SPECIAL NOTE: The design of this course is such that topics in "Managing Research" and "Managing Design" serve as potential topics for team research projects and presentations. Consequently, instructor notes are limited to an extremely brief overview.

MANAGING

ENGINEERING

RESEARCH

AND

DESIGN
DEFINITION OF TERMS

RESEARCH
directed toward achievement and/or
application of knowledge

DEVELOPMENT
use of research results
to produce something

DESIGN
creating a model of something new
CYCLES AND PHASES

Product Life Cycle

Technology Life Cycle

New Product Development Phases

Systems Engineering Phases
CONCURRENT
or
SIMULTANEOUS
ENGINEERING
(NSPE Phases)

<table>
<thead>
<tr>
<th>Stage 1</th>
<th>Stage 2</th>
<th>Stage 3</th>
<th>Stage 4</th>
<th>Stage 5</th>
<th>Stage 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conceptual</td>
<td>Technical Feasibility</td>
<td>Development</td>
<td>Commercial Validation &amp; Production Preparation</td>
<td>Full-Scale Production</td>
<td>Product Support</td>
</tr>
<tr>
<td>Project Team</td>
<td>*Inventor</td>
<td>*Research engineer</td>
<td>Development engineer</td>
<td>Test engineer</td>
<td>Mktg/cost estimator</td>
</tr>
<tr>
<td></td>
<td>Research engineer</td>
<td>Development engineer</td>
<td>Manufacturing engineer</td>
<td>Model engineer</td>
<td>Mktg/cost estimator</td>
</tr>
<tr>
<td></td>
<td>Manufacturing engineer</td>
<td>Manufacturing engineer</td>
<td>Manufacturing engineer</td>
<td>Process engineer</td>
<td>Mktg/cost estimator</td>
</tr>
<tr>
<td></td>
<td>Manufacturing engineer</td>
<td>Development engineer</td>
<td>Buyer</td>
<td>Marketing</td>
<td>Suppliers</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PRODUCT DEVELOPMENT TIME and COST
PRODUCT DEVELOPMENT INVESTMENT RECOVERY
PROTECTION OF IDEAS

Patents
Utility, Design, Plant

Marks
Trade, Service, Certification, Collective

Copyrights

Trade Secrets
"THE ILITIES"
PART ONE

RELIABILITY
The probability that a system will demonstrate specified performance for a stated period of time when operated under specified conditions

MAINTAINABILITY
The probability that a failed system will be restored to specified performance within a stated period of time when maintained under specified conditions

AVAILABILITY
The probability that a system, when used under specified conditions, will operate satisfactorily at any point in time when called upon to do so
"THE ILITIES"
PART TWO

LIABILITY
Legal responsibility for all aspects of performance, most frequently with respect to safety

ERGONOMICS
Application of biological and engineering data to problems of relating people and machines

PRODUCIBILITY (DFM, DFA)
The extent to which the product can be produced, and produced as economically as possible

VALUE ANALYSIS
Assessment of product components for the purpose of decreasing life cycle costs