

SYST 659 – Engineering Economic Systems: Economic Analysis and Assessment for Network, Telecommunication and Software systems (3:3:0)

Economic systems analysis, assessment, and management for information and knowledge centric industries, especially those that are network, telecommunication, and software intensive. Classic microeconomic concepts: theory of the firm and production, theory of the consumer, market equilibria, and normative or welfare economics. Economics in program management: economic valuation, cost-benefit and cost-effectiveness analysis, earned value, cost structures and pricing, cost as an independent variable, real options. Cost estimation in software and systems. Economic, legal and policy issues associated with information and knowledge networks and software. Evolutionary economics: increasing returns to scale, network effects, and path dependence. Economics of networks: network classifications, network externalities, industry structure, emergence of information and knowledge network of networks. Prerequisite: introductory background in microeconomics and calculus at the level of SYST 500.

The objective of this course is to provide a background in economic issues related to the contemporary information and knowledge network centric industries, especially those that are software intensive. A good background in classical and modern microeconomics is needed in order to be able to successfully formulate, analyze, and interpret contemporary issues in these situations. The first part of the course provides an overview of this introductory material. The course itself is comprised of five major parts. The major parts of the course are as follows.

1. **Microeconomics.** We will provide a concise overview of classical microeconomics including: production and the theory of the firm; theory of the consumer; market equilibria and market imperfections; normative or welfare economics, including imperfect competition effects and consumer and producer surplus.
2. **Program Management Economics.** We discuss economic valuation of programs and projects including: investment rates of return; cost-benefit and cost-effectiveness analysis; earned value management; cost structures and estimation of program costs and schedules; strategic and tactical pricing issues; and capital investment and options.
3. **Software Engineering Economics.** Cost estimation technologies involving precededent and unprecedent development, commercial-off-the-shelf (COTS) software, software reuse, application generators, and fourth generation languages. Evaluation of contemporary cost estimation methods in terms of: openness of underlying models, platform requirements, data required as inputs, output and accuracy of estimates provided by models. COCOMO I and II, and COSYSMO as examples of a cost model, Function point cost estimation models.
4. **Evolutionary Economics.** There are needed extensions to classic microeconomic to enable satisfactory treatment of the increasing returns to scale, network effects, and path dependent issues generally associated with telecommunications and information networks. We present a discussion of evolutionary economics, with a particular focus on guidelines for success in industries subject to these characteristics.
5. **Economics of Networks.** In the final part of the course, we provide a discussion of such information and knowledge network issues as compatibility, interconnection, and interoperability, and the influences of these and coordination to technical architecture standardization and regulation upon pricing and quality of service such as to lead to emergence of a network of networks.

There will be no formal required text for the course. We will distribute draft copies of a work in progress on the WebCT site for the course:

Sage, A. P., ***Engineering Economic Systems: Analysis, Planning, and Management***, John Wiley Series in Systems Engineering and Management, to appear.

There are several contemporary texts that will be particularly useful as references for the course. These are useful but not at all required. These include:

- Baetjer, H. Jr., ***Software as Capital: An Economic Perspective on Software Engineering***, IEEE Computer Society Press, 1998.
- Boehm, B. W. et al, ***Software Cost Estimation with COCOMO II***, Prentice Hall, 2000.
- Coombs, Paul, ***IT Project Estimation : A Practical Guide to the Costing of Software***, Cambridge University Press, 2003.
- Noam, E. M., ***Interconnecting the Network of Networks***, MIT Press, Cambridge MA, 2001.
- Sage, A. P., ***Systems Management for Information Technology and Software Engineering***, John Wiley and Sons, New York, 1995.
- Shy. O., ***The Economics of Network Industries***, Cambridge University Press, New York, 2000.
- Wheatley, Jeffrey J., ***World Telecommunication Economics***, IEE Press, London, 1999.

There is a variety of literature available on the Internet and this will be an important tool for the course. A course web site will be established using the WebCT (Web Course Tool) software implemented by GMU. All enrolled students will have access to this site.

Instructor: Andrew P. Sage, Office: STII Room 311, Phone 703-993-1506, Fax: 703-993-1521, EMail: asage@gmu.edu

SYST 659-002, Course Call Number 06348, Spring 2004, Wednesday from 4:30 PM to 7:10 PM in Innovation Hall, Room IN 223.

Grades will be determined as follows: 50% - exams, 20% - term paper, 30% - home assignments. Two take home exams will be given, one at the middle of the semester and one at the end of the semester. There will be a term paper on economic systems analysis tailored to the special interests of the student, including a written report and oral presentation. Prerequisites: an introductory background in microeconomics and calculus and TCOM 500, or instructor consent.

SYST 659 - Syllabus and Class Schedules (subject to change) – Spring 2004

0. **Introduction and Background Material, Introduction to WebCT** – 21 January.
1. **Microeconomics:** Production 28 January, Consumption 4 February; Market Equilibria 11 February; Normative Economics 18 February.
2. **Program Management Economics:** Economic Program Valuation, including real options, 25 February; Pricing and capital investment 3 March. Mid Term Break - 10 March. Mid Term exams due 17 March.
3. **Taxonomy of Software and System Cost Estimation Models.** Cost models: COCOMO I and II, COCOTSMO, COSYSMO, function points. Cost estimation technologies involving commercial-off-the-shelf (COTS) software and systems, software reuse, application generators, and fourth generation languages. Problems with existing models in terms of structure, complexity, and size estimation accuracy. Automated tools for software estimation. Part 1, 17 March, Part 2 - 24 March, Part 3, 31 March, Part 4 – 7 April.
4. **Evolutionary Economics and Economics of Networks:** Compatibility, Interconnection, Interoperability, and Architectural Issues 14 April; Pricing, Quality of Service and Emergence of a Telecommunication Network of Networks 21 April. Network and Path Dependency 28 April.
5. **Term Papers and Final Exams Due** - 12 May.

APS: 1 November 2003