I. GENERAL COURSE INFORMATION

VIRGINIA TECH
NORTHERN VIRGINIA CENTER
DEPARTMENT OF INDUSTRIAL & SYSTEMS ENGINEERING

ISE 5124 MANAGEMENT OF QUALITY AND RELIABILITY

Spring 2009
Dr. K. Triantis

Scope

This course presents the discipline of developing (enhancing) the quality capabilities of enterprises and their systems. Quality development involves a host of activities that include but are not limited to: assessing, planning, designing, measuring, documenting, assuring, controlling, improving, empowering, facilitating, and leading. The approach taken in this course is to study these activities in the context of developing both production and managerial processes. It is assumed that by doing so, that the quality of the organization’s products and services will improve. Concepts will be demonstrated by studying selected case studies and by completing a class project.

Justification

The effective management of quality and reliability determines in part the long-term sustainability and growth of an organization. Managers face the challenge of worldwide competition and quality management presents a strategic opportunity to succeed in this competitive environment. This course is designed to enhance the understanding of how production and managerial processes operate in an organization and to explore quality improvement strategies for these processes.

Prerequisites

This course will present as part of its curriculum probabilistic and optimization principles and techniques. Students should be conversant with the basic principles of probability and statistics and the math programming principles covered in ISE 5104.
Major Course Concepts and Techniques

1. The constrained optimization problem associated with quality
2. Multiple definitions and dimensions of quality
3. Quality management systems
4. Quality management system development (design/evolution)
5. Total quality management
6. Quality standards (Baldrige, ISO, etc.)
7. Core principles and values
8. Quality management assessment
9. Quality measurement
10. Design of measurement instruments
11. Planning for quality (strategic and operational)
12. The economics of quality
13. The characteristics approach
14. Quality costs
15. Process improvement
16. Process capability
17. Sampling
18. Reliability assurance and engineering
19. Correlation versus causation
20. Systems thinking and modeling

Educational Objectives

There are four broad educational objectives that relate to the management of quality and reliability that need to be developed for an engineer who manages and practices quality. These include: qualitative skills (everyone), statistical modeling skills (a few), facilitation skills (a few), and hard-to-measure life changing objectives (hopefully many). The course will focus primarily on the first set of qualitative educational objectives hoping to inspire continuous quality improvement within enterprises.

Qualitative Educational Objectives

1. Appreciate the multiple facets (dimensions) of quality;
2. Define a process (system structure) that leads to the provision quality products and services;
3. The use of quality standards;
4. Understand the economics of quality and measure quality-related costs;
5. Design and implement quality assessment surveys;
6. Complete survey verification and validation;
7. Identify the physical, organizational, decision-making structures within systems that are responsible for quality behavior;
8. Identify key cultural aspects that impact quality behavior;
9. Identify critical quality variables in a system (enterprise) and their relationships to other variables;
10. Understand how to elicit tacit knowledge in decision-makers that impact quality;
11. Complete quality planning and policy analysis;
12. Work within teams to manage quality.

**Statistical Modeling Educational Objectives**

1. Develop very specialized statistical modeling skills that enable the modeler to address a series of very complex quality problems;
2. Define statistical process capability;
3. Design acceptance sampling procedures and control charts;
4. Design statistical based experiments;
5. Become in-house trainers of statistical quality principles and modeling.

**Facilitation Educational Objectives**

1. Develop facilitation skills that enable individuals to become leaders in quality improvement initiatives and manage the organizational change with respect to quality.

**Hard-to-measure Life Changing Objectives**

1. Experience the addictive power of looking for quality in organizations that provide both services and physical products.

**Professor**

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Class Meeting Time

Thursday: 4:00 p.m. - 6:45 p.m.

Texts, Case Studies and References

The quality management literature has a plethora of reference materials since it spans over one hundred years of academic and empirical work. The references presented subsequently have provided the background information that was used as the foundation of the course notes. Students are encouraged to consult these references and other materials that complement the following reference list. References and case studies indicated by an * are required for the course.


*Garvin, Steinway and Sons*, Harvard Business School, Case #682-025, 1981.


*Triantis, K., 2009, Class Notes for ISE 5124.


## II. OUTLINE OF TOPICS AND READINGS

### Program of Study

<table>
<thead>
<tr>
<th>Day</th>
<th>Topic</th>
<th>Assignment</th>
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<tr>
<td>1/22</td>
<td>Introduction; The Necessity of Quality Improvement; Research: The</td>
<td>Ch. 1 (G); Ch. 1 (E)</td>
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<tr>
<td></td>
<td>System Performance Laboratory</td>
<td>Unit_#1: Introduction;</td>
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<td>Unit_#2: System Performance Lab</td>
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<td>1/29</td>
<td>Historical Overview of the Quality Movement; Definition Of Quality;</td>
<td>Ch. 1 (G); Chs. 1, 2 (E)</td>
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<td>Multiple Dimensions Of Quality</td>
<td>Unit_#3_Historical Overview;</td>
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<td>Unit_#4_Definition of Quality</td>
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<td><strong>Final Formation of Research Project Groups</strong></td>
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<tr>
<td>2/5</td>
<td>Total Quality Management (TQM); Quality Management System (QMS)</td>
<td>Ch. 8 (G); Ch. 3 (E)</td>
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<td>Definition</td>
<td>Unit_#5_Quality Management Systems;</td>
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<td>Unit_#6_Quality_Management;</td>
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<td>Unit_#7_Hackman and Wageman Definition of the Quality Problem and the</td>
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<td>Unit of Analysis</td>
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<td>2/12</td>
<td>QMS Development: Introduction; Assessment; Quality Assurance and</td>
<td>Chs. Introduction, 2.1, 16 (G);</td>
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<td>Unit_#9_Audits/Assurance;</td>
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<td>Unit_#22_Systems/Approach</td>
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<td><strong>Project Proposals Due</strong></td>
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<td>2/19</td>
<td>Baldrige Award Criteria</td>
<td>Ch. 2.8 (G); Ch. 3 (E)</td>
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<td>Unit_#10_Baldrige_Award</td>
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<td>Ch. 15 (G); Chs. 4, 8 (E)</td>
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<td>Hank Kolb (case study)</td>
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<td><strong>Hank Kolb Case Study Due</strong></td>
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<td>3/5</td>
<td>QMS Development: Measurement; Quality Costs; Economic Justification</td>
<td>Chs. 2.2-2.5, (G); Ch. 8 (E)</td>
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<td>3/26</td>
<td>QMS Development: Strategic Planning and Design; Quality Organization</td>
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<td>4/2</td>
<td>QMS Development: Operational Planning, Process Improvement</td>
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<td>4/9</td>
<td>Correlates of Quality; Characteristics Approach Steinway &amp; Sons (Case Study)</td>
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<td>4/16</td>
<td>Characteristics Approach</td>
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<td>4/23</td>
<td>Vendor Relations; Acceptance Sampling Procedures</td>
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III. PROJECT DESCRIPTION AND CASE STUDIES

**ISE 5124 - RESEARCH PROJECT DESCRIPTION**

The objective of the project is to implement and integrate the concepts and techniques presented in this course. The first task is to select an organizational process (system) that will be analyzed in terms of its quality management capabilities. It is important to analyze a process/system that has a significant quality issue/problem. The quality/problem should drive the course project.

The process/system for which a significant quality problem is found will be represented as a system for which inputs, outputs, outcomes, activities, goals, objectives, boundaries, feedback mechanisms can be defined. It is recommended that this process is work-related but it does not have to be. The key is to obtain access to the process, information and the decision-makers that impact its performance.

A generic outline for the project is presented subsequently. This outline delineates the tasks that need to be accomplished for the project. It is expected that the final project document will follow this outline format. Weights indicate the importance of each section for the final grade of the project.

1.0 Introduction (5%)

1.1 Project Objectives

1.2 Motivation for selecting the "Process" and its Need for a Quality Improvement Effort; Definition of the Quality Problem/Issue

1.3 Overview of the Methodology that will be Used

1.4 Organization of the Report

2.0 Process Definition (15%)

2.1 Overview of the Process (with a clear definition of the process boundaries)

2.2 Quality Mission

2.3 Inputs (resources used)

2.4 Transformation (value-adding) Activities that define the Production or Administrative Process

1A flow-process diagram that clearly presents the inputs, transformation activities and outputs is required for the final document.
2.5 Outputs (resources produced)

2.6 Outcomes

2.7 Quality Related Goals

2.8 Feedback Mechanisms for Production and Quality Issues

2.9 Managerial/Administrative Support Mechanisms/Processes

2.10 Customers (Internal/External)

2.11 Vendors (Internal/External)

2.12 Other Important Stakeholder Groups

3.0 Definition of Quality (15%)

3.1 Relevant Definitions (Product-Based, User-Based, Manufacturing-Based, etc.)

3.2 Dimensions of Quality

3.3 Definition of Product/Service Non-Conformances

4.0 Quality Management System Definition (15%)

4.1 Criteria

4.2 The Interrelationships among the Criteria

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2If the process you are studying is an administrative process, focus on other administrative processes that support it.

3For each dimension, give examples (criteria, declarative statements) that give a detailed descriptive definition of each dimension.

4These dimensions of quality can subsequently be used for statistical process control, statistical definition of process capability, acceptance-sampling procedures, design of experiments, and data envelopment analysis.

5Start with one or more of the known standards (Baldrige, ISO 9000, Capability Maturity Model, etc.) and choose the criteria that are the most relevant for the process. Re-state (re-formulate) the criteria so that they are applicable to your process specifically.
5.0 Quality Management System Development: Assessment (20%)

5.1 Instrument

5.2 Assessment Results

5.3 Evaluation of the Assessment Results (Descriptive Statistics, Correlation Analysis, Multiple Regression, Factor Analysis etc.). What are the Determinants of Excellent/Poor Quality Behavior?

5.4 Evaluation of the Assessment Instrument

5.4.1 Reliability

5.4.2 Validity

6.0 Systems Modeling: The Qualitative Model (15%)

6.1 Quality Problem Definition Revisited (quality issues; policies; model purpose; system-subsystem definition; time horizon; endogenous/exogenous excluded variables; reference modes)

6.2 Key Dynamic Hypotheses

6.3 Qualitative Model

6.4 Verification Validation

7.0 Quality Management System Development: Operational Planning (10%)

7.1 Quality Improvement Goals

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6Assessment instrument should contain an introduction, items (based on the dimensions (section 3.2) and quality management system criteria (section 4.1)), a Likert-type response format and a possible weighing scheme for the items. If no weighing scheme is provided, all items are weighted equally.

7It is imperative that each team is able to get a minimum of fifteen responses to respond to the assessment instrument. Respondents can be customers (internal/external), vendors (external/internal), employees, managers, and any other member of an important stakeholder group.

8Determine the root causes of quality behavior. Describe the main production characteristics.
7.2 Implementation Strategy to Achieve Quality Improvement Goals (resources, quality organization, costing, etc.). How is the quality problem/issue being addressed?

7.3 Policy Analysis

8.0 Conclusions (5%)

8.1 Future Research/Implementation Issues

8.2 Assessment of Project

For the project proposal that is due on *February 12* it is expected that each team will submit sections 1, 2, and 3 of this outline so as to obtain feedback. The grading of the whole project will take place at the end of the semester. It is mandatory that the final project document be typed and double-spaced. The final document for the project is due on *April 16*.

Class Presentations

Each group is asked to submit on *April 16* project presentation materials. These materials should contain 10 - 15 pages where the project is described. Each presentation should last a maximum of twenty minutes with questions and answers.
ISE 5124 - CASE STUDY QUESTIONS

Two case studies will be discussed during the semester. Each team is expected to submit a written response (typed and double-spaced) to the following questions.

I. Hank Kolb (due on February 26)

Questions:

1) What are the causes of the quality problems on the Greasex line? (Detailed Analysis; present at least four items; 40%)

2) Why was Hank hired? (10%)

3) What should the responsibility of the Quality Department for the Greasex product be? Make sure that you include items that are most relevant to the problems identified in question #1 (present at least four items; 10%).

4) What should Hank do? Why? Discuss the following:
   a) An immediate course of action (within the first 48 hours) (30%)
   b) And an intermediate and longer-term course of action. (10%)

II. Steinway (due the week of April 9)

Questions:

1) What accounts for Steinway's reputation as a manufacturer of high-quality pianos?
   a) Analyze the competitive environment. (15%)
   b) What are Steinway's strategic resources? (15%)
   c) What are the main contributors to Steinway quality? (15%)
   d) How does the distinction between conformance and performance relate to the case? (5%)

2) Should Steinway introduce the model K? Why or why not? Substantiate your decision by explicitly discussing two reasons. (20%)

3) What other advice (discuss two strategic alternatives other than the model K decision) would you give to P. Perez taking into account: (30%)
a) His responsibilities "downstairs" to Steinway?

b) His responsibilities "upstairs" to CBS?
IV. COURSE GRADING

<table>
<thead>
<tr>
<th>Grade Distribution</th>
<th>% of Final Grade</th>
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<tr>
<td>Class Participation</td>
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<tr>
<td>Hank Kolb (Team Effort)</td>
<td>5</td>
</tr>
<tr>
<td>Steinway (Team Effort)</td>
<td>15</td>
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<tr>
<td>Exam 1</td>
<td>20</td>
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<tr>
<td>Research Project (Team Effort)</td>
<td>50</td>
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**Grading Policies:**

**Class participation:** Throughout the semester you will be called upon to contribute to the class discussion. If you are called upon and do not respond because you are not in class more than three times during the semester you will receive one letter grade less than you would otherwise receive. If you are called upon and do not respond because you are not in class more than four times during the semester you will receive two letter grades less than you would otherwise receive.

**Case Studies:** Each group assignment has to have the following naming convention: Group Site_Group # (this number will be assigned by Michael)_Case Study Name_Date of Assignment (for example, NVC_1_Hank_Kolb_2/19/09)

20% of the total points assigned to a case study (which constitutes an assignment) will be forfeited for the first assignment handed in late. Assignments handed in late subsequently will receive no credit. Assignments handed in that are not consistent with the naming convention will not receive credit.

**Project:** The final document for the project is due on April 16. Projects handed in late will forfeit 20% of the project grade. Projects will not be accepted after April 23.

Each project assignment has to have the following naming convention: Group Site_Group # (this number will be assigned by Michael)_Project Name_Date of Assignment (for example, NVC_1_Quality in Brewery X_4/16/09)

**Re-evaluation Requests:** All re-evaluation requests of any graded assignments, midterms, and projects should be communicated no later than one week after the graded assignment has been initially returned otherwise they will not be considered.
All of these grading policies will be strictly enforced.

Since 70% of the course grade is a function of a team effort, it is imperative that the team members collaborate in a spirit of trust and should equally share in the burden of each of the assignments. In the case that a team member is not working well within the team, each remaining member can evaluate the contribution of the "troublesome" team member. This evaluation should be submitted to me in writing prior to April 16. These evaluations will be confidential.

Evaluation of a "Non-Cooperating" Team Member
(Maximum Discretionary Points: 20 of the final class score)

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<tr>
<th>Contribution to Class Project and Case Studies</th>
<th>Penalty</th>
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<tr>
<td>Two-Thirds of the Required Effort</td>
<td>5 points</td>
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<tr>
<td>Half of the Required Effort</td>
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<tr>
<td>A Third of the Required Effort</td>
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<tr>
<td>No Effort at All</td>
<td>20 points</td>
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