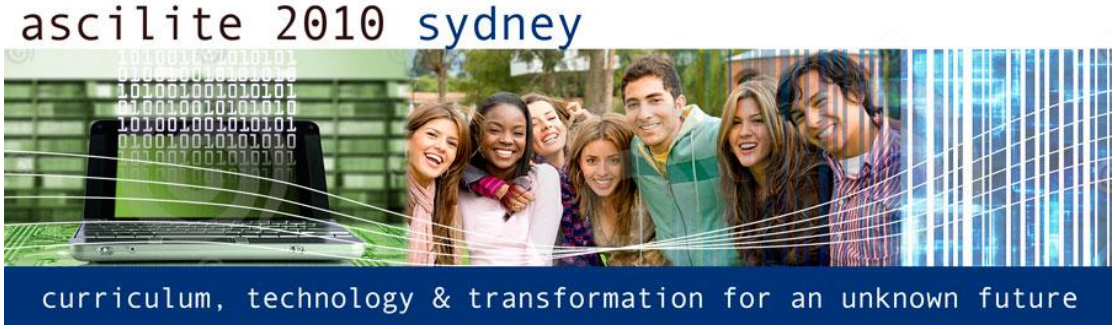

Fast and feral: Diversity, duplication and evolution in a university LMS

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In 2010, UNSW's Faculty of Engineering ran its own version of Moodle in parallel with institutional learning management systems. This looks like an inefficient local duplication of central services. But reflecting on the reasons why this happened, and on the outcomes so far, we realised that so-called 'feral' quick-fix software solutions can contribute a lot to the development of mainstream educational technology in universities. Specifically, they counteract some of the inevitable inertia, or more accurately homeostasis, in university systems with centrally managed online learning management. This case study illustrates the value of allowing for some local diversity and redundancy in a university's educational technology.

Keywords: online learning management systems, complex adaptive systems, innovation adoption.

Context

UNSW is a large university, and its central institutional IT/educational technology systems are managed to achieve reliability, possibly at the expense of responsiveness. The Faculty of Engineering is itself as large as many smaller universities, and its teaching academics vary widely in their attitudes to adopting new educational technologies. Some are innovators who want to try out (and in some cases build) new online learning tools. Some are early adopters willing to give new methods a go. Others are less interested in changing how they teach and the tools they use (Rogers, 2003).

In our context, we have noticed that some innovators and early adopters have opted out of using the institutional online learning management systems (LMSs) because they cannot meet changing needs. For example, within our Faculty of Engineering, the School of Computer Science and Engineering has never used any institutional online learning management system – preferring to run its own systems using open source software to which various other tools can be added at will ... in an environment where many of the staff like to control the software they use. Elsewhere in the Faculty another project used an external Moodle service to support collaborative teaching across several universities. Some of the people who opt out of our institutional systems have been highly inventive. But their inventions have largely remained isolated from mainstream use. Paradoxically those who look like 'laggards', because they are resisting adoption of new institutional tools, are also learning technology innovators. In the School of Computer Science and Engineering, some academics are routinely developing or evaluating open source learning technologies as part of their research activity. The School already hosted numerous educational technology tools locally. So when we were looking for facilities to try out alternative online learning tools, they were happy to help out.
In contrast, our Faculty-wide first year engineering design course[1] ENGG1000 used the institutional online learning management system along with various other services and tools (not integrated). The

[1] A 'course' is what other institutions may call a subject, unit or module – typically lasting one semester for 6 units of credit.

course involves large classes. Each semester, over 1000 students select from 12 or so different projects, which they work on in teams of 4 or 5. The online tools used had always been a compromise and we were continually exploring options for improvement. Then a change in the institutional eLearning platform meant that ENGG1000 had to transfer, quickly, to a new system that wasn't quite ready to cope with its complexity.

Modelling complexity and adaptation

Our experience exemplifies the challenge in providing centrally managed and planned processes without stifling innovation and responsiveness – in particular with large, complex and devolved universities like UNSW. Complex adaptive systems models help to frame the challenge of learning technologies as part of a continuing process of adaptation in a constantly shifting environment (Russell, 2009). Successful practices from the past shape what becomes embodied materially in the fabric of institutional infrastructure, expectations and administrative systems ... which in turn shapes future processes.

Things have changed since early online learning managements systems were developed by and for a minority of users, and barely affected mainstream campus university systems. An analysis of an annual US survey on top ten IT issues in higher education notes that "supporting the learning management systems that provide essential academic support is [one of the top three] consumers of financial and human IT resources, even though these issues may not be of high strategic importance" and also notes that "developing concerns reflect the tension between needing to keep operations running efficiently and needing to plan and prepare for an uncertain future" (Ingerman et al., 2010).

We hear that people in our university's central IT services have referred to software solutions developed locally within the Faculties as 'feral'. Complex adaptive systems models of organizations suggest that tensions and choices between institutional systems and local developments are inevitable. Rational allocation of resources acts to reduce diversity (Andriani 2001). At the same time diversity enhances a university's ability to adapt; but only if there are networks to link up the diverse perspectives, creating distributed cognition (van Fenema 2005). So our isolated innovators are both a part of the problem and a part of the solution.

Universities can exhibit resistance to change, or in terms of mechanistic models, inertia. A mechanistic approach implies pushing harder to overcome the resistance – perhaps by investing in more resources and staff, or enforcing rules and compliance. Such change management strategies may work in some contexts, but they have a poor record of success in higher education (Kezar, 2001). Change resistance in a university is more like the organizational equivalent of homeostasis in a biological system. When there is a local deviation from the norm, the rest of the system adjusts around it to maintain the overall system integrity.

Complex adaptive systems models can take account of how individual and departmental practices evolve as part of a broader system of academic activities and technologies (Russell, 2009). Here, we use these concepts of complexity and systemic adaptation to interpret local responses to institution-level decisions on new online learning management systems. Figure 1 represents mutual adaptation between forms of learning activity, material support technologies and educational development processes as triangle at the base of a tetrahedron, where academic context has an influence on all three dimensions. We use this as a framework to make sense of what happened in the UNSW Faculty of Engineering.

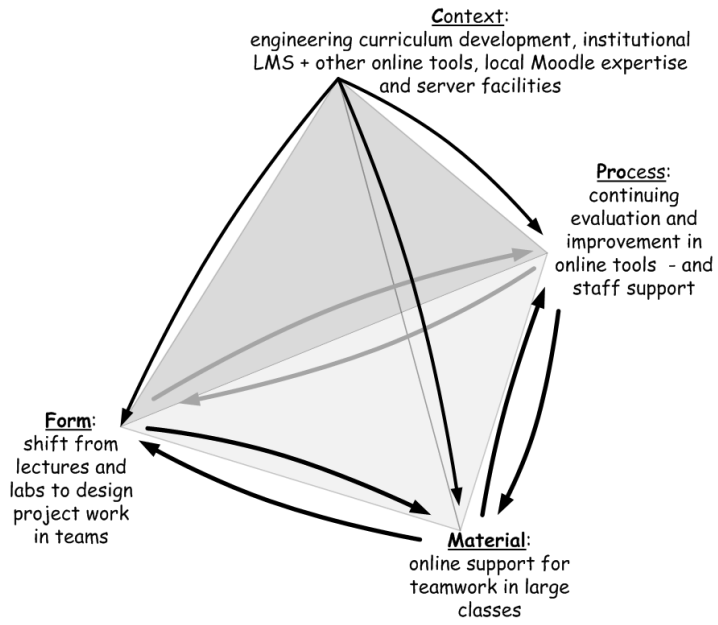

Figure 1: Environmental influences on learning technology use in ENGG1000 (based on Russell, 2009)

Evolutionary solutions

In 2004-5, after several years in which the use of online learning had been growing at over 30% a year, UNSW rolled out an institutional online LMS based on WebCT Vista 3. The expectation was that the system would make it easier for late adopters of online learning to use standard tools and services, while also giving innovative users a greater range of tools to work with. By the time the roll-out was complete, LMS upgrades were already available. But frequent upgrades and changes could discourage new users, so after much debate, there were no further changes until 2009-10. By then the software lagged so far behind current versions that staged gradual upgrades were impossible. So UNSW moved directly to the latest version provided by the same vendor, Blackboard 9.0, even though it had not been thoroughly tested. Our initial review of Blackboard 9.0 was generally positive, both aesthetically and in the range of tools it offered. However, after testing and preparing to migrate Engineering courses, we found that the group management and selective release functions could not support the processes we had set up for managing ENGG1000.

By semester 2 of 2008, UNSW had an established 1st year engineering design course (i.e. subject or unit) that used a mix of web-based tools used to support team projects (McAlpine et al., 2006). In addition to the standard tools within WebCT Vista (e.g. discussion forums, selective release, quizzes, assignments) the course used two external tools: CPR (Calibrated Peer Review for peer marking of individual work) and iPeer (for team contribution feedback). So in terms of the framework shown in Figure 1, the forms of learning activities and the material technologies that supported them had mutually adapted through a process of evaluation and improvement, within an institutional context that for several years had included a stable LMS environment.

Student satisfaction surveys for Engineering as a whole, over several years, have shown that students think their lecturers could make more and better use of the online tools available to them. In ENGG1000 in particular we thought that lecturers might be more likely to use the online tools if they helped to reduce further the administration work involved in managing hundreds of students working in small teams. So when we were faced with a loss of some of the online team management functions if we adopted Blackboard 9, we began to look at other options. One option was to continue using WebCT Vista until Blackboard was upgraded further. However, the Faculty had experience of using Moodle and we had access to a hosted external service. We also had internal programming and server capacity within the School of Computer Science and Engineering. What follows is a more detailed account of our response to changes in the institutional online learning management systems.

LMS internal tools

Initially in WebCT Vista, each of the ENGG1000 project groups had a separate online module, maintained by the project coordinator. Most project groups had several hundred students, who had to be allocated to small teams. Some project coordinators created their teams manually to ensure balanced teams. Others, especially those with larger classes, used random allocation to teams within the LMS. All groups and teams had discussion forums that were also manually configured. When students decided to change projects, this involved more administration work. At this stage, a few project coordinators still chose to ignore the online systems and organise the project work manually – despite initial student feedback that the online tools were useful (McAlpine et al., 2006).

External tools

Both iPeer and CPR had no integration with the WebCT Vista LMS. Students had to be enrolled manually into both tools, using different account credentials for each. This caused a lot of confusion about login details and generated many support calls and emails.

Administrative requirements for iPeer:

- Staff list upload + course creation & authorisation
- Student list upload and course enrolment
- Manual password resets by admins for any lost/forgotten accounts
- Outcomes export bug prevented results from being exported.

Administrative requirements for CPR:

- Staff list upload + course creation & authorisation
- Student list upload and course enrolment
- Custom assignment timings to deal with US Pacific times used.

CPR is hosted at UCLA in the USA and server assignments only display US Pacific Time causing confusion to both administrators and students for assignment completion dates. It has been used in other disciplines across UNSW to provide peer review functions lacking in the LMS (Rourke et al., 2008). Generally CPR delivered the service it promised and allowed students to mark each others' work.

iPeer, an open source project from the University of British Columbia, was hosted locally in the Faculty. It provides rubrics for students to rate each others' contributions to team project work. However, some bugs prevented the full use of the tools, especially for retrieving final marks and comments, for notifying students and for use within other marking systems. The original developers were no longer available to help us deal with bugs, and we found that we were among the most active and experienced in a limited pool of users. Rather than attempt to deal with the software problems ourselves, we decided to explore other options.

Improvements in 2009

By 2009, we had redesigned the use of WebCT Vista for ENGG1000 to cut down the administrative work in coordinating over 1000 students in 12 projects. All students were enrolled in the same online module, and used an online sign-up sheet to select a project. Once they had done this, selective release criteria gave them access their specific project's content and activities. They then had a 2-week period in which they could change project. But when students did change projects, the coordinator still had to change the online enrolment manually.

We used the quiz tool to build teams within each project based on quiz responses, to ensure that each team contained students with range of experiences – e.g. mixing language backgrounds and experience with hand tools. However, these results had to be exported from WebCT Vista via csv file to a spreadsheet, to build teams manually based on filtering results, and then the teams were uploaded into pre-configured team groups in the LMS.

We also decided to find a replacement for iPeer and decided on WebPA, an open source project sponsored by the University of Loughborough in the UK, and supported by an active community of

users. We installed the software locally. An initial trial found a few bugs related to appearance of the tool, which were corrected and shared back to the project community. The tool still required manual enrolment and setup, which meant users needed separate logins once again. After some modifications, WebPA proved useful and functional, but still required administrative work because it was not integrated with the LMS.

So we made the following customizations in WebPA:

- Group upload of students
- Password reset option
- Results csv export including grades and comments
- Custom email script based on above mentioned csv to notify users of grades and anonymous comments.

New LMS in 2010

During semester 2 of 2009, we were preparing for the upgrade to BlackBoard 9 for semester 1 of 2010. We found that Blackboard 9 did not have the functions needed to support the complex group management needed in ENGG1000, and there was no possibility of making changes. So we explored the potential of the open source LMS Moodle, using expertise within the Faculty, which already had a number of experienced Moodle users.

There was a plan to provide a UNSW Moodle service as one of a range of environments within an integrated institutional learning technology service. We trialled this (currently externally hosted) Moodle service, on a blended online/classroom course in the 2009-10 summer term, but the service was not fully integrated with institutional student administration systems. Our original strategy with ENGG1000 was to set up our own local Moodle system in order to start preparations for semester 1 of 2010, and then to transfer to the institutional Moodle service once it was integrated with student administration systems.

However, by the beginning of 2010 we had, with minimal cost and effort, built up our own parallel Moodle service with a number of customizations to support ENGG1000. Some of these were not going to be available in the externally hosted Moodle by the start of semester – in particular automated student enrolment and authentication from the university student administration systems via local LDAP. With over 1000 students, manual enrolment was not an option. At this point, continuing with our own Moodle service, at least for semester 1, seemed like the best option. This integration and enrolment automation required custom authorisation accounts for communication with central student records. We used these accounts to create custom cron jobs to enrol students into the appropriate courses within Moodle plus system authentication, which also included retrieving student data such as names, emails, and program/course codes. We then established and registered a domain for the local virtual server hosting Moodle, and acquired a Security Certificate for enhanced login security.

Moodle customisations

Moodle's default functions of groups and groupings used along with selective release criteria, alleviated the administrative workload in setting up large numbers of project and team discussion forums. Moodle also allowed for further customisations to support large courses and group work. Initial customisations included:

- **group choice tool** plug-in to allow students to pick their projects, with limits on enrolments and a time limit for students to change their minds (PHP code, and MySQL DB changes to original Choice tool)
- **selective release criteria** including dates and groupings, for management of project support resources and tools. (PHP code changes to Moodle to enhance release criteria settings)
- **threaded view of forums** for easy navigation in discussions (PHP code, and AJAX customizations)
- **export options** to allow instructors to collect lists of students and groups (PHP code changes)
- **group import** feature to allow instructors to import student lists into groups, either new or pre-defined (PHP code changes)
- **search facility** so that instructors can search the gradebook by student ID (PHP code changes).

Further customisation and integration

As semester 1 progressed, we introduced further enhancements:

- **a new html editor** to improve users interactions posting content
- **new maths tools** for posting equations and graphs (ASCIIMath, ASCIIsvg)
- **integrated WebPA**, with single-sign-on feature for users coming via Moodle (Custom SSO, PHP code changes)
- **automatic group and user creation** from Moodle to WebPA (Custom PHP code)
- additional integration with Moodle to allow instructors to build and add WebPA activities from within Moodle (Custom PHP code)
- **ability to import WebPA marks and comments** directly into the Moodle gradebook (Custom PHP code, mods to MySQL DB).

June–December 2010

In June 2010, there was a decision to continue with the Engineering Faculty Moodle service for the rest of the year, pending decisions about support for an institutional Moodle service, and an expected Moodle upgrade. We surveyed users – both staff and students – at the end of semester 1.

Students (183 responses thus far from around 2500) are ambivalent about whether the Engineering Moodle service is better than other LMS options, and several suggest improvements to the interface. However, there are almost as many student complaints related to the way lecturers were using the system. Students also reported using other digital communication tools to support their project work – Facebook and Google services (wave and docs) in particular.

Staff (17 responses so far) on the other hand are more positive about Moodle. This is not surprising given that the main aim of many of the customizations was to ease the administration workload. This seems to have worked. Staff preferred the Moodle service to others available and did not use any additional tools other than those integrated with the Moodle service.

Some students have been using several different learning management systems, and a number did complain about this. Nevertheless, given the 'quick and dirty' approach we have taken, with minimal support and expenditure (one learning technologist and a couple of people doing casual work on coding and testing compared to huge central project teams), the results were exceptionally effective.

Continuing work in semester 2 includes:

- **a new TeamBuilder plug-in** to provide further automation of team creation process (team formation based on questionnaire responses from students who have signed up for a project)
- **upgrade or replacement options for the CPR tool**
- **improvements to the interface design** to address student complaints (accomplished by adopting the same theme as the externally hosted UNSW Moodle service, which had been designed for consistency with other UNSW online tools)
- **test Moodle upgrade to 2.0.**

Figure 2 shows a Gantt chart of the work to date. A few of the customizations developed in the Faculty's Moodle service have been implemented in the institutional Moodle service. Some have been shared with the Moodle community more widely.

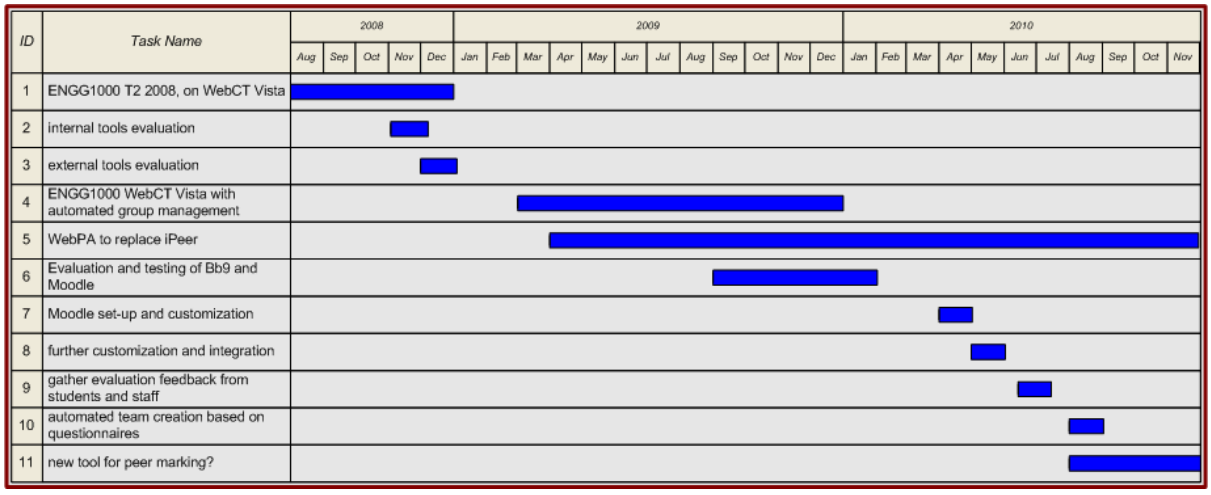

Figure 2: Gantt chart of ENGG1000 online developments

Discussion

Between 2004 and 2009 in the context of a stable institutional LMS, there were irreversible changes in the relationship between learning activities and tools in ENGG1000, maintained by continuing evaluation and improvements. Then a sudden change in the context, a new LMS, shook up the established ways of running online support. It was only when we started developing a local (temporary) Moodle service we realised that we could easily introduce improvements that had not been possible with the institutional systems, such as improved integration with other tools.

The development was not planned this way. It just happened as part of the local homeostasis. Everything we did was based on understanding of how the course worked in WebCT Vista. Rather than disrupt what was working well in ENGG1000, we started looking for ways to maintain the integrity of our system for supporting team projects in large classes. Then we found that different tools were not only able to fill the gap, but also opened up new possibilities.

Interpreting evaluation data

The feedback from students and staff using an online LMS has to be interpreted in terms of the development of the system as a whole – and not just on what appears to please, or what tools are reported to be most useful. Online tools that save staff time can indirectly help the student experience, in that they can encourage more staff to use the tools and therefore address the student comments that their teachers are not using the tools effectively. Yet from the student perspective, smoother administration and better functioning teams will be less visible and therefore unlikely to be attributed to the LMS.

Academic teaching staff and students make rational decisions about the technologies they use for teaching and learning. If a technology saves them time and effort they will use it. If it takes too much time to learn and they can't see any benefit, they will reject it. While this is obvious, it is not always easy to see how many different individual decisions combine to create a larger systemic response.

The Engineering Academics using the local Moodle system like it because it saves them time and gives them more control. Students are perhaps neutral because all of their LMS experiences were equally flawed, and depended on the capacity of their teachers to use the tools effectively. For self-organised work within teams, some students chose familiar tools they found easier to manage, like FaceBook and Google. Each person has a diversity of potential responses to learning technology in different contexts – previous experience and skills, time available, perceived benefits, roles and expectations, and so on.

Adaptability

Allen (2001) argues that an adaptive (learning) organisation needs two things: (i) allowance for non-average behaviour and internal diversity rather focusing exclusively on efficiency and control; (ii) networks linking up local learning to make it systemic. The UNSW Engineering Moodle case supports

the argument for diversity. It is beyond the scope of this paper to comment on how our experience will contribute to the broader university network. However, since some of the customizations we developed have already been made available to institutional systems and the Moodle community, we can claim some limited success in this respect. Figure 3 illustrates our experience in terms of the model in Figure 1, as a sequence of interactions between material technologies and forms of learning activity, mediated by development and adaptation processes.

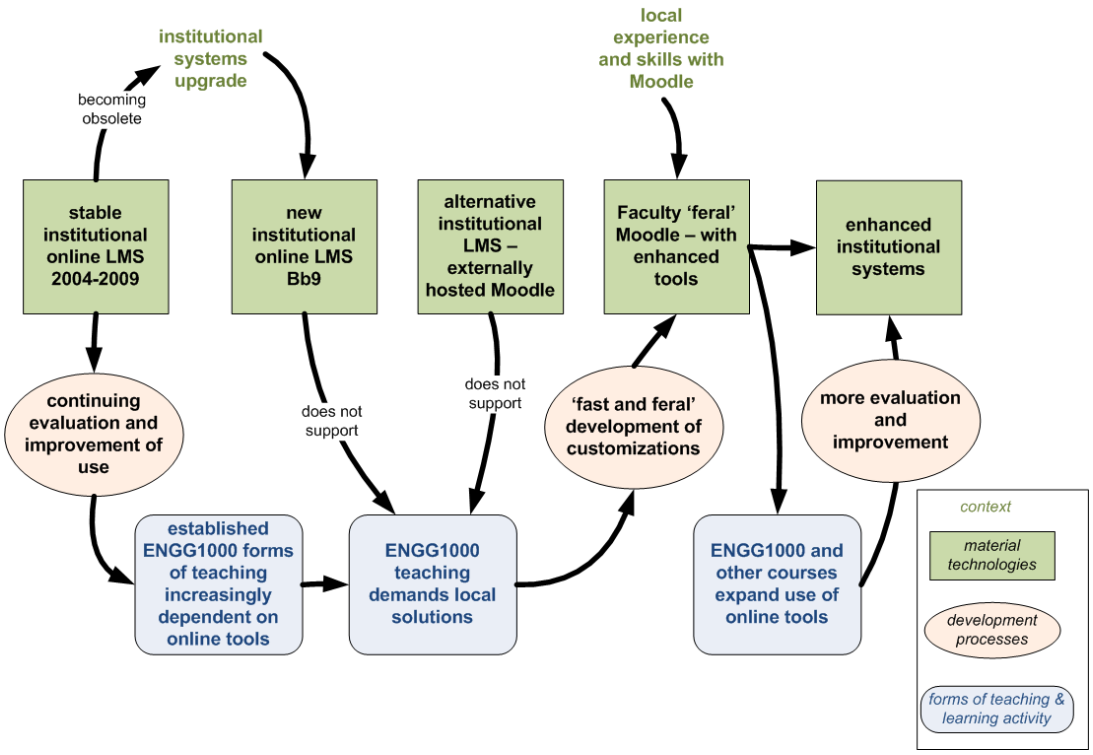

Figure 3: Local developments supporting adaptation in institutional systems

Allowing for local diversity allows for constant testing and evaluation of different options – evolution and emergence rather than top-down design and planning. The development of the Moodle customizations in this case was accidental, resulting from a local (homeostatic) response to a change in the environment, the loss of an established LMS.

Another dimension of this adaptability is the process of evaluation and improvement. We ran a quick survey using SurveyMonkey to inform immediate action. A more rigorous and reliable study would have taken more time and planning than was available, and would have been too late. This raises some questions about how we scale up and the links between pilot and mainstream systems.

We have been able to introduce and evaluate local facilities that were not available from the main institutional systems. Once a wide range of locally developed and external tools are available to students through transparent portals with single sign-on, then 'feral' local developments could become part of the adaptable and reliable institutional learning technology system, as shown in Figure 3.

Conclusions

What we describe here is not a planned process with designed outcomes. It is an evolutionary process, in a complex and unpredictable context, with emergent outcomes. Our account of developments in the UNSW Faculty of Engineering illustrates the need to allow for local diversity, even to the extent of duplicating some facilities, so that the university's online learning system can adapt more nimbly to changing needs. We have not put forward arguments about open source versus licensed software. While our experience has been that it is easier to 'go it alone' with open source software like Moodle, this was context-specific. It so happened that in this case there was a local need and local resources (expertise and servers) for developing in Moodle. The same thing could happen with different software and different expertise in another context, for example in developing plug-ins for commercial software.

The concept of simultaneous centralization and decentralization is not a contradiction, but rather a 'duality', two sides of the same organizational coin (Fenton and Pettigrew, 2000). In this case, local 'feral' developments, necessary in the short term, provide a model for developing a more adaptable institutional system. However, to contribute to adaptability they need to be knitted into the institutional networks – rather than being killed off in the name of reducing inefficient duplication.

A large population of feral cats may be a problem. But kittens from a feral cat population can make delightful domestic pets if they are adopted early enough and looked after so that they don't breed uncontrollably and endanger other species.

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