

## **ASEE 2008: HOTS for Independent Reading and Research in Applied Engineering**

Master of Engineering in Professional Practice (MEPP) <http://mepp.engr.wisc.edu>

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### **Advice to Engineering Librarians**

#### **Use of Bloom's Taxonomy for HOTS in Research Projects**

#### **5-Year summary of MEPP IRRAE Research Topics**

### **Advice to other librarians**

- **Win them over with a mini literature search**
  - Show them this is an effective way to get things done.
  - Not used to reading how someone else solved a problem
  
- **Document Delivery**
  - Unfamiliar with a free service. Too good to be true.
  
- **Support them**
  - Any problem you have – come to me.
  - Convince them that you like to get lots of questions
  
- **Repeat yourself. Re-explain**
  - Some people don't hear you until they are in the middle of a problem.

### **Why it's worth the extra effort...**

- **Distance students ask questions that help improve services for everyone.**

**Working engineers are solving real and difficult problems.**

  - Tests the library resources and librarians' skills.
  
- **Proven success of program**
  - Students develop information literacy skills
  - Students want to use library resources after graduation.

## Evaluation

- Overall – continued increase in perceived “value”

...improved research skills considerably	agree 50%	strongly agree 50%
...improved communication skills	agree 50%	strongly agree 39%
...what I learned will be useful...now: ...in the future:	agree 50% agree 56%	strongly agree 39% strongly agree 39%
...library databases were valuable	agree 44%	strongly agree 56%

- Here’s what we heard – appreciation expressed for the work accomplished!

### IRRAE milestone assignments in relation to Bloom's Taxonomy

The concept of HOTS (Higher Order Thinking Skills) grows out of the higher levels of Bloom’s Taxonomy. This effort at applying Bloom’s taxonomy to the milestones of the Independent Reading and research course help to set requirements in advance for class participants and provides the instructors with improved assessment tools.

*Taxonomy of Educational Objects: Book 1 Cognitive Domain*, Benjamin S Bloom, ed. Longman, New York: 1956. Adapted and applied by Patrick Eagan and Paul Ross for “Independent Reading and Research in Applied Engineering” – Master of Engineering in Professional Practice.

Bloom's Cognitive Level					
Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation
<b>IRRAE Project Proposal</b>					
Include facts about a problem to be solved.	Discuss and describe the problem.	Demonstrate or illustrate the expected use of the proposed solution.	Categorize and review possible implications of the proposed solution.	Plan a unified approach to solution (timeline, budget, personnel).	Assess likely level of success; predict value of proposed solution.
<b>IRRAE Literature Review</b>					
Use research to discover the state-of-the-art facts.	Discuss related research, show relationships, and review the relative completeness of the information.	Apply the research to the problem; indicate what is useful and what is not.	Interpret and arrange your discussion to effectively deal with the topic.	Combine different ideas and research information to provide a clear and coherent summary	Draw conclusions as to what parts of the problems have or have not been solved. Recommend next steps.
<b>IRRAE Project Document - Draft and Final Version</b>					
Establish an effective factual basis for project (good research completed).	Discuss and relate the research, explain connections between elements of research and the problem.	Apply facts and research to the identified problem; show effective problem solving for the project.	Identify and relate components of the problems and elements of the research; establish relevance.	Assemble, organize and present elements of the problem and details of research to demonstrate a coherent and complete solution.	Assess significance of your work, likely impact, recommend next steps; note any prospective problems or future issues

**Independent Reading and Research (IRRAE) – 5 years of projects**

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**Note the distribution of research topics relevant to advanced practicing engineers and the broad range of knowledge and experience required for engineering librarians.  
60% of the topics chosen by these engineering technical leaders are OUTSIDE the specific realm of traditional engineering.**

Topics and 5-yr Distribution		Characteristic Concerns	Research tools
<i>Technical and design</i>	40%	<i>Technical; standard engineering and technical design</i>	<i>Engineering and technical; computer technology; scientific in specific areas; medical; standards, regulations, patents</i>
<i>Quality/testing</i>	20%	<i>Tools and methods for measuring, testing, improving quality</i>	<i>Engineering and technical; materials; business and management</i>
<i>Management and methods</i>	20%	<i>Current techniques, methods and strategies relating to economics, marketing, best competitive practice</i>	<i>Business and management; news and trade news; communication; economics, global competition; international business</i>
<i>Human factors/training</i>	20%	<i>Training and education, work environment, international concerns, employee retention</i>	<i>Humanities, social sciences, medical, education and training, cultural, communication, ethics</i>

<b>IRRAE Topics Summer 2007</b>	<i>Technical and Design: 11 Management and Methods: 5</i>	<i>Quality/testing Methods: 4 Human factors/Training: 4</i>
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***Technical and Design***

Research on Server Visualization Workload Management  
Ceramic Capacitor Surface Mount Technology in a Harsh Environment  
Silgan Containers Manufacturing Corporation’s Exploration of RFID  
Heavy-Duty Hybrid Certification and Tax Credit  
Bioreactor Control System Optimization Strategies  
CAN Bus Alternatives in Diagnostic Medical Equipment  
Data Mining Applications Using Decision Tree Analysis  
Incorporating “Hardware-in-the-Loop” into the Controls Development Cycle  
Controlling SKYPE at “Company” Border Access Points  
Wind Power at Rock Island Arsenal: Site Considerations and Wind Resource Measurement  
Thermistor Formulary Modification for Greater Durability and Reduced Manufacturing Cost

***Quality/Testing Methods***

Best Practices for Modal Impact Testing  
Compaction Control Using the Soil Stiffness Gauge  
“Reliability Centered Maintenance” Optimization – the State-of-the-Art  
Accelerated Reliability Testing of a Master Cylinder Primary Cup Seal

***Management and Methods***

Reducing the Order Fulfillment Cycle Time in an “Engineered to Order” Environment through Improved Materials Management

Change Management as part of UTC's "ACE"  
 Developing Business Decision Making Strategies Utilizing Game Theory  
 New Product Introduction Process Improvement Using Quality Function Deployment (QFD)

**Human Factors/Training**

Implementing Risk Management – a Systems Engineering Approach to Hazard Identification  
 Corporate Communication Plan Development  
 Improving Employee Engagement and Retention  
 Strategies for Improving Communication Between German and American Technical Personnel

<b>IRRAE Topics Summer 2006</b>	<b>Technical and Design: 14 Management and Methods: 4</b>	<b>Quality/testing Methods: 5 Human factors/Training: 3</b>
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**Technical and Design**

Sharing up-to-date "as-built" Engineering Drawings for the Manufacturing Facilities of Large and Geographically Dispersed Enterprises  
 Implementation Requirements of On-Board Diagnostics (OBD) in Off-Road Diesel Equipment  
 Understanding Class I Hazardous Location Requirements Specific to Hydrogen Applications. An interpretation of the NEC, NFPA, BOC Gases, and other industry specifications – focus on electrical codes  
 Designing a Structural Cast Iron Component for a Tractor Utilizing Finite Element and Bolted Joint Analyses  
 Three-dimensional Scanning Equipment for Reverse Engineering Aircraft Components  
 Evaluation of Possible Electric Drive Train Systems for a Self Propelled Sprayer  
 Stoichiometric Compression Ignition – Emission Impact & Feasibility  
 A Recommendation Report Comparing the Advantages and Disadvantages of No-till Farming in Illinois  
 Existing and Innovative Approaches to Audio Compression  
 Automated Detection of Paint Surface Defects on Automotive Surfaces  
 Technical Evaluation of the FATHOM Steady-State Pipe Flow Computer Code  
 Parametric Model Selection of x-ray Attenuating Materials  
 Guidelines for Driveline Angles during PTO Durability Testing of Agricultural Tractors

**Quality and Testing**

Risk Management and Contingency Analysis Methods for the NOvA Experiment  
 Methods of Measuring & Evaluating Windshield Aerodynamic Properties and Effects on Motorcycle Riders in Wind Tunnel Testing (With Emphasis toward Windshield Design Characteristics)  
 Medical Imaging Vendors and Their Support for the New Supplements to the DICOM standard  
 Commercially Available Software Tools for Statistical Process Control (SPC) Calculations and Monitoring  
 Best-practice Methodology Using Advanced Mathematics for Statistical Data Analysis Applied to Test Data

**Management and Methods**

The Impact of Lean Product Development techniques on product speed to market  
 Marketing and Management Components of a Business Plan for an Accessory Line  
 One Product Development Process; Lean Design for Six Sigma.  
 Fallacies of the Design-Build Concept for Large Industrial Facilities

**Human Factors/Training**

Water and Wastewater Problems in Africa; Career Path Development  
 Survey of Regulations for Manufacturers of Medical Devices that Emit Ionizing Radiation - training materials  
 Managing Geographically Dispersed Virtual Teams

<b>IRRAE Topics Summer 2005:</b>	<b>Technical and Design: 8 Management and Methods: 5</b>	<b>Quality/testing Methods: 5 Human factors/Training: 5</b>
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**Technical and Design**

Design of a Centrifugal Pump Impeller  
 Fuel Cells for Aircraft Emergency Power  
 Biodiesel to Reduce Harmful Emissions and Decrease Foreign Oil Dependence

Applications of Particulate Filters to Off-Highway Heavy Duty Diesel Engines  
 Cost of Atria in Public Sector Buildings  
 Gear Coatings to Increase Power Capacity and Reliability  
 Alternative Energy Technologies for Military Ground Vehicles  
 A Strategy for Modeling Agricultural Equipment in Pro/Engineer

**Quality/testing Methods**

Investigating Bearing Failure Using Prognostic Health Monitoring (PHM) on Aircraft Power Generators  
 Non-destructive Testing methods to Detect Cracks in Aircraft Components  
 Infrared Thermography in the Design and Prototyping of Industrial Electronics  
 Improving Specs, Design and Testing to Prevent Software Disasters: Four Case Studies  
 Software Risk Management for Patient Monitoring Programs

**Management and Methods**

Integrated Contingency Plan – Spill Prevention and Control, Resource Conservation and Recovery, Storm Water Pollution Prevention  
 Developing a Hybrid Technique for Implementing Process Management  
 Implementing a Concurrent Engineering Program at LM Tactical Systems  
 Increasing Customer Loyalty Equals Increased Sales and Profits  
 QRM Gets a Trial Run

**Human factors/Training:**

Urgency Addiction: Personality Problem or Current Business Culture  
 Breaking the Boundaries in the Modern Workplace: A Case for Positive Deviance  
 Promoting a Culture of Safety to Improve Test Lab Decisions  
 A Proposed Solution for On-the-Job Injuries Among Airplane Baggage Handlers  
 Planning and communicating for a Plant Shutdown

<b>IRRAE Topics Summer 2004</b>	<b>Technical and Design: 10 Management and Methods: 7</b>	<b>Quality/testing Methods: 6 Human factors/Training: 6</b>
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**Technical and Design**

Dense Wavelength Division Multiplexing/ Fiber Optic Communication  
 In-vehicle networks/Local Interconnect Networks (LIN)/By-wire Apps  
 Shot-peen Process to improve connecting rod reliability  
 GIS Applied to Airport Security and the MANPADS threat  
 A Comparison of Autocode generation tools  
 Mechanisms to prevent stainless steel oxidation and corrosion in aqueous cleaning conditions  
 Use of industrial grade electrical components (COTS) in military applications  
 Requirements for cooling/radiator systems for heavy duty trucks  
 Automatic Dependent Surveillance-Broadcast (ADS-B) and the National Airspace System (NAS)  
 Embedded Passives (resistors and capacitors) in printed wiring boards

**Quality Methods**

Predictive Maintenance (PdM) technologies for production lines  
 IEEE standards for test and diagnostics/IEEE SCC20  
 Fault Tolerance for aerospace power units  
 SEMI F47 Voltage Sag Guidelines  
 Hardware Torque Retention Process Improvement (nuts and bolts)  
 Evaluation of FEA and CAE tools in the design and development of latch mechanisms

**Management and Methods**

Identifying Competitive Patents  
 Semiconductor/Business Partnerships with China  
 Calculating ROI on Automated Testing Methods  
 Feasibility and benefits of Decentralized Customer Service  
 Methods of Project Ranking for Research and Management: Scorecard Model

Information System Security Engineering (ISSE) for the US Department of Homeland Security  
 Engineering failure investigation team processes: RCA process challenges

**Human factors**

- Small Project Teams and team-building/conflict resolution
- Educational outreach: Humans in Space
- Understanding and resolving the Problem Solving Impasse in Engineering
- How to Set Appropriate Roadway Speed Limits
- Issues and Information for Transitioning to Management roles
- Acceptable actuation forces for mechanical operator levers on agricultural tractors

<b>IRRAE Topics Summer 2003</b>	<b>Technical and Design: 10 Management and Methods: 5</b>	<b>Quality/testing Methods: 6 Human factors: 6</b>
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**Technical and Design**

- Controlling Engine / Powertrain Gear Noise
- Software Processes for Safety-Critical Systems
- Automotive Paint Application Using Robotic Electro-Static Rotary Bell Applicator Technology
- Methods Used to Determine Thermal Analysis of Wire Harness Bundles
- The Design Characteristics of Pre-chamber Nozzles and Their Potential Effects on Pre-chamber and Main Chamber Combustion
- Understanding and Controlling Carburetor Variability
- High Density Storage Media: MO vs. DVD
- Solder Reduction in Aluminum Die Casting Engineered Surfaces for Die Cast Tooling
- The Use of Permeable Asphalt Pavements as part of a Sustainable Stormwater Management System
- A review of Factors Contributing to Robust Design Requirements

**Quality Methods**

- Geometric Dimensioning and Tolerancing (GD&T)
- Design for Six Sigma
- Researching Industry Metrics for Process Improvement
- Improving PRO/E Model Utilization Effectiveness in Planning and Instructional Communication for New Tractor Assemblies
- Design of Experiments: Methods and Applications for reducing Process Variation
- Measurement System Assessment Methods and Sources of Measurement Error (Improving needle bearing cage bar-skew measurement)

**Management and Methods**

- Value Selling: An Introduction for Hach Ultra Analytics Sales Associates
- Inventory Control and Inventory Optimization – Reducing Inventory
- Best Management Practices for Improving Energy Efficiency at Solvay Chemicals Peroxygen Facilities
- Collaborative Manufacturing Recommendations for Johnson Polymers
- Using Throughput Accounting for Better Decision Making

**Human factors**

- Reducing Carpal Tunnel Syndrome with Proper Workstation Configuration
- Minimizing Fear and Anxiety in the Workplace
- Limiting Product Liability through the Effective Use of Product Warnings
- Organizational Factors for Successful Knowledge Management Systems
- The Human Side of Knowledge Management
- The Psychological Impacts of Nuisance Alarms on the Human Operator