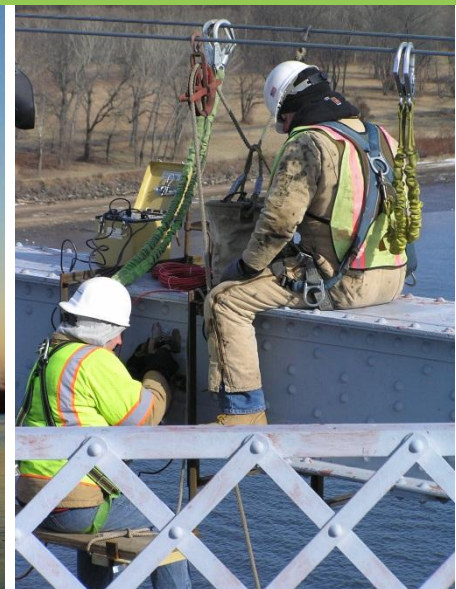


Maintaining and Preserving Long Span Signature Structures



David S. Lowdermilk, PE
John Jeffers
George Nyikita



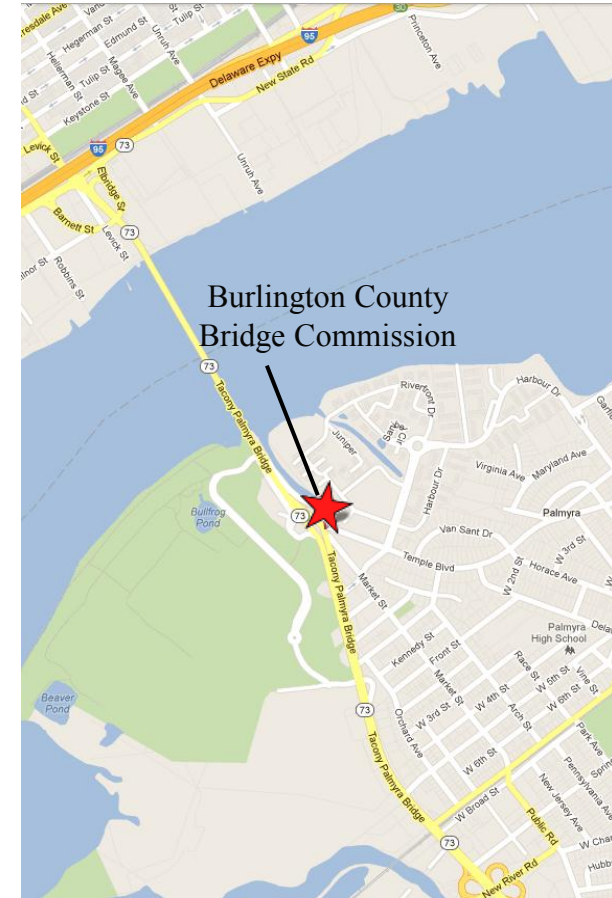
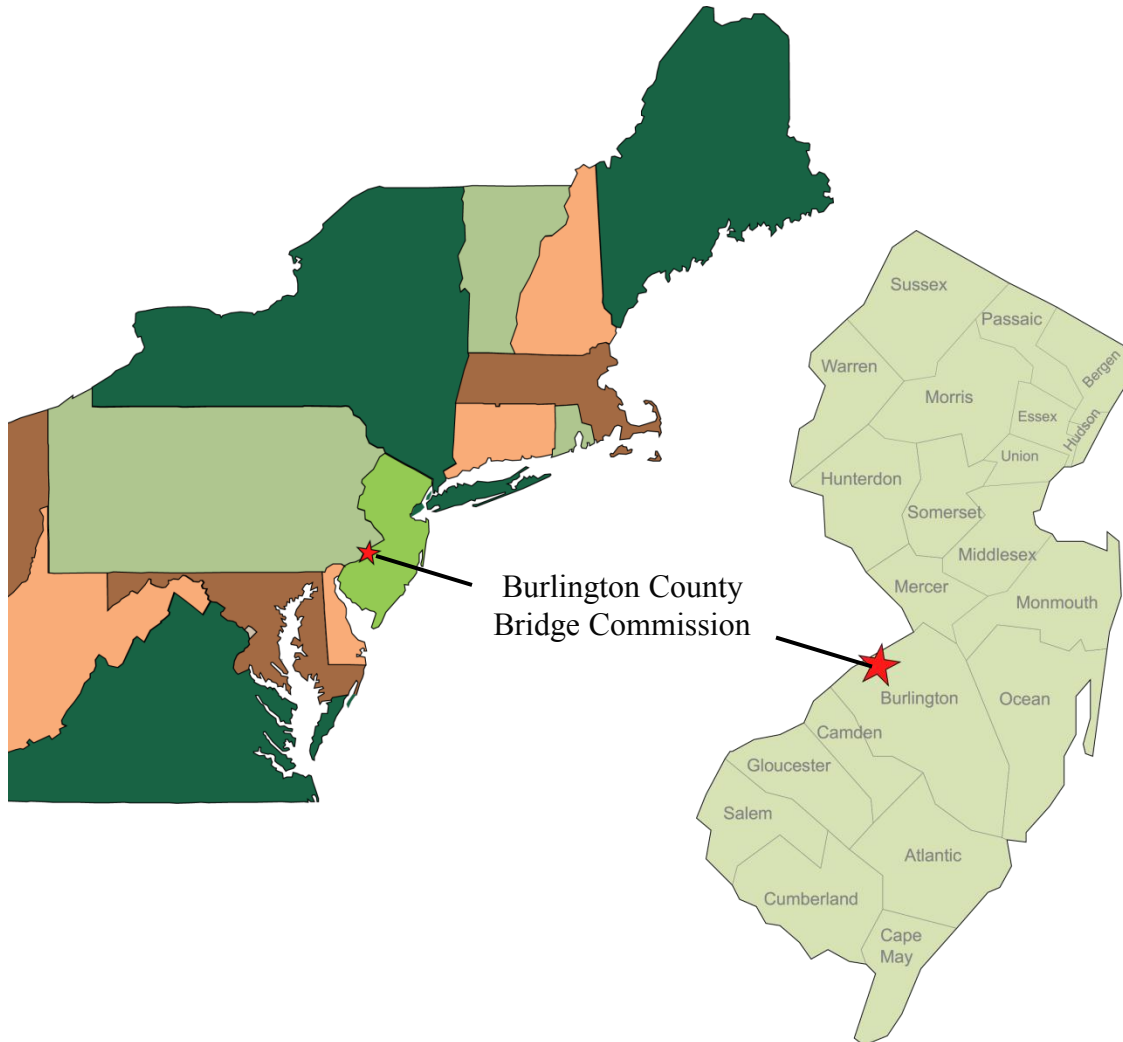
Burlington County Bridge Commission

Assets

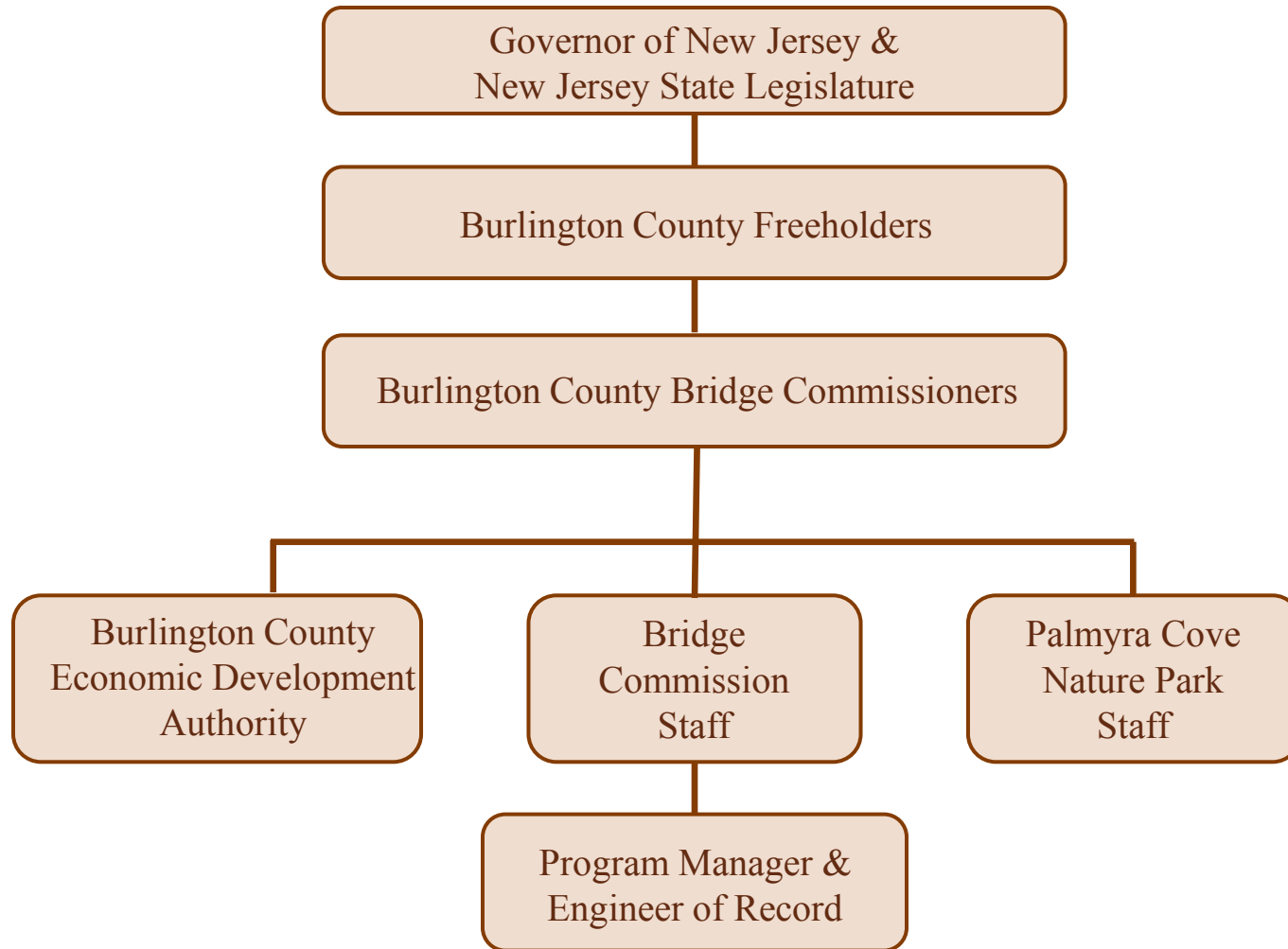
- Number of bridges
- Real estate holdings
- Palmyra Nature cove
- Economic Development



Location of the Commission



Governance



Administration

- Maintenance
- Toll Operations
- Finance
- Human Resources
- Police

*** Note there is no in-house engineering staff**



Engineering and Program Management

- Three on site Engineers
 - Resident Engineer
 - Construction Engineer
 - Electrical Engineer
- Full service design staff
- Inspection staff
- Underwater Inspection Staff
- Program/Capital Management



How does it all work?



ASCE Report Card – 2001 and 2005

Category	2001 Grade	2005 Grade	Comments
Bridges	C	C	<p>Between 2000 and 2003, the percentage of the nation's 590,750 bridges rated structurally deficient or functionally obsolete decreased slightly from 28.5% to 27.1%. However, it will cost \$9.4 billion a year for 20 years to eliminate all bridge deficiencies. Long-term underinvestment is compounded by the lack of a Federal transportation program.</p>

ASCE Report Card – 2009

Category	2009 Grade	Comments
Bridges	C (barely)	<p>Showing no significant improvement or elevated level of decline, the nation's bridges were assigned a barely average grade of C. While some progress has been made in recent years, more than one in four (26 percent) of the nation's bridges remain either structurally deficient or functionally obsolete. And, current investment in bridge construction and maintenance, \$10.5 billion, is less than the \$17 billion needed annually to improve current bridge conditions.</p>

The U.S. Infrastructure Crisis

Non-tolled Interstate Funding

- Federal Highway Trust Fund
- 18.4¢ per Gallon of Gasoline
- Gas Tax not increased in nearly 20 years
- Not Indexed to inflation
- Spending power of 7.5¢ in 2012 dollars

The U.S. Infrastructure Crisis

Tolled Infrastructure

- Dependent on User Fees
- Expectations of Performance
- Public Perception
- Cost of Tolls vs. Ridership

When are Technology Applications Relevant?

Potential Intervention

Increase Load Restriction



Retrofit Design

Avoid Replacement

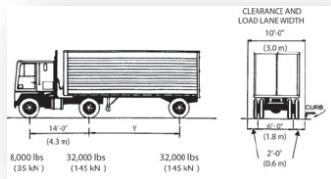


Construction

Monitor Repairs / Retrofits



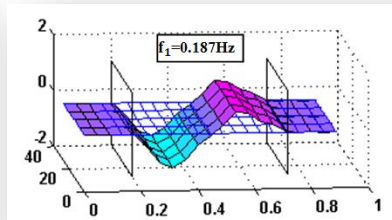
Refined Load Ratings



Fatigue Assessment



Vibration Assessment



Operation / Maintenance

Movable Structures



Situational Awareness



Case Studies on Long Span Bridges



Tacony-Palmyra Bridge

Designed by Ralph Modjeski

Open to Traffic on August 14, 1929

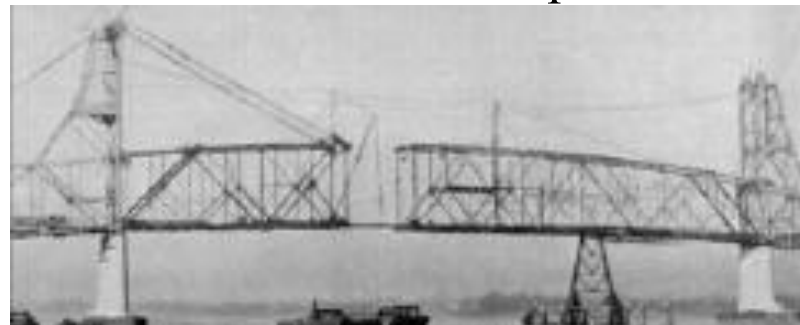
Includes a through-tied arch, a three span continuous half through truss, several deck girder viaduct spans, and a rolling double leaf bascule span.



Burlington-Bristol Bridge

Open to Traffic on May 2, 1931

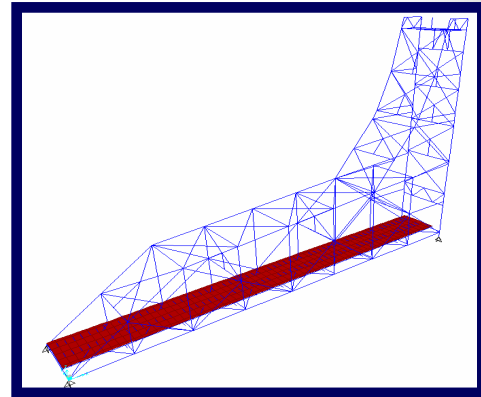
Includes a 550 foot center lift span.



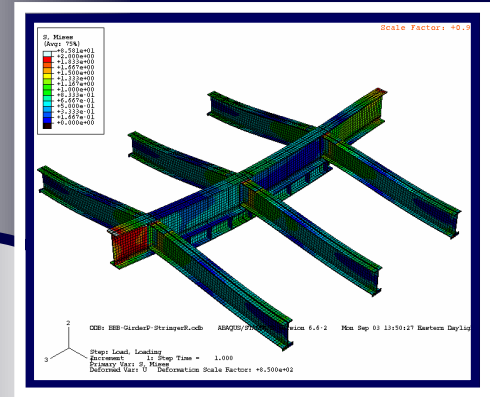
Burlington-Bristol Bridge



Modeling



Global



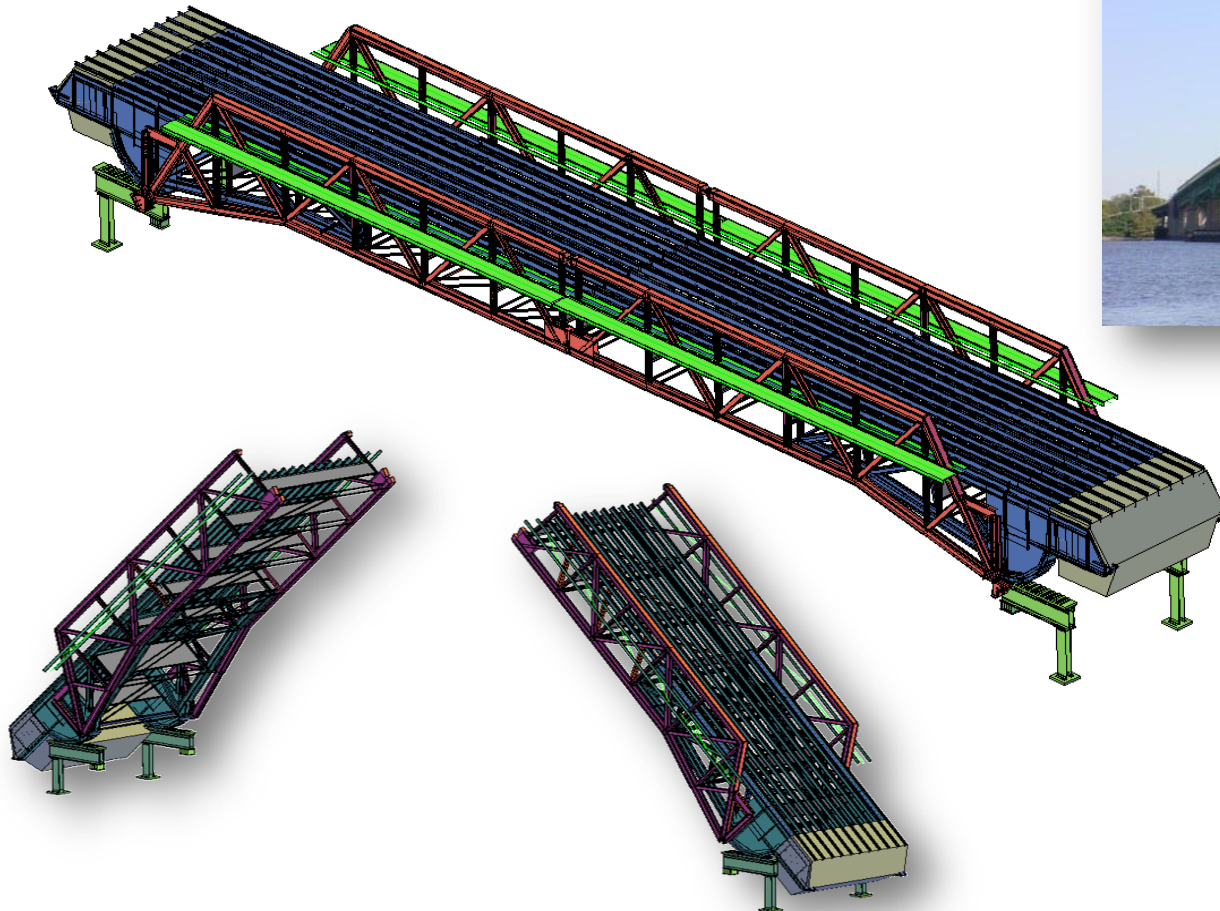
Local

Experiment



Tacony-Palmyra Bridge

Track construction processes, resulting stresses/actions, and verify construction staging/design



Instrumentation Included

- Electrical resistance strain gages
- Vibrating wire gages
- Tilt Sensors
- Temperature Sensors
- High-Resolution Network IP Cameras

Tacony-Palmyra Bridge

3/18/2011 1:24:25 PM

Waiting For New Event

Normal



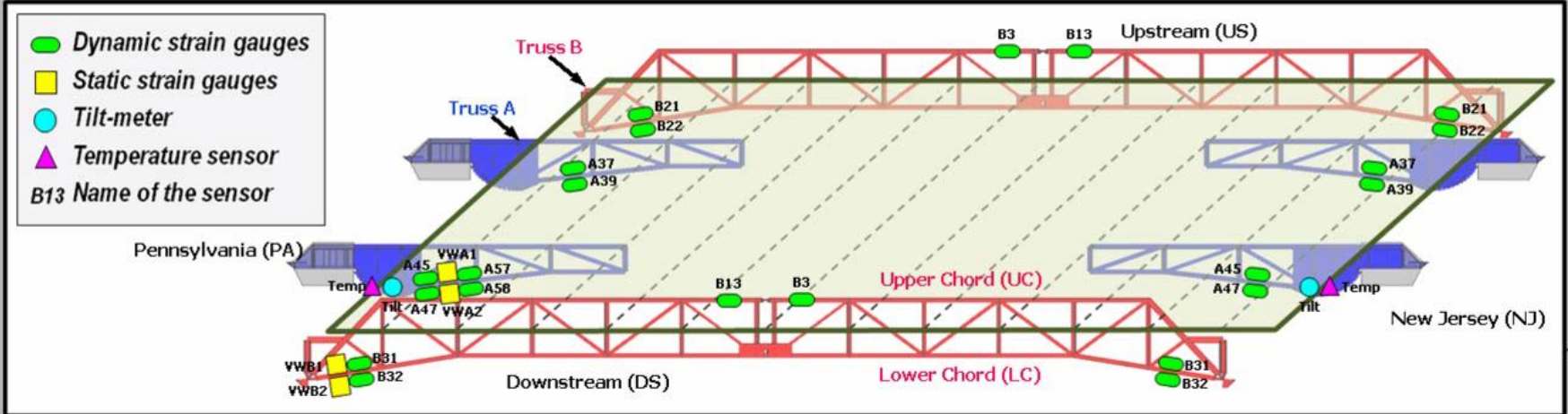
Password

Enter Password:

Please Log In



Panoramic Camera View Four Camera Views



Tacony Palmyra Bridge Monitoring System Playback

Camera 1 2010-09-08 14:06:12

Camera 2 2010-09-08 14:06:12

Camera 3 2010-09-08 14:06:12

Camera 4 2010-09-08 14:06:12



Bascule Opening | Bridge Graphic | Define Plots | Configuration | Exit

Event Type
 Live Opening
 C:\Drexel Data Storage\Open Events\2010-09-08 Open\2010-09-08_140718 (Open)

Archive Format View:

Event Start: 2:04:08.050 PM 09/08/2010

Start: 0.0 sec End: 250.0 sec

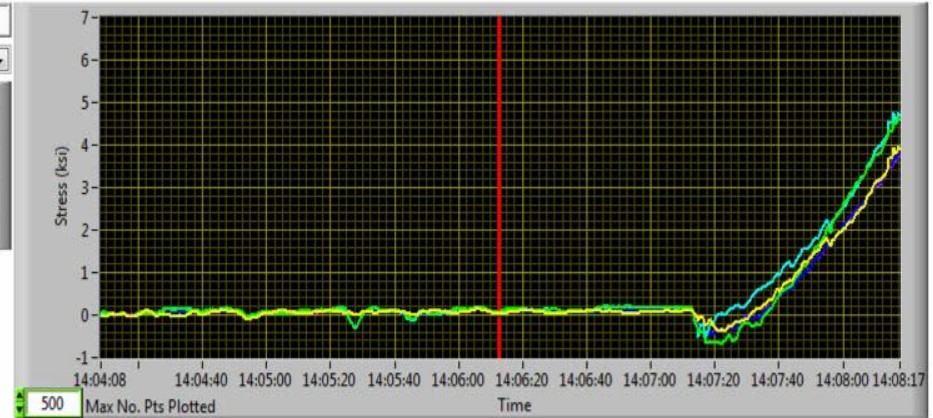
Event Time Range (sec): 0 to 824.8

Graph Cursor: Free Center End

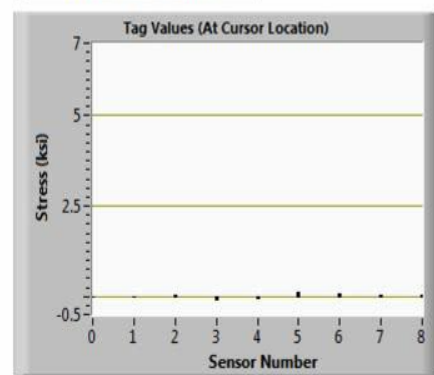
Time Step: 1.6 sec Timespan: 250.0 sec Graph Cursor: 125.0 sec Cursor Time: 2:06:13.050 PM

Dynamic Static View

- PA LC Truss A**
- Defined Y Scaling
- PA-US-LC-A39
 - PA-DS-LC-A45
 - PA-DS-LC-A47
 - PA-DS-LC-A57
 - PA-DS-LC-A58



PA LC Truss A and B Defined Y Scaling



- 0-PA-US-LC-B21 (-0.02)
- 1-PA-US-LC-B22 (-0.02)
- 2-PA-US-LC-A39 (0.01)
- 3-PA-DS-LC-B31 (-0.02)
- 4-PA-DS-LC-B32 (-0.01)
- 5-PA-DS-LC-A45 (0.08)
- 6-PA-DS-LC-A47 (0.08)
- 7-PA-DS-LC-A57 (0.04)
- 8-PA-DS-LC-A58 (0.04)

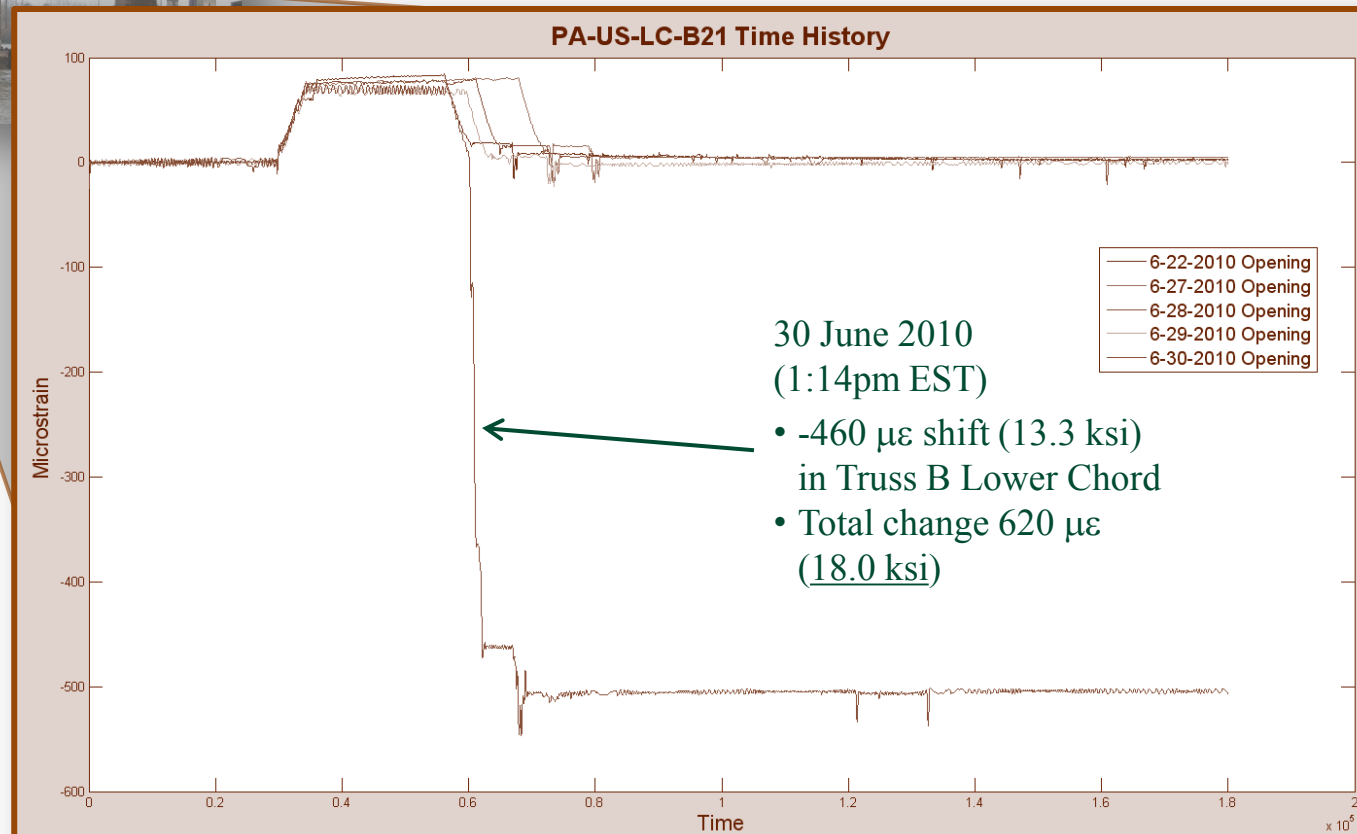
- PA LC Truss B**
- Defined Y Scaling
- PA-US-LC-B21
 - PA-US-LC-B22
 - PA-DS-LC-B31
 - PA-DS-LC-B32



Tacony-Palmyra Bridge



Strain Time Histories Captured Along the Lower Chord of Trusses A and B During Construction (22 June 2010 through 30 June 2010)

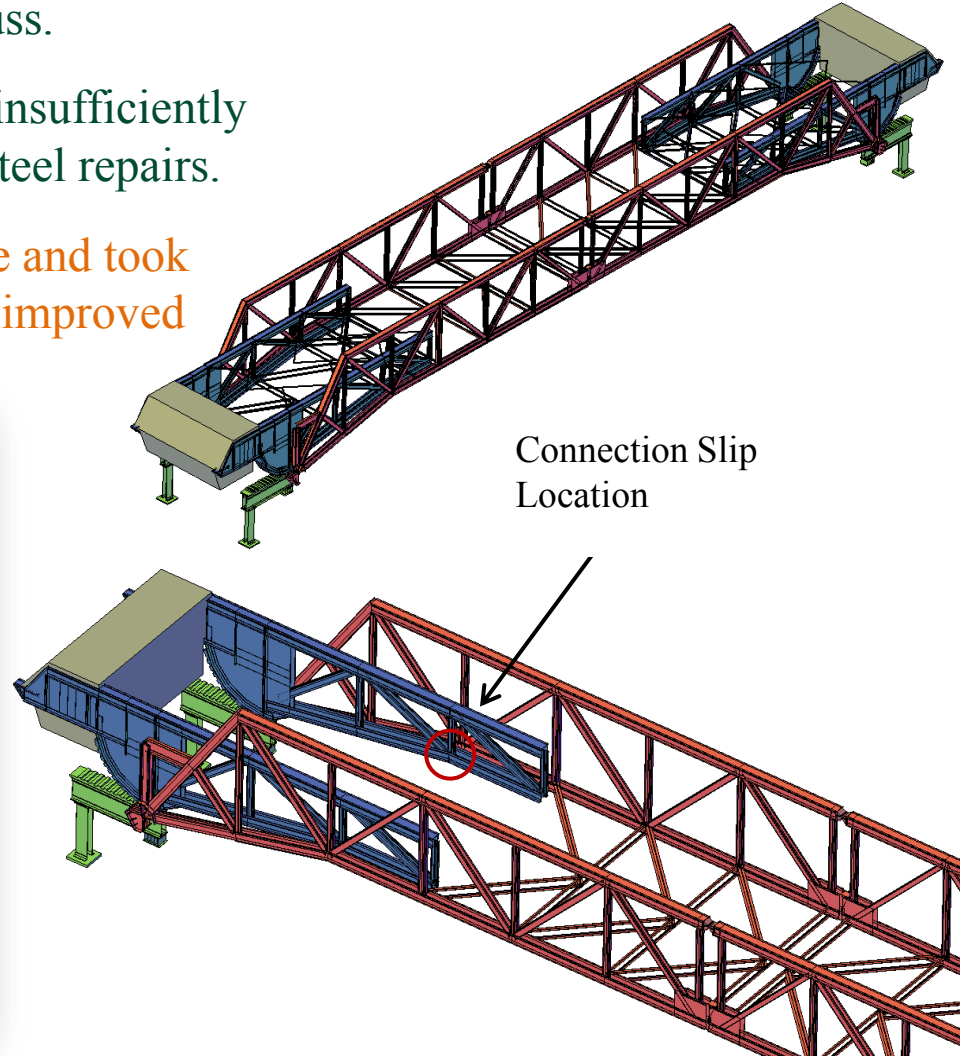
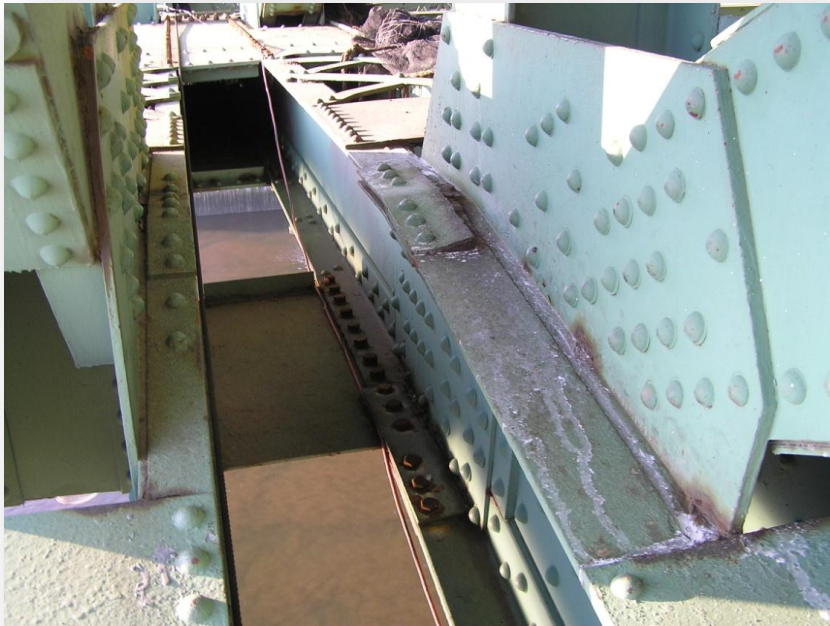


Tacony-Palmyra Bridge

The cause was traced (through direct interpretation and FE analysis) to a connection slip in the lifting truss.

The slipped occurred because the contractor insufficiently tightened temporary bolts in anticipation of steel repairs.

Outcome: Contractor was alerted to the issue and took appropriate corrective actions...construction improved

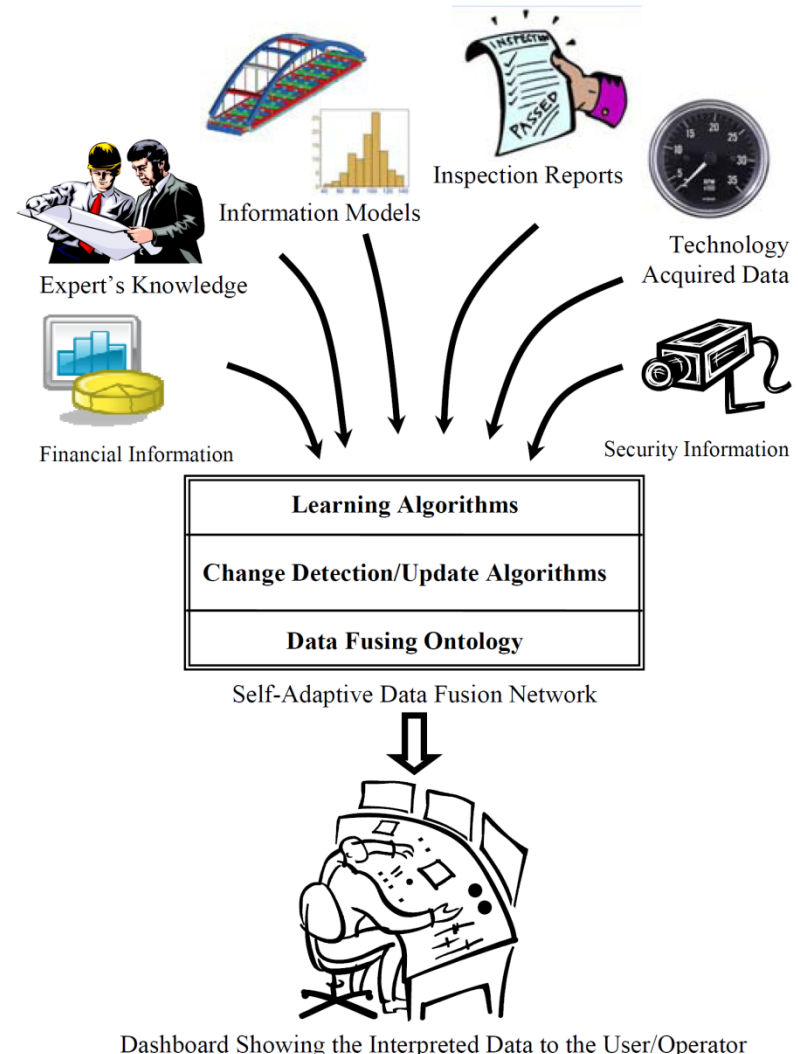


Management of Assets at BCBC

- Capital Program
- Maintenance Program
 - In-house Structural Maintenance
 - In-house Electrical Maintenance
 - Contractor Maintenance
- Topside and Underwater Inspection Program
- Palmyra Cove Nature Center

Management of Assets at BCBC

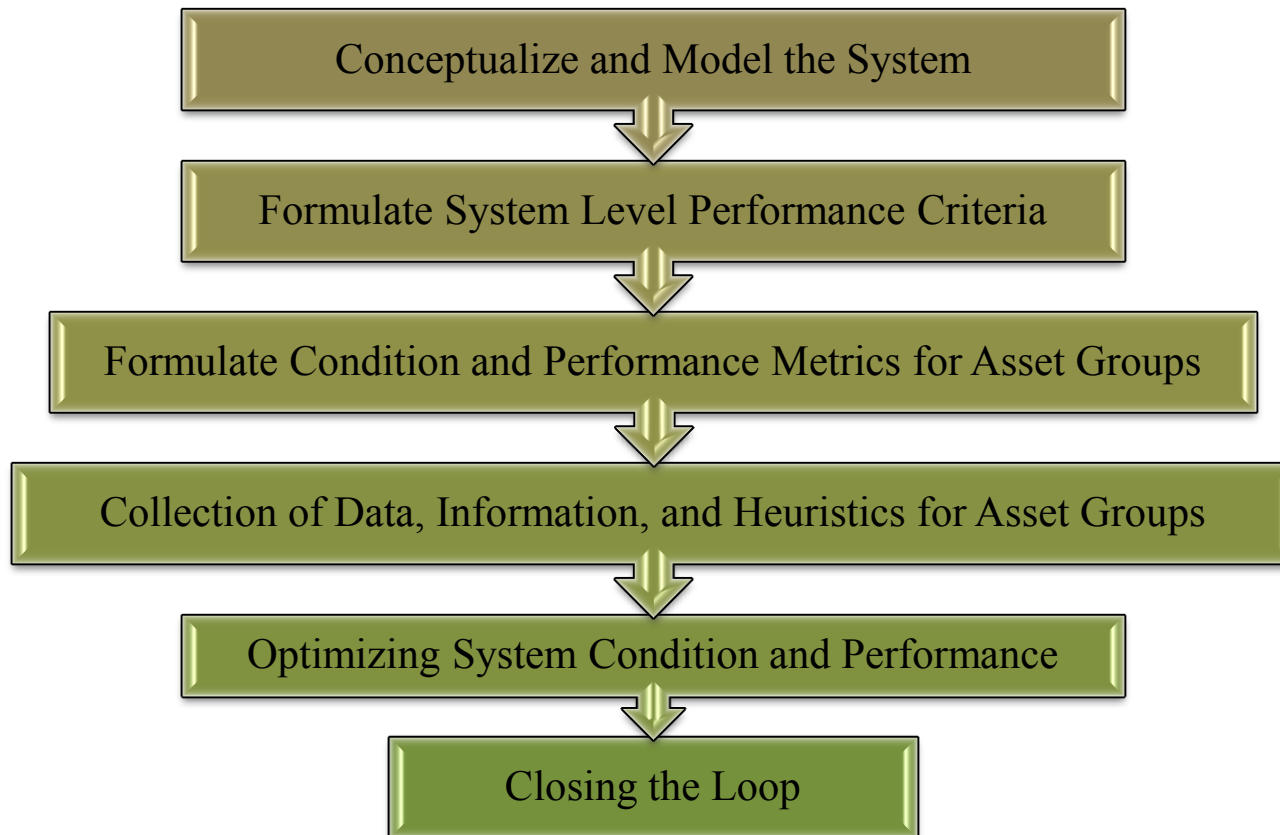
Different knowledge sources (e.g., expert knowledge on the operation and maintenance of infrastructure), information sources (e.g., bridge information model) and data sources (e.g., raw sensor data, images and videos) need to be integrated to support inspection, maintenance, operation, financial decisions, etc.



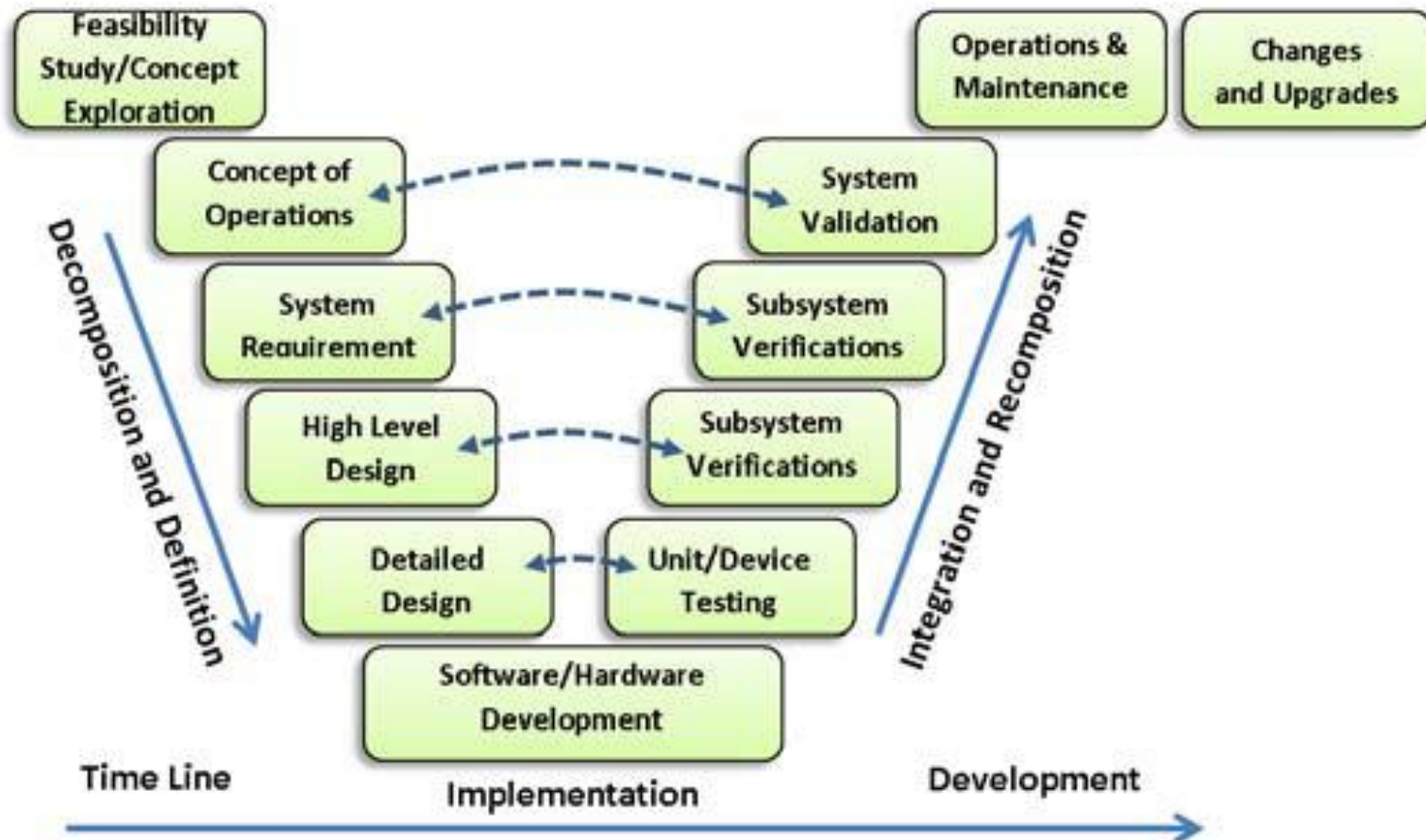
Dashboard Showing the Interpreted Data to the User/Operator

Performance Based Asset Management

Six generic steps to performance based asset and risk management



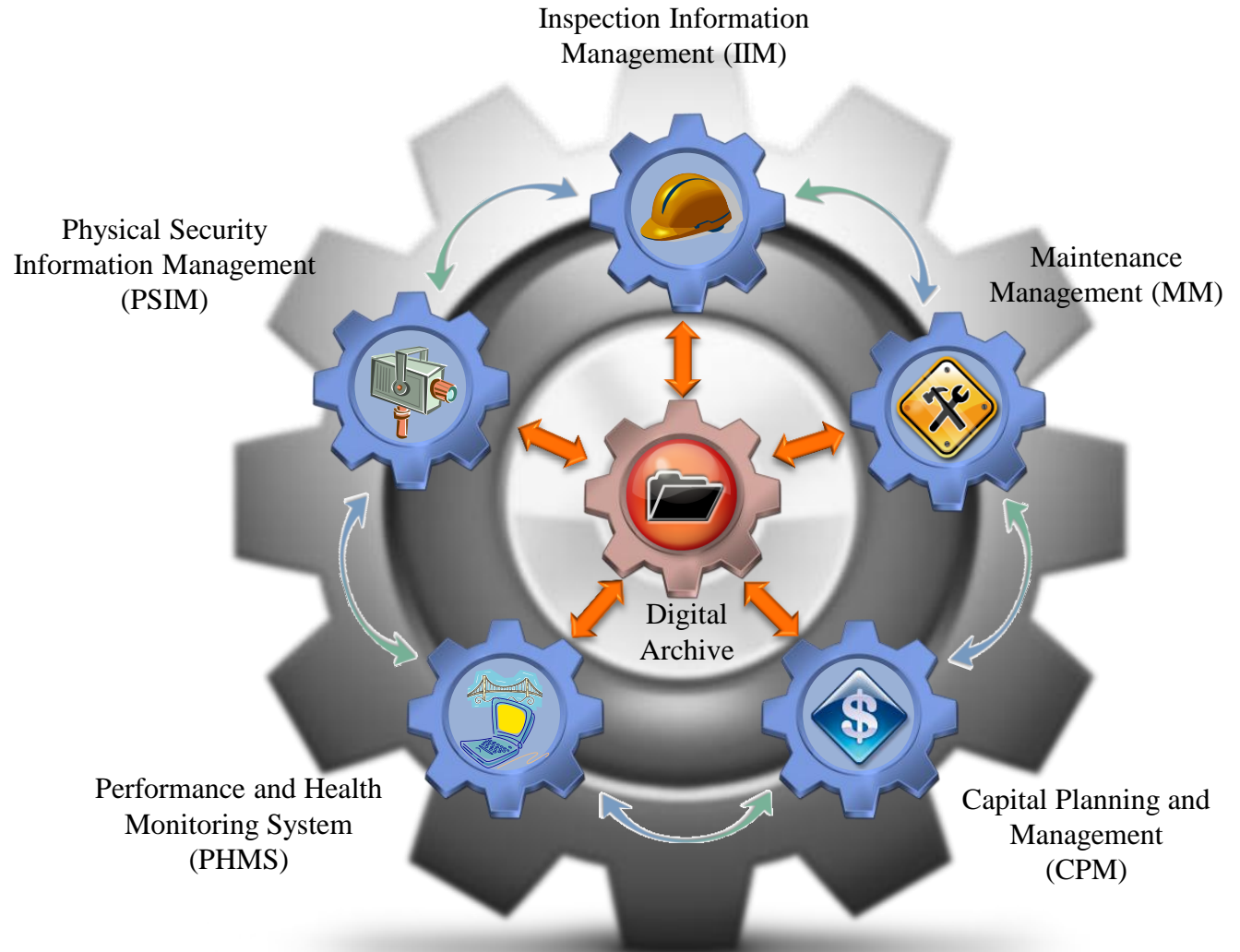
BCBC Asset Management



Systems Engineering V Diagram for iCOMPASS

iCOMPASS at a Glance

*intelligent
Centralized
Operations
Maintenance
Performance
And
Security
System*



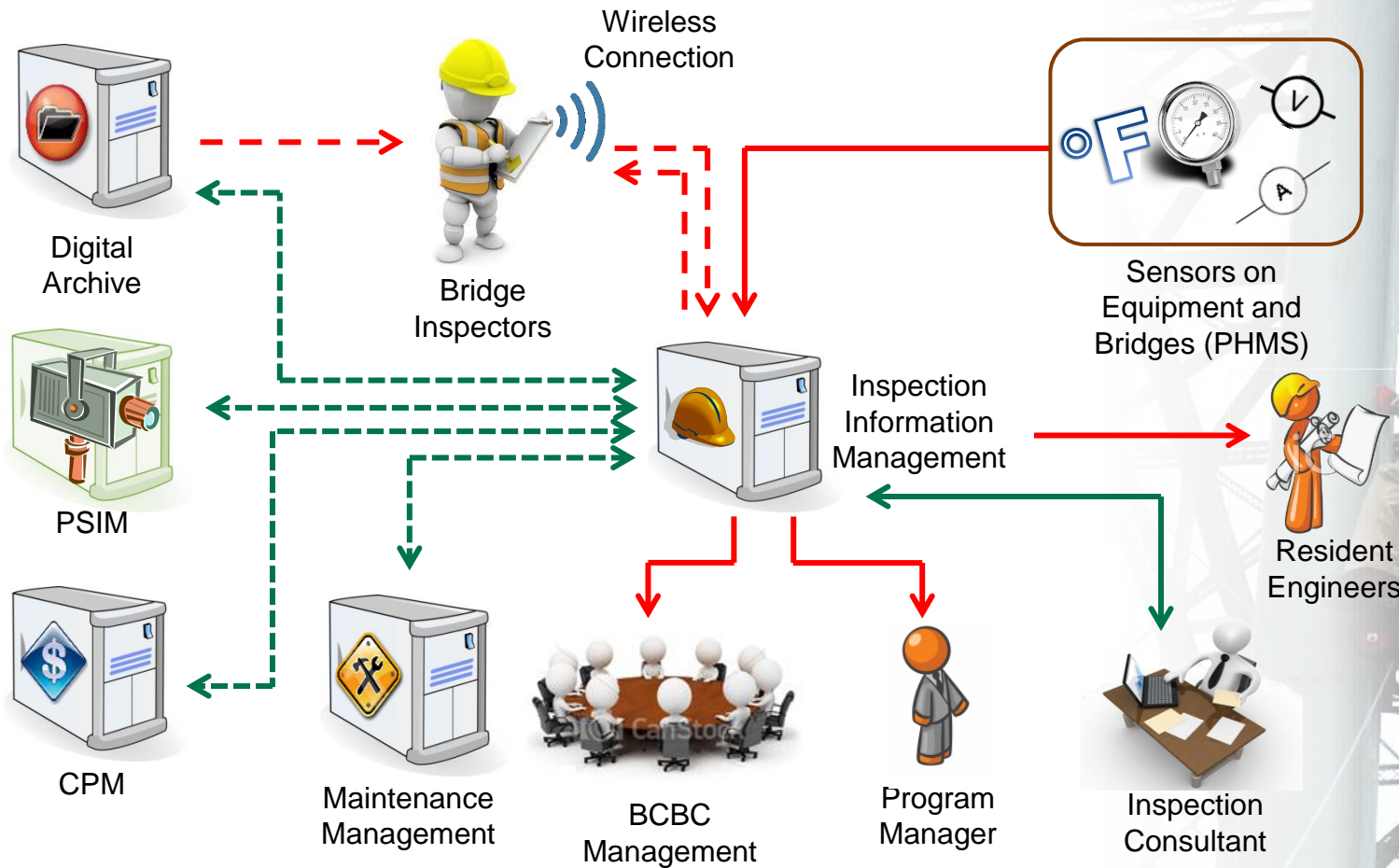
Inspection Information Management (IIM)



- Management of inspection information
- Utilize smart tablet applications
- 3D visualization of the bridges
- Live communication between the inspector, inspection supervisor and the Owner
- Digital reporting
- Increased inspection efficiency
- Communication between Inspection Module and other modules



Inspection Information Management (IIM)



Maintenance Management (MM)

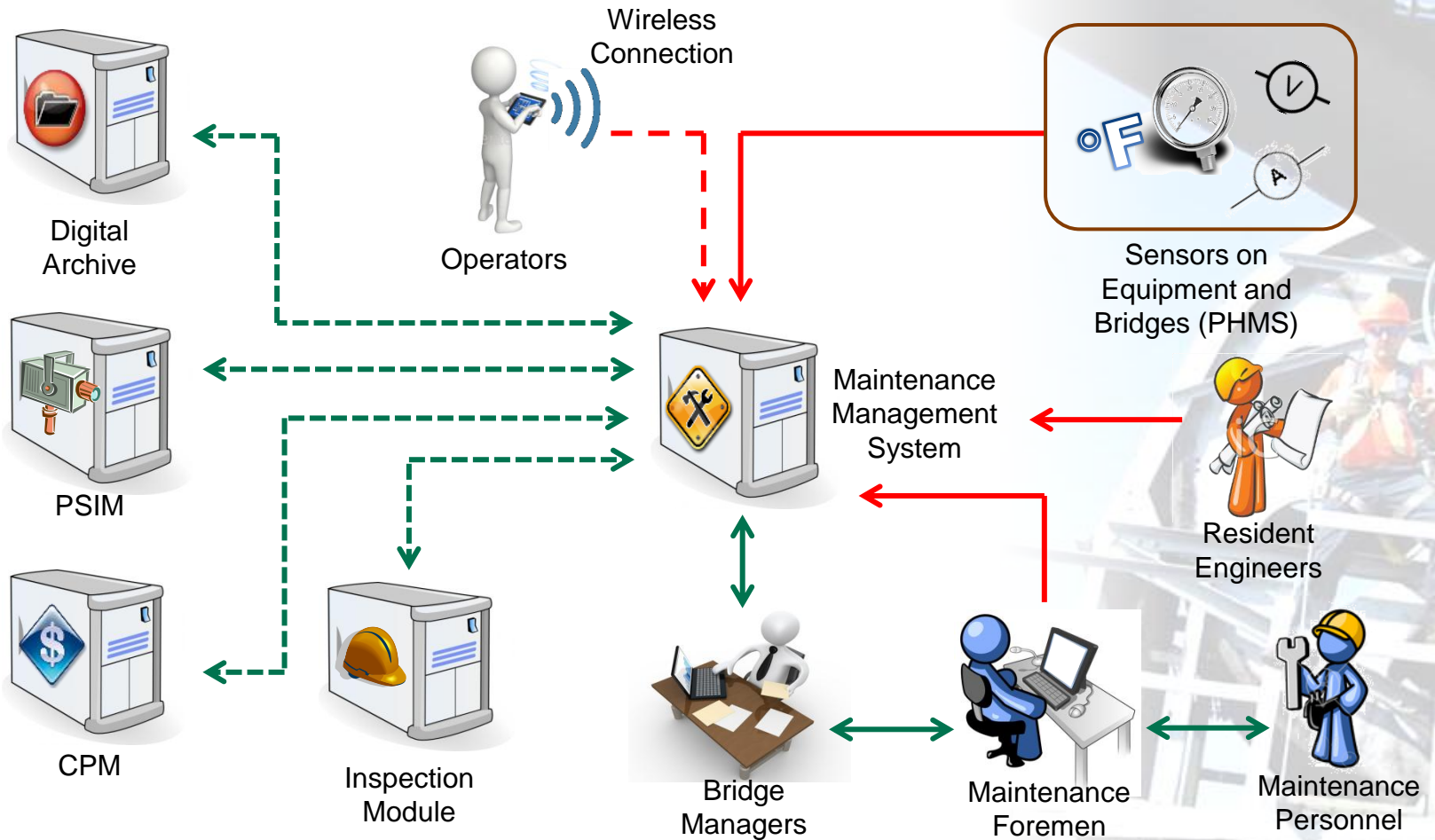


Benefits

- Generate and track work orders
- Routine or emergency work orders
- List of materials, equipment and task instructions
- Digital reports and checklists on handheld tablets
- Increased reliability in monitoring of bridge machinery
- Increase institutional efficiency
- Situational awareness



Maintenance Management (MM)



Capital Planning and Management (CPM)

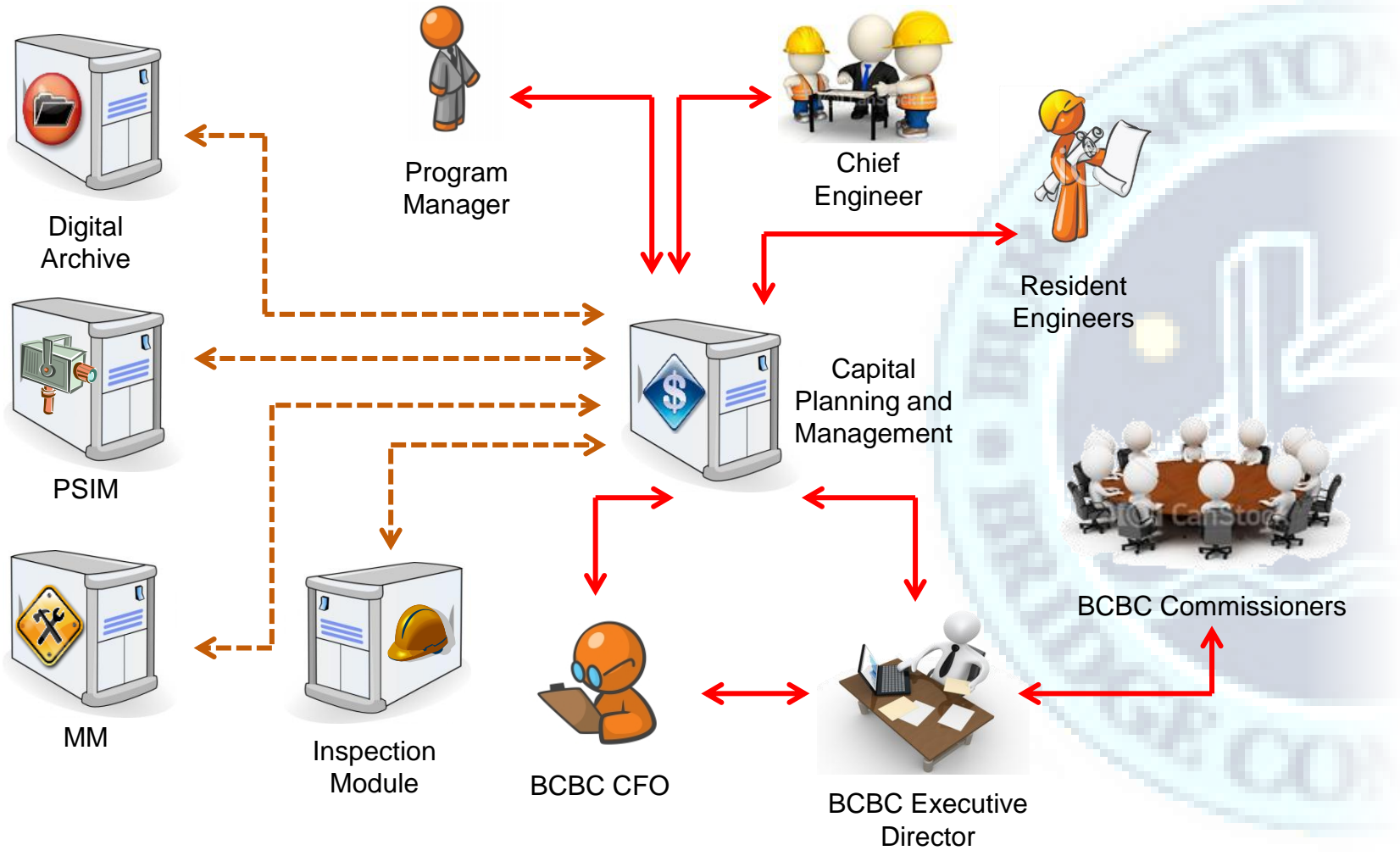


Benefits:

- Planning and tracking of capital projects
- Electronic Invoicing and bidding
- Updating of commodity market prices
- Cash flow management
- Increased institutional efficiency and awareness
- Archival of contractual documents
- Different reporting levels for the Commissioners, Commission Staff, Engineers, etc.



Capital Planning and Management (CPM)



Performance and Health Monitoring System (PHMS)

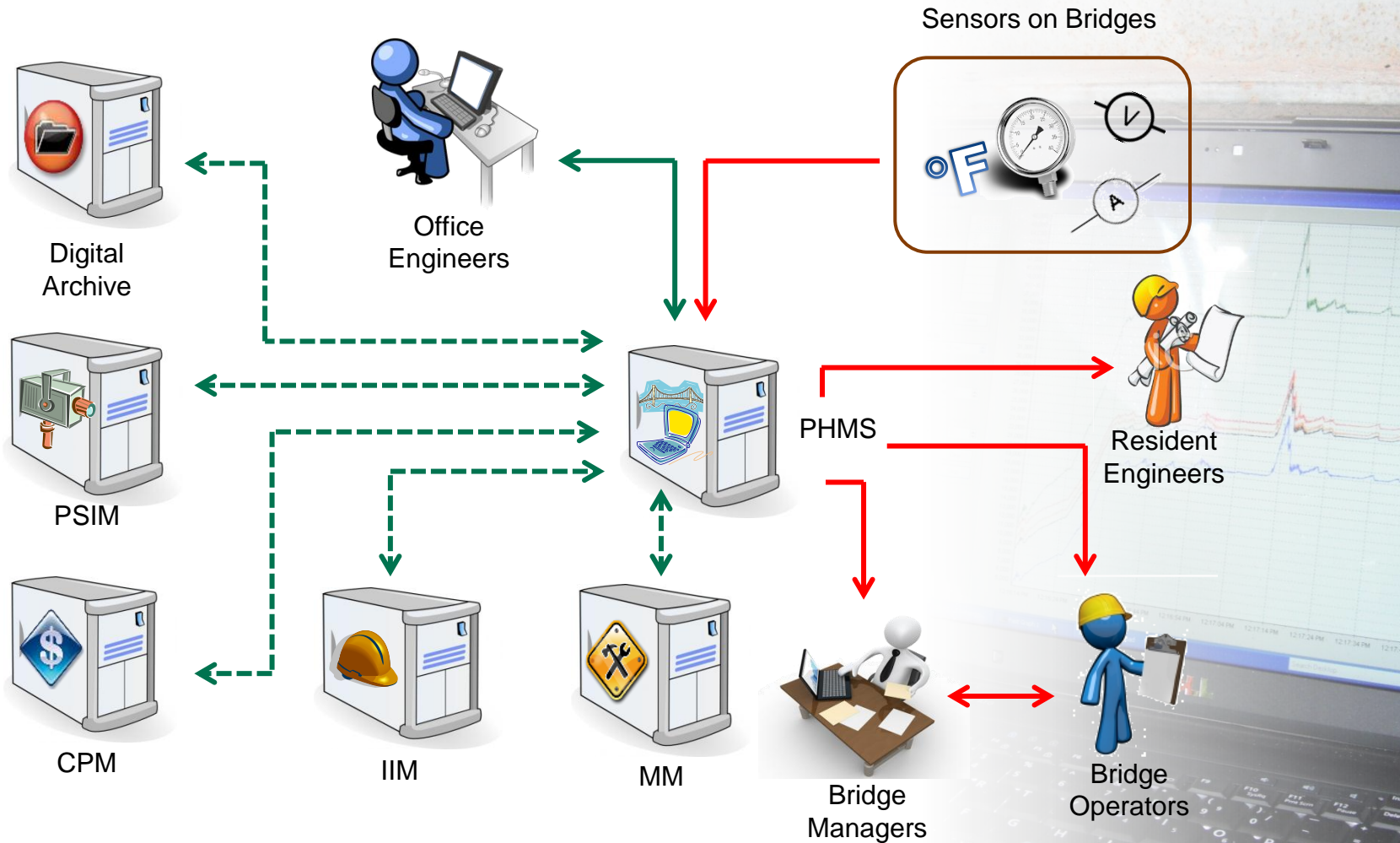


Benefits:

- Real-time roadway condition for major bridges
- Real-time operator displays of span opening characteristics (height, angle, etc.) as well as ship movement through video
- Remote access to operator displays and periodic reports for managers
- Over-weight vehicle identification (data and video)
- Immediate safety evaluation of the structure due to unforeseen events (earthquake, hurricane, impacts, etc.)
- Permit managers, engineers and operators to view relevant information and generate reports as needed through web-based applications
- Situational awareness



Performance and Health Monitoring System (PHMS)



Physical Security Information Management (PSIM)

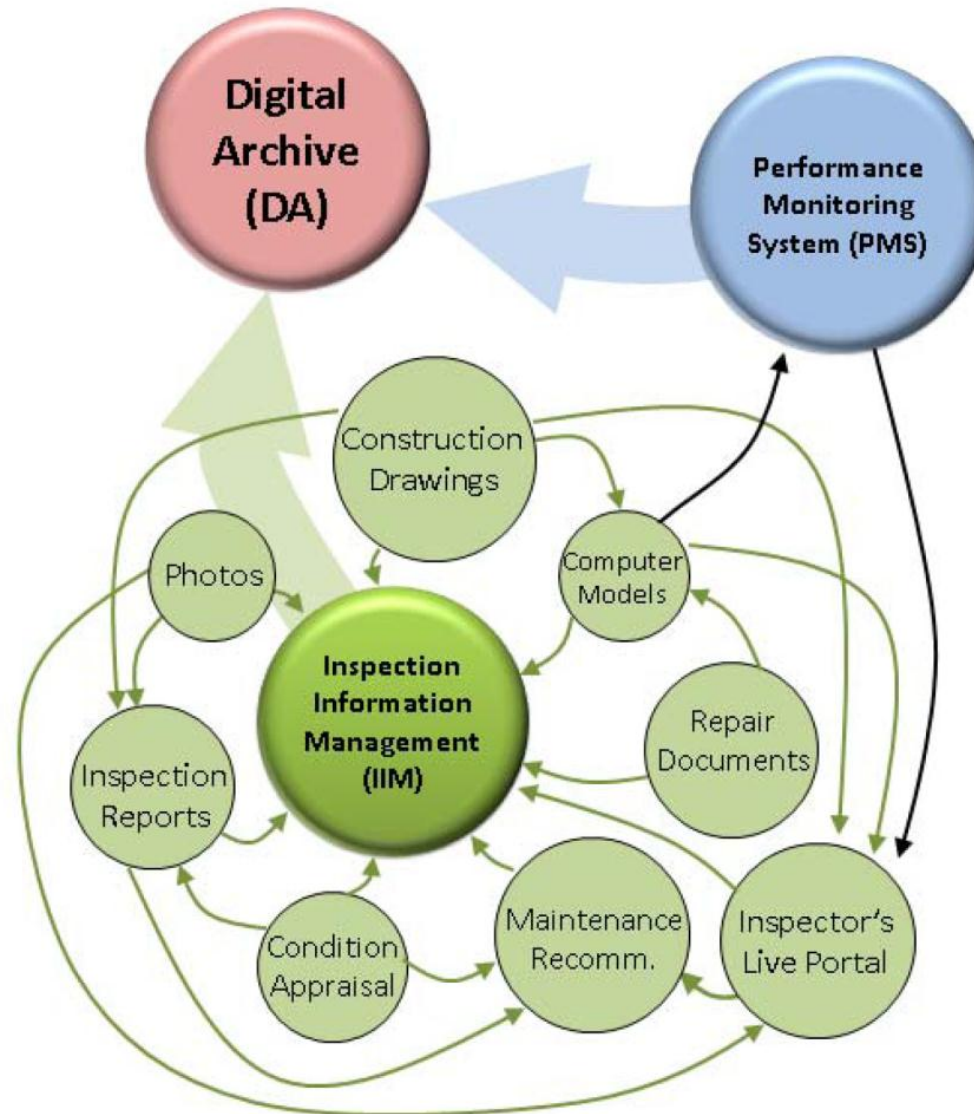


iCOMPASS and PSIM:

- Coordination with BCBC's security system provider
- Share alerts and notifications
- Share data and videos on demand
- Access to the digital archive



Information Flow



Questions?

Thank You

