

E-LEARNING PROCESS MATURITY IN THE NEW ZEALAND TERTIARY SECTOR

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ABSTRACT

Elsewhere (Marshall and Mitchell, 2002, 2003, 2004), we have presented the idea that tertiary organisations engaged in e-learning might benefit from the application of process maturity modeling in better understanding their e-learning capability. These ideas, which have been successfully applied in a number of fields including software engineering, provide for a system of evaluating the ability of organisations to create and deploy e-learning that is independent of the particular technologies and pedagogies used. As well as providing valuable information for management oversight, resource allocation and strategic planning, this type of analysis also offers the prospect of being able to compare organisations across an entire sector, with the view to identifying common strengths and weaknesses. In this paper we present the preliminary findings of a detailed examination of institutional e-learning process capabilities as determined through the application of the eMM model and discuss how these can be used to determine both institutional and sector-wide priorities for investment and development.

1 INTRODUCTION

A significant challenge facing most tertiary institutions is identifying organizational strategic and operational priorities for investment in e-learning capability. In short, containing the rising cost of e-learning infrastructure while maximizing the educational outcomes for students. The challenge facing institutions developing e-learning is similar to that which faces organisations engaged in the development of complex software systems and which resulted in the development of process improvement models such as the Capability Maturity Model (CMM, Paulk *et al.*, 1993) and SPICE (Software Process Improvement and Capability dEtermination, El Emam *et al.*, 1998; SPICE, 2002). The similarities have lead us to apply the same approaches used in the development of the software process improvement models to the development of a potential e-learning process improvement model or eMM (Marshall and Mitchell, 2002, 2003, 2004) and which is summarised below in section 2.1.

Many analyses of e-learning focus on the outcomes of individual initiatives in isolation rather than providing a deeper analysis of the contributions of the institutional context. The problem is the need for a more holistic approach with a focus on best systems rather than on individual practices (Hagner, 2001). A detailed understanding of organizational aspects of e-learning is needed for institutions to incrementally improve their overall e-learning capability (Laurillard, 1997), particularly as institutions will usually need to choose from the range of possible areas needing improvement, those that result in the greatest benefits for students and for the institution as a whole. The challenge with undertaking such an analysis is that e-learning as a field, particularly mediated through the world wide web, is comparatively immature and many aspects of what is needed for organisations to be successful are not yet well understood.

Despite this uncertainty, large sums of money are being invested by many institutions uncertainty remains over whether the investment is resulting in improved learning outcomes for students (Conole *et al.*, 2000; Taylor, 2001). This problem was noted in the New Zealand Government funded *Highways and Pathways* document:

“In its research to date, the Advisory Group has found very little evidence of evaluation of strategies that might inform New Zealand’s strategic vision [on e-learning].” (ELAG, 2002, p19)

“More fundamentally, concerns remain among many teachers about the validity and quality of learning possible through on-line provision. These concerns are reinforced by the lack of agreed standards for academic quality and resource development.” (ELAG, 2002, p11)

Academic quality standards for e-learning exist to some extent in the form of heuristics and other benchmarks such as the Seven Principles of Chickering and Ehrmann (1996) and the Quality on the Line benchmarks (IHEP, 2000) but these are insufficient in themselves. Institutions need to be able to apply these ideas in practice and learn from the experience so that e-learning delivery is improved in a systematic and sustained manner. Elsewhere (Marshall and Mitchell, 2004), we have suggested that these can be framed in a form that allows for an independent assessment of organizational process capability. In this paper we present the results of a preliminary survey of three tertiary organisations that form part of a larger project being conducted with the support of the New Zealand Ministry of Education’s Tertiary e-Learning Research Fund.

2 DISCUSSION

2.1 OVERVIEW OF AN E-LEARNING MATURITY MODEL

Process maturity models were proposed in the early 1990s in the field of software engineering in response to a perception that significant amounts of money were being wasted on poorly managed software projects, and that organisations were not learning from the experience of these failures. The Capability Maturity Model (CMM) proposed that organisations “matured” from ad-hoc processes through to a culture of continuous improvement in five steps (Paulk *et al.*, 1993). As organisations moved up the levels, it was contended that they would become more capable, and ultimately more successful. An important aspect of this approach is that it does not impose any requirement that organisations used particular technologies or development methodologies, but rather that they explicitly understood what they were doing and why. The benefit of moving through the levels is that the organisation, through defined and managed processes, better understands what it is doing and where to focus resources to improve and refine on successful developments.

Subsequent to the CMM, extensive work with software practitioners resulted in a more expanded approach known as SPICE (El Emam *et al.*, 1998; SPICE, 2002). SPICE added the idea that success depended on the adoption of a number of mutually supportive practices that were determined from an analysis of successful development projects. These practices were organised into a number of process categories. When determining the process maturity of a given organisation, evidence was collected as to how well each of these practices were performed and the results presented in a summary form.

Application of this approach to e-learning (Marshall and Mitchell, 2002, 2003, 2004) has resulted in a model of process capability in the area of e-learning with five process categories (Table 1).

Process category	Brief description
Learning	Processes that directly impact on pedagogical aspects of e-Learning
Development	Processes surrounding the creation and maintenance of e-Learning resources
Co-ordination	Processes surrounding the oversight and management of e-Learning
Evaluation	Processes surrounding the evaluation and quality control of e-Learning through its entire lifecycle.
Organisation	Processes associated with institutional planning and management

Table 1: E-Learning Maturity Model Process Categories

Within these process categories, an initial set of practices have been identified (Table 2) from the Seven Principles of Chickering and Ehrmann (1996) and the Quality on the Line benchmarks (IHEP, 2000) in order to explore the utility and validity of the model’s approach (Marshall and Mitchell, 2004).

Learning: Processes that directly impact on pedagogical aspects of e-Learning	
L1.	Courses are designed to require students to engage themselves in analysis, synthesis, and evaluation as part of their course and program requirements
L2.	Student interaction with faculty and other students is an essential characteristic and is facilitated through a variety of ways
L3.	Faculty clearly communicate how communication channels should be used during a course or programme
L4.	Faculty manage student expectations over the type and timeliness of responses to student communications
L5.	Feedback to student assignments and questions is constructive and provided in a timely manner
L6.	Students are instructed in the proper methods of effective research, including assessment of the validity of resources
L7.	Learning outcomes for each course are summarized in a clearly written, straightforward statement
L8.	Assessment of students communicates high expectations
L9.	Student work is subject to clearly communicated timetables and deadlines
L10.	Courses are designed to support a diversity of learning styles and to ensure accessibility
Development: Processes surrounding the creation and maintenance of e-Learning resources	
D1.	Guidelines regarding minimum standards are used for course development, design and delivery
D2.	The reliability of the technology delivery system is as failsafe as possible
D3.	Learning outcomes, not the availability of existing technology, determine the technology being used to deliver content
D4.	Technical assistance in course development is available to faculty
D5.	Faculty are encouraged to use technical assistance when (re)developing courses
D6.	Faculty members are assisted in the transition from classroom teaching to online instruction
Coordination & Support: Processes around the day-to-day management and support of e-Learning delivery	
C1.	A centralized system provides support for building and maintaining the e-learning infrastructure
C2.	Students have access to sufficient library resources that may include a "virtual library" accessible through the WWW
C3.	Faculty and students agree upon expectations regarding times for student assignment completion and faculty response
C4.	Students are provided with hands-on training and information to aid them in securing material from a range of sources consistent with the discipline or subject.
C5.	Students have convenient access to technical assistance throughout the duration of the course/program
C6.	Students are provided with detailed instructions regarding the electronic media used in a course prior to commencing it
C7.	Students are able to practice with any technologies prior to commencing a course
C8.	Questions directed to student service personnel are answered accurately and quickly
C9.	A structured system is in place to address student complaints
C10.	Instructor training and assistance continues through the progression of the online course
C11.	Academics are provided support resources to deal with issues arising from student use of electronically-accessed data
Evaluation: Processes surrounding the evaluation and quality control of e-Learning through its entire lifecycle.	
E1.	The programme's educational effectiveness is formatively and summatively assessed with multiple, standards based, and independent evaluations
E2.	The programme's teaching/learning process is formatively and summatively assessed with multiple, standards based, and independent evaluations
E3.	Summative data such as enrolment numbers, completion rates, and costing is used as a measure of effectiveness within course/programmes
E4.	Success of technology/innovation used as a measure of effectiveness within course/programmes
E5.	Intended learning outcomes are reviewed regularly to ensure clarity, utility, and appropriateness
E6.	Instructional materials are reviewed periodically to ensure they meet programme standards
E7.	Faculty capability in making the transition from classroom to online teaching is formally assessed during training
Organisation: Processes associated with institutional planning and management	
O1.	A documented set of formal criteria are used to determine access to funding and other resources which support course and programme (re)development
O2.	A documented technology plan is in place and operational to ensure quality of delivery standards
O3.	A documented technology plan is in place and operational to ensure the integrity and validity of information delivered, collected and stored
O4.	Before starting a programme, students are advised of any particular requirements of that programme to ensure they possess the personal and technical skills needed for that programme
O5.	Students are provided with supplemental course information that outlines course objectives, concepts and ideas
O6.	Students are provided with supplemental course information that outlines admission requirements, tuition and fees and other relevant administration information
O7.	Students are provided with supplemental course information that outlines requirements for additional resources such as books or other materials
O8.	Students are provided with supplemental course information that outlines student support services.
O9.	Before starting a programme, students are advised of any particular technological requirements of that programme to ensure they have access to the minimal technology required by the course design

Table 2: E-Learning Maturity Model Process Groups and Practices (Marshall and Mitchell, 2004)

Performance of each of these practices is assessed using a six level scale modeled on that of the SPICE system (Table 3). The assessment is made as to the extent with which each level of the model is reflected in e-learning projects and courses undertaken by the institution. Performance at each level ranges from not being done through to being done in all projects and courses. The results can then be presented visually in order to quickly assess areas of strength and weakness without needed to have a deep understanding of pedagogy, technology or e-learning research and practice. This simple visual presentation, illustrated below in Table 4, can then be easily and quickly understood by senior managers who are not experts in e-learning, and used to inform operational and strategic planning.

e-Learning Maturity Model: Levels	
Level	Focus
5: Optimising	Continual improvement in all aspects of the e-Learning process
4: Managed	Ensuring the quality of both the e-learning resources and student learning outcomes
3: Defined	Defined process for development and support of e-Learning
2: Planned	Clear and measurable objectives for e-learning projects
1: Initial	Ad-hoc processes
0: Not performed	Not done at all

Table 3: E-Learning Maturity Model Levels

Experience of applying these assessments in the field of software engineering suggests that most, if not all, institutions initially assessed will do poorly (SEI, 2004). This is not surprising as one of the drivers for the model in the first place is that widely held perception that e-learning could be implemented more effectively and efficiently in most institutions.

2.2 APPLICATION OF THE MODEL TO NEW ZEALAND TEOS

Previously (Marshall and Mitchell, 2004) we have presented the application of the model to a single institution. While this was sufficient for the purposes of explaining the model and exploring the basic aspects of its implementation, there is clearly a need for a more extensive process of development and validation. The SPICE model and associated frameworks were subjected to a series of workshops known as the “SPICE Trials” in order to build confidence in the approach and to test that the practices met certain criteria for validity (El Emam *et al.*, 1998):

- Are the practices that were chosen the characteristics that tend to make a process more capable?
- Do the practices cover all the relevant capabilities defined at each level?
- Are the practices defined so as to be independent of each other?
- Is this set sufficient to characterize a range of capabilities?
- Do the practices represent the “universal truths” of process capability?
- Are the practices genuinely applicable to any process?

As well as providing an opportunity to test and further develop the practices, the current project is also testing ways of collecting the assessment information efficiently and building awareness of the model. The project is intended to have the following outcomes:

1. **A validated model** and expanded set of practices identified through examination of existing e-learning projects in the participating institutions which can form the basis of ongoing research, development and examination of institutional e-learning capability.
2. **A detailed evaluation of e-learning process capability for each participating institution** which could be used to guide internal consideration of their e-learning capability.
3. **A summary of e-learning capability across all of the participating institutions** which would provide an initial overview of capability and relative performance on a sector wide basis (all institutions would be anonymously reported on), suitable for publishing, peer review and for informing strategic planning at both institutional and sector-wide levels.

It is important to emphasize that the individual institution analyses are confidential and are only going to be reported publicly in a summary form. The intention is to apply the model methodology outlined above and determine whether the theoretical design is both practical and useful, thus validating the approach. The real output is the confidence that the outcomes will provide institutions choosing to use the model to inform their own strategic and operational management of e-learning. In order to achieve these outcomes in the limited time available, the project has been broken down into three phases:

Phase 1(Jul-Aug 2004)

- Distribution of e-learning process-capability model to interested institutions for consultation and final agreement to participate in project.
- Development of detailed programme for evidence collection and visits to participating institutions in e-learning process-capability study.

Phase 2(Sep 2004-Jan 2005)

- Collection of evidence of e-learning process-capability from participants.
- Evaluation of e-learning process-capability evidence collection process.
- Redevelopment of e-learning process-capability model to reflect feedback and evidence collected.

Phase 3(Feb-Mar 2005)

- Dissemination of validated e-learning process capability model and self-assessment methodology to all New Zealand TEO's.
- Reporting project outcomes to the Ministry of Education.

A total of twenty-one organisations have been approached to participate in the study. It is expected that detailed reports will be produced for between five and ten of these covering a range of institutions from small rural polytechnics to waananga and large urban universities. The approach to participate includes a consent form and a detailed questionnaire that collects the raw data for analysis, both of which are available from the project web site (<http://www.utdc.vuw.ac.nz/research/emm/>). In this paper we report on the results of three New Zealand universities analyzed with the initial set of practices listed in Table 2 using the data supplied by the questionnaires. The results of the analysis are summarized in Table 4 below.

The first observation is that the data presentation makes overall comparisons between the three organisations comparatively easy. It is possible to compare directly individual practices but the analysis also makes general trends evident as well. Of course, it is not possible to make sweeping statements with only three data points, but it is expected that once the project data collection and analysis is complete we will be able to detect systemic weaknesses and strengths as well as individual ones.

The three analyses presented suggest that weaknesses may exist particularly in the area of development (D1-D6), coordination and support (C5-C11) and Evaluation (E3-E7). Other areas are comparatively strong, such as organisation (O5-O7) and this probably reflects their being required by existing audit and review processes in the sector. There is also some suggestion that the practices in the learning area may be generally stronger and this possibly arises from traditional strengths and a strong ethos of teaching and learning which is present amongst the teaching staff.

Outside of these overall comparisons, there is an indication that University C is somewhat weaker in its overall e-learning capability when compared to the other two institutions. In particular, many practices are ad-hoc and informal. This would suggest that rather than investing in particular projects or infrastructure, there is a need to focus on defining better internal processes for many practices and then communicating these within the institution. Resources could also be focused on the practices within evaluation (E3-E7) in order to better understand the student perceptions and needs. Universities A and B cannot, however, be complacent. University A also appears to be weak in the area of evaluation (E3-E7) and despite some strength in the areas of development and coordination, there are also significant weaknesses. Similarly, University B has weaknesses in the area of coordination (C6-C10). In the final version of the model, it will be possible to drill down into these areas and identify possible actions that can be taken to address both individual practices as well as overall performance.

	University A					University B					University C				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Learning: Processes that directly impact on pedagogical aspects of e-Learning															
L1.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
L2.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
L3.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
L4.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
L5.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
L6.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
L7.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
L8.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
L9.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
L10.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
Development: Processes surrounding the ceation and maintenance of e-Learning resources															
D1.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
D2.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
D3.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
D4.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
D5.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
D6.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
Coordination & Support: Processes around the day-to-day management and support of e-Learning delivery															
C1.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
C2.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
C3.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
C4.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
C5.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
C6.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
C7.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
C8.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
C9.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
C10.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
C11.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
Evaluation: Processes surrounding the evaluation and quality control of e-Learning through its entire lifecycle.															
E1.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
E2.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
E3.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
E4.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
E5.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
E6.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
E7.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
Organisation: Processes associated with institutional planning and management															
O1.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
O2.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
O3.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
O4.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
O5.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
O6.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
O7.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
O8.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
O9.	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█



Table 4: E-Learning Maturity Model Analysis of Three New Zealand Universities

2.3 SECTOR WIDE ANALYSIS

The presentation of the results of the three analyses in Table 4, as well as allowing for easy reference and comparison between the three institutions also illustrates a significant opportunity of this type of analysis. As noted above, once sufficient numbers of these analyses have been performed, it will be possible to look at the entire tertiary sector in one single glance and identify potential systematic weaknesses that can be addressed. Already, the comparisons suggest a general lack of defined processes and management of e-learning projects at other than an individual level.

The benefits to policy makers and government from such an overview are clear, but there is also the practical benefit that institutions that are uniquely outperforming the rest of the sector can be analysed so as to allow for that success to be replicated. Once sufficient analyses have been performed to protect the confidentiality of the institutions, it will also be possible to look at contextual factors such as student demographics or institutional type as well as the evolution of sector capability over time in response to factors such as strategic direction and investment from government.

3 CONCLUSION

The analysis presented in this paper barely touches the surface of what we believe can be learnt from the application of process maturity models in e-learning. An obvious extension is adding more data on more institutions, but also on changing capability over time. As well, the current set of practices are only an initial starting point, preliminary work on analyzing the literature suggests that the full set is at least three times the size. As well, the current process of collecting the data for analysis is very demanding, so the intention is to explore the possibility of providing some form of self-analysis tool that might also support a partial analysis, rather than the comprehensive capability determination offered by the full model.

Based on the work to date, we believe that the model presented has a number of advantages over traditional benchmarking (Marshall and Mitchell, 2004):

- i. Firstly, an e-learning model could provide a road map for higher education institutions looking to improve their e-learning processes. Most academics are familiar with the ad-hoc approach to e-Learning where development of resources and support of students have more to do with individual heroics than good institutional planning. While some tertiary education institutions have embraced e-Learning in a major way, many are looking for a clear model to guide their ongoing development of resources and enhance their support processes. It is clear that a series of signposts or a map that might guide institutional planners in areas of resource allocation and staff and student support has some merit.
- ii. An accepted framework might also provide academics with the necessary means to encourage greater institutional involvement and provide University management with the framework necessary to frame long term institutional planning. The advantage of the proposed model is that it presents a high enough overview that it can usefully understood without a need to examine detailed reports and metrics.
- iii. Support for institutional planning might be enhanced by the ability of an institution or even a school to benchmark its current capability in an effort to identify and prioritize necessary improvements in its current practices. The lack of a unifying framework for e-Learning makes it difficult for institutions to compare themselves against other bodies in meaningful ways. Importantly the model would allow for different technical platforms, organizational models and pedagogical beliefs. This might aid inter- and intra- institutional collaboration by allowing entities to identify areas in which improvements may produce the most immediate value as well as establish a framework for collaboration on future initiatives.
- iv. Another area in which the model may quickly show a benefit is in its use as a way of organizing the diverse collection of ideas and heuristics in the e-learning literature so that individual practitioners or teams can conduct informal self-assessments. Feedback from such experiments will provide a valuable input into the evolution of the model presented and also ensure that new heuristics can be identified and codified for testing and use. An extensive

literature review is currently underway to provide an expanded set of practices for evaluation and use.

Perhaps most importantly, like the software process improvement approaches, the model might form the basis for an ongoing discussion within the e-learning community with a view to identifying the key practices, heuristics or activities necessary for achieving improvements in e-learning activities. By enabling a sector wide comparison discussion and analysis of e-learning capability that is independent of factors such as technology platforms and pedagogical choices there is the potential to rapidly identify organizational factors that support academic and other staff in effective e-learning and also inform strategic and operational resource allocations within institutions and also across the sector.

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