GEORGE MASON UNIVERSITY

VOLGENEAU SCHOOL OF INFORMATION TECHNOLOGY AND ENGINEERING

SYST 490/495 Senior System Design Project (2008/2009)

8/22/2008

Instructor: Dr. George L. Donohue
Office: Rm 121 S&T II
Lecture: Robinson Hall, Rm B111
Lab: S&T II Rm 18
Time: TTh 12:00 – 13:15
Office Hours: Tuesday/Thursday 14:15 to 15:45, (lunch mtgs 13:15-14:15 by apt.)

Suggested Reading:

Thomas L. Friedman***, The World is Flat: A Brief History of the Twenty-First Century,*** 2006 Farrar, Straus and Giroux Publishers

FE Review Manual, Michael Lindeburg, 2002
http://www.ncees.org/exams/study_materials/fe_handbook/ (17.5 Mbyte pdf file)

Objective: These two courses, together, provide the Capstone experience to the Systems Engineering undergraduate program. It provides the students with the opportunity to put all of the course material that you have covered in the last 3 to 4 years into practice. It also provides the faculty with the opportunity to test your ability to have assimilated the course material and certify that you are ready to receive the Bachelor of Science degree in Systems Engineering. In addition to providing you the opportunity to utilize the systems engineering processes (e.g. requirements determination, work-breakdown structures, Pert Charts, test and evaluation, life cycle costing, etc.) it will require you to use your analytical skills in system modeling, simulation and decision making. Emphasis in these courses will also be placed on written and verbal communication skill development and the creative process of engineering design. You now have the basic skills that should allow you to create new systems that are technically sound, affordable, environmentally compatible and safe. You are required to describe your problem definition, scope, value hierarchy, requirements analysis, modeling and simulation approach for your designs in the Program Proposal that you will submit in late November and present to your sponsors and the faculty in early December. You will be required to manage a complex, unstructured project using the management and teamwork skills that you have developed. The class will be divided into seven project teams, each working on a real problem. Each student MUST maintain a personal log of all design activity, to be inspected upon demand. You MUST submit a weekly time sheet to your team timekeeper to be used in your EVM project control and submitted at all major program reviews. Qualifying teams will be entered into inter-scholastic senior design competitions at the end of the Spring Semester (SIEDS 2009, 24 April, 2009, USMA TBA May, 2009). Decide which Track you want to compete in this semester.

Competition Tracks:

- Data Mining & Statistics
- Simulation & Stochastic Modeling
- Human Factors & Cognitive Engineering
- Math Modeling & Optimization
- Risk Analysis, Technology Management & Policy
- Life Cycle Analysis
- System Economic Analysis

Semester Schedule:

Aug. 26. Introduction to the course, design problems and time-sheet system. Background discussions and data exchange. Seven (5-6 person) teams will be formed based upon my initial core team selection today. Each Project Formulation team will be allowed trades and selections from the "Free Agent Pool" to assemble a team with the best qualifications for achieving a successful project conclusion. The Project teams are suggested to form sub teams such as: 1) process and data analysis team and 2) a modeling, analysis and simulation team 3) Graphics, web page design/implementation, and presentation team, etc.. It is anticipated that team leadership duties may rotate throughout the 9-month period of the project (based upon demonstrated performance and workload considerations). This is a 3 hour Lab course and thus a ***minimum of 10 to 12 hours/week of productive effort is expected***.

Each member of the class will give a substantial presentation at some point in the project to faculty and outside project sponsors. Each student will be graded upon his/her presentation ability. The Project Proposal and the final Project Report will be graded for writing style and completeness. The total project grade will represent a sizable portion of each student's final grade. In addition, each student will be ranked by each team member for total contribution to the program outcome.

August 26. Class Organization and Objectives. Discussion of Design Philosophy
August 28. Continue team Formulation and Project Discussion
September 2. . Lab computer hardware and software audit and Team organization day
September 4. Continued discussion of team projects
September 9. Discussion of Team Projects and Project Scope
September 11. Individual team activity
September 16 Review Value Hierarchy, Requirements Traceability, WBS, PERT and Critical Path and Life Cycle Concepts, Review Modeling and Simulation for design trade-off analysis
September 18. Individual team work
September 23. Teams Present mini discussions of status to date
September 25. Teams Present mini discussions of status to date

Submit Problem Definition and Preliminary Requirements Document, Proposed SOW, Project Labor Cost Estimate for EVM tracking. **Present**

Initial Level 3 Work Breakdown Structure, Estimated Project Time Schedule and Gantt/PERT/CP Charts. (Last Day to Drop class)

September 30. Team A and B Presentation *
October 2. Team E and F Presentation *
October 7. Team C and D Presentation *
October 9. Team G Presentation *
October 14. Prelim Report Pass Back and MTE Review
October 16. Mid Term Exam
October 21. Discuss Project Investment Decision Report Format and Modeling and Simulation Plan requirement
October 23. Pass Back Exam and Discussion *mid term team self evaluation*
October 28. Meet with individual team SPONSORS for progress discussions
October 30. Meet with individual team SPONSORS for progress discussions
Nov. 4 & 5 Meet with individual teams for discussion by appointment
Nov. 6. Formal Team Progress Presentations*
Nov. 11. Formal Team Progress Presentations
Nov. 13. Formal Team Progress Presentations
Nov. 18. individual team work
Nov. 20. individual team work
Nov. 25. individual team work
Dec 2,3 & 4 Dry Run Presentations; Final Proposals submitted for Faculty and Sponsor evaluation
Dec 5. Final Proposal Presentations to Faculty and Project Sponsors
Dec 16. Present first semester ***team self evaluation*** and Plan for second semester. Revised Project Milestones

* Actual presentation order will be determined by random draw

Grading: Each student's final grade will be determined as follows:

30% Mid-Term Exam
25% Project Proposal and Final Project report (written)
25% Faculty / Sponsor Evaluation of Team Presentation
10% Team Project productivity self evaluation
5% Individual presentations
5% Timesheets/Notebooks

Team Assignments:

Team composition decided Aug 26/ 28.

Project Descriptions:

A) New York Port Authority Helicopter Transport System
Sponsor: NASA, Faculty Advisor: Dr. Lance Sherry

Design a helicopter transport system to serve the 4 to 6 airports serving the NYC metropolitan region. The downtown heliport must be part of the system. The team must consider the passenger's price elasticity, all investment and operations/maintenance costs, airspace compatibility, noise footprints and maximum passenger capacity. Both existing and potential future heavy lift helicopter designs must be considered. Based on a NPV analysis, find the optimum system design.

B) Airport Environmental Monitoring System
Sponsor: Metron Aviation, Dr. Terence Thompson, Faculty Advisor: Dr. Lance Sherry

Aircraft using airports and nearby airspace have environmental impacts in terms of air pollutants and noise. The metrics for these impacts can be seen as spatio-temporal distributions of intensity. In environmental-management systems, real-time monitoring of these metrics is needed to provide measurements that can be used to periodically calibrate models that estimate the noise and air-pollution impacts throughout the region. Noise and emissions detectors will have different sensitivities and latency between aircraft passage and signal peak. They will also have different roll-off of sensitivity as a function of distance from the source, wind direction, and possibly other factors. Dispersion effects will be especially pronounced for gaseous and particulate emissions as they mix with the atmosphere. Compare both a ground and UAV based system based on NPV investments and performance.

C) West/Rhode River Water Quality Monitoring System
Sponsor: West/Rhode River-keeper, Chris Trubauer; Faculty Advisor: Dr. George Donohue

The West and Rhode Rivers are major rivers feeding the Chesapeake Bay. They are located approximately 20 miles south of Annapolis Maryland. The River-keeper is responsible for monitoring the water quality of these rivers in cooperation with the Maryland Department of Natural Resources (DNR). The Smithsonian Environmental Research Center is located on the Rhode River and has a continuous water quality monitoring system. The DNR maintains a historical data base and the River-keeper updates spatial-temporal data on a semi-periodic basis. It is desired to conduct projects that will enhance the water quality of these rivers and thus eventually the entire Bay. It is desired that a system-dynamic model be developed that would work in conjunction with a GIS based

system being developed by a graduate student at Penn State university that would relate system projects (i.e. oyster bed deployments and dredging activity) to river water quality. It is also desired that an improved water quality monitoring system be designed using RFID technology to facilitate better and more efficient sampling. A complete design, including cost, Value Hierarchy, water quality transfer functions, systems dynamic model in matlab and projected performance must be developed.

D) Chesapeake Yacht Club Ten Year development Plan
Sponsor: Chesapeake Yacht Club Board of Governors, Vice Commodore Art Parsons; Faculty Advisor: Dr. George Donohue

The Chesapeake Yacht Club is located on the West River, Maryland. It is a private, not-for-profit yacht club with slips for approximately 140 yachts. It is a member owned, full service yacht club that provides slips, swimming, fuel, and food/beverage service. The club is anticipating a major dredging operation either this winter or next and has a large range of future capital investments that need to be made. The Board of Governors requires the development of a member based Value Hierarchy and a systems dynamics model (matlab) to plan for future financing and investment strategy. A major replacement of the pier structure is anticipated within this time period. The increasing cost of fuel may affect the future club membership in strategically important ways. The price elasticity of fuel will be considered in this analysis and design.

E) Highway Congestion Management System
Sponsor: Noblis, Andrew Girard; **Faculty Advisor: Dr. Karla Hoffman**

The USDOT May 2006 white paper, *National Strategy to Reduce Congestion on America's Transportation Network*[1], calls for the consideration of new, non-traditional solutions to the problem of congestion, including the use of congestion pricing as a tool to more efficiently match road user travel demand and roadway infrastructure capacity. The proposed Noblis/George Mason University research plan continues to explore an innovative concept in the potential deployment of congestion pricing: combining complete-trip travel time reliability thresholds with a guaranteed reliable travel for roadway to efficiently align incentives of both road users and roadway operators. Although a significant departure from current operational practices, this concept represents an opportunity to squarely address the interlinked congestion-mobility-productivity problem rather than to simply mitigate or reduce congestion.

F) Design a new Student RFID transaction Card
Sponsor: TBD,

Design a new student ID card that will allow 2-way communication for campus wide alerts and to provide a complete student/faculty transaction system for campus meals, building entry control/tracking, etc.

G) T Boon Pickens Energy Plan Evaluation
Sponsor: SEOR, Faculty Advisor: Dr. George Donohue

Evaluate the national energy plan proposed by T. Boon Pickens. The evaluation will consist of review of the plan, independent life-cycle-cost estimates, system dynamic model and 10 year cost and development plan.