



SYSTEM DESIGN

IE 477 - IE 478

Course Coordinators:

Savaş Dayanık

Nesim K. Erkip

Emre Uzun

TTO Coordinator:

Yeşim Gülseren

Assistants:

Ece Çiğdem

Berk Şahin

İsmail Burak Taş

Serkan Turhan



Characteristics

- Project-based and Problem Solving
- Synthesis – Capstone Project
 - Oral and Written Communication
 - Team work
- Two semesters, but you will receive a grade at the end of each semester



Learning Outcomes

(Previous presentation – S.Aktürk)

- Analyze system data to identify problems
- Know how to access information and do literature survey
- Formulate problems and propose solution methodologies
- Construct mathematical models of the system and validate based on actual data
- Effectively use teamwork (Peer Evaluation)
- Prepare reports and presentations to explain ideas
- Practice professional and ethical responsibility



Learning Outcomes and Project Work

- **THROUGHOUT THE PROJECT WORK**
 - Effectively use teamwork (Peer Evaluation)
 - Prepare reports and presentations to explain ideas
 - Practice professional and ethical responsibility
 - **PROPOSAL**
 - Analyze system data to identify problems – Agreement on the **SCOPE**
 - **END OF FALL SEMESTER**
 - Access information and do literature survey – **IE CAPSTONE**
 - Formulate problems and propose solution methodologies – **FEEDBACK**
 - Construct mathematical models of the system – **MODEL, VERIFY**
 - **MARCH 2020 -**
 - **VALIDATE** based on “actual” data
 - What-if analyses, integration, implementation – **BENCHMARKING, REPORT**
-



Project Proposal - **SCOPE** (Late Oct. – Early Nov.)

- Complaints and symptoms from the company
- Required outcomes, expectations: **Deliverables**
- Project constraints and limitations

Read, Recall

Factual Analyses

Group Discussions



IE tools

Critical Thinking

Think out-of-the-box

Definition and Scope of the Problem - CONSENSUS

!!Go beyond the initial description!!

Main project activities: Workpackages, Timetable



Explanations – IE CAPSTONE

- Currently, your strenght is “engineering education”
 - Engineers – numbers – facts
 - IE Capstone Project – Meaning?
 - IE303, IE325, IE375 and others
 - Text Books for courses – First thing to read
 - ~ 60 % of the your work can be handled
 - References in the text book – a good start to go further
 - Designing a system means a preparation to repeatedly implement “almost the same” approach over time.
-



Explanations - **FEEDBACK**

- Industry Advisor's role: A representative for the owner of problem - organization your work for
 - Academic Advisor's role: Supporting/criticizing your work and give you leads
 - Coordinator's role: Assessment of your work + mediator between owner and academics.
 - Your role: Critically listen to and understand all sides. Get feedback from Industry and Academic Advisors as much as possible; from coordinator(s) only in planned meetings.
-



Explanations - MODEL

- **Model** (Merriam-Webster)
 - (1) a description or analogy used to help visualize something that cannot be directly observe
 - (2) a system of postulates, data, and inferences presented as a mathematical description of an entity or state of affairs
 - **Elements of a Decision Model: Alternatives, Constraints, Objective Criterion (or Criteria)**
 - **Mathematical Model** – approaches you have seen in almost all IE courses consider some kind of a decision model
 - Symbols, flowcharts, relations – Further to be developed as
-



Explanations - **VERIFY**

What is model verification?

- Check if models constructed (approach) are yielding results, solutions as intended (expected)
 - Make sure that everything is correctly represented (Math program, computer code, state-space, ...)
 - Intuition, sanity check, discuss with advisors
 - No need to have real data
 - Make sure you have a model to represent the trade-offs present in the real system
 - Persuade all: Your approach is useful
-



Explanations - **VALIDATE**

What is model validation?

- Check if models constructed are yielding results comparable to current affairs when current decisions are implemented
 - Make sure that you come up with a way of validating (not necessarily exact)
 - Use of past data to compare
 - Implementing your approach in a small-scaled part of the real-system
-



Explanations – BENCHMARKING

- Benchmarking is testing and showing the benefit of your approach compared to what is currently done – a natural consequence of the **Validation** step.
 - You need the following:
 - How are those decisions are made in the current system? (ANALYSIS OF THE CURRENT SYSTEM)
 - Performance measures (ANALYSIS OF THE CURRENT SYSTEM)
 - Data needs
 - Comparison methods: Simulation using the past data; Implementation of your approach by the company; others
-



Explanations – **REPORT-1**

- Oral, written communication
 - Important when you are asking for feedback
 - Make sure communications are recorded
 - Always send e-mails to all parties
 - Record telephone communications to all
 - Minutes of meetings – prepare and send to all to check correctness, completeness
 - Reports - Rules are **strict** with respect to **format**.
No rules with respect to headings, titles, etc (only **recommendations** in what to include in the report)
-



Explanations – REPORT-2

Final Report Work – Should include:

- 1) Details of your approach to solve the identified problem (*updated?*) agreed upon by **SCOPE** (submitted to academic advisors and company) for grading/understanding the impact
 - 2) Plan to integrate your solution with the current system's operation – System Integration
 - 3) Details of how you analyzed the system and how you carried out the computations, estimations, etc of your approach as a **manual** (submitted to the company) so that they can further use it. **Manual** is more **algorithmic**
-



Learning Outcomes and Project Work (to recall)

- **THROUGHOUT THE PROJECT WORK**
 - Effectively use teamwork (Peer Evaluation)
 - Prepare reports and presentations to explain ideas
 - Practice professional and ethical responsibility
 - **PROPOSAL**
 - Analyze system data to identify problems – Agreement on the **SCOPE**
 - **END OF FALL SEMESTER**
 - Access information and do literature survey – **IE CAPSTONE**
 - Formulate problems and propose solution methodologies – **FEEDBACK**
 - Construct mathematical models of the system – **MODEL, VERIFY**
 - **MARCH 2020 -**
 - **VALIDATE** based on “actual” data
 - What-if analyses, integration, implementation – **BENCHMARKING, REPORT**
-



Teamwork

- Teamwork – assessment through peer-review
 - Essentials:
 - We want you to assess your peers in the group not as friends, but professionals working together
 - Our expectation is to communicate and spend effort to solve issues before it is too late
 - Details:
 - Forms to fill every semester - Please discuss within your group and come to a mutual understanding on how to realize the evaluation procedure



Ethical and Professional Responsibility

- Projects are important for the reputation of Bilkent IE Department – value of your diploma
 - Companies are likely your future employers or partners
 - Ethical and Professional Responsibility:
 - Your commitment to signed agreements of the project
 - Your responsibility to carry-out oral and written promises made
 - Your manner and behavior while communicating within the group, with advisors and supervisors, etc
 - Any information source or material from literature should be cited
 - Technical results should be clear and reproducible
 - Any violation by any group will affect all of us, our reputation and value of your BU diploma
-



Industrial Project

A typical text book explanation

- The following steps may be taken:
 - Study/analyze the system to understand the problem
 - Formulate the problem and define scope of the project
 - Literature Review
 - Develop models
 - Implement the models using appropriate software or your own codes
 - Validate the model and test your results
 - Implement the proposed system/prepare manual
-



Role of Real Data

- Very important
 - Unfortunately not necessarily available (at all or on-time) in the requested format depending on the detail level desired
 - **Do not wait** for data to be available to set the details of your approach – will be **too late**
 - Be **concise** and **moderate** while asking for data
 - Be prepared to process (and clean) large chunks of data, in case it is available
-



IE 478 Assessment Criteria-1

(Previous presentation – S.Aktürk)

- **System design:**
 - Model development and validation: The proposed model can be an optimization, statistical, database, marketing or simulation model
 - Consideration of alternatives: Extent to which the team demonstrated critical thinking in the design process
 - Scenario / what if analysis: Model usage for changing environments
 - Creativity: Extent to which the team developed a novel solution to the design problem while still achieving a functional design
 - Technical competencies: Extent to which and validity of the technical aspects have been used properly, including methods, tools and techniques
-



IE 478 Assessment Criteria-2

(Previous presentation – S.Aktürk)

- **Success of the design:**
 - Attainment of project deliverables: Extent to which the goals of the project and end-user specifications have been met
 - Benchmarking: A comparison of the current and proposed system should be provided along with a cost/benefit analysis
 - Implementation and system integration: Extent to which the proposed system is successfully implemented and integrated into the existing system – if not applicable, then a detailed implementation plan and a pilot study is to be provided)
 - End-user evaluation and assessment: A written statement from the industrial advisor(s) evaluating the project
 - Impact on the organization: Affect of the proposed system on the organization (financial impact, simplified operations, etc) – performance measure(s) used in validation
 - Global and societal impact: Consideration
-



IE 477 Assessment Criteria

- **Your progress** with respect to the level desired for the complete project, see IE478 Assessment Criteria
 - Our expectation:
 - Brief definition of the Problem
 - Analysis of the current system
 - Literature Review
 - Previous studies in the scientific literature
 - Similar Studies in the industry
 - Proposed Methodology
 - Model Development and verification
 - Timetable + workpackages clearly specified (and preliminaries on the work should have been initiated) for IE478
-