

**A Proposal for a Masters of Engineering Degree in Systems Engineering
Taught Using Distance learning
(DL MEng in SE)**

Proposer/Contact Information

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Program Information

	Current (if any)	Proposed
Program Title (i.e., major field; major subject)	Systems Engineering	Systems Engineering
Award (e.g., degree; certificate):	Master of Engineering	Master of Engineering
HEGIS Code:		
Program [SED]Code:		

I. Proposal Narrative

1. Purpose

The purpose of this proposal is to gain approval to award the Master of Engineering (Systems Engineering) degree, an existing graduate degree, on the basis of courses taken in a distance-learning format, along with a small but critical face-to-face component.

2. Background and Motivation

"I would found an institution where any person can find instruction in any study."
Ezra Cornell, 1865

There are approximately 73,000 Bachelor's degrees in engineering awarded in the U.S. annually, and about one-half as many Master's degrees. However, the Master's degree is increasingly viewed as the requirement for effective professional practice in engineering. In recent years, this position has been espoused very directly by several of the major engineering professional societies. For example, the American Society of Civil Engineers has adopted Policy Statement 465, which states, in part, "The ASCE supports the concept of the Master's degree or equivalent as the first professional degree for the practice of civil engineering at the professional level." The National Academy of Engineering Committee on the Engineer of 2020, Phase II also views the baccalaureate degree as a "pre-engineering" degree. They challenge the engineering profession to recognize and reward the distinction between entry level engineers and engineers who have "mastered an engineering discipline through further formal education." They state specifically, "Adequate depth in a specialized area of engineering cannot be achieved in the baccalaureate degree."

As more and more engineers pursue Master's level education, the demand for Master's programs is increasing and will rise dramatically in the coming years. Many of those prospective Master's degree students are engineers who already have professional jobs, and who want to pursue a professional Master's program without leaving their employment. For these mature students, part-time study, often based on distance learning, is a necessity.

Systems Engineering is a valuable discipline for Master's level study because many engineers from various undergraduate disciplines find that they are deeply involved in designing and implementing complex systems. Master's level study in that area can support their career goals and give them tools for continued improvement of professional skills. Thus, the Master of Engineering (Systems Engineering) degree program is an important place for Cornell to begin its offerings of distance learning based professional Master's study.

There is strong interest in this initiative from local companies that have international operations. For example, Steven Betza, the Director of the Engineering Leadership Development Program at Lockheed Martin in Owego, strongly supports this initiative (see attached letter). Companies like Lockheed Martin have a global perspective with engineers working in many different facilities around the world. To be an effective partner with such companies, Cornell also needs to have a global view of educational opportunities and offerings. Distance learning is a vital element of meeting their needs.

In addition to strategic partnering opportunities with major companies that employ thousands of engineers, there is also substantial evidence of demand for distance learning based Master's study by individual engineers in various locations around the U.S. and the world. This fall alone, we have received inquiries from more than 100 engineers looking for a distance learning Master's program in Systems Engineering. At present, we are forced to respond that we do not offer such a program. We believe it is in the University's interests to respond more positively to the demand for this type of Master's study. Furthermore, we believe that this type of program can be created in a way that has the full rigor and educational value of the on-campus offerings.

3. Cornell Systems Engineering Program History

The Cornell Systems Engineering Program is designed to promote an understanding of the Systems Engineering process throughout an organization enabling our students to better design and manage complex systems that will evolve over their life cycle. The program is designed to help engineering professionals make trade-off decisions in high-risk environments and to make the transition from managing independent engineering projects to creating globally optimized integrated solutions to meet customer needs.

Founded in 1999, the Cornell Systems Engineering Program grew out of strong corporate interest from General Motors, the Xerox Corporation, Applied Materials, and Lockheed Martin. Based on continued feedback and input from industry, our course content and curriculum continue to evolve and are designed to be highly responsive to industry needs

The Systems Engineering Program quickly developed two courses in systems engineering and made these available to the sponsoring companies via distance learning. In particular, the commitment of General Motors to these initial offerings was critical to their success. In 2001, the Program instituted an on-campus Master of Engineering degree program. In 2003, the Program created a one-week short course in systems engineering fundamentals. In 2004, the Program created a Minor in Systems for M.S. and Ph.D. students. In 2006, the program started offering a third course in systems engineering, emphasizing the role of reliability in the design and operation of complex systems. Since 1999, over 800 students have had significant exposure to the concepts of systems engineering through these offerings.

4. The Systems Engineering On-Campus Degree Program

The Systems Engineering Program emphasizes the fundamentals of requirements analysis, systems architecture, product development, project management, operations research, optimization, simulation, systems analysis, integration and verification. The program's strength in these areas helps promote an understanding of the systems process throughout an organization and prepares students to transition from designing and managing independent engineering projects to creating integrated solutions that meet customer needs. Courses are offered via traditional in-classroom delivery as well as distance learning and online options--all designed to meet a student's particular needs for enhanced learning.

The Master of Engineering (Systems) is designed for students who want to specialize in Systems Engineering. It presently requires a minimum of thirty credit hours. Students must complete the following required ("core") courses:

- Applied Systems Engineering (3 credits)
- Systems Architecture, Behavior, and Optimization (3 credits)
- Project Management (4 credits)
- Systems Engineering Project (6 – 8 credits)

Approved electives account for the remaining credits to reach the minimum of 30 credits required for the degree and are to be chosen from the following areas:

- Systems Modeling and Analysis (at least 1 course): Courses that enrich the understanding of generic methods to design and analyze systems including courses in simulation, feedback and control, decision-making, reliability analysis, and risk analysis.
- Systems Applications: Courses that provide depth in the design and operation of specific systems such as power, communication, software, manufacturing, and transportation.
- Systems Management (at most 1 course): Courses that enhance student understanding of the management activities and processes which are necessary to successfully design and operate systems.

5. Suitability of the Systems Engineering Curriculum for Distance learning

The Systems Engineering core courses are well suited to being taught in a distance-learning format. There are no laboratory experiences requiring specialized equipment and no computer experiences requiring site-licensed software. Much of the material is methodology-oriented and lends itself to traditional lecture-style presentation. These lectures can be recorded and transmitted asynchronously.

Delivery of Systems courses via distance learning does pose a few challenges. There are experiential exercises in the Project Management course that cannot be taught through distance learning. However, by reorganizing the curriculum, these course components can be delivered using face-to-face short courses. There are also required collaborative experiences, such as the Systems Engineering Project, that are more difficult to replicate for off-campus students. However, the College of Engineering has already surmounted this challenge by pioneering the facilitation of geographically dispersed teams and providing the technology to support collaborative workgroups in real-time.

6. Target Population

Need, nature, and extent

The target population for this degree program are young working professionals who satisfy the admission criteria for the MEng in Systems Engineering but who cannot afford to interrupt their careers for full-time, on-campus graduate study. These are typically mature students who have at least one year of work experience when they begin their graduate work. We have many years of experience in working with such students through our relationship with Lockheed Martin – Owego. Our initial target geographical area is New York State but there is already interest from Lockheed Martin for us to consider an international audience consisting of facilities in Canada and the UK reporting to the Owego site.

Demonstrated interest

Steven Betza, Director of Engineering Leadership Development for Lockheed Martin Systems Integration – Owego, has written a strong letter of support for this proposal. We currently have 260 inquiries on file from students seeking to find a distance learning Master's degree program in Systems Engineering. There were 100 inquiries in the Fall 2006 semester alone. Additional letters of interest and support are attached to this proposal.

7. Technology and Facilities

By distance learning, we refer primarily to the transmission of on-campus lectures to remote sites, and the facilitation of faculty-student interaction by electronic and other means. There are numerous proven technologies to support distance learning and new technologies continue to evolve. The SE Program currently offers courses with both synchronous (two-way live audio and video) and asynchronous (web-based video-streaming) delivery methods. Web-based course administration tools (the Blackboard course management system) are used extensively. Courier services are used for the timely delivery of dated confidential materials such as exams.

The University has invested in excellent distance learning facilities in Ives Hall. These facilities are well staffed and are adequate to support a limited distance learning degree program.

8. Face-to-Face Instruction

The distance learning degree program shall include a minimum of two weeks (ten days) of face-to-face interaction with classmates and Cornell faculty. The two weeks are not required to be contiguous. They may be conducted on-campus or at a remote site. The purposes of this requirement are to:

- initiate new students into the program,
- facilitate the networking and bonding of classmates within a cohort,
- establish standards for performance,
- create a sense of identification with the institution of Cornell University,
- complete the team-based experiential learning components of the on-campus program, and
- conduct project presentations and project evaluation.

The face-to-face instructional component shall be designed to satisfy two credit hours of the degree program.

9. Equivalence

Equivalence of Rigor and Quality

All distance learning courses offered by Cornell for academic credit shall meet the same standards for rigor and quality as on-campus courses and shall be taught by Cornell faculty.

Distance learning degree students seeking academic assistance in their courses shall have access to teaching assistants and faculty comparable to their on-campus counterparts.

Equivalence of Respect

Distance learning degree students shall be considered to be fully matriculated graduate students of Cornell University, with full student privileges, rights, and responsibilities.

All credit-bearing distance learning courses shall be viewed as equivalent to on-campus versions of the same course. Graduate degrees granted shall not bear any distinction as to the manner in which credits were earned (distance learning or on-campus).

10. Assurance of Academic Integrity

The SE Program shall obtain third party verification of academic integrity observed by the student in the off-campus completion of exams or major assignments for each Cornell course in the degree program.

11. Admission and Enrollment Criteria

The basic admission criteria for the on-campus and distance learning degree programs shall be the same; however, applicants must document at least one year of work experience in a relevant field to be eligible to enroll in the distance learning degree program. All successful applicants will have, as a minimum, a baccalaureate degree in engineering, mathematics, or science, conferred by an accredited college or university. Additional selection criteria may apply for enrollment in the distance learning degree program.

The SE Program reserves the right to restrict distance-learning enrollments based on program capacity, the geographical location of the student, and the technical or administrative capability of the program to provide adequate service to the student.

Students eligible to enroll in the distance learning degree program shall be admitted into the degree program using the same process as on-campus MEng applicants and may opt to enroll in either the distance learning program or the on-campus program. With sufficient advance notice, matriculated distance learning degree students may also transfer into full-time on-campus study at the beginning of any semester of their study.

12. Distinctiveness (from on-campus and undergraduate instruction)

It is understood that the residential experience is central to the Cornell undergraduate degree. There is no intent to replace or erode the undergraduate residential experience with this proposal.

On-campus undergraduate students are excluded from core SE courses except by permission of the instructor. The pre- or co-requisite for enrollment in a core SE course is a significant experience in a team-based project. There are a small number of seniors who satisfy this requirement and are admitted to these courses. Undergraduates shall not be permitted to register for the distance learning versions of these courses.

Lecture attendance and class participation is required of all on-campus students in core SE courses. Typically, a portion of the grade is reserved for class participation. An exception is granted for graduate students pursuing the Minor in Systems Engineering who experience course conflicts between classes in their home department and core, non-experiential courses (SYSEN 510, SYSEN520) required for the minor. In this case, and

with the written permission of the student's graduate committee chair and the instructor, the student is allowed to participate in the distance-learning course.

13. Policy on Re-use of Recorded Lectures

Recorded lectures are intended for use by students only within the semester in which they are delivered. At the end of each semester, distance-learning students shall be required to delete or dispose of any copies of lectures they may have made during the semester.

Recorded lectures, or portions thereof, may be used in other graduate courses with the approval of the originating faculty member.

14. Ownership of Course Materials

Course materials developed for use in a distance learning course shall be subject to the same ownership policy as materials developed for use in traditional on-campus courses.

15. Tuition and Fees

All students in the Systems Engineering degree program, both the on-campus and the distance learning variants, shall enroll and be registered in the Graduate School as fully matriculated students in the MEng degree program.

Students in the distance learning degree program shall pay tuition and fees pro-rated on a per-credit hour basis and shall be enrolled for a minimum of three credit hours per semester. The distance-learning student is expected to complete the degree requirements within five years. In special circumstances, the student may request a leave of absence. The degree requirements must be satisfied within seven years.

Students in the distance learning degree program shall be charged tuition and fees at a College of Engineering Special Program rate. This rate shall include a distance learning technology and administration fee.

Distance learning students shall be exempt from the requirement of purchasing health insurance.

16. Program Review

In the fourth and seventh years of operation, the Systems Engineering Program shall undergo an academic review with oversight by the Faculty Committee on Program Review (FCPR). The first such review shall be a self-study. The second review shall include an external review. The Systems Engineering Program shall maintain annual and cohort-based statistics of enrollments and student academic performance to facilitate these reviews.

17. Faculty Professional Development in Distance learning

The University shall provide resources sufficient for faculty to develop their teaching skills and adapt their curricular materials to succeed in distance education.

Course Development Support

The SE Program typically provides teaching assistant support to a faculty member in the field of Systems to assist in creating a distance-learning course or in converting an

existing on-campus course to support distance learning. This support is provided at least one semester in advance of the first scheduled distance-learning offering.

Faculty Rewards and Compensation

Teaching a distance-learning course is more demanding of the faculty member than teaching the same course on-campus without the distance component. Course administration is more complicated and an extra effort is required to keep off-campus students as engaged in the learning process as on-campus students. For this reason, it is typical for the SE Program to provide faculty in distance learning courses with support and/or compensation in excess of that provided to other faculty. This support or compensation may consist of (and is not limited to):

- Team teaching assignments or a lighter course load;
- Support for graduate students;
- Extra salary compensation.

In addition, there exist numerous other opportunities for faculty to enhance their skills and to mount new distance learning courses. These include support from the School of Continuing Education and Summer Sessions and from Faculty Innovation Grants.

Cornell SCE Support

Faculty developing distance learning courses for the SE Program will be supported by the Cornell School of Continuing Education and Summer Sessions with a range of support services:

- determining technological needs,
- organizing non-academic production components of the course,
- resolving copyright issues,
- creating a marketing plan, and
- coordinating resources for the improvement of online teaching skills.

Cornell Faculty Innovation Grants

“The Faculty Innovation in Teaching (FIT) program is part of a larger distributed learning initiative supported by the President and the Provost. The program is designed to allow faculty to develop innovative instructional technology projects that have the potential to improve the educational process.

The program provides faculty with the technical staff and other resources necessary to plan and implement their projects, thus allowing faculty to focus on their pedagogical objectives.

The Provost has funded a number of staff within CIT’s Academic Technologies & Media Services division whose explicit focus is to support these innovation projects. Project support comes primarily in the form of the development services required to turn faculty ideas into reality. These services are coordinated by CIT’s Academic Technologies & Media Services staff in collaboration with campus partners, such as the Library and the Center for Learning and Teaching. Funds have also been made available for the purchase of hardware, software, and other technical services/assistance that might be required. Support is also available for faculty release time.

It is a goal of the Faculty Innovation in Teaching program to support the cycle of innovation beyond implementation of individual projects. Faculty will be encouraged to participate in program activities that promote scholarly discussion of the relationship between pedagogy and technology, and to share information with the larger Cornell teaching community.

Scheduled Special Interest Groups and other avenues of communication are intended to support faculty in identifying best practices and technology solutions that merit further exploration. These and other forums will be available for faculty to share their experiences, explore evaluation findings and make recommendations regarding the future direction of instructional technology at Cornell.”

Source: <http://www.innovation.cornell.edu:5000/fig/content/about>

18. Benchmarking

Johnson Graduate School of Business

Boardroom Executive MBA Program

“The Cornell Boardroom Executive MBA program is delivered over 17 months in a combination of residential sessions and videoconferencing-based boardroom sessions. The three residential sessions are each between 10 days and two weeks in length and held on the campuses of both Cornell University in Ithaca, NY, and Queen's University in Kingston, Ontario. In addition to these residential sessions, the international collection of Boardroom Learning Teams is connected via a multi-point, interactive videoconferencing network for boardroom sessions. These are held on sets of three consecutive Saturdays with the fourth Saturday off.... The Global Business Project's one-week field study rounds out this learning experience.”

“Program participants within one city are organized into Boardroom Learning Teams, typically comprised of six to eight individuals. Each team is assigned a boardroom location in its home city, and these teams stay together for the entire length of the program.”

“For the class starting in July 2006, we are targeting selected sites in New York State, Ohio, Washington State, and Washington, D.C. for Boardroom Learning Teams.”

“The bottom line: this team-based, technology supported program allows you to earn prestigious dual degrees in just 17 months - without sacrificing the quality of the learning experience and without interrupting your job or life.”

Source: <http://www.johnson.cornell.edu/academic/boardroom/format.html>

Columbia University

Columbia Video Network

“Columbia Video Network (CVN) [is] the graduate distance learning program of Columbia University's School of Engineering & Applied Science (SEAS). CVN enables students globally to pursue residency-free, fully accredited engineering courses and degree programs completely via the Internet, allowing students to view their lectures anytime and anywhere.

“Graduate Degree Programs are fully accredited by the Middle States Commission of Higher Education.

“Columbia Video Network (CVN) brings graduate engineering education to you through distance learning. Students earn the same credits and degrees as their on-campus counterparts without actually coming on campus.

Columbia Departments Offering Masters Degrees

- Applied Mathematics
- Biomedical Engineering
- Chemical Engineering
- Civil Engineering
- Computer Science
- Earth & Environmental Engineering
- Electrical Engineering
- Industrial Engineering Operations Research
- Materials Science and Engineering
- Mechanical Engineering

Lecture Delivery Method

“Columbia Video Network lectures are delivered via Internet with both streaming media and download options. Lectures are asynchronous, which means that they are recorded and generally posted to the Internet the same day the class meets. Students interact with professors and teaching assistants primarily by e-mail. Professors and their teaching assistants may also establish telephone "office hours" for consultation.

Homework and Exam Submission Method

“Homework assignments are posted in CVN's Student Center, where students can retrieve it via the Internet. To submit finished homework, students either upload or fax their work to CVN using a customized fax coversheet. The homework will then be automatically posted to CVN's Student Center for viewing by both the instructor and the student. CVN students can view their own homework posted online, so safe transmission is self- confirming.

“Instructors return assignments and exams to students through the same method. In this way, students can view the instructor's handwritten comments and corrections.

Exams

“Students choose a proctor, subject to CVN approval, to monitor their test-taking. The exam may be taken at one's workplace or other suitable venue. On the day of the exam, and at the time specified by the instructor, the student's proctor will be able to download and print out the exam to be administered. After the test period is over, the proctor faxes the finished exam to CVN for auto-posting to the CVN Student Center.

Equivalence

“When you are a CVN student, you ARE a Columbia University student. Because you will take the same classes as on-campus students, do the same homework, and take the same exams, your degree, transcripts, and diploma are the same.

No Need to Come to Campus

“CVN students do not ever need to visit the Columbia campus, but they can if they wish. It is possible to sit in on a class, to meet your professor, and best of all, to walk with all other Columbia students on graduation day. In many ways, CVN's system offers the best of both worlds.

Columbia Program Costs

“Many CVN students are company sponsored, and CVN accepts a variety of tuition vouchers. The tuition for one credit hour (or one "point") is \$1122. The newly matriculating student also has some one-time charges, such as the transcript fee, which covers transcripts for the student's lifetime.

“Typical tuition for a newly matriculating student registering for a three credit course would be \$3366 + transcript fee \$75 (one-time) + video special fee \$55 (one-time) + online viewing \$350 = \$3846”

Source: <http://www.cvn.columbia.edu>

Georgia Institute of Technology

Program Description

“Georgia Tech offers seven M.S. degree programs via distance delivery. To enroll in the program, you must meet the same admission requirements as those who attend classes on campus. You will need to adhere to Georgia Tech's rigorous academic standards to earn the same degree as your on-campus counterparts. You may apply any time to Georgia Tech for admission the following term. Upon acceptance to the program, working engineers typically enroll in one course per term. Most companies provide tuition reimbursement for these classes.

“Most of the degree programs require thirty credit hours (typically, 10 courses) to obtain a master's degree. A thesis is not required, and you must maintain a 3.0 grade point average. Please refer to the websites of each of the programs for curricular details.

How the Program Works

“Courses are offered via the internet to off-campus students. Video cameras record faculty lectures and student-faculty interaction during regular graduate classes. These recordings can be viewed via video-on demand through the internet using WebCT or CD-Roms. Supporting class materials are also accessed through WebCT. Student-to-student and student-to-faculty interaction occurs using telephone, email, fax server, bulletin boards and the threaded discussion capabilities of WebCT.

“Georgia Tech offers approximately 65-70 courses each semester, except during the summer when a small number of courses are available. Check the Georgia Tech website for current and planned class offering.

“Access to the electronic library, the computer facilities of Georgia Tech, and the Internet is available to you with a home or business computer and a modem. Internet instruction includes links to other web-based materials and features the power and capability of Georgia Tech's sophisticated computer network. Student-to-student and student-to-faculty interaction occurs using bulletin boards and the threaded discussion capabilities of WebCT.

Participating Departments

“If you have been accepted into a Georgia Tech graduate program, courses can be applied toward a master's degree in the following areas:

- Aerospace Engineering
- Building Construction & Integrated Facility Management
- Electrical and Computer Engineering
- Environmental Engineering (MSEnvE)
- MS from Environmental Engineering
- Industrial Engineering
- Mechanical Engineering
- Medical Physics

Principles of Good Practice

“The Georgia Tech Distance Learning program adheres to the WCET Principals of Good Practice.

http://www.wcet.info/services/publications/accreditation/Accrediting_BestPractices.pdf

Equivalence

“The degree you earn through the Georgia Tech Distance Center for Distance Learning is a Master of Science degree exactly like the degree you would earn if attending courses on campus. There is no distinction between video and campus on your diploma.

Proctor

“Every semester all RGO and PDO/G students MUST select a proctor to administer, supervise, and authenticate that exams were taken by the student according to the guidelines established by Georgia Tech. All proctors will be approved by the Center for Distance Learning. If you do not have an approved proctor you will not receive exams.

GT Distance Learning Tuition

“Distance Learning tuition for 2006-2007 school year is \$801 per semester credit hour except Building Construction which is \$1156 per credit hour.”

Source: <http://www.cdl.gatech.edu/dl/servlet/DLHome>

Stanford University

Masters Programs at Stanford

“The Honors Cooperative Program (HCP) is the only part-time graduate program offered by Stanford University. It allows working professionals an opportunity to earn a graduate engineering degree through SCPD [Stanford Center for Professional Development] while maintaining employment.

“HCP students apply to the department in which they would like to pursue a graduate degree through the normal graduate admissions process, and compete with all other applicants for admission to the program. Once admitted, the HCP students implement degree study on a part-time basis through SCPD. HCP students are fully

matriculated graduate students of Stanford University, with full student privileges, rights, and responsibilities.

“HCP students must complete the 45 units of master's degree study in five years. They file study plans for their degree program, and are tested and graded to the same standards as on-campus students. Eighteen units may be transferred from the Non-Degree Option (NDO) to the HCP program.

To participate, industry students must have the support of their employer as a member company of the Stanford Center for Professional Development.”

Source: <http://scpd.stanford.edu/scpd/programs/mastersDegree.htm>

Member Companies Benefits

“The opportunity to participate in Stanford engineering classes for credit on a part-time basis is available to students whose employers are members of the Stanford Center for Professional Development (SCPD). [Membership benefits include:]

- “SCPD provides an easily accessible gateway to School of Engineering (SoE) education by world-renown faculty, to state-of-the-art research, and to emerging interdisciplinary programs.
- Access to Stanford courses supports technology transfer, and recruitment and retention efforts at member companies.
- SCPD is positioned to garner resources and support for newly emerging educational delivery technologies, coupled with the interests of faculty and customers, to improve engineering and technology management education.
- By outsourcing education and training administration to SCPD, companies reduce burdensome administrative tasks.”

Source: <http://scpd.stanford.edu/scpd/members/companies/>

Annual membership fees range from \$1000 to \$3000 depending on the number of employees in the company. Member companies agree to appoint an education manager and an administrative coordinator. Member companies also agree to provide exam monitors of suitable rank.

Stanford Departments Offering Masters Degrees

- Aeronautics and Astronautics
- Applied Physics
- Biomedical Informatics *
- Chemical Engineering
- Civil and Environmental Engineering
- Computer Science *
- Electrical Engineering *
- Management Science and Engineering *
- Materials Science and Engineering
- Mechanical Engineering *
- Statistics

* Departments offering master's degrees that may be completed entirely online.

Other departments offer a range of courses that are broadcast, but still require some attendance on campus for degree completion:

- BioMedical Informatics

- Computational and Mathematical Engineering
- Education - Learning Design and Technology

Stanford Delivery Technology

“In order to meet the varying locations and scheduling needs of its students, SCPD delivers its courses in a variety of formats, including the following:

- “Stanford Online: delivered over the Internet via streaming media, courses are posted online within two hours of the live Stanford University course concluding.
- Broadcast: transmitted through microwave technology, SITN broadcasts up to 75 courses a quarter, both live and tape-delayed.
- Two-way Video: using videoconferencing technology, students can participate in two-way compressed video

“Member companies within an approximate 35-mile radius, ranging from San Francisco to San Jose, may receive the broadcast signals with the use of a simple roof-mounted antenna.

“A frequency-changer must be installed on the company's premises. It converts the microwaves to VHF TV frequencies and enables students to view the classes on standard television receivers.”

Source: <http://scpd.stanford.edu/scpd/about/delivery/>

Tuition and Fees

Students in the Honors Cooperative Program pay \$1,240 per unit (3 unit minimum) for the 2006-2007 Academic Year. HCP students must enroll for a minimum of 3 units of coursework each quarter, unless they have been granted a Leave of Absence. There is an additional one-time \$80 document fee and a per-quarter Associated Students of Stanford University fee of \$30. Total tuition and fees for 45 units is estimated to be \$56,330.

University of Southern California

DEN (Distance Education Network)

“Established in 1972, the USC Viterbi School of Engineering's Distance Education Network was a pioneer in the distance learning arena, utilizing the most cutting-edge technology to enable professional engineers to take USC engineering courses for graduate degree credit without having to set foot on the campus.”

“DEN offers over 30 Master of Science degrees to choose from - more than that of any leading research university.”

Source: <http://den.usc.edu/prospectives/overview.htm>

“DEN strives to meet the needs of engineering professionals, providing the opportunity to advance your education while maintaining your career and other commitments. By breaking down geographical and scheduling barriers, DEN allows you to take your classes anytime and anywhere.

How DEN Works

- “Courses are transmitted from studio classrooms at the USC campus via an Internet-delivery system. DEN students are viewing the same lecture as on-campus students.
- Students can view the courses live, or later at their convenience. Lectures are archived for the entire semester and can be downloaded.
- Live instruction is interactive - students can call by a toll free phone line to ask the professor questions, or use threaded online chat.
- Professors' in-class notes are digitized and posted so students can print them and watch the lecture.
- Homework is submitted by email or fax to the DEN Document Center.
- Exams are proctored at local testing centers (with the exception of Los Angeles based students, who are required to come to campus for their exams).”

Source: <http://den.usc.edu/prospectives/howdenworks.htm>

USC Master of Science Degree Programs – Online

“Each degree program [below] can be completed entirely online.

- Aerospace & Mechanical Engineering
- Astronautics and Space Technology Division
- Biomedical Engineering
- Chemical Engineering
- Civil Engineering
- Computer Science
- Electrical Engineering
- Industrial & Systems Engineering
- Materials Engineering
- Petroleum Engineering”

Source: <http://den.usc.edu/programs/degreeprograms.htm>

Tuition and Fees

Off-campus students pay \$1,151 per unit, plus a \$500 DEN fee per course and \$43 in student fees per semester, for the 2006-2007 Academic Year. There is an additional fee of \$25 per exam taken at a certified testing center. Total tuition for 30 units is estimated to be \$34,530. Fees for a five-year program are estimated to add \$6,180 to this for a total degree cost of \$40,710.

Corporate Partners

USC lists several corporate partners. In particular, “The Boeing Company has selected the team of the University of Southern California (USC) and the University of Missouri-Rolla (UMR) to provide its engineering employees with an opportunity to enroll in a graduate program in Systems Engineering.

“Boeing employees and its suppliers worldwide have the opportunity to earn a Master of Science degree or Graduate Certificate in Systems Architecture & Engineering.”

Source: <http://den.usc.edu/programs/boeing/index.htm>

II. Curricular Information

1. How many committee members will a student be required to have?
Master of Engineering students require only one committee member: their academic advisor.
2. How many registration units are required for your degree program(s)?
None. The Master of Engineering program is exempt from the requirement of registration units.
3. Will students be scheduling their exams with the Graduate School?
No. Master of Engineering students do not sit for graduate field exams.
4. Will students be required to submit a project (circle **yes** or **no**) or a thesis (circle **yes** or **no**)?
Master of Engineering students in Systems Engineering are required to complete a project. This applies to the current on-campus program and the proposed distance-learning program.
5. Will students submit their project or thesis to the field or to the Graduate School?
Students submit their project report to the field through the Systems Engineering Program Office. This applies to the current on-campus program and the proposed distance-learning program.
6. Will a master's degree be awarded to students who pass their A exams and continue on for the Ph.D. (circle **yes** or **no**)?
No. Master of Engineering students do not sit for graduate field exams.
7. Will a master's degree be available to a student who was admitted into a Ph.D. program but who will be not continuing on for the Ph.D. (circle **yes** or **no**)?
No. Not applicable.
8. Do graduates of your program qualify for professional licensure? (If so, which ones.)
No. Professional certification is available through the International Council of Systems Engineering (INCOSE).
9. Will the Papers Option be available to Ph.D. candidates? If yes, please describe.
No. Not applicable.
10. What is the effective beginning date of the proposed curricular change?
January 1, 2008.
11. How long will currently registered students (or students on leave) have to complete a degree under the current structure?
There are no currently registered students who are affected by this new program.

III. Student Enrollment and Funding

12. Describe the projected student enrollment over time and **indicate the sources and amounts of funding for those students for the duration of their degree programs**. Please address all costs associated with student enrollment (internal and external fellowships, assistantships, stipends, and financial aid) for both domestic and international students. **Note that the Graduate School can not provide fellowships or stipends for new degree programs**

Initial entering cohort is anticipated to be 15 students and increase by 5 per year. The students in the distance-learning program will be self-funded with assistance from their employers. The Systems Engineering Program does not require any form of fellowship to institute this distance-learning program.

IV. Program Format

13. If your proposal requires a change in format or delivery mode (e.g., distance learning), describe the availability of relevant courses, faculty, resources, or support services.

The degree requires 30 credit hours of instruction. Of those, at least two credit hours will be delivered in the form of face-to-face modules to be developed upon state approval of the curriculum. Seven credits will be delivered in the form of systems engineering project work supervised by Cornell faculty. The participating departments will be compensated for the faculty supervision time out of Program revenues.

The remaining twenty-one credit hours will be delivered by means of seven three-credit courses taught using distance-learning technology. Of these seven courses, five courses are already being offered in distance-learning format. They are:

- *SYSEN 511 Applied Systems Engineering*
- *SYSEN521 Systems Architecture, Behavior, and Optimization*
- *SYSEN531 Systems Engineering for the Design and Operation of Reliable Systems*
- *CEE691 Principles of Project Leadership*
- *CEE697 Risk Analysis and Management*

The program requires at least two additional three-credit courses within the College of Engineering to be converted to distance-learning format. These courses will be selected from the dozens of eligible electives across the College, with the participation of the home departments. Departments and faculty participating in distance learning will be compensated out of Systems Engineering Program revenues. The Systems Engineering Program and the College of Engineering will provide support for the conversion of courses to distance learning format.

Additional support services, as detailed in the proposal, include those provided by the School of Continuing Education and Summer School and those available through the Faculty Innovation Grants.

14. If your proposal is based, even in part, on distance learning technologies, please describe those and indicate the percentage of instruction that will be delivered through those technologies.

At most 28 credit hours of the required 30 credit hours for the degree will be delivered using distance learning. At least two credit hours are delivered in face-to-face instruction.

The current plan calls for twenty-one credit hours to be based on courses taught on-campus, to on-campus students, but made available to distance-learning students through various video technologies. The Systems Engineering Program uses both synchronous and asynchronous methods of delivery. Off-campus sites participating in synchronous delivery connect to the classroom using live, two-way audio- and video-conferencing capabilities. The course is delivered to both on- and off-campus students simultaneously and both groups are able to participate in the classroom discussions. Off-campus sites participating in asynchronous delivery view the lectures in a post-production interactive video available over the Internet, hosted by a Cornell website. The video is posted on the website within 24 hours of its delivery to an on-campus audience. In practice, the video is available immediately after the lecture is delivered and often while the lecture is still in progress. In the current technology, the video features a resizable video frame of the instructor speaking and a large image of the instructor's slides or drawing surface. The video is indexed so that the student can advance to or review any part of the lecture.

Project supervision will account for up to 7 credit hours. This will be facilitated by on-campus visits of the students, where possible, and by various technologies for remote design collaboration (teleconferencing, videoconferencing, shared websites, and Webex). The Systems Engineering Program will provide support to the supervising faculty to employ the technology that best meets the needs of the project.

15. If your proposal involves a change of (instruction) location, specify that location and describe the availability of relevant courses, faculty, resources, or support services.

This distance-learning program requires no change in location.

16. If your proposal involves a change in the program calendar -- from, say, two academic years to one calendar year -- describe that change in detail. Demonstrate that the program remains sound in terms of content as well as structure (i.e., minimum number of contact hours; required number of credits, courses, and registration units; availability of faculty, staff, and support services). Address the special needs of international students re: obtaining visas and compliance with all INS regulations. Address the resolution of grievances that might arise if, for example, a student can not meet the degree requirements in the allotted time because of program design.

The proposed degree program is equivalent to the existing on-campus degree program. The difference is that a majority of the credits may be taken in a distance-learning format.

To meet the needs of working professionals, it is essential that this program be offered as a part-time degree. This class of students cannot be expected to complete more than eight credit hours a semester. For job flexibility, the demands of travel and family life, the accommodation of corporate education schedules, and the scheduling of distance-learning courses it is necessary to allow for as few as three credits in some semesters. For example, because of the intensive nature of project work and the extreme

demands such projects sometimes place upon a student's time, some companies strongly discourage students from taking any other course in the semester they use to complete the project course. Also, until the College of Engineering portfolio of distance-learning courses expands beyond the minimum, some students may experience difficulty in scheduling electives to complete the degree.

Two- and three-year variants of the part-time degree program will be designed. The table below shows two possible variants that satisfy the requirements of the existing degree in part-time. The modules refer to the face-to-face short courses to be developed.

Year	Semester	Two-Year Program	Three-Year Program
1	Summer	Module 1 (0 credit)	Module 1 (0 credit)
1	Fall	SYSEN511 (3 credits)	SYSEN511 (3 credits)
1	Fall	SYSEN531 (3 credits)	
1	Spring	SYSEN521 (3 credits)	SYSEN521 (3 credits)
1	Spring	CEE691 (3 credits)	CEE691 (3 credits)
2	Summer	Module 2 (1 credit)	Module 2 (1 credit)
2	Fall	Elective (3 credits)	SYSEN531 (3 credits)
2	Fall	Elective (3 credits)	Elective (3 credits)
2	Fall	Project (2 credits)	
2	Spring	Elective (3 credits)	Elective (3 credits)
2	Spring	Project (5 credits)	
2	Summer	Module 3 (1 credit)	Module 3 (1 credit)
3	Fall		Elective (3 credits)
3	Fall		Project (3 credits)
3	Spring		Project (4 credits)

We propose a minimum of three credits per semester to permit the design of programs for different groups of working professionals and to accommodate the needs of students in exceptional circumstances. This would translate to the degree being completed in at most five years unless a leave of absence is granted. The maximum period of matriculation, including any leaves, shall be seven years.

The availability of faculty is not an issue for courses that are already offered in distance-learning format as part of the on-campus degree program. This includes SYSEN511, SYSEN521, SYSEN531, and CEE691.

The Systems Engineering Program is in the process of identifying faculty members to offer existing engineering electives in a distance-learning format. For the near future, arrangements will be made with individual faculty members and their department chairs. Professor Jery Stedinger is currently offering CEE697 (Risk Analysis and Management) in a distance-learning format. Professor Paul Francis has expressed interest in offering CS 419 (Computer Networks) on a one-term trial basis. The Systems Engineering Program offers support to faculty members and revenue sharing with their departments as compensation for the additional teaching effort required for distance learning.

The face-to-face modules will likely be offered during summer either immediately before the fall semester or immediately following the spring semester. The core faculty in the Systems Engineering Program has experience in developing and teaching short courses for industrial audiences. Responsibility for teaching these courses shall be

shared by the Systems faculty members of three departments (Civil and Environmental Engineering, Mechanical and Aerospace Engineering, and Operations Research and Information Engineering). The Systems Engineering Program shall compensate these faculty members for their summer teaching activities.

17. If you are proposing either a joint or dual degree option, additional information will be needed. Please contact the Graduate School.

Not applicable.

V. Staffing and Operations

18. Does your field faculty have endowed appointments only, contract college appointments only, or both? Will the field membership change as a result of this proposal? (If so, describe.)

The field has both endowed and contract college members. Field membership will not change as a result of this proposal.

19. Will any faculty need to make changes to their concentrations and areas of research as recorded on their faculty cards? (If yes, faculty cards on file with the Graduate School will need to be updated.)

No.

20. Comment on the need for additional staff, space and/or financial resources relevant to the implementation of your proposal and describe how you will meet those needs.

The Systems Engineering Program is administered jointly with the School of Operations Research and Information Engineering. The administrative manager is Jessica Best.

It is anticipated that an additional staff member will be hired into the Systems Engineering Program to provide teaching support services for the distance-learning program. The role of this individual will be to ensure that all matriculated part-time students in this program get access to the resources they need to be successful in their coursework. This will include, but is not limited to, access to the website for viewing video-streamed lectures, access to electronically mediated course management exchanges (ex. Blackboard), access to instructors and teaching assistants for resolution of educational issues, homework drop boxes, exam proctoring, and timely grading.

The Systems Engineering Program has prepared a budget for the incremental expenses required to mount this distance-learning degree program. The additional expenses, including technology costs, administration, staff, and revenue sharing with departments, are estimated to be \$315,000 per year. Depending on tuition assumptions, the break-even number of students to matriculate each year is under fifteen. The College of Engineering has approved the budget for planning purposes.

VI. Institutional Concerns

21. Comment on the University's institutional need for this change in, or addition to, the graduate curriculum.

At the Inauguration Ceremony of Cornell University, Ezra Cornell delivered a brief speech in which he said, "I hope we have laid the foundation of an institution which shall combine practical with liberal education, which shall fit the youth of our country for the professions, the farms, the mines, the manufactories, for the investigations of science and for mastering all the practical questions of life with success and honor. I believe that we have made the beginning of an institution which will prove highly beneficial to the poor young men and the poor young women of our country." Since the inception of this institution, there has been an egalitarian ideal together with the recognition of the importance of the practical arts in raising the material well being of its students. To hold to those ideals and yet to prevent part-time study at the professional masters level is incongruous. Wealthy students from around the world will continue to come and be educated at Cornell. The question is whether working professionals in our own state will have access to a degree from the College of Engineering. The technological problems of delivering education at a distance have been largely solved. It requires only the will to reach out and work with the potential students employed in the companies all around us, delivering a quality education in the practical arts to the best of our ability.

22. Describe the positive effects of this change on other fields or Cornell faculty.

Numerous faculty members will comment on the benefits of having mature students in the classroom. Infusing our classes with students who are immersed in the working world will enrich the experience of faculty and students alike. This initiative will increase the level of contact between the College of Engineering and technological companies in upstate New York.

23. Address the negative effects, if any, of this change on other fields or Cornell faculty and explain how those effects will be mitigated.

A common apprehension of distance learning is the extra effort required to teach in this format. While we believe some of this apprehension to be exaggerated, we do not deny that success in this format requires skill, preparation, and attention to detail. We believe that success in a distance-learning format also improves the experience for on-campus students. The Systems Engineering Program is committed to supporting faculty in distance-learning courses so that their experience is pleasant and their efforts rewarded.

24. In the event that your proposal does not receive approval, how [else] might you accomplish the goals it represents?

If the distance-learning proposal were not approved, but a part-time degree option were approved then we would seek guidance on the extent to which Cornell credits earned in distance-learning could be counted toward the satisfaction of the on-campus degree program. We would attempt to develop a part-time degree program with the maximum allowable distance-learning component.

If neither the distance-learning, nor the part-time aspect of this proposal are approved then we do not see a viable alternative to meeting the needs of working professionals in upstate New York for a professional degree in Systems Engineering. We

would find it necessary to direct their inquiries to other universities. We would continue to offer our distance-learning courses to be used as transfer credits into degree programs at other universities.

VII. Attachments

25. Attach a sample multi-year curriculum and schedule of course for the typical student enrolled in this program. Include evidence that minimum State requirements are met re: contact hours, credits, etc., if applicable

A sample two-year and three-year program curriculum is included in the text of our responses in section VI. Program Format, above.

26. List and describe new academic courses for which you will seek approval, if applicable.

The face-to-face modules will be developed upon approval of this proposal. The current plan is for three modules, totaling 2 credit hours. These courses will be submitted to the College of Engineering for approval.

Module 1 (3 days, 0 credits) Cohort orientation, instrumentation, course advising. This module would be taken before enrolment in the first semester in the program (August).

Module 2 (5 days, 1 credit) Systems engineering and project leadership. This module would be taken before the midpoint of program (May).

Module 3 (5 days, 1 credit) Systems architecture and integration. This module would be taken before program completion (May). This could include final project presentations.

27. Please include evidence of a faculty vote and address the results including the thinking behind negative votes or abstentions.

The Master of Engineering Committee approved the proposal in November 2006 by a unanimous vote.

The Field of Systems approved the proposal in December 2006 with 10 members of the field voting (all in favor).

The Engineering Policy Committee (EPC) reviewed the proposal and recommended its acceptance by the College of Engineering. The EPC presentation to the College of Engineering Faculty is attached.

The Faculty of the College of Engineering voted on February 6, 2007 in favor of the proposal (48 for, 15 against, 15 abstentions). Those opposed to the motion focused on the additional workload required to teach in a distance-learning format, the small number of courses currently available in a distance-learning format, and the inferiority of the distance-learning experience compared to on-campus learning. Those in support of the motion spoke of the enhancement to on-campus teaching provided when courses convert to distance-learning format, the needs of working professionals, the commitment of the Systems Engineering Program to quality instruction, and the need of the faculty to encourage new initiatives such as this.

27. Attach a current and a revised FIELD/Subject and concentration list if necessary.

The current curriculum requirements for the M.Eng. degree in Systems Engineering are listed in Section II. Proposal, Subsection 4, The Systems Engineering

On-Campus Degree Program. No change in curriculum requirements is proposed for the distance-learning form of the degree program. The two credit hours planned for face-to-face modules would be applied toward the four-credit Project Management requirement (to supplement the three-credit distance-learning course in Project Leadership, CEE691) and the elective portion of the degree.

28. Attach copy text for eventual publication on the graduate school website and on-line application.

The Systems Engineering Program emphasizes the fundamentals of requirements analysis, systems architecture, product development, project management, operations research, optimization, simulation, systems analysis, integration and verification. The program's strength in these areas helps promote an understanding of the systems process throughout an organization and prepares students to transition from designing and managing independent engineering projects to creating integrated solutions that meet customer needs. Courses are offered via traditional in-classroom delivery as well as distance-learning and part-time options--all designed to meet a student's particular needs for enhanced learning.

The basic admission and graduation criteria for the on-campus and distance-learning degree programs are the same; however, applicants must document at least one year of work experience in a relevant field to be eligible to enroll in the distance-learning degree program. All successful applicants will have, as a minimum, a baccalaureate degree in engineering, mathematics, or science, conferred by an accredited college or university.

The Systems Engineering Program reserves the right to restrict distance-learning enrollments based on program capacity, the geographical location of the student, and the technical or administrative capability of the program to provide adequate service to the student.

30. Attach evidence of support from all relevant faculty.

31. Attach support letters from your college Dean and others as relevant.

Forthcoming.

32. (For new major fields, new degree programs, or new academic initiatives): Provide the names and addresses of three [non-Cornell] professors who could serve as potential external reviewers if this is required by Albany.

Prof. F. Stan Settles, Professor of Astronautics and Industrial and Systems Engineering, University of Southern California

Dr. Cihan Dagli, Program Director, Systems Engineering Program, University of Missouri-Rolla

Dr. Richard Grzybowski, Research Director, Systems Engineering & Program Management, Corning Inc.

List of Attachments

- *Letter of support, Steven Betza, Lockheed Martin*
- *Letter of support, Randy Simpson, Schweizer Aircraft*
- *Letter of support, Tim Corsmo, Applied Materials*
- *Letter of support, Ed Alef, General Motors*
- *Presentation of Engineering Policy Committee to the College of Engineering Faculty, David Hysell, Chair.*

Lockheed Martin Systems Integration – Owego
1801 State Route 17C
Owego, NY 13827

October 30, 2006

Dr. Peter Jackson
Director, Systems Engineering Program
Cornell University
Rhodes Hall 218
Ithaca, NY 14853

Dear Dr. Jackson:

I am writing to express Lockheed Martin's support for a proposal to award the Master of Engineering in Systems Engineering degree (an existing graduate program) through courses taken in a distance learning format, supplemented by a small, but well selected, face-to-face component.

Since 2000, Lockheed Martin Systems Integration – Owego has enrolled over eighty (80) students in the Cornell MEng Systems Engineering program, and it is the cornerstone of our Engineering Leadership Development Program (ELDP). The quality of the Cornell SE degree is outstanding, as it: (1) builds a superior base in the theory and practice of Systems Engineering, (2) allows students to gain additional depth in their core discipline (e.g. ECE, MAE, etc.) through electives, and (3) includes an invaluable two-semester design project which we have tailored to model a real-world, full-lifecycle engineering program.

In recent years, Lockheed Martin has welcomed the addition of new courses and electives offered through distance learning (both synchronous and asynchronous), and the significant benefit that this has provided to our graduate students who balance a full-time professional work schedule with the completion of the MEng degree over a regimented three-year time period. These courses have allowed our students to participate in a "virtual" classroom with no compromise to course quality.

Awarding the Master of Engineering in Systems Engineering through distance learning (and a well chosen face-to-face component) is of mutual benefit to both Cornell and Lockheed Martin, including:

- The ability to expand our ELDP program to students in LM Canada and LM United Kingdom who organizationally report to Lockheed Martin Systems Integration – Owego.
- The ability to offer the Cornell MEng program to high achieving ELDP students across Lockheed Martin, with over 250 new Lockheed Martin employees selected for this program each year.
- The ability to offer a more flexible MEng program to non-ELDP Lockheed Martin employees who enroll and complete the program on a self-paced basis each year.

In summary, I would like to offer Lockheed Martin's highest recommendation for approval of this proposal to the Master of Engineering Committee and Cornell Senior Administration. This is a high-priority initiative for us, and a great opportunity to further expand our already successful academic-industry partnership. If I can be of further assistance in your evaluation, please do not hesitate to contact me at (607) 761-7353.

Sincerely,

(Signature on File)

Steven J. Betza
Director, Engineering Leadership Development
Lockheed Martin Systems Integration – Owego



SCHWEIZER AIRCRAFT CORP.
A Subsidiary of Sikorsky Aircraft

ELMIRA/CORNING REGIONAL AIRPORT
1250 SCHWEIZER ROAD • HORSEHEADS, NY 14845 USA

January 15, 2007

Professor Peter L. Jackson
School of Operations Research and Industrial Engineering
Rhodes Hall 218
Cornell University
Ithaca, NY 14853

Dear Peter:

Schweizer Aircraft Corp. is a rapidly growing aviation company located in the Southern Tier of New York. The company's primary focus is in the design and manufacture of rotorcraft and surveillance aircraft. The company also supports various internal and external cooperative research programs including the X-2 Technology Demonstrator Rotorcraft. Although the company has a remarkable 65 year history, it is poised for tremendous financial and technological growth in the upcoming years.

An area which has already seen tremendous growth is our Engineering Department. We have doubled our department's size and increased our technical capability markedly in the past four years. We currently have a department of 46 engineers and plan on further increasing the staff size to over 80 within the next three to four years.

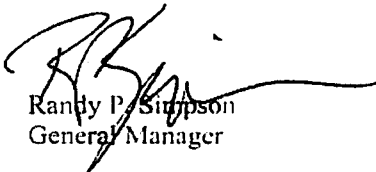
Schweizer engineering would like to expand its knowledge and capability in Systems Engineering. As our products and projects grow technologically and in complexity, the need for engineers qualified/educated in systems engineering has developed. We see the need for specific Systems Engineers and Systems Engineering training/education for many of our general staff.

During your recent visit we were excited to hear about your proposed Distance Learning (DL) Degree in Systems Engineering. We are very interested and would actively support such a program. We have several staff members who have already expressed/shown strong interest in such a program since they can further their professional education while staying on the job.

Please keep us informed of any progress in the program approval. We look forward to working with you and Cornell University on this and other endeavors.

Regards,

SCHWEIZER AIRCRAFT CORP.



Randy P. Simpson
General Manager

RPS/jb



Tim Corsmo
3050 Bowers Avenue
Santa Clara, CA 95054
January 4, 2007

Professor Peter Jackson
Director, Systems Engineering Program
School of Operations Research and Industrial Engineering
Rhodes Hall 218
Cornell University, Ithaca, NY 14853

Dear Professor Jackson:

As one of the corporate sponsors of the initial Systems Engineering distance learning program and a driving force behind the one-week short course, Applied Materials is committed to improving our Systems Engineering capabilities. As the company faces the challenges of an increasingly mature industry and fewer opportunities for technological differentiation in our core business, our ability to execute effectively becomes more and more critical to our success. Systems Engineering has become a core competency, essential to the attainment of our business goals.

The Applied employees who participated in the early ASE1 and ASE2 programs gave the courses high marks for relevance, quality and instructional excellence. The delivery medium was the only obstacle to greater participation by our Engineering community. With that obstacle removed, plus curriculum expansion to a full, advanced degree, the Cornell program will be the preferred solution for Applied Materials.

Applied Materials is very interested in a Masters of Engineering Degree in Systems Engineering that is delivered through distance learning. We look forward to the opportunity to again work with the Cornell team to further enhance our product development capabilities and productivity.

Sincerely,

T. J. Corsmo

Tim Corsmo
Head, Applied Global University

From: edward.r.alef@gm.com
To: pj16@cornell.edu
Sent: Wednesday, January 03, 2007 8:28 AM
Subject: Proposed DL Degree in Systems Engineering

Dear Peter,

It is well documented within the automotive industry that a solid organization capability in systems engineering is critical to compete in an intensely competitive global market.

The Cornell University course SYSEN511 Applied Systems Engineering has not only been endorsed by the GM Technical Education Program but as been subscribed by over 80- engineers. The GM endorsement and subscription can attest to the importance of this course and, more broadly, this discipline.

Further, we are in discussion stages with your university to bid on an additional course in this area for the Fall 2007 term which we are calling Vehicle Architecture.

I applaud your innovative efforts to work with industry in this very important discipline.

Thank you for the opportunity to support this academic effort.

Ed

Ed Alef

Technical Fellow - Education, GM Technical Education Program

Mailcode: 483-710-137

Powertrain Headquarters - Building C

Phone: (248) 857 - 8753

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Engineering Policy Committee Review of Distance Learning Initiative in Systems Engineering

Ken Birman (CS), Harold. Craighead (AEP)

Ashim Datta (BEE), Terrence Fine (ECE)

Emmanuel Giannelis (MSE), Mircea Grigoriu (CEE)

Shane Henderson (ORIE), David Hysell (EAS, chair)

Stuart Leigh Phoenix (TAM), Mark Psiaki (MAE)

Paul Steen (CBE), Warren Zipfel (BME)

...

Kent Fuchs (ex-officio), David Gries (ex-officio)

Michael Spencer (ex-officio), Zellman Warhaft (ex-officio)

1. Are additional faculty positions needed to support the DL initiative, and if so, what form of appointment is envisaged for those faculty, and how would they be supported?

- Negotiations of services and commitments will be made with various department chairs to maintain and increase the number of elective courses offered as DL. Maintaining these courses is seen as the respective department chair's responsibility and also revenue sharing will be arranged with department chair, not individual faculty.
- Questions arise concerning how a junior faculty investing in this program will be seen in the tenure process (persons hired in these lines will be required to teach DL courses). The program should support the junior faculty at tenure time.
- Still, it seems as if the responsibility for this program rests with one or a few faculty members, and the college should be prepared to support it more tangibly.

2. How can we be sure that the students receive a quality degree that deserves the good name of Cornell?

- The burden of proof rests with the new program, which will have to demonstrate quality at three- and six-year reviews. The reviews will need to be as carefully designed and executed as the DL program.
- At this stage, the program appears to be sufficiently well motivated and constructed to warrant trial.

3. Will a sufficient number of classes be available in DL format to ensure a reasonable selection for DL students?

- Several courses for the program already exist in DL mode, and others will become DL irrespective of the proposed program. The face-to-face course(s) have to be developed.
- Two planned electives would constitute the bare minimum to get the program going, and it appears that the viability of the program depends on maintaining those two elective courses. More electives are expected to come on board with time.
- It was suggested that it would be prudent to start with more than the two minimum elective courses, although economics argues against this.
- At the moment, neither elective is firmly in place, although the chairs of ECE, CEE, MAE, and ORIE are being consulted (ECE and ORIE most immediately).

4. Lockheed's letter regarding the importance of distance learning is impressive? Are there any other similar letters?

- General Motors Technical Education Program
- Applied Materials Global University
- Schweizer Aircraft

5. Office hours can be of great help to many on-campus students. Has a feasible alternative to office hours been considered for off-campus students?

- A number of technologies exist with sufficient maturity to facilitate remote office hours. For the JGSM DL program, advising through email has been successful.
- Distance learning is a different experience, and keeping the personal connection with an off-campus audience requires extra effort from the instructor, but this has been done.

6. It is not clear how a third party can guarantee academic integrity. What can be done if, for example, the exams of some students from the same unit are similar?

- An authorized person from a participating company (i.e., Lockheed Martin) who is seen as a disinterested party can assume this responsibility. This has been done by USC/Boeing.
- Outside of such company situation, the student will have to utilize a testing center for a fee.

7. How can we preserve the quality and quantity (already in short supply) of suitable M. Eng. projects while adding an additional body of students.

- High quality projects arise from the corporate participants. An example is the Fireball competition at Lockheed Martin.
- Project quality also benefits from the maturity of the students involved and the experiences they've gained through corporate affiliation.

8. The comparison with the USC program seems to be the most relevant.
Can we learn more about their experience?

The DL proposal from Systems Engineering appears to be well considered and thought out, and specific concerns raised by the EPC have been addressed. We support continued work toward a DL degree program in this instance and suggest that firmly establishing electives be the priority at this stage. However, we do not view the program as a template for college-wide implementation. The program is based on a one-of-a-kind, resource-intensive model requiring enormous effort on the part of a few individuals. It has limited course offerings and does not appear to be easily scalable. Much more college support would be required to replicate DL programs widely in other departments.