2026 FTA STATE SAFETY OVERSIGHT AND RAIL TRANSIT AGENCY SAFETY WORKSHOP

March 25–27, 2026 | Arlington, VA

Session 5

Risk-Based Inspection: Data Analysis

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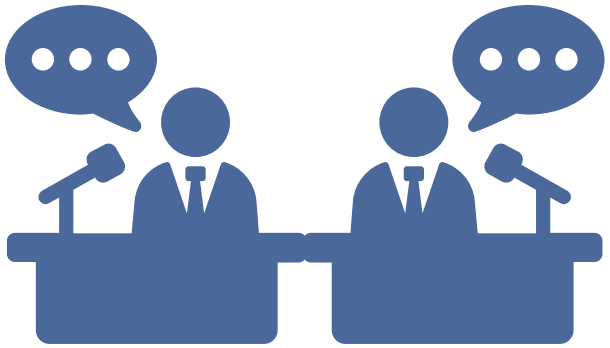
Federal Transit Administration

RBI Program Implementation



Panel Presentations

Data collection, analysis, and prioritization approaches

Roundtable Discussion

Successes, challenges, and opportunities

Panelists

FTA

Office of the
Chief Data Officer

Sasan Faraj

Data Analysis and
Visualization

Washington

Metrorail Safety
Commission (WMSC)

Thomas Zurla & Davis Rajtik

Data Analysis and
Visualization

Agenda

- Introductions
- Foundations
  - Asking the Right Question
  - Making Data Suitable & Actionable
  - Principles of Data Analysis
  - Meaningful Insights & Data Visualizations

Foundation #1: Asking the Right Question

What is the one safety risk you hope to proactively identify with your data?

Where do you see data?

Safety Program

- ✓ Event & Hazard Records
- ✓ Corrective Action Plans
- ✓ Near Misses

Inspections

- ✓ Inspection Records & Schedules
- ✓ Capital Project Schedules
- ✓ Records of defects and Failures

Maintenance

- ✓ Workorder Requests
- ✓ Out of Service Logs
- ✓ Maintenance Schedule

What does data look like?

DATA: A value or set of values representing a specific concept or concepts.
(Source: resources.data.gov)

Common Data Types

1 Numeric

- Counts
- Measurements
- ID Numbers

Dates and Times

- Event timestamps
- Schedules

Text

- Names
- Categories
- Descriptions

Boolean

- Yes/No
- True/False flags

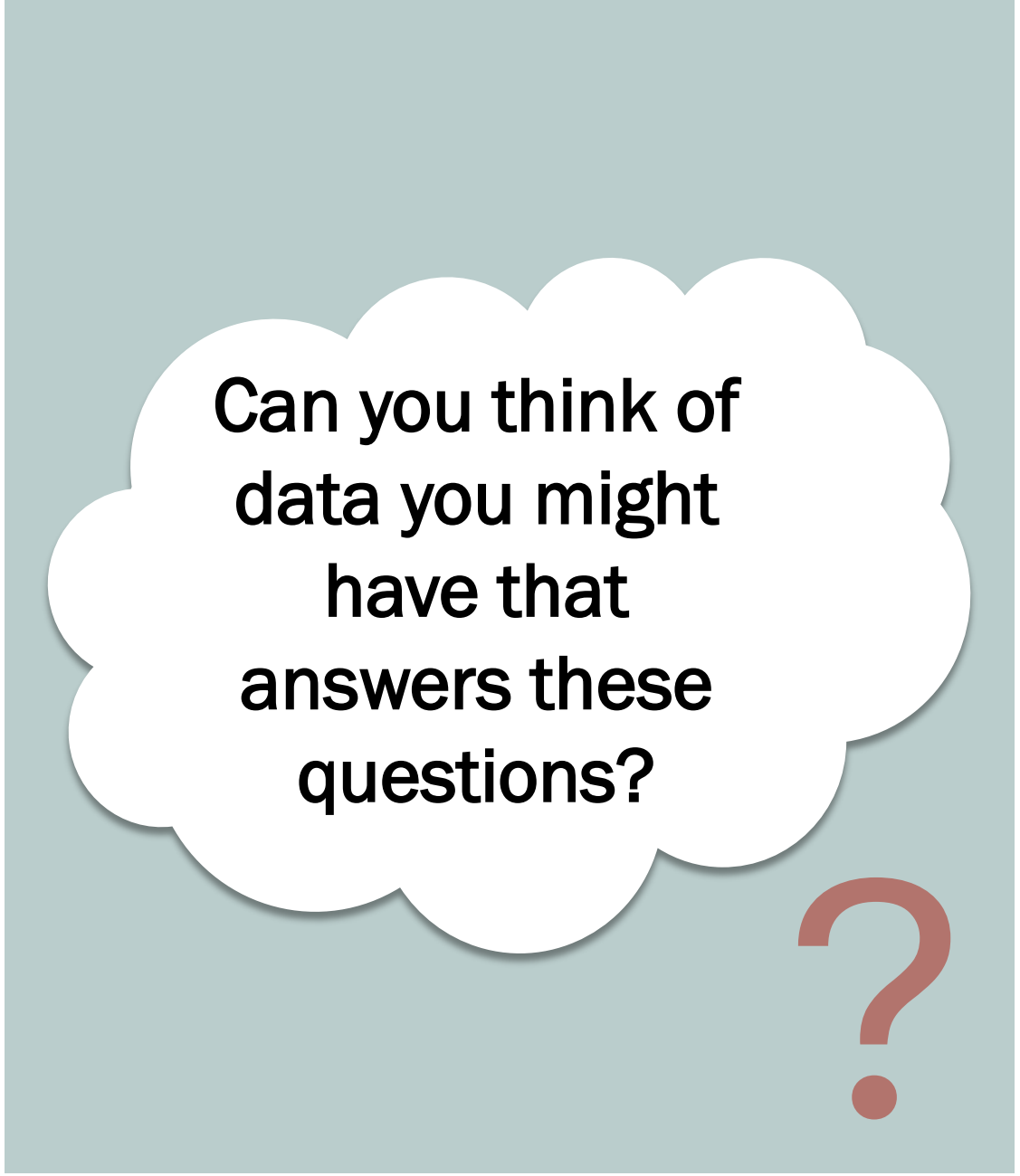
Structured vs Unstructured

Structured Data: Organized in a specific format, making data easy to search and analyze (e.g., spreadsheets).

Unstructured Data: Lacks a specific format, making it difficult to search and analyze (e.g., text documents, video).

Within risk-based programs, we often need to answer:

- What is happening?
- What is the risk and where do we see it?
- What should we focus on next?



Foundation #2: Making Data Suitable and Actionable

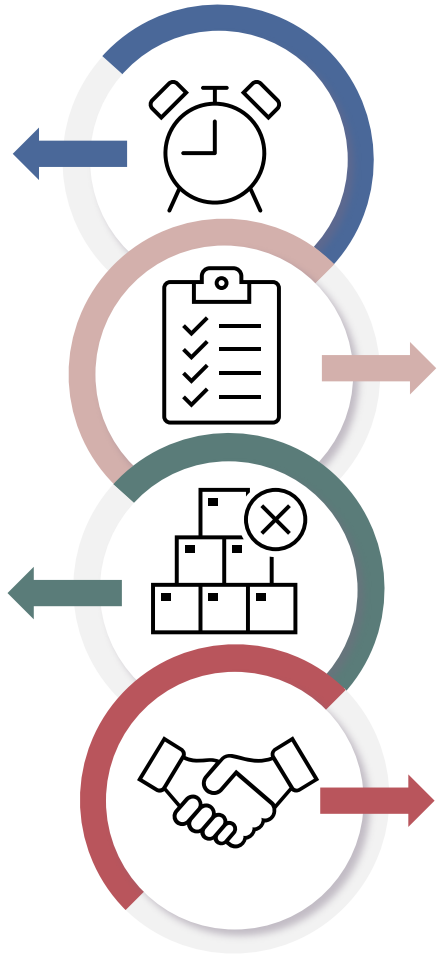
What takes data from basic to actionable?

Timely

Available when needed—not after the decision is made.

Structured

Usable and clean—organized in a way that allows for analysis and action (not stuck in hard-to-use formats).



Trustworthy

Verified and complete—not based on guesswork.

Sharable

Accessible to the right people—not siloed or hidden.

Note: This list is not exclusive

Scenario: Office Potluck

Imagine you are hosting an office party before a long holiday weekend. Everyone will try and bring a separate dish, and you are in charge of coordinating all the logistics and making the event run smooth.

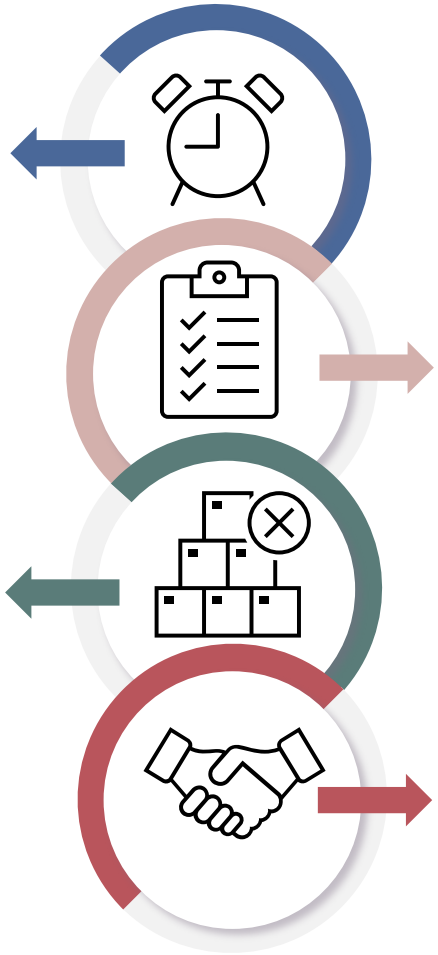
What type of information do we need to run this process?

Application to Safety, Program, Maintenance, and Inspection Data

Examples of Actionable Data

Timely

- How quickly are near misses recorded and responded to?
- When our maintenance records and schedules updated?



Trustworthy

- Who verifies the data within safety and event logs, and how frequent are they verified?
- Is your analysis well documented and reproduceable?

Structured

- Do you record elements of work orders, inspection results, and corrective action plans into tables, or are they just textual narratives?

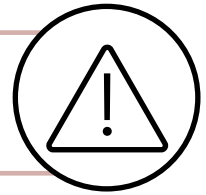
Sharable

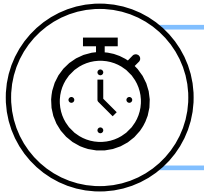
- Can the safety analyst and the program manager both access the source data?

Note: This list is not exclusive

When Data Isn't Ready, We Risk...

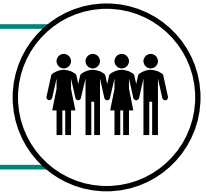
MISSED INDICATORS – Key trends or warning signs go unnoticed.

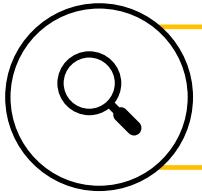




DELAYED ACTION – Decisions are stalled or based on outdated info.

MISDIRECTED RESOURCES – Time and resources could go to the wrong things.





LEADERSHIP BLIND SPOTS – It's hard to act with confidence.

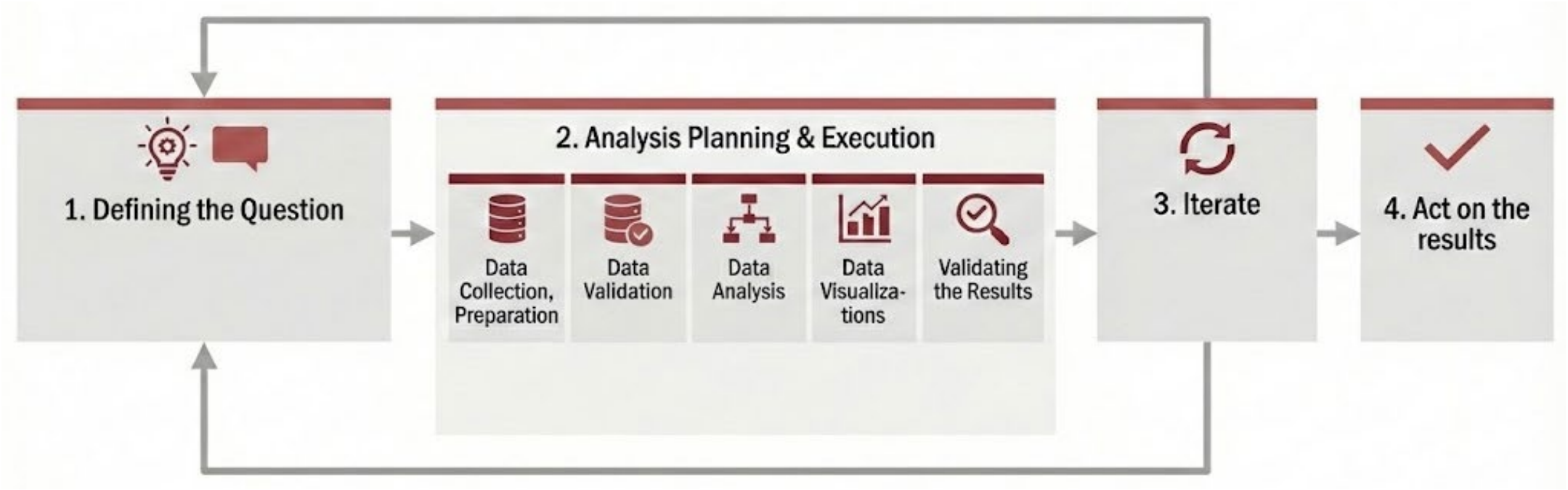
FRUSTRATION AND REWORK – Teams repeat efforts or make wrong assumptions.

Foundation #3: Principles & Steps of Analysis

Thinking Risk-Based Inspection Programs

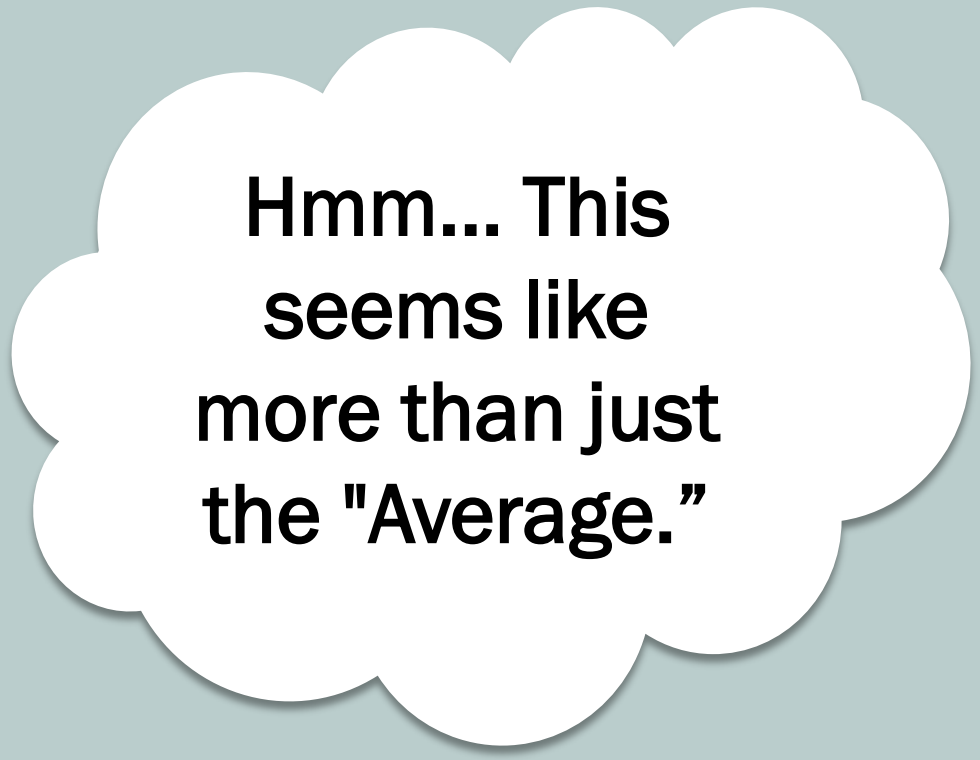
1. Is our data analysis prioritizing *meaningful* risk (severity and context) over simple volume (counts and totals)?
2. Does our analysis capture the full context or just a snapshot in time?
3. Is our methodology rigorous, reproducible and defensible?

What are the steps to an analysis?



Analysis is not just an average. Analysis …

- **Explains** how factors influence each other or **nuances** in the data.
- **Provides context** on historical trends.
- **Gathers evidence** from multiple points of views.



Documentation & Reproducibility

- Enable access to source data, where feasible and appropriate.
- Create a How-To Guide to navigate any sort of interface or spreadsheet.
- Write a methodology so people understand how a result was obtained.
  - When describing your results, explain the data sources and any processing steps.
  - Explain everything as if someone has *no* background in topic.

Foundation #4: Meaningful Insights and Visualizations

Why is Data Visualization Important?

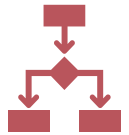
A good data visualization can help to **translate complex data and analyses into actionable outputs** that can be understood by everyone.

Simplify Findings

- Synthesize data into an **easily interpretable product.**
- Communicate to audiences of **various levels of understanding** on the topic.

Tell a Story

- Efficiently **identify patterns, trends, and relationships.**
- Guide the audience toward the most important **big picture takeaways.**



Empower Decisions

- Empower leaders to:
  - Communicate insights effectively **in real-time.**
  - Make **clear and confident decisions.**

What Makes an Effective Data Visualization?

Effective data visualizations require careful consideration and construction:

1. Know Your Audience
   - Who is the intended audience?
   - What kind of decision / conclusion do you want the audience to be able to make?

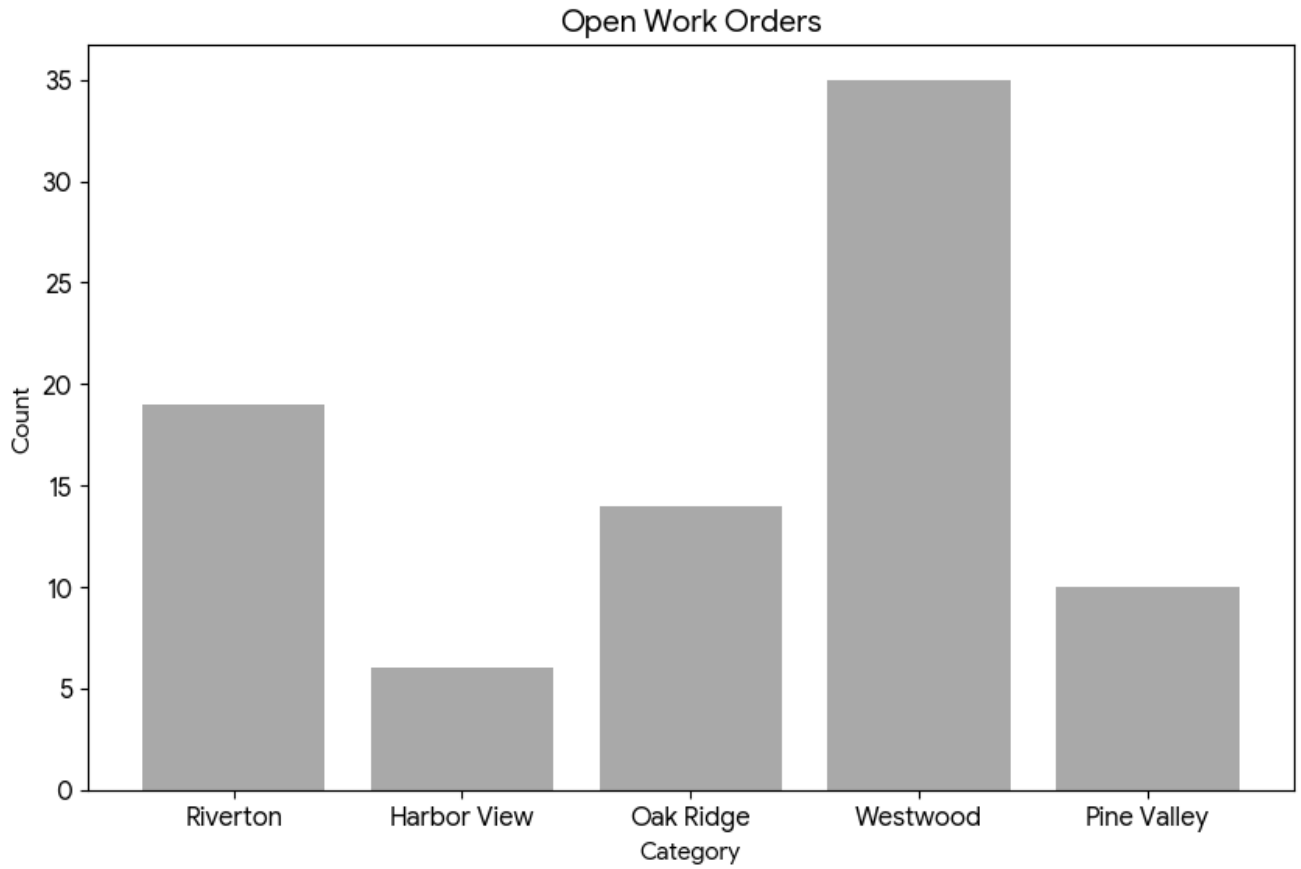
2. Tell a Clear Story
   - Be sure there is enough context for the audience to be able to see the story you are trying to tell
   - Present metrics in comparison with targets, thresholds, and/or previous reference data

3. Prepare your Data
   - Quality, well-structured data is the foundation of any visualization.
     - Validate data accuracy and reliability – inaccurate data leads to an inaccurate result
     - Ensure data is structured to support analysis – do any transformations need to take place first?

4. Choose the Most Appropriate Type of Visualization for your Data and Intended Message
   - What insight are you trying to convey?
     - Showing a trend → line chart; comparing categories → bar chart; correlation → scatter plot
   - Avoid pie charts when there are lots of groups.

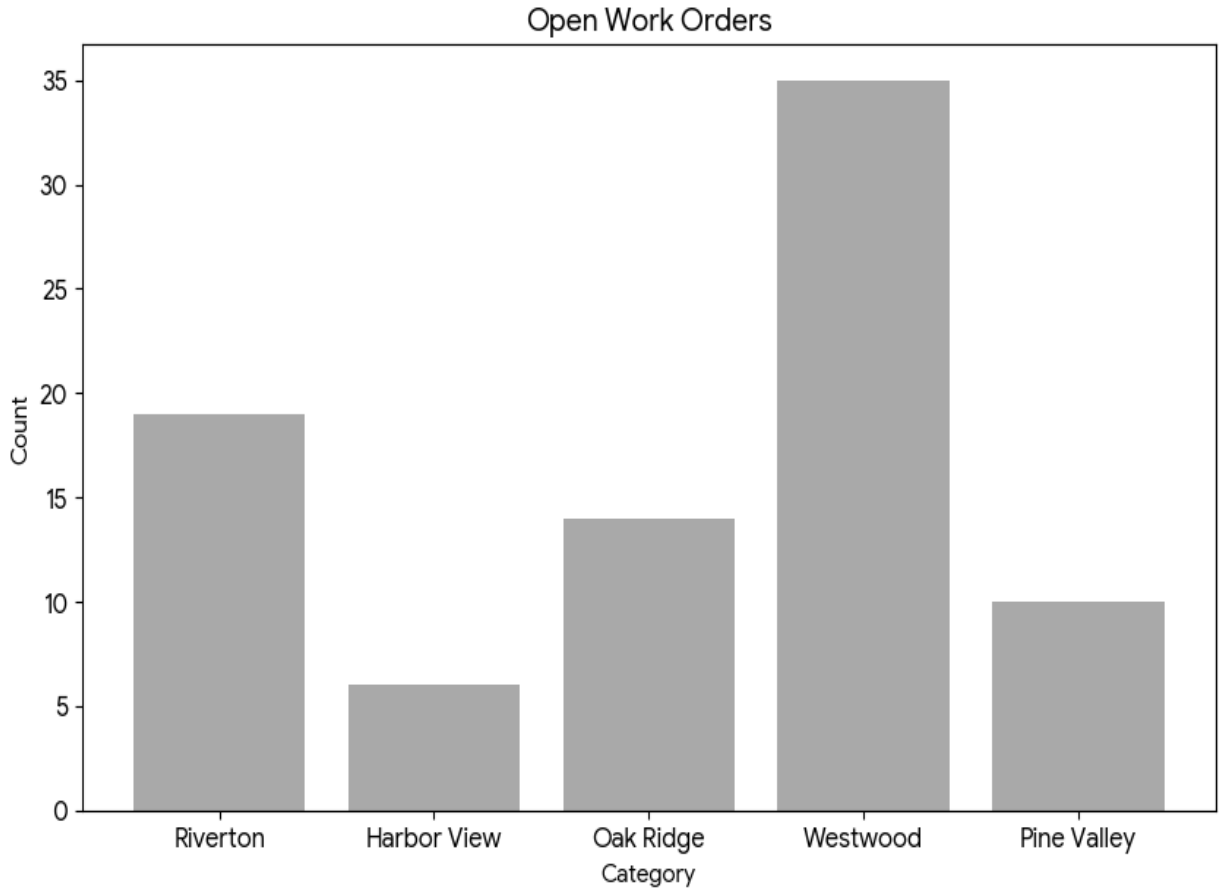
Example “Bad” Visualization

- Examine the visualization on the right: what issues do you see?
  - Is the purpose and message clear?
  - Can the audience easily identify the intended patterns and trends?
  - Is there anything misleading about the way the data is presented?



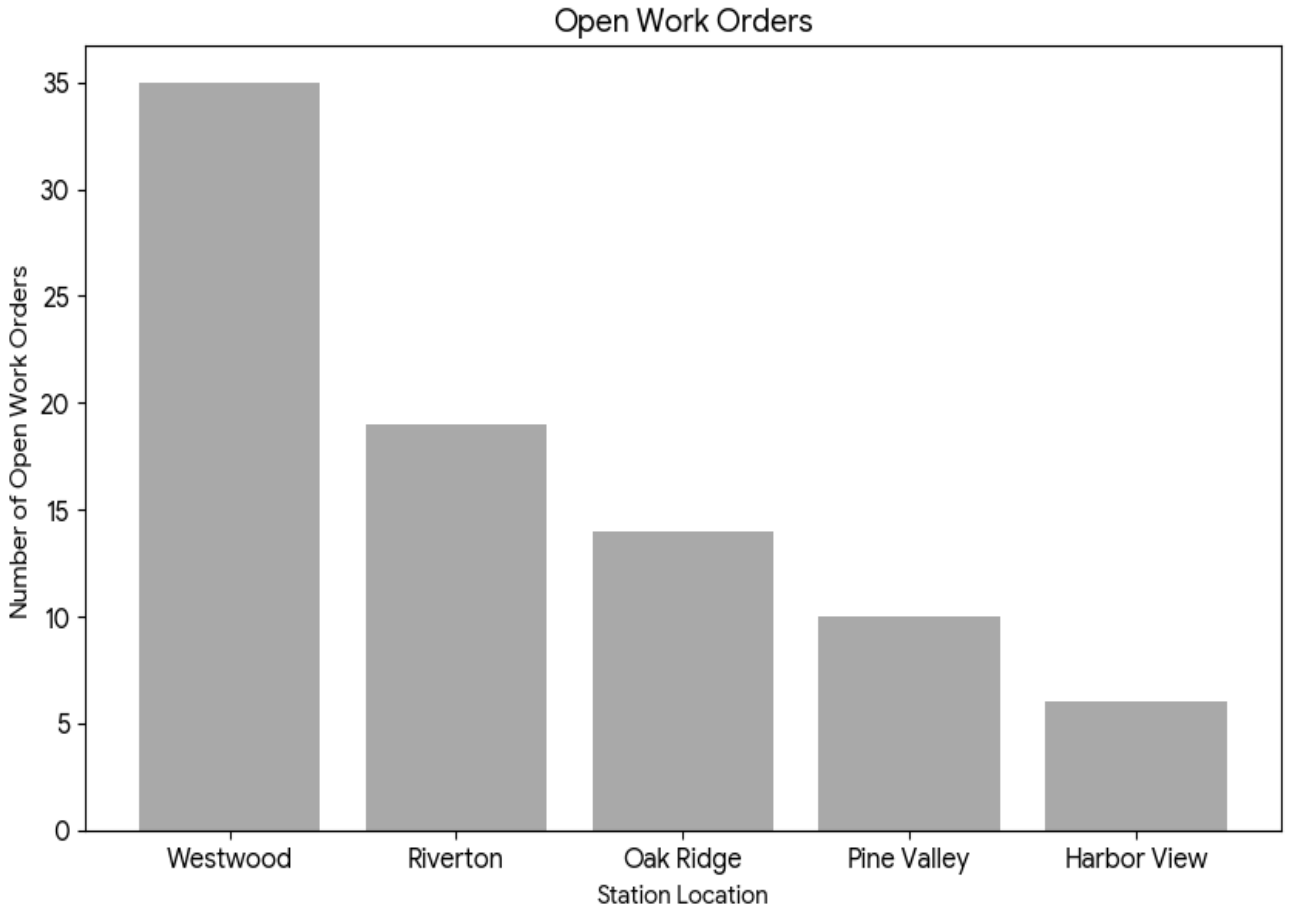
Example “Bad” Visualization (cont.)

- Examine the visualization on the right: what issues do you see?
  - Is the purpose and message clear? What is value? Who needs to make a decision based on this?
  - Can the audience easily identify the intended patterns and trends? The bars are unordered.
  - Is there anything misleading about the way the data is presented? Lack of clarity can also lead to misinformation.



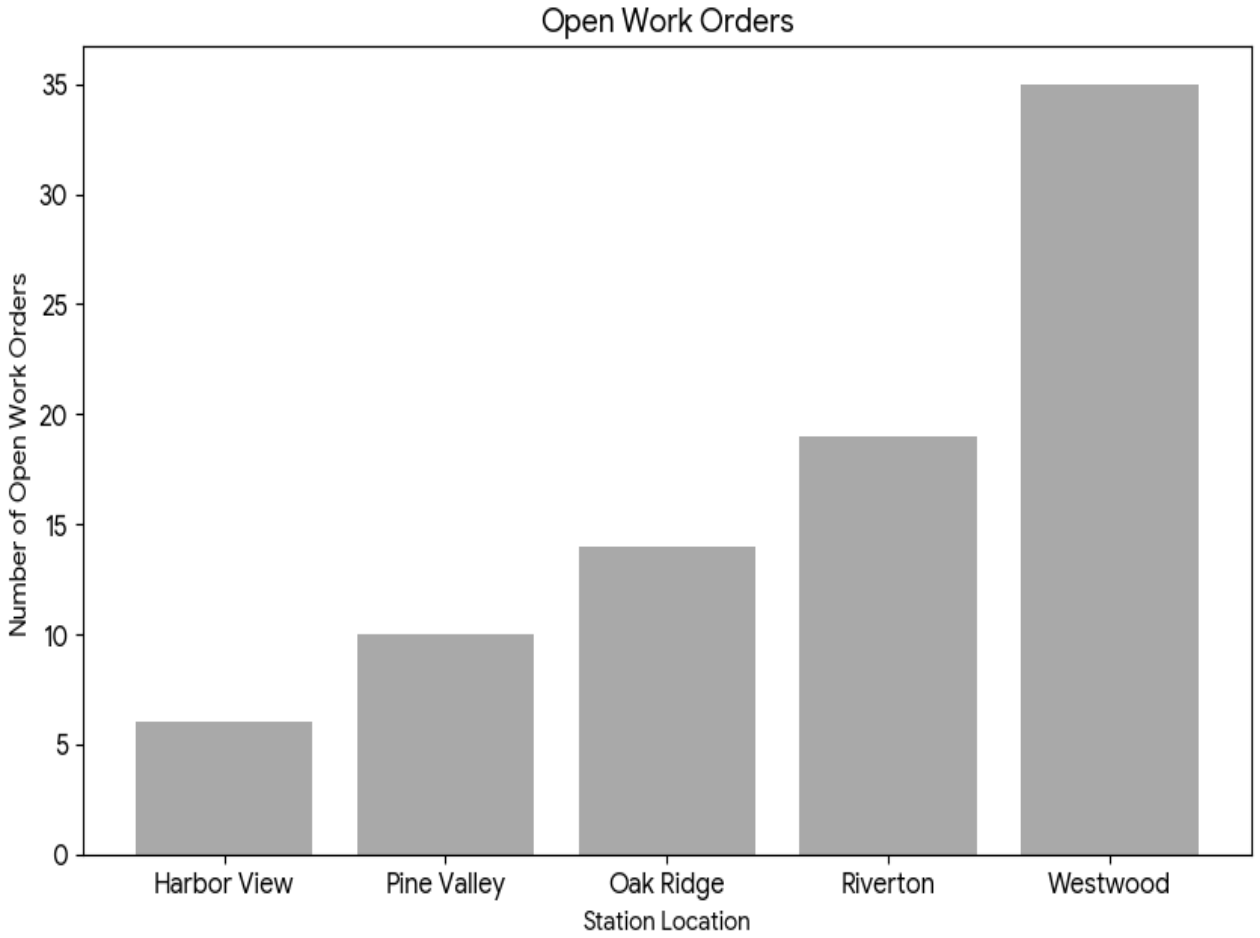
Fixing a “Bad” Visualization

- Take another look at the ineffective **Labor Hour** graph we analyzed earlier – what could we do to improve it?
  - Clarify the labeling.
  - Order based on Number of Open Work Orders.



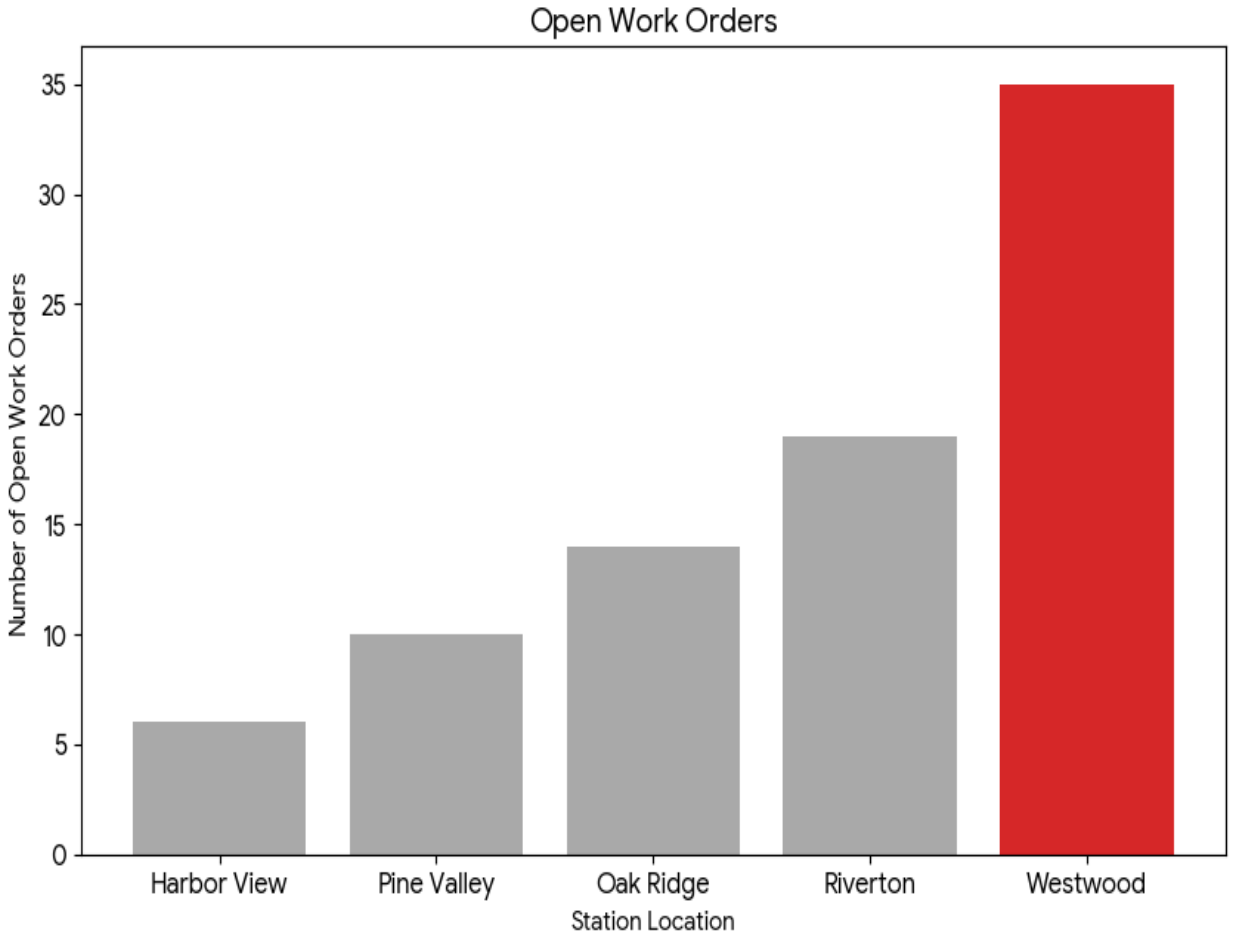
Fixing a “Bad” Visualization (cont.)

- Take another look at the ineffective **Labor Hour** graph we analyzed earlier – What could we do to improve it?
  - Clarify the labeling.
  - Order based on Number of Open Work Orders.
  - Continue to adjust orientation.



Fixing a “Bad” Visualization (cont.)

- Take another look at the ineffective **Labor Hour** graph we analyzed earlier
  - What could we do to improve it?
    - Clarify the labeling.
    - Order based on Number of Open Work Orders.
    - Continue to adjust orientation.
    - Create distinction and add a message. Add more context to the x-axis.
    - Does this answer the question? What other information (or data) do we need?



DESTINATION:
DATA…DATA…DATA…

Safety Oversight of the

Washington Metropolitan Area Transit Authority

WMATA OVERVIEW

1976, Rail Service Began

~12,000 employees

128 miles of track

9 rail yards

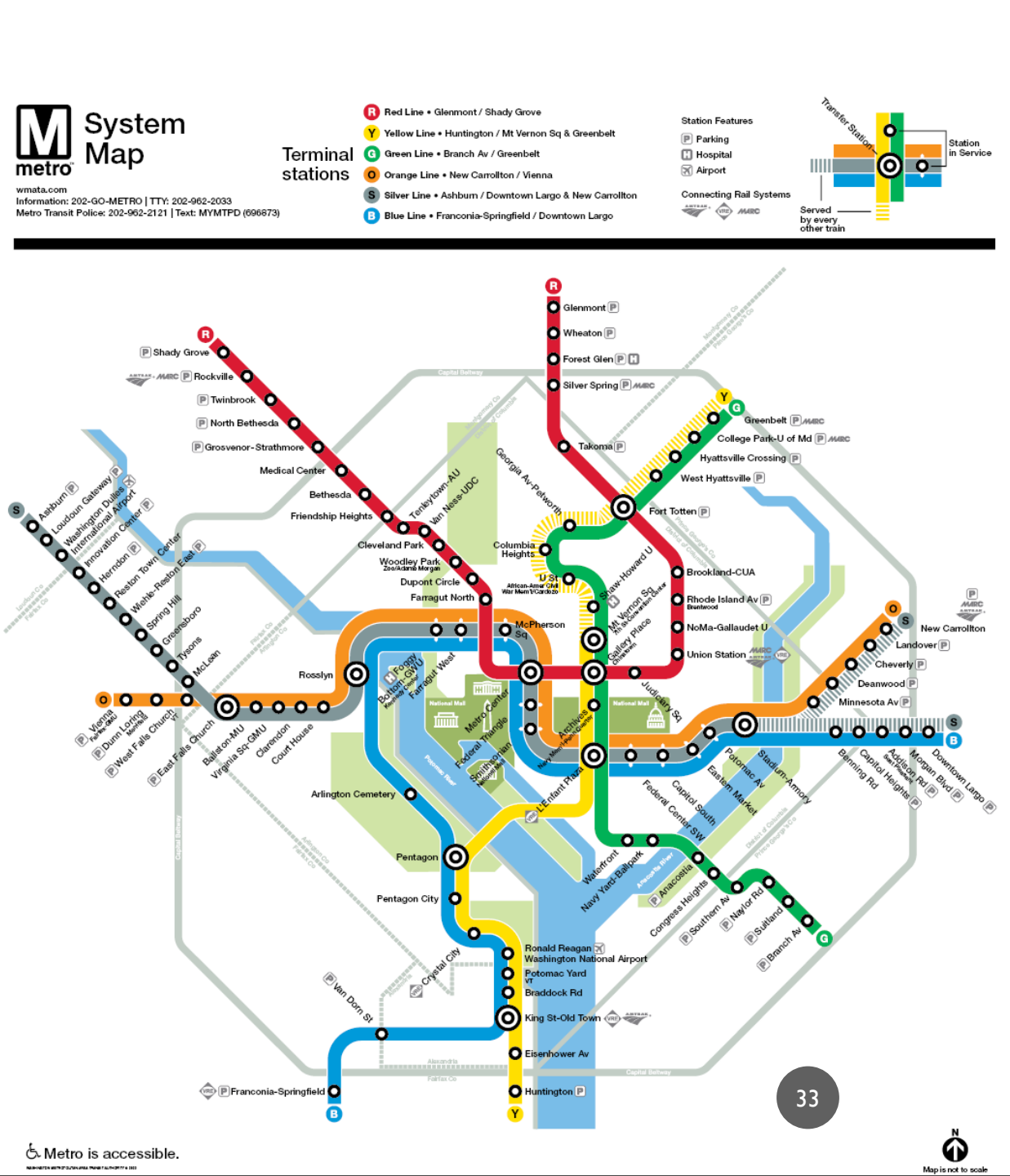
98 stations

1178 active railcars

>146.8 million rail trips (2025)

Metrobus **(no oversight by WMSC)**

MetroAccess **(no oversight by WMSC)**



WMSC CHALLENGES

Initially…

- Data expertise
- Data sources and limitations
- Data value

Maturing…

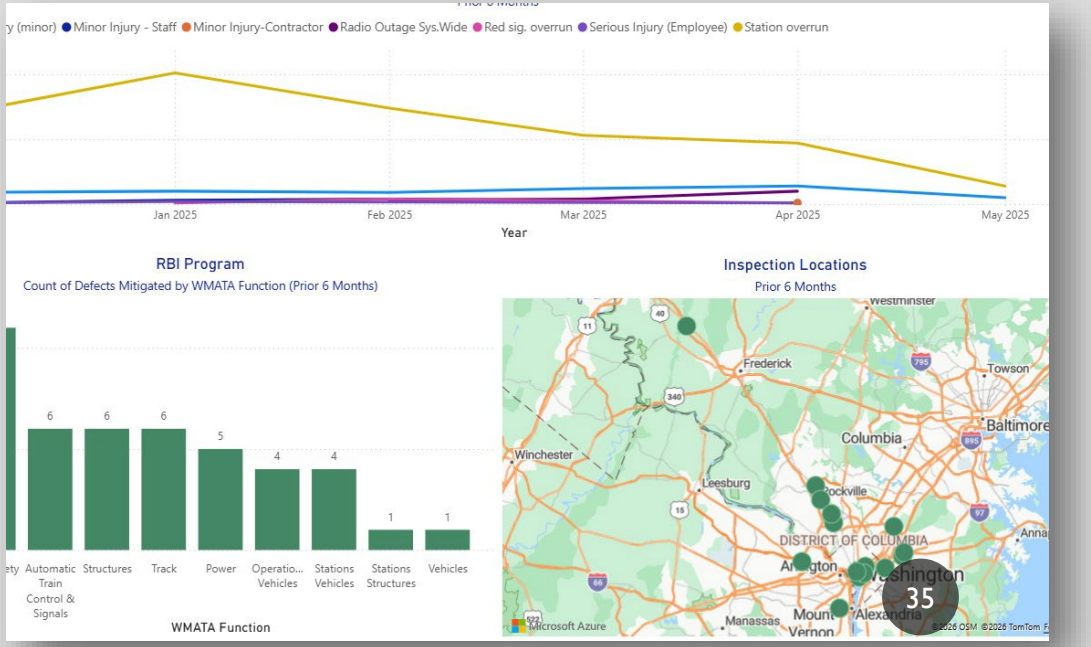
- Shared taxonomy
- Continuous process
- One size does not fit all

IN THE BEGINNING

Start. Use existing data access (internal and external)

Test. Proof of concepts – *not ready for primetime*

Build. Success depends on feedback from key users and aggregators



Early Test Dashboards

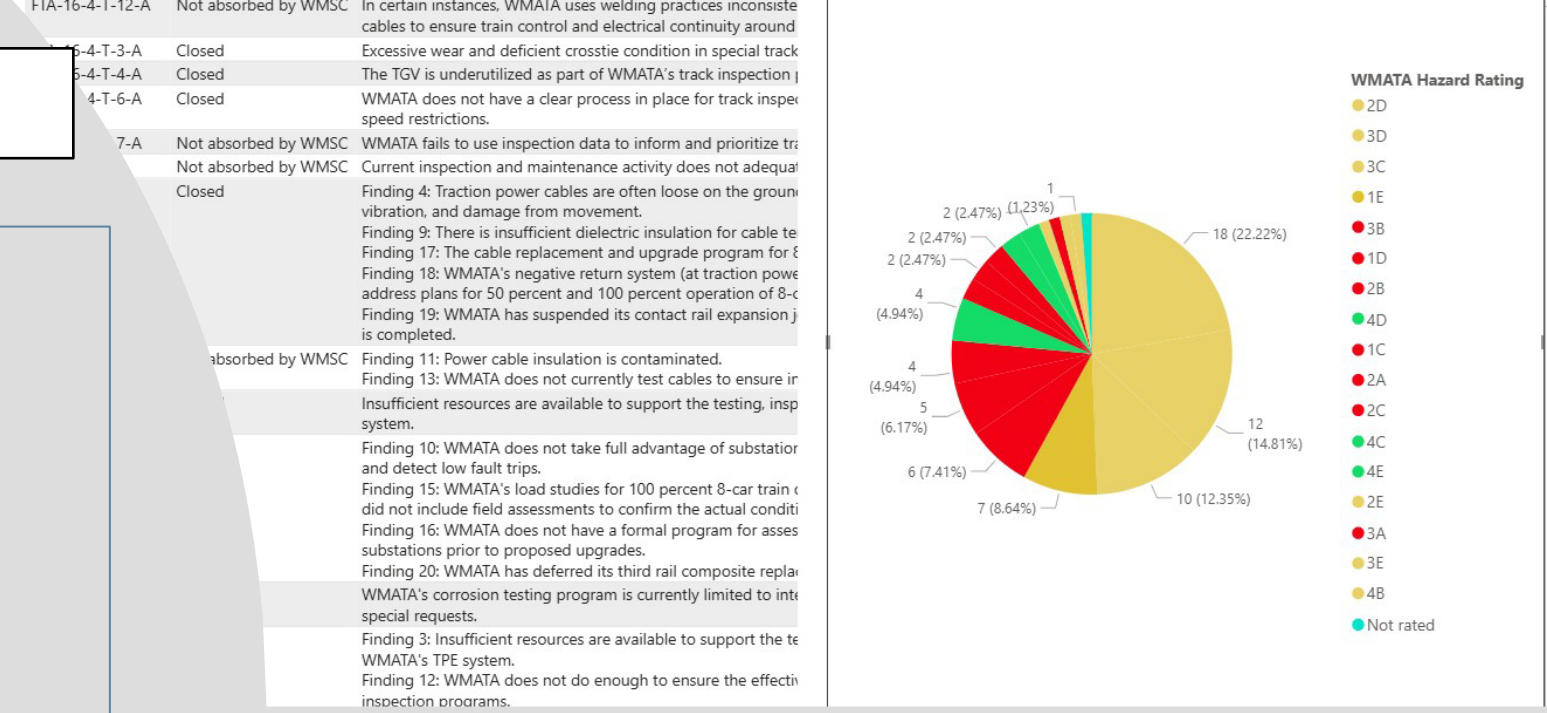
Evolve data reports or visualizations.

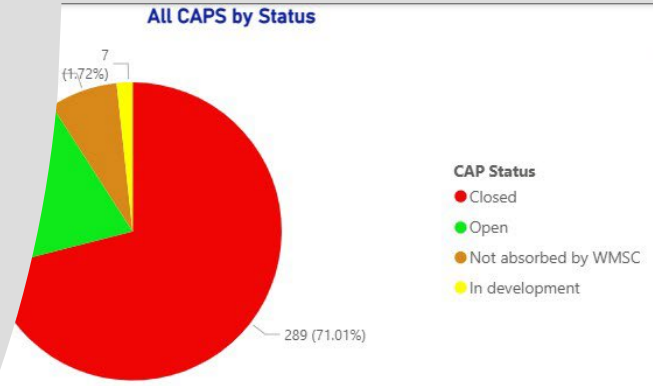
Feedback → edits or changes → Additional feedback (repeat)

Continue to build off new or recent dashes

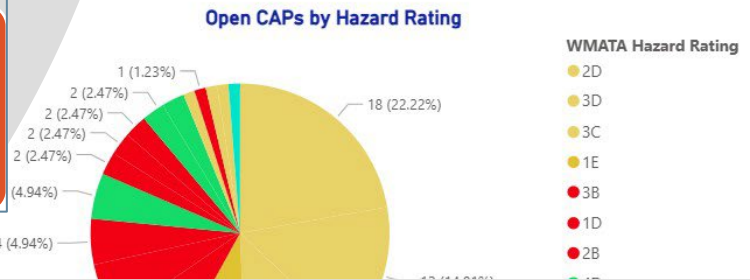
There is no 'end' point

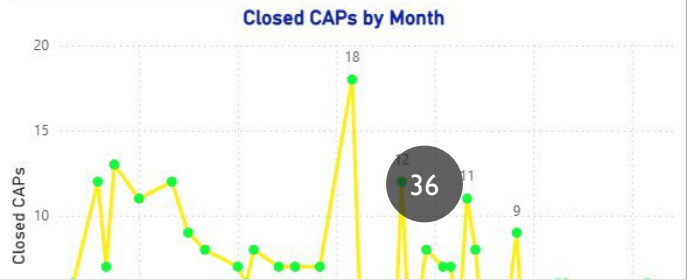
Feedback from key stakeholders is key to improvements!





Cap ID	CAP Status	Finding/Recommendation
FTA-16-4-T-11-A	Not absorbed by WMSC	WMATA does not apply the same quality contr installed fasteners that it would apply to those new line segment.
FTA-16-4-T-12-A	Not absorbed by WMSC	In certain instances, WMATA uses welding prac standards to install cables to ensure train cont mechanical joints.
FTA-16-4-T-3-A	Closed	Excessive wear and deficient crosstie conditior and addressed.
FTA-16-4-T-4-A	Closed	The TGV is underutilized as part of WMATA's tr
FTA-16-4-T-6-A	Closed	WMATA does not have a clear process in place impose and remove speed restrictions.
FTA-16-4-T-7-A	Not absorbed by WMSC	WMATA fails to use inspection data to inform
FTA-16-4-T-9	Not absorbed by WMSC	Current inspection and maintenance activity d system.
FTA-17-1-10	Closed	Finding 4: Traction power cables are often loos contamination, vibration, and damage from m Finding 9: There is insufficient dielectric insulat

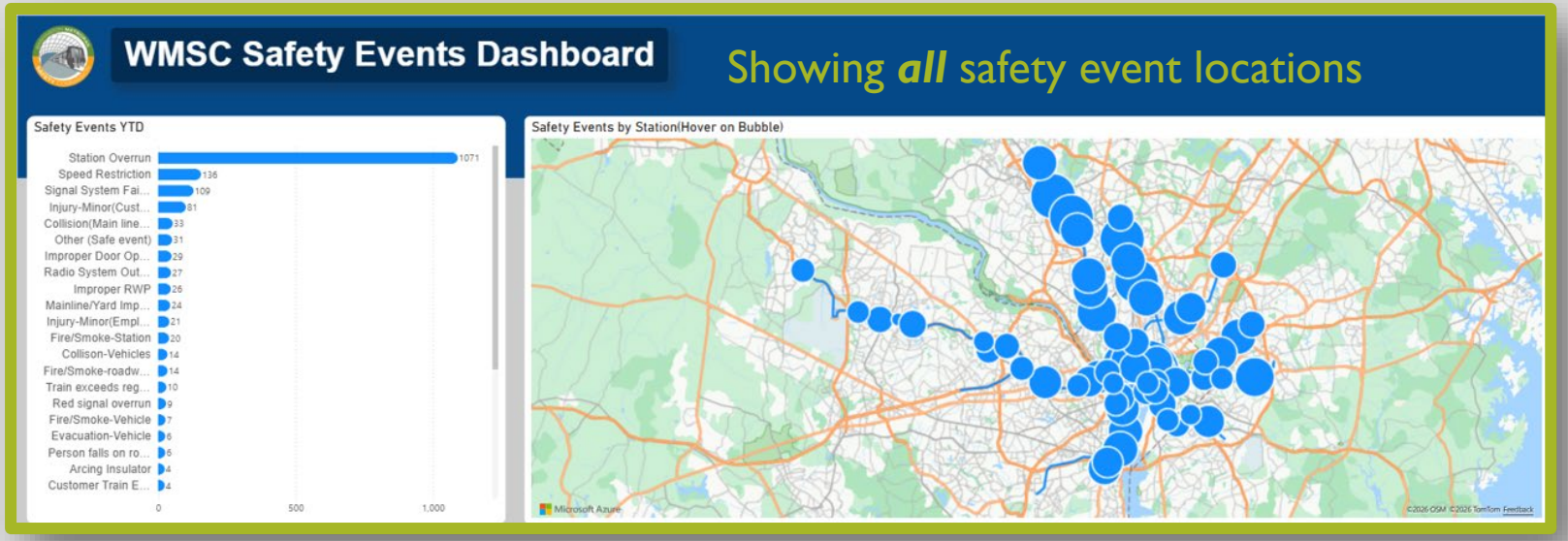


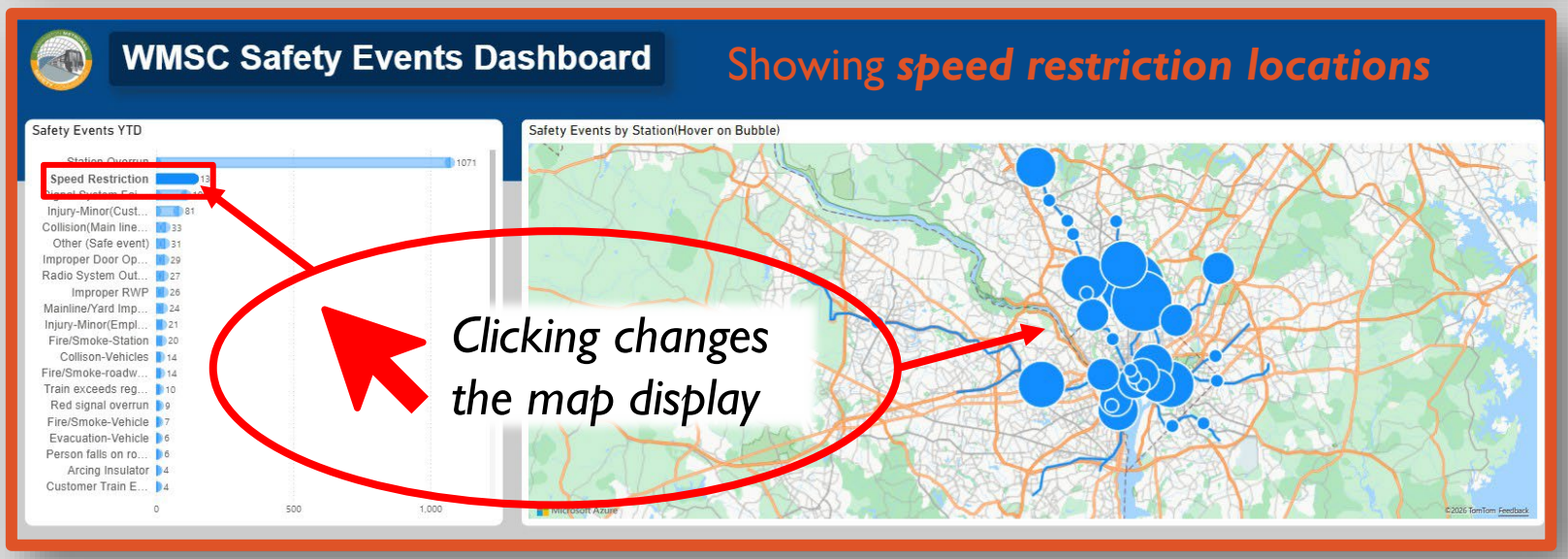


Dashboards Today

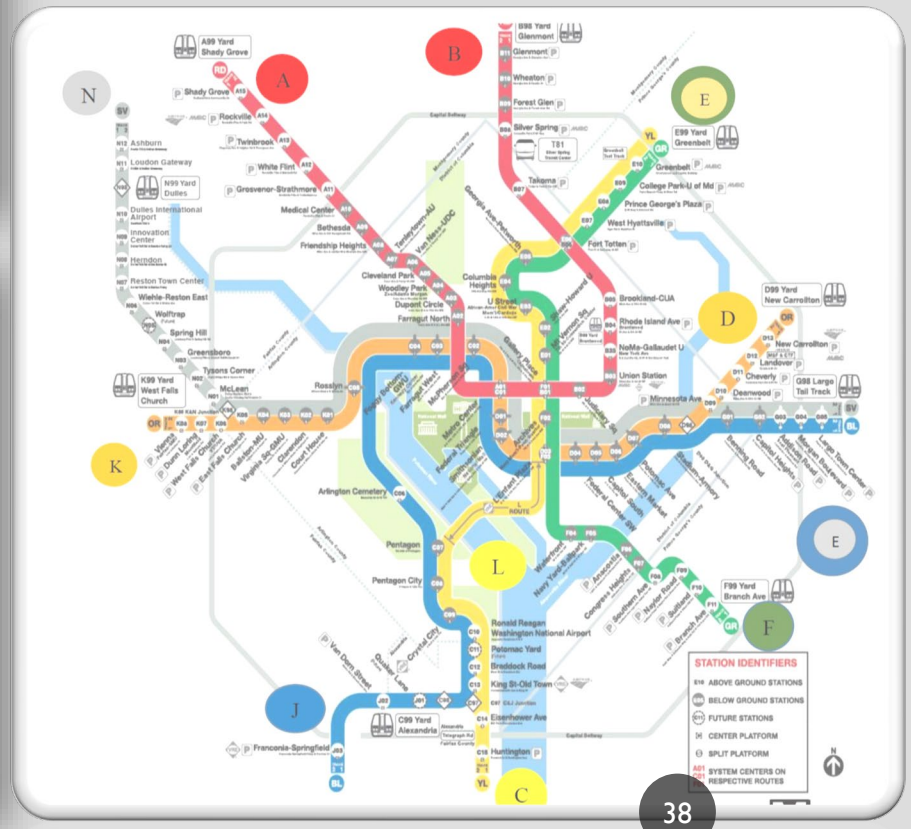
- Current WMSC Safety Event Dashboard (key metrics)
- First dashboards are now steady state
- Each SSO will have unique data sources and visualization preferences

Data Visualization Tools





Data visualization tools like Power BI make data accessible in a way Excel or simple tables cannot



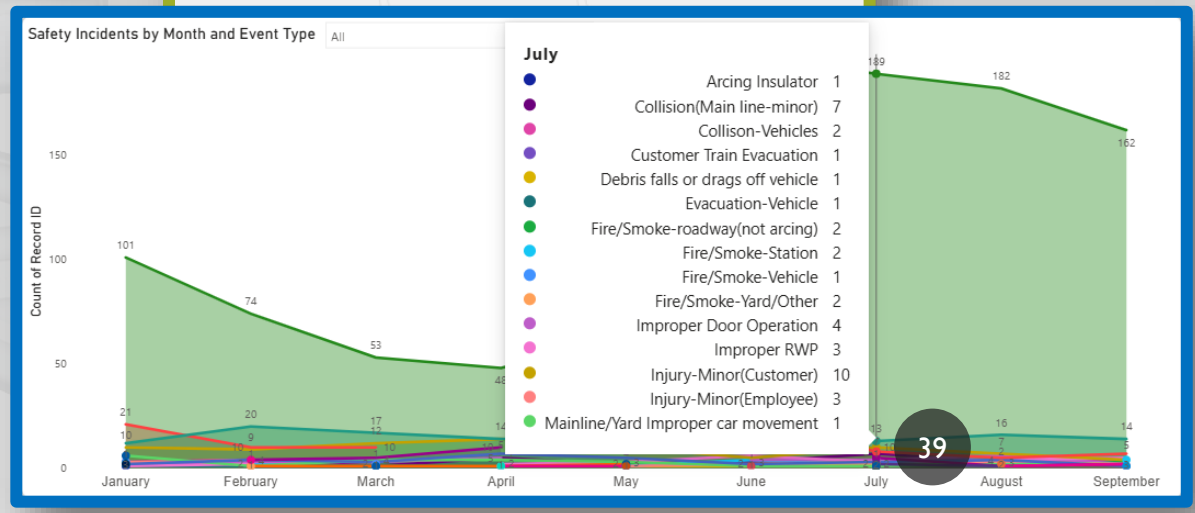
Explore Features to Optimize

Decomposition Tree
("Decomp Tree")

Power BI has a variety of visualization tools

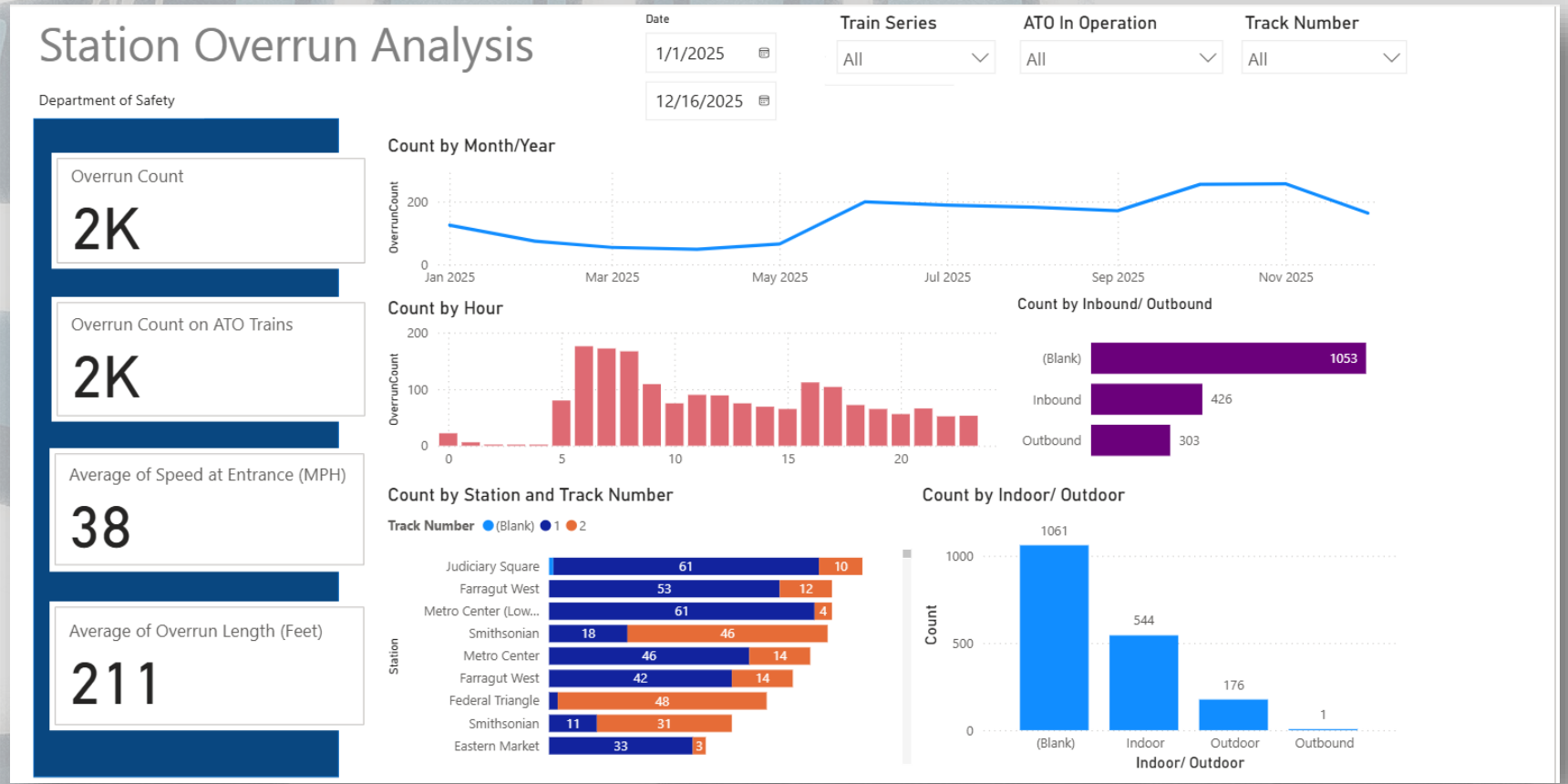
Explore features to determine best visual

Safety events over time



WMATA's Data Mart: Station Overruns

- Use RTA Data (WMATA "Data Mart" shown here)
- Work with what exists
- Ideal state can be achieved over the long run



WMSC Overrun Dashboard

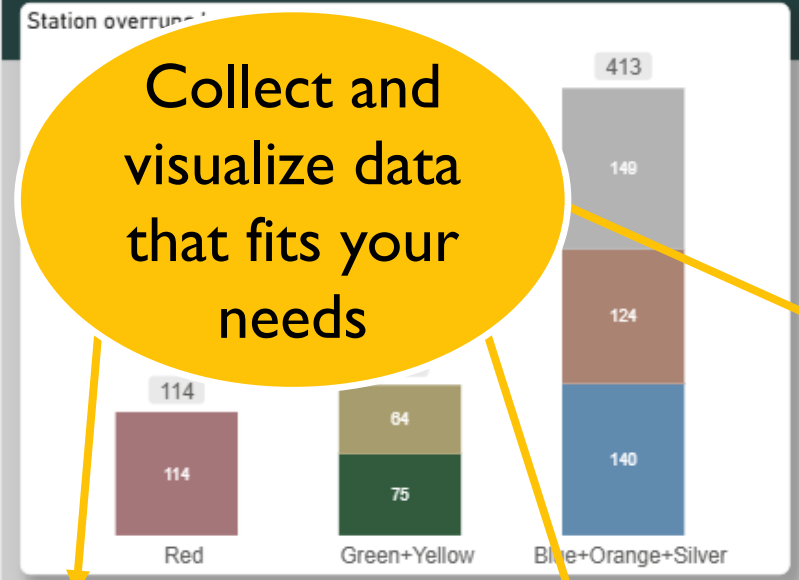
Reset

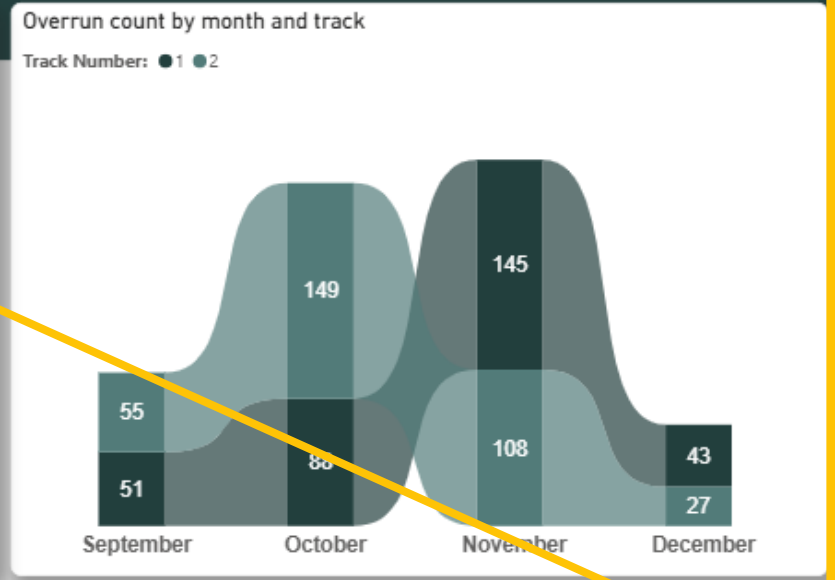
Incident Date/Time: Last 120 Days
9/9/2025 - 1/6/2026

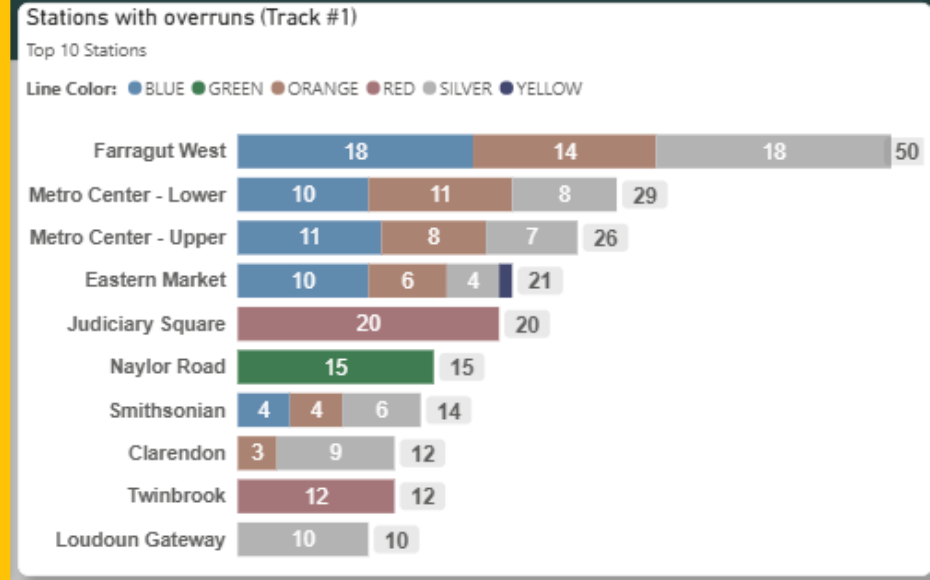
Line color: All

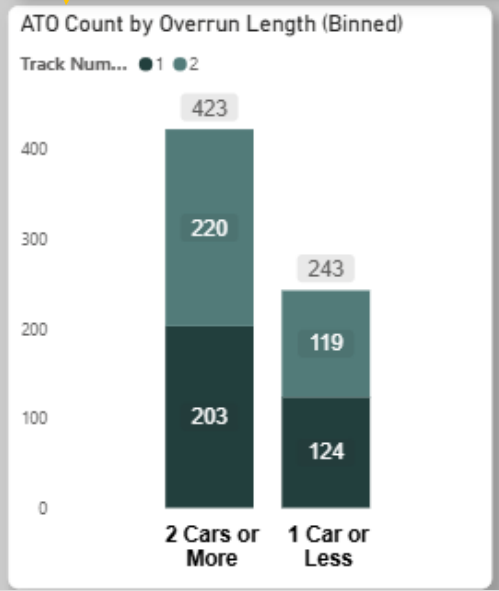
Line Group: All

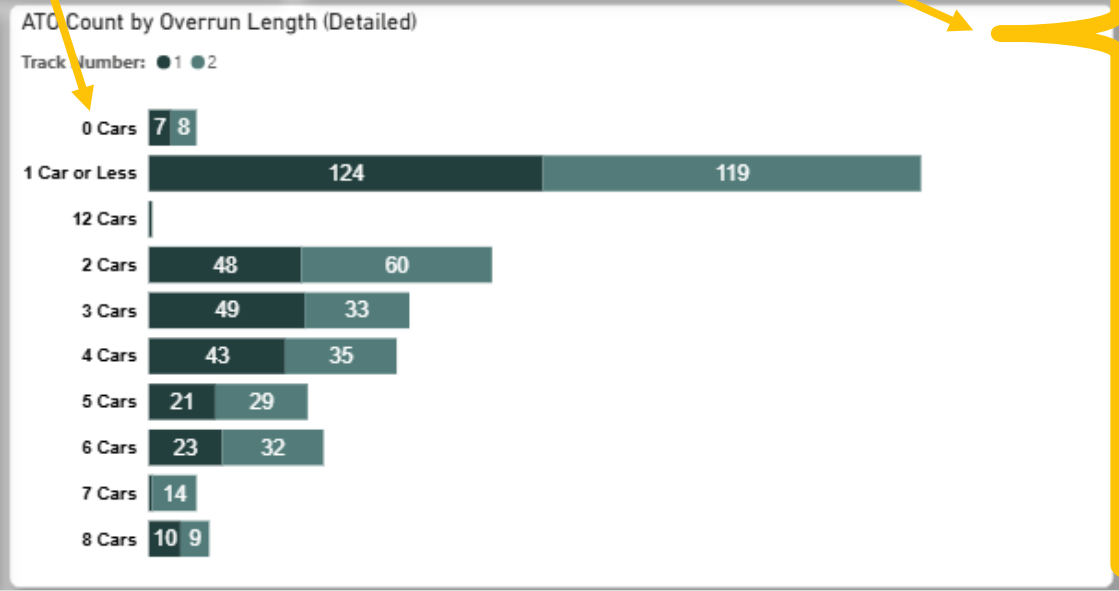
Collect and visualize data that fits your needs

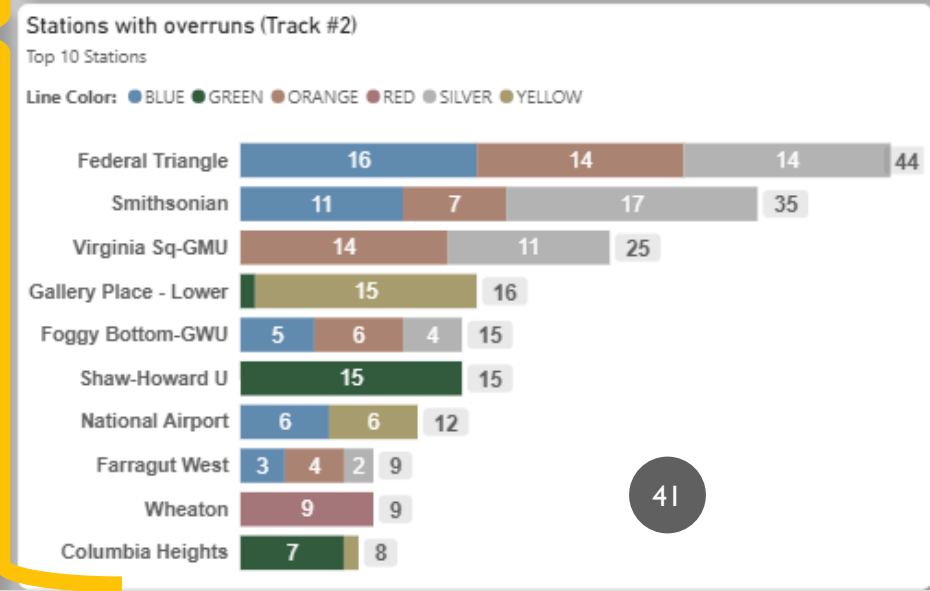












WMSC Inspections Dashboard

Inspection Status

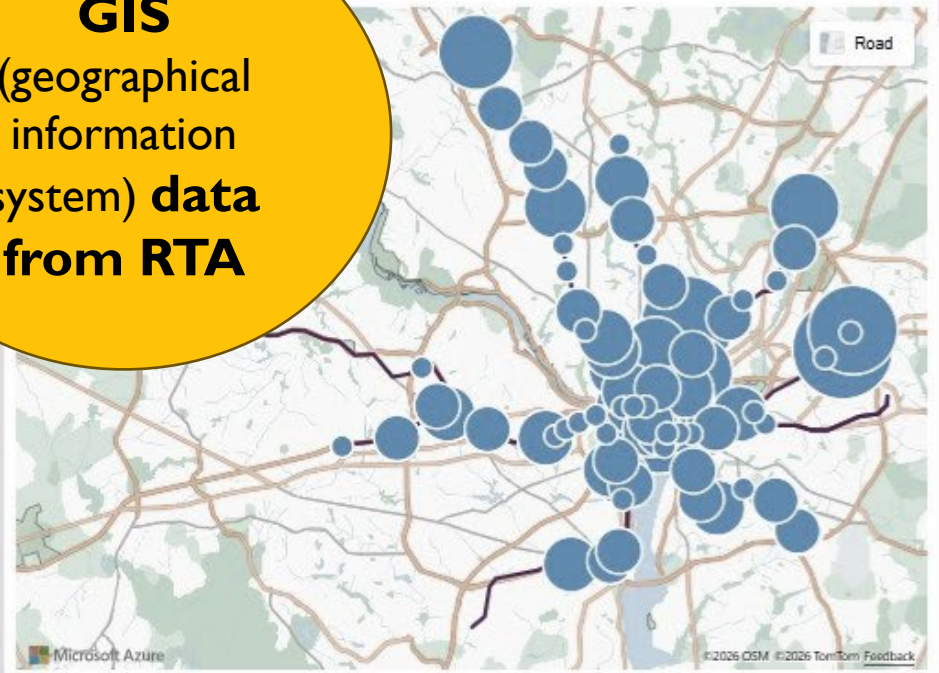
Open	Pending Future Verification	Closed
0	1	84

Avg Days b/w Inspection and Report

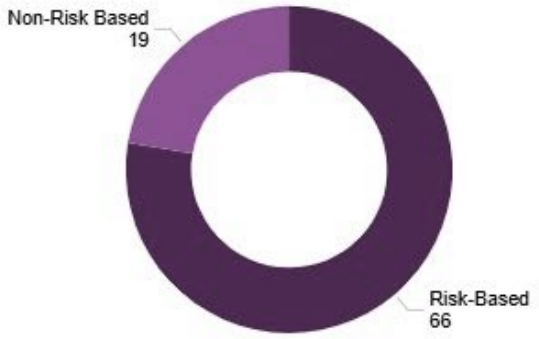
2.09

Inspections with Defects

GIS (geographical information system) **data from RTA**



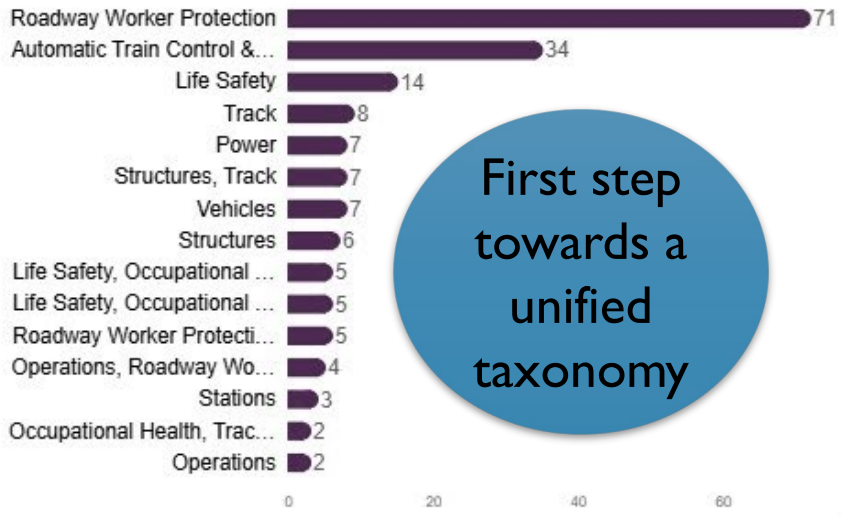
Risk-Based/Non-Risk Based Count



Inspections by Risk-Based Code

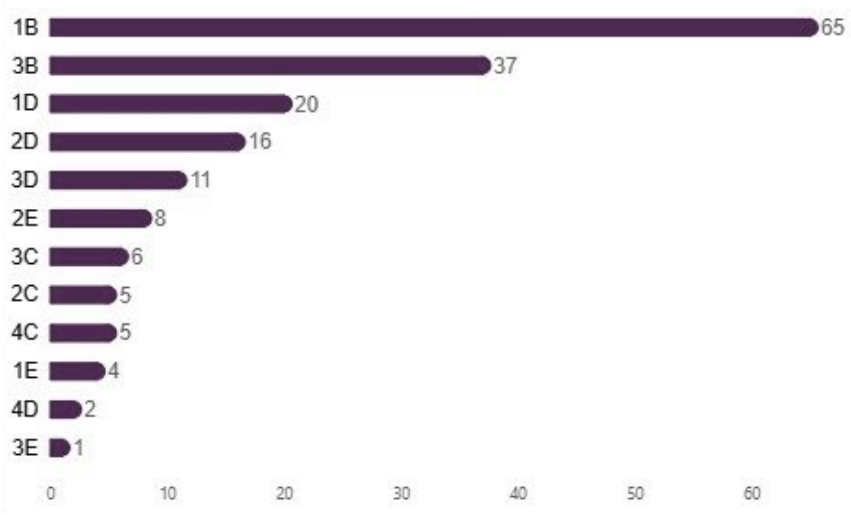
Explore your internal SSO data

Defects Mitigated by Functional Activity Code



First step towards a unified taxonomy

Defects Mitigated by Hazard Rating (Risk Assessment)



Facility Name	Inspection Count
METRO CENTER STATION	14
CARMEN TURNER FACILITY COMPLEX	12
FORT TOTTEN STATION	10
GALLERY PL-CHINATOWN STATION	10
NEW CARROLLTON YARD OPERATIONS BUILDING	9
L'ENFANT PLAZA STATION	8
UNION STATION	8
RHODE ISLAND AVE-BRENTWOOD STATION	6
SHADY GROVE YARD OPERATIONS	6
COLUMBIA HEIGHTS STATION	5
GREENBELT YARD COMMISSIONING BUILDING	5
FARRAGUT NORTH STATION	4
GEORGIA AVE-PETWORTH STATION	4
GROSVENOR-STRATHMORE STATION	4
JUDICIARY SQUARE STATION	4
NOMA-GALLAUDET U-NEW YORK AVE STATION	4
U ST/AFRICAN-AMER CIVIL WAR MEMORIAL/CARDOZO STATION	4
WOODLEY PARK-ZOO/ADAMS MORGAN STATION	4
ALEXANDRIA YARD PLANT MAINTENANCE BUILDING	3
ARCHIVES-NAVY MEM'L-PENN QUARTER STATION	3

WMSC Inspections Dashboard

Inspection Status

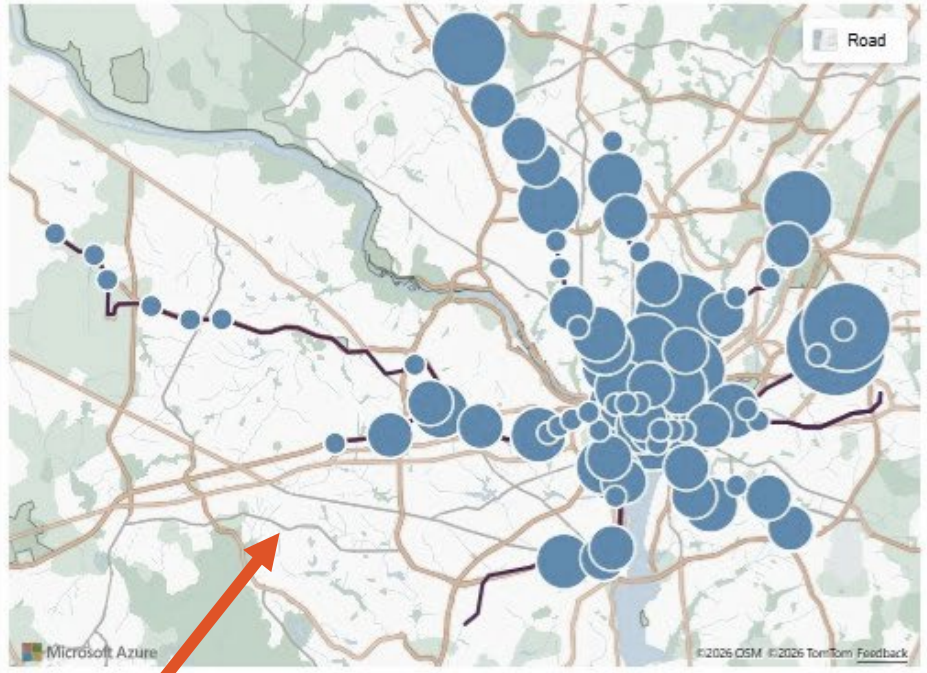
Open	Pending Future Verification	Closed
0	1	84

Avg Days b/w Inspection and Report

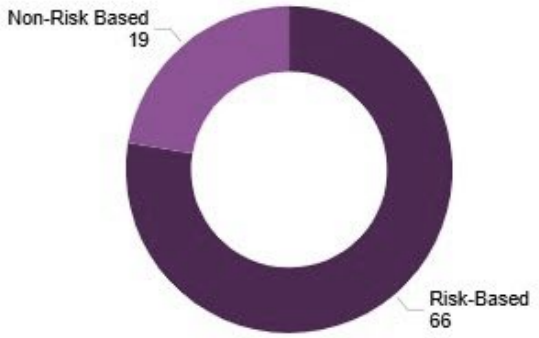
2.09

Inspections with Defects

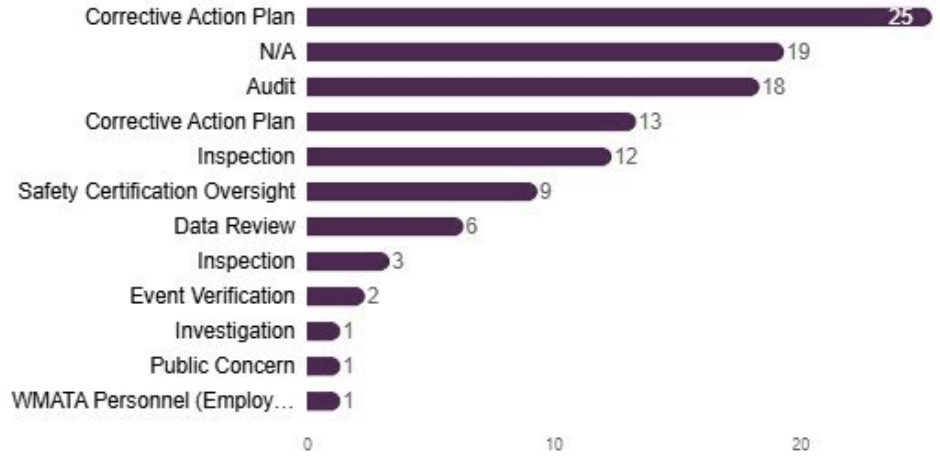
Inspections Conducted (Bubble Size)



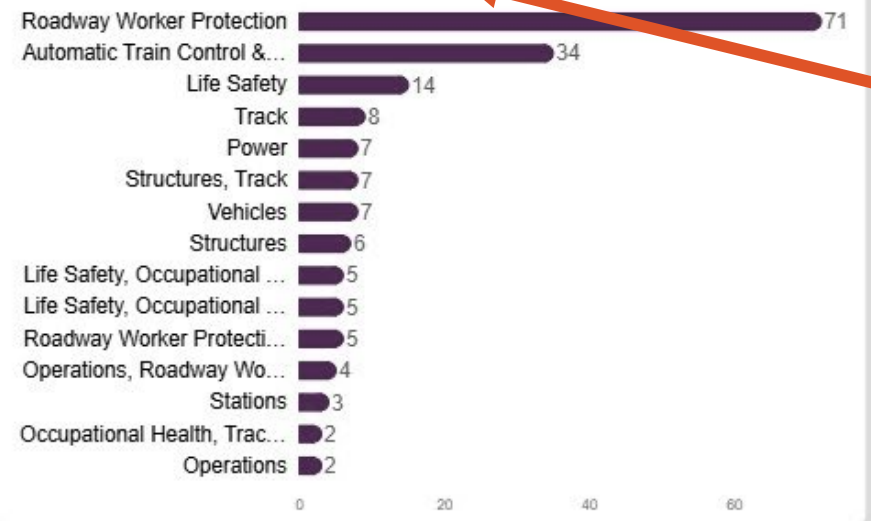
Risk-Based/Non-Risk Based Count



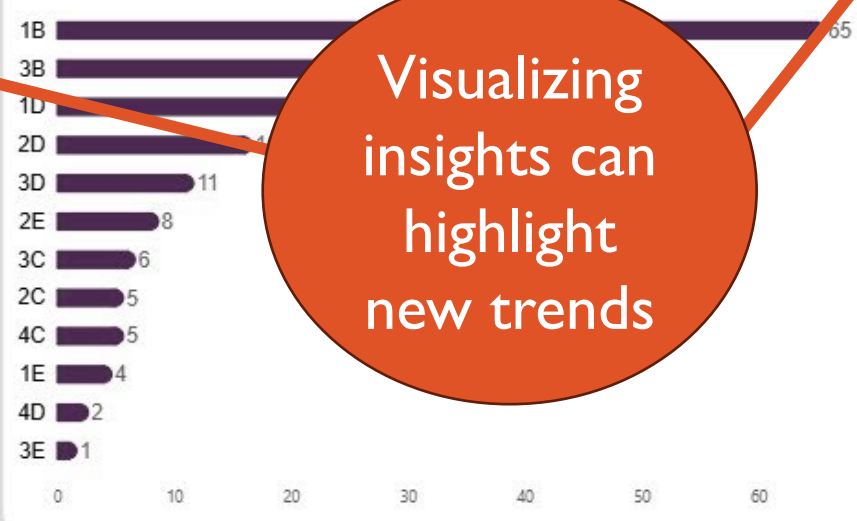
Inspections by Risk-Based Code



Defects Mitigated by Functional Activity Code



Defects Mitigated by Hazard Rating (Risk Assessment)



Visualizing insights can highlight new trends

Facility Name	Inspection Count
METRO CENTER STATION	14
CARMEN TURNER FACILITY COMPLEX	12
FORT TOTTEN STATION	10
GALLERY PL-CHINATOWN STATION	10
NEW CARROLLTON YARD OPERATIONS BUILDING	9
L'ENFANT PLAZA STATION	8
UNION STATION	8
RHODE ISLAND AVE-BRENTWOOD STATION	6
SHADY GROVE YARD OPERATIONS	6
COLUMBIA HEIGHTS STATION	5
GREENBELT YARD COMMISSIONING BUILDING	5
FARRAGUT NORTH STATION	4
GEORGIA AVE-PETWORTH STATION	4
GROSVENOR-STRATHMORE STATION	4
JUDICIARY SQUARE STATION	4
NOMA-GALLAUDET U-NEW YORK AVE STATION	4
U ST/AFRICAN-AMER CIVIL WAR MEMORIAL/CARDOZO STATION	4
WOODLEY PARK-ZOO/ADAMS MORGAN STATION	4
ALEXANDRIA YARD PLANT MAINTENANCE BUILDING	3
ARCHIVES-NAVY MEM'L-PENN QUARTER STATION	3

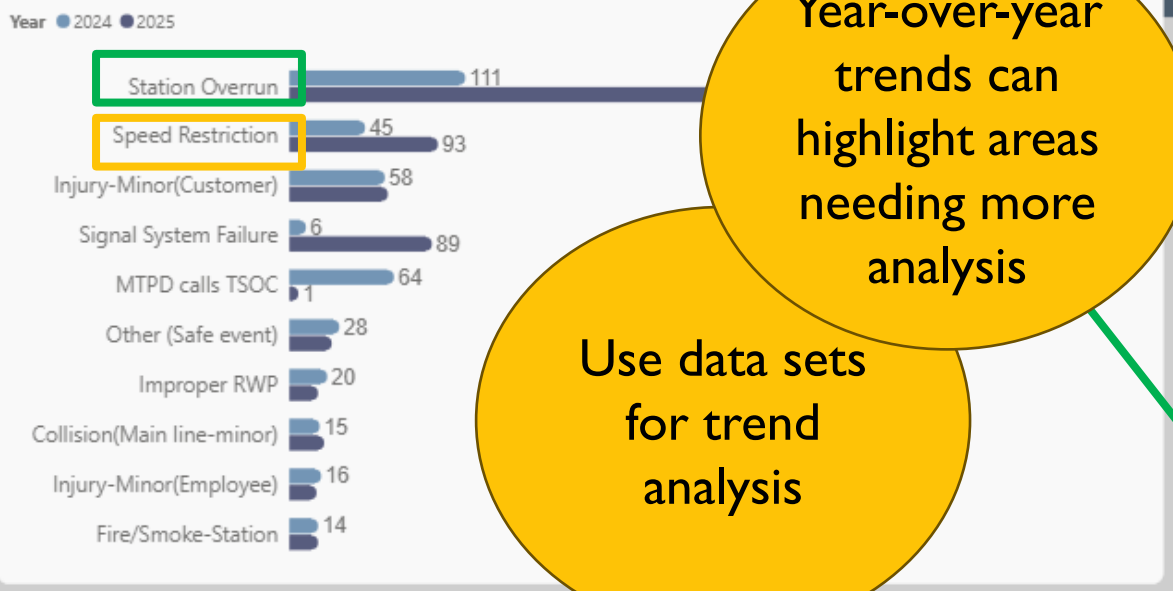
WMSC Safety Events YoY

Month: All

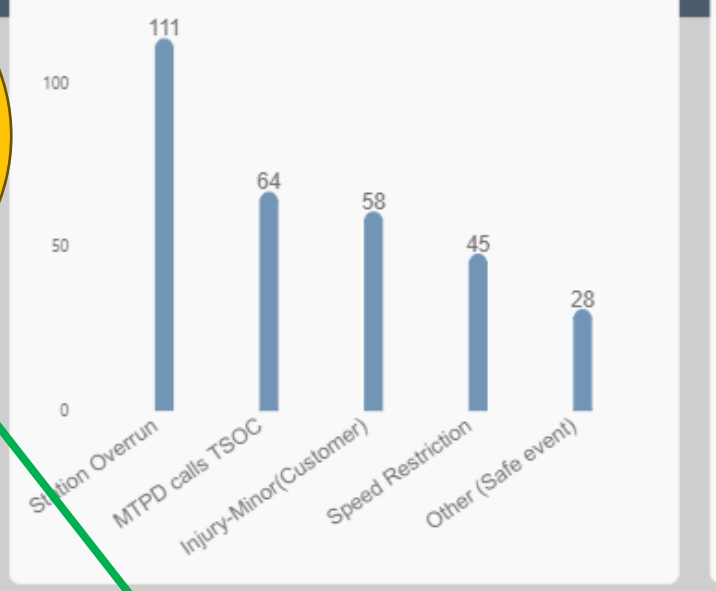
Year-over-year trends can highlight areas needing more analysis

Use data sets for trend analysis

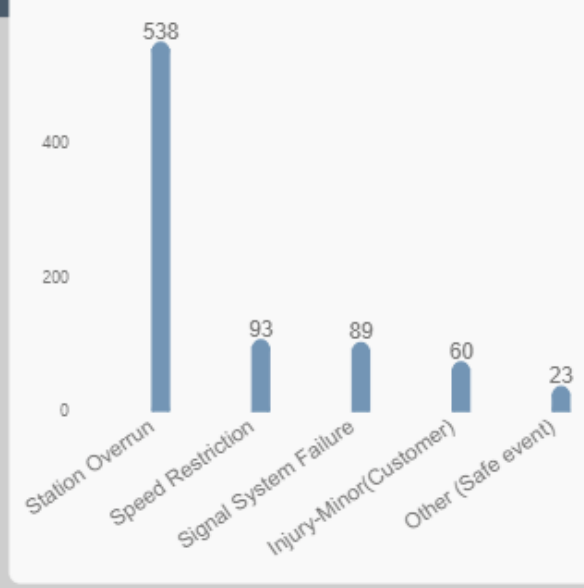
Top 10 safety events



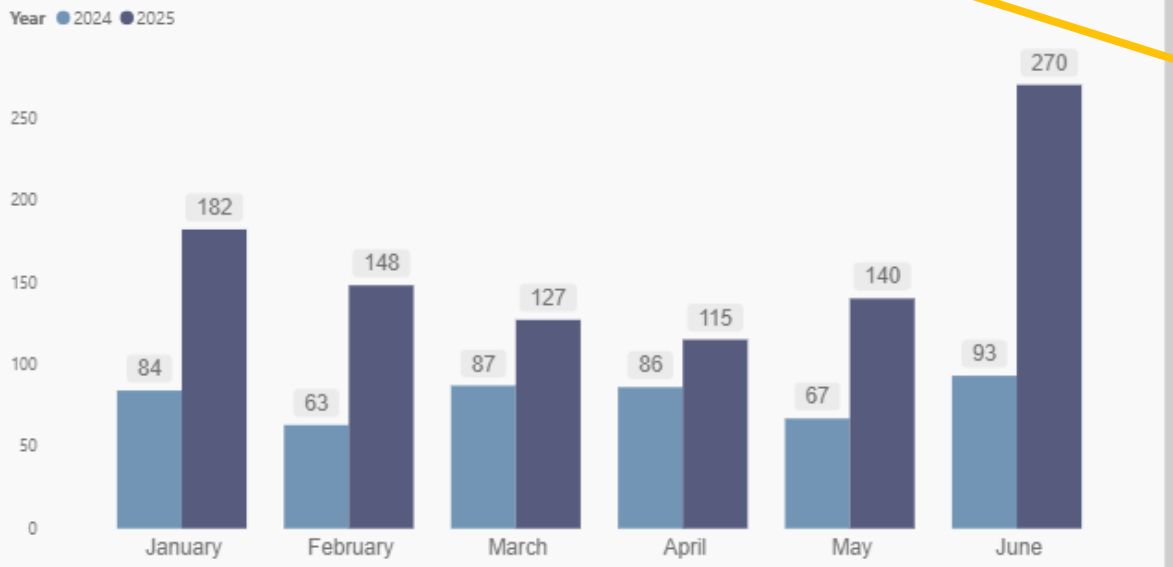
Top 5 Safety Events in 2024



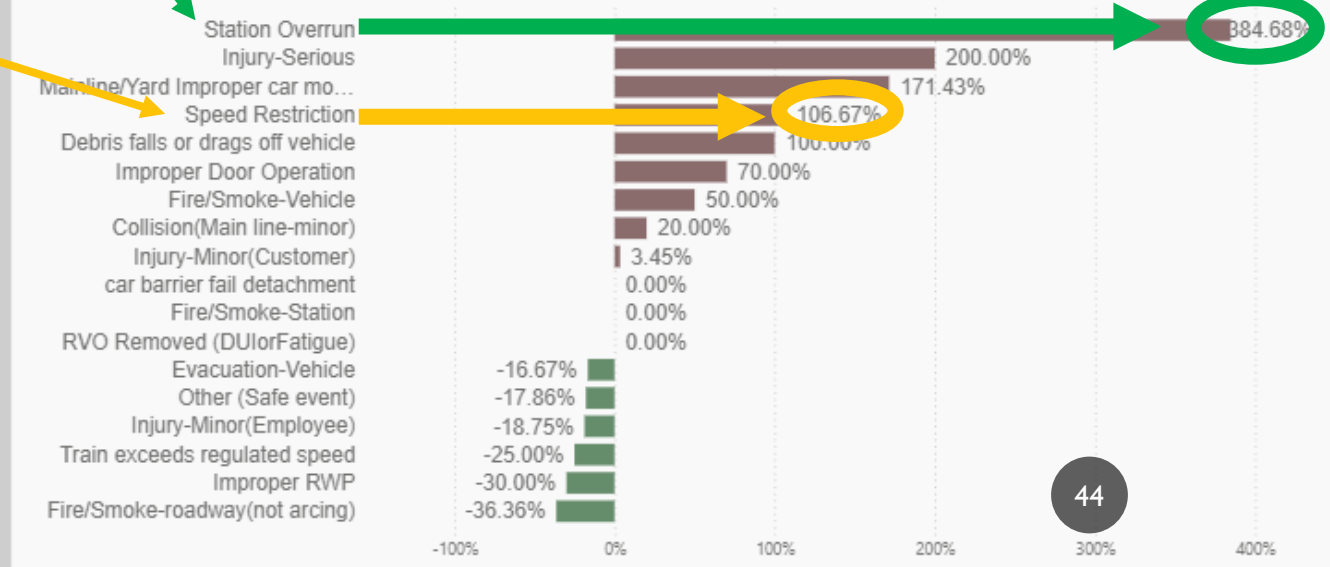
Top 5 Safety Events in 2025



Count of Event Code by Month Name and Year

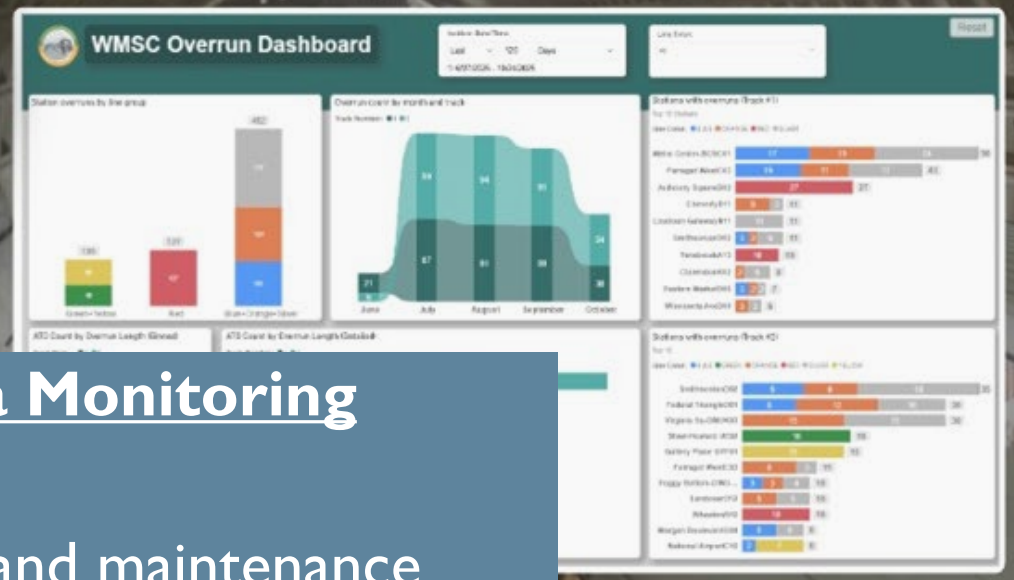


Safety events - 2025 over 2024



WMSC Dashboard Catalogue

ct dashboard:

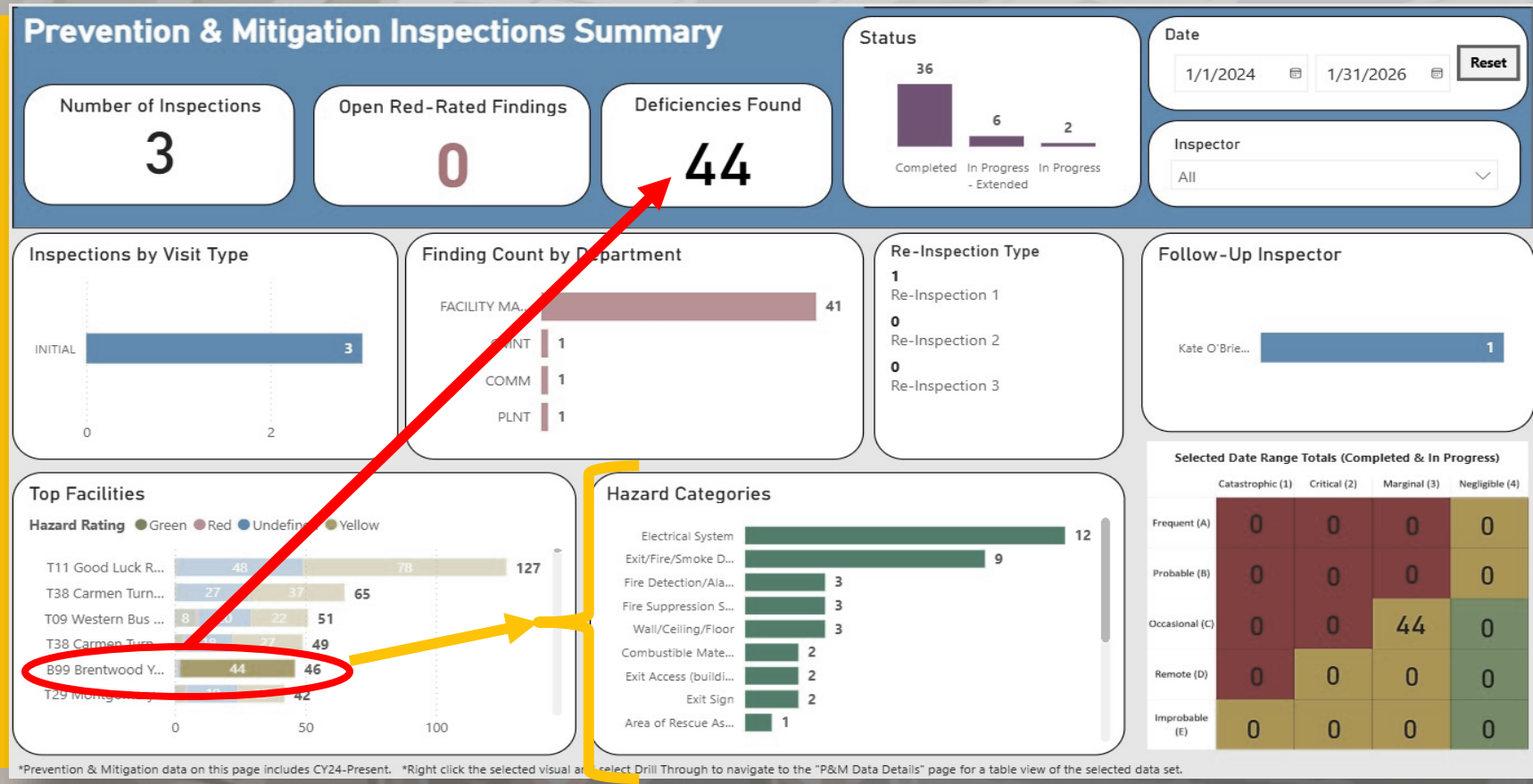


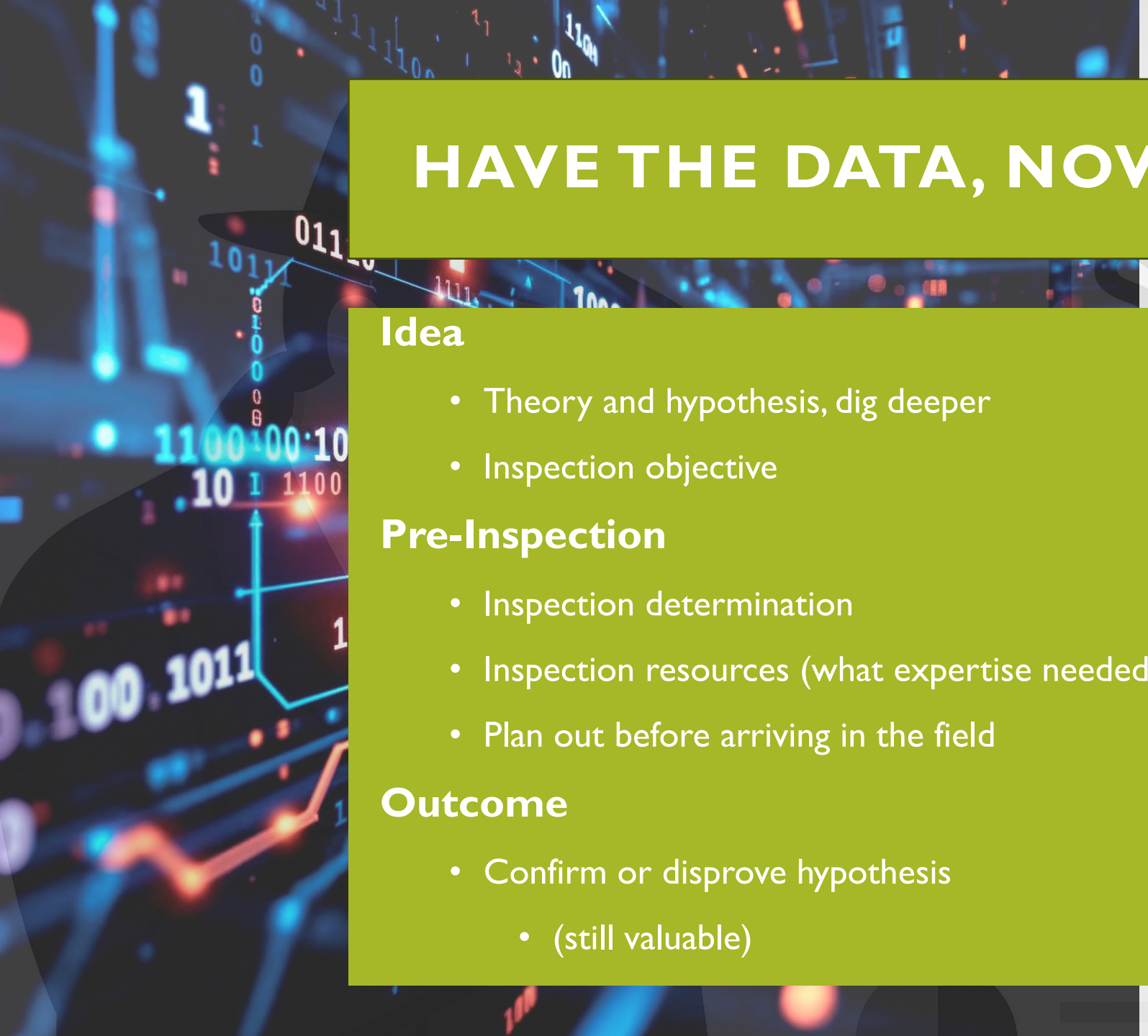
WMSC Data Monitoring

- Dashboarding and maintenance
- Review dashboards monthly, semi-annual, quarterly
- Regular meetings
  - Quarterly, Monthly, Weekly
  - Ad hoc meetings
- Pull on threads

Brentwood Yard Risk-Based Inspection Example

- RTA Inspection data showed higher-than-average number of deficiencies at Brentwood
- 44 deficiencies at Brentwood
- 15 average per rail yard (includes Brentwood)
- Deficiencies per inspection at Brentwood were 7 while average was 3 (includes Brentwood)





HAVE THE DATA, NOW WHAT?

Idea

- Theory and hypothesis, dig deeper
- Inspection objective

Pre-Inspection

- Inspection determination
- Inspection resources (what expertise needed)
- Plan out before arriving in the field

Outcome

- Confirm or disprove hypothesis
  - (still valuable)

Starting Out

- Take first steps (starting out is better than nothing)
- Develop or acquire skills
- Sources of Data
  - Data quality (need reliable + not static-no PDFs)
  - Data value (how does it further mission)
  - Start with what is available

1 of 3

Getting to Maturation

- Add new data as becomes available
- Taxonomy (define and tag data in consistent way)
- Location Data (GIS or addresses)
- Importance of maintenance data
- Cognizant of changes to data management (can cause chaos with analysis)

2 of 3

Maturation … *but not finished*

- Maintain data visualization tools going forward
- Update files on a regular schedule
- Trend analysis
- Apple-to-apples
- Outliers require further research
- Put data to use (review data on a regular, achievable schedule)

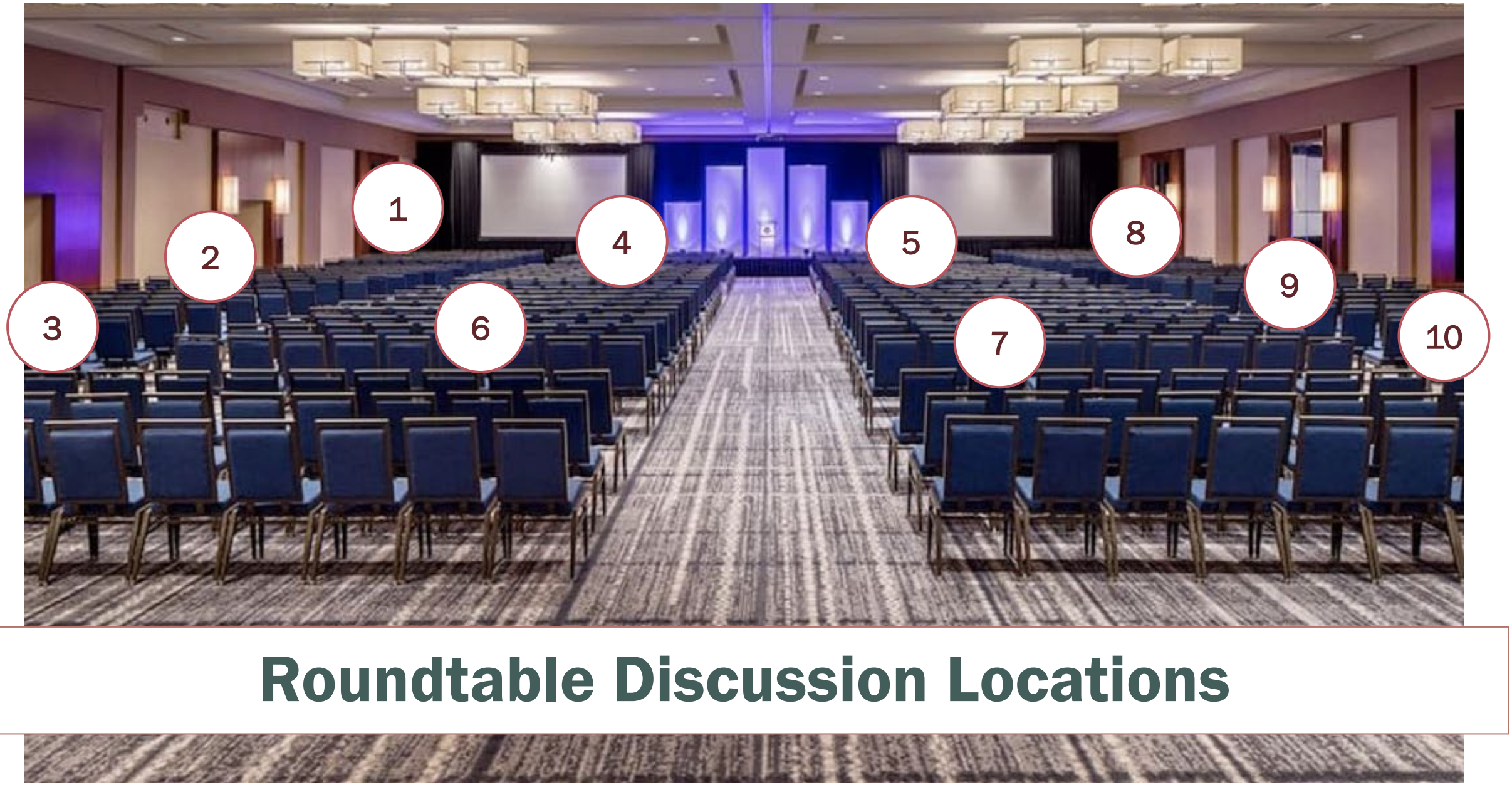
3 of 3

Contact Information

Risk-Based Inspection Program
FTA-RBI@dot.gov

Roundtable Discussion Groups

1	2	3	4	5
TDOT LADOTD GDOT WVDOT FDOT	WSDOT WisDOT ArDOT ODOT (OH) NCDOT	CoPUC (CO) VDRPT PREMB HDOT	MDOT (MI) MoDOT MnDPS PennDOT	TxDOT MDOT (MD) ODOT (OR)
6	**7**	**8**	**9**	**10**
ODOT (OK) NJDOT UDOT	WMSC ADOT (AZ) CPUC (CA)	WMSC MDPU	WMSC IDOT	WMSC NY PTSB



Roundtable Discussion Locations

Roundtable Discussion Groups

1	2	3	4	5
TDOT LADOTD GDOT WVDOT FDOT	WSDOT WisDOT ArDOT ODOT (OH) NCDOT	CoPUC (CO) VDRPT PREMB HDOT	MDOT (MI) MoDOT MnDPS PennDOT	TxDOT MDOT (MD) ODOT (OR)
6	**7**	**8**	**9**	**10**
ODOT (OK) NJDOT UDOT	WMSC ADOT (AZ) CPUC (CA)	WMSC MDPU	WMSC IDOT	WMSC NY PTSB

Session 6

Risk-Based Inspection: Implementation Roundtable

Cyrell R. McLemore, PMP®, TSSP

Senior Inspection Specialist, Office of Safety Oversight and Compliance

Federal Transit Administration

Small Group Discussion

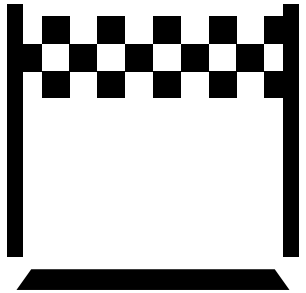
Topic 1: Data Analysis & Visualization

Topic 2: Prioritization & Implementation Takeaways

- Discussion questions are listed on the provided handouts
- All groups have the same discussion questions
- Each group will report out during the large group discussion

Large Group Discussion

Challenges



Successes

Takeaways

Contact Information

Risk-Based Inspection Program
FTA-RBI@dot.gov