival preservation of the papers is assured. This section continues the treatment of the electronic journal as a sample case of a publication mechanism from the hierarchical world transferred to the network society. Similar cases could be made for the book and conference proceedings. For an electronic journal such as *Crossings*, the archival issue is twofold, pertaining to *data formats* and *availability.*

The issue of *data formats* as it pertains to preservation is a distinctively modern one. The traditional journal or book format—symbols inscribed on paper—requires no

external apparatus to be displayed, and knowledge published in such media does therefore not become obsolete due to the nature of the format in which it is specified. In comparison, any book or journal in electronic form requires the presence of some device to allow the content to be displayed to the reader. In this respect, an electronic journal is comparable to a journal published on microfiche: both require the availability of a suitable display device in order for the content to be presented to the reader.

The *Crossings* journal in its current form is essentially a website and therefore relies on current standards in hypertext mark-up to make the content available to the readers. We have chosen to make the papers available in a language known as XHTML, and while this assures a high degree of compatibility with current web browsers, it is unlikely that future browsers (say fifty years from now) will continue to retain compatibility with this standard. Hence, XHTML despite being a good choice for the moment, is far from an appropriate format for the long-term preservation of knowledge.

Instead, we have chosen to mark up papers using a language called XML that as a format is less prone to obsolescence. In short, XML allows publishers to define a customised format suitable for their particular domain and via a series of rules translate content marked up in that format to any other format, such as the current 'flavour of the day' in web standards. The only prerequisite is the availability of a program that can apply the rules to the original content. Whenever a new standard for content comes along, the publisher writes one new set of rules and applies them to all the existing content. This assures that the original content can with relative ease be transformed into a more current format, no matter what that format is.

Various approaches to the data format problem are being adopted by organisations concerned with the archival preservation of knowledge. Another is Project Gutenberg—a volunteer-based initiative that aims to make available in electronic form content for which copyright has expired. Project Gutenberg's approach to data formats has been to avoid mark-up altogether and make texts available as plain (ASCII) text files. While avoiding any sort of mark-up does make the content more independent of transient technologies, it also limits the form of the content severely. The plain text format is really only suitable for rather simple texts in English. Content containing French, Japanese or Hindi characters cannot be formatted this way, and neither can documents containing more complex forms of embedded content such as hyperlinks, figures, images, audio or video.

The second issue pertaining to knowledge preservation, *availability*, has to do with the way the actual marked-up data is guaranteed preservation. This is a separate issue from data formats; a given document can be available or not, regardless of whether the format in which it is specified allows it to be displayed. A given microfiche may be available from a library, but whether a microfiche reader exists is a different question. The content published in *Crossings* is stored on the computer where the web server is running, and the availability of the data therefore depends on the operation of that physical machine. This type of storage is vulnerable to a vast array of threats: hardware failures, software failures, power failures, attacks of various sorts including break-ins and computer viruses. Even assuming continual maintenance by a human operator, a web server is far from suited for any kind of archival preservation. As to availability, the approach adopted by *Crossings* has been simple: Backups of the

content are stored off site and copies on paper and CD-ROM are periodically submitted to key university libraries. While this is a distinctly old-fashioned approach, paper still has its merits, and the combination of print for preservation and website for distribution will remain until superior solutions appear.

The nature of such solutions can be either technological or administrative in nature. An example of the former is Ross Anderson's 'Eternity Service', proposed in a note published at a 1996 cryptography conference. Anderson observed that 'the advance of electronic publishing has placed at risk our inheritance from Gutenberg' (1996, p. 2) because our current means of electronic publishing (for example, web-sites) makes it possible—even relatively straightforward—to 'depublish' material. For this reason, electronically published material is highly vulnerable to censorship. As a remedy, Anderson proposes the 'Eternity Service', a globally distributed file storage, modelled on the Internet infrastructure, with no centralised components and therefore inherently uncensorable and highly resistant to even the most extreme threat scenarios. When publishing a document through the service, the publisher would pay a fee which would assure the availability of the document for a fixed period of time (for example, fifty years) into the future.

Although Anderson's main concern is the particular threat of censorship, the technology he proposes addresses the general problem of preservation of data over long periods of time and in potentially hostile circumstances. Adopted at a global scale, technology such as this could potentially replace the knowledge preservation function traditionally performed by university libraries. While existing content not available in digital formats would still be stored in libraries, new content could be published through a service such as Anderson's. Universities could contribute to the operation of the service through purchasing and operating a portion of the hardware and software required for the service and/or via financial support towards the preservation of key material, such as certain books and journals, much like the collections now found in physical form in university libraries are built via the purchase of selected books and journals.

An alternative solution could be based in administrative rather than technological change. Currently, *Crossings* is the only electronic journal published by the University of Dublin, and the editors are themselves responsible for the operation of the website and assuring availability of the content. The university library plays no part in the operation of the journal beyond storing copies of the papers in print and on CD-ROM. With the advent of multiple electronic journals being published by the same institution, a certain economy of scale could be achieved by centralising key administrative functions, such as the operation and maintenance of hardware and software, backup of content, etc. Also with regards to data formats, a unified approach to mark-up and transformation rules shared by several journals would assure a higher degree of future availability for all journals with a significantly lower investment of time and effort by administrative staff. As traditional centres for knowledge preservation, these roles seem to fall naturally within the scope of university libraries.

Regardless of whether future forms of preservation will be based mainly in technology or administration, it is beyond doubt that an increasing portion of the content will be available electronically and that, as users of these archives, we will have even easier access to even more material than before. While this is certainly preferable to information starvation, it also means there is more information to

process and digest. The promises made by current developments in preservation technologies therefore seem to support the notion of an increased focus on the input section of the academic's personal feedback loop. To someone whose day is already filled with information, this trend can seem a little intimidating.

6 The Academic as Information Jockey?

The above outlines a few aspects of the four knowledge processes performed by the university with special attention to how these processes are being shaped by (and are shaping) advances in information technologies. Whilst far from being an exhaustive treatment, it is hoped that the issues raised have made for an interesting discussion and provided food for further thought. Recalling Pelikan's model of the university as a four-legged table, it is clear that all four legs are currently undergoing significant changes and that these changes will be decisive for the university's future role in the network society. To sum up, the trends identified here—the increasing scale of teaching and research subjects, the increasing number of students, the immediate availability of vast quantities of material via advances in diffusion and preservation technologies, a mode of creativity grounded in multiplicity—all point towards significant changes in many academic activities. Developments in knowledge advancement, transmission and diffusion in particular seem to indicate that, as participants in the knowledge processes, we will be consuming, combining and communicating ever greater amounts of information. Whether this means that academics (and also students) will be 'reduced' to information jockeys remains to be seen. While the new modes of thinking, communicating and creating may seem intimidating at times; they may also have advantages of which we are not yet fully aware. In 1970 Hazel E. Barnes wrote:

> Within the University and in society generally we are increasingly aware of ourselves as creators, not revealers of a new kind of future for mankind, as authors of the historical process, not as actors bound in fidelity to a preconceived context (1970, p. 23).

To this author, the awareness and the sense of empowerment described by Barnes are intimately connected with the network society and may very well go hand in hand with the new creative modes and the ability for rapid adaptation. If so, this may turn out to be quite fortunate, because to fulfil the responsibility associated with redefining and reinventing the university on a continual basis, that is just what we need to be: creative, aware and empowered.

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