Development of a Successful Program in Reliability and Maintainability Engineering

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Overview

• **Goal**
  – Provide a case study that may be useful in developing new reliability programs.

• **Outline**
  – What Reliability programs do we have at UT
  – History of how they were developed
  – Components of the program
  – What makes them successful
Reliability Programs at UT

• Reliability and Maintainability Center (RMC)
  – University - industry association dedicated to improving industrial productivity, efficiency, safety & profitability through advanced maintenance and reliability technologies and management principles
  – Industrial Center since 1996 with ~30 members

• Reliability and Maintainability Engineering Program (RME)
  – Interdisciplinary Academic Program
    • Undergraduate Minor in RME
    • Graduate Certificate and/or MS in RME
  – Local or Synchronous, Interactive Distance Delivery

• Prognostics, Reliability Optimization and Control Technologies (PROaCT) Laboratory
  – Interdisciplinary research program with professors and students in industrial, mechanical, nuclear engineering, and statistics.
UT History in Industry Focused RME

• 1988 - Preventive Maintenance Engineering Laboratory (PMEL) under Nuclear Engineering
• 1995 - Proposal to Develop College-wide Maintenance and Reliability Center (MRC)
  – Industry roundtable in July
  – Director named in September
• 1996 - Initial Meeting with 12 Charter Members
• 1997 - NSF Combined Research and Curricula Development (CRCD) Grant to develop 4 MRE courses
• 1997 - Internship Program Created
• 2000 - Initial Academic Program
  – Undergraduate Certificate
  – Graduate Certificate
• 2007 - New RME Programs Approved
  – Master of Science in Reliability and Maintainability Engineering
  – Undergraduate Minor in Reliability and Maintainability Engineering
• 2009 - MS with Specialization in Prognostics
• 2010 - RME Minor most utilized minor in the COE
UT Reliability and Maintainability Center

The Maintenance and Reliability Center is a university-industry association dedicated to improving industrial productivity, efficiency, safety & profitability through advanced maintenance and reliability technologies and management principles.

* Education
* Research & Technology Assessment
* Information Sharing
* Business Support & Alliances

50 Companies with a Desire to Improve
Components of Reliability and Maintainability Engineering Program

• Process vs. Product Focus

• Original Academic Programs
  – Undergraduate Certificate with Industry Partnership
    • Coursework (2 courses)
    • Summer Bootcamp
    • Internship (12 weeks)
  – Graduate Certificate
    • 4 courses: 12 hours
    • Stats 560 Mathematical Statics for Reliability
    • NE 483 Introduction to Reliability Engineering
    • NE 484 Advanced Maintenance Engineering
    • NE 579 Advanced Monitoring and Diagnostic Techniques

Internship Class of 1998

Internship Class of 2000
Internships

Alcoa, Bayer, Dow, DuPont, Eastman, Energizer, Fluor Global, Harley Davidson, Jacobs, Nissan, NiSource, Novelis, ORNL, Owens Corning, Redstone Arsenal, SABIC, Schlumberger, SNL, Y-12, ....

Boot Camp Course
Maintenance Technology Teaching Labs
Real Time Interactive Distance Delivery

- **Supports the working class.**
- Courses are delivered live and interactively (i.e., synchronous delivery) to the student's desktop computer via the World Wide Web
- Taught in “Dual Delivery” format
- Instructor wears wireless microphone
- Local students attend class or log in from home
- Distance students
  - Multipoint audio communication
  - View slides, whiteboard, demos, etc.
  - Students can raise hands
  - Make presentations to class
  - Courses archived
- **Content Delivery Methods**
  - PowerPoint slides
  - Whiteboard
  - Windows application sharing
  - Video or audio clips
Graduate Programs in Reliability Maintenance and Engineering

- **Interdisciplinary program** offered by the College of Engineering through one of the following six departments:
  - Chemical and Biomolecular Engineering
  - Electrical Engineering and Computer Science
  - Industrial and Systems Engineering
  - Materials Science and Engineering
  - Mechanical, Aerospace and Biomedical Engineering
  - Nuclear Engineering
- Offered on campus and through web-based, synchronous, interactive, distance education.
- The RME graduate certificate program (12 hours) is designed to allow the credits to be applied towards an M.S. degree.
Support and Integrate with Research Programs
**Give your COE Graduates a Niche (RME Minor)**

Fifteen hours of coursework are required:

<table>
<thead>
<tr>
<th>Core courses:</th>
<th>Hours</th>
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<tbody>
<tr>
<td>Introduction to Maintenance Engineering</td>
<td>6</td>
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<tr>
<td>Introduction to Reliability Engineering</td>
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<table>
<thead>
<tr>
<th>Statistics or Math Requirement (choose 1):</th>
<th>3</th>
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<tbody>
<tr>
<td>Probability and Statistics for Scientists and Engineers (Stats 251)</td>
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<tr>
<td>Probability and Statistics (Math 323)</td>
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<tr>
<td>Chemical Engineering Data Analysis (ChE 301)</td>
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<td>Probability and Random Variables (ECE 313)</td>
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<tr>
<th>Electives (choose at least 2):</th>
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<tr>
<td>Process Dynamics and Control (ChE 360)</td>
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<tr>
<td>Engineering Data Analysis and Process Improvement (IE 300)</td>
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<td>Statistical Process Control (Stats 365) (for non IE)</td>
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<td>Process Improvement through Planned Experimentation (IE 440)</td>
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<td>Signals and Systems (ECE 315)</td>
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<td>Introduction to Pattern Recognition (ECE 471)</td>
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<tr>
<td>Mechanical Engineering Instrumentation and Measurement (ME 345)</td>
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<td>System Dynamics (ME 363)</td>
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<tr>
<td>Nuclear and Radiological Engineering Laboratory (NE 304)</td>
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**Total: 15**

- 10% of COE graduates have the RME Minor – most desired minor in COE
Summary

• Garner strong industrial support
  – Get their input on curriculum and laboratories
  – Partner through internship programs
  – Partner with research opportunities
  – Meet their needs!
• Make it available to a wide range of students
  – An interdepartmental college-based program reaches more students
  – Increase your reach through distance education
• Build expertise to increase industrial and government research opportunities
• Explain the employment benefits to increase enrollment and promote student success (students will figure this out themselves)