

Advances in Civil Integrated Management (CIM)



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What is Civil Integrated Management (CIM)

- ◆ The rapid development of information technologies and the growing need for accelerated project delivery with improved quality are driving transportation project participants to *develop and utilize more effective ways of planning, designing, constructing, maintaining, operating and managing transportation facilities through their life cycle*. A recently developed paradigm of Civil Integrated Management (CIM) is generally being accepted as the preferred framework to achieve this goal in the highway industry. You may also have heard this referred to as Virtual Design and Construction, or VDC.
- ◆ Known in the vertical construction industry as Building Information Modeling, or BIM.

What is Civil Integrated Management (CIM)

- ◆ The Federal Highway Administration (FHWA) has quickly captured the concept of this new business paradigm and defined the term Civil Integrated Management (CIM) as follows:
- ◆ *“CIM is the collection, organization, and managed accessibility to accurate data and information related to a highway facility. The concept may be used by all affected parties for a wide range of purposes, including planning, environmental assessment, surveying, construction, maintenance, asset management, and risk assessment.”*

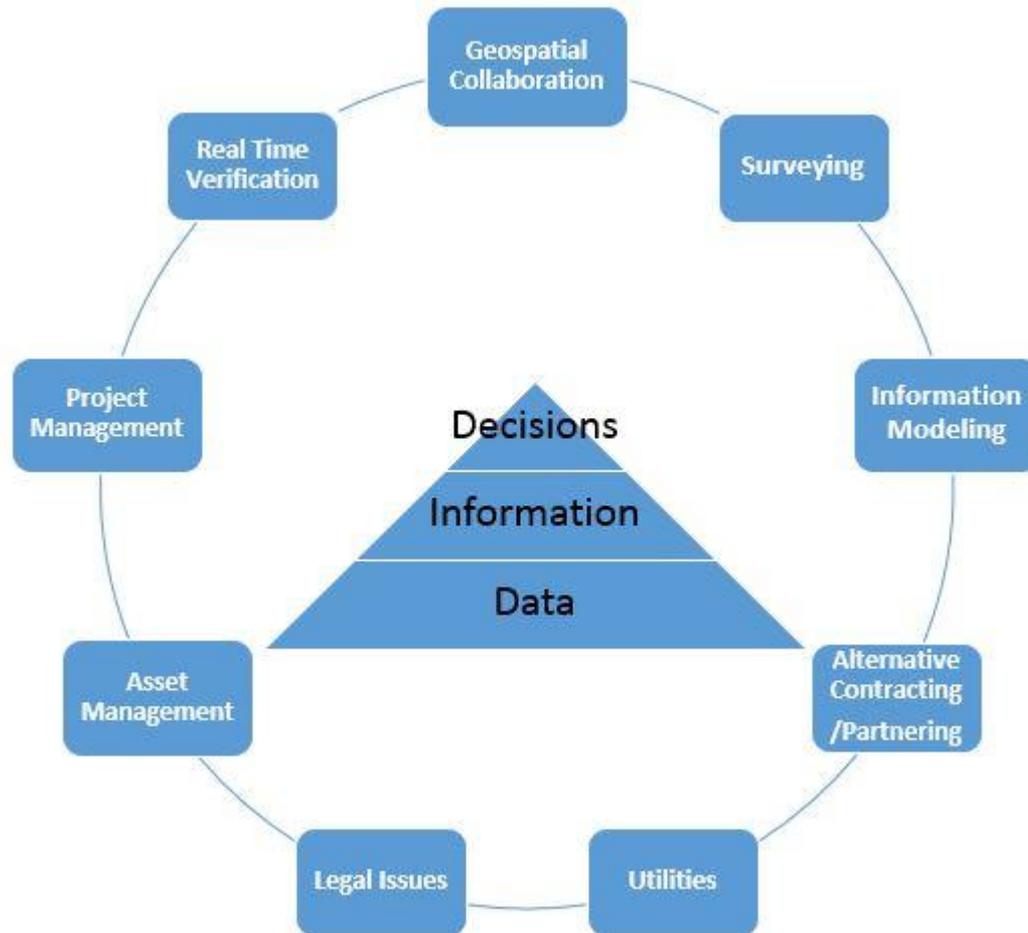
What is Civil Integrated Management (CIM)

- ◆ Another recent definition promulgated by FHWA that is highly relevant to the discussion of CIM is Intelligent Construction Systems and Technologies (ICST); ICSTs have the ability to collect, store, analyze, and process information, and to make and execute an action or decision that results in quality construction. This is in conjunction with components, processes, and software that assist in a more effective system of construction.
- ◆ The FHWA has identified approximately 150 technologies as ICST in their strategic roadmap which they determine to have potential for accelerating transportation projects during the construction stage.

What is Civil Integrated Management (CIM)

- ◆ Both FHWA definitions state the necessity of having an overriding 'framework' which includes (1) data exchange mechanisms for sharing information across stakeholder and functional area boundaries, (2) a standard way to define, organize, understand, and utilize various ICST components in order to accumulate relevant information over the entire life cycle of the facility, and (3) the ability to leverage various digital data based tools and processes not only during the design and construction phases of individual facilities, but also for long-term agency asset operation and maintenance. This framework is the foundation of CIM.

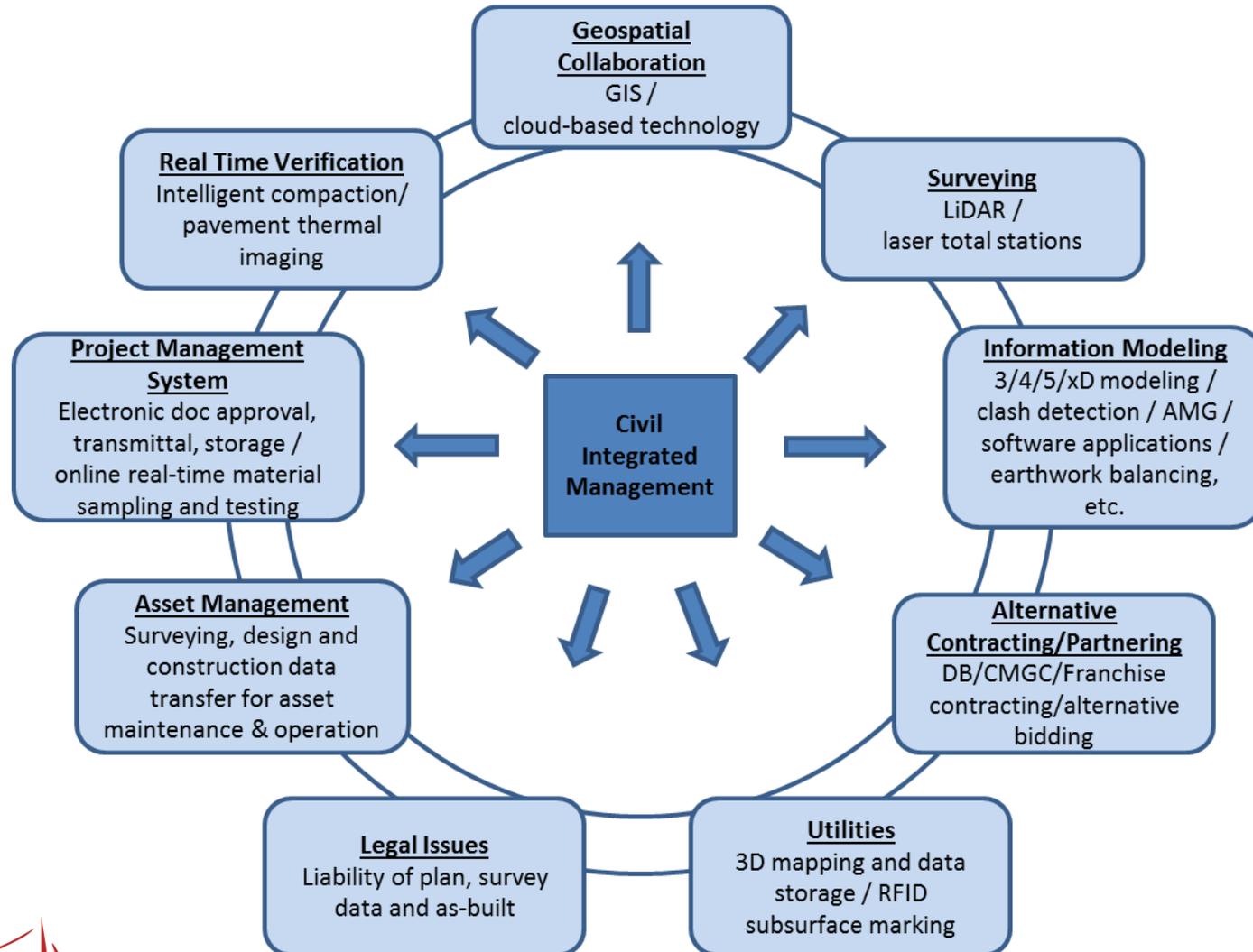
What is Civil Integrated Management (CIM)



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- ◆ The core building blocks of CIM are 3D Engineered Models, which are compatible with technologies such as LiDAR (light detecting and ranging for surveying and establishing data points for physical features), subsurface geophysics (location of water table or buried objectives), automated machine guidance (AMG), Intelligent compaction (IC), and others. The departure from traditional document based project delivery and management to a system based on models necessitates redefined workflow processes; raises digital data storage and data interoperability issues; and also it awakens legal issues such as the ownership of digital data and models.

What is Civil Integrated Management (CIM)



Why Civil Integrated Management (CIM)

- ◆ With limited resources and public expectations higher than ever, all parties to highway construction projects must work together and utilize emerging technologies for the fast, friendly, efficient, and safe delivery of projects. FHWA and three national associations – AASHTO, ARTBA, and AGC – are jointly promoting “Civil Integrated Management” (CIM) to highlight these types of resources.
- ◆ FDOT collects and manages large amounts of data in the planning, design, construction, maintenance, and asset management of our infrastructure, mostly existing in silos and traditionally shared by paper or digital paper.
- ◆ CIM = Intelligent Construction + Partnering

Why Civil Integrated Management (CIM)

777 Family



Computing & Design/Build Processes Help Develop the 777

CAD/CAM Systems



In the mid-1980s, The Boeing Company invested in three-dimensional CAD/CAM (computer-aided design/computer-aided manufacturing) technology. The pilot programs clearly demonstrated the benefits of modeling airplane parts as three-dimensional solids in the CATIA (computer-aided three-dimensional interactive application) system. CATIA - along with several Boeing-created applications - allowed Boeing engineers to simulate the geometry of an airplane design on the computer without the costly and time-consuming investment of using physical mock-ups.

Value of Digital Pre-Assembly

Studies show that the most pervasive problems in manufacturing airplanes are:

- ▶ part interference (incidents of assembly parts overlapping each other) and
- ▶ difficulty in properly fitting parts together in aircraft final assembly.

By 1989, Boeing was confident that it could significantly reduce the costly rework caused by these problems by digitally pre-assembling the airplane on the computer. The technology offered:

- ▶ improved accuracy in part design and assembly,
- ▶ instantaneous communication capability,
- ▶ improving the quality of airplane designs, and
- ▶ reduction of the time required to introduce new airplanes into the marketplace.

The opportunity to apply the new CAD/CAM approach as well as other new engineering and manufacturing ideas came in 1990 with the launch of the Boeing 777 twinjet.

Why Civil Integrated Management (CIM)

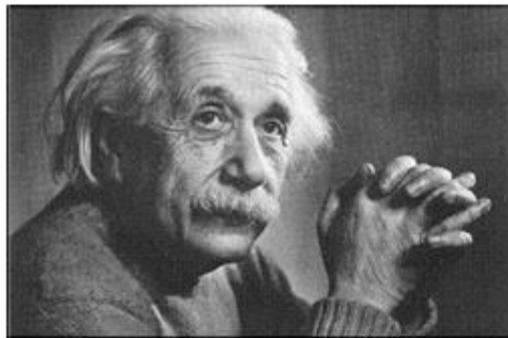
777 Family



Computing & Design/Build Processes Help Develop the 777

Through innovative applications of computing technology, the 777 program exceeded its goal of reducing change, error and rework by 50 percent. Parts and systems have fit together better than anticipated and at the highest level of quality.

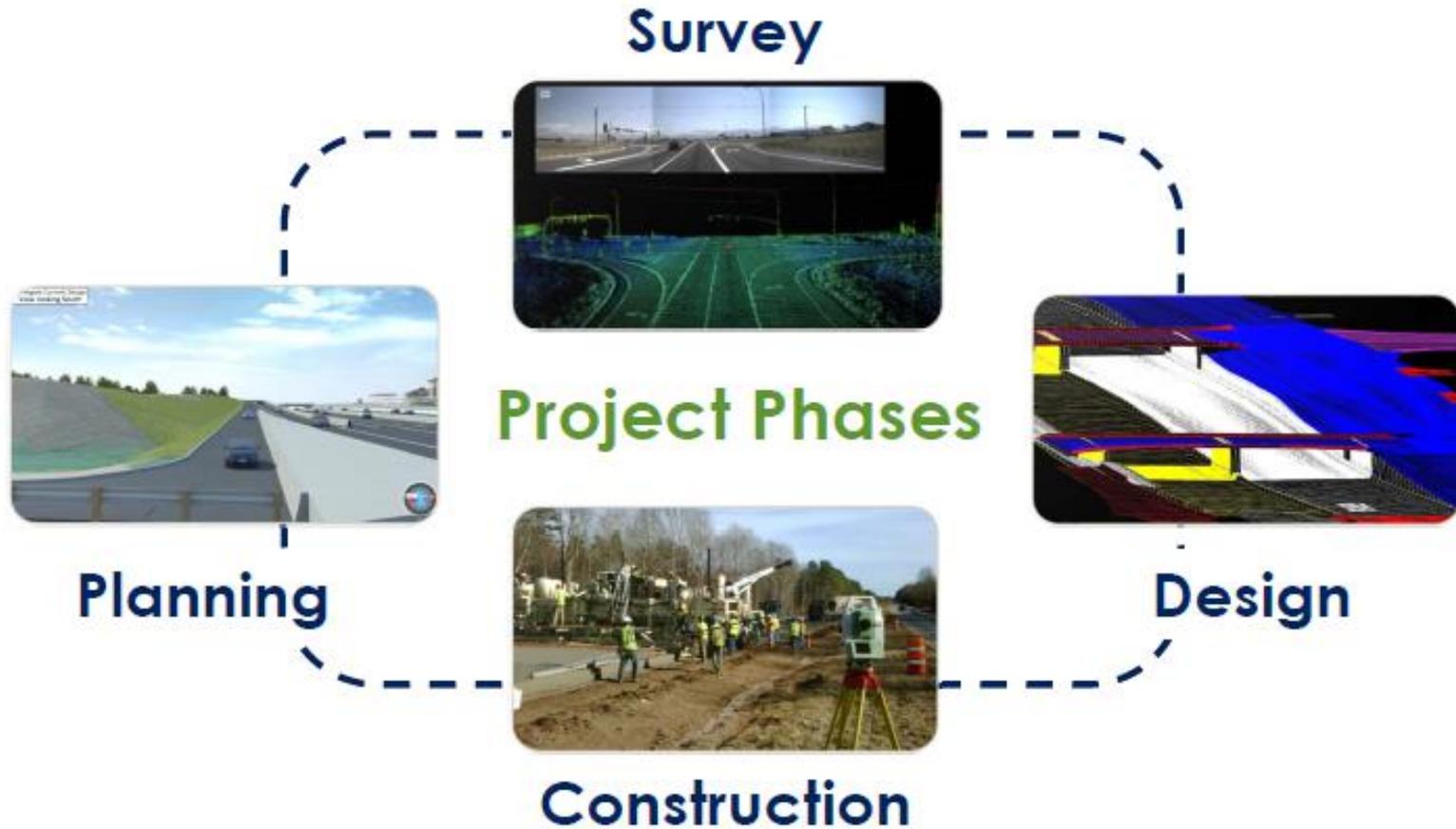
The first 777 was just .023 of an inch -- about the thickness of a playing card -- within perfect alignment while most airplane parts line up to within a half inch to each other.



**“If I can visualize it,
I can understand it.”**

Albert Einstein

Why Civil Integrated Management (CIM)



Why Civil Integrated Management (CIM)

- ◆ Summarizing ...
- ◆ The world is changing, and we are not obligated to perform site construction the way we did it 15 years ago.
- ◆ We reserve the right to make better decisions than we have in the past, by integrating data and information with new technologies for innovative solutions.
- ◆ Our goal is to make the model the basis of not only how we collaborate during design and construction of a project or corridor (Connected Site), but also how we maintain and manage the same corridor, as well as plan for future growth and changes (Life Cycle Management)

Why Civil Integrated Management (CIM)



Real Time Verification

Integrated with Construction

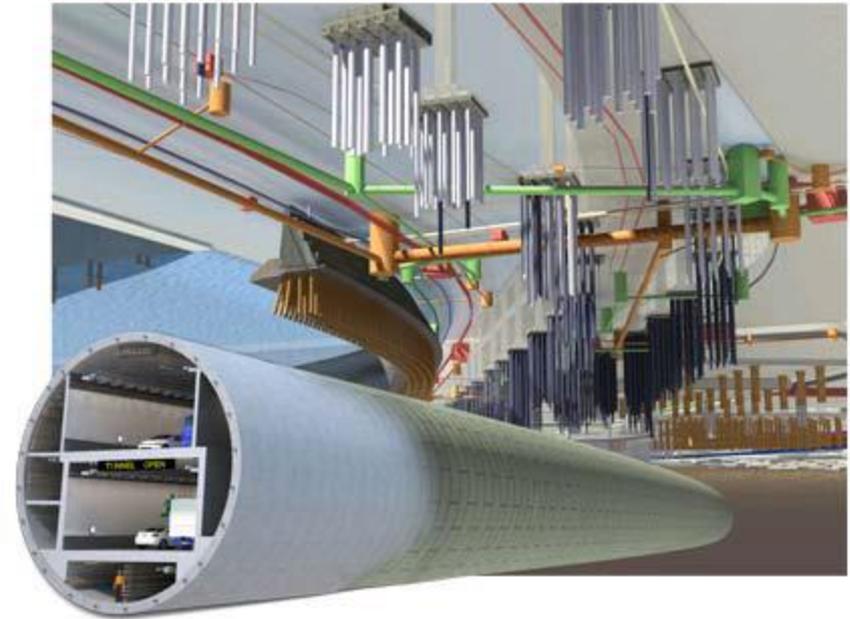
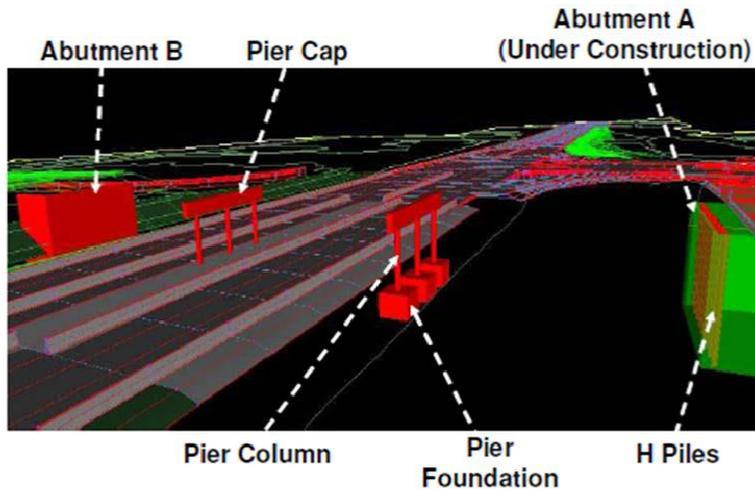
- Intelligent Compaction
- Pavement Thermal Imaging
- RFID for materials quantity and certification transmittal
- In-cab weight scales
- Video surveillance for remote construction inspection and recording

Surveying

Integrated with Construction

- Light Detection and Ranging (LiDAR)
- Equipment flexibility, precision and accuracy of survey, and data processing and storage
- Laser Total Stations

Why Civil Integrated Management (CIM)



Information Modeling

Integrated with Construction

- Public Outreach
- Software applications
- Optimizing construction means and methods
- Earthwork balancing
- Equipment automatic guidance control systems
- 3/4/5/x D Modeling

Utilities

- Integrated with Construction
- 3D Mapping and data storage
- RFID subsurface marking

Where Does FDOT Start

- ◆ Getting started can seem like getting on a horse at full gallop, especially with technology advancing so quickly.
- ◆ FDOT has some very valuable tools and technologies
 - ✓ Collection of Static, Mobile & Aerial LiDAR
 - ✓ Collection of Static, Mobile & Aerial Photogrammetric Images
 - ✓ 3D Design & Modeling CADD Tools
 - ✓ Alternative Design & Contracting Methods
 - ✓ Moves to Digital Documents & Field Tablets
 - ✓ Digital Historic Records Retention (EDMS)
 - ✓ GIS System
 - ✓ Transportation Statistics

CIM Topics for Discussion

- ◆ Where are the potential savings & cost avoidances?
- ◆ How can construction schedules be streamlined & shortened?
- ◆ How will the quality of PS&E plans improve with model-based delivery?
- ◆ How can we collect & process data with appropriate accuracy & efficiency?
- ◆ How well will this work for both Design-Build and Design-Bid-Build projects?
- ◆ How will FDOT need to change its design reviews and construction reviews?
- ◆ What will be the investment in workforce training and data infrastructure?
- ◆ How will legal issues be handled when models are provided pre-bid?
- ◆ How will evolving technology issues be funded & supported?
- ◆ How will we keep up with future trends and applications?

Where is CIM on a National Basis

- ◆ NCHRP 20-68A; U.S. Domestic Scan Program
- ◆ Scan 13-02; Advances in Civil Integrated Management
- ◆ Domestic Scan in July & August, 2014
- ◆ Arora & Associates, P.C.; Scanning Team Chair
- ◆ Iowa State University; Subject Matter Expert
- ◆ Scan Team Members from FHWA and DOTs in Iowa, Utah, Michigan, Pennsylvania, Arizona & Florida
- ◆ Scan Locations include Utah, Texas, Virginia, Iowa, Wisconsin, Michigan & New York

Where is CIM on a National Basis

- ◆ The purpose of the scan is to examine projects that utilize CIM technologies and partnering efforts between State DOTs, consultants, contractors, and materials suppliers. The scan will consider organization factors (e.g. size of program, degree of centralization or decentralization, and outsourcing) that may influence a state DOT, consultant, materials supplier, or contractor's ability to utilize CIM
- ◆ The team will meet with project management, design, materials suppliers, and construction staff to assess the effectiveness of the technology and partnering efforts currently being used by the state DOT's, consultants, materials supplier, and contractors.

Where is CIM on a National Basis

- ◆ The scan team will document;
 - ✓ Identified proven intelligent construction technologies
 - ✓ Construction project performance measures being used
 - ✓ Successful partnering techniques, including virtual meetings, wireless data sharing, and paperless communication as applicable.
- ◆ The team aims to harvest early experience, knowledge and opinions of engineers, managers and staff members who have been involved with the implementation of CIM for their projects and organizations.

Where is CIM on a National Basis

- ◆ The Panel developed a specific set of over 50 Amplifying Questions with the Subject Matter Expert, combined and organized within the Five Categories shown below, to facilitate discussion and provide insights during visits with the organizations on the Domestic Scan. Most of the questions are in the first two categories.
 - ✓ Technical Considerations
 - ✓ Organizational Considerations
 - ✓ Performance Measures
 - ✓ Legal Considerations
 - ✓ Future Vision

What's Next in Florida

- ◆ One of the FHWA Every Day Counts 2 Initiatives adopted by FDOT in the current cycle is 3 Dimensional Modeling, often referred to as 3D Engineered Models for Construction
- ◆ FDOT representatives have participated in 3D Engineered Models for Construction Workshops in Arkansas and Alabama
- ◆ FHWA has agreed to Conduct a 3D Engineered Models for Construction Workshop in Florida, currently in the planning stage for early September, 2014 in Orlando
- ◆ Participants will include key staff from FDOT, Contractors, Consultants and FHWA

The FDOT Office of Design Vision for CIM

- ◆ We will show the strength to culturally change to the systematic and collaborative management of data and information
- ◆ We will have removed the thought of data silos
- ◆ We will recruit differently; hire people who think geospatially, not unlike teenagers today.
- ◆ We will invest in tools and consultants differently
- ◆ We will program our project funding differently; spending for the right data at the right time

The FDOT Office of Design Vision for CIM

- ◆ We will recognize that data has intrinsic value, managing it more broadly and efficiently
- ◆ We will collect data once and use it many times
- ◆ We will scope projects differently
- ◆ We will manage projects differently
- ◆ We will manage the life cycles of our corridors, projects and facilities

Why Civil Integrated Management (CIM)

- ◆ A major takeaway from the Alabama Workshop in May was provided by a Manager of a Major Contractor using 3D Engineered Models in many parts of his business. He used the analogy that once you start doing business this way, you don't go back. **It would be like going home and unplugging your microwave.**
- ◆ We know how much technology has touched and changed our personal lives in many ways. We know that CIM and related technologies are here to stay. What will change will be the adoption rate and the level of success enjoyed by those that get on board.
- ◆ CIM is a true Game Changer.

What About You

- ◆ The Training Message ...
- ◆ Where Can You Start? How Can You Get Aboard the Galloping Horse?
- ◆ Remember ... the Core Building Blocks of CIM are 3D Engineered Models
- ◆ Can You Accept the Challenge to Think Outside of the Box and Beyond Your Own Data Silo?
- ◆ Are You On Board? Hang On ... It's EXCITING!

Advances in Civil Engineering Management

Questions??