A Mobil Learning Environment System Infrastructure (MoLE-SI)

An Education Unit-based Pilot Study

Challenge Addressed in this Proposal

After a long and well-serving life, the inflexible and fixed computer labs located within departments are quickly becoming insufficient and inadequate to handle the increasing number of students in classrooms; the ability to bring the state-of-the-art technology for enhanced pedagogical approaches to both students and faculty has become “hindered" by this type of model. A new and efficient alternative is needed. The key goal of this proposal is to validate, at the educational unit level, a new paradigm, The MoLE-SI (Mobile Learning Environment and Systems Infrastructure, see below), before making recommendation for adoption to a college level, university wide, and possibly beyond.

Proposed Solution Alternative: MoLE-SI, a New Paradigm

Based on the challenges stated above, it was decided to find a solution accommodating the major needs of the students for their direct benefit, by creating a very dynamic, engaging, and more effective and efficient learning environment as an alternative to the existing computing resources provided by the PCLABs, while taking advantage of the new high bandwidth wireless and network infrastructure of our campus. Additionally, this new alternative environment is expected to provide enhancements to the current instructional model in both departments, Chemical Engineering and Computer Sciences. Furthermore, it will be an effective test bed for new educational technology of core interest to TTU’s Technology Institute.

MoLE-SI (Mobile Learning Environment and Systems Infrastructure) is a collaborative effort between the Office of the Dean of College of Engineering, along with the departments of Chemical Engineering and Computer Sciences, as well as with the Technology Institute (see section on Partnership, below); it is one particular approach addressing the needs described above. It has three main components, a rich, dynamic, and modern pedagogical classroom environment facilitated by furniture and other components such as network camera and video projector, as it can be seen in Figure 1 (Part C), coupled with the second component, a scalable and highly available information technology infrastructure (Part B), providing the students with an on-demand access of software development packages and engineering software via Remote Desktop Services. These services allow the usage of TTU hosted software from any location provided with Internet connectivity. User authentication and other security layers are part of the back-end configuration to minimize the exposure to network threats. Additionally the hardware resources of the computational back-end in MoLE-SI will be physically distributed to provide redundancy in case of failure.

There is one final component, *the students and their portable devices* (Part A). The students themselves add a very distinctive and core characteristic of MoLE-SI, it’s mobile. They will now use their own portable (Netbook/Notebook) devices to access the software resources using TTU’s new wireless infrastructure. A minimum and recommended system requirement specification for portable systems has been studied and submitted to Admissions Office as well as that of Public Affairs, and both are included in the Flyer (See Section on Immediate Impacts and Appendix) provided.

This prototype solution was tested during the small scale pilot study performed during the Fall of 2009 with the support of Apple and Lenovo (See Section on History of the Development and appendix presentation). The students involved in the project were very excited by the performance results and capabilities of the back-end infrastructure and very often they expressed that their own modern computer systems could not perform comparably.

Foreseen Benefits: The Broader Impacts

Based on a preliminary small scale pilot study conducted by the Department of Chemical Engineering in collaboration with the Office of the Dean of the College of Engineering (see below and appendix) and the experience accumulated within the Department of Computer Sciences and the Technology Institute, the following are examples of potential benefits.

- Enable students to have a (mobile) laboratory experience anywhere they choose, lounges, dormitories, cafeteria, etc., in short*: deliver the classroom to the student and not the student to the classroom*. A total of 600 students/per semester will be experimenting with MoLE-SI. In addition the Technology Institute will benefit using MoLE-SI as a test bed.
- Focus on support opportunity-enhancing infrastructure rather than repetitive client-side offerings.
- Assess the value of MoLE-SI in order to find potential benefits for other departments, the university as a whole, and other institutions in the state; in particular those within TBR.
- Successful implementation of the MoLE-SI Initiative at the unit level, would lead TTU (potentially) to be a pioneer institution in bringing a transformative culture in areas that are quite relevant to STEM disciplines. Today, serious limitations prevent taking full advantage of the implementation of Part A (of MoLE-SI).
- Take superb advantage of the New Wireless Infrastructure, as planned by ITS to be deployed in the coming semesters using Federal Stimulus Money.
- Provide a cost effective alternative solution to standalone computer laboratories enhancing the efficiency and effectiveness of the four cornerstone fixed laboratories. In other words, MoLE-SI complements current ITS efforts.
- Allow the students to use TTU hosted on demand software all the time anywhere, and allow faculty to take full advantage of these software in collaborative and active learning approaches.
- Provide students and faculty with a more dynamic and engaging learning environment that complement effectively the integration of the Tablet Initiative of the Technology Institute at TTU.
- Reduce the costs associated with maintaining a large number of fixed computer stations and simplify the logistic of ITS personnel.
- Introduce the necessary hardware, and technologies like VDI, to assess the implementation of the first computer cloud for the College of Engineering; afterwards, the data and study results can be scale up to other units and the university.
- Improve student's learning with technology as is required by the ABET accreditation process in engineering disciplines.
- Foster enhanced teaching models for forward-thinking faculty members that, for example, like to implement team-based learning in "real-world" and critical thinking strategies well aligned with university efforts such as QEP that will make a stronger case for the next accreditation visit.[1]

[1] Chemical Engineering learning ABET outcomes are centered around hands-on, team-based learning, and critical thinking. These are all part of the Hi-PeLE Model that was a 2009 QEP award winning methodology and recently

- Create efficient funding flows that innovate and not duplicate services. The scaling aspects tested within the small pilot program seem to be very promising. This proposal would allow a validation at a unit level before making a decision for a college (and beyond) level.
- Cooperate with other university programs seeking to enhance and expand the student experience such as the Learning Commons.
- Provide a logical and financially sustainable information cloud promoting student success. This will facilitate and encourage the use of eBooks as a primary textbook tool rather than traditional printed books as a long-term, cost-saving measure for a student body that has seen the cost of traditional, printed books steadily increase.
- Gather data to develop business partnerships to support MoLE-SI reducing the fiscal liability of technology implementation to the university.

Partnership: A "Group Genius" Approach

Dr. Keith Sawyer, author of "Group Genius" has championed the idea of a more innovative and creative approach based on contributions of many, as opposed to the traditional “solo" contribution. MoLE-SI is a partnership among two different academic units, i.e. the Department of Chemical Engineering (Pedro Arce, Chair of Department and Becky Asher, Assistant), the Department of Computer Sciences (Douglas Talbert, Chair of Department and Eric Brown, ITS person) the College of Engineering (Marbin Pazos-Revilla, ITS person) , and the Technology Institute (Ken Wiant, Director). The project proposal has relied (on a consultation basis) on the input from Dr. David Huddleston (Dean of the COE), Dr. Joe Biernacki (Professor of Chemical Engineering), and Dr. Mario Oyanader (Adjunct Professor of Chemical Engineering). Students at the senior and sophomore levels in Chemical Engineering were part of the small scale pilot program during the Fall 2009 semester (see below).

Background: The Mindset behind MoLE-SI

The role of laboratory experience has been in constant change in technology-based disciplines for the past decade. With the advent of cheaper, more efficient, more mobile technological tools, students spend less time in the traditional, structured computing facilities and more time in unstructured, social facilities where collaboration more than isolation is the rule.

This model is not unexpected as computing disciplines have stressed team dynamics as an essential part of the design and development processes for the past 30 years. In parallel to the team model, mobile computing devices are cheaper and more prevalent in society. Freshmen entering the university are no stranger to personal data assistants (PDAs), smart phones, and laptops. The mindset is not one of convenience but expectations. Students entering the college level experience are within the so-called generation "Y" that cannot function without cell phones, readily available computer, and iPod-like devices.

In order to meet these expectations, university departments must rethink the concept of a “computer lab.” Consideration must not only include the discussion of equipment but of distance and location. Therefore, *flexibility* in time and *mobility* in space become primary characteristics of a new paradigm in educational uses of state-of-the-art technology. These characteristics incorporated into a *new paradigm* (at a site location) make an excellent prototype to promote an effective use of distant education integrated with either real or virtual contact. In an era of distance education, pandemic

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highlighted by the NSF as one of the most effective "best practices" in developing innovative and creative engineers.

planning, and business continuity goals, the question must be asked, “How can we innovate and create a new model of learning that allows taking advantage of both technology enhancement and pedagogical learning-based approaches? And, how can we redefine the concept of "face-to-face environment?” Along with an effective use of funds available, this is the mindset driving MoLE-SI and the focal pilot study described in this proposal.

History of the Development: Brief Summary

A preliminary MoLE-SI study was conducted for a period of time during the 2009 Fall Semester with faculty and staff from Chemical Engineering, two groups of students from this department, the assistance of several hardware vendors, the office of the Dean of the College of Engineering, and ITS, represented by Marbin Pazos-Revilla (see appendix). During the life of this study, the students were able to use engineering software remotely using either their own laptops, or laptops that we were able to provide. The resource usage on the different servers and other important variables were closely monitored, and a survey was conducted. This survey showed high interest from the freshmen students to see the implementation of the infrastructure proposed by MoLE-SI. This validates some of the observations made above in the background section.

Student and faculty from the Chemical Engineering Department participated in two informative workshops conducted by an Apple Team. Also, a team from Lenovo visited the department and discussion took place exploring possible alternative and services. It was clear that a MoLE-SI model has not been used in engineering schools; the MoLE-SI Task Force was constantly focused on options that maximize both flexibility and mobility. After the small scale pilot program was conducted, the task force presented the findings to other departments within the College of Engineering, the Department of Chemistry and the College of Business. All the feedback received has been very positive and words of encouragement of a unit level pilot emerged; this is a central focus of this proposal.

Immediate Impacts: Modifications, Requirements, Progress Made.

Two of our major labs, PH205 and PH204, will be obsolete by ITS standards by July 1, 2010 and this situation, added to the current financial situation faced not only by TTU but by many other Higher Education Institutions in the state and the nation, requires us to find alternative solutions in order to maintain and improve the current computing services provided to the students. In addition, partial service step down is needed for BR 206 and 207 via reconfiguration including basic power strip upgrades to make these rooms more laptop friendly. MoLE-SI will greatly assist with an innovative and efficient approach rather than a simple "replacement" of old-fashion technology. The pilot will also impact the way students interact with technology, requiring them to move towards platforms that are being adopted by other universities (See ASU and UNCCH, for example). This will need:

- Mandatory laptop requirement for current and future CSC and ChE students. All the approval have been requested and obtained from the University at this point.
- Announcement of undergraduate laptop purchase requirement for the 2011-2012 academic year. A flyer (see appendix) with all required information has been approved by the Admission Office and final version is being designed by the Public Affairs Office.
- Preliminary business agreement development for hardware and software service using non-university resources. Initial checking has been made and there is no foreseen difficulties for implementation as needed for the unit pilot study.
- Preliminary work with Financial Aid to assure that students could use federal and state financial aid funds to purchase computing equipment. This has been preliminary agreed to by the office

of financial assistance and final arrangements are planned to be ready for implementation for the Fall 2010 Semester.

- All CSC courses will encourage the student to have client-side computing resources available.

The 2011-2012 academic year phases will include the following elements (beyond the one year pilot):

- Elimination of the remaining fixed client computers in BR 206 and BR 207
- Initiation of the software helpdesk in the Learning Commons to support the laptop programs in CSC and ChE.
- Purchase of 15 spare laptops for student and faculty checkout while their systems are being repaired (CSC).
- Complete work with Financial Aid and the Business Office to reaffirm student support agreements are in place (for all students within the participating units).
- All CSC courses will assume that the student has client-side computing resources available.

Alignment of Proposal with University and TAF Objectives

Tennessee Tech University is uniquely positioned to take a leadership role in campus computing for the Tennessee Board of Regents by demonstrating innovation in spite of challenging economic conditions. Creating opportunities for innovation in the classroom by faculty and students alike is at the heart of the campus QEP program. The application of pervasive technologies is at the heart of the administration's recent focus on computing. Doing so with a more efficient use of university and student body dollars is at the heart of the university mission and financial goals. This project, based upon solid data, works in unison with these ideas. In addition, goals of the TAF funds are focused on innovation of technological and related items that synergistically will enhance student and faculty performance. This proposal identifies a model platform that shows three components, i.e. Part A, Part B, and Part C (see Figure 1) that work complementary to achieve a unified beneficial affect with an optimization of student and university funds.

Outcomes and Assessment

This educational unit level pilot study has two primary outcomes, both of them to be thoroughly evaluated to make adjustment for a successful implementation and scale-up to a college, university and (possibly) beyond. The first is the data gathering on technology performance of MoLE-SI. The preliminary guidelines developed at the small scale pilot study will be tested and validated (see Appendix). The second outcome is the impact of MoLE-SI on the technology-enhancement of learning and pedagogical approaches for both student and faculty. A set of tools is being currently developed to assess pre- and post status on the subject in collaboration with the Technology Institute and other relevant units available at the University. It will be conducted at different levels of the curriculum and it will be integrated with the continuing improvement as suggested, for example, by ABET[2].

Future Phases

Future phases of the MoLE-SI initiative will be based upon surveys and other feedback mechanisms from the faculty and student body. As part of the current proposal, an assessment of pre

[2] This effort will be a powerful demonstration that funds allocated by university sources are being effectively used to show innovation and improvement in educational objectives of paramount importance to accreditation agencies.

and post MoLE-SI status is planned to be conducted. This not only will include the technical enhancement aspects but also the pedagogical improvement on student learning and faculty experience. While work would continue to achieve the service levels of more mature computing initiatives such as CCLI, much of our local policy must be made using information from our local experiences. The findings will be summarized in a report so that it is available for those interested in achieving their transformation into MoLE-SI. Furthermore, we also seek to publish information about our experiences in conferences and journals so that others can benefit from our experience. The unit level pilot results will be used to generate curriculum improvement proposals supported by federal initiatives such as CCLI and/or similar ones.

Budget Justification

The total budget for the MoLE-SI proposal is \$ 149,239.00; however, matching from the College of Engineering in the amount of \$ 26,205.00; the Department of Chemical Engineering, in the amount of \$14,659.00; and the Department of Computer Sciences, in the amount of \$ 40,000.00, and Microsoft and RCM Technologies matching \$ 5,000, the total amount reduces **the TAF request to: \$ 63,375.00, only a 42.4% of the total** funds required. (see budget details). Also, the contribution from Microsoft in terms of service for the servers is due the fact that MoLE-SI has been identified as a new and innovative initiative for the use of computers in education.

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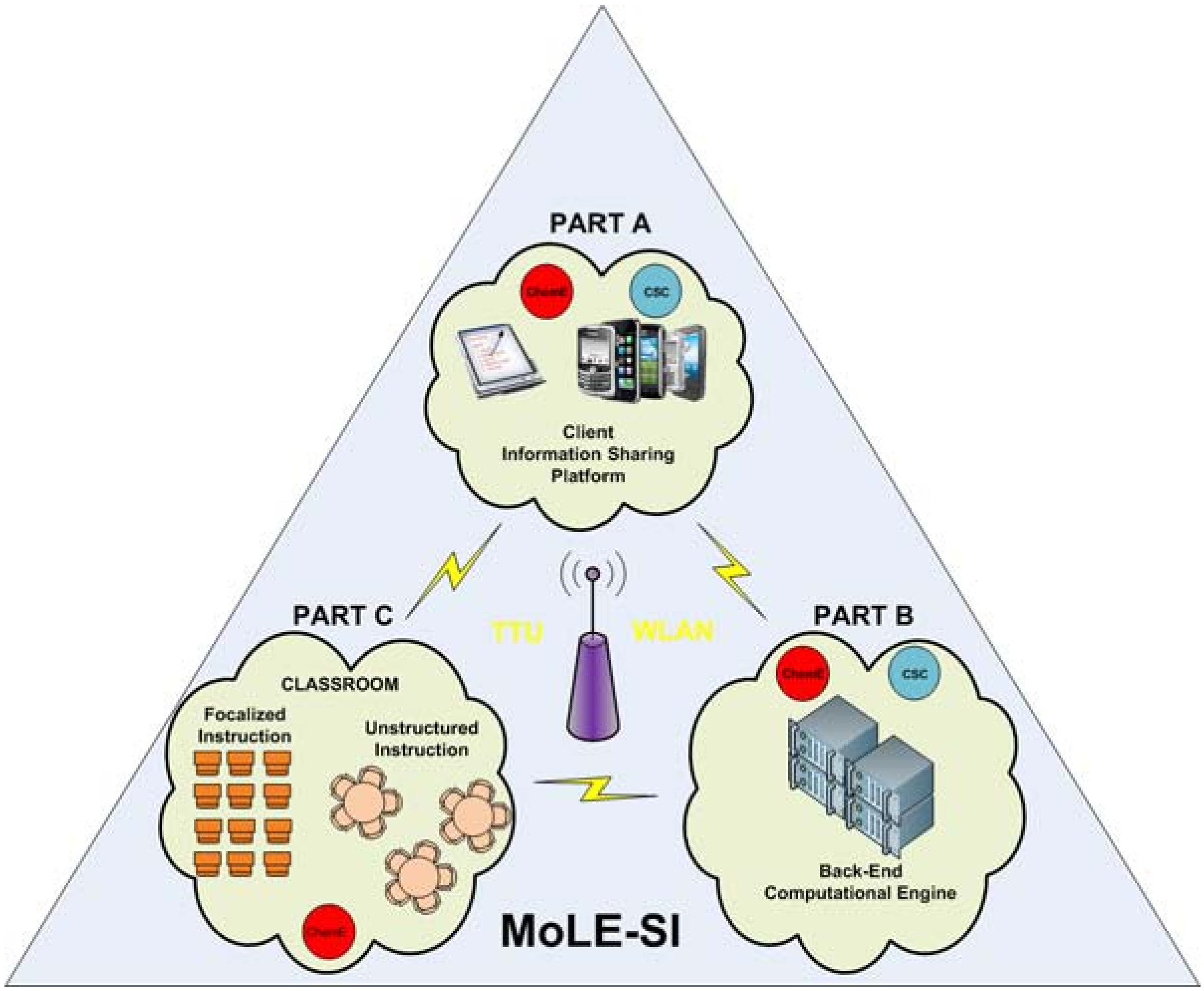

Figure 1 – MoLE-SI Conceptual Platform showing its different components

Budget

The total cost of the project could be divided in different categories, consisting of Furniture, Technology, and Labor. For brevity purposes, only major items and overall cost figures are included below for each individual category.

Technology			**Furniture**	
WACOM 21" Monitor	$2,100.00		Power Modules	$6,550.00
Axis Network Camera	$1,100.00		Chairs	$9,580.00
DELL Poweredge 905 Servers & UPS	$83,400.00		T-Legs	$2,820.00
DELL Optiplex Desktop	$1,110.00		Contingency	$1,895.00
Cables and Accesories	$600.00		**Total**	**$20,845.00**
Astaro 320 Security Gateway	$5,360.00			
Microsoft Consultations Services	$5,000.00		**Labor and Materials**	
Windows Server 2008 Licenses	$1,025.00		Electrical	$7,510.00
Windows Remote Desktop Licenses	$4,400.00		Materials	$5,244.00
Laptops	$5,000.00		Shades	$700.00
Projector	$1,100.00		Contingency	$1,205.00
Universal Projector Mount	$170.00		**Total**	**$14,659.00**
Projector Security Enclosure	$170.00			
Spectrum Media Manager Lectern	$1,800.00			
Da-Lite 3:4 Motorized Screen	$1,400.00			
Total	**$113,735.00**		**Grand Total Before Matching**	**$149,239.00**

Matching Funds	
College of Engineering	$26,205.00
Chemical Engineering Department	$14,659.00
Other Sources provided to CSC Dept.	$40,000.00
Microsoft & RCM Technologies	$2,500.00
Microsoft	$2,500.00
Total	**$85,864.00**
Grand Total After Matching	**$63,375.00**

Note: An additional important investment in this project will be all the student-owned laptops incorporated into MoLE-SI. This specific item could be considered as a match line to the above Matching Funds group. If we consider the average student owned computer to cost $900.00 this specific matching fund item would reflect a figure of half a million dollars.

Appendix