THE UNIVERSITY OF TEXAS AT EL PASO
COLLEGE OF ENGINEERING
Educational and Research Models for Academia Industry Government Collaboration

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Agenda

- Who We Are
- Motivation for new Collaboration Models
- Work Plan
- Introduction to RIMES
- Business Models
- Major Outcomes/Results
- Future Work
College of Engineering

- UTEP Roots
- 1st degrees offered
  - Engineer of Mines (1914) TSSMM
  - B.S. in Mining Engineering (1919) TCMM
- Now only Doctoral/Research
  Intensive University with a Mexican-American majority student population
UTEP Doctoral Enrollment Growth

Chemistry (2007)
Computer Science (2005)
Interdisciplinary Health Sciences (2005)
Civil Engineering (2003)
History (1999)
Biological Sciences (1997)
ESE (1995)
MASE (1992)
Psychology (1992)
Computer Engineering (1991)
Geological Sciences (1974)
College Programs

UNDERGRADUATE
PROGRAMS/DEPARTMENTS

MS PROGRAMS
- Civil Engineering
- Computer Science
- Computer Engineering
- Electrical Engineering
- Environmental Engineering
- Industrial Engineering
- Information Technology
- Manufacturing Engineering
- Mechanical Engineering
- Metallurgical & Materials Engineering
- Systems Engineering

PhD PROGRAMS
- Civil Engineering
- Computer Engineering
- Computer Science
- Environmental Science & Engineering
- Materials Science & Engineering
- Manufacturing (TCB Approval)
- Bioengineering (TCB Approval)
COE at a Glance: 2008-2009

- Enrollment (3042): 2436 BS, 418 MS, 188 PhD
- Graduates: 250 BS, 137 MS, 20 PhD
- 80 Faculty
- $24.5 M external funding
- $15.86 M total endowments
Major Contributor to Diverse Workforce

- UTEP College of Engineering is the:
  - #1 producer of Hispanic American BS
  - #4 producer of Hispanic American MS
  - #2 producer of Hispanic American PhD

- #1 Graduate School for Hispanics (Hispanic Business Magazine)
Current Research Centers

- Center for Transportation Infrastructure Systems (CTIS)
- W.M. Keck Center for 3D Innovation
- Research Institute for Manufacturing and Engineering Systems (RIMES)
- Cyber ShARE Center for Excellence
- CsER: Center for Space Exploration Research
- Center for Entrepreneurship, Innovation & Commercialization
Motivation for New Collaboration models
Challenges of the 21st Century

Challenges According to NAE:

- Energy
- Water
- Environment
- Global Warming
- Sustainability
- Improve medicine and healthcare delivery
- Reducing vulnerability to human and natural threats
- Expand and enhance human capability and joy
What it means?

- Multidisciplinary to Trans-disciplinary team work
- End-to-end Systems thinking
- Non-traditional Skills required from Engineers:
  - New Technology/SOS/Product Development
  - Assess Techno-economical feasibility
  - Team work in multi-functional environments
  - Management
  - Taking idea from Concept to Commercialization
- Joint Academia/Industry/Government efforts: **Ecosystems**
NASA’s Best Engineers

What are the characteristics and behaviors of the “Best Engineers” that set them apart?

- 38 Characteristics
  - 36 out of 38 Soft Skills
  - 2 out 38 Hard Skills
- Skills grouped into
  - **SOFT**: 1) Leadership, 2) Attitudes, 3) Communications, 4) Systems thinking
  - **HARD**: 5) Technical Acumen

REF: October 16, 2008 Christine Williams, NASA-SELDP Program Director
Charles M. Vest has observed “the engineering world is disappearing.”

Only 40% to 60% of students who start in engineering continue on to finish a degree in engineering.

Society is demanding a broad based, liberal engineering education.

Paradigm shift from Theory to Practice.

Encourage Team work, Creativity and Innovation.
Industry Challenges

- Competitiveness/Productivity
- Development times from 18-24 months in mid-80s to 3-6 months in 21st Century
- R&D Budgets decreasing drastically
- Dynamic requirement changes
- Retiring workforce
- Demographics change
- Globalization
WORK PLAN
SE Work Plan

2006
- DISCOVERY
  - Industry Needs
  - UTEP Capabilities
  - Programs Offered
  - Financial Models
  - Course Inventory

2006-2007
- STRATEGIC
  - College Objectives
  - Analysis of Options
  - Analysis of programs offered by other Universities
  - Program Objectives
  - Target Audience
  - Admission Requirements
  - Sources of Funding
  - Deployment Options
  - Advisory Board
  - Internal Trial (spring 2007)
  - Program Approval
  - Multi-department Participation
  - Industry Support
  - Government Grants
  - Certificate Offering
  - Curricula Definition
  - THCB Approval
  - Lines of Research

2007-2008
- DEPLOYMENT

2008-
- OPERATIONS
  - Certificate GA
  - MS GA
  - Ph.D. Definition
  - Research Center
Program Objectives

- To educate engineers, researchers, educators who will address the cross-disciplinary engineering needs of the 21st century
- To educate professionals who will not only be technically competent across interdisciplinary emerging technologies but also address and adapt to changes and challenges associated with the increasing complexity of systems
- To engage engineers from different fields in the application of cross-disciplinary processes and models to resolve industry problems
- To develop the necessary communication skills to engage with customers and agree on goals in complex systems development
- To train and educate systems educators to respond to the global economy and to work in international environments
Curriculum Development Principles

- Industry Surveys to determine needs
- Industry Participation in Advisory Role
- Government Agencies in Advisory Role
- Courses with high content of experiential learning through multi-disciplinary teamwork
- Practice Based Program
- Multi-departmental collaboration
Advisory Board

- AB will be constituted by at least seven members who will serve one year term
- AB composition:
  - Two (2) members from in-town industries
  - Two (2) members from out-of-town industries
  - Three members from UTEP
- Members selected by Graduate committee
Advisory Board roles

- Provide input to UTEP on industry expectations of the Systems Engineering program
- Guide in the definition of a vision and a mission statement for Systems Engineering at UTEP
- Review curriculum and course content
- Help in the selection of students from industry to enroll in the program
- Help “advertise” the program within their companies and industry in general
- Advise on creation of projects and areas of research of interest to the industry
- Meet on regular basis to review and track Systems effort progress within UTEP and compare with national and international trends.
Advisory Board Members

- Jacobs Engineering
- NASA
- LMC-Aeronautics
- Raytheon
- WSMR
- FAA
- MIT
- INCOSE
- Sandia National Labs
- Miratek
- ATAMIR
RIMES Objective

- To facilitate interactions among colleges and industry to foster total systems-level thinking
- To address SOS applications oriented research areas
- To advance practice based multi-disciplinary educational programs
- To research and publish advances in Systems Engineering emerging technologies
- To stimulate the adoption of standards and best SE practices within industries.
Areas of Research

- MPT for Integrated Development
- SOS Formal Requirements Methodologies
- MBSE & Modeling Languages
- Application of SOA to SOS (Next Gen NCS)
- Trade-off studies
- Lean/Enterprise SE
- SoS Reliability (Prognostics, Resilience)
- SoS Risk Analysis
Creating a SE Track @ UTEP

- Ph.D. SE 90 Credits (M.Sc. Plus 60 credits) >4+ (2013)
- M.Sc. SE 30 Credits (5 Core + 2 Special Topics + 3 Electives) >1+ (2009)
- Interdisciplinary M.Sc. In Engineering w/ SE concentration ASAP (2007)
- Graduate Certificate SE 15 Credits (5 Core) ASAP (2007)
Business Models
Business Working Premises

- Educational non-for-profit
- Financial support to students required
  - 75% <20K Family Income
  - 68% work
- Engaging Industry and Government
- Resources for Infrastructure a must
- Enhancing student’s probability of success
- Long Term Sustainability
# Research Comparison

## ACADEMIA
- Basic/Fundamental
- Technology/Process
- Specialty Specific
- Insightful Papers
- Intellectual Property
- Individual Reward System

## INDUSTRY
- Stakeholder Value-added
- Increased Competitiveness
- Improved Processes
- Product Specific Innovation
- Trans-disciplinary
- Solutions to current problems
The Challenge

- Knowledge Transfer Gap
- R&D Alignment
- Timeframes
- Inter & Intra Communications Flows
- In-depth understanding of Technology needs and/or Company Practices
- Interface Agreements
- Transactional
Type of Projects

- Extension Programs
- Technical Assistance/Consultancy
- Developmental
- Research
Available Mechanisms

- **Traditional Funding**
  - Government Agencies Grants for Research (T&M)
  - Internships, Fellowships, Scholarships (Fixed Allocation)
  - Extension Programs (T&M)
  - Technical Assistance Programs (T&M and/or Shared cost)

- **Non-traditional Funding:**
  - Industry Contracts for Developmental and Research (Research Outsourcing)
  - Service Agreements (Basic/Application/Commercialization)
  - Combinations thereof
Non-Traditional Funding

- Fixed Firm Pricing
  - Commit to deliverables on time and on cost
  - Commit Qualified Resources
  - Manage effort ("PI & PM")
  - Legally Binding contract

- Service Agreements
  - Technical Assistance, Developmental Projects & Research Projects

Creation of a Customer-Supplier Relationship
Research & Developmental

**INDUSTRY**
- LMC-Aeronautics (SA, FFP)
- Skunk works (FFP)
- Jacobs Technology (SA)
- Raytheon Research (IDS & NCS) (FFP)
- Hamilton Sundstrand (FFP)
- University Medical Center
- AT&T

**Government**
- DOC-NIST (T&M)
- NSF (T&M)
- USDA (T&M)
- DOE (T&M)
- NRO
- CIA
- AFRL
Research Model

(1) BASIC
- Non-disclosure
- IP Inventory
- Supported by Industry
- Research On-premise
- PI-PM two way flow
- Regularly scheduled reviews
- Joint Publication/Review

(2) APPLICATION
- IP University, Industry, Joint
- Clearance Process
- Development sponsored by Industry
- In their Labs

(3) COMMERZIALIZATION
- Joint Agreement between the parties
Students/Faculty Involvement

- Full Time summer employment w/industry
  - Developmental (PI, PM)
  - Research (PI, PM)
- On-campus:
  - RA 20+ hours per week on projects (PI)
- Off-Campus:
  - Full time assignment (PM)
- In all cases exposure to Executives
Service Agreements (Developmental)

- Jacobs Technologies/NASA
- Hamilton Sundstrand
- LMC-Aeronautics (Developmental Projects)
- AT&T Developmental Projects
- Etc.
Service Agreement (TA)

- AFRL
- Boeing
- LMC
- UMC
- >400 SME

- NIST-TMAC
  - Federal Government
  - Academia
  - SME
- Manufacturing Sector
- <500 employees
- Separate Accounting
- Economic Impact
- Audited by GAO
Relations with Universities

- **Host institution provides**
  - Facilities,
  - Labs,
  - Expertise, and
  - Students

- **University partners housed in academic departments**
  - East Central in TEEX
  - Gulf Coast in College of Technology
  - Metroplex in College of Engineering
  - Paso del Norte in College of Engineering
  - South Texas in Academic Research Centers
  - West Texas in Office of Research

- **South Central housed in Manufacturing Systems Dept.**
- **Exec Council member serves as interface with host**
Existing COEs

- Lean Manufacturing, Six Sigma, Black Belt Certification
- Quality (ISO9000, AS9100, EMS, etc.)
- Strategic (Business Plans, Market Strategies,
- Workforce (TWC, Leadership, Management Skills, etc.)
- Technology (Innovation, Insertion and Commercialization)
Skills Development

**TMAC Partners with TWC and Community Colleges**

- Tyler College
- Lone Star College
- San Jacinto Junior College
- Houston Community College
- Wharton Community College
- Dallas County Community College District
- Collin County Community College District
- Tarrant County College District
- Hill College
- Grayson County College
- El Paso Community College
- South Texas College
- South Plains College
- Alamo Community College
- Austin Community College
- Temple College

Total Booked-in GY 13-14: $4,158,961
Challenges Working Within University

- Universities policies and procedures
  - Take time to understand; however, they
  - Protect the center
- University provides credibility, financial stability
- Financial systems not designed for consulting operation
- Industry Consultancy/Developmental not highly valued by the system and/or the faculty
- Developing image has been a challenge
- State policies influence university budget
  - Merit raises
  - Travel
Lessons Learned

- Projects must have an impact on competitiveness/productivity
- Multi-year planning & commitment (Financial & Technical)
- Two way knowledge transfer (researcher/production)
- PI & PM cross-functional and organizational networking
- Co. awareness programs and joint follow up after contract fulfilled.
- Relational Model more adequate for Experiential projects
- University MUST understand the project’s strategic context
- Face-to-face regular reviews
Major Outcomes/Results
Major Outcomes

- Positive outcomes in student development, program growth, recognition, and numerous unsolicited research offers to collaborate.
  - 40% per year growth in student numbers each of the last 3 years
  - 200% increase in industry and government funding $1.2 M to $3.8 M YE10
  - Expect to reach $6.0 M by YE12

- We are contributing to define, create and implement an academic model to address the known challenges for the engineer of the 21st century
  - Bringing together Academic, Research and Technology Development programs at different levels to encourage multi-disciplinary work, to foster end-to-end systems thinking and to close the gap between engineering academic research and industry applied research needs
Future Work
Future Work

- Evolve traditional IE Department into a 21st Century Enterprise Systems Program
- Creating expertise in:
  - Energy Systems
  - Health Management
  - Sustainability
  - Knowledge Management
- Define Vision for 2012:
  - Where should we house an organization like RIMES?
  - What is the best governance model for RIMES?
  - Should we be a not-for-profit organization?
  - Is RIMES a point solution to the problem of the 21st century engineer? And if so, is that a bad thing?
  - Can we sustain high industry interrelations as we grow?
  - Should we cap enrollment if our principles are threatened?
Vision 2012

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Questions?

Thank you