MITCET Proposal

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SUMMARY: To create a full-circle global, educational experience that teaches the basics of engineering to a multinational student base, uniting these students through virtual technology, and providing an integrated system of feedback and mentorship among prior, current and future students. Success will be measured by the impact on students by a functional, interactive website with daily posts by students in all locations, comparative analysis of geographic impact on engineering problems, and a tangible archive of lectures, and student work.

The Need

It's a small world, after all. As globalization expands and borders shrink, the world's populations witness the importance of understanding and embracing other cultures. The current economic, political, and health climates of our world bring us closer and closer to each other on both personal and national levels. With all this conjoining and uniting, broad shifts are emerging. One is in the difference in opportunity for some of us to experience and appreciate this globalization. Economic statistics indicate that gaps in general opportunity and wealth are expanding, which increase the internationalization of only a limited subset of the world's population. Another shift lies in a potential tendency toward a homogenized "international individual", where specific cultural identities are suppressed in favor of the global persona. While a notion of 'citizens of the earth' is undoubtedly a positive and encouraging symbol, particularly when it comes to environmental and political challenges, cultural heritage and diversity offer a variety and flavor to life that we might otherwise miss. They also provide a creative fertile ground for solutions to problems not limited by a linear path of cultural singularity. In other words, what two to three cultures might provide in terms of solutions may be a sum greater than its parts. Hence, a marriage of these ideas might be considered a form of *"glocalization"* where individuals are interacting on both a local and global scale.

The two challenges facing the exposure to international experiences identified above – prohibitive cost and cultural homogenization – will be addressed in this proposal. It is our aim to provide an international educational experience to undergraduates at MIT and the University of Tokyo, at no cost to them. We aim to provide this through both interactive technology and the opportunity to participate in travel abroad. The arena in which this exchange will take place is an undergraduate engineering course. We intend to offer a course that will take place in both universities, with a shared curriculum, that creates a global classroom which celebrates the unique contributions of each culture. This *glocalization* is mirrored by the engineering problems the students will face in the project portion of the course. Students will be asked to consider what engineering challenges are universal and which are site-specific. Climate, politics, financial resources, geology – all are unique to location, and all will alter the types of solutions available to the same problem. Students will learn that while common approaches are the beginning, each engineering challenge ultimately must be considered in context of a specific region.

Cross-cultural interaction inevitably encompasses the challenge of time zones and seasonal shifts. Particular to this proposal is a ~12 hour time difference in East Asia, as well as a shift in the academic calendar with UT's spring semester running April – July and the MIT semester running January – May. This presents not only a challenge on a daily basis, but also of curriculum and course expectations. These are significant barriers to interactive communication among participants and to joint academic programs. Indeed, the academic community has expressed the importance of global experiences in their education, as referenced in the Report of the Task Force on the Undergraduate Educational Commons and the GEOMIT, mentioned in this call for proposals. We believe distance to be a significant challenge to

fostering this experience, and therefore, hope to discover solutions to overcoming the distance/time problem, at the same time preserving the enriching experience of other cultures.
The importance of project-based learning has been identified by the OEIT, whereas, it involves student engagement in the learning process, as opposed to a passive lecture structure, and it requires that students respond in real-time to problems that arise. Student projects can offer advantages such as teamwork and the application of methodologies and principles such as determining a figure of merit, developing rules of thumb, etc. By structuring activity around *glocalization,* students will learn both the benefits of cooperation as well as the unique challenges that are local to a given culture and/or continent.

Therefore, within this proposal, we see two broad skill-sets our students will develop:

1. Cross-cultural Communication Skills
2. Engineering Practice through Project-based Learning

It is our intention to explore ways that technology can enhance project-based learning and overcome the barriers of distance, thus creating a no-cost opportunity for all students to experience the mind- and world-expanding chance to interact with other cultures.

Meeting the Need: The Course

"3.003 Principles of Engineering Practice", currently in its second year and supported by D'Arbeloff funds, will serve as the model course for a hierarchy of student offerings from Freshman to Graduate level, all centered around a common theme of joint global curricula, executed by joint global projects. We aim to expound on this highly successful project-based undergraduate course by establishing a global network of universities teaching identical curricula, simultaneously, each to a distinct classroom of students. The first year will be taught at MIT and the University of Tokyo. If successful, year two will introduce a location in Europe, likely the University of Ghent and/or Oxford University. The students at each location will communicate with each other through an infrastructure of technology-based media to solve assigned problems, to discuss and observe the similarities and differences of the geographically disparate locations, and to understand which aspects of engineering are ubiquitous and which are constrained or assuaged by site-specific attributes. The students will be divided into project groups, each made up of half MIT students and half U Tokyo students. The groups will work together using common information technology to complete course assignments and learning. Summer cross-internships will follow the Spring course, and subsequently, a framework for lifelong involvement and communication as advanced students and mentors.

The purpose of this curriculum is to teach the universal principles of engineering practice. History has shown that these principles are necessarily global in both content and context; and that they are multidimensional with technology, economic, social and political aspects. One of the best parallels to our purpose was enumerated by Norman Augustine, former CEO: Lockheed Martin:

- Emphasize the basics.
- Develop team skills.
- Teach the political process.
- Develop communications skills.
- Place greater emphasis on "Systems Engineering".
- Understand the internationalization of human activity.
- Open the doors wider to women and minorities.
- Commit to continuing education.

The success of this project is the inculcation of the above attributes into generations of students who will lead in the solution of global infrastructure problems together. The program elements of joint projects, student exchange and industry mentoring that are facilitated by a common information technology infrastructure are a modest beginning to achievement of that success criterion.

MITCET Proposal

Whereas the Engineering Process consists of 4 steps: 1) Learn the principles, 2) Design the experiment, 3) Apply methodology and achieve results, 4) Analyze and recommend action, it is in stages 2 and 3 that we feel we can be innovative. By crossing borders and through technology, we aim to explore new ways that the engineering process might be enhanced.

Meeting the Need: The Technology

We seek to construct a technology infrastructure consisting of a website for administration, teaching, resources (both reference and computational simulation), mentor participation and video/text/forum for conferencing students and teachers. Students of each course will integrate with the technology daily as a central hub of interaction and project development. Course progress and project-based learning results will be posted and communicated through blogs, wikis, document uploads, lecture videos, and interactive media. We aim to also establish similar resources for the interaction, contribution, and communication with industrial mentors.

Technology-assisted interaction will take place in two formats: fixed and interactive. The fixed forms of course media will include slide-sets, assigned reading in texts, and digital lectures. Interactive forms will include wikis, blogs, Skype video, and bulletin boards. We also aim to explore the possibility of supporting technologies offered through the iCampus initiative, such as remote labs, computer simulation tools, sketch tools, and other teaching tools.

The fixed media are traditional in nature and will provide a staple of class structure. In order to synchronize the curriculum in multiple university locations, we hope to consult the expertise of other faculty with experience in linking international institutions. In particular, we plan to seek the guidance of Prof. Linn Hobbs (DMSE, MIT), whose experience with the University of Surrey and the MISTI program would be invaluable. It is our hope that he will act as an "angel" that reviews both curricula and aligns and amalgamates each into one body. Guest lectures will be webcast live and made available on MIT World (see examples from last year: http://mitworld.mit.edu/series/view/124). Complete files of all guest lectures will again be made available on MIT World or another campus media venue. We seek the technical support of AMPs and/or OCW for the video recording and production of all course lectures. We also aim to capture archival versions of the course to be made available on Open Courseware. These venues will be important in maintaining a library of documents and references for the course.

The more lithe, active component of the course will be contained in a dynamic website that houses multiple modes of technology interface. Basic communication between the international groups of students will take place via blogs, a wiki, and Skype-type chat applications. At times, we hope to schedule opportunities for the students to talk with each other in real-time. For these occasions, they will be scheduled in the morning in Tokyo and early evening in Cambridge. The mode will likely be a form of video conferencing, as we feel it is important for the students to "meet" at least once or twice in the duration of the course. For the remainder of the time, students may use blogs and wiki innovation in order to maintain conversation threads regarding their joint projects. This technology will allow for the challenging time shift the students face. In other words, one student in Tokyo may pose a question on the wiki in the morning Tokyo-time, and another student may answer it morning Cambridge-time. While this is an existing technology, it does help maintain connection among students, in addition to avoiding mass emailing and "reply all" methods of communicating to a broad audience.

Lectures will also be videotaped and made available to each site within the timeline of the course. While we envision a shift in the curricula due to semester shifts, the taping of lectures will enable us to offer a time-shifted, as well as a semester-shifted course. In other words, because the UT semester begins in

MITCET Proposal

April, and the MIT semester begins in February, we face a challenge in hosting a "simultaneous" shared curriculum. However, by digitally recording the lectures and making a portion of the course modular in nature, we are able to offset the curriculum by roughly 6 weeks. If MIT World is unable to produce digital files of lectures within this time-frame, we will pursue alternative options on campus, for example TechTV, AMPs or OCW. A detailed chronology of the program is described below.

The digital lecture files, as well as the other above-mentioned media will be hosted on a centralized website, with restricted access to only class participants and supporting groups. We intend to seek the guidance and material support of the Office of Education Innovation and Technology as well as projects such as the Technology-Enabled Active Learning initiative within iCampus, for assistance in constructing this website. We also hope to learn about the possible opportunities xTutor and Magic Paper might offer in terms of a framework website and drafting/sketching technologies, respectively. We feel that these existing technologies could offer added value to a *glocalized* course, specifically where a time and semester shift is involved. It also our intention to discuss with the teams at OEIT and others about possible new technologies that might be customized to achieve our goals.

Below are excerpts from websites from the above-mentioned initiatives that we feel match our vision:

OEIT
The Office of Educational Innovation and Technology engages with the MIT community to develop, disseminate and advance the sustainability of educational innovations through the strategic use of technology.

OEIT channels its energies into three broad areas to reify educational opportunities enabled by technology.

- Bridging research and learning - leveraging innovative tools to bring the practice of research to the process of learning.

- Linking content to the curriculum - providing leadership and coordination of activites that address how digital content is integrated into teaching and learning.

- Fostering communities of innovation and practice - supporting communities of common interest centered around specific technology solutions, such as visualization, active learning, emerging pedagogies, etc.

iCampus
The iCampus Outreach Initiative disseminates innovative educational technology tools that can make a significant, sustainable difference in how students learn, remember, and shift from absorbing facts and concepts to creating new ideas and solutions themselves. With generous support from Microsoft Research, iCampus Outreach seeks higher education institutions looking to adopt new educational tools, and provides the software, supporting documentation, and guidance to assist in the successful implementation of these tools.

--The individual initiatives we are specifically interested in include, but are not limited to:

TEAL
Technology-enabled active learning is a teaching format that merges lectures, simulations, and hands-on desktop experiments to create a rich collaborative learning experience. TEAL classes feature:

** Collaborative learning—students working during class in small groups with shared laptop computers*
** Desktop experiments with data acquisition links to laptops*
** Media-rich visualizations and simulations delivered via laptops and the Internet*
** Personal response systems that stimulate interaction between students and lecturers*

iLabs
Online laboratories (iLabs) are experimental facilities that can be accessed through the Internet, allowing students and educators to carry out experiments from anywhere at any time. Remote labs enrich science and engineering education by vastly increasing the scope of experiments that students have access to in the course of their academic careers. Harnessing the Internet, MIT's iLab middleware enables students to use real instruments, rather than simulations, via remote online laboratories using their browser. Unlike conventional experimental facilities, iLabs can be shared and accessed widely by students and other audiences across the world that might not otherwise have the resources to purchase and operate costly or delicate lab equipment.

PREP
Peer-Review Evaluation Process, is a design methodology for use in teams. It is a process by which four to six individuals develop ideas and then share them as a team, so that the team can then select the best idea. It has been used successfully at MIT in Mechanical Engineering Course 2.007, in which students design and build robots for a competition held each spring. The PREP process may be done manually, or it may be done in a web-enabled version written on top of Microsoft SharePoint.

Magic Paper
The Natural Interaction research project (formerly Magic Paper) enables a novel form of interaction with software, making it possible to describe things by sketching, gesturing, and talking about them in a way that feels completely natural, yet have a computer understand the messy freehand sketches, casual gestures, and fragmentary utterances that are part and parcel of such interaction.

Cross-Departmental Support

Due to the potential widespread appeal of our *glocalized* classroom model, we hope to establish a form of curriculum that might be applied to subsequent courses within and extending beyond the School of Engineering. For that purpose, we are seeking the support of the Department of Materials Science and Engineering, as well as the Dean's Office of the School of Engineering. It is our hope that once the basic infrastructure is constructed and deemed successful, the above-mentioned offices will supply additional funding to extend our curriculum to other courses. Consideration for a possible larger-scale impact includes the adoption of this model to other universities within the United States and abroad of a third and fourth geographical location (currently being considered: University of Ghent and components of the Singapore/MIT Alliance). In addition, we have secured in-kind support from the MISTI office to aid in the preparation of MIT and incoming foreign students to the cross-cultural elements that might affect our students. Details follow.

In later iterations of the *Glocalized Classroom*, we envision a stepped curriculum of courses, following the same themes of engineering principles, but with options stretching across departments while

simultaneously potentially fulfilling degree requirements for departmental majors. Possible course offerings include environmental sustainability and engineering economics. It is at this level, where we aim to introduce a European location. Additionally, once a student has taken 3.003J at his or her host institution, the following class may be taken abroad. In other words, any student at any of the sites will have the choice of location and the option to study abroad. For the MIT students abroad, daily and/or weekly interaction with MIT will support a consistent collegial allegiance, thereby upholding the vigor and focus of his or her MIT academic path. Frequent monitoring, written and oral student reports and posting by faculty in addition to the mentor system will provide traveling students with a link and communication channel with their advisors.

MISTI

The MIT International Science and Technology Initiative (MISTI) has a long-standing dedication to aiding the transition of MIT students as they travel abroad by providing guidance in cultural and pedagogical differences, practical suggestions for navigating foreign lands, and maintaining a link to home for students abroad. The Japan Program within MISTI is the longest-running program, in operation since 1981, consisting of internships abroad, workshops, pre-travel coursework, and informal Japanese luncheons at MIT. MISTI, and specifically, Daniela Reichert, the Japan Program Coordinator, is committed to supporting the MITCET-funded *Glocalized Classroom Initiative*. Prior to travel to Japan, the MISTI program will host a presentation where they will brief the MIT students on what to expect and how to prepare for an internship abroad. MISTI has also offered to help establish a peer network of alumni who have previously traveled and studied in Japan and link them with current students. This dovetails harmoniously with MISTI's alumni network, as well as this proposal's goal to provide multi-year mentorship among students.

MISTI will also welcome all 3.003 students to attend their 2-day retreat in January on how to work in a Japanese research / industry community. This is hosted on MIT campus annually and supported through MISTI funds. Thirdly, MISTI offers a Spring Training Session, offered once per week during Spring semester from 5:30 – 7pm, and has generously offered to extend an invitation to all 3.003 students to attend at no cost.

In a discussion with Ms. Reichert regarding potential challenges that cross-international groups face, she identified a need in the inherently different cultural styles between Japanese and American students and how that can impact classroom interactions, where American students tend toward a vocal and interactive style of participation, and the Japanese students tend toward a more reserved and formal participation. Reichert recommends a facilitator to help bridge these two styles and teach the students to appreciate and foster the other culture's approach. Again, the goal being celebration of unique contributions, within a global setting. Through the MITCET funding, we hope to explore how technology might aid in bridging these cultural norms, perhaps through software adaptations in real-time exchanges that allow a prescribed number of vocal contributions.

Assessment Plan

Guidelines for the measurement and assessment of specific and achievable goals have become increasingly important within the teaching environment. In order to establish whether students are receiving the full benefit of the learning experience proscribed in ways that are matched to the intent of the teaching institutions, many governing bodies have indicated a need for a precise method of accounting for the learning milestones and desired outcomes, beyond standard evaluation methods. Therefore, we intend to consult the Technology Learning Lab within the Department of Undergraduate Education for their expertise in current and exploratory methods of assessment. It is our hope that through cooperative

consultation, they will outline a model for assessment that is catered to our scenario. The goal of the assessment will include:

1. Clearly defined goals for student learning, the measured success of project-based learning
2. Demonstrated understanding of Engineering Principles
3. Identification of unforeseen challenges in collaboration across distance
4. Mediation of cross-cultural challenges that were predicted
5. Assessment of the benefit of an international student base to each set of students
6. Identification of universal engineering problems / solutions and site-specific challenges / solutions.
7. Suggestions for future courses based on execution and evaluation of the initial model course

The TLL offers a wide range of teaching support that we hope to apply. These include:

Instructional Support

* *Workshops in teaching and learning*
* *Individual consultations*
* *Classroom Videotaping Program*
* *Support for educational innovation*

Research

* *Cognitive behavior*
* *Interdisciplinary education project*
* *Small group pedagogy*

Assessment

* *Innovations in pedagogy*
* *Educational technology*
* *Learning space*

MITCET Proposal

Course Chronology – Milestones

Description
It is anticipated that freshmen will take the initial course offering as a 9 (1-2-6) unit 3.003J at their host institution in the Spring semester. Their first exchange travel will commence during the following summer session as part of Year 2.

The Fall semester of Year 2 will feature Year 1 students mentoring of incoming students in a 4 unit global seminar. In brief, Year 1 will physically set up the relationship with the partner University of Tokyo, synchronize the curriculum within their platform, and build the common technology infrastructure that will host all communication. If granted, Year 2 will see the half the MIT students and half the UTokyo students: i) travel to partner institution for project follow-up and a course-related internship, ii) return to home institution to participate in a global seminar offering as the next step in developing an integrated and active mentorship for Year 2 incoming students, and iii) the spring offering of 3.003J. Initially, the Fall seminar will link generations of students, and beyond Year 2 we anticipate a 3.004J, etc. offerings for sophomores, upperclassmen and graduate students to evolve.

Goal of Large-Scale Impact: To offer a series of engineering courses from Freshman to Graduate, taught locally and globally, with joint curricula and joint international student groups interacting through an advanced technology infrastructure, and supported by a tight network of cross-year mentorship.

Year One

June 2009:	Begin website construction and curriculum alignment.
Summer 2009:	Travel to University of Tokyo to set up program.
September:	Complete design phase of website with OCW, OEIT, iCampus and IS&T.
November 2009:	Complete Beta version of website. Test-run site with external users.
January 2010:	Go-live of tested full-version site.
February 2010:	Begin MIT side of 3.003 course.
February 2010:	Prof. Wada, U Tokyo, visits MIT students to establish connection to Japan site.
February and March 2010:	MIT students design presentations on engineering principles to give to UT students upon their April semester start.
May 2010:	UT students present to MIT students on application of principles in context of class project.
June 2010:	MIT faculty visits Univ. of Tokyo to enhance connection to MIT site.
June 2010:	MIT course finishes.

Year Two

July 2010:	UT course finishes.
July/August 2010:	Half of MIT students travel to Tokyo; Half of UT students travel to MIT for follow-up on project work. Each group to meet with other half of class student body to remain at the respective home institution. Potential supplemental industry internship option. **Note: The summer travel is open to any generation of former 3.003 student*
Summer 2010:	Administrative evaluation of course assessment, recommendations for change.
August / Sept 2010:	Host Mentorship seminar and kick-off mentorship program.
September 2010:	Begin MIT side of 3.003.

MITCET Proposal

PERSONNEL

PI: Lionel C. Kimerling, DMSE

Key MIT Faculty: Anant Agarwal, EECS; Jesus DelAlamo, EECS; Gene Fitzgerald, DMSE; Linn Hobbs, DMSE; Randolph Kirchain, ESD; Silvija Gradecak, DMSE; Fred Salvucci, ECE; William Uricchio, CMS; Chris Weaver, CMS

International Senior Personnel: UTokyo: Kazumi Wada, Dept. Head of Materials Engineering; Prof. Toshi Koseki; Prof. Satoshi Watanabe, Prof. Toyonobe Yoshida; Prof. Toshio Suzuki

Program Director: Mindy Baughman

Support/Organizational Staff: Thomas Delaney, Writing Center; Lisa Page, DMSE; Daniela Reichert, MISTI; Staff at OEIT, TLL, DUE, IS&T

FUNDING – YEAR 1

Source	Expense	Target Amt
DUE	Base funding – logistics of set-up	$5,000
	Travel – 1 Japan site visit by Prog. Director	$3,000
	50% Program Director salary + EB & Vac Accrual	$41,000
	¾ month summer faculty salary + EB	$12,000
OEIT	Core website framework – design and construction	tbd
OCW	Video conferencing	tbd
IS&T	In-kind technical support	
		$61,000