Introduction to the National University Rail Center: Education, Research, Workforce Development and Technology Transfer

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When Rail Meets Soil
Technical Workshop
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Presentation Outline

• Background
• NURail Center Introduction
• NURail Center Mission, Theme, Strategic Planning & Partnerships
• Introduction to NURail Partners’ Activities
• Conclusions/Your Input
Railroads vital to short- and long-term U.S. transportation effectiveness

- **Safe, Economical, Energy Efficient, Environmental and Sustainable Transport Mode**
  - **Freight railroads** - Most successful in the world
    - 43% of intercity freight ton-miles
    - Vital to economic competitiveness
    - Continued traffic growth
  - **Passenger rail** - Expansion and new initiatives
    - Urban, commuter & regional rail expanding
    - New, intercity, high-speed rail projects and proposals
  - **Challenges and technology opportunities for both**
Solutions and People Needed

• **Technology, Operations and Policy Advancements**
  – Ongoing incentives to improve safety, efficiency, quality, reliability and capacity
    • **Technologies** - train control, brakes, health monitoring, locomotives
    • **Operations** - planning, dispatching, capacity
    • **Policy** - financing, community economic development, decision-making

• **Human resources**
  – New generation of railroad engineering and transportation professionals needed
    • Plan and manage railway organizations
    • Design, build and maintain systems
    • Safely, efficiently and reliably operate trains
U.S. Needs a Balanced Transportation System

We need a *balanced* transportation educational and academic research program to achieve and sustain it
Serious rail industry demographic challenge

- Aging rail industry workforce
  - 50% may retire in the next 5 years
- Expanding demand
- Nation needs a new generation of rail professionals
- Where will they come from?
- Colleges and universities?
- Unlike highway, **very** few academic programs teach principles of engineering and transport
- Why?

(Data from a Class 1 railroad)
Highway: rail academic transportation funding ratio has been about 100 : 1
Introduction to UTC Program and NURail Center

- University Transportation Centers UTCs are groups of colleges and universities conducting research, education and technology transfer with a specific transportation-related focus
- Funded by the US Department of Transportation (DOT) - Research and Innovative Technology Administration (RITA)
- RITA reorganized the UTC program in 2011, stressing a new, multi-modal focus
- 10 Regional Centers and 12 Tier-1 National Centers
- The National University Rail (NURail) Center consortium proposed formation of the first, rail-focused UTC in the program’s history
- Proposal received broad industry and government support
- RITA (Now OST) selected the NURail Center proposal and launched in 2012, re-competed and reauthorized for 2014/15
Three Principal Elements of NURail Mission

• **Technical Research**
  – Identify strategic needs and conduct a portfolio of research ranging from basic to applied
  – Complimentary to, and supportive of, industry and government research
  – Work with private and public sector rail community to complete research to advance rail transport

• **Education and Workforce Development**
  – Inspire rail interest among faculty and students of all ages
  – Develop courses and curriculum in rail engineering and transport
  – Traditional and non-traditional educational delivery

• **Technology Transfer and Research Implementation**
  – Build on existing stakeholder partnerships, and develop new ones
  – Broadly communicate results using publications, industry workshops, conferences, on-line seminars and web-based tools
NURail Center theme “Economic Competitiveness”

- Principal NURail Center focus is on *shared rail corridors*, in which freight and passenger trains share right of way and/or infrastructure
  - Timely and critically important topic to *all* major stakeholders
  - Challenging infrastructure, rolling stock, operational and institutional problems
  - Drives research toward critical, cutting-edge challenges
  - Ideal “crucible” for both research and educational programs
  - Prepares faculty and students to understand key problems and make important contributions to advance the field
  - Implementation of results driven by strong relevance to rail community
Strategic Development Planning

- Variety of sub-themes needing both short- and long-term research
- NURail is developing Strategic Development Plans (SDP) to provide guidance and focus during the course of the UTC grant, and beyond
- Topics range from technology and operations, to planning and policy
  - Integrated Railroad Track/Vehicle Interaction and Dynamics
  - Railroad Safety and Risk
  - Rail Network Capacity Analysis and Planning
  - Urban, Regional and High-Speed Passenger Rail Implementation
  - Multimodal Freight Transportation
  - Funding, Finance, Community and Economic Development
Domestic and International Cooperation with Private & Public Sector

- Association of American Railroads
- Class 1 freight railroads
- Amtrak
- Commuter railroads
- Rail supply industry
- Engineering firms
- State DOTs
- FRA
- International universities and rail research institutes
Introduction to NURail Partners’ Activities
• Research
  – Effects of mixed use traffic on rail line capacity
  – Optimized infrastructure upgrade for higher-speed operation
  – Mechanistic design of crossties and fastening systems for mixed use trackage
  – Passenger train risk minimization strategies for shared corridors

• Education
  – Development of new HSR academic courses and curriculum
    • HSR Engineering
    • HSR Project Planning
    • HSR Construction Management
    • HSR Operation and Maintenance
    • Shared Rail Corridor Engineering & Operation
  – William W. Hay Railroad Seminars & webcasts
University of Illinois at Chicago

• Research
  – Dynamics of Derailment: Wheel climb at large angle of attack; longitudinal train forces
  – Vehicle-Track Interaction: Simulation of train on deformable rails and substructure
  – Structural Materials: Recycled plastic rail ties
  – Rail and Transit Capital Funding: Coordination of capital planning, taxation, and development for value capture
  – Environmental Assessment GIS Tool
  – Freight Mode Choice Modeling

• Education
  – Railroad Vehicle Dynamics; Track Engineering

• Outreach
  – Future Leaders in Planning (FLIP) program
Rose-Hulman Institute of Technology

- **Education**
  - **CE 490 Railroad Engineering**
    - Interdisciplinary – CE-EE-ME
    - Spring Enrollment – 10 CE & ME
    - 40 class periods
  - **CE 489 Senior Capstone Design**
    - Spirit of Terre Haute Deming Park
    - INRD & Terre Haute Parks
      - New track alignment
      - New terminal
  - **RHIT AREMA Student Chapter**
    - December 2012 – 16 members
    - 7 Chapter Meetings
    - 7 Rail Field Trips
University of Kentucky

• **Research**
  – Tie-Ballast interaction/Tekscan sensor
  – 3D grade crossing assessment model
  – Shared corridor financing and startup
  – Lock and dam disruption impact on rail (collaboration with MTIC UTC)

• **Education**
  – Development of new multimodal operations course
  – Development of new multimodal operations text
  – New REES modules
  – RailCats AREMA student chapter
    • Operation lifesaver
    • Top railroad executives as guest speakers
    • E-Day
    • Field trips to operating railroads
Massachusetts Institute of Technology

• **Research**
  
  – High-Speed Rail (HSR)
    
    • The CLIOS Process is applied in combination with scenario analysis and real options to account for the exceptional uncertainty encountered in HSR in the Northeast Corridor (NEC)
    
    • Various bundles of strategic alternatives are developed for the NEC with special attention directed toward institutional and technological flexibility
    
    • International HSR experiences: Lessons for the U.S.
    
    • Consideration of additional U.S. corridors
Michigan Technological University

- **Research**
  - Driver Attention and Rail Crossing Safety
  - Austempered Ductile Iron (ADI) for Railroad Wheels
  - Collaborative (3) Projects with Michigan DOT

- **Undergraduate Student Projects**
  - Locomotive Sand Tank Sensor Development (EE)
  - Type E coupler re-design (ME, MSE, CE)
  - Michigan Grade Crossing Surface Evaluations (CM, CE)
  - Rail Promotional Video (SS, HU)

- **Education / Outreach**
  - Rail Transportation / Engineering Certificate
  - Rail and Intermodal Transportation Summer Youth Program
University of Tennessee, Knoxville

- **Research**
  - Behavior of Railroad Bridges with Hybrid Composite Beams
  - Assessment of Foreign HSR Bridge Design Practices
  - Development of New Damping Materials for Ballastless Trackbed
  - Evaluation of Terminal Capacity Models for Rail Freight Flow Analysis

- **Education**
  - Incorporate railroad modules in existing CE courses (e.g., Materials, Asphalt Design)
  - Short courses for working professionals
  - REES I and II modules and training
  - AREMA Student Chapter

- **Technology Transfer**
  - Supporting TRB and ASCE rail committee activities
  - Specialty rail workshops and short courses
  - Hosting JRC 2013
Your Input

- What do you see as critical rail research issues?

- What would you like to see in a new graduate?

- We are committed to helping develop:

  Next Generation Railroads and
  Next Generation Railroaders
Thank You!

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