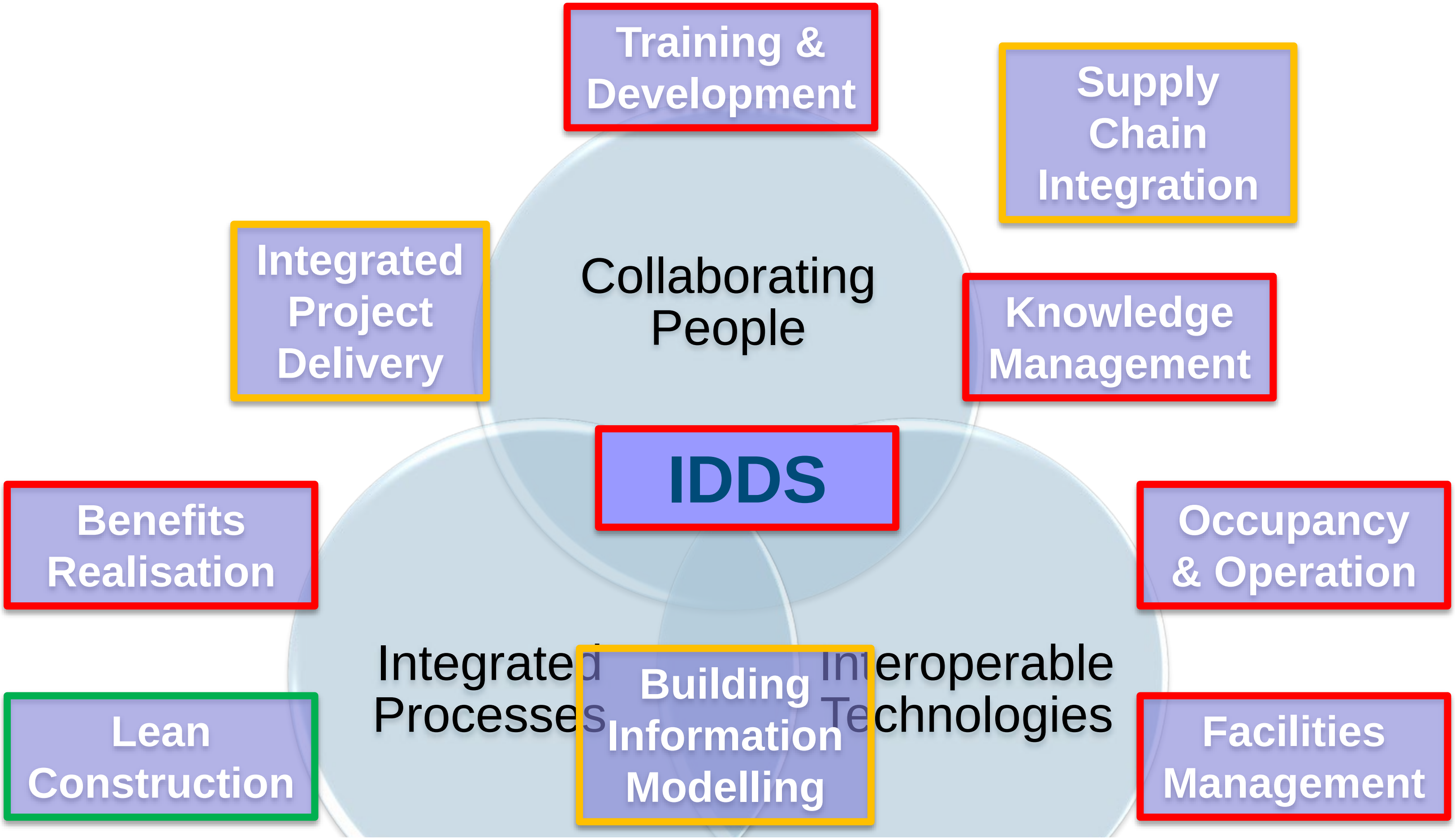
CIB
BIM / IDDS Seminar
November 1, 2013

Deploying IDDS in the U.S.

Dr. S. Shyam Sunder
Senior Advisor for Laboratory Programs
National Institute of Standards and Technology
U.S. Department of Commerce

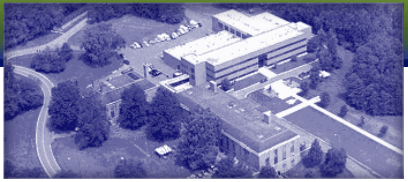
Outline

- BIM + IPD + Lean + SCI…= IDDS
- Examples of Deploying IDDS in the U.S.
  - Infrastructure, Process Plants, Government Facilities
- Observations
- IDDS + O&M + Optimization
- Delivery of IDDS Practices



Vision: to minimise all forms of **waste**,
whilst delivering greater assured **value**
for **sustainable** whole lifecycle **outcomes**

International Council for Research and Innovation in Building and Construction



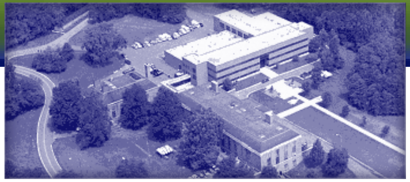
INTELLIGIENT CONSTRUCTION & SYSTEMS TECHNOLOGIES (ICST)

FHWA's Current and Planned Research

Federal Highway Administration
Turner-Fairbank Highway Research Center

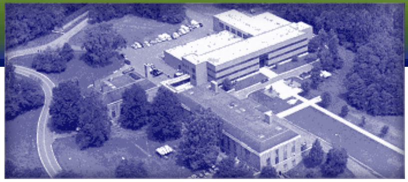
Richard B. Duval, P.E.
&
Lou Triandafilou, P.E.

October 4, 2013



How do the ICST research activity classifications and research activities themselves fit with the R&T strategic plan objectives?

- ICST research projects support these Strategic Plan Objectives:
  - **Project Delivery** - Improve the ability of transportation agencies to deliver projects that meet expectations for timeliness, quality and cost.
  - **Infrastructure Performance** - Improve highway condition and performance through increased use of design, materials, construction and maintenance innovations

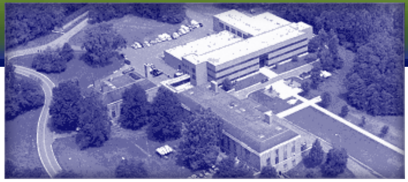


Development of National Bridge Information Modeling (BrIM) Standards

Brian Kozy, PhD P.E.
Senior Bridge Engineer – Steel Specialist
Federal Highway Administration

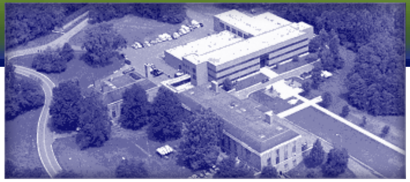
Louis N. Triandafilou, P.E.
Office of Infrastructure Research & Development
Team Leader – Bridge & Foundation Engineering Team

U.S. Department of Transportation
Federal Highway Administration



Objective

This research is intended to develop, implement, standardize, and demonstrate an efficient and robust digital data exchange protocol (and file format) that could be used to digitally describe bridge engineering information



Deployment of BrIM Standards

- This work is intended to be "seed" development, with handoff to industry for long-term
- Standards will be open source, with management by consortium
- Schema descriptions will utilize XML

Vision & Bridge Lifecycle (Enterprise) Process Map

Vision of Multi-Year Implementation Roadmap

- Practical Implementation

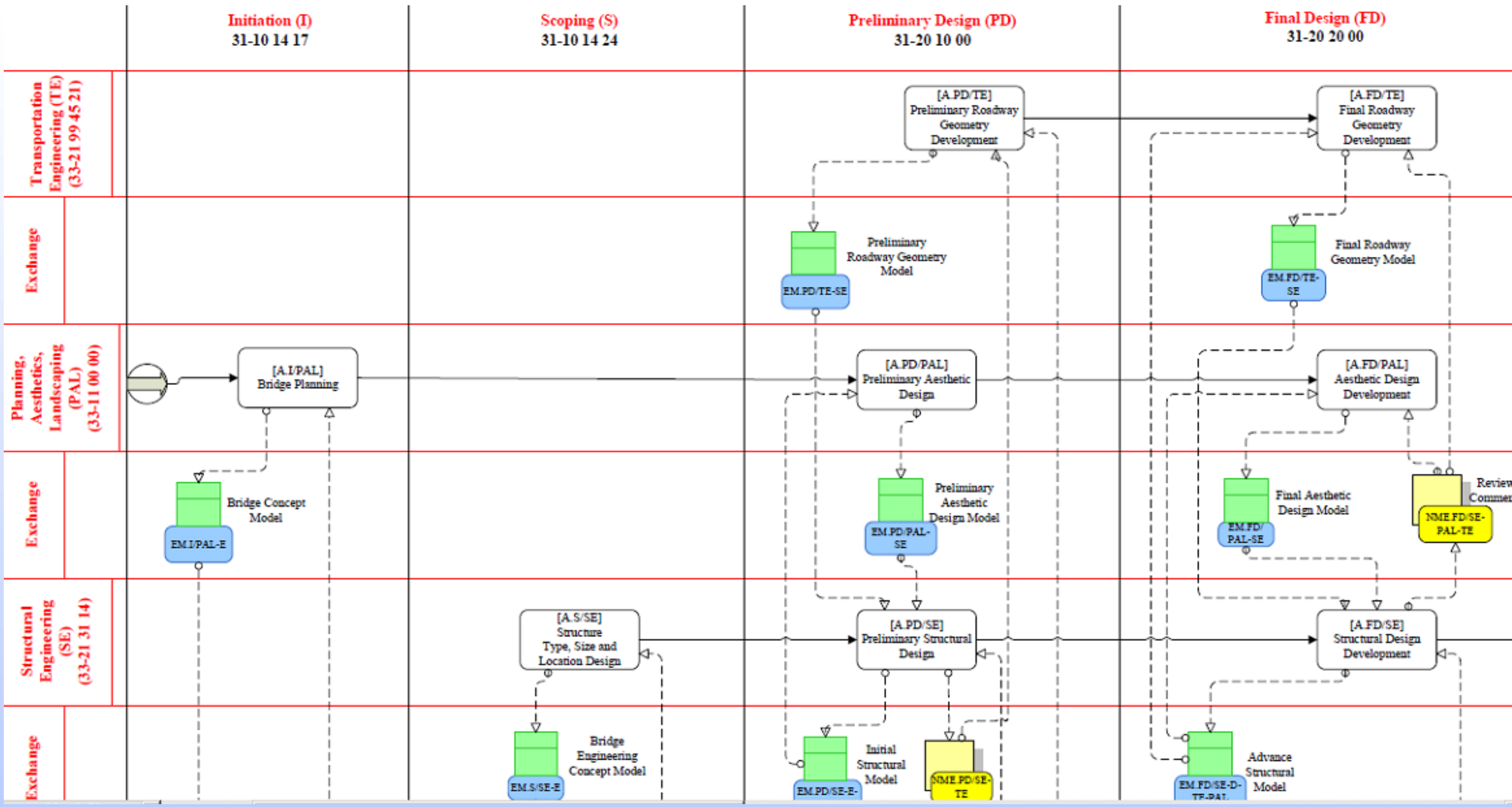
Information Technology (IT) facilitated interoperability throughout the entire bridge lifecycle

- Model/Modular

Either a (set of bridge industry-specific) model(s) or a integral part of the larger Civil Integrated Management (CIM) (or NIEM?, or IFC(5?), or next-gen transXML, or ...) umbrella

Vision & Bridge Lifecycle (Enterprise) Process Map

Process Map — Streamlined and Improved IT- enabled Managing Method



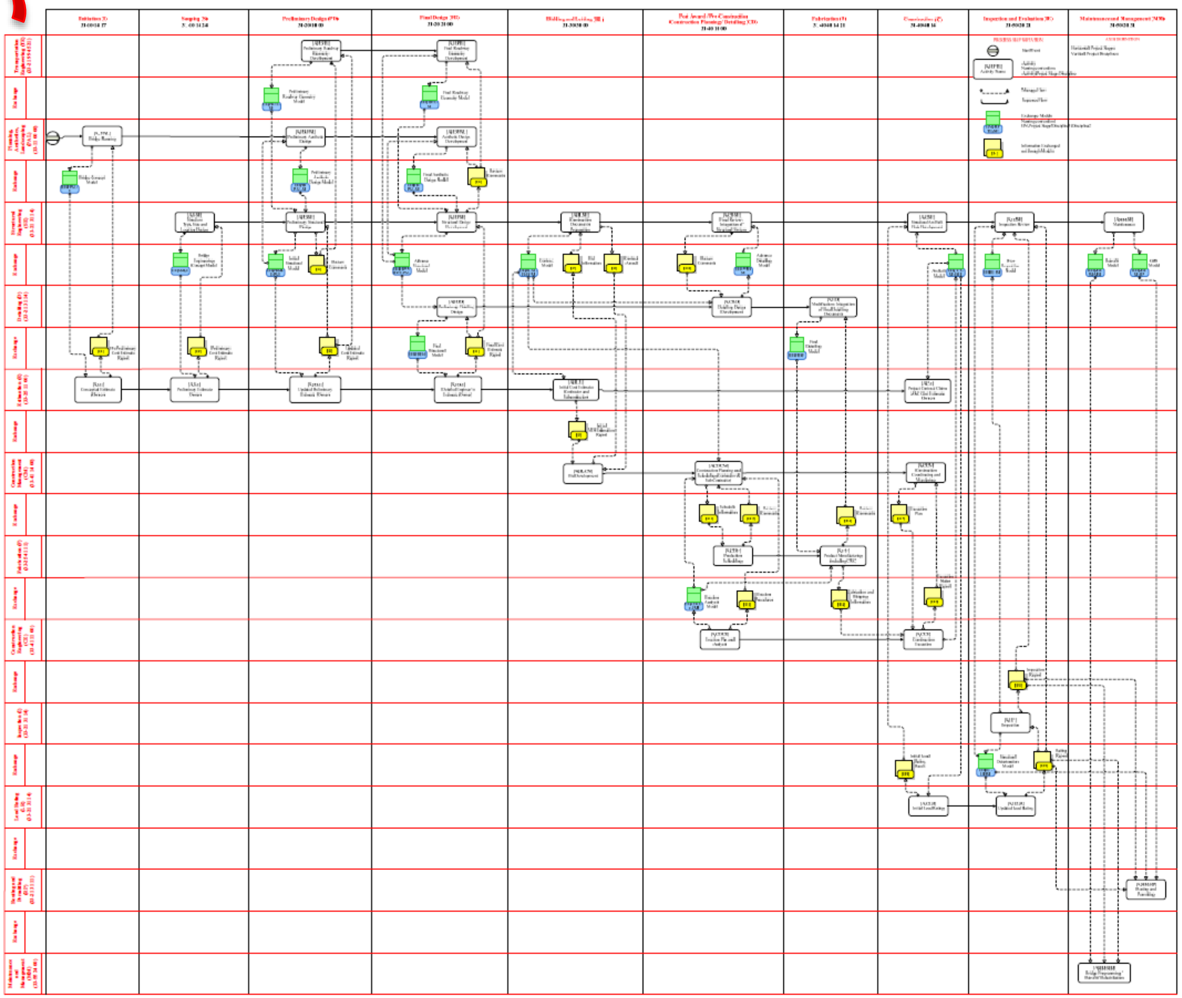
Portion of Bridge Enterprise Process Map (Chen et al. 2013)

Process Map Notation

Project Disciplines:

- Detailing
- Estimating
- Construction Management
- Fabrication
- Construction Engineering
- Inspection
- Load Rating
- Routing and Permitting
- Maintenance and Management

……



Project stages:

- Bidding and Letting
- Post-Award/Preconstruction Planning/ Detailing
- Fabrication
- Construction
- Inspection and Evaluation
- Maintenance and Management
- Management

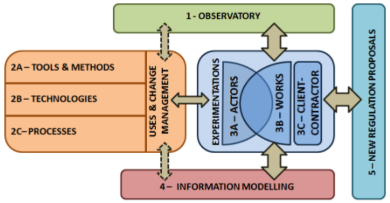
……

Geodesign Summit Europe

September 19–20, 2013 | Herwijnen, Netherlands

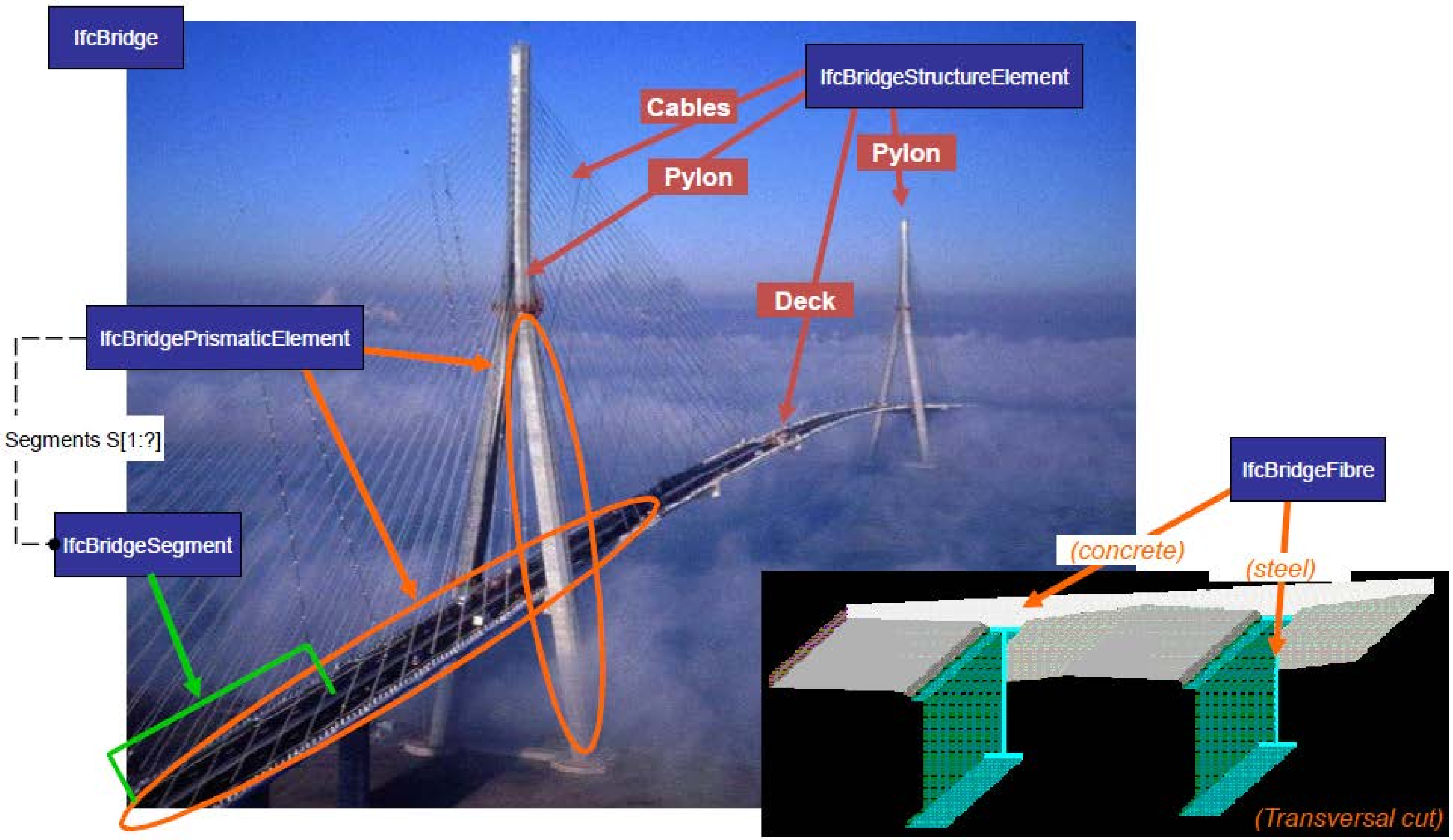
Modélisation des INformations INteropérables pour les INfrastructures Durables

Christophe CASTAING - EGIS

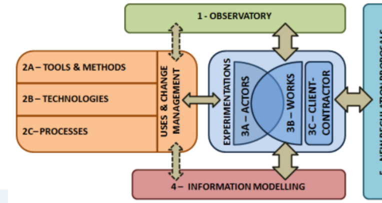


- # Information Modeling :

IFC Bridge



INFRA – LOD



Modélisation des INformations INterop pour les INfrastructures Durables

Project

FUNCTIONS

Concerned Networks

Systems

- Road
- River
- High Voltage

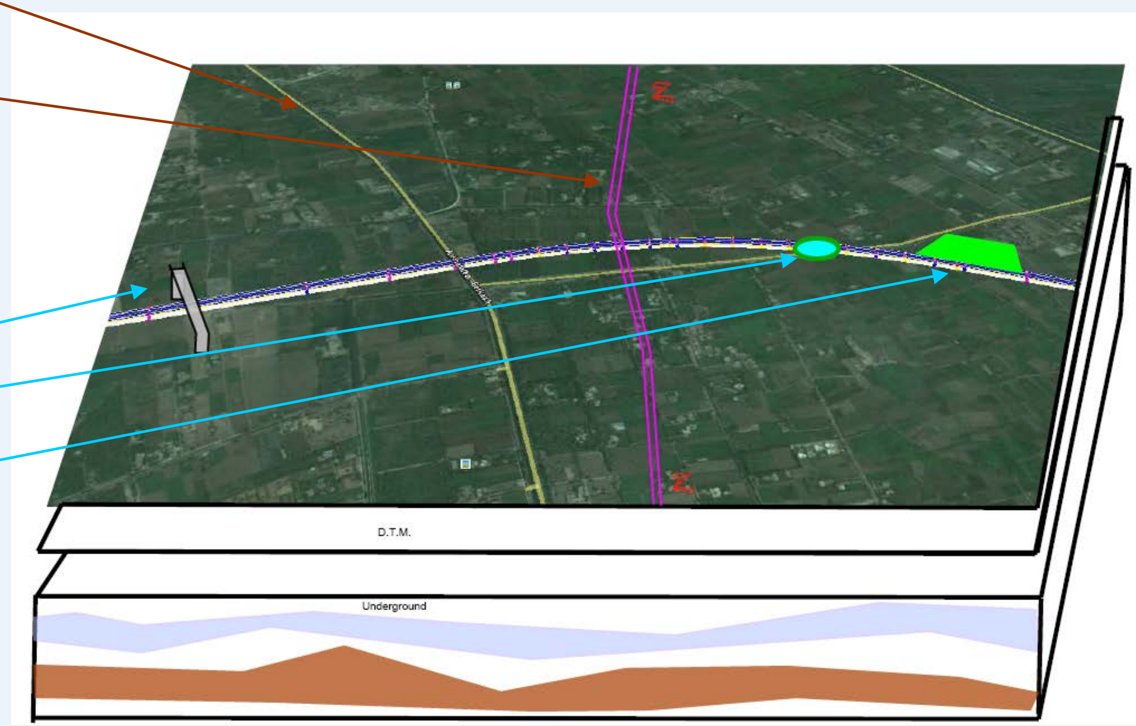
Motorway CH0-CH99

Systems

- TOLL PLAZA
- INTERCHANGE
- SERVICES AREA

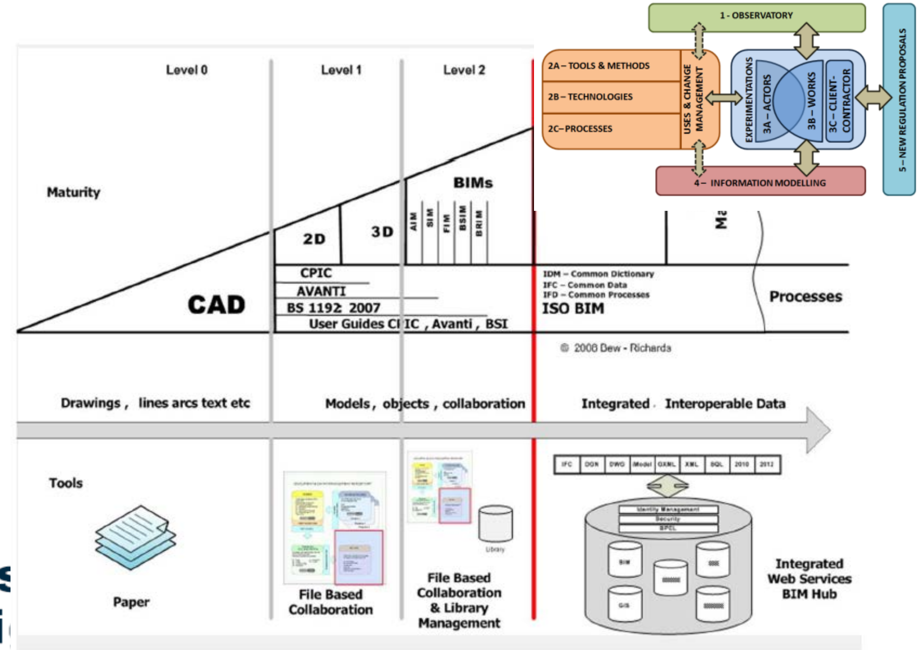
DTM

Underground

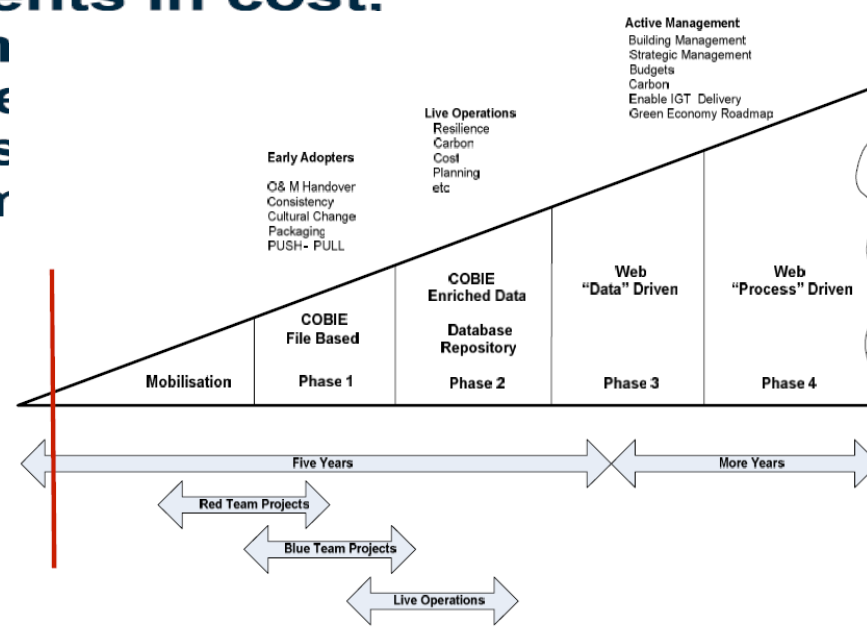


Analysis | Simulations | Schedule | QTO | ...

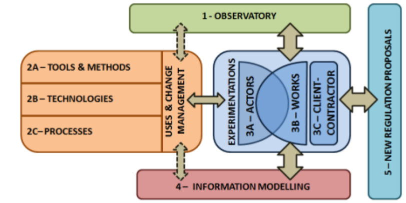
• Observatory :



Government as
derive si
improvements in cost.
value an
performance
use of open s
inform

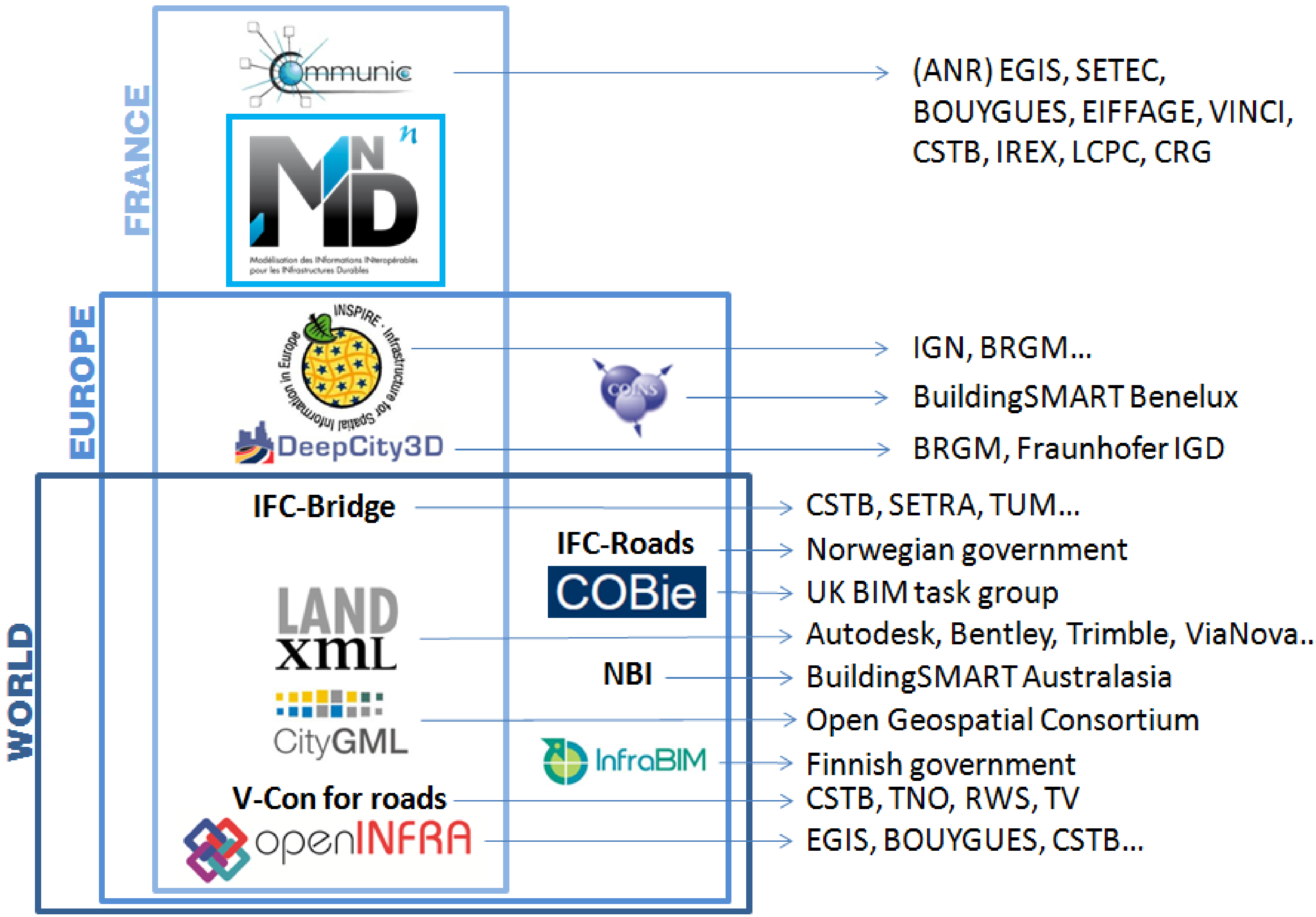


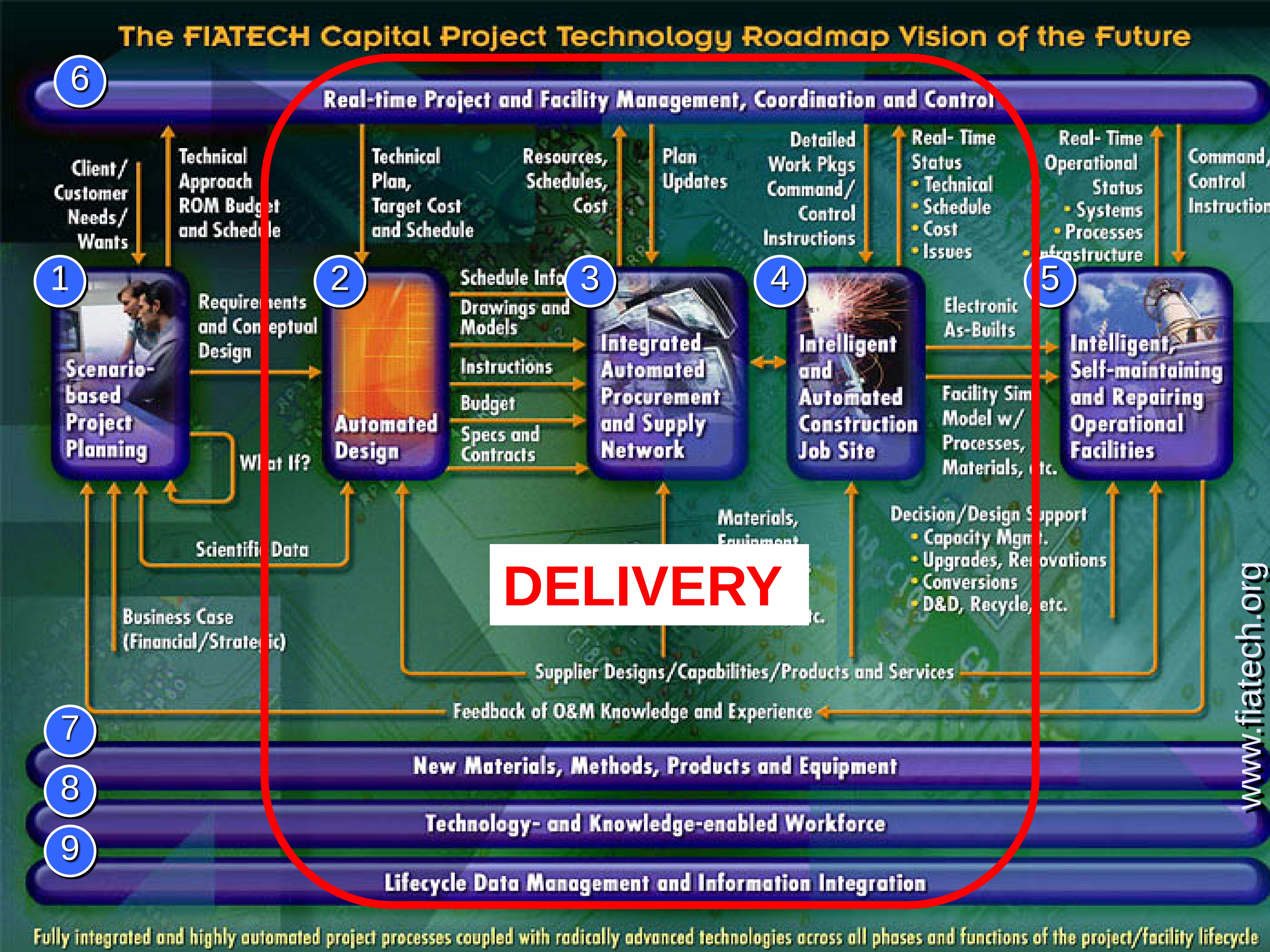
BIM Task group:
a UK Government initiative



- Observatory :

MAP OF ACTUAL INITIATIVES DEDICATED TO INFRASTRUCTURES





The FIATECH Capital Project Technology Roadmap Vision of the Future
6
Real-time Project and Facility Management, Coordination and Control
Client/ Customer Needs/ Wants
Technical Approach ROM Budget and Schedule
Technical Plan, Target Cost and Schedule
Resources, Schedules, Cost
Plan Updates
Detailed Work Pkgs Command/ Control Instructions
Real- Time Status
• Technical
• Schedule
• Cost
• Issues
Real- Time Operational Status
• Systems
• Processes
Command/ Control Instruction
1
Scenario-based Project Planning
Requirements and Conceptual Design
What If?
2
Automated Design
Schedule Info
Drawings and Models
Instructions
Budget
Specs and Contracts
3
Integrated Automated Procurement and Supply Network
4
Intelligent and Automated Construction Job Site
Electronic As-Builts
Facility Sim Model w/ Processes, Materials, etc.
5
Intelligent, Self-maintaining and Repairing Operational Facilities
Scientific Data
Business Case (Financial/Strategic)
Materials,
Decision/Design Support
• Capacity Mgmt.
• Upgrades, Renovations
• Conversions
• D&D, Recycle, etc.
DELIVERY
Supplier Designs/Capabilities/Products and Services
Feedback of O&M Knowledge and Experience
7
New Materials, Methods, Products and Equipment
8
Technology- and Knowledge-enabled Workforce
9
Lifecycle Data Management and Information Integration
Fully integrated and highly automated project processes coupled with radically advanced technologies across all phases and functions of the project/facility lifecycle
www.fiatech.org

Business Essential

Infrastructure and Process Plant Configuration Management

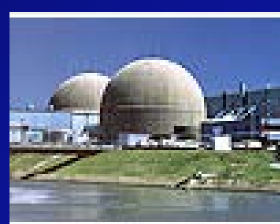
Design Basis

Design Requirements
"What needs to be there"

Conform

Conform

Physical Configuration
"What is actually there"



Conform

Plant Docs

Facility Configuration Information
"What we say is there"

Work Processes must assure that:

Elements conform all the time
All changes are authorized
Conformance can be verified

R.Adams, Dominion

Business Challenge

Infrastructure and Process Plant Configuration Management

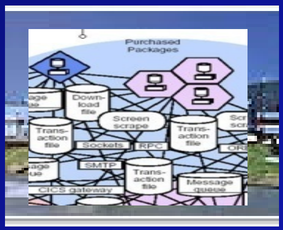
Knowledge Workers

Challenge

Challenge

Paper-based Quality Assurance Process

Automation Systems



Challenge

Plant Documentation

Lots of Tribal Knowledge , Semi-Connected and Disconnected Systems, Manual Processes and yes…… Paper

Observations

- Where there are:
  - compelling business drivers,
  - multiple stakeholders who recognize the need for improved processes,
  - commitment to defining increments of capabilities viable for broad deployment,

  leaders are applying IDDS and transforming industry practices.

- To succeed, it is essential to understand :
  - larger business and supply chain context,
  - IT landscape and supporting services,
  - information needed for commissioning, operations, maintenance and optimization,
  - where there are inefficiencies and potential productivity gains that could benefit multiple stakeholders.

- Enterprises must assess their internal IDDS readiness level and the IDDS readiness capacity of their potential partners and target markets when planning an IDDS strategy.

- There are **overlapping and duplicative efforts to build the semantic and services infrastructure** for broad adoption of IDDS in the different sectors and regions of the capital facilities industry.

Discussion

- CIB could provide unique value by:

developing mechanisms that enable communication and collaboration on cross-cutting challenges and advancements to build the IDDS semantic and services infrastructure.

- This could develop into IDDS recommended practices.

Note: The challenges of global coordination and convergence for achieving the aspirations of openINFRA is an excellent example for articulating the institutional and technical challenges.

- Should IDDS enable Operations and Optimization?

Back-up Slides

BIM + IDDS

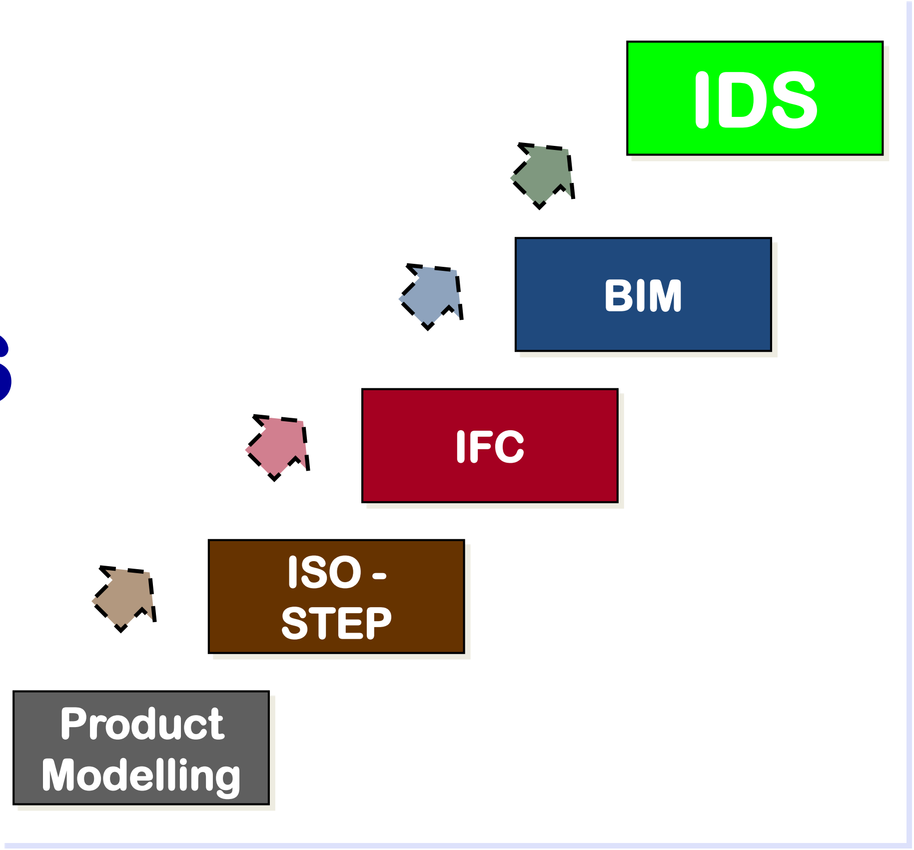
- BIM is transforming engineering and construction.
  - Building Information Modeling / Integrated Design and Delivery Solutions
- Stakeholders are changing their sectors, e.g., structural steel .
- Bridge industry is changing to life cycle delivery.
- Process and power industries know they must transform delivery and operation of future plants.
- Integration of supplier processes, expertise, and systems for optimizing is still largely untapped.
- Synergy of combining manufacturing and construction innovation
  - Common challenges in advancing systems integration, intelligent sensing, control and automation
  - Distributed configuration management of federated information and controls
- BIM + IPD + Lean + SCI…= IDDS

	Near-term Research Priority / Mid-term Research Priority / Long-term Research Priority
Target One Develop improved sustainability models & measures	*IDDS should enable a more coherent approach to sustainability modelling and achievement, whether at the building or area scale*
	❑ Expand human behaviour modelling ❑ Develop Human Building Interfaces ❑ Develop performance & consumption models ❑ Develop knowledge-based architectural programme ❑ Coherent information flow and reusable knowledge development
Target Two Define the Built Environment Information Fabric	*An information fabric should be developed which extends to campus/ city scale models to solve emerging infrastructure network problems and facilitate integration of traditionally disparate domains*
	❑ Support building operations & assets ❑ Modelling on installation scale but integration on geographic scale ❑ Information systems lifecycle & interoperability ❑ Context-based individualised interaction ❑ Collaborative project development process & legal framework ❑ Presentation of information on construction and use
Target Three Improve current practices	*IDDS must provide the cohesive element to overcome the obstacles of trying to tackle fundamental change to current practices, particularly by developing improved knowledge management*
	❑ Further adapt industrial design processes for the product and its manufacture ❑ Design, construction & supply chain improvement ❑ Technological development ❑ Electronic submission & approval systems ❑ Facilities & operations management advances
Target Four Cultural change & knowledge management and dissemination	*It is essential that we capture knowledge and re-use it both in practice and education, so that we can foster improvement at the pace of the fastest, rather than at the pace of the slower majority*
	❑ Industry/ enterprise business process re-modelling ❑ Develop new and expanded collaborative roles/ technologies ❑ Develop new pedagogy for integrated design & construction curriculum ❑ Types of Knowledge Management needed for technology transfer vs. steady state ❑ Dissemination & diffusion model ❑ Performance management & measurement

The Evolution of IDS

A Historical Perspective

(CIB IDS Workshop June 2009)



OpenBIM required
Building Agency
bject servers and
s being

Germany. Some adoption of BIM (e.g. Bavaria) but varies across agencies and States.

Denmark. Several state agencies require BIM, especially for larger projects; BIM use high and IFC required for interoperability. Guidelines being developed.

Sweden. Late 2012 five Swedish State agencies and companies collaborating in promoting BIM.

Norway. Statsbygg ha
collaborated with the U
development of its own
guidelines.

nandated for
and used by a
contractor and a
on supplies
rket

Finland. Arguably wor
in use of BIM. Senate P
guidelines requiring BIM
for interoperability rece
updated into national C
BIM Requirements (CO

nt mandated
d all asset
COBie format on
ded projects by

Japan. Major design fi
general contractors lea
use of BIM. General co
making efforts to utilize
detailing and constructi
planning phases. Archit
Institute of Japan and o
investigating BIM and r
issues.

ng at adapting/
SA's NBIMS-US

South Korea. On-goin
programme on the man
BIM use on Governmen
and considerable stand
development.

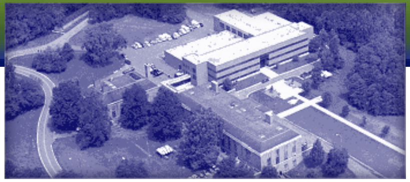
vernment client
nd States have
andards (e.g.,
rvices
and US Army
ers). Many large
architects have
t many rely on
to employ it on
roject. Lean
d Integrated
also gaining

Australia. BuildingSMART leading adoption of BIM adoption patchy. History of using Alliancing, although with mixed reviews..

New Zealand. Government in early stages of exploring best approaches for employment of BIM on Government projects as cornerstone of planned productivity improvement by 2020.

Singapore. Automated code checking for many years; now encouraging the use of BIM, including teaching at Universities.

China & Hong Kong.
Considerable BIM exper
implementation low. H
Housing Authority BIM
guidelines. 2012: "BIM
the future IT solution in
The Chinese Governme
strongly supporting BIM

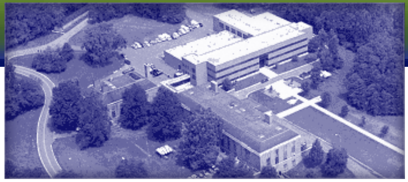


Current FHWA Research

Addressing Challenges in Intelligent Construction Systems and Technologies (ICST)

Scope:

The contractor shall address gaps identified for ICST from project development through construction and develop guidance for State highway agencies to assist them in determining how best to use ICST to improve accelerated delivery. The scope of the study covers various types, sizes and scopes of transportation projects using ICST delivered by State highway agencies. The study involves collecting, organizing and analyzing data from various State highway agencies and other facility owners using ICST. Addressing the known gaps in how electronic information/data is shared and used by other parties.

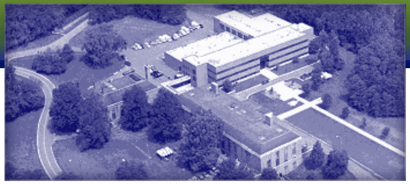


Current FHWA Research, cont'd

Objectives: Working with States, documenting barriers, and developing guidance.

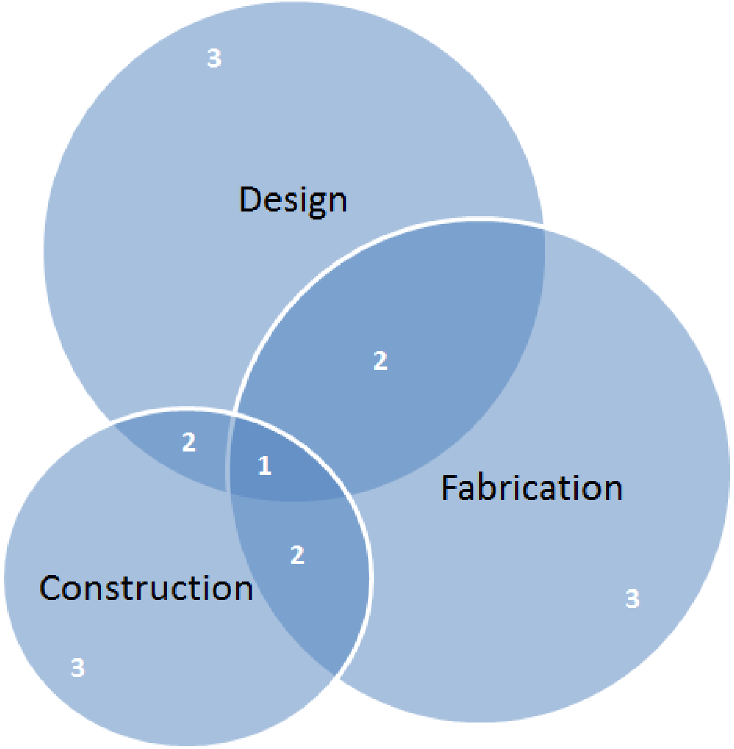
1. Further identify **gaps in design procedures, design manuals, applications**, etc. for highway agencies **to properly generate accurate *3/4/5 D models and electronic data*** for downstream uses in construction.
2. Document **ICST success stories and best practices**, and best uses for individual technologies.
3. Document the **types of costs and resources required by industry and agencies for implementation** of these technologies, and their associated return on investment.
4. Document the **ICST challenges in the areas of surveying, utilities, real time verification, and data management**
5. Provide a **technology development plan** to address the challenges and opportunities encountered in the project.

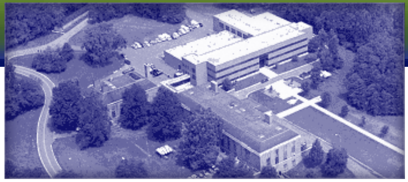
– **Awarded Contract September 2013 to Transtec Group Inc.**



Purpose and Need

- Many stakeholders in evolution of project have need of same engineering information
- Most information lends itself to digital format
- 3 Levels, with increasing stakeholder interest





Expected Outcomes

- Widespread interoperability between engineering software platforms is achieved
- Move practice towards digital delivery and receipt of project information
- Supports advanced modeling and analysis and visualization
- Accounting aspects of design are streamlined
- Move away from paper
- More efficient and less errors

Bridge Data Protocols for Interoperability and Life Cycle Management Work-in-Progress

Stuart S. Chen, Ph.D., P.E.

UB Bridge Information Modeling Research Group

Hanjin Hu, P.E., Ph.D. Candidate, LEED Green Assoc.
Najaf Ali, Ph.D. Candidate
Rohit Srikonda, P.E., MSCE, M.S. Candidate in CSE

Department of Civil, Structural and Environmental Engineering
University at Buffalo

June 2013

Selected Developments in Related Fields

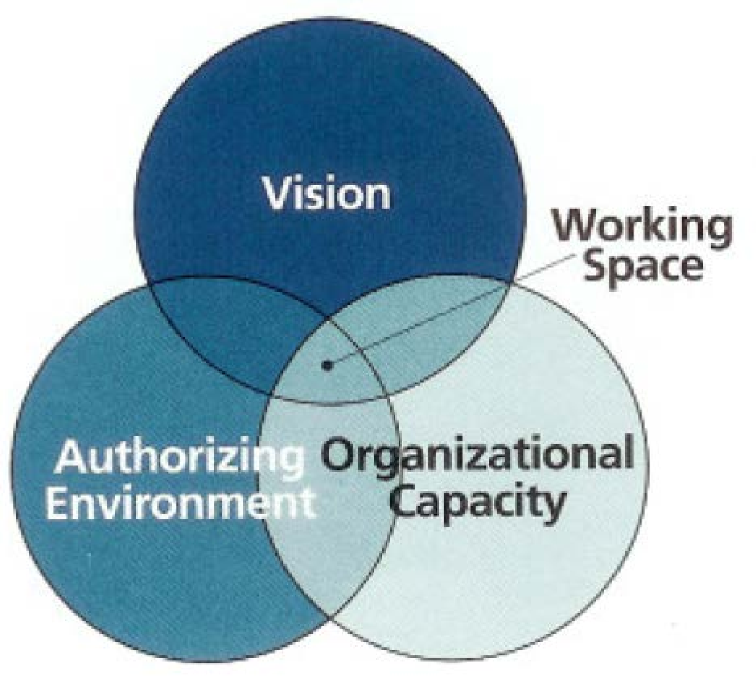
resources/liaisons; mutual interests to varying degrees…

- Infrastructure (e.g., IFC-Infra, buildingSMART) ∩ Geospatial (e.g., OGS)
- Steel structures (e.g., AISC, FIATECH & ISO 15926)
- Concrete structures (e.g., ACI for cast-in-place, PCI for precast/prestressed, PTI for post-tensioned, nuclear for their audit trail requirements)
- Geotech (e.g., gINT, DIGGS)
- AASHTO (e.g., TCEED, transXML/NCHRP 20-94, NCHRP 20-83(03), etc)
- Manufacturing (e.g., NIST initiatives, etc) & Construction (e.g., BIMForums)
- Electric Power Plants (e.g., EPRI, etc)
- Emerging Technology Law (e.g., AIA and ConsensusDocs BIM Addenda)
- Application software consortia (existing or perhaps yet to be constituted)
- Markup languages & models (e.g., ISM) for structural/FEM data exchange
- other existing and emerging exchange standards (e.g., COBie, SPie, BIMSie, BPie, ELie, LCie, QTie, WALLie, etc)

Implementation Roadmap

Overview

A range of recent and emerging state-of-art technologies have the potential to transform the efficiency, effectiveness, reliability, cost-effective life cycle management of bridge network in coming decades.



Approach Recommended:

Roberts Leadership and Management Model

Implementation Roadmap

Examples of Roberts Model Elements

Roberts Model Element	Example
Vision	As a result of BrIM-standards based interoperability being implemented, owners dealing with construction claims could quickly access the searchable electronic “audit trail” that is a byproduct of BrIM – enabled processes to quickly assess the merits of claims just as easily as a contractor with suitable access to model data can interrogate it instead of issuing RFI’s.
Authorizing Environment	Increasing interconnectedness of pieces of the workflow is increasingly realized by software translators, and the integrative Vision embraced by various stakeholders (owners, designers, contractors, etc.) in the bridge lifecycle in a given owner’s jurisdiction
Organizational Capacity	In an owning agency organization and the consulting firms serving them, long standing animosities between previously separated highway design and bridge design squads reduce over time; re-tooling of CAD technicians and bridge engineers to productively use 3D modeling tools, possibly partially subsidized using MAP-21 funds incentivizing deployment of ABC technologies.
Working Space	Progressive CEO’s and managers clearly understand and champion the vision throughout the organization in an energetic and sustained manner to facilitate the migration from initially non-interoperating software operated by a not-fully-IT-savvy workforce to collaboratively influence that agency’s next-gen CAD standards and associated workflows to implement Task 12 – generated data exchange standards (or suitable derivative(s) thereof)

COBie

an open-standard
for managed assets


Permafile
HEAVY DUTY
STORAGE
BOX
02225
TECH MANUALS

AS-BUILT RECORD OF EQUIPMENT AN D MATERIALS

Furnish [one copy] [[_____]copies] of preliminary record of equipment and materials used on the project [15] [_____] days prior to final inspection. This preliminary submittal will be reviewed and returned [2] [_____] days after final inspection with Government comments. Submit [Two] [_____] sets of final record of equipment and materials [10] [_____] days after final inspection. Key the designations to the related area depicted on the contract drawings. List the following data:

RECORD OF DESIGNATED EQUIPMENT AND MATERIALS DATA				
Description	Specification Section	Manufacturer and Catalog, Model, and Serial Number	Composition and Size	Where Used

SPARE PARTS DATA

Submit [two] [_____] copies of the Spare Parts Data list.

a. Indicate manufacturer's name, part number, nomenclature, and stock level required for maintenance and repair. List those items that may be standard to the normal maintenance of the system.

PREVENTATIVE MAINTENANCE

Submit Preventative Maintenance, Condition Monitoring (Predictive Testing) and Inspection schedules with instructions that state when systems should be retested.

a. Define the anticipated length of each test, test apparatus, number of personnel identified by responsibility, and a testing validation procedure permitting the record operation capability requirements within the schedule. Provide a signoff blank for the Contractor and Contracting Officer for each test feature; e.g., liter per second, rpm, kilopascal gpm, rpm, psi. Include a remarks column for the testing validation procedure referencing operating limits of time, pressure, temperature, volume, voltage, current, acceleration, velocity, alignment, calibration, adjustments, cleaning, or special system notes. Delineate procedures for preventative maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize corrective maintenance and repair.

b. Repair requirements must inform operators how to check out, troubleshoot, repair, and replace components of the system. Include electrical and mechanical schematics and diagrams and diagnostic techniques necessary to enable operation and troubleshooting of the system after acceptance.

HARDWARE SCHEDULE

Prepare and submit hardware schedule in the following form:

Hardware Item	Quantity	Size	Reference Publi-cation Type No.	Finish	Mfr Name and Catalog No.	Key Control Symbols	UL Mark (If fire rated and listed	BHMA Finish Desig-nation

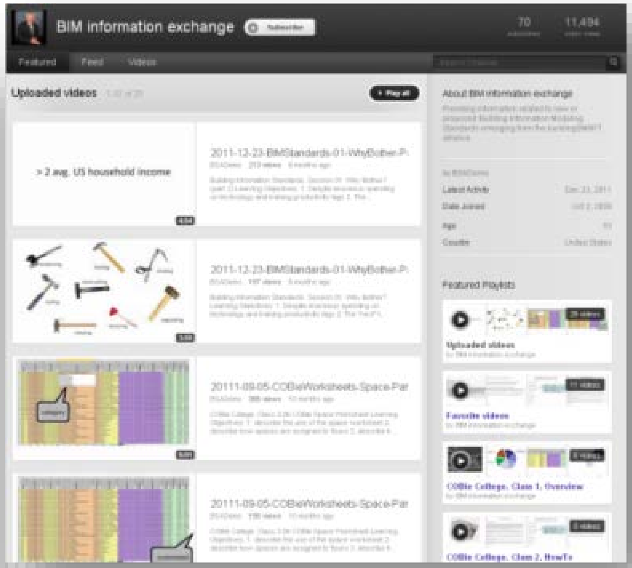
SIGNAGE, INSTALLATION

SIGNAGE PLACEMENT SCHEDULE				
Door/Room Number	Sign Type	Text	Insert(s)	Symbol/Remarks
[_______]	[_______]	[_______]	[_______]	[_______]

WARRANTY MANAGEMENT PLAN

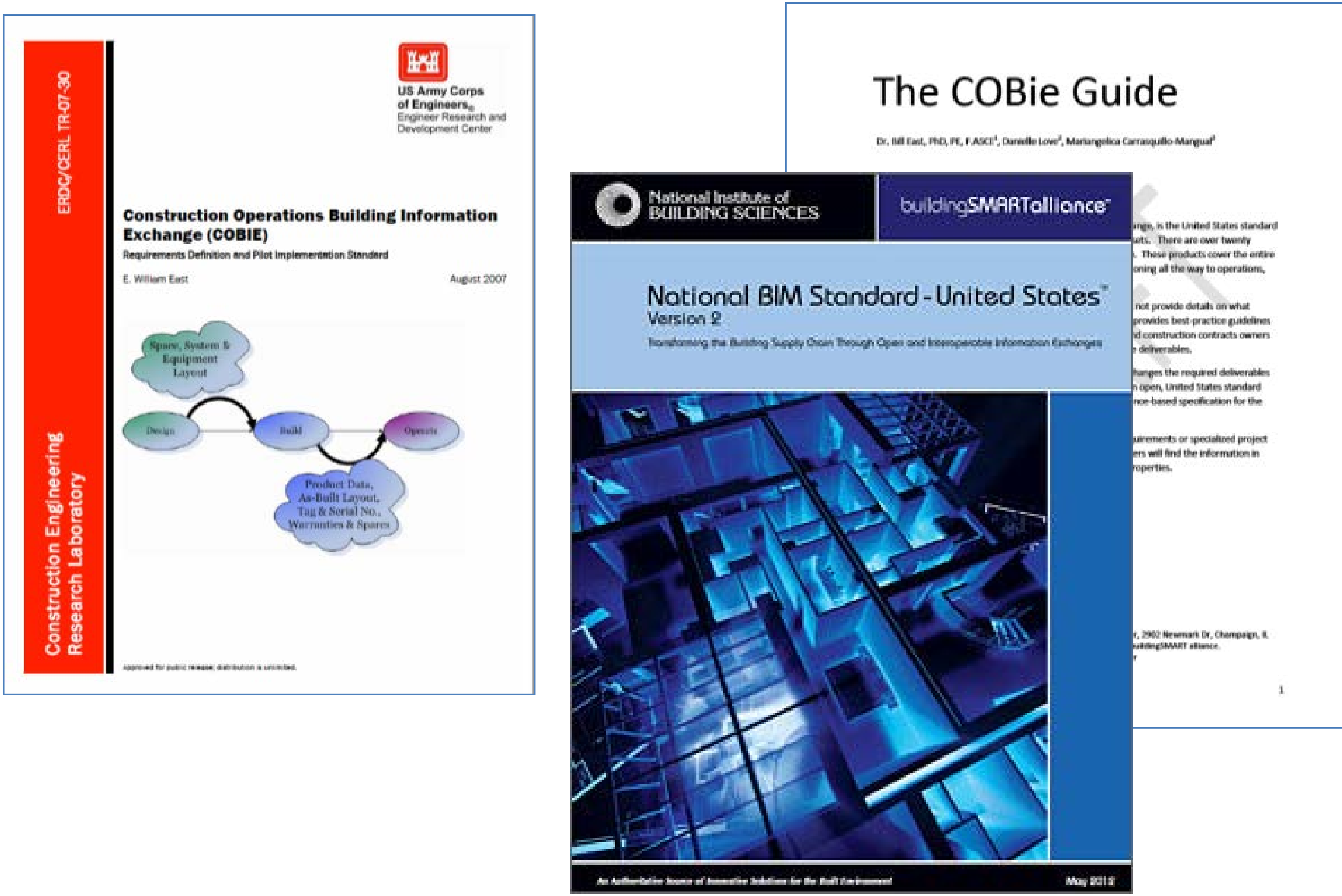
d. A list for each warranted equipment, item, feature of construction or system indicating:

(1) Name of item.
(2) Model and serial numbers.
(3) Location where installed.
(4) Name and phone numbers of manufacturers or suppliers.
(5) Names, addresses and telephone numbers of sources of spare parts.
(6) Warranties and terms of warranty. Include one-year overall warranty of construction, including the starting date of warranty of construction. Items which have extended warranties must be indicated with separate warranty expiration dates.
(7) Cross-reference to warranty certificates as applicable.
(8) Starting point and duration of warranty period.
(9) Summary of maintenance procedures required to continue the warranty in force.
(10) Cross-reference to specific pertinent Operation and Maintenance manuals.
(11) Organization, names and phone numbers of persons to call for warranty service.
(12) Typical response time and repair time expected for various warranted equipment.



2007 2008 2009 2010 2011 2012 2013

http://www.wbdg.org/resources/cobie.php,
http://www.linkedin.com/groups?home=&gid=2638637&trk=anet_ug_hm
http://www.youtube.com/user/BSADemo/videos?view=1


ERDC/CERL TR-07-30
US Army Corps of Engineers
Engineer Research and Development Center
Construction Operations Building Information Exchange (COBIE)
Requirements Definition and Pilot Implementation Standard
E. William East
August 2007
Spare, System & Equipment Layout
Design
Build
Operate
Product Data, As-Built Layout, Tag & Serial No., Warranties & Spares
Construction Engineering Research Laboratory
Approved for public release; distribution is unlimited.
The COBie Guide
Dr. Bill East, PhD, PE, F.ASCE, Danielle Love, Mariangelica Carrasquillo-Mangual
National Institute of BUILDING SCIENCES
buildingSMARTalliance
National BIM Standard - United States
Version 2
Transforming the Building Supply Chain Through Open and Interoperable Information Exchanges
May 2012

****
DRAFT   UFGS-01 79 00 (AUG 2013)

Drafting Activity: USACE

UNIFIED FACILITIES GUIDE SPECIFICATION

****

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 79 00

Construction-Operations Building information exchange (COBie)
08/2013

****

PROJECT DELIVERY METHODS FOR

Water & Wastewater Infrastructure
Design-Build
– and –
Construction Management At Risk

WATER DESIGN-BUILD COUNCIL
AN ASSOCIATION OF LEADING DESIGN BUILDERS

Produced by the Water Design-Build Council
October 2012

WATER DESIGN-BUILD COUNCIL
AN ASSOCIATION OF LEADING INTEGRATED DESIGN BUILDERS

The Water Design-Build Council

Trade organization of national design-build companies that serve the water and wastewater industry

MARKET FOCUS:
Water / Wastewater Capital Projects

- Facility expansions / refurbishments
- Treatment process upgrades
- Conveyance / collection
- Residuals management
- Energy efficiency
- Water resources development / maintenance
- Asset management tools & systems

WDBC Mission

- Advocate for the added value and applications of Design-Build and CMAR delivery, specifically in North America
- Defines and develops Design-Build and CMAR best practices for owner planning, procurement and project implementation
- Promotes collaborative relationships between Owners and industry practitioners that create innovation and quality solutions to save time and cost, with less risk for all parties

Water / Wastewater Project Drivers and Objectives

- Services demand – schedule/time priority
- Regulatory driven – schedule and performance priorities
- Treatment processes - innovative solutions
- Reliability and operational flexibility – best value
- Lower and predictable O&M cost – life cycle cost
- Budget constraints – acceptable firm cost
- Community and economic impacts – reduced risk

Project Delivery Defined

- A comprehensive process including planning, design, permitting, construction, testing & acceptance and other related services, necessary for executing a capital project

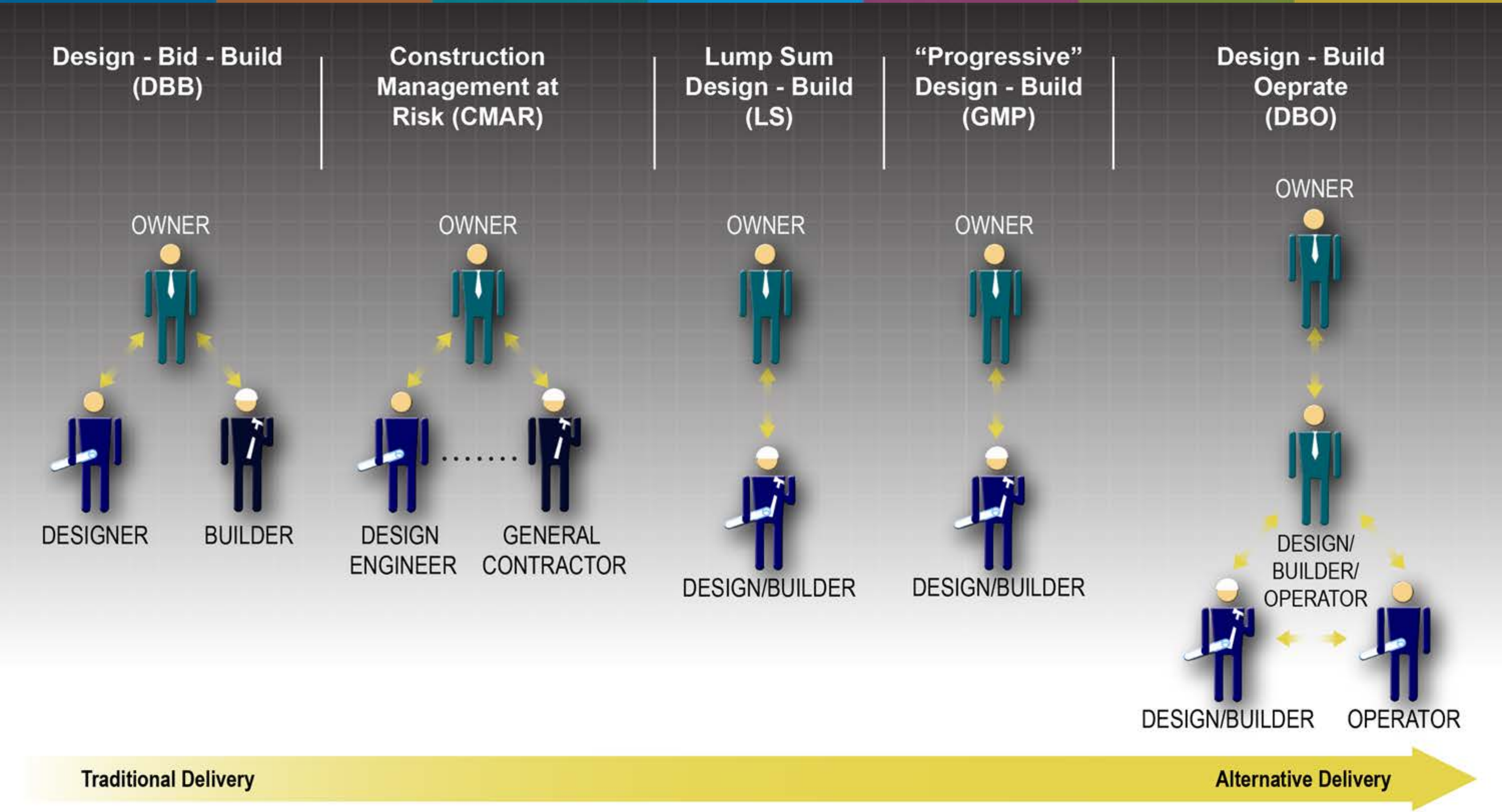
- Fundamental Owner decisions for Project Acquisition

What Project Delivery Method ?

What Procurement Method?

What Contracting Approach?

Project Delivery Methods

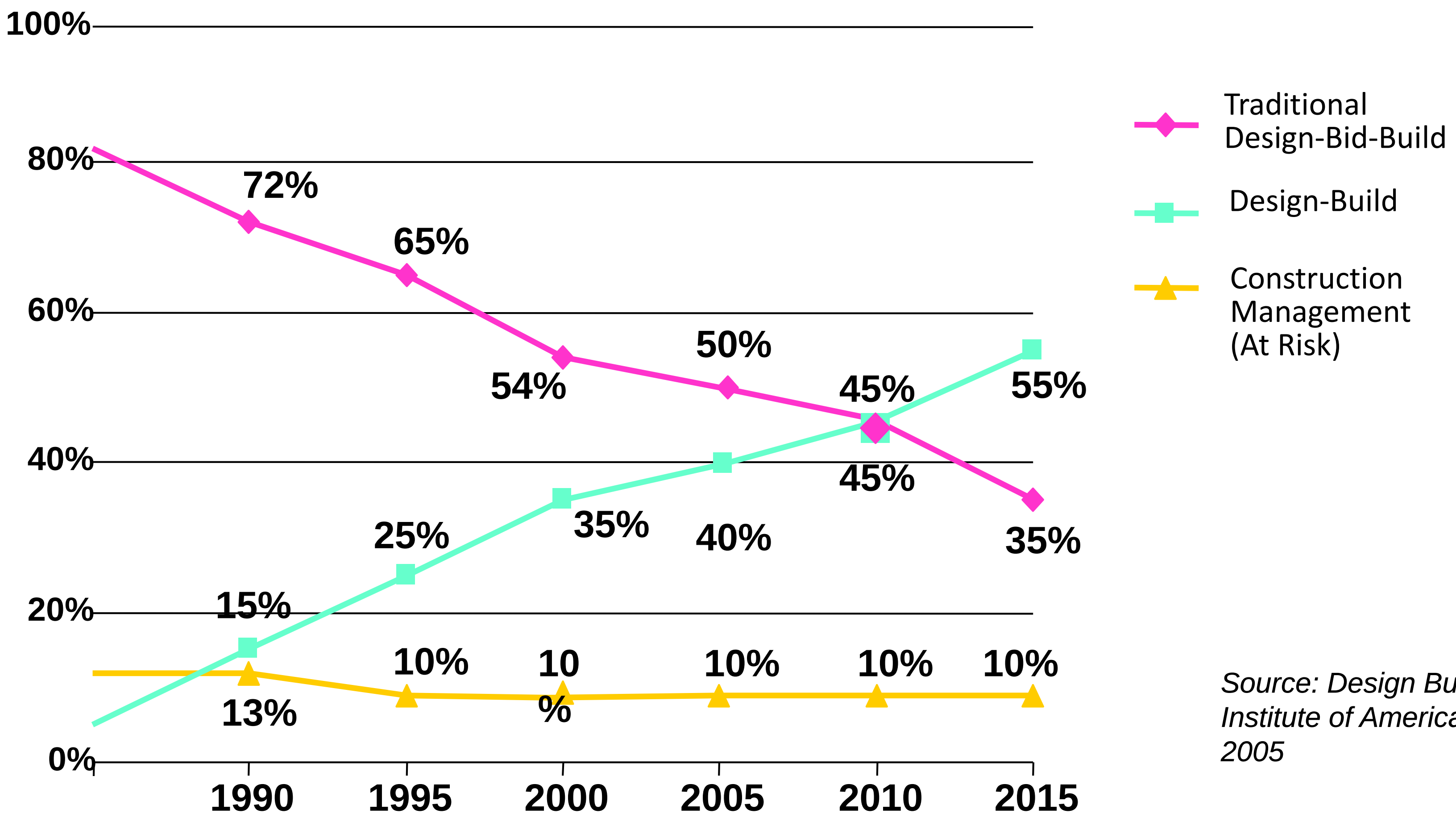


Design-Build Market Perspective

- Major utilities consider design-build as a standard delivery process
- Active market with many players and team structures
- Major projects are being implemented throughout US and Canada

- Many forms of design-build being applied by owners
  - Progressive design-build
  - Lump sum design-build
  - Design-build-operate
  - Design/CMAR
- Project drivers remain
  - Cost
  - Schedule
  - Risk transfer
  - Performance
  - Single point of accountability

Market Changes

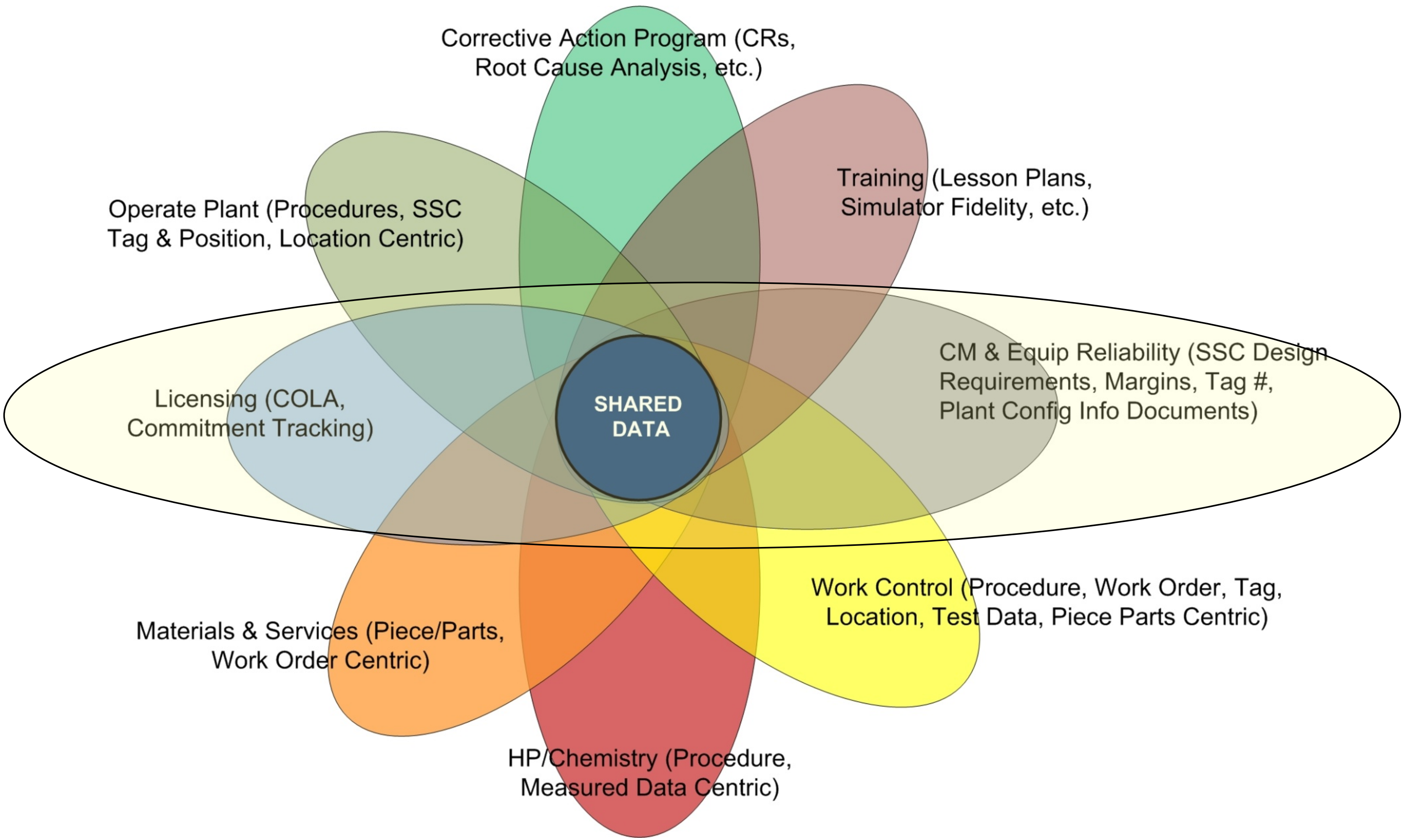


Source: Design Build Institute of America 2005

2009 WDBC Owners Survey Data

Data to be updated in 2013

Owner/Operator Data Requirements



K.Barry, EPRI

Exciting Times

- Engineering and construction are changing.
- Some sectors are changing industry's integration, automation, agility and profitability, e.g., U.S. steel fabricators.
- Bridge industry is transforming the delivery, operation and maintenance of the U.S. bridge portfolio.
- Process and power industries know they must transform delivery and operation of future plants.
- Integration of supplier processes, expertise and systems for optimizing design, delivery and operations is still largely untapped.
- Synergy of combining manufacturing and construction innovation
  - Common challenges in advancing systems integration, intelligent sensing, control and automation
  - Distributed configuration management of federated information and controls
- IDDS principles are being deployed.