The spirit of collaboration

CP Road Map Tracks

National CP Road Map Program Executive Committee Meeting
Kansas City, Missouri
March 28, 2007

Ted Ferragut, President
TDC Partners
PCC paving is an integrated system that still has knowledge gaps
What is the National Plan? 
The CP Road Map

Comprehensive, collaborative, strategic plan for concrete pavement research and technology
Unifying Vision of the Plan

By 2015, the highway community will have a comprehensive, integrated, fully functional system of concrete pavement technology that provides innovative solutions for customer-driven performance requirements.
Why the CP Road Map?

• To meet the paving challenges of the future

• To guide the investment of research dollars for the next ten years

• To promote cooperation among fund managers and all stakeholders
Research Plan Summary

• 12 tracks
• 250 problem statements
• $250M
• 10 years
Hallmarks of the Plan

Not

• Owned by any organization
• Tied to any one fund

• Promotes cooperation and synergy
• Leverages ideas and funds
• Merges research and implementation

Unity through common goals
1. Performance-based Mix Design and Analysis System

• Mix Optimization and Proportioning Guide
• Lab equipment of the future
• Regional and national criteria
• Integration with design and field quality control

Analyze for:
• Compatibility of materials
• Environmental influences
• Cracking
• Early set
• ASR
• Curling and warping potential
• New materials, including variability
1. Performance-based Mix Design and Analysis System

Major Activities Underway

• Large Size Stone (U of Ohio)
• Optimizing Mixtures (FHWA-Transtec)
• ACI 211 Modifications
• Mix Optimization (Pooled Fund)
• Air Void Systems (multiple)
• Internal Curing (VDOT and NIST)
• Slag in PCC (WisDOT)
• De-Icer Impacts (multiple)
• Blended Cements
1. Performance-based Mix Design and Analysis System

Nearly 70 Mix-Related Projects Underway or Recently Completed
2. Performance-based Design Guide

- Beyond the AASHTO ME Guide
- All concrete design in one place
- Pavement preservation and restoration
- High speed computerized performance analysis
# Research Track 2 (DG) Phasing

**Performance-Based Design Guide for New & Rehabilitated Concrete Pavements**

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Subtrack DG 1

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DG 2.6</td>
<td>Framework for Design Guide, Structural Model, &amp; Implementation</td>
</tr>
</tbody>
</table>

### Subtrack DG 2

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DG 2.7</td>
<td>Development of New Analytical Procedures for Concrete Pavement Structural Model, and Validation</td>
</tr>
<tr>
<td>DG 2.8</td>
<td>Improvement of 3D Under-IT Structural Model for Limited Plan Concrete Pavement and Groundwater-Resilient Concrete Pavement Used in Reconstruction and New Build</td>
</tr>
<tr>
<td>DG 2.9</td>
<td>Development of Novel Concrete Pavement Models for Performance-Based Design and Analysis</td>
</tr>
<tr>
<td>DG 3.0</td>
<td>Improvement of Dynamic Modelling of Concrete Pavement Systems for Use in Design and Analysis</td>
</tr>
<tr>
<td>DG 3.1</td>
<td>Structural Models for Special New Types of Concrete Pavements and Designs</td>
</tr>
</tbody>
</table>

### Subtrack DG 3

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DG 3.3</td>
<td>Development and Enhancement of Concrete Material Models for Improved Pavement Design</td>
</tr>
<tr>
<td>DG 3.4</td>
<td>Development and Enhancement of Network Analysis Models for Improved Pavement Design</td>
</tr>
<tr>
<td>DG 3.5</td>
<td>Development and Enhancement of Rigid Pavement Design Models</td>
</tr>
<tr>
<td>DG 3.6</td>
<td>Development of Novel Concrete Pavement Design Models</td>
</tr>
</tbody>
</table>

### Subtrack DG 4

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DG 4.0</td>
<td>Framework for Improved Mechanistic Design Procedure</td>
</tr>
<tr>
<td>DG 4.1</td>
<td>Development of Improved Mechanistic Pavement Design Guide Procedures</td>
</tr>
<tr>
<td>DG 4.2</td>
<td>New Mechanistic Pavement Design Guide Procedure for Parabolic Deflection Curves</td>
</tr>
</tbody>
</table>

### Subtrack DG 5

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DG 5.1</td>
<td>Implementation of the Worked-Out Design Guide</td>
</tr>
</tbody>
</table>

---

**Concrete Pavement Collaborative Research Program**

14
2. Performance-based Design Guide

Major Activities Underway

• ME Guide Implementation
• Modeling
  • Environmental effects (AZ State)
  • Temperature/Moisture (UT)
  • Traffic Characteristics (Multiple)
• Improved JPCP Deterioration Models (NCHRP)
• Implementation / Validation of ME Guide
• Improved drainage work (NCHRP)
• Tie bar design (ACPA-ARA)

The Next Generation of Design
2. Performance-based Design Guide

Major Activities Underway

- Implementation
  - Concrete Overlay Workshops
  - CRCP Manuals

The Next Generation of Design
3. High-Speed NDT & Intelligent Construction Systems

- Continuous monitoring
- Improved production process
- Automatic recordation of quality control
- Feed to pavement management system

- Smoothness
- Thickness
- Consolidation
- Strength
- Curing
- Workability
- Steel location
- Texture

and more
# Research Track 3 (ND) Phasing

**High-Speed Nondestructive Testing and Intelligent Construction Systems**

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Subtrack ND 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field Control</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ND 1.0. Framework for Field Control</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ND 1.1. Field Quality Control Tests for Performance-Based Concrete Mix Design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ND 1.2. Field Validation of Field Quality Control Tests</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ND 1.3. Revise Performance-related Specifications to Include Concrete Mix Properties</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Subtrack ND 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nondestructive Testing Methods</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ND 2.0. Framework for Nondestructive Testing Methods</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ND 2.1. Concrete Temperature, Strength, and Stiffness Sensing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ND 2.2. Concrete Pavement Thickness Sensing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ND 2.3. Dowel/End Bar Alignment Sensing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ND 2.4. Concrete Curing Effectiveness Sensing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ND 2.5. Concrete Pavement Support Sensing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ND 2.6. Workability Sensing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ND 2.7. Sensing of Air Systems in Concrete Pavement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ND 2.8. Concrete Mix Volumetrics Sensing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ND 2.9. Concrete Pavement Smoothness Sensing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ND 2.10. Concrete Pavement Texture (Skid Resistance, Slip Resistance) Sensing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ND 2.11. Pavement-Wide Noise Sensing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ND 2.12. Embedded Intelligent Concrete Paving</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Subtrack ND 3</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NDT and Intelligent Control System Evaluation and Implementation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ND 3.0. Framework for NDT &amp; Intelligent Control System Evaluation and Implementation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ND 3.1. Workshops on Field Quality Control Testing of Concrete Pavement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ND 3.2. Workshops on Nondestructive Testing and Evaluation of Concrete Pavements</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ND 3.3. Web-Based Training for Implementing Concrete Pavement Research Products</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ND 3.4. Unified Concrete Pavement Management System</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. High-Speed NDT & Intelligent Construction Systems

Major Activities

• Smart Cure (FHWA-Transtec)
• RoboTex (ISU-Transtec)
• Pavement Profile on Paver (Manufacturers)
4. Optimized Surface Characteristics

Safe, Quiet and Smooth

Optimized conditions

• Friction
• Noise
• Smoothness
• Splash and spray
• Lateral drainage
• Light reflectance
4. Optimized Surface Characteristics

Major Activities

• Noise (FHWA-ISU-ACPA)
• Surface Smoothness (FHWA)
• ProVal Smoothness Measurements (FHWA)
• Purdue Tire/Pavement (ACPA)
• Truck Noise Source Mapping (NCHRP)
• Tire/Pavement Noise Consortium (Pooled Fund)
• Guide for Pavement Friction (NCHRP)
• Creative Texturing (FHWA)
# Research Track 4 (SC) Phasing

## Optimized Surface Characteristics for Safe, Quiet, and Smooth Concrete Pavements

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Concrete Pavement Surface Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Subtrack 4.1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtrack 4.1.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtrack 4.1.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtrack 4.1.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Subtrack 4.2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtrack 4.2.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtrack 4.2.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtrack 4.2.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Subtrack 4.3</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtrack 4.3.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtrack 4.3.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtrack 4.3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Subtrack 4.4</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtrack 4.4.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtrack 4.4.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtrack 4.4.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Subtrack 4.5</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtrack 4.5.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtrack 4.5.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtrack 4.5.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Subtrack 4.6</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtrack 4.6.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtrack 4.6.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtrack 4.6.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Subtrack 4.7</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtrack 4.7.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtrack 4.7.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtrack 4.7.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Notes

- **Concrete Pavement** collaborative research program
- **CP ROAD MAP**
- **22**
5. Equipment Automation and Advancements

- Next generation of construction equipment
- Advanced batching
- From placement to curing to one-pass installation of drains
- Partnership with equipment manufacturers
5. Equipment Automation and Advancements

Major Activities

- Hyper-Mobile Concrete Batching & Mix Plants (G&Z)
- Twin-Shaft Batch Mixer (G&Z)
- Two-lift Construction of Aggregate (Virginia Tech)
- Roller Compaction Guidelines (PCA)
- Stringless Concrete Paving (ISU)
6. Innovative Joints

- Cross cutting – from design to performance
- Incremental Improvement
- Breakthrough technology to supplement dowel technologies
- From long-life pavement to thin overlays
6. Innovative Joints

Major Activities

- Synthesis of Dowel Bar Research (IHRB)
- Evaluation of Transverse Joint Forming (IDOT)
- Lab Study of Structural Behaviour of Alternative Dowel Bars (ISU)
- CRCP Crack Width (U of I)
- Field Evaluation of Elliptical Fiber Dowels (ISU)
7. High Speed Rehabilitation & Construction

- From planning to computer simulation
- From slip form to pre-cast
- From minor recycling to one-pass remove and place pavement
7. High Speed Rehabilitation & Construction

Major Activities

- Precast Panel Demonstration (FHWA)
- Precast Post-tensioned Demonstration (FHWA)
- Slab Replacement (NYDOT)
- Traffic Management Optimization Pilot Studies for Reconstructing Urban Freeways (FWHA-Caltrans)
8. Long Life Concrete Pavements

- From 30 to 50 years and beyond, with reliable and cost effective pavement solutions
- Improved designs
- Improved mixes
- Better joint designs
- Better approach to operational requirements

Three Approaches

- Major foundation and slab designed for no intrusion
- Major foundation and slab with rapid renewable surface course
- Major foundation - slab remove and replace and upgrade
8. Long Life Concrete Pavements

Major Activities

• Extended Service Life Forensics (FHWA-U of Ohio)
• Long Life Scan Tour Implementation
  • Two-lift Construction
  • Deep Foundations
9. Accelerated & Long Term Data Collection

Accelerated testing; test roads, beyond LTPP, to collect, store and retrieve the next generation of pavement data accurately, quickly, and efficiently
9. Accelerated & Long Term Data Collection

Major Activities

• CAPT Pooled Fund
• Accelerated Pavement Testing Guidelines (NCHRP)
• Accelerated Loading of Sub-Base (LDTD)
• MnRoad
10. Pavement Performance

Can we get out there to measure our pavements anymore?

Pavement management and feedback systems, including sensors embedded in the pavement
10. Pavement Performance

Major Activities

- Smart Reinforcements and Connectors (Canada)
- Rolling Wear Deflectometer (FHWA-ARA)
- Pavement Forecast Models (Toledo U)
- Evaluation of Pavement Management and Rating System (KTC)

Roles and responsibilities and economic strategies for the future including innovative contracting, economics for various pavement solutions, sustainability, public-private partnerships and a new technology transfer system

Major Activities

• CP Road Map Road Administration
12. Advanced Materials

From idea to lab to field to service to meet special conditions, environmental challenges, and faster construction
12. Advanced Materials

Major Activities

• Thin Cementitious Overlays (UK)
• Textile Reinforced Concrete (SA)
• Pervious Concrete
• Carbon Dioxide-treated Materials
• Self-consolidating Concrete for Paving (ISU)
Summary

Major Activities

• Over 150 relevant projects identified to date
• Number may be over 250 when done
• Additions coming:
  • International work
  • Training and implementation work
Discussion

Ted Ferragut
TDC Partners
703-836-1671
tferragut@tdcpartners.com