OPEN TO CHANGE?
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OPEN SOURCE SOFTWARE, OPEN ACCESS, AND OPEN EDUCATIONAL RESOURCES IN HIGHER EDUCATION

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1. OPEN EDUCATIONAL RESOURCES ARE HERE TO STAY

Higher Education is facing three major trends: the growth in importance of information technologies; the spread of market discourse and market incentives for higher education institutions; and the internationalisation or globalisation of higher education. As a result of these developments, many institutions experience growing competition, which can be addressed by strategies to protect and use the institution's intellectual property to create competitive online offers for education and research. In some cases, market methods are implemented to gain maximum revenues to the institution. In contrast to these developments, alternative strategies emerge, emphasising the need for openness and sharing as a fundamental value of research and education. In this paper I will argue that open sharing of learning resources is a growing phenomenon that is here to stay and, together with other technological developments, will have an impact on higher education. The trends of sharing software programmes, research outcomes and learning materials are already so established that they are generally thought of as movements. But they also have so much in common that they could be looked upon as three distinct parts of a common movement – a movement towards openness.

Although many agree that e-learning in higher education has so far not lived up to promises made during the dot-com boom, nonetheless over the last years online education has become increasingly prominent. Although data is somewhat scattered, there are obvious signs that e-learning is growing in the higher education sector. Part of this trend is the growing use of reusable content objects – or open educational resources (OER). The OER movement owes much of its inspiration to the Open Source Software and Open Access movements, and is as likely as those to become a well-recognised phenomenon within higher education. Underlying technological and economic drivers are creating favourable conditions for the OER movement. These include improved information technology infrastructure, cheaper and more readily available hardware and software as well as emerging business or cost recovery models for institutions involved in free sharing of learning resources. In addition, there are altruistic, economic and other incentives for institutions and individual academics to use, produce and share OER. With a strong technological push for more user involvement coupled with opportunities for both economic and non-economic benefits of institutions as well as individuals, institutions could probably benefit from OER even with minor changes in institutional strategies or policies; although more radical actions might be needed for some institutions. Major distance teaching institutions have recommended that universities and colleges should act and join the Open Educational Resource movement sooner rather than later, since there is a significant risk in failing to act when developments are so rapid (OECD, 2007).

The growing availability and use of OER illustrates some trends, which are also apparent outside the education sector, such as unbundling of content. For instance, as in the music industry where albums are losing ground in favour of individual tracks, granularity is also increasingly demanded in education. Personalisation of services is also a key trend in many sectors. There are increased demands and costs for information technology investments in higher education, which in turn oblige institutions to rethink their organisation. At the same time, individual learners are seeking more control as shown by the expansion in informal learning and use of personal learning environments. These trends are reducing the importance of institutionally-controlled learning management systems. All of these developments speak of challenges to today's higher education with a specified curriculum delivered to large groups of students and completed at a predetermined pace.

1.1 The O-decade

In the further analyses of this trend towards openness, three different strands will be examined: the development process used for creating software called "Open Source Software"; new ways of publishing academic literature on the Internet called "Open Access"; and finally the trend of making educational material available for free on the Internet called "open educational resources". There are other "open" movements as well, e.g. Open licenses, Open Spectrum, Open Biology, Open Journalism, Open Politics, Open Data, etc. In this context, Materu (2004) states "if the nineties were called the e-decade, the current decade could be called the o-decade". All of these movements owe a great debt to the development of the Internet, but, apart from the Internet, what else do Open Source Software, Open Access and OER have in common?

Although there is no exact definition of how to understand it, the use of the word "open" is not chosen arbitrarily. The two most important aspects of openness have to do with free availability over the Internet and as few restrictions as possible on the use of the resource. There should be no technical barriers (e.g. undisclosed source code), no price barriers (e.g. subscriptions, licensing fees, pay-per-view fees) and as few legal barriers as possible (e.g. copyright and licensing restrictions) for the end-user. The end-user should be able not only to use or read the resource but also to adapt it, build upon it and thereby reuse it, given that the original creator is attributed for her work. In broad terms this is what is meant with "open" in all three movements. It is also what is more or less covered in the definition used by The Open Knowledge Foundation when they say that knowledge should be legally, socially and technologically open.

For the purposes of this paper, absence of technical, price and permission barriers are enough to call a product "open". Thus, software like Linux and OpenOffice are Open Source Software, whereas products from Oracle or Microsoft (such as Word, Excel and PowerPoint) are not. Articles that can be found through the search engine OAIster and periodicals listed at the Directory of Open Access Journals are open articles and journals, whereas journals available only to paying subscribers are not. Moreover, learning resources and courses that can be found on the Internet and used for free are OER, while programmes available only to registered students or learning resources sold by publishers are not.

It should be made clear that, although there are strong feelings in all three movements against certain big commercial players, there is no inherent anti-business philosophy in the open movement. Some Open Source Software advocates want to avoid commercial applications of their work and encourage others to do the same but others have invented new business models and prospering companies based on the use of Open Source Software. The same is true for Open Access – while some proponents see Open Access as a way to combat the scientific publishing industry, others have started new businesses on the basis of open publishing. Also, within the budding OER movement, some argue that open education might be a way to mitigate the effects of the commercialisation and commoditisation of education, while others are looking for new business models for educational institutions by using OER.

Moody (2006) pointed out striking parallels in the way the Open Source Software and the Open Access movements have developed. So far this scheme does not include the OER movement, probably because it is the most recent and least developed one. It might also be the case that, even though the first staggering steps of OER were very much inspired by the Open Source Software movement, its further growth will take a quite different path.

This paper will give an overview of the rise of each of the three movements with a special focus on OER as the most recent and least known of the three. Their main characteristics will be listed as well as their impact for higher education and some of the challenges they face for the future. Finally, we take a look at what the future might bring.

1.2 Why openness – what are the arguments?

The first and most fundamental question anyone arguing for free and open sharing of software or content has to answer is "why?" Why should anyone give away anything for free? What are the benefits of doing that? Advocates of each of the movements have arguments in favour of their specific cause, but there are also general arguments that apply to all three. They can be divided into pull arguments which list the gains that can be reached by open sharing of software, scientific articles and educational materials, and push arguments that register threats or negative effects that might arise if software developers, scientists and educationalists do not share their work openly.

Starting with the push side, it is sometimes argued that if universities do not support the open sharing of research results and educational materials, market forces will marginalise traditional academic values. The risk of monopoly is often used to support the Open Source Software movement. For instance if everyone is using Microsoft programmes, or a combination of a combined hardware and software monopoly by too many using Apple's iPod music players listening to iTunes.. Critics of large scientific publishing houses claim risk of monopoly ownership is also important as regards scientific literature. The possibility for researchers to keep a seat at the table in decisions about the disposition of research results in the future is sometimes said to be at risk. Increased costs and vulnerability, increased social inequality and slower technical and scientific development are other concerns.

On the more constructive side, a number of possible positive effects of open sharing are put forward. For instance, free sharing means broader and faster dissemination and thereby more people are involved in problem-solving which in turn leads to rapid quality improvement and faster technical and scientific development; decentralised development increases quality, stability and security; free sharing of software, scientific results and educational resources reinforces societal development and diminishes social inequality. From a more individual standpoint, open sharing is claimed to increase publicity, reputation and the pleasure of sharing with peers.

Open standards

When talking about openness, it could be argued that open standards should be included since they are so important for the possibility for different software applications to operate together. We are surrounded by standards but seldom notice them. A standard is a specification, a practice, or a reference model, which is used to define an interface between two or more entities such that they can interact in a predictable fashion (Walli, 2005). It is the standard for the breadth for railway tracks that makes it possible for trains from different countries to travel across continents, and the standard for compact discs that makes them playable on CD players from different manufacturers, and it is the use of standards when designing computer software that enables applications to operate on different hardware and to interact with other pieces of software. There are two kinds of standards – *de facto* and *de jure*. A *de facto* standard typically emerges as a result of a single vendor having an overwhelming market share or monopoly. Microsoft's Windows and Word are good examples as well as Apples iTunes technology. Organisations and committees with established processes for adopting a standard produce *de jure* standards. They are open in the sense that they are built in a public or inclusive consensus-based process and can be used by anyone free of charge. Although open standards are of great importance to the interoperability of software, and are thus implemented by many Open Source software projects, the development of new standards is an even more specialised task than Open Source Software development carried out by both companies and independent researchers, and goes beyond the immediate interest of the academic community. Therefore it will not be a part of this chapter.

2. THE HISTORY OF OPEN CULTURE

2.1 It all started with Open Source Software

The Open Source Software movement is now more than 25 years old. It dates back to the early 1980s and has become a very powerful grassroots initiative, which has revolutionised software development and influenced the whole technology sector. The leading personality behind the movement is Richard Stallman, who introduced the idea while working at the MIT Artificial Intelligence Lab and was the initiator of the open source operating system, GNU, in 1984. The fundamental concept behind Open Source Software is that the source code (i.e. the human readable code) should be accessible to read, copy and adapt. The philosophical underpinnings sound very simple, but the tenets on which it is based – collaboration, community and the shared ownership of intellectual resources – have resulted in remarkable innovation.

In the early days of computer technology there was no meaningful distinction between hardware and software or between user and programmer. "There was only the computer and the people working on it", as Weber (2004) stated in his thorough analysis of the success of Open Source. In the 1970s the distinction between system software and applications developed, and the computer became a universal machine able to run any application designed within the limits of its own processing performance. The first versions of software that could be used on different computers were developed. Many of these developments took place within a culture of free sharing. Companies developing proprietary software - i.e. software with restrictions on use and copying -challenged this philosophy and prompted Stallman to found the Free Software Foundation. The Free Software Foundation aimed to create an entirely free operating system that anyone could download, use, modify, and distribute freely, which is now well known as Linux.

It is important to note that free software is not free because it has no price. Stallman points out that: "free software does not mean that the software is free, as in no payment. When I speak of free software, I'm referring to freedom, not price. So think of free speech, not free beer." (Fitzgerald & Suzor, 2005) According to the Free Software Foundation there are four criteria that determine whether a program is free or not. It is free if you have the freedom to:

1. Run the program, for any purpose.
2. Modify the program to suit your needs. To make this freedom effective in practice, you must have access to the source code, since making changes in a program without having the source code is exceedingly difficult.
3. Redistribute copies, either gratis or for a small fee (typically covering only the marginal reproduction costs).
4. Distribute modified versions of the program, so that the community can benefit from your improvements.

Stallman also found a way to ensure that anyone using free software code to create and distribute new work is obliged to disclose his or her own code. This was addressed via the creation of a lawfully binding obligation through a licence, called the GNU General Public License. As Fitzgerald and Suzor (2005) puts it:

> This was Stallman's powerful insight: copyright in software code can be used not only to close access and exploit its benefits for monetary reward but can also be claimed at the source to structure open access down-stream. Software source code that was released free to access would remain free to access, and any improvements would also be free to access.

This means that open software does not represent a denial of intellectual property but a new way to manage it. But the ambiguity of the word "free" and the fact that free software often can be obtained at no

cost have created frequent misunderstandings of the aim of the free software movement to be "users should never pay" and perceived as anti-commercial in spirit. The Open Source Initiative was formed in 1998 in response to this, and they began using the term "Open Source" to describe software that follows its own criteria of openness. The philosophy of the Open Source Initiative is somewhat different than that of the Free Software Foundation. It is focused on the technical values of making powerful, reliable software, and is more business-friendly. The Open Source Initiative is less focused on the moral issues of free software and more on the practical advantages of the Open Source Software distributed development method.

While the fundamental philosophy of the two movements is different, both the Free Software Foundation and the Open Source Initiative cooperate on a practical basis in software development, efforts against proprietary software, software patents and the like. Stallman refers to the Free Software Foundation and the Open Source Initiative as two political parties in the same community. Writers and community supporters use the terms Free and Open Source Software (FOSS) or Free/Libre/Open-Source Software (FLOSS) as a way to refer to the "Open Source" community, which embraces both ideals, and its software, without taking a side between the two philosophies or their methods.

2.2 The genesis of Open Access

The genesis of the Open Access movement dates 10 – 15 years back. The first pre-print service, which made available articles not yet published in peer-reviewed journals, was established in 1991. In 1994, a professor of cognitive science, Stevan Harnad, posted what he called a "subversive proposal" saying that since researchers' only interest in publishing is to share their ideas with as many of their peers as possible they are happy to give their papers away. In this situation, the price tag of a journal subscription not only imposes an undesirable restriction on sharing and in the age of Internet is no longer even necessary. Consequently, he concluded, researchers should immediately start self-archiving their papers on the Internet thereby maximizing the impact of their ideas (Poynder, 2004). Harnad was not the inventor of the Open Access movement, but his assiduous work for Open Access since then, gives him a similar status as Richard Stallman in the Open Source Software movement.

Although the movement started slowly, it gained considerable momentum in the last few years with the launch of a number of initiatives that have received a great deal of support from several national funding agencies like the National Institute for Health (USA) and the Science and Technology Committee in the UK.

Important Open Access statements

- The Budapest initiative (Open Society Institute, 2002).
- The Berlin declaration (Max Planck Society for the Advancement of Science, 2003).
- The ECHO charter (Lund University, 2003).
- The Bethesda Statement on Open Access Publishing (Earlham College, 2003).
- The e ACRL Principles and Strategies for the Reform of Scholarly Communication (Association of College and Research Libraries, 2003).
- The Wellcome Trust position statement on open access (Wellcome Trust, 2003).
- United Nations World Summit on the Information Society (WSIS) Declaration of Principles and Plan of Action, (WSIS, 2003).
- International Federation of Library Associations and Institutions (IFLA) Statement on Open Access to Scholarly Literature and Research Documentation (IFLA, 2004).
- Australian Group of Eight Statement on open access to scholarly information (Australian Group of Eight, 2004).

In January 2004, Ministers participating in OECD's Committee for Scientific and Technological Policy recognised that fostering broader, open access to, and wide use of, research data will enhance the quality and productivity of science systems worldwide. The Ministers adopted a Declaration on Access to Research Data from Public Funding. In January 2006, an independent group of researchers commissioned by the European Commission (2006) gave, as their first policy recommendation, a call to guarantee public access to publicly-funded research results shortly after publication. According to Suber (2007), 2006 was an important year for the Open Access movement with five out of eight Research Councils in the UK adopting clear Open Access mandates and there were quasi or virtual mandates from national research funding bodies in at least five more countries. Eleven research institutions adopted Open Access mandates or strong Open Access policies in 2006. In addition, there were Open Access requests and encouragements from five more. In May 2006, an American senator introduced the bipartisan Federal Research Public Access Act of 2006 which, if passed, would require that agencies with research budgets of more than USD 100 million enact policy to ensure that articles generated through research funded by that agency are made available online within 6 months of publication. (InfoToday, 2006)

What is Open Access?

There is no single definitive description or definition of Open Access. Still, it is agreed that Open Access is centred on free availability and unrestricted use of scientific literature on the Internet. The movement is dedicated to removing price barriers (such as subscriptions or licensing fees) and permission barriers (in the form of copyright and licensing restrictions) to scientific literature. It takes advantage of the ease and efficiency of information exchange via the Internet.

> "An old tradition and a new technology have converged to make possible an unprecedented public good. The old tradition is the willingness of scientists and scholars to publish the fruits of their research in scholarly journals without payment, for the sake of inquiry and knowledge. The new technology is the Internet. The public good they make possible is the world-wide electronic distribution of the peer-reviewed journal literature and completely free and unrestricted access to it by all scientists, scholars, teachers, students, and other curious minds." (The Budapest Open Access Initiative, 2002)

As mentioned in the opening of the Budapest Open Access Initiative, there is a longstanding academic tradition of sharing knowledge and ideas. The publication of results is an essential part of scientific research, or, as is stated in the Bethesda declaration: "Scientific research is an interdependent process whereby each experiment is informed by the results of others". Researchers write books and articles not primarily for money (although some textbooks might give some authors revenue) but to further their research and to improve their career prospects. Traditionally they have looked to publishers for help with dissemination and peer review. The publishing industry and the scientific journals have usually been the main medium to achieve this, but now the industry is failing to deliver speedy dissemination, economical access and peer review quality as well as it used to. Scholars are therefore increasingly interested in alternative models, especially Open Access.

Another line of argument for Open Access is that when taxpayers fund public research, the results should be freely accessible. Peter Suber (2006), one of the leading advocates for Open Access, develops this argument at length. If research papers based on publicly-funded research are locked away in conventional journals that require payment for access, then taxpayers end up paying twice for the same research. It is argued that it would be wrong to make taxpayers pay a second fee for access. Some researchers also contend that tax money should be spent in the public interest, not to create intellectual property for the benefit of private publishers, who acquire and profit from it, without paying the authors or compensating the public treasury.

A third argument, often pursued by university libraries, regards the rising costs for subscribing to scientific journals. A frequently quoted source is the American Association of Research Libraries (ARL, 2002), which claims that the price of journals has risen four times faster than inflation since the mid-1980s. Although it is recognised that it is not costless to produce peer-reviewed scientific journals, it is argued that there are better ways of paying the cost than charging the reader and creating access barriers. It is said that the overall costs of providing open access to this literature are probably lower than the costs of traditional forms of dissemination, and this creates an opportunity that should not be neglected.

A fourth argument for Open Access makes the case that individual researchers who publish openly receive more readers, citations and thereby achieve more impact than others. The first study on this issue, published in 2001, analysed almost 120 000 conference articles in computer science and related disciplines published between 1989 and 2000. It shows significantly higher numbers of citations for online articles compared to offline articles. An analysis of different publication venues, such as proceedings of a conference for a particular year, gave the same result.

> "If we assume that articles published in the same venue are of similar quality, then the analysis by venue suggests that online articles are more highly cited because of their easier availability. This assumption is likely to be more valid for top-tier conferences with very high acceptance standards. Restricting our analysis to the top 20 publication venues by average citation rate gives an increase of 286% (median 284%) in the citation rate for online articles." (Lawrence, 2001)

There are many vehicles for Open Access articles such as personal web sites, e-books, mailing lists, discussion forums, blogs, wikis, and peer-to-peer file-sharing networks. However the two primary vehicles for delivering Open Access to research articles are still Open Access journals, archives or repositories. The main difference is that Open Access journals conduct peer review. Peer review, or refereeing as it is known in some academic fields, ensures research papers are professionally evaluated by colleagues. By showing ones work to others, one can increase the probability that weaknesses are identified and addressed, based on the advice and encouragement of peers. The anonymity and independence of reviewers is intended to foster unvarnished criticism and discourage cronyism in funding and publication decisions.

2.3 The origins of Open Educational Resources

As information technologies have become more available, those involved in education have found that a vast number of digital resources are accessible from many sources. However, potential users face many obstacles, such as how to find resources, assess their quality, and understand the copyright or licensing conditions for their re-use. Many faculty members in universities are using the Internet in their courses resulting in a growing amount of course content available in digital format. Yet, until recently much of this material was locked up behind passwords within in-house systems. The OER movement aims to break down such barriers and to encourage and enable the sharing of content freely.

In 1994, Wayne Hodgins coined the term "learning object", and it quickly entered the vernacular of educators and instructional designers. One role of learning objects in the history of OER is the popularisation of the idea that digital materials can be designed and produced in such a manner as to be reused easily in a variety of pedagogical situations. The metaphor of Lego bricks is sometimes used to describe how learning objects can be used and reused in different contexts. In 1998, David Wiley invented the expression "Open Content" which caught the attention of Internet users and popularized the idea that the principles of the Open Source Software movement could be productively applied to content. Wiley also created the Open Publication License, the first widely adopted open license for content. The term OER first came into use in 2002 at a conference hosted by UNESCO, defined as "the open provision of educational resources, enabled by information and communication technologies, for consultation, use and adaptation by a community of users for non-commercial purposes." The current most-used definition of OER is: "Open Educational Resources are digitised materials offered freely and openly for educators, students and self-learners to use and re-use for teaching, learning and researc." To further clarify this, OER is said to include:

- Learning content: full courses, courseware, content modules, learning objects, collections and journals.
- Tools: software to support the development, use, re-use and delivery of learning content including searching and organization of content, content and learning management systems, content development tools, and on-line learning communities.
- Implementation resources: intellectual property licenses to promote open publishing of materials, design principles of best practice, and localization of content.

When comparing the definition of Open Source Software, Open Access and OER it becomes clear that OER is both the broadest and the most vague concept of the three. A wide variety of objects and online materials can be classified as educational resources: from courses and course components, to museum collections, and open access journals and reference works. Over time, the term has come to cover not only content, but also learning and content management software, content development tools, standards and licensing tools for publishing digital resources that allow users to adapt resources in accordance with their cultural, curricular and pedagogical requirements. This means that OER includes both Open Source Software tools used for development or delivery of learning content as well as Open Access articles used by an instructor in his or her teaching.

Examples of Open Educational Resource Initiatives

In the absence of a clear definition of OER, a description of a number of initiatives might give a better view of the concept and the movement. The movement gained considerable visibility when Massachusetts Institute of Technology (MIT) in Cambridge, USA, first announced its intention to make the materials of its courses available on the web for anyone to use in 2001. This decision resulted in the OpenCourseWare

project which as of November 2006 included 1 550 courses. OpenCourseWare consists of course materials that are voluntarily produced by 75% of the faculty of MIT. Anyone interested can download the materials, listen to and read them, but no tutoring is offered. Although assignments and exams are available, students have to be registered at MIT to be awarded certificates as a result of taking exams. Furthermore, since the materials are licensed under a Creative Commons license, researchers and instructors in schools and universities all over the world have the permission to reuse the material in their own teaching, and to make derivative works given that they attribute the author, do not use it for commercial purposes and distribute the resulting work under an identical license.

Although the MIT initiative is one of the better known at the moment, other important OER projects have taken different approaches. One example is the Open Learning Initiative at Carnegie Mellon University, in Pittsburgh, USA. The Open Learning Initiative approach grew out of collaboration among cognitive scientists, experts in human-computer interaction and faculty. The Open Learning Initiative's complete courses have innovative features such as cognitive tutors, virtual laboratories, group experiments and simulations. On the website, it is described as a new paradigm which adds "the crucial elements of instructional design grounded in cognitive theory, formative evaluation for students and faculty, and iterative course improvement based on empirical evidence". These courses make more use of different media compared to many of the plain PDF-files offered by MIT, and are more easily used for self-learners. This on the other hand makes them much more costly to produce and, so far, only ten courses are offered for free and one more is under construction. The Multimedia Education Resource for Learning and Online Teaching (MERLOT) represents yet another approach to OER. MERLOT is a community of over 40 000 individual members (growing by more than 700 per month) and higher education institutions from North America, Europe and Asia, as well as corporate partners and affiliates. Individual members contribute materials, assignments and comments to the MERLOT collection. It represents a different approach in many respects. One key difference is that MERLOT does not contain the actual materials, as they are located somewhere else on the Internet. MERLOT only stores a link, a description of the material, plus any peer reviews, member comments or assignments that are available. Another distinguishing feature is that the materials are typically not full courses, but smaller parts such as a lecture or presentation, a simulation, a link to a website, etc. These learning objects are primarily supposed to be put together into a meaningful unit by teachers and instructors, or used as a supplement to teachers' own materials. In January 2007, more than 15 500 resources were available through MERLOT, contributed by over 1 800 people. The number of users per month grew by almost 50% from 2004 to 2005, up to a mean of more than 40 000 visitors a month. (Hanley, 2005)

3. WHY SHARE FOR FREE?

Why is anyone to give away his or her resources for free? What are the incentives and motives for being involved in any of these movements? These questions can be posed both to individuals and institutions. The following section concentrates on incentives for individual programmers, scientists and instructors, coming back to the motives for institutions in the next section. Often, individuals and institutions are motivated by a variety of different reasons. In many ways, motives for producing OER are similar to those for producing Open Source Software. However, there are also differences which mirror the dissimilarities between the players involved and the distinctions between writing computer programs as compared to disseminating results of research and teaching.

3.1 Incentives for sharing software code

To develop computer programmes and write software code for complex operating systems is a huge task and can seldom be done by a single person, both because of its size and its complexity. A division of

labour is needed to acquire all skills needed and to be able to finish the assignment within reasonable time. Software development is a multifaceted endeavour for several reasons. As Weber (2004) explains, the programmer often does not know under which conditions his program will be used, and furthermore, software is invisible and difficult to visualise – "software structure exists on multiple logical planes, superimposed on one another. Software is conceptually more like a complex poem or a great novel in which different kinds of flows coexist across different dimensions." Due to this complexity, great poetry is almost always the product of a single mind. This is also why the division of labour in software development at first was described via the metaphor of surgical teams where "one does the cutting and the others give […] every support that will enhance his effectiveness and productivity."

However, the Open Source development process takes on this challenge from a different angle. The key element, as described by Weber, is voluntary participation and voluntary selection of tasks. Anyone can join an open source project, and anyone can leave at any time. The collaborative development process of Open Source Software, strongly simplified, starts with a software developer trying to "scratch an itch", to solve a problem he or she is facing. The developer needs a particular application that does not exist and decides to write it and invites others, who might have the same problem, to collaborate. The collaborators propose new features, modifications of the code or bug fixes that might or might not be accepted by the original developer. Small projects might have simple decision-making processes; larger ones develop hierarchies of gatekeepers, developed on an implicit principle of meritocracy.

Since the software by definition is open to anyone to use, without participating in the development process, how does the process work successfully and ensure that enough people contribute? Altruism and amusement for enthusiasts, which are two explanations, is not enough to clarify the phenomenon. Paul Graham (2004), himself a famous programmer, has written a book and an essay on how "hackers" work. In technical circles, "hackers" refer to skilled programmers rather than software pirates or technicians involved in illegal activity, as common use of the term implies. His explanation Open Source Softwareis that developers like good tools, or even find it unbearable to use bad tools.

> "Great hackers also generally insist on using Open Source Software. Not just because it's better, but because it gives them more control. Good hackers insist on control. This is part of what makes them good hackers: when something's broken, they need to fix it. You want them to feel this way about the software they're writing for you. You shouldn't be surprised when they feel the same way about the operating system."

Building on research and surveys among developers, Weber (2004) proposes six kind of motivations on the individual level: the fun, enjoyment, and artistry of solving interesting programming problems; having the job as a vocation; the experience of a joint enemy where Microsoft is the villain; individual ego boosting where the work does the bragging; to gain reputation by being involved in successful projects; and finally a shared identity and belief system within the community of developers.

Lerner and Tirole (2002) start from a more classic economic perspective and propose two immediate benefits and two delayed rewards that may counter the opportunity cost for the individual. The immediate benefits may be that the programmer improves his or her skills when working on the Open Source program; the other is that it simply might be more fun to participate in a "cool" Open Source project than performing the normal routine tasks. The two proposed delayed rewards are the career concern incentive which refers to future job offers or shares in commercial Open Source-based companies; and the ego gratification incentive which stems from a desire for peer recognition.

Bonaccorsi and Rossi (2004) conducted a survey of 146 Italian companies and compared their incentives with those of individual programmers. They found significant differences in motivations:

> "[F]irms emphasise economic and technological reasons for entering and contributing to Open Source and do not subscribe to many social motivations that are, by contrast, typical of individual programmers."

After revising several attempts by economists to explain why developers participate in Open Source development projects, Tuomi (2005) concludes that:

> "Although it is not clear whether the developers maximize their benefits in any systematic sense, it is clear that they do take them into account. In addition to straightforward economic benefits, however, open source developers consider a broad set of possible benefits, including the excitement of being part of a meaningful social project that can potentially change the world. In other words, open-source developers are motivated and incentivized in many ways and for many different reasons. The particular strength of the open-source model is that it allows multiple motivational systems to co-exist and to be aligned so that the system development goes on.."

3.2 Motives for sharing research results and learning resources

It has already being noted that some researchers find it to be in their own best interest to publish their research results openly on the Internet. Many find that alternative publication and distribution models offered by Open Access suit their needs better in terms of being read and having an impact in their field than traditional methods. So the individual researcher may find personal motives for sharing his research for free although others may find it more favourable for their careers to publish in well-known journals. Other arguments for Open Access include strengthening the academic tradition of sharing knowledge and ideas with others, or avoiding that taxpayers pay twice for research results may of course also influence individual researchers to publish openly.

Drivers and barriers

So far, the incentives for individual researchers, teachers and instructors to share learning resources are less comprehensively mapped and less well-known than the motives for open access publishing or participating in Open Source Software projects. Before looking at motivations for participating in the OER movement, one must first examine a number of drivers and barriers that set the basic conditions and include technical, economic, social, policy-oriented or legal considerations. (OLCOS, 2007; OECD, 2006b).

The technological and economic drivers include improved, less costly and more user-friendly information technology infrastructure (such as broadband), hardware and software. Content is cheaper and easier to produce and costs can be further reduced by sharing. New economic models are emerging around the distribution of free content. Legal drivers include new licensing schemes that facilitate free sharing and reuse of content, while social drivers include increased willingness to share.

A technical barrier is lack of broadband availability. Lack of resources to invest in hardware and software for developing and sharing OER is an economic barrier. Barriers such as these are often mentioned as significant obstacles in developing countries. Social barriers include lack of skills to use the technical innovations and cultural obstacles against sharing or using resources developed by other teachers or institutions.

Motives for individuals

The motives for individuals to become engaged in OER are similarly complex. Drawing on the literature and experiences from the OECD case studies, four main groups of reasons appear:

1. *Altruistic or community support reasons* – sharing is a moral imperative, stimulates further innovation, offers personal satisfaction to know that ones materials are available and used all over the world, and pleasure of cooperative development with peers and sharing with others.

2. *Personal non-monetary gain* – publicity, "egoboo" or reputation within the open community. Sharing might be a way to academic rewards like tenure and other employment prospects. Specific gains from participating in OER activities include support for digitizing teaching materials and clearing copyright for third party materials, opportunities to restructure and systemize lectures and for getting feedback, and finally increased possibilities for future publication.

3. *Commercial reasons* – a strategy to enhance the commercialized version of the content. Creating an open content version of the material, e.g. a draft (pre-print) or a chapter, may in fact be a strategy for enhancing the final, commercial product. Sharing might help get a new product to market more quickly, gaining a first-mover advantage, and it might help build a community of users that will support a new product or process; it might stimulate the sales of related products. Tracking use and reuse creates a form of market research and high use data is invaluable for launching commercialization scenarios. Providers of tools (e.g. platforms) might treat users are as *co-developers*, sharing freely tools that they can use to create valuable content.

4. *It is not worth the effort to keep the resource closed* – in cases of a small but useful cumulative innovation, the creator might conclude that it is not worth the time and effort to obtain a patent. Or, the creator might conclude that intellectual property mechanisms might not effectively protect the innovation, e.g. where many others have similar information, where it would be difficult to keep the development a secret, and where the development can be easily replicated. Furthermore there is the fact that "what is junk to one may be gold to another"; the off cuts or digital junk of one person may be the building blocks of knowledge and creative genius for another.

Findings from OECD (2007) suggest that practical considerations are more important for teachers than altruistic concerns, such as assisting developing countries, outreach to disadvantaged communities, or bringing down costs for students. At the same time, however, the least important factor for respondents was personal financial rewards. When asked about the most significant barriers among colleagues not using OER in their teaching, the respondents pointed out lack of time and skills, together with the absence of a reward system. A perceived lack of interest in pedagogical innovation among colleagues was also mentioned. The barriers described correspond with lessons learned from an Australian evaluation of an institutional learning environment, which included a learning resource catalogue. (Koppi, 2003) The authors conclude that "[t]he issue of reward for publicising teaching and learning materials is of paramount importance to the success of a sustainable learning resource catalogue where the teaching staff themselves take ownership of the system". To establish a credible academic reward system that includes the production and use of OER might, therefore, be the single most important policy issue for a large-scale deployment of OER in teaching and learning.

Motives for institutions

From an institutional point of view, there are a number of reasons for OER involvement. Vest (2004), former president of MIT, has given five reasons for MIT to "give away all its course materials via the Internet". The overall intention of the initiative is said to be to advance education and widen access but other benefits cited include greater opportunity for MIT faculty to see and reuse each others' work, a good record of materials, increased contact with alumni, and a way to help their own students become better prepared.

Since MIT is a campus-based institution it has been argued that the OCW initiative did not threaten its core business. It would be much more risky for a distance-teaching institution to try something similar. That makes it even more interesting to look at the reasons for the Open University in the UK, to launch its OpenLearn initiative. McAndrew (2006) lists eight motivations including that the philosophy of open content matches the Open University's mission; and that the OER movement is developing and the Open University should join sooner rather than later. He also mentions the risks for the institution in doing nothing when technology and globalisation issues need to be addressed and the fact that this could be a route for outreach beyond the existing student body. Furthermore it is seen as a chance to learn how to draw on the world as a resource and as a test bed for new technology and innovative ways of working. It is also seen as a demonstration of the quality of Open University materials in new regions and a way to work with external funding bodies that share similar aims and ideals.

The main reasons for engaging in OER activities can be summarised as follows:

1. *Sharing knowledge is a important and also in line with academic traditions*, as pointed out by the open access movement. Openness is the breath of life for education and research. Resources created by educators and researchers should subsequently be open for anyone to use and reuse. Ultimately this argument is supported by the United Nations Human Rights Declaration, which states: "Everyone has the right to education. Education shall be free" (Article 26).

2. *Educational institutions should leverage taxpayers' money by allowing free sharing and reuse of resources developed by publicly funded institutions*. To lock learning resources behind passwords means that people in other publicly funded institutions sometimes duplicate work and reinvent things instead of standing on the shoulders of their peers. It might be seen as a drawback for this argument that it does not distinguish between taxpayers in different countries – learning resources created in one country may be used in another country, sparing taxpayers in the second country some money. However, as pointed out by Ng (2006), free-riding of this kind may not pose so much of a problem since the use of a learning resource in a foreign country does not hinder the use of the same resource by domestic teachers. Instead, he says "allowing free-riding may be necessary for the growth of a good community as they help draw new members by words of mouth. Also, free-riders themselves may learn to value the community more over time, so much that some of them may share eventually."

3. Open Source Software *"What you give, you receive back improved."* The costs for content development can be cut by sharing and reusing, thereby making better use of available resources. Also, the overall quality should improve over time, compared to a situation where everyone always has to start from scratch.

4. *It is good for public relations and it can function as ashowcase, attracting new students.* Institutions, like MIT, have received a great deal of positive attention for their decision to make their resources available for free. Other institutions could do the same. Carson (2006) shows that 31% of the freshmen at MIT became aware of the MIT OCW prior to making their decision to apply to MIT and, out of those, 35% indicated that the site was a significant influence on their choice of school. Furthermore John Hopkins OCW reports that 32% of their visitors during their first year of operation indicated their status as prospective students. A variation of the fourth argument is the wish to reach out to new groups, to people without access to, or prior knowledge of, higher education.

5. *There is a need to look for new business models and new ways of generating revenue.* Many institutions face growing competition as a consequence of the increasing globalisation of higher education and a growing supply of free educational resources on the Internet. In this situation there

is a need for innovation in business models,, such as offering content for free, both as an advertisement for the institution, and as a way of lowering the threshold for new students, who may be more likely to enroll – and therefore pay for tutoring and accreditation – having had a taste of the learning on offer through open content.

6. O*pen sharing will speed up the development of new learning resources, stimulate internal improvement, innovation and reuse* and help the institution to keep good records of materials and its internal and external use. These records can be used as a form of market research if one is interested in the commercial potential of individual resources.

It is difficult to say to what extent the above incentives are driving forces behind OER initiatives, other than those mentioned above , as more research is needed. It should also be emphasised that a combination of several of the motives listed here are likely to be in play simultaneously, both altruistic motives and economic incentives.

In OECD (2007), three main arguments are given for governments to support OER projects:

1. They expand access to learning for everyone but most of all for non-traditional groups of students and thus widen participation in higher education.

2. They can be an efficient way of promoting lifelong learning for both the individual and the government.

3. They can bridge the gap between non-formal, informal and formal learning.

The underlying drivers and inhibitors as well as motives for developing and sharing OER are summarised in Table 1.

Table 1. Drivers, inhibitors and motivations for developing and sharing open educational resources

Motivations for producing and sharing open educational resources		
Governments	**Institutions**	**Individuals**
Widen participation in higher education	Altruistic reasons	Altruistic or community supportive reasons
Bridge the gap between non-formal, informal and formal learning	Leverage on taxpayers' money by allowing free sharing and reuse between institutions	Personal non-monetary gain
Promote lifelong learning	"What you give, you receive back improved"	Commercial reasons
	Good public relations and showcase to attract new students	It is not worth the effort to keep the resource closed
	Growing competition – new cost recovery models are needed	
	Stimulate internal improvement, innovation and reuse	

Underlying drivers	**Underlying inhibitors**
Technical: Increased broadband availability; increased hard drive capacity and processing speed; new and improved technologies to create, distribute and share content; simpler software for creating, editing and remixing.	*Technical:* Lack of broadband and other technical innovations
Economic: Lower costs for broadband, hardware and software; new economic models built around free content for recovering costs.	*Economic:* Lack of resources to invest in broadband, hardware and software. Difficulties to cover costs for developing OER or sustaining an OER project in the long run.

Social: Increased use of broadband, the desire for interactivity, increased skills and willingness to share, contribute and create online communities.	*Social:* Absence of technical skills, unwillingness to share or use resources produced by someone else.
Legal: New licensing regimes facilitating sharing of free content.	*Legal:* Prohibition to use copyrighted materials without consent.

4. THE IMPACT ON HIGHER EDUCATION INSTITUTIONS

4.1 Open Source Software in Higher Education

About ten years after Stallman's initial initiative, in the mid-1990s, the idea of Open Source Software gained momentum with the emergence of the Internet. Developers such as Linus Torvalds, the initial creator of Linux, pioneered new organizational schemes that made it possible for hundreds of volunteer programmers to participate in joint software development over the Internet. The Open Source Software movement arose from this large-scale participation, which includes software developed under the GNU General Public License and more than 40 other license agreements.

Although the use of Open Source Software is very common today, many non-expert users are not very familiar with it because it has not yet made significant inroads onto the personal computer desktop in the form of an operating system or office applications, such as word processors or spreadsheets. Even so, many users are not aware that they may be regularly using Open Source Software and data formats simply by browsing the Internet and using email. Indeed, these two common household uses of computer technology would be unworkable without Open Source Software. The open source Web server software, Apache, which sends Web pages to the computer of someone accessing a site, has dominated its market segment since 1996 and now holds three times the market share of its nearest competitor, Microsoft. A study newly released by the European Commission shows that Open Source Software applications are first, second or third-rung products in terms of market share in several markets, including web servers, server operating systems, desktop operating systems, web browsers, databases, e-mails and other information technology infrastructure systems. (UNU-MERIT, 2006) Defined broadly, Open Source Software-related services could reach a 32% share of all information technology services by 2010 and the Open Source Software-related share of the economy could reach 4% of European GDP by the same year.

What makes Open Source Software so attractive? Why do people and institutions not professionally involved in software development care about open source? There are a growing number of reports stating several benefits of Open Source Software. A symposium arranged by the European Commission (2001) came to the conclusion that there is extensive experience in the use of Open Source Software in the public sector in Europe and that Open Source Software is used because of adaptable functionality, lower overall costs, vendor independence and adherence to open standards, interoperability and security. UNESCO's International Institute for Educational Planning lists the following advantages of Open Source Software:

- Increasing choice and competition.
- Aligning Open Source with Open Standards objectives.
- Positioning software as a public good.
- Increasing technological self reliance.
- Reducing vendor lock-in.
- Increasing transparency.
- Minimizing security risks.

A comparative study among tertiary education institutions in Australia, New Zealand and the United Kingdom showed "that Open Source Software is already being used by all tertiary education institutions

who responded to the survey and that the major reasons for this were lower total cost of ownership and freedom from software vendor dependence". (Glance, 2004) The British OSS Watch (2006) reports "a positive picture of the use of Open Source Software emerges in both higher education institutions and further education institutions". It is said, "although only 25% of institutions mention Open Source Software in an institutional policy, in practice 77% of institutions consider Open Source Software when procuring software". An American study shows that 57% of all higher education institutions in the USA are using some form of open source infrastructure software, including operating systems and databases (Abel, 2006). One third of institutions have implemented open source applications (including course management systems and portals), but still, about the same share of the institutions has yet to give "serious consideration" to Open Source Software although with few rejecting it outright. Abel concludes that higher education institutions are looking for alternatives to commercial software and are concerned about whether commercial providers can meet their "unique needs". OECD (2005) reports that even though commercial vendors of software have attained significant market share in the sector of higher education, development of in-house software and use of Open Source Software are noteworthy trends. The appeal of in-house Open Source Software lies in perceived inadequate functionality or pedagogic limitations of commercial offerings, despite platform functionality becoming increasingly customisable.

In addition to the classical Open Source Software development model, a number of successful development projects (like Sakai, Open Source Portfolio, and Kuali) within the higher education sector are building on a somewhat different model. As described in Wheeler (2007) the distinguishing feature of this Community Source Model is that many of the investments of developers' time, design, and project governance come from institutional contributions and some commercial firms rather than from individuals. They tender existing staff time rather than new cash. The model has been used by institutions realising they are trying to solve a similar problem, and agree to pool their resources under a project board of institutional leaders. The UNU-MERIT study (2006) estimates that almost two-thirds of all Open Source Software is still written by individuals; companies contribute about 15% and other institutions such as universities, another 20%.

The assertions that Open Source Software should be superior to proprietary software are of course questioned. It has been argued that the rationales for open source have rarely been carefully justified or studied. This has left room for proprietary software developers to make the counterargument that, when the total lifetime costs for installing, operating and maintaining software are taken into account, the low cost of open source becomes questionable. In this argument, license costs are in any case a minor part of total costs.

Furthermore it is sometimes pointed out that for large organisations like universities, the challenges of implementation, support and maintenance of Open Source Software can be very problematic. As a Chief Information Officer at an American university puts it: "[d]esign and development are fun and exciting. Moreover, at some point in the process, you can declare success and move on. Maintenance and support have neither the glamour nor the defined end points. They're not as much fun, and they last forever". (Stunden, 2003) She concludes that universities need to develop creative collaborative solutions to the dilemma of maintenance and support very soon if they want their Open Source Software initiatives to succeed. A similar point of view has been expressed in case studies of universities conducted by OECD, where the need for related services, trustworthiness and reliability in well-proven applications was given as reasons for using proprietary software. (Pedro, 2006)

Table 2: Examples of Open Source Software projects in education

Software project	Description	URL
LAMS	A tool for designing, managing and delivering online collaborative	http://www.lamsinternational.com/

	learning activities	
Moodle	Learning Management System	http://moodle.org/
Dspace	A digital repository system which captures, stores, indexes, preserves, and distributes digital research material	http://www.dspace.org/
EduCommons	OpenCourseWare Management System designed specifically to support OpenCourseWare projects	http://cosl.usu.edu/projects/educommons/
Schoolforge-UK	Community implementing open content in UK education using OSS	http://www.schoolforge.org.uk/index.php/Main_Page/

4.2 The impact of Open Access

Scientific publishing is big business. It is estimated that the core scientific, technical and medical publishing market worldwide is between USD 7 – 11 billion. (OECD, 2004) At the moment the Open Access movement challenges scientific publishers, as a growing number of scientists are willing to share their work openly on the Internet.

Open Access journals are not necessarily different from other scientific journals. The only difference is that Open Access journals are freely available on the Internet for anyone who wants to access them. Open Access journals can be financed in different ways, but the principle is usually that those with an interest in disseminating the content pay the production cost upfront so that access can be free of charge. There are two primary models of the pay-to-publish system:

1. The individual author or his institution or funding agency pays the production cost to a journal.
2. The institution (the university library) pays an annual membership fee to a journal for its' entire research staff which allows them to publish in that journal.

In both cases, but particularly the first, the cost of publication is seen as a part of the cost of research. Open Access advocates also claim that to avoid excluding authors that cannot pay the processing fee, Open Access journals often waive the fee if the author cannot pay.

In addition to these two distinct models there is a huge variety of models falling between these two approaches, and support systems where institutions support journals produced by their staff. According to OECD (2004), rather few journals use the pay-to-publish model. It is more common to support publications with donations, bequests, institutional support, priced add-ons or auxiliary services. Furthermore, it is said "[t]hese models are still evolving and it is still relatively early to judge their role and viability with respect to other emerging and established models".

The pay-to-publish model can be questioned on the ground that major research institutions that produce a lot of published articles would actually end up paying more in such a system, compared to the traditional one. This argument was suggested by one of the leading publishers of scientific journals, Reed Elsevier, in a submission to the UK House of Commons Science and Technology Committee Inquiry into Scientific Publications:

> "[W]hile Britain's spending on journal subscriptions currently amounts to 3.3% of the world's total, UK researchers contribute a much higher 5% of all articles published globally.

> As a result, we estimate that the UK Government, foundations, universities and researchers could together pay 30-50% more for STM journals in an Open Access [publishing] system than they do today." (OECD, 2004)

OECD (2004) lists other work coming to similar conclusions, but also authors coming to the opposite conclusion.

The Wellcome Trust, the world's largest medical research charity funding research into human and animal health, is advocating and supporting Open Access publishing. They commissioned two reports looking into costs and business models in scientific research publishing. In the second report it is concluded that Open Access publishing should be able to deliver high-quality, peer-reviewed research at a cost that is significantly lower than the traditional model while bringing with it a number of additional benefits. It is calculated that the estimated costs per article for typical pay-to-publish journals is about 30% lower than for typical subscriber-pays articles. As a result, the Wellcome Trust have adopted a policy of providing grant holders with additional funding to cover the costs of page processing charges levied by publishers who support the Open Access model.

Regarding economic sustainability of Open Access journals, Open Access advocates point out that since publication of research results is of fundamental importance to the research community, there is a great deal of money committed to supporting scientific journals. In an Open Access model, costs of peer review, manuscript preparation, and dissemination are lower than the prices currently paid for subscription-based journals, and thus many argue they are therefore economically sustainable. As Open Access spreads, libraries will realise large savings from the conversion, cancellation, or demise of subscription-based journals.

Open Archives

An alternative publishing model to Open Access journals are Open Archives. An Open Archive is a digital database of articles accessible from the Internet. They can be organised by subject area, discipline or by institution. As already noted, an important difference between Open Archives and Open Access journals is that archives do not perform peer-review. Archives ensure long-term preservation of digital objects at the same time as making articles and other digital objects openly available. However, they may limit uploading of items to a specific discipline or authors from a restricted number of institutions.

Open Archives can include theses and dissertations, course materials, learning objects, data files, audio and video files, institutional records, or any other kind of digital file, or they can be limited to pre-prints and post-prints of journal articles. A pre-print is any version prior to peer-review and publication, usually the version submitted to a journal. A post-print is any version approved by peer review. Sometimes a colour code is used to differentiate between the policies of different repositories or archives:

- Gold: provides Open Access to research articles without delay.
- Green: permits post-print archiving by authors sometimes with a delay of 6-12 months.
- Pale green: permits pre-print archiving by authors.
- White: published and peer-reviewed articles.
- Gray: pre-prints or internal "know-how" material.

Authors need no permission for pre-print archiving. When they have finished writing the pre-print, they still hold copyright. If authors transfer copyright in the post-print to a journal, then they need the copyright holder's permission to deposit it in an Open Archive. There are different estimations of the share

of journals that allow post-print archiving, but it seems to be two thirds or more. If a journal does not allow it, then the author can still archive the pre-print and the corrigenda (i.e. the differences between the pre-print and the post-print).

An additional argument for Open Access is the speed of dissemination. The main time problem is the process of peer review, which is just as time consuming for Open Access journals as for traditional scientific journals. In this case, pre-print publication might be an alternative. The need to "cut down the lag time between the completion of an article or chapter and its availability to the scholarly community" was given as one of two main arguments for establishing a pre-print repository for working papers in classics at Princeton University, USA. (Poynder, 2005)

What then is known about the impact of self-archiving? According to advocates, it has many positive societal effects: it is beneficial for the individual scholar since he gains more readers and more citations; it is reasonably simple to do (it is estimated to take an author about 15-20 minutes extra); but still estimates show that only 15% of authors do self-archive and 78% have never done it. (Poynder, 2005) There are probably two main factors behind these rather modest numbers:

1. The lack of awareness of the Open Access movement as such and possible benefits from self-archiving.
2. The uncertainty over copyright, meaning that many scholars are not very well versed in open licenses and different models for both sharing research openly while still retaining some rights over the material.

Together with the question of how to sustain initiatives over time (see section 5.3), these issues seem to be two of the most important challenges for the Open Access movement at the moment.

4.3 The significance of Open Educational Resources

It has already been repeated in this paper that the OER movement is still in its infancy and it is difficult to know what impact it might have in the future. All that can be said so far is that the number of projects and initiatives is growing fast. For the moment it is not possible to give an accurate estimation of the number of existing Open Educational Resource initiatives. Alongside a number of large institution-based or institution-supported initiatives, there are numerous small-scale activities.

Since 2001, the numbers of initiatives and resources available have increased dramatically. According to evaluations done at MIT, 8.5 million visits were paid to MIT OCW content from November 2004 to October 2005, showing an annual increase of 56%. The growth in traffic is said to be steady and increasingly global: 57% were non-US visits. Twenty-one per cent of visitors came from Western Europe, 15% from East Asia and 6% from South Asia. The remaining 15% of the traffic originated in Eastern Europe, the Middle East, Africa, the Pacific, Central Asia and the Caribbean combined. Carson (2005) reports that self learners, typically with a bachelor's or master's degree, seem to make up the bulk of traffic (47%), followed by students (32%), and educators (16%). Higher percentages of educators use the site in developing regions, such as East Asia, Latin America, Eastern Europe, and the Middle East and North Africa. Self-learner percentages continue to be highest in North America, East Asia and Western Europe. (Carson, 2005) Both the MIT model and the actual resources are widely copied at the moment. An OpenCourseWare consortium has been established which at the moment include more than 100 higher education institutions and associated organisations from 13 countries plus 11 affiliated international organisations. The MIT OpenCourseWare material is translated into both traditional and simplified Chinese, Portugese, Spanish and Thai. In all there are over 2 700 courses available as OpenCourseWare at the moment.

The number of available articles, individual curriculum units, modules, and simulations are growing at a terrific rate. AEShareNet in Australia have approximately 20 000 objects available for free educational use. In Europe, the biggest distance teaching universities from nine different countries including Russia and Turkey are starting a project called Multilingual Open Resources for Independent Learning (MORIL) sharing resources to enrich their own curricula and improve training offers both in terms of number of courses freely available and in terms of languages. The English language Web site, Wikipedia, contains over 1 500 000 articles, while Math World contains 12 600 entries. Rice University's Connexions project currently hosts more than 3 600 open learning objects and 190 courses available for mixing and matching into study units or full courses. The University of California, Berkeley offers over 150 videos of course lectures and symposia, in total more than 250 hours, free of charge through Google Video. Textbook Revolution contains links to 260 freely available, copyright-cleared textbooks. The European ARIADNE Foundation offers links and federated searches in several networks and repositories. UNESCO's International Institute for Educational Planning hosts a wiki containing a listing of "OER useful resources" with links to portals, repositories and open content projects. Even more difficult than to list the number of initiatives would be to estimate the quantity of available resources, even with a narrow definition of OER. On top of the resources accessible through initiatives like the ones listed above, many more can be found by using search engines like Google or Yahoo!.

There is a great need to identify the users of OER and understand how OER are typically used. With the scattered data available, one can only depict a very general picture of users and producers of OER. It is a global movement, although most of the production of resources currently takes place in developed countries. The majority of producers of resources and OER projects are based in English-speaking countries in the developed world. Furthermore, the movement seems to grow via both top-down and bottom-up mechanisms; new projects are started at institutional level at the same time as individual teachers and researchers use and produce OER on their own initiative. The institutions involved so far seem to be well-reputed internationally or in their countries, rather than unknown or low-status institutions. Both small and large institutions are involved, as well as campus-based and distance-teaching establishments. About half of the institutions are involved in some kind of established partnership for sharing resources with others. Most of them have educators in post-secondary institutions as their primary target group, although students and the general public are also often mentioned too. The users of OER appear to come from all over the world. Many seem to be well-educated self-learners, but educators are probably also prominent users. OER are fostering international cooperation between institutions as well as peer to peer collaboration. Initiatives, particularly those based in institutions, produce transparency and might stimulate increased quality control and competition to benefit individual learners as well as taxpayers generally. The concept of OER strengthens traditional academic values of sharing and collaborative creation of knowledge.

OER is likely to impact on higher education institutions whether they are involved in OER projects or not. Curriculum, pedagogy and assessment will all be affected. With thousands of OpenCourseWare and other OER courses from internationally well-reputed higher education institutions available for free, teachers will need to realise that students compare their curriculum with others. Anecdotal data suggest that this is already happening. Concerning pedagogy, the role of the teacher is already changing from being the "sage on the stage to the guide at the side". OER is likely to accelerate this process since the role of the teacher as a supplier of teaching material and the only guide to knowledge is also diminishing. As regards assessment, the increase in non-formal and informal learning will probably enhance the demand for assessment and recognition of competence gained outside formal learning settings. Private educational providers in some countries already offer such services, and the supply of private providers using OER and offering tutoring, assessment and credits for a fee may be growing. Established higher education institutions may very well need to adapt to such demand and become increasingly focused on assessment organisations while diminishing their focus on teaching.

To conclude this chapter assessing the impact of OER on higher education institutions one final argument for institutions to become involved in OER projects can be presented. In the OECD project on OER several institutions mentioned the risk of doing nothing in a rapidly changing environment. Some distance teaching universities are struggling with the fact that a major part of their income at the moment stems from sales of teaching materials developed and marketed as a part of their teaching methodology. In some cases these materials are not available in digital format. Instead they are sent by mail to paying students, a model that is increasingly losing its marketability. According to OECD (2007) a shift towards a more up-to-date model of production and distribution would need to go hand in hand with a restructured cost recovery model in which OER will most probably have a prominent role.

5. CHALLENGES TO THE OPEN MOVEMENT

As already pointed out, the costs for higher education institutions to adopt Open Source Software products can be measured in different ways. There are no licensing fees for Open Source Software, but on the other hand the cost for adopting, customizing, maintaining, and developing the system might be considerable, sometimes 75-80% of the cost of proprietary software. Still many institutions have chosen to walk down this road and thus face a number of challenges. Young (2004) has listed five of the most important. The first is the need to catch the attention of enough enthusiastic developers. Since Open Source Software relies on volunteers a successful project must attract a critical mass of users – a community willing to take time to update and extend the software. Otherwise it will soon become outdated. The second challenge is to agree on what Open Source Software means or agreeing on a limited number of licenses that can be used. A multiplicity of licenses will cause confusion about what is allowed and what is not, thus slowing down or stifling the development process. Thirdly, there is a need to secure budgets for "free" software. It is a significant risk that Open Source Softwareinstitutions might not set aside enough resources to train staff members and customize the software. This view is supported by Lynch, a leading analyst of technology trends in education, libraries publishing, who notes that costs and complexity of software development have ratcheted up, illustrated by the fact that American higher education institutions are involved in many fewer projects today than during the 1990s. (Hawkins, 2006)

> It's clear that in higher education today, we need to pick our projects very carefully; we can't support many projects concurrently. The danger here is that this makes us much more conservative in picking our projects, because we can't afford to have any of them to fail. (Lynch in Hawking, 2006)

Wheeler (2007) argues that the "unbridled demand for IT services" coming from students, faculty, staff, and other academic stakeholders makes it necessary for higher education institutions to engage in Open Source Software development projects with other institutions, both as a way to reduce costs and to ensure a better fit to the rather unique needs of higher education. He argues that the Community Source development model is promising model for higher education.

A fourth challenge mentioned by Young is to get staff members to abandon existing products and switch to use the new software. The final challenge is to get institutions to work with companies, not against them, meaning that there can be a need to involve commercial technical support or to co-operate with companies to get them to open up their proprietary software so that the institution might mix and match Open Source Software and commercial options.

Higher education institutions need to find ways to deal with these challenges for Open Source Software products to have a future within academia. One can also raise more fundamental issues for the future of the whole Open Source Software development model. (Tuomi 2005) Many of his examples show

the risks of Open Source Software becoming a victim of its own success. For example, the recruiting of new developers might decrease as a result of commercial software vendors increasingly making their source code available and thus diminishing the motivation for starting new open source projects. Or, if programming tools become so advanced that useful applications can be developed by anyone, taking the fun and "cool" aspect out of Open Source Software development. The ultimate victory, that Open Source Software drives proprietary software out of the market, could very well result in a loss of identity for the OSS movement, since much of its strength derives from having a common enemy (i.e. Microsoft and other proprietary software developers). Other kinds of threats are also discussed such as the risk of individual Open Source Software developers being sued for damages, while commercial vendors usually make contracts that free them of all liability. In addition, some private companies (e.g. Microsoft) are attacking the Open Source momvement on the basis of infringement of patented technologies in the development of Open Source Software. However, at the moment neither of these challenges or threats seems to be enough to stop the success of the Open Source movement.

5.1 Copyright issues

Copyright law takes its definition from international conventions and is similar in most countries. It asserts that you cannot reproduce, copy or communicate to the public copyright material without the permission of the copyright owner. In short, the default rule is that all kinds of use not expressly permitted by the copyright holder are prohibited. Copyright primarily serves an economic function; by granting creators monopoly rights in their creations for a limited time (usually the life of the creator plus 50-70 years), copyright enables them to receive remuneration for the use of those creations. This in turn, provides an incentive for further creativity and innovation.

A disrupted balance

There are two important exceptions to the rule that without permission one cannot reproduce, copy or communicate copyright material to the public: fair use, which exists in some countries (e.g. USA), and educational use. In their whitepaper on obstacles to educational use of copyrighted material in the digital age, Fisher and McGeveran (2006) conclude that the exceptions to copyright that may protect uses of content for digital learning are "frequently narrow, cumbersome, incompatible with new technology, or vague". Gowers (2006) comes to a similar conclusion in his review of the British intellectual property regulations. The appropriate balance between the rights of authors (or publishers if they are the rights holder) and the larger public interest is disrupted. At the moment this is the most cumbersome obstacle to an increased use of digital learning materials in general and OER in particular. Fisher and McGeveran identify three important steps to improve this situation:

1. Reform of at least some problematic rules in American legislation would improve the status of educational uses of content.

2. Greater reliance on technology to help users analyse the need to secure licenses for using content and to assist with such rights clearance where necessary.

3. Increased distribution of content under more open license models such as Creative Commons, thus enlarging the amount of content available for unencumbered educational use.

Before publishing educational resources which make use of third party materials, the author, or the publisher, must make sure they have the right to use these materials. One consequence of the distorted balance is that this process is even more important and difficult. The clearance process, which Fisher and McGeveran (2006) refers to as the "permission maze" requires the user to:

1. Establish whether a license is required or not, which sometimes requires sophisticated legal analysis.

2. Locate the appropriate rights holder, which sometimes is easy and sometimes not.

3. Agree to a license, which can be difficult since large rights holders sometimes ignore small educational users since the potential revenue might not be sufficient to engage in a negotiation.

4. Pay for the license, which can be very expensive.

5. Carry out other terms and restrictions of the license such as a requirement that the educational user employ digital rights management systems to protect the content.

Trouble can arise at any of these points and, as reported in OECD (2007), the difficulties and costs related to rights clearance for use of third party content are considerable, in some cases almost half of the cost for the whole OER project.

Lack of awareness and support

While publication, consumption and distribution of texts were mediated through physical media, academics remained for the most part unaware of the licensing that underpinned the exploitation of copyright. The Internet and other digital media have changed this. By having access to publishing and production tools, and by licensing access to a digital, ephemeral product rather than a physical object such as a book or journal, researchers as well as teachers now must engage with licensing as never before. And they are, for the most part, either unprepared or unwilling to engage with cumbersome licensing procedures.

Although many academics are willing to share their work, they are often hesitant as how to do this without losing all their rights. Open content licenses, such as the Creative Commons licenses, have been developed to accommodate this problem by providing a way of controlled sharing with some rights reserved to the author. In 2002/3, the RoMEO project in the UK made a survey of 542 researchers about what kind of rights they wanted to retain over their work. (Gadd, 2003) A majority (over 60%), were happy for third parties to display, print, save, excerpt from and give away their papers, but wanted this to be on the condition that they were attributed as the authors and that all copies were verbatim. 55% wanted to limit the usage of their works to educational and non-commercial use. The RoMEO report concluded that the protection offered to research papers by copyright law goes far beyond the requirements of most academics. Easier ways of retaining only those rights that the individual author wants to retain are needed, together with active advice and support regarding open licensing from higher educational institutions. A recent comparison of seven Australian universities underpins previous international research showing that relying solely on voluntary deposits by academics of research articles to open access archives will result in approximately 15% contribution. (Sale, 2006) Requirements to disseminate research output via an open archive coupled with effective author support policy results in much higher deposit rates research materials.

5.2 Quality and relevance

Both the Open Access and the OER movements are victims of their own success. A rapidly growing number of articles, learning resources archives and repositories are giving priority to the issue of finding and identifying high quality resources. There is a need for effective search and discovery tools. Items of

interest to a researcher or teacher may not be part of library catalogues, federated databases or online journal subscriptions. Many reside in local databases, available via the web but difficult to locate and essentially invisible to the scholar. There are technical solutions to this problem, for instance, attaching metadata (data about data or descriptive information about materials) to the resources to make them easier to find for harvesting machines utilised by users via search interfaces. However, adding metadata to a resource is time consuming. It also faces the same problem as software programmers do – the person adding metadata does not know under which circumstances other people will use it, i.e. the search for the resource may commence from a totally different perspective than the person adding the metadata predicted, making it difficult or impossible to find the resource. The problem with metadata increases inversely with the size of the resource, , since the time spent adding metadata will be proportionally larger for small resources and the possible ways of using them probably more diverse than for a large resource like a scientific article. The lack of a common taxonomy across countries, languages and cultures is another significant barrier that needs to be overcome to improve the possibilities to find relevant learning resources. An alternative approach might be to use folksonomies where users themselves add free metadata to resources while using them. It is currently used extensively by many well-known commercial services such as YouTube and Flickr, but so far this approach is untested on a larger scale and little documented academically.

The OAIster project is an example of a service using metadata to facilitate the search for Open Access articles. OAIster was developed to make it easier for metadata to be shared among institutions. Institutions have to apply a protocol determining how the information about its resources should be displayed, to make it possible for an automatic harvest to be done regularly. OAIster co-operate with both Yahoo! and Google to make the OAIster metadata available also through the commercial search engines. In December 2006, OAIster gave access to almost 10 million objects from 722 institutions. In the autumn of 2005 they typically had 18 000 – 19 000 visitors a day and hundreds of thousands users on Yahoo!. (Hagendorn, 2005a) According to Hagendorn (2005b), OAIster never set out to be a focal point of Open Access, but nevertheless it contains virtually all the self-archived materials available as well as many images, texts, datasets and videos.

The corresponding service for OER are provided by repositories like MERLOT, ARIADNE, a British repository called Intute, the Dutch DAREnet, and the US-based Gateway to Educational Materials among others. Searches for materials are typically made on the basis of discipline, and sometimes on criteria such as resource category, most downloads, etc. These search categories illustrate the problem of relevance and quality. Too many results from a search for learning materials only makes it difficult and time consuming to find the most relevant resources and the ones of best quality. Many repositories therefore try to help teachers and students by giving them options to narrow their search.

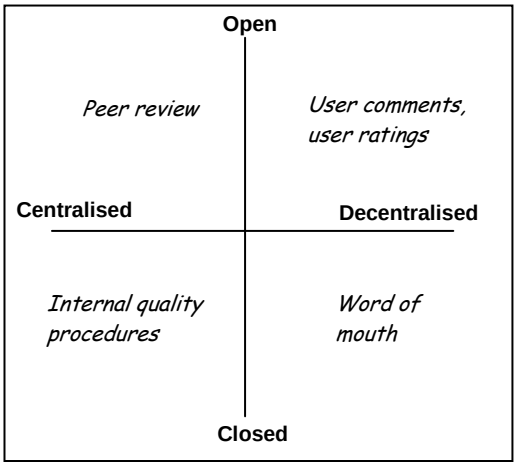
The question of quality still remains problematic. Open Source Software projects often use a meritocratic system where the more skilled and experienced programmers review the code delivered by less experienced community members. Open Access journals normally use peer review to decide which articles should be published. Some repositories offer the same opportunity. As described in the section on Open Access, the peer review process is one of the most used quality assurance processes in academia. As well as being a well-known and well-understood routine, there are other arguments for using peer review schemes to guarantee the quality of resources in a repository. Taylor (2002) argues the process can be used to come to terms with the lack of a reward system by giving recognition and reward to the creator of a learning resource, as well as a dissemination method. Furthermore, there is a need to make review decisions credible. An open peer review according to agreed criteria is well suited to this, Taylor claims, but this system is both expensive and time consuming. In addition, the peer review system is sometimes criticised for not being as impartial as alleged, and also having a conservative impact on research. The scientific journal Nature has tested this process, and attracted a great deal of attention but few contributions.

Some institution-based providers take another quality management approach. They use the brand or reputation of the institution to persuade the user that the materials offered are good quality. If not, the prestige of the institution is at risk. Most probably they use internal quality checks before the release of the courses, but these processes are not open in the sense that users of the resources can follow them.

A third approach is a decentralised process, where individual users decide on whatever ground they like whether a learning resource is of high quality, useful, or good in any other respect. Users are invited to rate or comment on the resource or describe how they have used it. Often, services will display the number of downloads for each resource on the website. This is a kind of low level or bottom-up approach often used on Web-based market places, music sites, etc. The argument for such an approach would be that quality is not an inherent part of a learning resource, but rather a contextual phenomenon. It is only in the specific learning situation that it can be decided whether a resource is useful or not, and therefore it is the user who should be the judge. Also, in the same way that Open Source Software brings together many minds to develop a software product, a grassroots quality system allows many minds to contribute to the quality rating approach of the website.

To sum up there are several alternative ways of approaching the quality management issues. As shown in Diagram 1, it can be managed via a centrally designed process or in a decentralised manner, one might use open processes or more closed ones. Arguments can be made for all these approaches (maybe with the exception of the word-of-mouth method), much depending on which kind of Open Educational Resource initiative or programme one is considering. All sorts of combinations could also be used.

Figure 1: Quality management processes for OER initiatives



5.3 Sustainability of initiatives

So many Open Access and Open Educational Resource initiatives have started during the last years, that there is now significant competition for funding. Although some projects have a strong institutional backing, it is most probably start-up funding that will no longer be provided after a few years. Therefore, it is important to seriously consider how the initiatives can be sustained in the long run. The same seems to be true for Open Access journals using the pay-to-publish model. The US based Public Library of Science, an important player in the Open Access movement, is experiencing financial difficulties due to increased costs of running its Open Access journals, despite rising incomes from authors fees and advertising revenues.

The pay-to-publish model is sometimes mistakenly considered as the only business model for Open Access journals, but there is actually a range of options. The Open Society Institute have produced guides to business planning both for launching new Open Access journals (2003) and for converting a subscription-based journal to Open Access (2004). They list a number of models for generating income. Together with some models identified by Dholakia (2006) and Downes (2006) there is a range of options to explore for Open Access and OER initiatives.

- The *Replacement model*, where open content replaces other use and can benefit from the cost savings as a result of the replacement. This model has a natural limit since it can only generate the same amount of resources as it replaces.

- The *Foundation, Donation or Endowment model*, where an external actor such as a foundation provides funding. This is primarily a start-up model that will probably not be viable in the long run, but it might be transferred into a *Government support model*, which can be a long-term option in some countries.

- The *Segmentation model*, where the provider, simultaneously with resources for free, also provides "value-added" services to user segments and charges them for these services – such as sales of paper copies, training and user support, ask-an-expert services etc. This model, together with the conversion model, is among the most used in the education sector.

- *Conversion model*, where "you give something away for free and then convert the consumer to a paying customer".

- The *Voluntary support model*, which is based on fund-raising campaigns. Another version of this model is the *Membership model* where a coalition of interested parties – organisations or individuals – is invited to contribute a certain sum as seed money or on an annual basis.

- The *Contributor-Pay model* where the contributors pay the cost of maintaining the contribution, which the provider makes available for free. This basic Open Access model may also be used by Open Educational Resource projects.

Other options may be membership fees, advertising, and sponsorship. Since each initiative is unique, no single model will fit all. Instead there is a need to discover different approaches that might be useful in a local context. Dholakia also stresses that growing competition among initiatives creates a need to develop strong brands, user communities, increased site usability and improved quality of the resources offered. Community -building and marketing are important because they enable users to form strong connections with the website. Moreover the institution can learn from the community about what works and what does not work on the website. It also gives possibilities for rapid diffusion, and strong community influence user behaviours, increasing the probability for users to come back to the repository.

An alternative approach to building an Open Educational Resource programme with a strong institutional backing is the *Community Model*. This calls for more grassroots activities where individuals contribute with their time, knowledge and resources on a voluntary basis. In this approach, production, use and distribution is decentralised, compared to institutional programmes where at least production and distribution are centralised. From a community perspective, one might take an alternative view on the over-all concept of sustainability. From this standpoint, it is not enough to look at the advantages and disadvantages of different revenue or funding models – one should look not only at who pays for the resources but also who creates them, how they are distributed and how one can work with them. Some of the aspects to consider are:

- Technical considerations such as discoverability of the resources;
- The kind of openness and constraints on access and use that is given users;
- Content models (e.g. the possibility to localise content) and issues of licensing;
- Staffing models and incentives for people to contribute resources;
- Alternative workflows to the traditional design—use—evaluation model, to models without a clear distinction between production and use or between the user and the producer. The concept of co-production is important here.
- Maintenance and updating of resources.

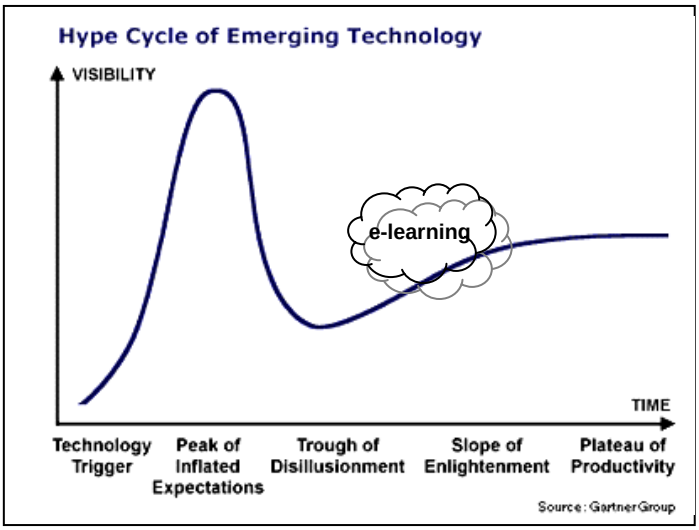
Since the community model builds on voluntary work and enthusiasts, sustainability is not so much a matter of financial resources as of dismantling barriers that hinders the community to flourish and grow. Tentative actions could be to find alternatives to the existing intellectual property rights regime and changing the mind set of donors not only to include funding to institutional initiatives but also to loosely composed communities.

6. THE FUTURE OF OPEN EDUCATIONAL RESOURCES

As mentioned in the introduction, online education is becoming increasingly prominent at the moment. A report from the Sloan Consortium (2006) shows that American universities provide distance learning to almost two million users, with a rate of increase of 23% during 2002-2003 and about 18% the

year after. Almost 17% of all students in USA are taking at least one online course. 2 200 college and university leaders participating in the study believe that online education is as good as or better than face-to-face education. Furthermore, the Financial Times reported an estimate from IDG that more than USD 25 million were spent on e-learning in Singapore alone in 2004 and this figure is expected to triple by 2008. (FT 20/03/2006) A similarly positive view on the future of e-learning is given in a recent study on e-learning in Europe conducted by CEDEFOP, an EU agency promoting vocational education and training, gathering the viewpoint of 600 respondents in a mix of learners, teachers, and support personnel. (Mc Cullough, 2006) Another study, based on college instructors and administrators, also show high expectations of a growth of blended learning and with online components of at least as high or higher quality than face-to-face teaching. (Kim and Bonk, 2006) Together with an OECD study on e-learning (OECD, 2005), it predicts that reusable content objects will have a significant impact in the near future. Kim and Bonk concludes that "these findings seem to reflect the perceived importance of online technologies for sharing and using pre-existing content". In the words of Sir John Daniel, former Vice Chancellor of the Open University in UK: "The most promising initiative in e-learning is the concept – and the developing reality – of OER." (Daniel, 2006)

Figure 2. The Hype Cycle of Emerging Technologies (Source: Gartner Group)



In the absence of more systematic data, findings reported in section 4.3 indicate a rapid expansion in terms of projects, people involved and the number of resources available. This suggests that e-learning in higher education has now gone past the "trough of disillusionment" in Gartner's "Hype Cycle of Emerging Technology". Building on this figure it seems if as e-learning has passed the peak and the bottom of the curve and is entering a phase of more slow but steady growth. OER are an important element in this development.

It is possible to identify a number of drivers and barriers setting the basic conditions for the OER movement. These could e.g. be technical, economic, social, policy oriented and legal. (OLCOS, 2007 and OECD, 2006b)

Starting with technical drivers these include:

- Increased broadband availability;
- Increased hard drive capacity and processing speeds coupled with lower costs;
- Rise of technologies to create, distribute, and share content;

- Provision of simpler software tools for creating, editing, and remixing;
- Decrease in cost and increase in quality of consumer technology devices for audio, photo, and video.

As described earlier, the economic drivers include monetary incentives for sharing content for free and the emergence of new business models for institutions and individuals wrapped around free content. For educational institutions, economic drivers could also include opportunities to reduce costs by cooperation and sharing. Other economic drivers are:

- Lower cost of broadband Internet connections;
- Lower costs and increased availability of tools for creating, editing, and hosting content and lower entry barriers.

Social drivers comprise altruistic motives, non-monetary gains for individuals, and opportunities for institutions to reach out to new social groups. Legal drivers include the rise of new legal means to create and distribute open tools and content, for example, open licensing schemes such as Creative Commons. Policy drivers would include the need to leveraging an initial investment of public taxpayers' money by encouraging free sharing and reuse among publicly-funded educational institutions, and the will to make knowledge available to individuals and institutions that would not otherwise have access.

Barriers for using or producing OER could be characterised in the same way – as technical, economic, social, policy oriented and legal. Technical barriers include absence of skills to exploit technical developments mentioned as drivers and lack of broadband availability. Lack of resources to invest in hardware and software for developing and sharing OER is an example of an economic barrier. Other economic barriers are difficulties in covering costs for developing educational resources and sustaining an OER project in the long run. Technical and economic barriers are often mentioned as significant obstacles in developing countries. Social barriers include cultural obstacles against sharing or using resources developed by other teachers or institutions. There seems to be a paradox within the academic community, which strongly emphasises the importance of openly sharing research results and building on existing scientific data, but at the same time often displays an unresponsive attitude towards sharing or using educational resources developed by someone else.

Collectively, the drivers for higher educational institutions to start use, produce and share OER seem to be stronger than the barriers at the moment. Even minor changes in institutional strategies or policies might have positive effects for the institution. Drawing on results from OECD (2007) another conclusion is that universities and colleges should act and join the OER movement sooner rather than later since there is a high opportunity cost in doing nothing when developments are so rapid. From the perspective of individual researchers and educators, a number of possible positive effects were listed for publishing teaching materials openly. But restrictions posed by copyright law and the lack in many institutions of a reward system to foster the development and use of OER are still important inhibitors.

6.1 The production of Open Educational Resources

It has already been argued that, at least in the initial phase, the bulk of the OER available have been created in a bottom-up, grassroots manner. As in the case of Open Source Software there are at least two development models – the "classical model" with individuals working together and the "community source model" where institutions co-operate – OER are developed both by individual enthusiasts working together, as well as by large institution-based initiatives. To be successful in the long run, the Open Educational Resource movement can probably not rely on funding from institutions, governments or foundations. Besides the need to develop viable revenue models for long-term sustainability, the Open

Educational Resource movement will most probably also need to find a development model at least partly as successful as the Open Source Software development model.

In his analyses of why the Open Source Software model of development has been so successful, Benkler (2005) argues that one of the most important reasons is that Open Source Softwaremany people can contribute small modules. The task looks more attractive when one does not need to devote too much time to it. With a lot of people engaged, the burden on each individual becomes lighter. Open Access is somewhat similar, in the sense that self-archiving is rather easy. It does not take much extra work for each person to contribute his work to an Open Archive, but if many people do it – the benefit for all is significant. Benkler asks if the same model could be applied to the production of OER. He starts by examining the most successful example of open content production so far, namely Wikipedia. Wikipedia is created in a collaborative way. It is, just as Open Source Software projects, characterised by the possibility to participate voluntarily and without spending too much time on the project.

On the other hand the sister project to Wikipedia, Wikibooks, is not at all as successful. According to Benkler, this is due to the fact that it is not possible to divide book chapters into small enough parts. If divided into small pieces, the process of compiling the individual contributions to chapters will probably be more time consuming than writing the whole book yourself. The lesson then is that, for Open Educational Resource to be successful, the possibility for many individuals to make limited contributions is crucial. Step by step, it has become easier to create digital content. Software tools are becoming gradually more user-friendly, and now one can create a website, blog or wiki in a few minutes using online tools, often provided for free. In addition, as Wiley (2006) pointed it is becoming increasingly easy to participate in the OER movement. Some of the technological advancements supporting this development are:

- Simpler infrastructure or software for managing open resources (such as eduCommons in USA, Austria, Netherlands, Japan, China).
- Simpler infrastructure for linking and federating OER repositories (such as the European Schoolnet LIMBS open source brokerage system).
- More efficient production of resources, because of the possibilities of podcasting, screen casting, video casting, blogs, wikis etc.
- User-friendly storage exemplified by Video iPod and other external, portable storage devices – typically very small devices which have the capacity to hold a full academic program of materials.
- Simpler approach for mirroring repositories locally, which makes it feasible to use resources without broadband connections (eGranary with approximately 40 partner sites in developing countries).
- Easier distribution and interoperability between repositories (e.g. RSS, XML and ATOM feeds are techniques which have made distributing and reusing metadata popular; metadata standards such as Learning Object Metadata to enable sharing of resources/metadata across repositories due to common description formats).
- Simpler process for reusing resources because of software that simplifies the assembly, contextualisation and aggregation of resources.

Impact of emerging technologies on higher education

So, what influence will emerging technologies have on higher education apart from increased production and use of OER? Looking at the impact of technology on higher education in the near future, the annual Horizon Report (2006) describes a growing trend of using personal devices that students already own such as mobile phones and MP3 players for delivery of educational content. Students are increasingly expecting individualised services and open access to media, knowledge information and learning. Alexander (2006) gives a similar picture when he describes growing technological trends and their impact

on higher education, as does Hilton (2006). Unbundling of content, as in the music industry where full albums losing sales ground in favour of individual tracks, and personalisation of educational services is expected to become more frequent. Both these trends – growing expectations of individualised services and the unbundling of content – speak of challenges to today's higher education sector, by threatening the traditional approach of deploying a fixed curriculum delivered to large groups of students and completed at a predetermined pace.

Other features of interest for the education community include:

- Collaborative filtering, facilitating the finding of "most interesting" resources through filtering techniques.

- Social networking tools to facilitate ongoing conversations, recommendations and cross-linking of resources.

- Services based on RSS feeds (continually updated feeds from host websites as well feeds of content from personal libraries of end-users with information about thematically relevant content). Feeds can include any type of content, from texts, to pictures, or even video- and podcasts. (OLCOS, 2007)

There is also the increased use of social software, such as blogs and wikis, social book marking, social tagging, collaborative authoring platforms with real time interaction. These tools lower the bar to entry for average users since participating is a matter of contributing small posts, rather than pages, voice messages and pictures – not only texts. Small pieces of information are made into larger entities developed in a collaborative and often open way. These trends are part of "Web 2.0", which is partly the emergence of new applications and partly new user habits and attitudes, sometimes described as the Internet has shifted "from being a medium, in which information was transmitted and consumed, into being a platform, in which content was created, shared, remixed, repurposed, and passed along". (Downes, 2005) Also this development shows that e-learning applications are beginning to look and behave like networks rather than one-way delivery tools, where content is created, used and distributed in a much more open and collaborative way – on the terms of the learner rather than the institution.

Another development is the emergence of personal learning environments. E-portfolios have been around for some years now as means for students to store, present and sometimes discuss the results of their work. The open source project, Eduspaces (previously known as ELGG) has created an online personal learning space, based on personal publishing and social networking. It is particularly attractive for users as it allows them to leverage existing feeds and services they use elsewhere in a new environment, rather than having to start creating content from scratch. Eduspaces might be seen as an early version of personal learning environments – complements or competitors to learning management systems, which are becoming gradually more common in higher educational institutions. It is through a learning management system or similar applications that institutions handle course administration, publish courses and digital resources, etc. In contrast, personal learning environments focus on the learner rather than the course, offer the learner more autonomy than traditional learning management systems, and are particularly well suited for independent, self-directed styles of learning which are typical in higher education. This development points to a shift of power from the institution to the learner, a situation where the student or learner to a growing extent manages his or her own learning. Easy access to a growing number of OER for the learner will probably reinforce this trend. As O'Hear (2006) writes, the traditional approach to e-learning tends to be structured around courses, timetables, and testing.

> That is an approach that is too often driven by the needs of the institution rather than the individual learner. In contrast, e-learning 2.0 takes a "small pieces, loosely joined" approach

that combines the use of discrete but complementary tools and web services – such as blogs, wikis, and other social software – to support the creation of ad-hoc learning communities.

6.2 Looking ahead

As described in section 3, there are many reasons for governments to take a proactive role and support further growth in production and use of OER. At the end of this chapter, we will examine the consequences of OER and open publication in the event that it becomes the norm in the tertiary education sector. Again, as explained in section 3, considerable growth of OER is likely to cause an increase in informal and non-formal learning. Individuals and companies would probably be less ready to pay for pre-packaged university courses offered at a time and speed decided by the university. Technological development is driving the unbundling of content and personal learning environments, and simultaneously strengthening the individual's independent learning, works in the same direction. In turn, this would increase the demand and need for recognition of skills and knowledge gained through informal and non-formal learning. Most countries are looking for ways to widen participation in higher education - but, cynically speaking, governments are interested ensuring the workforce has better skills, not necessarily in enabling more people to achieve university degrees. If they can meet this aim in a less costly way, i.e. less economic support to the university sector,, they might very well be interested in promoting this. There is also a growing tendency on the labour market to look at actual competencies rather than formal degrees – a tendency that might grow stronger given a globally mobile workforce. There would probably also be an increase in private providers offering non-traditional university courses, such as tutoring and assessment of skills gained through informal learning. Furthermore, OER is likely to affect the individual teacher or university instructor. The role of "sage on the stage" is already changing towards "guide at the side". With more free content available the role as supplier of knowledge and teaching material will diminish and accelerate the change in teachers' roles.

The combined impact of these developments is likely to force universities to rethink their "business model", in line with the alternatives listed in section 5.3. As described in OECD (2007) some major distance teaching universities are already doing this. Development along these lines would affect universities in several ways; they would probably need to disintegrate many of their pre-packaged courses and prepare to respond to the demands of their customers in a more flexible way.

What, then, would happen to universities if all content was open, and is this likely to happen? Things would probably not be very different if all content was open and freely available. Universities would not be able to charge students or others for the access to content, compared with the situation outlined above. Universities will probably need to rethink their economic strategy and adapt to the changing circumstances in any case. The change would be more complete if all content was open, but it would be a matter of degrees of change needed, not the kind of change. Furthermore such a development is not very likely. A comparison with the Open Source Software and Open Access movements show that their market share is growing but they are not, and will probably never be, in a monopoly situation. For the foreseeable future OER will probably exist alongside closed non-commercial and commercial content.

6.3 Conclusion

Currently, there are many technology-related trends impacting on higher education institutions. Technological development has created drivers and lowered the threshold for individuals and institutions to create, use and share software programmes, research findings and learning resources. With thousands of courses from internationally well-reputed higher education institutions available for free, teachers will need to face the fact that students compare their curriculum and materials with others, and institutions have to face even more fierce competition due to open scrutiny of their resources. Higher education institutions need to rethink their strategies and find new ways of creating revenue. Strong technological drivers

together with motives for both individuals and institutions to use and produce OER, as well as arguments for governments to support this development, makes it possible to conclude that OER are here to stay.

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