IE 361 Module 1

Course Introduction and Process Identification and Analysis

Reading: Chapter 1 and Section 2.1 *Statistical Quality Assurance for Engineers* (Sections 1.1-1.3 of Revised *SQAME*)

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Course Syllabus/Schedule

- Syllabus and grading
- One regular 2-hour meeting per week
  - Demonstrations
  - Labs
  - Problem Sessions
  - Discussions of Course Group Projects
  - Exams
- Students are responsible for viewing modules and doing the associated exercises *before* class (bring completed assignments, a calculator, and the textbook to class)
- Additional meetings with your instructor to discuss how the projects are going will be scheduled a group at a time

Introduction

- "Quality" ... What is it? What is its connection to "statistics" (SQC)?

Some illustrative cases:

- Lexus Infinity vs. Toyota Tercel?
- Aunt Maude's vs. McDonald's?
- A chauffeured limo vs. CyRide?

There are facets of the colloquial meaning of "quality" that have to do with

- *Appropriateness* of a product (there are apples and there are oranges ... there are different species of goods and services)
- *Small variation* from what is intended or expected (as a matter of fact, "variation" almost always implies "unquality")

Introduction

A common definition of "quality" is **fitness for use**. And this has 2 main dimensions:

1. Quality of design (that is concerned with appropriateness and cleverness of features ... product species)
2. Quality of conformance (that is concerned with small variation from what is designed and intended)

It is the second of these that is the main concern of IE 361.

A pair of illustrative cases:

- CyRide and bus schedules
- The early Ford Escort transaxel story

Introduction

What has "quality" to do with "statistics"?
Statistics is concerned with

1. collecting *data*
2. summarizing *data*
3. drawing properly qualified inferences on the basis of *data*

all in a framework that explicitly recognizes the reality of and absolutely unavoidable nature of *variation*.

The connection between quality and statistics is that one can only assure quality through empirical studies (the collection and interpretation of data). Further, the link between variation and unquality is a strong one, and statistical methods provide ways to quantify, dissect, and probe for physical sources of variation/unquality.

Hard Truth

Like it or not, if one is going to do quality assurance, one is going to do statistics. The only real question is whether it will be done effectively. IE 361 intends to provide the concepts and tools to enable you to do it effectively.

Introduction

What are some features of modern quality culture?

- A "process" (as opposed to "product") orientation
- A "customer" (both internal and final) focus
- Continuous improvement
- Fads and buzzwords

A real electronics company clean room example (illustrating the benefits of process orientation):

Initially	Later
14% yield	65% yield
80 people working in the room	8 people working in the room (no engineers!)
process bottleneck	plenty of capacity
concentration on sorting good from bad	still need to sort, but not as the main focus

Introduction

A "process orientation" causes one to think of "customers" before the final/end customer. From this point of view, everyone in an organization has processes with both "vendors" and "customers."

Quality Function Deployment is a popular discipline aimed at getting all members of an organization focused on delivering what the end-customer needs.

There are (and will be) many varieties of programs and jargon that have to do with logical, data-based process improvement. (Among them have been "TQM," "ISO 9000," Six Sigma," etc.

The course textbook is organized around a generic 6-step process oriented quality assurance/improvement cycle. This serves as the intellectual framework for the course material and a guide to "what to do" in an ideal course project.

Vardeman and Jobe Table 1.1 A Six-Step Process-Oriented Quality Assurance Cycle (and Corresponding Tools)

	Step		Tools
1.	Attempt a logical analysis of how a process works (or should work) and where potential trouble spots,sources of variation, and data needs are located.	[•] [•]	Flowcharts (§2.1) Ishikawa/fishbone/cause-and-effect diagrams (§2.1)
2.	Formulate appropriate (customer-oriented) measures of process performance and develop corresponding measurement systems.	[•] [•]	Basic concepts of measurement/ metrology (§2.2) Gage repeatability and reproducibility studies (§2.2)
3.	Habitually collect and summarize process data.	[•] [•]	Simple quality assurance data collection principles (§2.3) Simple statistical graphics (§2.4)

Table 1.1 (cont.)

	Step		Tools
4.	Assess and work toward process stability.	[•]	Control charts (Ch. 3, Ch. 4)
5.	Characterize current process and product performance.	[•]	Statistical graphics for process characterization (§5.1)
		[•]	Measures of process capability and performance and their estimation (§5.2, §5.3)
		[•]	Probabilistic tolerancing and propagation of error (§5.4)
		[•]	Estimation of variance components (§5.5)
6.	Work to improve processes that are unsatisfactory.	[•]	Design and analysis of experiments (Ch. 6, Ch. 7)

Introduction

The basic deviation from the outline provided by Table 1.1 that will be seen in IE 361 is a significant expansion of the discussion of the application of statistical methods to metrology. We will do much more than is found in Chapter 2 of the existing printed version of *SQAME* towards the quantification and improvement of the effectiveness of measurement by use of statistical methods. Chapter 2 of the revision-in-progress of *SQAME* made available to you in `.pdf` form presents this expanded set of material.

Logical Analysis of How a Process Should Work

A first step in improving a process is almost always to "map" that process, i.e. to understand how that process works or should work. Sometimes simply laying out "the way things are" and comparing them to "the way things are supposed to be" is adequate to identify what needs immediate attention. Even when this is not the case, conducting a logical process analysis serves to show one where data are needed for complete understanding, and to identify potential sources of variation/unquality.

Two simple tools that are useful in this preliminary process analysis are fishbone/Ishikawa diagrams and process flow charts. For sake of illustration, consider using these in the context of "mapping" the process of delivering a "quality" airline flight. Here first is a partial fishbone diagram that might be made by a corporate analyst concerned with airline customer satisfaction.

Logical Analysis of How a Process Should Work

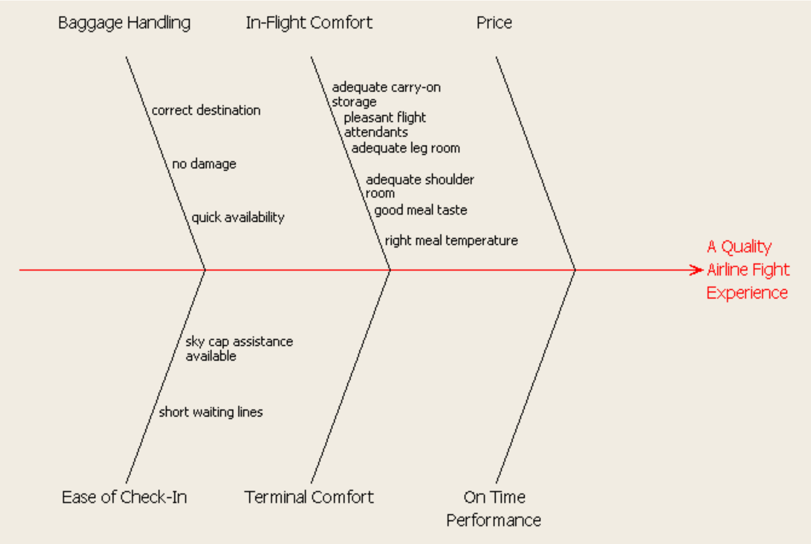

Figure: A Partial Cause-and-Effect/Ishikawa/Fishbone Diagram

Logical Analysis of How a Process Should Work

A process flow diagram can help illuminate interconnections between elements of how something is done. When one makes such a diagram there are two dimensions available for representing the process. One (say top-to-bottom) is typically used to at least roughly represent time order of the various elements. The other (say left-to-right) can usefully indicate some other important variable like physical location or departmental responsibility.

Here is a partial process flow diagram for an airline flight, made from the point of view of a passenger.

Logical Analysis of How a Process Should Work

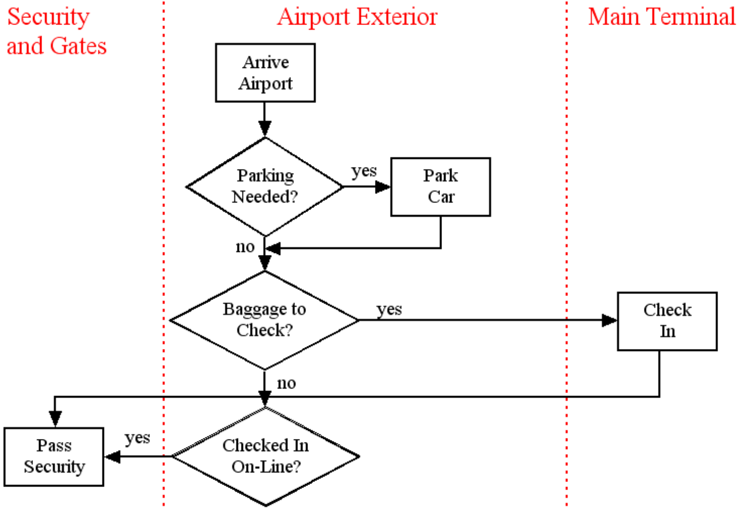

Figure: A Partial Flowchart for an Airline Flight

Logical Analysis of How a Process Should Work

Without simple organizational tools like cause-and-effect diagrams and flowcharts, one has little hope of even naming all of the important elements of a complicated process, let alone seeing where attention might be needed.