Cultivating Global Competency and Entrepreneurial Mindset for Engineering Students

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Agenda

1. WPI’s Project-based Curriculum
2. China Hub @ WPI
3. Operations and Industrial Engineering Program
4. Technology-based Innovation & Entrepreneurship
WPI’s Project-based Curriculum

- Teamwork skills
- Communication skills
- Problem solving skills
- Project management skills

WPI’s Motto: Theory and Practice

Great Problem Seminars (GPS)
Six themes, each seminar is 6 credits

HUA Requirements
Humanities & Arts (6 courses; 18 credits)

Interactive Qualifying Project (IQP)
Non-major related, 3 courses → 9 credits

Major Qualifying Project (MQP):
Major related; 3 courses → 9 credits

Students’ progress of integrated skills

• Teamwork skills
• Communication skills
• Problem solving skills
• Project management skills
Undergraduate Projects

• **Great Problem Seminars (GPS): 1\textsuperscript{st} year**
  – Introduces freshman to team-based project work

• **Humanities and Arts Requirement (HUA): 2\textsuperscript{nd} year**
  – Individual exploration aimed at critical analysis, research skills or art
  – Link: [http://www.wpi.edu/Admin/OAA/Designs/hua.html](http://www.wpi.edu/Admin/OAA/Designs/hua.html)

• **Interactive Qualifying Project (IQP): 3\textsuperscript{rd} year**
  – Team-based analysis of impacts of technologies on society
  – Link: [http://www.wpi.edu/academics/Projects/index.html](http://www.wpi.edu/academics/Projects/index.html)

• **Major Qualifying Project (MQP): 4\textsuperscript{th} year**
  – Practical, related to major; usually team-based
  – Link: [http://www.wpi.edu/academics/Projects/index.html](http://www.wpi.edu/academics/Projects/index.html)

• **Global Project Centers:**
  – Link: [http://www.wpi.edu/academics/igsd/project-centers.html](http://www.wpi.edu/academics/igsd/project-centers.html)

• 30+ Global Project Centers;
• > 60% participation rate
• WPI’s first giant stride towards global engagement

• Strategically positioning WPI at the forefront of global education market
More employers are seeking new college graduates that require \textit{less training but can adapt themselves quickly} to a new job environment as well as work easily in a team that is often cross functional.

Transition Time

Innovative
Entrepreneurial
Competitive
Technology-driven
Flat
Complex
Globally-integrated
Building Blocks of China Hub

1. Grants
   - NSF Global Education grant (2005 – 2008)
   - DoEd Business and International Education (BIE) grant (2009 – 2011)
   - DoEd Undergraduate Int’l Study & Foreign Language (UISFL) grant (2012 – 2014)

2. Education
   - Project Centers: Hong Kong IQP, Hangzhou IQP, and China MQP
   - Partnerships with 13 Chinese universities (7 in HK + 6 in Mainland)
   - China related curriculum
   - Seminar series on China @WPI

3. Research
   - Individual faculty research collaborations
   - IGERT (Integrated Graduate Education and Research Training)

4. Business Outreach
   - Project sponsors
   - MassMEP
   - Solar Decathlon
WPI’s Current Footprint in China Through Student Projects

- MQP partners and sponsors
- MQP Centers, MQP partners and sponsors
- HZ IQP Ctr.
- HK IQP Ctr.
- MQP sponsors

Map showing locations in China with labels for MQP partners and sponsors, MQP Centers, and IQP Centers.
China IQP Project Centers

- **Goal:**
  - Tackle real problems at nexus of society and technology; analyze socio-political context and stakeholder interests; make recommendations.
  - Nurture global scientists and engineers who understand connections between society and technology
- **Interdisciplinary teams; external sponsors**
- **Hong Kong IQP Center**
  - 12 years; 22-26 students per year
  - Education and urban planning as focus
- **Hangzhou IQP Center: Newly Launched**
  - Pilot projects in Fall 2014
  - Partner: Hangzhou Dianzi University
  - Sustainable urban growth as focus

WPI Partner
## Project Sponsors for Hong Kong IQP

<table>
<thead>
<tr>
<th>Educational Organizations, NGOs, Not-for-Profits, Corporations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lingnan University</td>
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<tr>
<td>World Wildlife Fund</td>
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<tr>
<td>HK University of Science and Technology</td>
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<tr>
<td>Maritime Museum</td>
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<tr>
<td>Hong Kong Institute of Education</td>
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<tr>
<td>Friends of the Earth</td>
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<tr>
<td>Caritas Charles Vath College</td>
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<tr>
<td>Designing Hong Kong</td>
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<tr>
<td>Hong Kong Polytechnic University</td>
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<td>Harbour Business Forum</td>
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<tr>
<td>Chinese University of Hong Kong</td>
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<tr>
<td>HK Business Environment Council</td>
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<tr>
<td>Caritas Francis Hsu College</td>
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<tr>
<td>World Wide Fund for Nature</td>
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<tr>
<td>Caritas Adult and Higher Education Services</td>
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<td>Jet Technics</td>
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<tr>
<td>Hong Kong Council of Social Service</td>
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<tr>
<td>Hong Kong Port and Maritime Board</td>
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<td>Hong Kong Museum of History</td>
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<tr>
<td>Civic Exchange</td>
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<tr>
<td>Urban Renewal Authority</td>
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*IEOM Conference (Dr. Amy Zeng), March 3-5, 2015*
China MQP Project Centers

• Multi-city MQP Center
  – Founded in 2005
  – Wuhan, Beijing and Greater Shanghai
  – Mixed-team Model

• Shanghai MQP Center (for CHE only)
  – Started in 2008

• MQP Student Participants
  – Majors: ME/MFE, MGE/IE, RBE, ECE, MA, FPE, MG, CEE, CS, CHE
  – Over 160 WPI Students, and over 250 Chinese students

• Six Universities in Mainland China as Partners
  o BJTU: Beijing Jiaotong University
  o HUST: Huazhong Univ. of Science & Technology (Wuhan)
  o HDU: Hangzhou Dianzi University
  o SU: Shanghai University
  o SJTU: Shanghai Jiaotong University
  o Tsinghua University (Beijing)
# Project Sponsors for China MQPs

<table>
<thead>
<tr>
<th>Multinational Corporations</th>
<th>China-based Organizations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Products</td>
<td>BASF-YPC</td>
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<tr>
<td>Amphenol – TCS</td>
<td>BJTU</td>
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<tr>
<td>Bodycote</td>
<td>Domestic Control</td>
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<tr>
<td>Caterpillar</td>
<td>Delta Investment</td>
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<tr>
<td>Johnson Control</td>
<td>Hangzhou Omnipay</td>
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<tr>
<td>Microsoft</td>
<td>HUST</td>
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<tr>
<td>Nypro</td>
<td>Jiangsu Aucksun</td>
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<tr>
<td>REM – Wuxi</td>
<td>2\textsuperscript{nd} Construction Company of Sinopec</td>
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<tr>
<td>Saint Gobain</td>
<td>Shanghai University</td>
</tr>
<tr>
<td>Staples</td>
<td>Tongji Hospital</td>
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<tr>
<td>Tyco</td>
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</tbody>
</table>
Features of MQP Centers

✓ Immerse in the local culture while tackling pressing problems for project sponsors;
✓ Learn through doing in multi-cultural, multi-locational project teams
✓ Multi-channel learning and communication
✓ Multi-faceted teaching and education

Project Implementation & Operations

• Two-phase Implementation Process

**PQP: Preparation for the China Project**
- 1 term, part-time, on campus
- First objective:
  - to understand the sponsoring company
  - to identify the project problem
  - to study the literature
  - to come up with a project plan
- Second objective:
  - to start communications
  - to build a sense of community

**MQP: Conducting the Major Qualifying Project**
- 1 term, full-time, in China
- Follow the project cycle
- Learn to solve a technical problem in an unfamiliar, new environment
- Learn to manage the project, team dynamics, and uncertainties
- Develop high-quality deliverables
  - Oral presentation & report
The Project Cycle

1. Problem Identification
2. Problem Statement
3. Project Goals & Objectives
4. Project Methodology
5. Literature Review
6. Information & Data Collection
7. Analysis
8. Recommendations
9. Implementation or Plan
10. Presentation & Report

Start in PQP, Revise in MQP
Complete in MQP
Impacts on Students and Sponsors

• Students acquire and practice skills of:
  – Communicating effectively in various contexts
  – Improving understanding of professional & ethical responsibilities
  – Understanding solution impacts and sustaining /exploiting benefits
  – Managing project, relationship, and team dynamics
  – Responding quickly to changes

• Students develop three major behavioral strengths:
  – the ability to work effectively in a multi-cultural, multinational team;
  – the ability to manage the challenges and differences of living in a completely foreign country while completing a successful project;
  – increased self-confidence for future career development and elevated cultural awareness.

• Opportunities for project sponsors include:
  – Establishing and maintaining a close relationship with a center of excellence
  – Generating value through fresh ideas and creative minds
  – Identifying new opportunities and suggestions for improving performance
  – Finding and training excellent candidates for future workforce
  – Carrying out pilot studies for strategic and operational initiatives
## China Hub at WPI

### On-Campus Curriculum Initiative

- **Chinese Language**
- **Content Courses**
- **Modules in STEM**

### On-Campus Events and Outreach

- **Academic Lectures**
- **Cultural Events**
- **K-12 Outreach**
- **Chinese Alumni**

### China Project Centers

- IQP Center
  - Hangzhou
- IQP Center
  - Hong Kong
- MQP Centers
  - Beijing & Shanghai

### Collaboration & Partnership

- **Academic**
- **Corporate**
- **US Grant Opportunities**
- **Chinese Grant Opportunities**

### Academic Programs

- **Joint Degree Programs**
- **Business School**
- **China Track**
  - 1st year GPS
  - 2nd year HUA
  - 3rd year IQP
  - 4th year MQP
- **Major**
  - Professional Communication
- **Minor**
  - Studies in China
- **Certificate**
• Founded in 1995;
• Affiliated with School of Business
• Accredited by ABET since 1996
IE Enrollment History (1996 – 2014)
IE Program Educational Objectives

• **Industrial Engineering Knowledge and Design Skills.** Graduates should be able to support operational decision-making and to design solutions that address the complex and changing industrial engineering problems faced by organizations, using current concepts and technologies.

• **Communication Skills.** Graduates should endeavor to seek to improve their communication skills and be able to demonstrate the effective application of various communication tools, approaches and methodologies to achieve their desired outcomes.

• **Teamwork and Leadership Skills.** Graduates should be able to serve as change agents in a global environment, based on strong interpersonal and teamwork skills, an understanding of professional and ethical responsibility and a willingness to take the initiative.
Current IE Curriculum

IE Curriculum at WPI

IE Core (9 courses):
- BUS1010: Leadership Practice
- BUS2080: Data Analysis
- BUS3020: Achieving Opr. Excellence
- CS 220X: Object-oriented Applications
- OIE2850: Engineering Economics
- OIE3410: Materials Mgt
- OIE3420: Quality Control
- OIE3460: Simulation
- OIE3510: Stochastic Models

IE Electives (3 courses):
- OIE3405: Work Systems Design & Layout
- OIE4410: IE Case Studies
- OIE4420: Practical Optimization
- OIE4460: Global Planning & Logistics
- MIS3720: Business Data Management
- MIS4720: Systems Analysis & Design

IE MQP Centers (3 courses)
- China Project Center
- Wall Street Project Center

IE Related Certificates:
- Lean Green Belt
- Six Sigma Green Belt

Technical Electives (3 courses)
- 3000/4000 level OR courses in MA

Supply Chains/Operations
Healthcare
Financial Services
Institute of Industrial Engineers
Worcester Polytechnic Institute Student Chapter

- Promote leadership in industrial engineering
- Stimulate professional and academic growth
- Network with classmates, professors, and industry professionals
- Represent the industrial engineering profession in a positive light
### Example Employers and Job Titles

<table>
<thead>
<tr>
<th>Manufacturing/Supply Chain</th>
<th>Financial Services</th>
<th>Healthcare</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAE Systems</td>
<td>The Hanover Insurance Group</td>
<td>Shire Pharmaceuticals</td>
</tr>
<tr>
<td>GE Transportation, GE Energy</td>
<td>Goldman Sachs</td>
<td>UMass Memorial Health Care</td>
</tr>
<tr>
<td>Philips</td>
<td>Dartmouth College Investment</td>
<td>Veterans Health Administration</td>
</tr>
<tr>
<td>United Technologies</td>
<td>KPMG</td>
<td>Arcadia Healthcare Solutions</td>
</tr>
<tr>
<td>Exxon Mobile</td>
<td>JP Morgan</td>
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<tr>
<td>Avery Dennison</td>
<td>Torino Capital</td>
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<tr>
<td>Urban Green Energy</td>
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</tr>
</tbody>
</table>

- Lean supply chain analyst
- Operational excellence specialist
- Industrial production manager
- Industrial engineer
- Process improvement specialist
- Business development associate
- Quality assurance engineer
- Investment analyst
- Sustainability engineer
- Project controls engineer
- Supplier quality engineer
- Manufacturing process cost modeler
- Manufacturing engineer
- Business analyst
- Lean project leader
- Training coordinator
- Test engineer
- Technical consultant
M.S. in Operations Analytics and Management

- 1997 – M.S. in Operations and Information Technology (MSOIT) programs.
- 2004 – M.S. in Operations Design and Leadership is split from MSOIT
- 2015 – M.S. in Operations Analytics and Management
MSOAM Curriculum: Required Courses

• 8 Required Courses (24 credits)
  – OBC 500  Group and Interpersonal Dynamics in Complex Organizations
  – OIE 500  Analyzing and Designing Operations to Create Value
  – OIE 552  Modeling and Optimizing Processes
  – OIE 541  Operations Risk Management
  – OIE 544  Supply Chain Analysis and Design
  – OIE 554  Global Operations Strategy

• Choose 1 (the other one will be an elective)
  – MIS 500  Innovating with Information Systems
  – MIS 571  Database Applications Development

• Choose 1 (the other one will be an elective)
  – OIE 555  Lean Process Design
  – OIE 558  Designing and Managing Six-Sigma Processes
MSOAM Curriculum: Electives

- **4 electives** (12 credits): Include the two courses from the above list and the following:
  - BUS 522 Global Business Experience
  - BUS 546 Managing Technological Innovation
  - BUS 597 Internship
  - MIS 573 System Design and Development
  - MIS 576 Project Management
  - MIS 581 Information Technology Policy and Strategy
  - MIS 582 Information Security Management
  - MIS 583 User Experience Applications
  - MIS 584 Business Intelligence
  - OBC 501 Interpersonal and Leadership Skills
  - OBC 533 Negotiations
  - OBC 536 Organizational Design
  - OBC 537 Leading Change
  - OIE 548 Productivity Management
  - OIE 553 Global Purchasing and Logistics
  - OIE 557 Service Operations Management

- **Special Topics**
  - BUS 598 Special Topics: Globalization, Social Responsibility and Organizational Strategy
  - BUS 598 Special Topics: Introduction to Health Systems
  - BUS 598 Special Topics: Introduction to Sustainability Management
  - OIE 598 Special Topics: Health Systems Modeling and Improvement
  - OIE 598 Special Topics: Optimization Methods for Business Analytics
APICS WPI Chapter

✓ Officially formed and started in 2012
✓ 90+ members now

✓ Activities
  o Guest speeches
  o World business night
  o Local company tours
  o Networking events
  o APICS Professional Development meetings
  o NE Supply Chain Exhibit & Conference
  o APICS North District Case Competition
  o APICS CPIM module training
Entrepreneurship and Supply Chain Management: A Necessary Duo for Successful New Business Ventures
More Universities Emphasizing Entrepreneurship

- **Harvard**: $10M Experiment Fund
- **Michigan**: MINTS & MCubed
- **Penn State**: Minor in ENTI
- **Drexel**: School of Entrepreneurship ($12.5M)
- **Villanova**: KEEN, Center for ICE
- **Temple**: $3M from the Blackstone Group
- **Philadelphia**: $3M from the Blackstone Group
- **Bucknell**: KEEN
- **Ursinus**: U-Imagine!
Means for Fostering Entrepreneurship

• **Strategies** (Coleman, 3/27/2014)
  – Establish supported policies and infrastructure that allow innovation to thrive
  – Build a vibrant ecosystem
  – Change the institutional culture and “encourage risk taking”

• **Tactics**
  – Expanding curriculum – **Minor in ETR** for *all* majors
  – Establishing a focused center, usually multidisciplinary
  – Providing initial funding
  – Providing physical space, “incubator”, “accelerator”, “network”
WPI Example: **Minor** in ETR

- Complete the following course:
  - BUS 2060: Financial Statement for Decision Making
- Complete **two** from the following list:
  - ETR 1100: Engineering Innovation and Entrepreneurship
  - ETR 3633: Entrepreneurial Selling
  - ETR 3910: Recognizing and Evaluating New Venture Opportunities
  - ETR 3920: Planning & Launching New Ventures
- Complete **two** of the following list:
  - BUS 2070: Risk Analysis for Decision Making
  - BUS 3010: Creating Value through Innovation
  - MKT 3640: Management of Process and Product Innovation
  - GOV 2313: Intellectual Property Law
- **Required:**
  - ETR 4930: Growing and Managing New Ventures

6 courses
My Experiment: *Integrating ETR into SCM*

OIE4460
Global Planning and Logistics

OIE 553
Global Purchasing and Logistics
Course Project

• a Milwaukee, WI based technology development firm
• A new patent – a fine particle separation process through using an innovative combination of physical and chemical forces in a low-energy, economical, and environmentally friendly fashion.
• Seeking to build two business ventures:

Tongo Cleaning Products

Red Mud Processing
## Course Project Design

<table>
<thead>
<tr>
<th>Tongo Products</th>
<th>Red Mud Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phase 1: Market Assessment</strong></td>
<td><strong>Phase 1: Market Assessment</strong></td>
</tr>
<tr>
<td>• Macro-market evaluation</td>
<td>• Macro-market evaluation</td>
</tr>
<tr>
<td>• Profile of the household chemical industry</td>
<td>• Profile of current state of Red Mud in the country</td>
</tr>
<tr>
<td>• Country-specific regulations and policies</td>
<td>• Country-specific regulations and standards for constructing chemical plants</td>
</tr>
<tr>
<td>• Import restrictions and IP laws</td>
<td>• Existing efforts or plans for treating the Red Mud</td>
</tr>
<tr>
<td>• Analysis of sales market and competition</td>
<td>• Sales markets for the recovered metals</td>
</tr>
<tr>
<td>• Case studies and best practices</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Phase 2: Market Establishment</strong></th>
<th><strong>Phase 2: Facility Location and Logistics Network</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Doing business in the selected country</td>
<td>• Location decision factors</td>
</tr>
<tr>
<td>• Transportation infrastructure</td>
<td>• Obtaining construction permit and potential barriers</td>
</tr>
<tr>
<td>• Design of distribution and sales channels</td>
<td>• Transportation infrastructure around the selected site and design of distribution and sales channels</td>
</tr>
<tr>
<td>• Market entry</td>
<td>• Risk mitigation and contingency plans</td>
</tr>
<tr>
<td>• Finding partners</td>
<td></td>
</tr>
<tr>
<td>• Source/Produce/Sell</td>
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<tr>
<td>• Risk mitigation and contingency plans</td>
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</tbody>
</table>
Tying with the Course Structure

- Introduction and Background
- Global Market Assessment and Market Entry Strategies
- Global Logistics Environment, Strategy Formulation, Inbound and Outbound Logistics
- International Logistics infrastructure and Logistics Network Planning & Design
- Logistics Service Providers and 3PL Markets & Players
- Purchasing, Global Sourcing and Evaluation

- Global Negotiation and Contract Management
- Material and Inventory Management
- Distribution, Network Strategies and Global Transportation Issues and Decisions
- Warehousing, Material Handling and Packaging for Global Markets
- Global Supply Chain Security and Risk Management
- Information Visibility and Technologies and Their Applications

Phase 1 of the Project

Phase 2 of the Project
Integrating ETR into SCM Courses

Development Chain
- Set of activities and processes associated with new product introduction

Business Plan vs. Supply Chain Planning
Integrating SCM into ETR Courses

- ETR 336X: Assessing Entrepreneurial Opportunities

<table>
<thead>
<tr>
<th>Course</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Introduction, Creativity, Innovation and Entrepreneurship</td>
<td>Concepts of Logistics, Logistics Infrastructure, Cultural Impact</td>
</tr>
<tr>
<td>3. Macro-Market Analysis: Is This a Good Market?</td>
<td></td>
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<tr>
<td>4. Macro-Industry Analysis: Is This a Good Industry?</td>
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<tr>
<td>6. The Team: What Drives Your ETR Dream?</td>
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<tr>
<td>7. The Team: Can You and Your Team Execute?</td>
<td></td>
</tr>
<tr>
<td>8. The Team: Your Connections Matter Which Matter Most?</td>
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<tr>
<td>9. The Business Model</td>
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<tr>
<td>10. Building Strategy Maps</td>
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<tr>
<td>11. Finding the “Right” Source of Capital and Why Bother with Accounting?</td>
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<tr>
<td>12. Valuation</td>
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<tr>
<td>13. Assessing Entrepreneurial Opportunities</td>
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<tr>
<td>14. Leadership and Entrepreneurship</td>
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Questions and Comments?

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