DIGITAL RESILIENCE IN HIGHER EDUCATION

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Abstract

Higher education institutions face a number of opportunities and challenges as the result of the digital revolution. The institutions perform a number of scholarship functions which can be affected by new technologies, and the desire is to retain these functions where appropriate, whilst the form they take may change. Much of the reaction to technological change comes from those with a vested interest in either wholesale change or maintaining the status quo. Taking the resilience metaphor from ecology, the authors propose a framework for analysing an institution's ability to adapt to digital challenges. This framework is examined at two institutions (the UK Open University and Canada's Athabasca University) using two current digital challenges, namely Massive Open Online Courses (MOOCs) and Open Access publishing.

Keywords: resilience, strategy, higher education, MOOCs, open access, digital scholarship

The digital challenge

The changes made possible by the combination of digital content and global networking have profound implications for all aspects of higher education. These impacts have been seen in many other sectors such as the music, journalism and retail sectors, and while there are considerable differences between these and higher education, they nonetheless demonstrate the potential of the digital revolution to lead to a significant shift in established practice.

This impact applies at both an institutional and individual level. For the individual scholar, Boyer's (1990) classification of scholarly activity provides a basis for identifying challenges faced by the advent of digital technology

In Boyer's definition of scholarship there are four components, each of which he suggests should be considered as of equal value by universities and government policy:

- Discovery - the creation of new knowledge in a specific area or discipline.
- Integration – is focused on interpretation and inter-disciplinary work.
- Application – this is related to the concept of service, but Boyer makes a distinction between citizenship and scholarly types of service, and for the latter it needs to build on the scholar's area of expertise.
- Teaching – much of the interpretation of Boyer can be seen as an attempt to raise the profile of teaching

For each of these elements we can see many new possibilities as set out by Weller (2011). An example in each of the four components might be the use of open data in research, the use of new publishing methods and networks to integrate work, the application of social media to public engagement, and the development and sharing of open education resources in teaching.

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At an institutional level there are concepts such as Christensen's (2007) disruptive technologies, and Anderson's (2006) long tail economy, but few frameworks as reliably and widely used in higher education as Boyer's work. The aim of this paper is to suggest one such framework, drawn from the field of ecology, that of resilience.

Resilience

In his 1973 paper on the stability of ecological systems, Holling defined resilience as 'a measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables.' It is a perspective that has been applied beyond the ecosystems Holling applied it to, and has found particular relevance to sustainable development and climate change (e.g. Hopkins, 2009). Hall and Winn (2010) have applied the concept of resilience to education, and open education in particular, arguing that resilience "develops engagement, education, empowerment and encouragement. Resilient forms of HE should have the capacity to help students, staff and wider communities to develop these attributes. As technology offers reach, usability, accessibility and timely feedback, it is a key to developing a resilient higher education."

Walker et al (2004) propose four aspects of resilience:

1. Latitude: the maximum amount a system can be changed before losing its ability to recover.
2. Resistance: the ease or difficulty of changing the system; how 'resistant' it is to being changed.
3. Precariousness: how close the current state of the system is to a limit or 'threshold'.
4. Panarchy: the influences of external forces at scales above and below. For example, external oppressive politics, invasions, market shifts, or global climate change can trigger local surprises and regime shifts.

Applying resilience to climate change, Hopkins (2009) suggests three factors that influence a community's resilience:

- Diversity: not being dependent on one crop or livelihood
- Modularity: a degree of self-reliance and protection from outside events, such as local food supplies
- Tightness of feedbacks: making the consequences of actions apparent to everyday life

Both of these models of resilience offer a useful means of considering the response of academia in general and individual institutions to the potential impact of new technologies. Building on Holling's work, resilience is now often defined as 'the capacity of a system to absorb disturbance and reorganise while undergoing change, so as to retain essentially the same function, structure, identity and feedbacks' (e.g. Hopkins, 2009).

This definition places the emphasis on the capacity to retain function and identity, and this is particularly relevant to scholarship. If scholarship is viewed as a set of functions that are useful to society in general (taking Boyer's four functions as an example), then the aim of digital resilience is to retain these core functions, but to allow them to be realised in new forms. This places a clear distinction between function and form. As Naughton (2009) stresses in terms of key factors about the impact of the internet:

> *"Don't confuse existing forms with the functions that they enable. It's the functions that matter. Forms may be transient, the product of historical or technological circumstances."*

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Taleb (2012) has argued that the perspective should move beyond resilience, and consider 'anti-fragility', stating "The antifragile is beyond the resilient or robust. The resilient resists shocks and stays the same; the antifragile gets better and better." This is to equate resilience with resistance. Indeed, a high resistance is not necessarily a benefit to an ecosystem, as Holling observed, for example some insect populations fluctuate wildly depending on environmental factors, but over time prove to be resilient. Resilience requires adaptation and evolution to new environmental conditions, but retains core identity. In ecosystems this means the species persists, although it may be adapted, and in organisational terms it means the core functions remain, although they may be realised in newer (and in Taleb's view), better ways.

In terms of higher education practice then, resilience is about utilising technology to change practices where this is desirable, but to retain the underlying function and identity that the existing practices represent, if they are still deemed to be necessary. The practices themselves are not core to scholarship rather that they are the methods through which core functions are realised and these methods can and should change. The peer review process in academic publishing for example, is a method of ensuring quality, objectivity and reliability. But it may not be the only or the best way of realising this, or at least its current incarnation may be subject to change. A resilience perspective would seek to ensure these core functions were protected, and not just resist at the level of the method.

Although resilience can be seen at the individual level, it is perhaps best applied to the institutional level, which can be seen as a complex ecosystem in itself, comprised of a number of individuals, behaviours and tasks. The resilience approach will now be considered for two current digital challenges, at two separate universities.

In this approach Walker's four aspects of resilience will be considered, and a score allocated against each aspect to provide an indicative measure of overall resilience. Each factor is given a subjective ranking of 1 to 10 (1 = low resilience, 10 = high resilience). A high score of more than 35 would indicate that it is probably not a particularly new challenge, (or that the institution was exceptionally well adapted already), and a low score of less the 15 would indicate that the institution faces a considerable threat from this challenge which it has not adapted to.

The Open University & MOOCs

In order to demonstrate the utility of the resilience conceptual model, the authors will apply it to two particular innovations that represent the challenges of new digital practices to higher education, namely Massive Open Online Courses (MOOCs) and Open Access publishing. The former will be considered at the UK Open University and the latter, in the next section, at Canada's Athabasca University.

The term MOOC was coined by Dave Cormier and arose after his analysis of one of the first MOOCs, the Connectivism and Connected Knowledge course (known as CCK08) run by George Siemens and Stephen Downes. Other early pioneers included David Wiley and Alec Couros, both of whom ran open versions of campus courses, whereby a course with fee paying students who have access to the course instructor, was made open to anyone to participate, but without the direct support and assessment of a tutor or lecturer.

The early experimentation led to more mainstream adoption of MOOCs, and in 2011 two Stanford Professors offered an open course in Artificial Intelligence which attracted over 100,000 students. This was followed by Harvard and MIT announcing a joint initiative to offer open courses, called EdX. In addition, the Stanford team founded a commercial enterprise, Udacity, to offer open courses and a number of universities offered courses with another private sector

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partner – Coursera. MOOCs have been trumpeted as having the potential to instigate wide scale and disruptive change in higher education, with Shirky (2012) suggesting they will have the same impact on education as the MP3 format had on music. He sees MOOCs as highly disruptive for higher education, arguing that "The possibility MOOCs hold out isn't replacement; … The possibility MOOCs hold out is that the educational parts of education can be unbundled. MOOCs expand the audience for education from current campus students to people ill-served or completely shut out from the current system".

Whether this is hype or not, MOOCs represent a good example for analysis in terms of digital resilience for a number of reasons. Firstly, they are a new practice which could only practically have been realised in a networked, digital context. Free, open education has been attempted before, but it was limited by physical and geographical constraints – only so many people could attend a lecture hall and correspondence formats lacked interactive and mediated variety and appeal. By contrast open online courses are available to everyone with an internet connection, and beyond certain server restrictions, it makes no difference if more students sign up. They also support mediated interactions in many formats – text, video, audio and multi-media in both asynchronous and synchronous modes. They are therefore a product of the digital revolution. The second reason they make a good case study is that they propose both a threat and opportunity to standard education practice, at least in the eyes of many participants. They are not therefore a niche interest, limited to only a specific discipline, culture or geography. Thirdly, they are present in increasing numbers now, and while some may make predictions (both positive and negative) about their future growth, there are sufficient numbers and interest to examine them today. They are not based on a possible model of what might or could happen, but a functional one that is occurring now. Daniel (2013) suggests that although we have seen other ventures disappear, MOOCs are likely to persist and that they "will have an important impact in two ways: improving teaching and encouraging institutions to develop distinctive missions." They are therefore an ideal case study for resilience.

For the Open University, MOOCs represent both a challenge and an opportunity. As a purely distance education institution it is arguably more vulnerable to their threat. If learners can study for free, the argument goes, then why would they pay for an education that isn't campus based?

In December 2012 the OU announced the launch of FutureLearn, a separate company founded by the OU, in consortium with a range of UK universities to provide MOOCs on a global platform (http://futurelearn.com). This represents a significant investment in terms of resource, finances and brand in MOOCs, which highlights their resonance with the OU's core functions.

Taking the four resilience perspectives then offers a means and a lens for both assessing this risk and highlighting potential courses of action.

Latitude

The OU developed a model of distance learning based around primarily printed units, accompanying media (be it television programmes, audio cassettes or DVDs), supported by a tutor, or associate lecturer. This is the Supported Open Learning (SOL) model, which Jones et al (2009) summarise as being based on three key factors:

1. Distance or Open Learning
   - Learning 'in your own time'
   - Reading, undertaking set activities and assignments
   - Possibility but not compulsion to work with others

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2. Resources
   - Printed course materials, assigned text books, audio and video cassettes, CD/DVD materials, home experiments, course and program web sites (previously broadcast TV programs)
3. Systematic support
   - An assigned course tutor, a regional network of centres, central library student and technical support
   - Tutorials held within regions, day schools and online (e.g. languages, summer schools)

The advent of elearning in the late 1990s saw an adaptation of this model, but not a fundamental shift. Bell and Lane (1998) describe how the implementation of ICT into the existing distance education model could be seen as combining the strengths of the traditional campus and distance modes. The OU introduced home computers in 1988 and implemented a large scale elearning course in 1999 (Weller & Robinson, 2002). This demonstrates that its core SOL model has not been so rigid that it cannot adapt, but equally that it is robust enough to survive new models of implementation. The OU then, has a reasonable degree of latitude, in that it has a history of adapting its model to accommodate new technology and practices.

With MOOCs, the degree of latitude required is still uncertain. The current MOOC model is unsupported (or mainly peer-supported), and free of cost to the students. This highlights a conflict with the OU's core SOL model, which posits human, tutor support as a core element, and which inevitably incurs a cost. Kop (2011) notes that learners in MOOCs "have to be confident and competent in using the different tools in order to engage in meaningful interaction. It takes time for people to feel competent and comfortable to learn in an autonomous fashion, and there are critical literacies, … that are prerequisites for active learning in a changing and complex learning environment without the provision of too much organized guidance by facilitators." For many of the learners that the OU traditionally engages with, developing these literacies through the supported model is a key function of the educational process. Further those who are challenged in their progress or capacity to attain these competencies have a variety of scaffolds and support services to draw upon at the OU. With MOOCs the options are largely limited to withdrawing from the course or seeking peer support.

However, there are many models available that could accommodate both elements, such as an additional services approach where the basic course is free, but learners pay for additional elements such as support, or a hybrid model that releases some content as a MOOC from existing paid-for modules. Further additional revenue models including for-profit sales of texts, referral services from employers wishing to recruit top performing, self motivated employees and the ubiquitous click through advertisements are now beginning to emerge that pay at least some of the costs without charging students directly. A similar model has already been implemented with the OU's OER repository, OpenLearn, where a proportion of all OU courses are released as free resources, and it has proven to be cost neutral (i.e. the number of students it attracts compensates for the additional cost of running the service). That FutureLearn has been established as a private company demonstrates that these business models will be explored, with additional services being the likely revenue stream.

Resistance

The OU is a large institution, with over 250,000 students, and 11,000 employees. As such it has needed to develop well defined processes for dealing with scale, for example in assignment handling, tutor allocation and student support. Inevitably large scale systems are more difficult to

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adapt than small scale ones, just as large companies are less adaptable than small, agile ones. The OU has developed a production model which was initially focused around print but has and continues to adapt to the different cost demands of e-learning (Bates, 1995).

Changing such systems is possible, but it requires strategic direction, leadership and is not done quickly. However, success depends on the degree of adaptation required. MOOCs appear to require many of the systems already in place, for example the IT infrastructure for dealing with large student numbers, e-learning content that is designed to be studied independently, methods for informal assessment, etc. The work done previously for OpenLearn specifically, and e-learning in general, lays a foundation that means MOOCs are technically feasible. More difficult are the broader issues such as ensuring a good student experience when there is no tutor present and implementing methods of informal assessment (such as Mozilla badges) and how these relate to official accreditation raise issues for a large scale institution with a global brand. In terms of resistance then the OU is well placed in that it has adaptable infrastructure, but susceptible in that it arguably has greater potential for damage to its brand than a smaller institution. Finally the OU is in many respects a victim of its success. Large student numbers can be seen as providing evidence for the success of the current business model and deflate motivation for change.

It is the examination of this factor that reveals the OU's solution to MOOCs in FutureLearn most clearly. The OU has the infrastructure systems required to support large scale, high quality MOOCs, but not the small nimble approach required for more experimental versions. A solution that meets these strengths offers the least path of resistance, since it does not require wholesale cultural change. FutureLearn therefore represents a model which most conveniently plays to the OU's strengths and renders resistance less of a consideration.

Precariousness

With 246,626 registered students in 2012 and a £252M reserve (Open University, 2012) the OU is not in an immediately precarious state, although both of these figures may be negatively affected by changes in the student fee structure as set out below. However, MOOCs have arrived at a time of great upheaval in the UK higher education system, with the introduction of student fees. This is dealt with in more detail in the next section under panarchy, as it represents an external force.

It has necessitated wholesale change in the model used by the OU both in terms of funding and course delivery. Student fees are associated with a qualification, and not with individual modules, requiring a shift in the granularity of operation to this higher level. This has required the types of large, systemic institutional changes mentioned above, which are possible, but are inevitably time consuming, often personally challenging and a drain on resources. Arguably then, this external influence has forced changes that have meant less attention and resource could be allocated to MOOC experimentation than might have been possible in previous eras.

A sudden, and large scale defection of learners to MOOCs away from formal study would be precarious for the OU, however this does not appear to be imminent. Indeed, it could be argued that MOOCs and formal education are complementary to one another, as MOOCs lead to low-risk engagement from learners, a proportion of which is then realised as formal study. A range of strategic analyses of MOOCs have been conducted at the OU, (e.g. Sharples et al, 2012) from a pedagogic, technical and commercial perspective, which suggests precariousness is not a major factor at this particular time, although there is a possibility for MOOCs to impact upon core business in the future. FutureLearn is seen as a deliberate attempt to reduce any threat of precariousness by owning a strategic, political solution to MOOCs.

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Panarchy

The influence of external forces is particularly relevant in this period, with a global financial crisis, an ongoing European crisis and changes in the higher education funding model in the UK. All of these factors may lead to a decline in the number of students entering and remaining in higher education programs. They probably also account for much of the interest in MOOCs, with open courses being proposed as a solution to the problem of costly higher education (e.g. Kamenetz, 2010).

As mentioned, the changes in funding structure have necessitated large scale institutional change at the OU, combined with a need to increase student fees to compensate for the loss of state funding. This may well result in different student demographics (for example a decline in leisure learners, but an increase in full time students who find the OU a cheaper option than campus students may occur), although it is too early in the process to assess these impacts.

MOOCs therefore enter the market at a time of great uncertainty, when panarchic effects are high for the OU (and all UK universities). This may account for the more cautious response from UK universities (Fazackerley, 2012), compared with that in North America.

In 2013 the OU is implementing a range of MOOCs, in educational technology, language, learning skills and learning design. These are adopting different approaches, for instance some are elements of existing courses and others are delivered as part of a research programme. They will use a range of technologies and support models. A university wide strategy will be informed by these early MOOCs, in addition to the existing experience of the OpenLearn team. This approach goes some way to ameliorate the effects of external forces and engage with the MOOC movement.

This analysis can be summarised in a subjective scoring, allocating a score of 1 (weak resilience) to 10 (strong resilience) for each of the four factors. A score of 20 or lower would indicate an overall susceptibility to this particular digital factor, but it will also highlight individual areas of weakness. For the Open University, such a scoring is set out in Table 1.

Table 1: Resilience factors for MOOCs for the UK Open University

Resilience factor	**Score**	**Comments**
Latitude	8	Based on ability and history of adapting to technological change
Resistance	8	Large institution with established systems & high reputation risk, solution plays to strengths
Precariousness	7	Not immediate, but comes in time of change & has direct relevance to OU model
Panarchy	6	UK subject to considerable upheaval in higher education sector
Total	29	An area of concern, but resources and practices allow adaptation. Dealing with large scale systems and the impact of UK sector changes are priorities for reinforcing resilience

The score of 29 indicates that MOOCs represent a challenge to the OU, but one which it is developing resilient practices to meet.

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Athabasca University & Open Access

Athabasca University, located in Alberta, Canada was founded shortly after the Open University with a similar mandate to provide high quality education access to students anywhere/anytime. Like the OU, the delivery model began with print and limited multi-media enhancement, individual tutor support and assessment. And like the OU, it is now near the end of a conversion to Internet based delivery and support. Unlike the OU, Athabasca has never reached the scale of the so-called mega universities (Daniel, 1996) with a part time student population of around 50,000, 140 full time academics and about 300 tutors.

Open Access is one component of a global move to openness, participation, transparency and accessibility noted in business, government, non-profit and educational sectors. These are instantiated in initiatives such as open government, (Mukherjee & Stern, 2009), participatory democracy (Pateman, 2012), DIY support (Fox, 2013) open source creation (Weber, 2004) and prosumers (Bruns, 2008).

Within education, the emergence and in some disciplines the dominance of open access publishing of scholarly papers in open access journals is the most visible evidence of this trend. There is a growing discontent over the proprietary model of publication by which private companies, publish scholarly works that they obtain through gratis contribution by authors, reviewers and editors and sell back to educational institutions for high cost with resulting large profit. More recently both private and public sector has been investing and producing open access textbooks and, to a lesser extent, open access monographs and novels. Obviously the question of a business model arises when discussing free distribution of any product, but a variety of revenue models from sponsorship, to advertising, from subscription to freemium (sale of a supplementary products) are being developed.

Athabasca University has been actively engaged in two aspects of open access publishing. The first is related to the use of open educational resources in courseware and the second to open access scholarly publication.

Courseware production, in web based formats, was traditionally done in-house by a team of academics, instructional designers, media producers and editors. Now policy and practice have evolved to compel developers to first look for and then utilize or built upon open educational resources (OERs). OERs are defined as "teaching, learning, and research resources that reside in the public domain or have been released under an intellectual property license that permits their free use and re-purposing by others" (The William and Flora Hewlett Foundation, 2012).

The second major use of open access at Athabasca has been the founding of Athabasca University Press (aupress.ca) as Canada's first open access scholarly press. The press will have published over 200 monographs or edited books by mid 2013 and continuously publishes eight peer reviewed journals. The books are sold in paper and epub formats, but are available in their entirety for free download in PDF format. All books and journals are subjected to rigorous peer review in a manner identical to University presses publishing with proprietary models. Revenue is generated from sales and by grants from various sources, but the press depends primarily on subsidy from Athabasca University. The University defends this contribution by arguing that "AU Press operates on the model of a knowledge-based economy, to which we contribute by providing peer-reviewed publications unfettered by the desire to commodify thought or to restrict access to ideas" (AUPress website).

Open access is now examined through the lens and four factors of resilience.

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Latitude

As discussed Latitude refers to the degree to which the system can be stressed and still retain its primary functions. Open Access publishing has long been at the heart of the mission for the university. The professoriate is compelled to "profess" in order to make a contribution to knowledge generation and to larger society. Open access publishing can be seen as meeting the commitment of universities within society, for example Brown et al (2007) argue that "a renewed commitment to publishing in its broadest sense can enable universities to more fully realize the potential global impact of their academic programs, enhance the reputations of their institutions, maintain a strong voice in determining what constitutes important scholarship, and in some cases reduce costs."

The traditional method for knowledge dissemination has been through the authoring, editing and production of scholarly works. Many universities support University Presses, with dissemination as their primary mission. However, these university presses do not usually generate profit and typically require subsidy from other university revenue lines. Thus, the further reduction in revenue and lack of business model often associated with OAP, can and often is, viewed by university press managers as yet a further blow to their latitude for resilience.

However OAP also offers a route for cost savings. Typically Universities spend hundreds of thousands of dollars annually on subscriptions to proprietary journals or to aggregated collections of these publications. If these funds were diverted to direct publication of scholarly works or to subsidy for open access presses that charge author publication fees, considerable savings (increased resilience) could be gained. However this would eliminate access to current proprietary journals, many of which rank as the most prestigious in their respective disciplines. Thus, such actions would require institutions to mandate open access publishing by their staff on a global basis – a coordinated activity that independent universities are unlikely to accomplish in the short term.

The Athabasca University Press, has not recovered its costs through paper and e-book sales. It seems unlikely that it will break even unless the University moves from a broad scholarly publication list, to one focused on textbooks or titles where paper purchase is the norm. Thus one could say that the Press decreases the resilience of the University, while at the same time increasing its mission for social contribution, increasing access, enhancing its reputation and providing a test bed for this area of open science and research. As an example of increasing social and public contribution, OAP has enhanced the rationale for public support, but as an institution charged with constraining or reducing its draw on the public purse the press has decreased overall resilience.

Resistance

Resistance to change can be seen as a natural trait, as Kahneman and Tversky's Prospect Theory (1979) reveals – people tend to judge the emotional impact of loss greater than that of gain, making them naturally risk adverse. However, resistance to change can also be viewed as a misalignment with the organizations plans for change and systems, support infrastructure for the change or lack of communication about the necessity for change (Dent & Goldberg, 1999).

Studies of resistance to open access publishing note differences across and within disciplines and different levels of support by individuals with more support from those individuals teaching from critical and emancipatory approaches (Pickerill, 2008). Studies even show varying degrees of support from librarians (Palmer, Dill & Christie, 2009) whom might be assumed to be the strongest advocates of more open dissemination practices.

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One source of resistance is the belief that impact (usually as calculated by subsequent citations of the work by other scholars), will suffer if the work is submitted to an open access publisher. Evidence for this belief has been mixed with some studies supporting this claim, while others showing that open access publishing increases citations (e.g. Davis, 2010; Hajjem, Harnard & Gingras, 2005). In a study in distance education, Zawacki-Richter, Anderson & Tuncay (2010) found that there was no significant difference between citations for articles in the six proprietary journals as compared to the six open access journals – though they did uncover an emergent trend in favour of open access. In this study as well as others, these findings are confounded by the effect from proprietary journals being generally older and arguably more prestigious journals due in large part to the emergence of open access publications only in the last decade.

Finally, increasing numbers of governments, institutions, research councils and professional organizations are tying their support for research funding to expectation of open access publishing of results (see for example the Finch report from the UK at http://www.researchinfonet.org/publish/finch/)

Thus, the resistance to OAP both in terms of general academia, and Athabasca specifically is declining.

Precariousness

OAP represents a way for Athabasca to increase its viability by greatly reducing the cost of the courseware (mainly texts) that it uses to support its courses. Unlike most other North American Universities, the cost of textbooks is included with the student fees for a course. Thus reductions through use of open textbooks, open sources software and other forms of open educational objects is likely to decrease the precarious situation that Athabasca currently finds itself in. Athabasca has in the last four years run deficit budgets with a net loss of $834,000 in 2012 (Athabasca University, 2012). This potentially places it in a precarious position regarding future investment in OA publishing, which is not seen as generating a profit.

The small deficit from Athabasca University Press could easily be compensated for by savings that result from the use of OERs in course production however. Of course, over time as open text initiatives such as those funded by the Saler and Gates Foundation, government initiatives and individual universities increase and supply of OERs increases, these costs savings will be multiplied, thus further reducing the precarious financial outlook faced by Athabasca and many other public educational institutions.

Panarchy

As noted earlier, OAP is but one component of a larger trend towards openness and transparency. Pressure for these arises not only from a rising sense of entitlement to what was once exclusive access to knowledge, but as well results from the affordances of global networks to supply information (and share responses to that information) at very low cost. In addition there is a growing commitment to participatory activities in governments and even in business as evidenced by the Arab Spring, Occupy WallStreet and shareholder activism – to name just three of many such movements. OAP can thus be viewed as an academic instantiation of this panarchical, global movement, and as such, Athabasca's existing presence in this area is a strong indicator of resilience.

Canadian higher education has suffered fewer of the panarchic effects seen elsewhere, although it still operates within a global financial crisis. This is lower than the impact seen in the UK however.

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Table 2 provides scores for each of the resilience factors for Open Access publishing for Athabasca.

Table 2: Resilience factors for Open Access for Athabasca University

Resilience factor	Score	Comments
Latitude	8	Established practice provides high degree of latitude
Resistance	5	Despite efforts to promote archiving of scholarly outputs, less than 50 % of faculty actually do post their work our institutional repository. In addition many faculty and professional staff define themselves by production of high quality OERs – not by use of the work of others.
Precariousness	7	OAP has potential to reduce costs associated with producing and more importantly purchasing commercial text books and software. Financial constraints may impact however.
Panarchy	8	The global demand for openness and transparency propels Athabasca use of OAP
Total	28	

Discussion

Higher education institutions are operating in an altered context now with the advent of digital, networked technologies. These offer alternative means of conducting existing practice as well as entirely new opportunities. Across the spectrum of activities performed by higher education institutions these amount to a considerable challenge for individual academics and senior managers to determine the best course of action.

The resilience model in ecology offers a model for considering how adept a system is at absorbing change. It thus offers a useful model for analysing an institution's ability to adapt within an altered environment, while retaining its core functionality.

The model is best used as a qualitative analysis tool to highlight areas of concern and to help set priorities. The scoring method set out in this paper is one method of achieving this, but there are no correct scores, these will be subjective. The methodology was conducted with a wider group of eight participants at the OU. Scores ranged from 23 to 32, but there was general consensus around the relevant issues and responses.

The analysis of these two institutions and two areas of digital impact reveals some interesting comparisons. The different national contexts are seen in the panarchy category, with Canada in a more resilient position. The timing and degree of current implementation is also significant. Athabasca has an already established practice and cultural attitude towards open access publishing, which allows it to accommodate new changes in this area. In contrast, MOOCs are relatively new, and although they map onto existing Open University practices, their direction and impact is still uncertain.

In both cases these developments offer potential to provide low revenue producing models that may cannibalize existing profit and support centres that have sustained the institution in past eras. Recent efforts at cost cutting and raising tuitions may seem like an effective response to the weakening capacity of cash short governments to support these institutions. However as Korhonen & Seager (2008) note, some seemingly rationale and even eco-effective responses to stress may in fact weaken the institutions long-term capacity to achieve its mission. There are no guarantees, but this examination of both MOOCs and OAP demonstrate the need for institutions to actively investigate, trial and develop new methods and models – despite their potential to

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radically alter the form (but hopefully not the vision, mission sustainability) of postsecondary institutions. Failing to do so, insures dominance of more resilient organizations.

As a framework for analysing the impact of a particular change wrought by new technology however the metaphor provides a means of identifying strengths and weaknesses and articulating responses.

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