



EPIC 1.08 – Distribution System Safety and Reliability through New Data Analytics Techniques

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STAR = System Tool for Asset Risk

The STAR proof of concept demonstrates a more effective way to calculate and visualize Asset Risk Scores for electric assets and systems

Asset and System Risk Scores can be used to improve Public Safety and Quality of Service, and better inform Risk Management, Planning, and Operational practices



Need

- Data analysis and automated integration to improve data cleanliness and reduce time spent on manual data collection
- Establish/ refine risk algorithms across all asset classes utilizing probability and severity of occurrence
- Refreshed and most current state of assets
- Risk scores at individual asset and system level provide additional risk perspective and understanding

**Enhance
Public & System
Safety**

**Consistent Approach to
Asset & Risk
Management**

**Support
Regulatory
Transparency**

STAR Resolution

- Develop an enterprise application that calculates and graphically displays risk scores to facilitate decision making using a consistent approach (considering probability and severity of occurrence) for both assets and systems
- Support the development of proactive and efficient asset management strategies
- Support integrated planning activities and rate case filings to develop investment plans based on prioritized risks
- Provide regulatory transparency on how PG&E considers risk in the development of business strategy and spending decisions

Disparate data sources are integrated

System runs asset risk algorithms

Risk calculation results are displayed through user interface

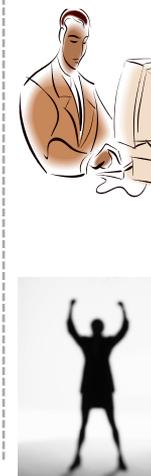
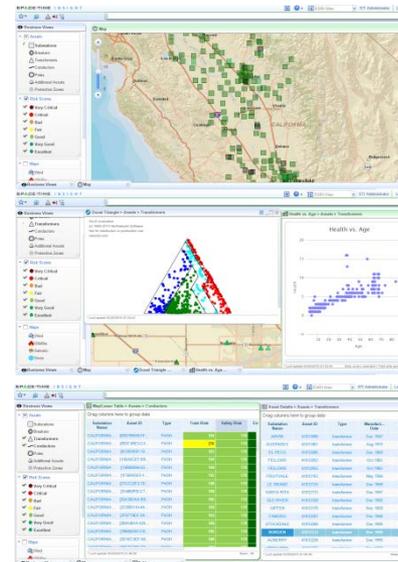
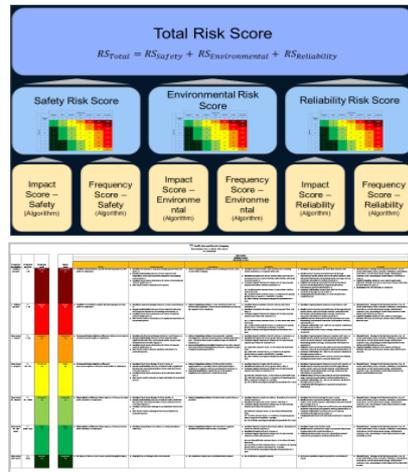
Users can track trends, identify high-risk areas, and make risk-informed decisions

Data Integration

Analytics

Visualization

Risk-Informed Decisions



Primary Users

- Asset strategists
- Risk analysts
- Investment planning
- Risk-Informed Budget Allocation team (RIBA)

Secondary Users

- System operators

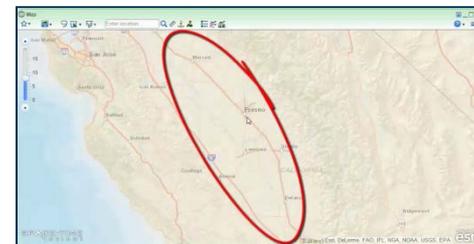
Functionality

- Develop algorithms to calculate asset and system risk scores
- Geospatially display risk information
- Trace risks to assets from any point in system

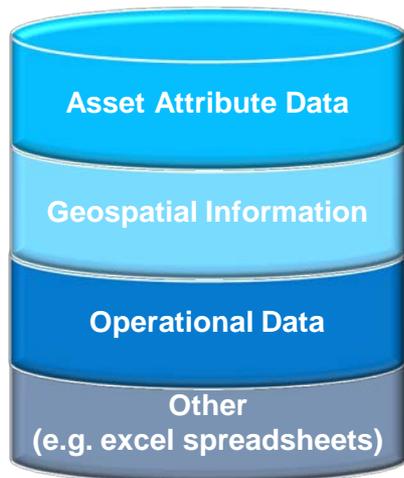


Geographic Scale

- Assets located in the California Central Valley Area



Data Sources



Assets Assessed

- Distribution wood poles **590,000**
- Distribution overhead conductors **425,000**
- Distribution breakers **2,000**
- Distribution substation transformers **300**

Total Risk Score

$$RS_{Total} = RS_{Safety} + RS_{Environmental} + RS_{Reliability}$$

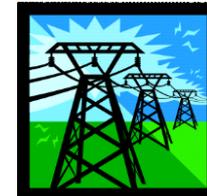
Safety Risk Score



Environmental Risk Score



Reliability Risk Score



Impact Score – Safety
(Algorithm)

Frequency Score – Safety
(Algorithm)

Impact Score – Environmental
(Algorithm)

Frequency Score – Environmental
(Algorithm)

Impact Score – Reliability
(Algorithm)

Frequency Score – Reliability
(Algorithm)

STAR Proof of Concept was evaluated during Sprint Demos and Testing using three criteria:

Software Quality, Implementation Ability, and Product Usability



Evaluation Criteria		
Software Quality	Implementation Ability	Product Usability
<p> Visual risk scores on the map and in tables</p> <p> Asset information available to the user</p> <p> Application integration with R programming language enables asset strategists</p> <p> Ability to integrate several source datasets</p> <p> User performance issues related to table querying/ sorting and application errors</p>	<p> Requirements and User Stories established online that allowed progress, feedback, and bugs to be tracked</p> <p> Lack of a system integrator resulted in some difficulty integrating disparate systems</p> <p> Creating electric system connectivity within the vendor application resulted in project delays</p>	<p> Navigation too complex (excessive “mouse clicks”)</p> <p> Thorough and useful product documentation for “out-of-the-box” functionality</p>



Proof-of-Concept Benefits

PG&E believes the POC demonstrated capabilities which evidence the business value of a production system

Market Landscape

- Provided insight into vendor capabilities in the areas of data integration, analysis, and visualization
- Set the stage for continued engagement with the analytics, visualization, and situational intelligence market

Algorithm Development

- Opened our eyes to how a production version of the application could provide a framework to further develop algorithms
- Identified the need to create failure models
- Identified the required analytics skillset
- Considered how a production version of the application can provide a framework to further develop asset risk algorithms

Geospatial Risk Algorithms

- Learned how to incorporate advanced geospatial (population, wind, fire maps) information into risk calculations

System Data and Capabilities

- Generated awareness of the importance of data quality and relationships between disparate data systems
- Led to a better understanding of data systems and an informed data approach to establishing a production system

Asset Strategy

- Demonstrated the need for having a strong foothold in risk analysis methodologies and how they should be applied to asset and system risk scores
- Exposed personnel to technology that leverages data to calculate risk scores and how to use that information when developing spending portfolios

Implementation Strategy

- Provided basis for developing an implementation strategy for a production system
- Identified the necessary resources required (internally and externally) to stand up and manage an asset risk tool
- Allowed PG&E to determine if a production system would provide business value and what kind of staged approach would lead to the best results



STAR Future - Expected Benefits

Quality of Service

- Improve public safety by identifying and addressing higher risk assets
- Reduce unplanned outages and customer interruptions
- Improve reliability measures by proactively managing assets

Planning

- Replacement of equipment at non-premium costs due to replacing before failure
- Turn unplanned replacements into planned replacements
- Avoid unneeded replacements as a result of better information
- Increase in productivity due to accelerated analysis/conclusions and increase in transparency and confidence of data
- Gain hours or reallocation of hours to do better analysis
- Improve ability to scope projects and bundle work
- Improve risk informed Capex spending, planning and processes
- Alignment with existing risk based processes
- Define "effective age" of assets which supports more accurate prediction of future performance of assets and asset classes

Operations

- Enhance O&M condition based maintenance using risk information

Other

- Improvement in rate case showings through enhanced risk informed decision making
- Increased efficiency in preparing rate cases and responding to data requests.
- Increased efficiency in preparing data for internal/external requests/audits/initiatives (risk requests may increase)
- Improve communication with stakeholders regarding assets and risks - community, regulatory, public
- Improve enterprise collaboration, apply best practices and governance



Appendix

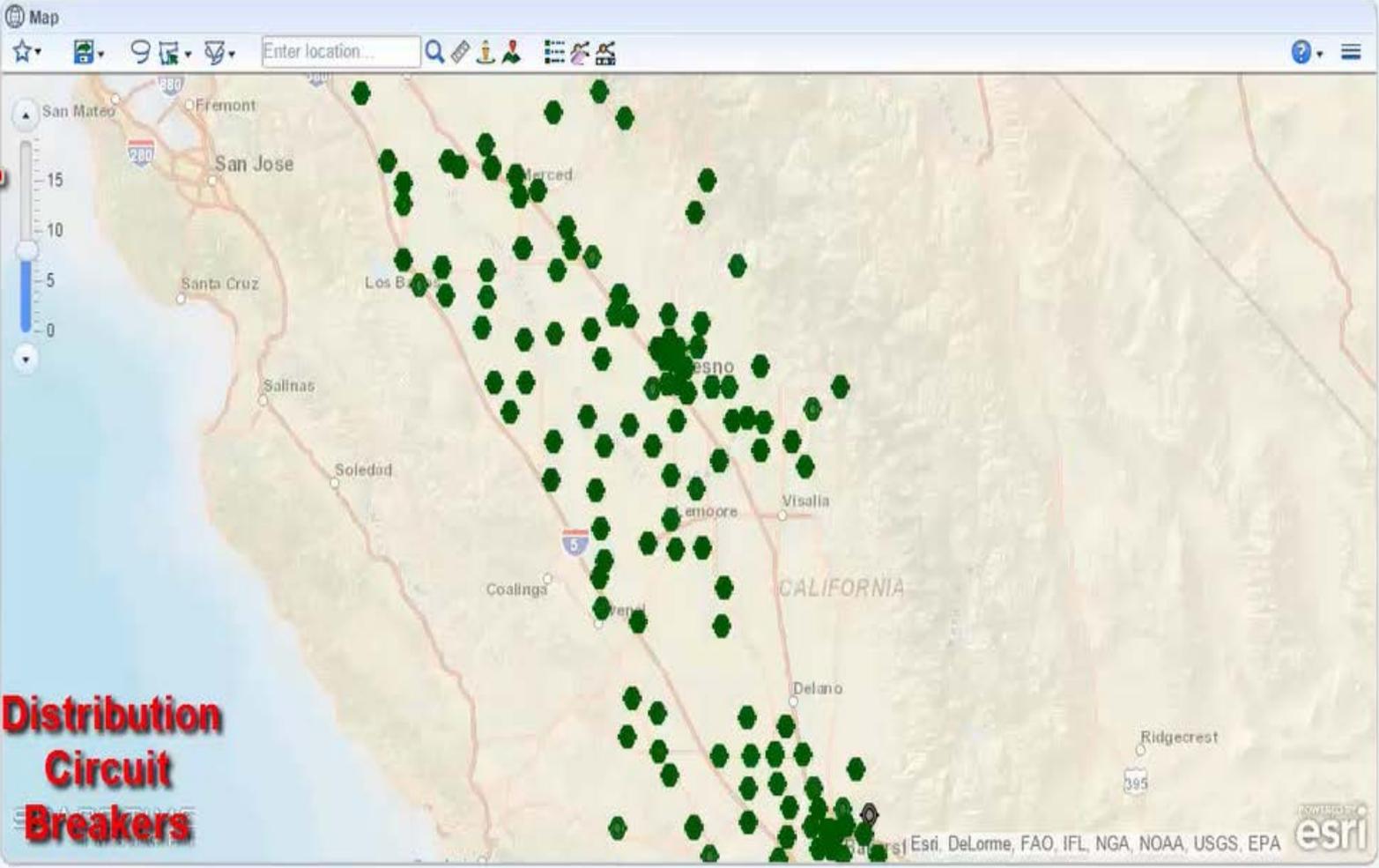
The screenshot displays the 'SPACE-TIME INSIGHT' web application interface. The browser address bar shows 'ESRI-View' and the user 'Shane Gebert'. The main map area shows a geographical view of California with several cities marked: Rosa, Sacramento, Oakland, San Francisco, Modesto, San Jose, Salinas, Fresno, San Luis Obispo, Bakersfield, Los Angeles, Las Vegas, Henderson, St. George, and Palm Springs. A vertical scale on the left side of the map ranges from 0 to 15. The left sidebar contains 'Business Views' with sections for 'Assets' (Substations, Breakers, Transformers, Conductors, Poles), 'Risk Scores' (Very Critical, Critical, Bad, Fair, Good, Very Good, Excellent), 'Maps' (Wind, Wildfire, Seismic, Snow), and 'Overviews' (Asset). The bottom of the interface shows 'Business Views' and 'Map' tabs.

SPACE-TIME INSIGHT

ESRI-View | Shane Gebert | Logout

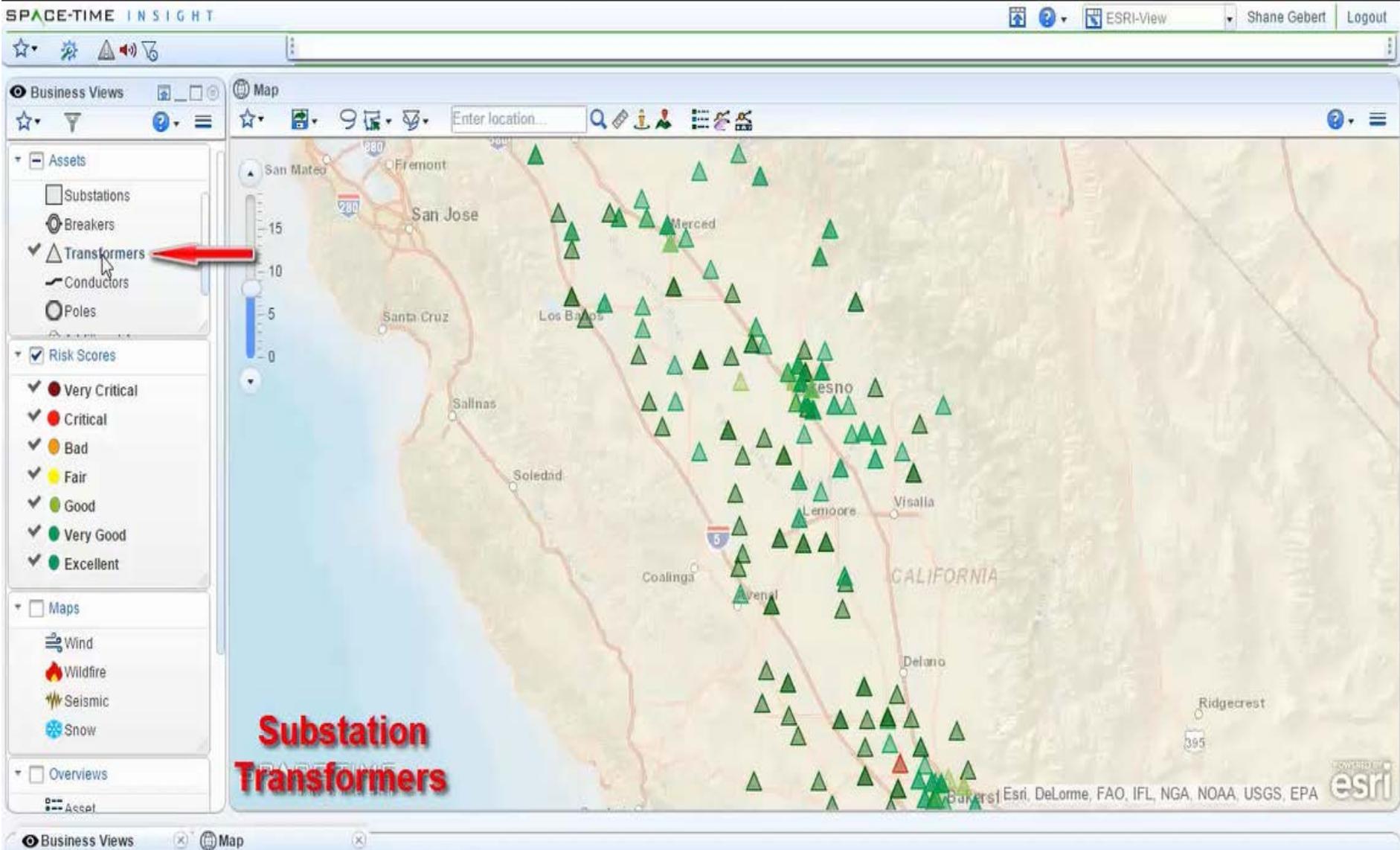
Business Views

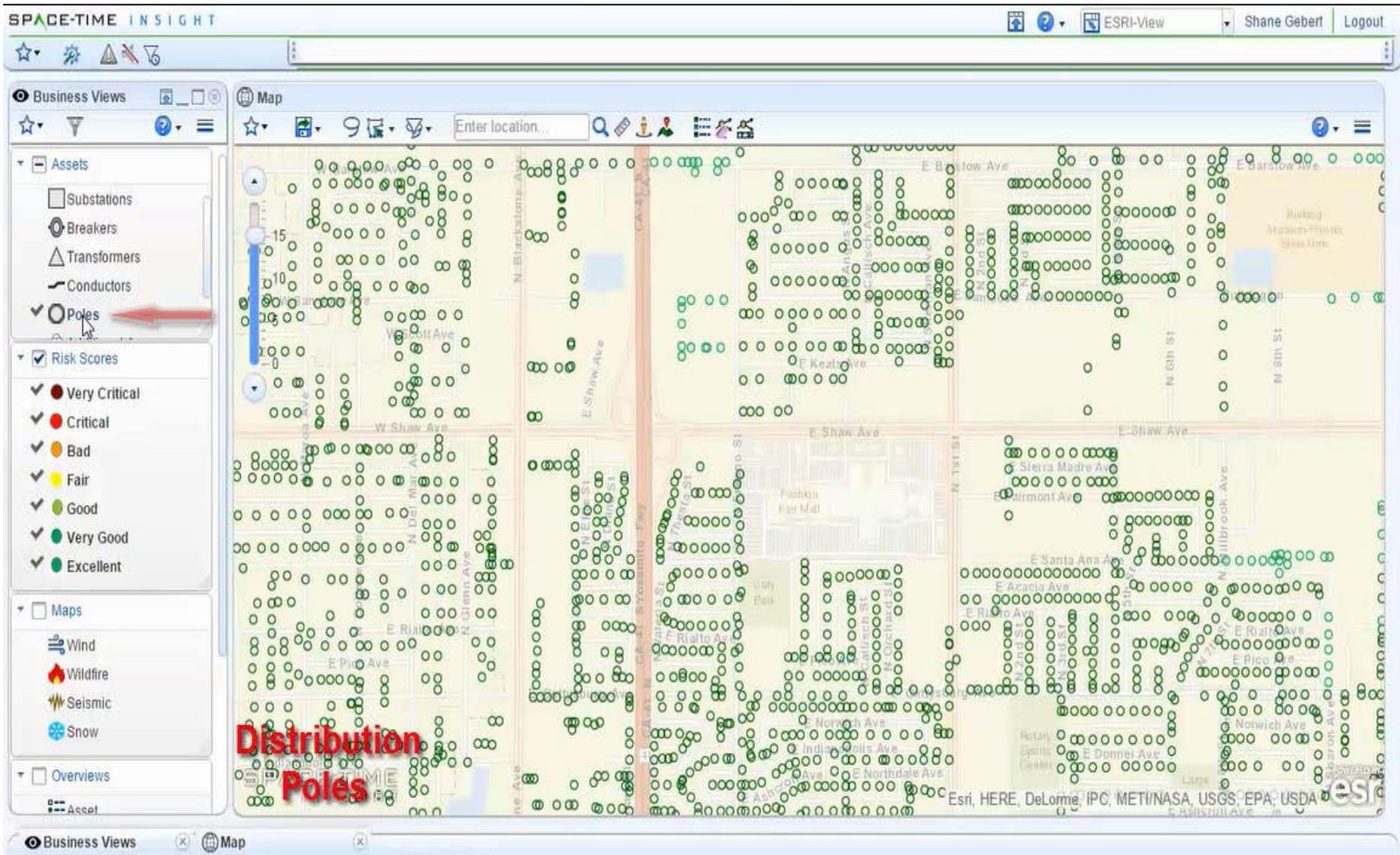
- Assets
 - Substations
 - Breakers
 - Transformers
 - Conductors
 - Poles
- Risk Scores
 - Very Critical
 - Critical
 - Bad
 - Fair
 - Good
 - Very Good
 - Excellent
- Maps
 - Wind
 - Wildfire
 - Seismic
 - Snow
- Overviews
 - Asset

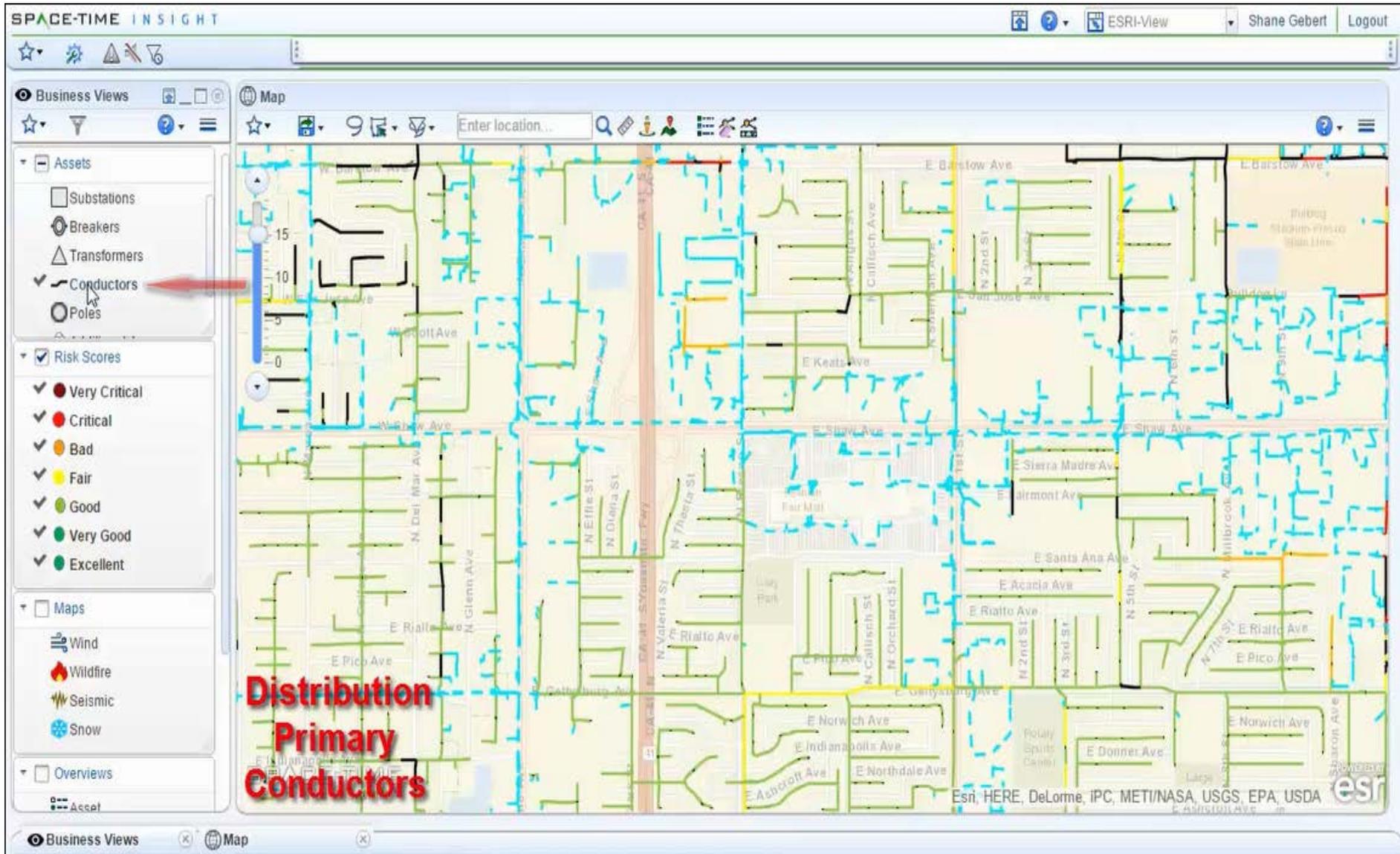


**Distribution
Circuit
Breakers**

Business Views | Map







SPACE-TIME INSIGHT

ESRI-View | Shane Gebert | Logout

Business Views | Map | Asset Details > Assets > Conductors

Assets

- Substations
- Breakers
- Transformers
- Conductors
- Poles

Risk Score

- Very High
- Critical
- Bad
- Fair
- Good
- Very Good
- Excellent

Maps

- Wind
- Wildfire
- Seismic
- Snow

Asset Details > Assets > Conductors

Asset ID	T...	Total Risk	Environment Risk	Reliability Risk	Safety Risk	H...	Conf
{9FB374...	PriOH	185	6	1	178	0	
{9FFD1...	PriOH	189	6	5	178	0	
{A0037...	PriOH	191	6	8	178	0	
{A00601...	PriOH	183	6	0	178	0	
{A01460...	PriOH	188	6	5	178	0	
{A046E...	PriOH	187	6	4	178	0	
{A09D0...	PriOH	197	6	14	178	0	
{A138E...	PriOH	185	6	2	178	0	
{A1488F...	PriOH	205	6	21	178	0	

Rows: 1 - 25 out of 676202

* Last update 04/23/2015 03:22:16

Map

- Map
- Asset Details
- Map/Lasso Table
- Health vs. Age
- Reliability Risk v...
- Environment Ris...
- Safety Risk vs. ...
- Total Risk vs. Age
- Asset Waterfall ...
- Risk Preview

SPACE-TIME INSIGHT

Esri, HERE, DeLorme, iPC, METI/NASA, USGS, EPA, USDA

Business Views | Map | Asset Details >...

The screenshot displays the SPACE-TIME INSIGHT web application interface. The main map area shows an aerial view of a residential or commercial area with overlaid infrastructure. Red lines represent a network of paths or boundaries, and a dashed cyan line indicates a specific path or boundary. The interface includes a top navigation bar with the application name, user information (Shane Gebert), and a Logout button. A left sidebar contains 'Business Views' and 'Assets' sections, with 'Risk Scores' checked. The 'Risk Scores' section lists categories: Very Critical (red), Critical (orange), Bad (yellow), Fair (light green), Good (green), Very Good (dark green), and Excellent (blue). The 'Assets' section lists Substations, Breakers, Transformers, Conductors, and Poles. A 'Maps' section lists Wind, Wildfire, Seismic, and Snow. An 'Overviews' section is also visible. A right sidebar shows 'Map Settings' with options for Base Maps (Imagery), Opacity (100%), Esri Layers (WorldTimeZones, USA, World Boundaries and Places Alternate, World Reference Overlay, World Transportation, Mean Annual Temperature), Esri Overlay Features (Navigation Control, Scale Legend), Imported km/kmz, and General Settings (Map object highlight color, Show only one information...). The bottom of the screen shows the URL: <https://starpoc.com/SIServer/htmlViewer.do?moduleId=732#>. The bottom right corner features logos for DigitalGlobe, Microsoft, and esri.

SPACE-TIME INSIGHT ESRI-View | Shane Gebert | Logout

Business Views

Assets

- Substations
- Breakers
- Transformers
- Conductors
- Poles

Risk Scores

- Very Critical
- Critical
- Bad
- Fair
- Good
- Very Good
- Excellent

Maps

- Wind
- Wildfire
- Seismic
- Snow

Overviews

- Asset

Map Enter location...

Asset Details Tab > Assets > Conductors > BARTON 1...

SI Suite | ESRI-View

Health & Risk	
Global ID	{C5A0D1DE-F537-49F8-8AA0-C73A097CE3FD}
Safety Risk	316
Environment ...	6
Reliability Risk	27
Total Risk	348
Health	
Confidence	

* Last update 04/23/2015 03:23:45

POWERED BY DigitalGlobe, Microsoft esr