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Ag Transportation Summit:

A Modern Infrastructure for Modern Agriculture

Using Technology for Management of Rural Bridges

www.lifespantechnologies.com

July 30, 2013

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Overview

- There's Pain Aplenty
- Visual Inspection
- The Unknown Zone
- Technology Concept
- Various Technologies
- Example Applications
- Best Practices

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Pain for DOTs, Users and Taxpayers

- **NBIS Visual Inspection Process:**
  - Just how accurate are those inspections?
  - Can we support tough decisions with that data?
- **Assuring Safety with Known Defects:**
  - Do cracks in the deck limit load capacity?
  - Is the corrosion-driven “section loss” compromising load capacity?
- **Traffic Management:**
  - Can we really stop overweight trucks?
  - Can we limit detours for school buses, emergency vehicles, farmers, miners, etc.?
- **Funding Levels:**
  - How can we assure safety with limited funding?
  - How can we help users, minimize political prioritization, and limit overall system risk?

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Just How Accurate is Visual Inspection?

- Visual condition ratings varied by +/- 2 states from the mean in a 2000 FHWA study. (1)
- "This methodology is highly subjective and produces variable results." (2)
- "Visual inspection also does not capture hidden deterioration or damage." (3)

1. ***Reliability of Visual Inspection***; Public Roads Magazine, March/April 2001
2. ***Condition Assessment of Highway Structures, Past, Present and Future***; TR Circular E-C104
3. **IBID**

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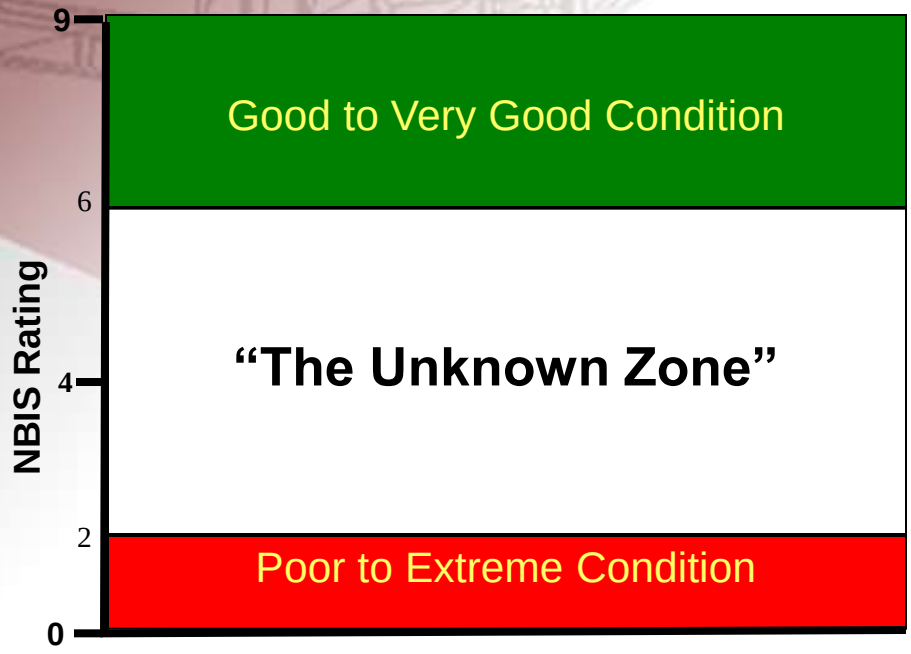
The Unknown Zone



- Makes planning and prioritizing major spending programs nearly impossible.
- Makes risk management not much better than guessing.
- Makes optimization of life cycle costs impossible.
- Results in unnecessary postings and detours for many commercial vehicles.
- **Inflates funding need for bridge rehabilitation and replacement projects.**

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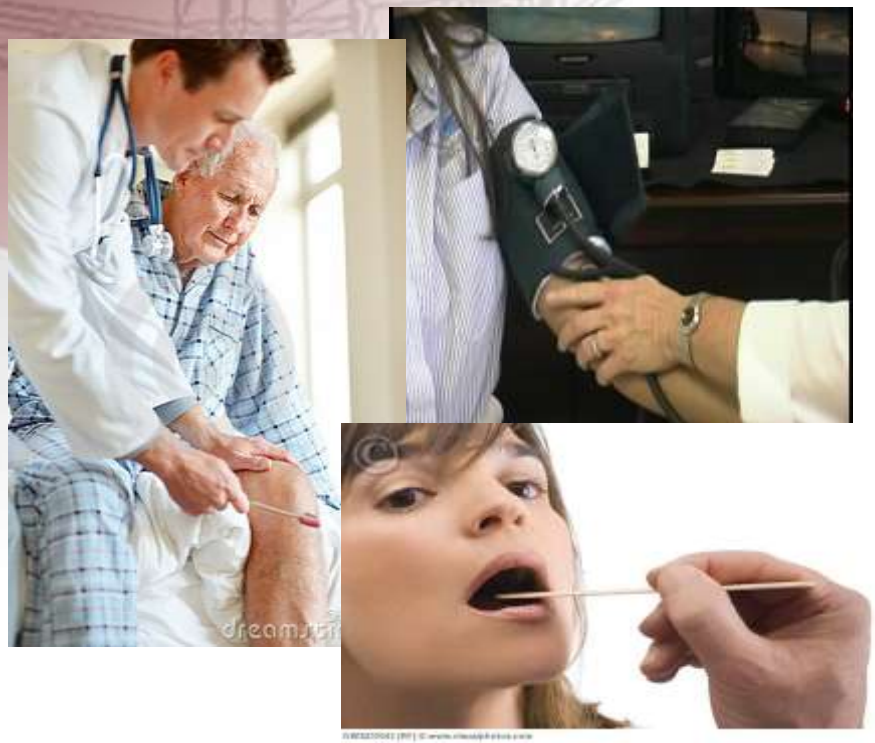
The Medical Analogy



- You feel sick and visit your doctor.
- Your doctor doesn't ask you any questions (bridges don't talk).
- Your doctor uses only a blood pressure cuff, reflex hammer and tongue depressor.
- Your doctor then concludes you need emergency surgery.
- **Would you settle for that, given these advanced technologies?**
  - **MRI, MRA, CT imaging**
  - **Laparoscopes and biopsies**
  - **Blood and other laboratory testing**

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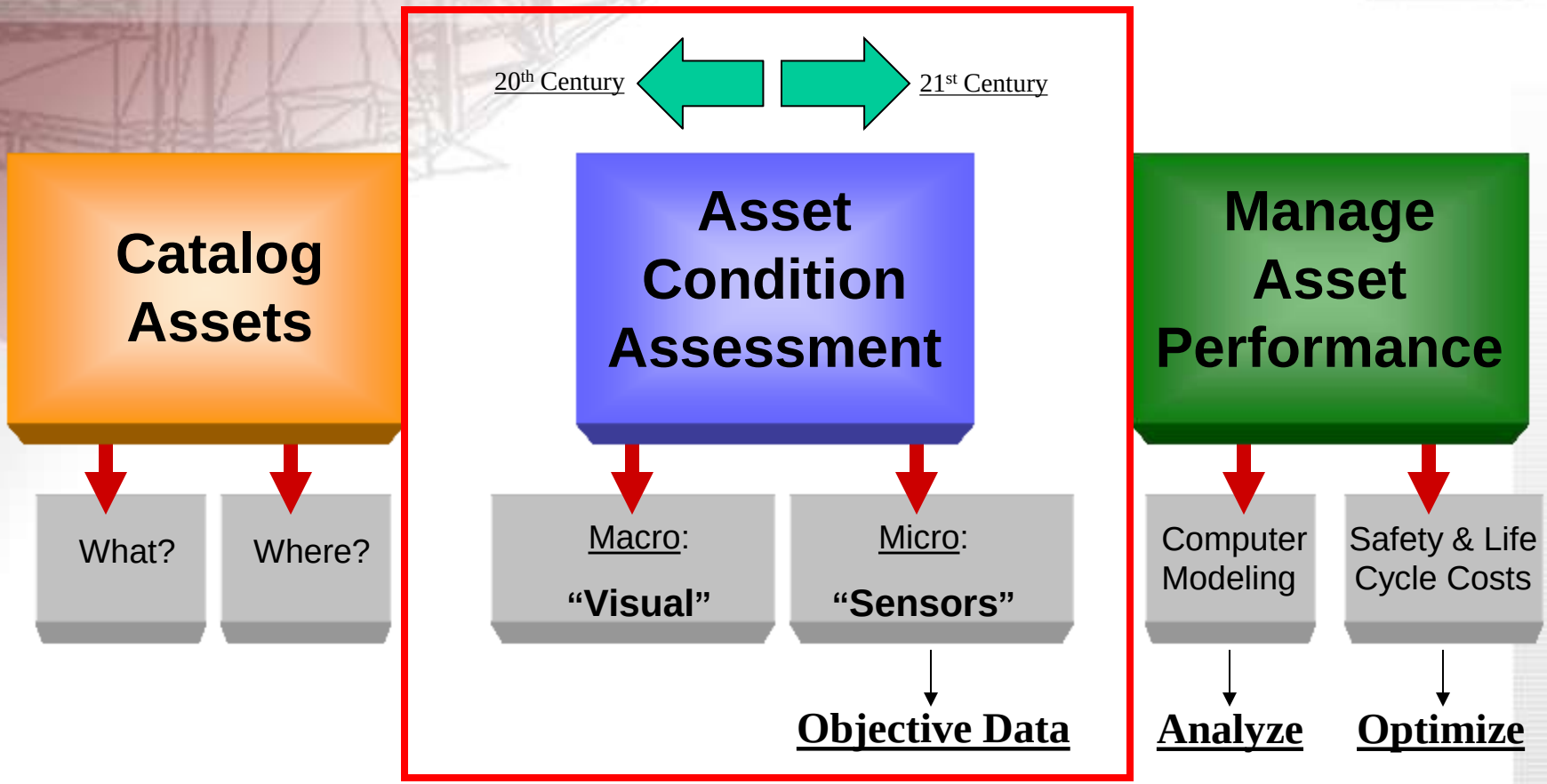
Modern Bridge Management



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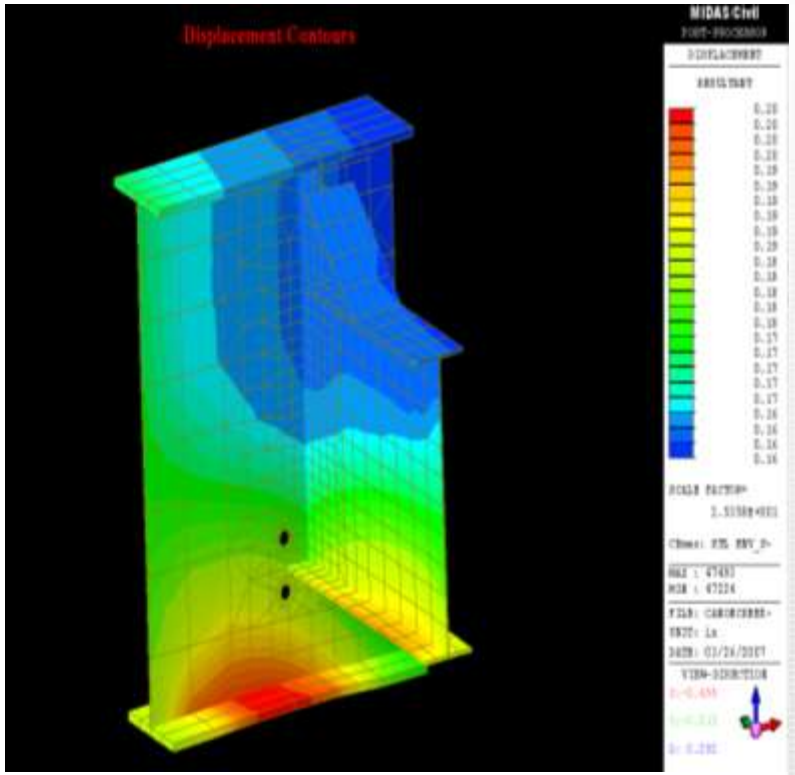
Technology Concept

- The bridge participates in managing its condition:
  - Checks strain and other parameters regularly.
  - Monitors known defects continuously.
  - Catalogs symptoms.
  - Communicates distress.
  - Supports definitive diagnosis using precise, objective data.
  - **Technology gives bridges a voice.**



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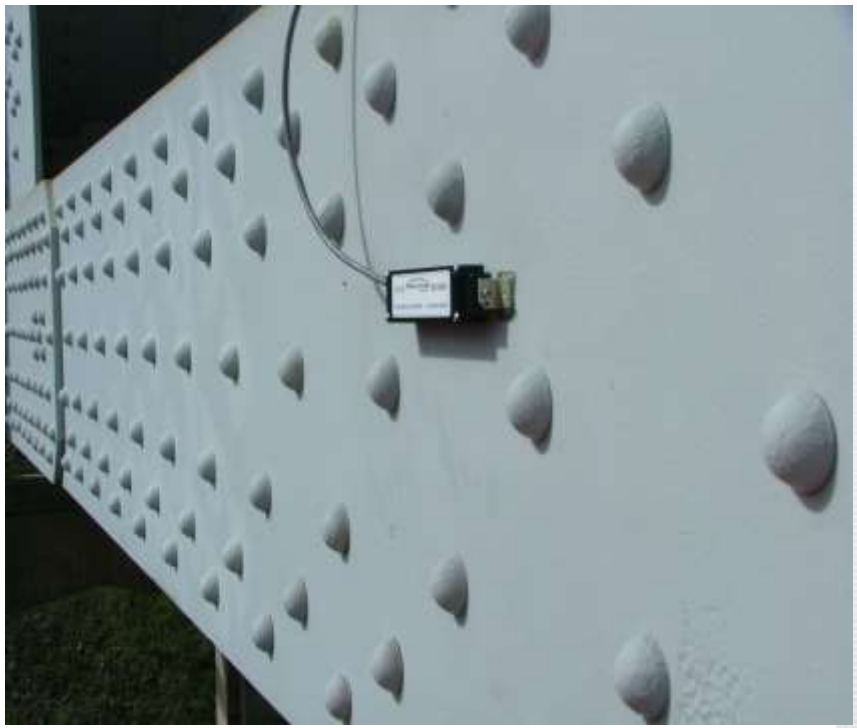
What are the Relevant Technologies?

- **Decks:**
  - GPR
  - Impact Echo
- **Superstructure:**
  - **Strain**
  - **Temperature**
  - Vibration
  - Tilt - 2 & 3 axis
  - Displacements, e.g. cracks
  - Acoustic Emission
- **Substructure:**
  - Tilt
  - Sonar



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Example Applications

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Assuring Safe Operation

- **Problem: Can we safely operate a bridge with substantial corrosion?**
- Owner: South Carolina DOT
- Project Date: 2010
- Objectives:
  - Monitor key locations for strain and temperature.
  - SCDOT wanted bridge to operate with no load postings to avoid 40 mile truck detours.
- Result:
  - Bridge was safe to use with max. highway loads.
  - SCDOT captured overloaded logging trucks.
- **Conclusions**:
  - **Safely deferred over $700,000 in unnecessary rehabilitation costs.**
  - **System will now be used on another structure.**

Evaluating Load Postings

- **Problem: How can we help local industry by reducing detours?**
- Owner: **South Carolina DOT**
- Project Date: 2012-ongoing
- Objectives:
  - Ask industry which bridges are a concern.
  - Using an AASHTO protocol, evaluate load capacity using objective sensor data.
- Results:
  - Progressive protocol very cost effective.
  - Data confirmed ½ of bridges evaluated did not need posting.
- **Conclusion**:
  - **SCDOT is putting a sensor kit in the hands of each bridge inspection team.**

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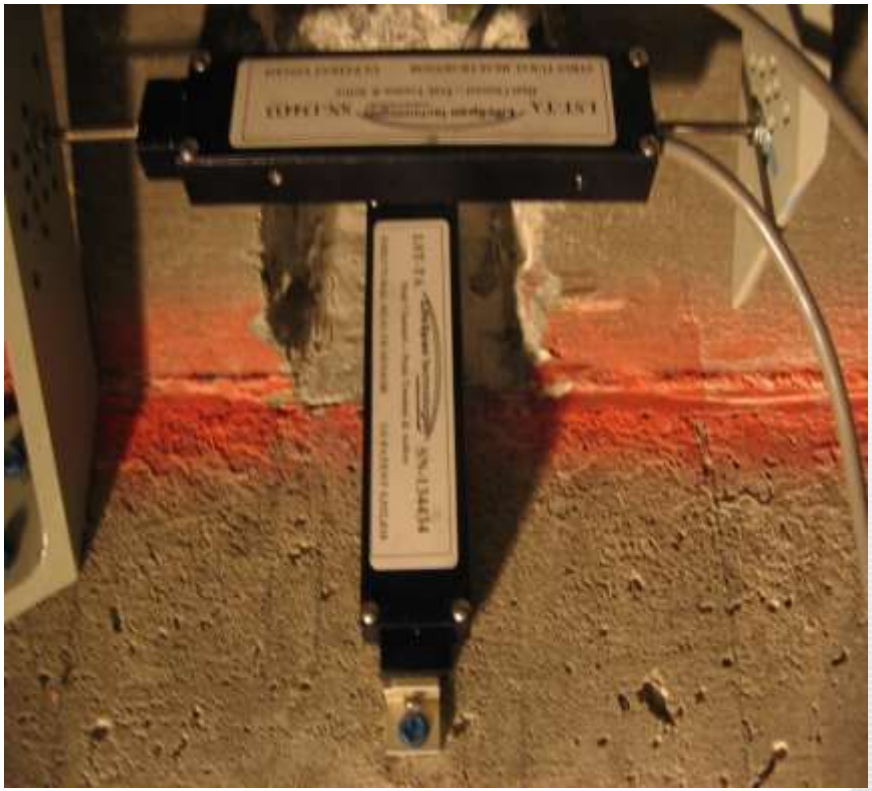
Repair Assessment

- **Problem: Did the innovative deck repair method work as expected?**
- Owner: **Caltrans**
- Project Date: 2009
- Objectives:
  - Monitor before repair for gaps.
  - Monitor after for > 1 year to confirm repairs worked.
- Results:
  - Initial monitoring confirmed problem.
  - Continued monitoring to confirm repair method worked long-term.
- **Conclusion**:
  - **Caltrans able to use same repair method in future to save millions vs. replacement of many similarly designed bridges.**



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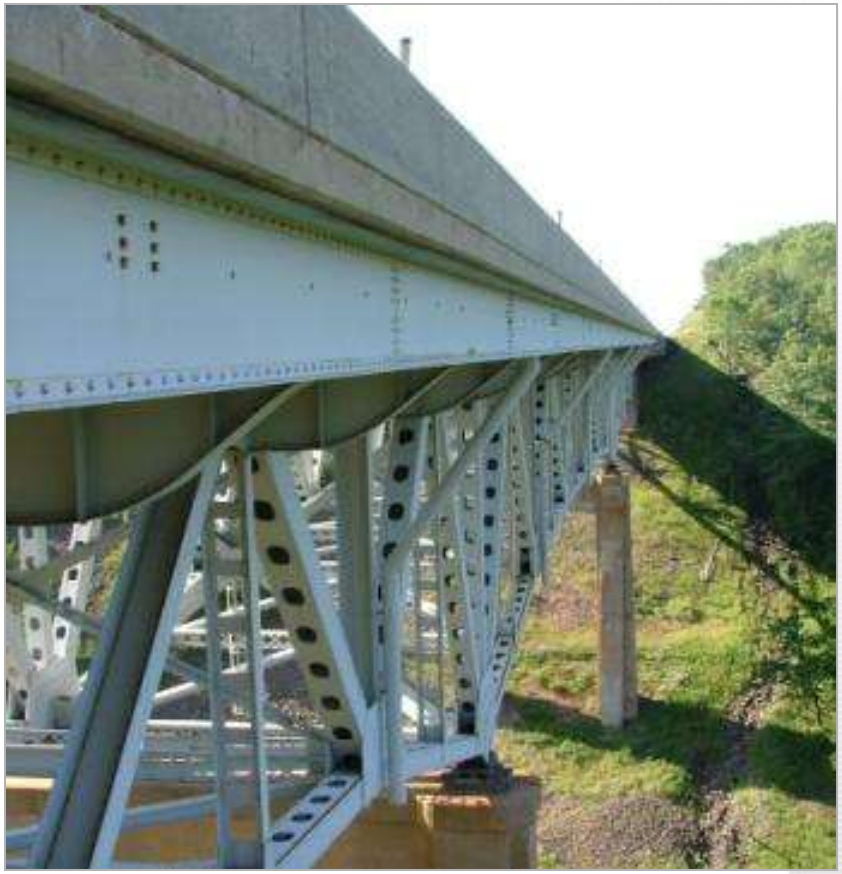
Deferring Repair

- **Problem: Is the third party recommended repair program necessary?**
- Owner: Pennsylvania Turnpike
- Project Date: 2005
- Objectives:
  - Monitor key tensile and compressive strains.
  - Calibrate an FEM to analyze current condition and recommended repair program.
- Results:
  - Recommended safe deferral of $875,000 repair program.
  - Repair program implemented anyway.
- **Conclusion:**
  - **Repair did not improve structural integrity.**



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Deferring Replacement

- **Problem: City faced with replacing 15 load-restricted short-span bridges.**
- Owner: City of Phoenix, AZ
- Project Date: 2008
- Objectives:
  - Stiffen bridge with CFRP wrap.
  - Monitor for 24 months to be sure.
- Result:
  - Monitoring program proved repair worked.
  - Load restrictions removed.
- **Conclusion:**
  - **Owner saves ~$3 million dollars on one bridge using a unique repair program.**

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Best Practices for Implementation

- Work with a commercial firm that has demonstrated experience.
- Use a progressive data-capture process to lower evaluation costs.
- DOT field staff can be used to collect data, further reducing costs.
- Start with simple AASHTO-approved load evaluation protocol.
- Solutions driven by tradeoff: cost vs. value of actionable data.
- If long-term monitoring is required:
  - Minimize number of sensors
  - Professional installation essential
  - System must have high reliability
  - Data center must have high reliability
- **Owners should demand an ROI – this is not research.**

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Take the Right Path for the Taxpayers

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Questions?