

HOW COLLABORATION VIA THE WORLD WIDE WEB CAN PROVIDE A GLOBAL PERSPECTIVE AND TRULY PROVIDE THE STUDENT WITH A WORLD CLASS EDUCATION.

Joseph Kasser
University of South Australia

BIONOTES

Dr. Kasser is both a DSTO Associate Research Professor at the University of South Australia (UniSA) and a Distance Education Fellow in the University System of Maryland. Prior to taking up his position at UniSA, he was a Director of Information and Technical Studies at the Graduate School of Management and Technology (GSMT) at University of Maryland University College (UMUC). There, he was responsible for the Master of Software Engineering (MSWE) degree and the Software Development Management track of the Master of Science in Computer Systems Management (CSMN) degree. He produced the first audio-visual lecture on demand graduate online class in the GSMT by pioneering asynchronous distance learning techniques as part of the University System of Maryland's Web Initiative in Teaching. He is the author of more than 15 papers on distance education. He is a recipient of NASA's Manned Space Flight Awareness Award for quality and technical excellence (Silver Snoopy), for performing and directing systems engineering. His web site at <http://www.umuc.edu/~jkasser> spans the globe. Dr. Kasser continues to teach software engineering at UMUC via distance education.

Dr. Kasser may be reached at: SEEC, Room F2-37, The Levels Campus, University of South Australia, Mawson Lakes, SA 5095. E-mail: Joseph.Kasser@unisa.edu.au

ABSTRACT

Universities teaching Information Technology (IT) at the graduate level are facing a major dilemma. On one hand there is a major demand for qualified instructors to teach IT. And at the same time there is a scarcity of knowledgeable personnel with the ability to teach mature students. In addition, the relatively few people who both have the knowledge and the teaching ability, in general, do not have the terminal degree qualifications¹ demanded by the accreditation boards. This paper proposes a solution to the dilemma and also outlines how:

- Collaboration via the World Wide Web provides a global perspective that can only be offered by an international joint degree which can truly provide the student with a world class education.
- The use of distance education technology no longer restricts a university to the use of local instructors. This realization opens various options for collaboration that can provide students with world class instructors.
- The principles of the limited competition embodied in a task-ordered contract when embodied into the teaming agreement have the potential to improve the quality of the courses offered in the joint degree.
- Some potentially problematic intellectual property issues may be reduced to non-issues.

¹ A terminal degree is generally one at the Doctorate level.

BACKGROUND

As we enter the 21st century, the demands on our technological personnel are greater than ever. For example:

- Major government funded systems development has traditionally been characterized by cost and schedule overruns and other (spectacular) failures.
- Employers need effective systems and software engineers to meet the demands of producing modern complex systems within the constraints of schedule and budget.
- Building modern complex systems with international subcontracts and partners requires that the builders have a global perspective.

At the same time, the universities teaching IT at the postgraduate level are now facing a major dilemma. While there is a demand for the mainstream technical courses, there is a scarcity of knowledgeable personnel with the ability to teach mature students. The relatively few people who both have the knowledge and the teaching ability, in general, do not have the terminal degree qualifications demanded by the accreditation boards. In addition, some highly specialized subjects may have such modest student demand that it is uneconomic for the institution to provide them.

IT is a fast moving industry. Courses need to be updated each time they run. Some times only minor updates are needed, at other times major updates are required. For example, at the beginning of this year, any course that contained material on the Y2K problem had to be revised. Thus in light of the current shortage of qualified personnel, courses may not get updated in a timely manner, and consequently the education provided to the students is less than optimal. Some universities are already solving part of the dilemma by purchasing courses that they do not have the resources to produce on their own.

Historically, universities have been repositories of knowledge and places to which students are attracted in order to acquire knowledge from the renowned academics. The university provides the infrastructure for the academic instructor to teach the graduate semester in software engineering. The infrastructure is more than just the classroom and administrative functions; it also includes research facilities and technical libraries.

The World Wide Web has, for the first time, made possible a significant change to historical paradigm of the university as a central learning location. Students can now attend a university without physically being present on campus. However, distance education technology applies to instructors as well as to students. Recognition of this factor allows universities to augment their local staff by the use of suitable persons located outside their geographical areas to staff their classes taught via distance education. For example, the Information and Telecommunications Studies Department at the Graduate School of Management and Technology (GSMT) at University of Maryland University College (UMUC) runs or has run online classes in software engineering subjects that are taught by adjunct faculty in Japan and Australia. In the Spring 2000 semester, the face to face Software Engineering Project class in the Master of Software Engineering degree [HREF1] was taught by an instructor in Adelaide, Australia and a teaching assistant in the classroom in College Park, MD. Interaction was by means of

- Asynchronous audio-enhanced PowerPoint presentations by both instructor and students. These presentations were posted in the virtual web based classroom.
- Synchronous face-to-face meetings in the classroom with the instructor participating (as required) via telephone or Internet Voice.
- Asynchronous text mode dialogue in the virtual web based classroom.

This paper proposes applying an industrial solution to the problem faced by individual universities, namely synergistic teaming to provide educational opportunities greater than those can be provided by the individual institutions. The traditional approach of teaching theory in academia does not work too well in systems and software engineering because it is a field that

is evolving rapidly. By the time a methodology gets into a syllabus the state of the art has moved on. In addition, while there are few proven theoretical methodologies in the field, any literature search of the field will show there are a lot of empirical approaches that have been published as symposia papers. Luckily, the part-time or adjunct faculty teaching systems and software engineering tend to be senior level people who are doing systems and software engineering as a full time job, and are teaching part time. These people, not only teach the theory as expressed in the text books, they are in an excellent position to comment on the theories and tell their students what works and what doesn't work. In effect they have returned to the tried and true approach to teaching engineering skills, namely the master-apprentice model. This is the teaching model adopted in the GSMT at UMUC from teaching courses in the Master of Software Engineering (MSWE) and Master of Science in Computer Systems Management (CSMN) Degrees

Even resorting to adjunct faculty does not provide enough qualified instructor candidates. While there are many experienced practitioners who could teach systems and software engineering in general they tend not to have terminal degrees. The accreditation criteria for universities which requires a specific minimum of instructors with terminal degrees for teaching at the postgraduate level thus tends to prohibit the use of their otherwise qualified instructors and significantly reduces that pool of available talent. Universities which are able to find experienced qualified practitioners with terminal degrees hire them to teach and then may find out that, while particular persons may have an excellent grasp of the subject, they cannot teach adult learners (mature students). And, as this situation is only discovered in the classroom, it becomes a lose-lose situation. The students suffer due to the lack of instruction, the instructor goes through a bad experience, and the university loses a valuable resource. Teaming has traditionally not been viewed as a solution to this problem because universities in a geographical area are competing for students among the same population. However the advent of the world wide web coupled with the growth of distance learning technology have made teaming a viable solution to the problem in certain situations.

SUGGESTIONS FOR ALTERNATIVE PARADIGMS

INSTITUTIONAL COLLABORATION AND PARTNERSHIPS

A team of universities, each well known in their area (geographical or expertise) offer a joint postgraduate degree in systems and software engineering or in any or both of the separate disciplines. As far as the team is concerned:

- One or more topics is/are taught only by the institution with the recognized expertise. The University of South Australia (UniSA), for example, would provide expertise in the systems engineering topics by virtue of its association with the System Engineering and Evaluation Center (SEEC) in suburban Adelaide.
- Several topics are taught by two or more institutions.
- The remainder of the topics is taught by all institutions in the team.
- The team is made up of institutions well separated by distance. Each is located in an area with potential students. For example UniSA could team with an institution in England, another in the Washington DC. area of the United States of America and one in India².

The courses are offered in several formats to suit the lifestyle of the adult learner. These include:

- Traditional synchronous classroom sessions over the course of a semester.

² England provides entry in the European Union as well as the British defence industry. Washington DC is the location of many contractors providing systems engineering services to the U.S. Government. India is a growing area in the field of systems and software engineering and students seem to be one of its major exports.

- Online sessions over the course of a semester via distance education in synchronous or asynchronous formats.
- Short three or five day block mode synchronous seminars³.
- The executive format of consecutive synchronous weekend sessions enhanced with web-assisted asynchronous extensions.

Students take courses from the institution of choice via their method of choice. In the situation in which a course is offered by more than one institution, the students will soon learn which institution and which instructors are more suited to their needs and plan their studies accordingly. This competition for students will tend to increase the quality of the courses and ensure that they remain reasonably current. For example, several students in the now terminated joint MSWE degree offered by the University of Maryland at College Park (UMCP) and UMUC did express preferences as to institutions and instructors in acquiring knowledge of specific topics⁴.

While each university locates instructors, the pressure on course coordinators (program directors) to find instructors for every course is lessened due to the duplication in course offerings.

CHARACTERISTICS OF INSTITUTIONAL TEAMS

Theoretically, forming teams should not be too difficult, in practice however, it will be a major accomplishment. The characteristics for successful teams in academia are the same as those for successful teams in industry, namely:

- Each member has something to contribute and lacks some capability provided by other members of the team.
- The members have compatible cultures. In the United States there tends to be two kinds of universities, the research university and the teaching university. As UMUC and UMCP found out, incompatible cultures are a major impediment towards forming a successful team.
- The institution understands the needs of, and cares for adult learners.
- The institutions provide most if not all of the systems and software engineering body of knowledge, or at least the subjects taught in current degrees in systems and software engineering.
- The full-time faculty at each institution has worked in the field successfully before entering into academia.
- Adjunct faculty, practicing what they are teaching, teach most of the classes. If they are not doing it while teaching, then they should have done it within the last two years.
- One institution has to administer the program, the others provide the quality control. This is the principle of checks and balances.
- As important as the instruction is the access to current journals and textbooks, and databases. The ability to provide these capabilities is critical when the student body is at a distance.
- Providing on-line access to the data is a service provided by more and more institutions, however providing access to physical books and journals are more difficult. While this capability can be provided overnight in the continental United States, or in Australia, at a reasonable cost, the cost of providing the service internationally is still prohibitive. The international members of the team provide the physical materials in their geographical areas.

³ The short seminars allow for instructors to be flown to their students, in the manner in which UniSA personnel offer courses in the United Kingdom and makes use of foreign talent in Australia.

⁴ It was not at all one-sided. Some students preferred UMCP, others UMUC.

In practice however, teaming will not be simple. Experience has already shown that it requires major commitments by each institution together with personnel in each institution committed to the vision of the team and providing their students with the best educational opportunities they can.

The challenge in forming a successful long-lived team is that it will be a true example of engineering a complex system and may even end up as a case study in one of its own classes.

Teaming is starting to happen. For example:

- UMUC and UMCP had a joint graduate program in Software Engineering. When the joint program terminated in May 1999, UMUC converted the degree to the on-line format while continuing the phase out of the joint students and as of September 1999 it was their fastest growing program (Kasser, et al., 1999).
- UniSA is actively collaborating with University College, London, in providing courses in systems engineering.
- (NETWORKING 2000), contained an announcement that Kyiv National University of Economics (KNUE) in the Ukraine was seeking Canadian colleges and universities interested in partnering with KNUE to develop joint degree/diploma programs and to organize international collaborative learning groups. Under the envisioned joint programs, upper-year KNUE students would enroll at a Canadian institution for a final year of distance studies and receive a degree or diploma from both institutions. The international collaborative learning initiative would see students in Canada and Ukraine working in groups over the Internet on a course project, monitored by faculty members from both institutions.
- Informal 'teaming' is also taking place wherein individual instructors teach at more than one university. However at this time, this informal teaming does not seem to cover the situation where the same instructor teaches the same or similar classes at the different institutions.

Other Benefits of Teaming Internationally

Other benefits include:

- The institutions in the team are not competing for students who wish to study in the classroom.
- Students are exposed to other ways of doing things in other nations and cultures. This exposure comes from both the instructors and their classmates.
- Students in the on-line classes work in teams on projects with people. This constructivist approach to learning provides both the global perspective and the ability to interact with co-workers in distant time zones.
- Australian and British universities offer research degrees at the Masters and Doctoral levels which do not have residency requirements. By teaming with a stateside university, the offshore degrees would be available to the professional in the USA who does not have the time to spend in a 'residency'. This opens a new market to the offshore universities. In addition, as well as raising the effectiveness of systems and software engineering, making this type of degree available in the USA would, in the long term, provide a greater pool of subject matter experts with terminal degrees for teaching in the classroom.

OTHER TEAMING APPROACHES

Institutional teaming for teaching systems and software engineering offers benefits to both institutions and students. As such it should only be a matter of time before the first such team is formed and offers world class graduate education in systems and software engineering. However as the co-located UMCP-UMUC experience has shown, teaming is not an easy road to undertake. The problems in forming a global team may seem insurmountable at the beginning of the process. The remainder of this paper examines some intermediate or alternative concepts

that may allow the institutions to achieve many of the benefits of formal teams, but with lesser risk of failure, and some potential other benefits.

THE CUSTOMER-CONTRACTOR TEAMING APPROACH

Consider the effect of changing the relationship between the university and instructor from that of employer - employee to that of customer - contractor.

Imagine a university with no full-time teaching faculty! Instead, the universities meet the need for instructors by issuing tenders for subject matter experts to create, teach and maintain complete courses in the systems and software-engineering curriculum.

The universities publish requests for proposals (RFP) for course material useable both in the classroom and via distance education on web sites and electronic journals. The RFP could also contain the Web URLs of the templates and standards for formatting the course material. The required material would comprise course materials, lecture notes, and even PowerPoint transparencies with audio accompaniment on a topic. Responses to the RFP could come from various places including:

- The research faculty at the institution.
- Research faculty at another institution.
- Another teaching university.
- Practitioners in industry; the traditional adjunct professors.
- A Company that provides training in systems or software engineering.
- Subject matter experts who can't or don't have the time to teach, teaming with teachers who have some knowledge of the subject.

The university would evaluate the offers based on whatever criteria the institution chooses to use. These criteria could include:

- reputation of the instructor,
- publications in the field,
- student evaluations,
- teaching experience,
- cost of course,
- delivery mechanism,
- quality of materials,
- the frequency of upgrades in a multi-semester course.
- degree of currency of reading material, and
- any other applicable criteria.

The competition would encourage the instructors to keep the material current. The institution could choose to tender for a single course, or the same course to be provided several times in several years. At this level there is no difference between this paradigm and the current situation as far as the students are concerned. However, the effect of this change could serve another purpose.

The instructor's perspective

Now look at the situation from the perspective of the instructor. The fee paid by the institution for producing and teaching one new course does not in general cover the costs to produce the course, teach it, and grade student work at a reasonable hourly rate. In addition, low enrollment may mean that after hours of preparation, a course is canceled with no subsequent remuneration for those hours of preparation. Luckily for the institutions, adjunct instructors primarily teach for reasons other than money. These reasons include the:

- Desire to be associated with the university, either for the glamour or for the library resources.
- Desire to pass on their knowledge and experiences to the next generation of systems and software engineers.
- Thought of transitioning from industry to academia in the future and the consequent need to build up teaching experience.

Yet academia in most universities is much more than teaching, and the skills and expertise developed by a career in industry are the factors that make a person a desirable subject matter expert, but not necessarily a desirable full-time member of the faculty. People who wish to transfer from industry to academia may not have the:

- Research skills needed in the traditional university.
- Teaching skills to interact with mature post graduate students.
- Administrative skills needed to deal with students outside the classroom in the role of a help desk operator providing advice and slicing away at red tape to facilitate the education of the student. These skills are a requirement in a teaching university like UMUC.

What if, instead of the instructors subcontracting to the universities, the universities come to the following agreement with the instructors? The instructors offer the courses and the universities administer the enrollment of the students in the class and pay the instructor on a per student basis. In this scenario there may be students from several universities taking the same class, working in teams together as if they were all in the same school, yet the instructor would file grade reports to the several institutions at the end of the semester! A Division of a major US Defense Contractor in the Washington DC Metro area has developed three postgraduate level face-to-face classes in systems engineering and telecommunications for its internal leadership development program. Each of the classes is accredited with up to four major universities. Employees in the contractor's program seek admission to one of the universities to pursue a postgraduate degree. They take the regular university's classes, as well as the three classes mentioned above. When the in-house class runs, the administrator has to report the student grades to the specific university in which the student is enrolled. That means grade reports can go out to up to four universities. In the distance education environment, the students could be located anywhere on or even near the planet as long as they have an Internet connection.

This scenario also has an impact on subjects that are taught infrequently at any single institution due to the lack of student demand and the financial loss of staffing a class attended by few students. In such a situation the student has to:

- Forgo the class - the student loses.
- Wait until the class is offered - the student may or may not be able to work out a schedule of classes to accommodate the delay.
- Take the class at another institution and transfer in the credits - the university loses the tuition payments.

Subject matter experts in the field could increase their income from teaching a class each semester by filling it with students from several institutions. This is a win-win-win scenario in that:

- The instructor benefits by the greater earnings from teaching.
- The student benefits by the availability of the class when the student needs it.
- The institution benefits by collecting the tuition because the class credit is not transferred in.

Common to all threads in this scenario is the global experience gained by the student in working with other students across institutions.

Multiple awards

Now speculate a little further. What if, instead of the RFP being for a single award, the university made multiple awards in the manner of a United States Government multiple-award task-ordered contract? When an institution received several offers that met its requirements, it could award the *opportunity to provide the course* to all qualified offerers and the students could take the class with their instructor of choice. For example, the university would announce that for 2001, any one of the classes in systems engineering offered by a list of approved instructors would be accepted as meeting the requirement for the subject. The university would provide the students with pertinent information about the instructors and the courses, and pay the instructor on a per student basis.

This competition could raise the quality of the education and also provide students with alternatives. For example a course on the software life cycle can be taught by different instructors in different ways. One instructor could be more formal and mathematical than another within the context of the same syllabus. This happens in the current paradigm. If the university is big enough and there are sufficient students, the university may run two sections of a class and the students choose if they want the version with or without the mathematics. In this paradigm, both versions would be available to students in smaller institutions.

For the smaller institutions, this scenario provides the same benefits as teaming with larger institutions. It allows them to offer more degrees than they could on their own. Since the subject syllabi will be published there will be a convergence between the syllabi on specific topics as taught by different instructors. The differences will be in the persona of the instructors. This might allow different instructors to charge more or less for their courses depending on their workload, their reputations or some other factor. Students may be prepared to pay slightly higher tuition rates for certain instructors, and the institution gets its percentage. The convergence of syllabi may lead to greater uniformity in what is actually taught in postgraduate degrees in systems and software engineering.

INTELLECTUAL PROPERTY ISSUES

In the customer-contractor paradigm, the instructors who provide the added value to the textbooks own the entire intellectual content of the courses; bypassing problems in the current paradigm. The following is an example of a problem that would be eliminated by this paradigm. The UMUC GSMT curriculum contains one of the few graduate level classes on Software Maintenance (MSWE 648) (Kasser and Kerby 1999), and one of the still fewer classes on the topic available in via distance education. The course content was first developed by the Program Director in 1998. He also taught the class for three semesters. As creating the course and upgrading it each time he taught it was part of his duties, the program director created a "work for hire" and UMUC owns the course. The program director has since left full-time employment at UMUC but continues to teach the course as an adjunct professor. The course ran in two sections in spring 2000 and needed upgrading. The module on Y2K needed a major upgrade and some of the other modules needed minor tweaks to stay current. The adjunct instructor made the upgrades for his distance mode section⁵. Since the upgrades were no longer made as a "work for hire", who now owns the rights to the upgraded parts of the course? Since MSWE 648 is one of the few postgraduate level classes on the subject of software maintenance, it should be a very marketable course. Thus the ownership of the intellectual property has financial implications to the person who modified the course.

⁵ In addition, the class also ran in a synchronous classroom section, so the two sections have begun to diverge in content.

CONCLUSIONS

This paper has covered some initial thoughts on the benefits of institutional teaming, an alternative relationship between instructors and institutions, and the implications of the changes in the relationship. The adoption of these thoughts could lead to a fundamental change in the nature of the university in the area of software and systems engineering. The institution would evolve from a centralized mode to a distributed mode and would no longer be a place where students come to learn from academic leaders. It would however, still be a place that provides the infrastructure for learning as well as continuing its role in providing postgraduate students with research opportunities.

REFERENCES

- Kasser, J.E., Kerby, S., Teaching Software Maintenance Online via (Mostly) Asynchronous Distance Learning, Forum for Advancing Software Engineering Education (FASE), Volume 9 Number 10, October 15, 1999.
- Kasser, Joseph E., et al., "Bringing the Master of Software Engineering Degree On-line at University of Maryland University College", SETE-99, Adelaide, Australia, 1999.
- NETWORKING, Volume 4, Number 8, 19 April 2000, published by the Node Learning Technologies Network. [HREF2]

HYPertext REFERENCES

- HREF1 <http://polaris.umuc.edu/~jkasser/classes/m6170002/mswe617.htm>, last accessed April 29, 2000.
- HREF2 <http://theNode.org> last accessed April 29, 2000.