



COMMONWEALTH of VIRGINIA
Office of the
SECRETARY of TRANSPORTATION

Performance-based Transportation Planning using Big Data: A Case Study from Virginia

Jitender Ramchandani, AICP, PMP

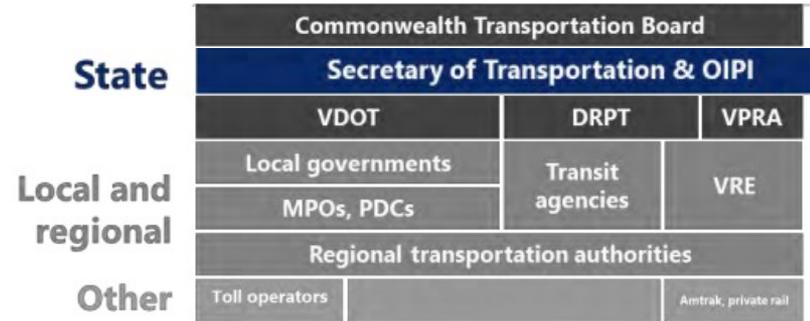
2022 AASHTO GIS-T Symposium, North Charleston, South Carolina

April 21, 2022



CONTEXT I About the office and the role

- **Virginia Office of Intermodal Planning and Investment (OIPI):**
 - An office within the Virginia Transportation Secretariat that supports and advises the Secretary in his role as the chairperson of the Commonwealth Transportation Board (CTB).
 - OIPI's Statewide Transportation Planning (STP) section develops VTrans - Virginia's Transportation Plan for the CTB.
 - VTrans identifies both transportation needs and priority locations that become eligible for over \$400 million in annual investments.



Source: Virginia Joint Legislative Audit and Review Commission (JLARC)

1. How to identify and prioritize needs ?
2. How to address the Data Conundrum?¹
3. How to communicate and solicit feedback on large datasets developed using complex methods?
4. How to deliver end products?
5. How to reimagine roles to reflect the new paradigm with different outputs and delivery mechanisms?

INCLUDED FOR CONTEXT
Developed new methods, processes, and methodologies

FOCUS OF THIS PRESENTATION
Execution of the methodologies requiring GIS, end products, and delivery mechanism

“The ability to simplify means to eliminate the unnecessary so that the necessary may speak.”

- [Hans Hofmann](#)

“If you can't explain it to a six year old, you don't understand it yourself.”

- [Albert Einstein](#)

“Almost all quality improvement comes via simplification of design, manufacturing... layout, processes, and procedures.”

- [Tom Peters](#)

CONTEXT I Guiding principles to address problem statements

- **Simplify such that solutions do not require reports and explanatory descriptions.**
 - Treat data as data - can be queried, downloaded, and re-used.
- **Reimagine OIPI-STP's role as a group that develops decision-making frameworks, not reports.**
 - View statewide planning as a process, not once in a two-year exercise.
 - Identify and address new user requirements to allow for new use-cases.
- **Ensure tighter integration between product and delivery mechanism to deliver greater value for end users.**

“Lacking a macro perspective on technology’s capability to transform the enterprise, these leaders may be missing the opportunity to collaborate on, prioritize, and integrate ad hoc technology-driven initiatives to deliver sustainable value.”

- Kark, K. (2019, July 10). *Reimagine Technology's role in the business*. The Wall Street Journal. Retrieved April 19, 2022, from <https://deloitte.wsj.com/articles/reimagine-technologys-role-in-the-business-01562720526>

CONTEXT | The Process

- **OIPI identified a wide variety of transportation needs for different travel markets based on context-specific methodologies and performance measures. Need categories include the following:**
 - Congestion
 - Travel Time Reliability
 - Intercity and Commuter Rail Travel Time Reliability
 - Transit Access
 - Non-motorized Access
 - Access to Industrial and Economic Development Areas
 - Safety
 - Capacity Preservation
 - Transportation Demand Management
- **OIPI also developed methods to identify transportation and priority locations.**
- **Developed solutions were delivered via an web application – [InteractVTrans MapExplorer](#).**



CONTEXT | Method

- The methodology relied on data from over 200 local, regional, state, and national sources.
- The execution relied on the VDOT Linear Referencing System which is based on the Virginia Geographic Information Network (VGIN) Road Centerline data.
- Over 200 million datapoints for over 800,000 directional roadway segments were analyzed.



PRODUCT AND PLATFORM | If there is a line, there is a need!



About ▾

Vision + Actions ▾

Needs + Priorities ▾

Long-Term Risk Register ▾

Intermodal VTRANS ▾

Map Explorer

Data Explorer

Search + Download **View + Download** Comment

VTrans Travel Markets >

Committed Projects and Studies >

VTrans Mid-Term Needs ▾

2021 VTrans Mid-term Needs

Default Symbology ▾

2019 VTrans Prioritized Mid-term Needs

2019 VTrans Mid-Term Needs (Nodes)

2019 VTrans Mid-Term Needs (Segments)

Political Boundaries >

Roadways and Safety ▾

Roadway Characteristics

Travel Time Index (TTI)

Planning Time Index (PTI)

Level of Travel Time Reliability (LOTRR)

Crash Data

VTrans Flooding Risk Assessment

Multimodal Facilities >

Intermodal Facilities >

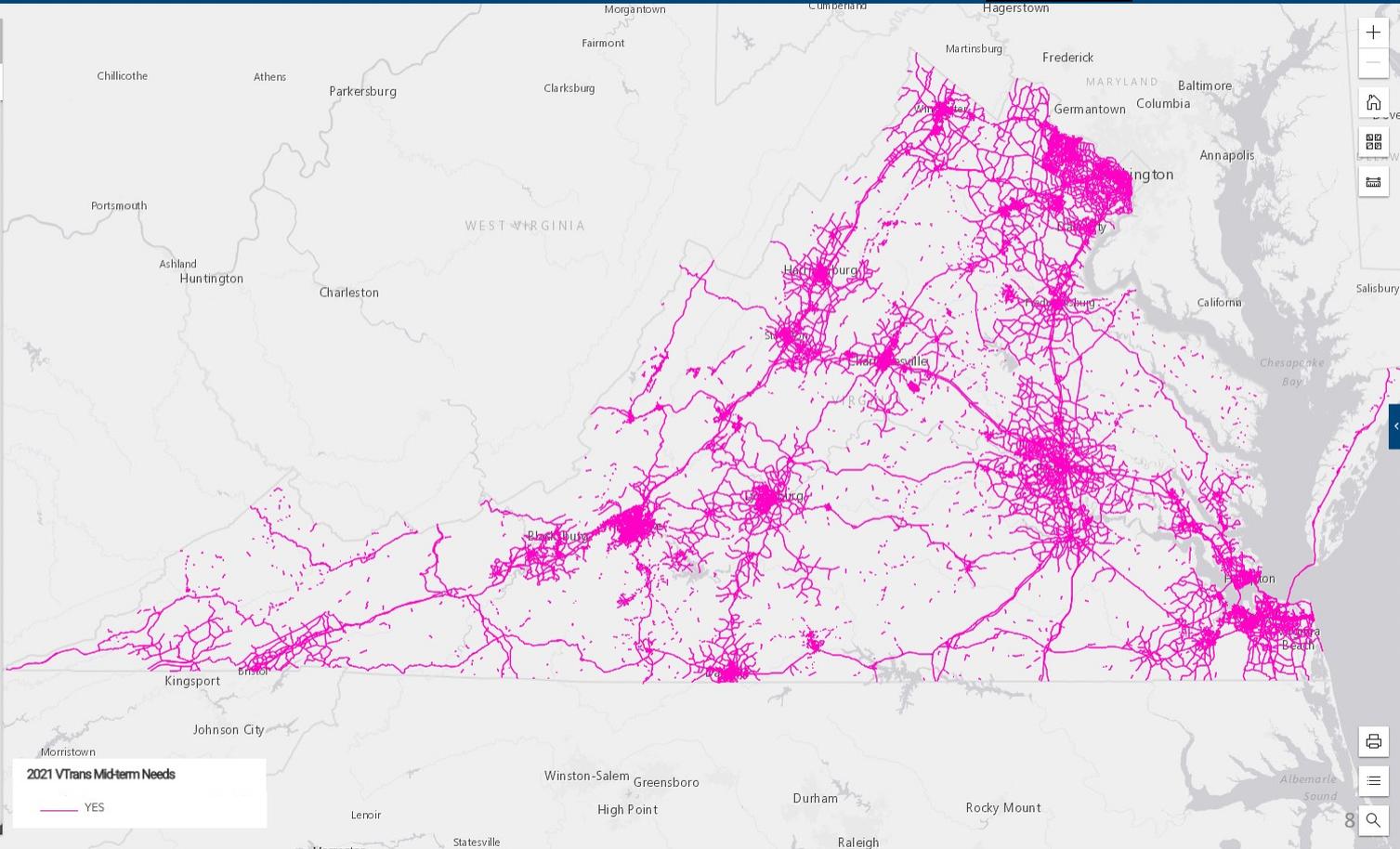
Freight ▾

Freight Performance Measures

Critical Urban and Rural Freight Corridors

Warehouses and Distribution Centers

Other >



2021 VTrans Mid-term Needs

— YES

Map navigation controls including zoom in (+), zoom out (-), home, full screen, and search icons.

PRODUCT AND PLATFORM | Minimize complexity with binary decisions



About ▾

Vision + Actions ▾

Needs + Priorities ▾

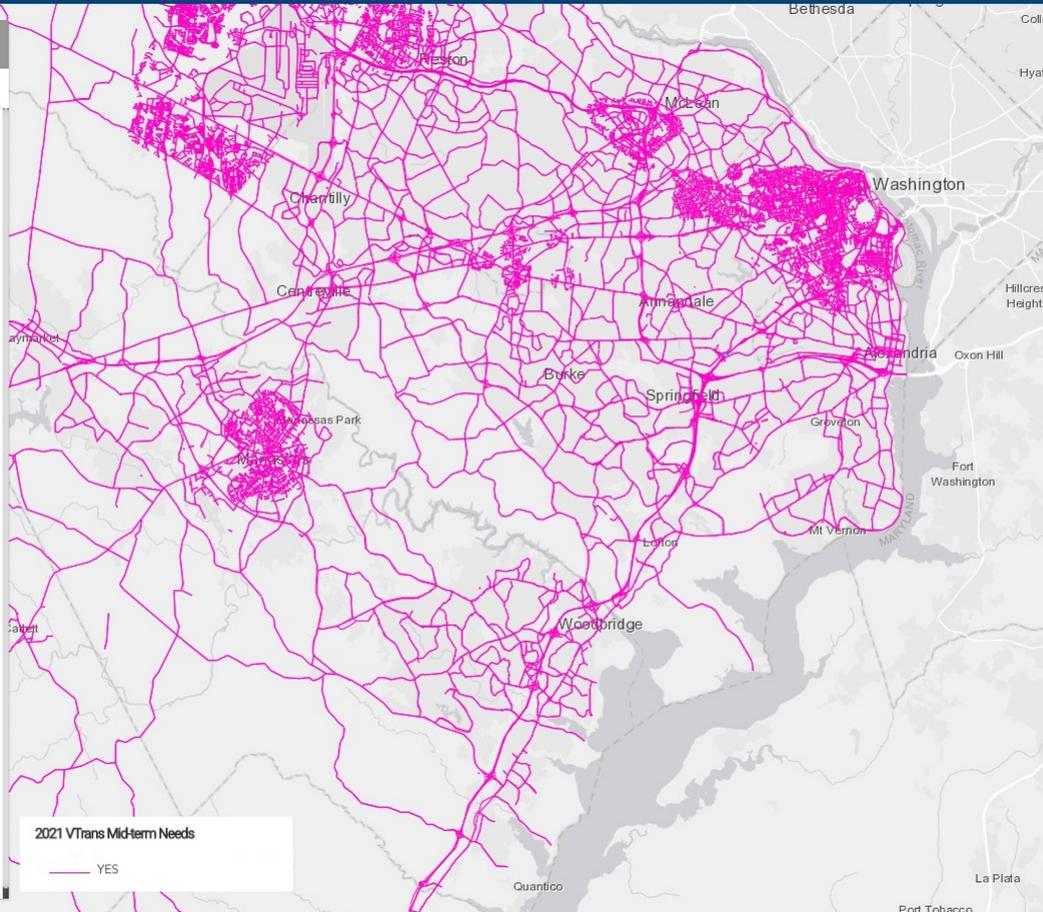
Long-Term Risk Register ▾

Interact VTRANS ▾

Map Explorer | Data Explorer

Search + Download | **View + Download** | Comment

- VTrans Travel Markets >
- Committed Projects and Studies >
- VTrans Mid-Term Needs ▾
 - 2021 VTrans Mid-term Needs 📄 ↻ 📍 🗨️
 - Default Symbology ▾
 - 2019 VTrans Prioritized Mid-term Needs 📄 ↻ 📍 🗨️
 - 2019 VTrans Mid-Term Needs (Nodes) 📄 ↻ 📍 🗨️
 - 2019 VTrans Mid-Term Needs (Segments) 📄 ↻ 📍 🗨️
- Political Boundaries >
- Roadways and Safety ▾
 - Roadway Characteristics 📄 ↻ 📍 🗨️
 - Travel Time Index (TTI) 📄 ↻ 📍 🗨️
 - Planning Time Index (PTI) 📄 ↻ 📍 🗨️
 - Level of Travel Time Reliability (LOTTR) 📄 ↻ 📍 🗨️
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 - VTrans Flooding Risk Assessment 📄 ↻ 📍 🗨️
- Multimodal Facilities >
- Intermodal Facilities >
- Freight ▾
 - Freight Performance Measures 📄 ↻ 📍 🗨️
 - Critical Urban and Rural Freight Corridors 📄 ↻ 📍 🗨️
 - Warehouses and Distribution Centers 📄 ↻ 📍 🗨️
- Other >



Zoom to 1 of 59

2021 VTrans Mid-Term Needs

Segment ID	00017074
Street Name	
Route Common Name	I-395S
Direction	Southbound
AADT	90,568
Need - Congestion Mitigation (CoSS)	YES
Need - Improved Reliability (CoSS)	NO
Need - Rail On-time Performance (CoSS)	YES
Need - Capacity Preservation (CoSS)	NO
Need - Transportation Demand Management (Limited Access CoSS)	YES
Need - Transportation Demand Management (non-limited Access CoSS)	NO
Need - Safety Improvement (CoSS Segment)	YES
Need - Safety Improvement (CoSS Intersection)	NO
Need - Congestion Mitigation (RN)	YES
Need - Improved Reliability (RN)	NO
Need - Capacity Preservation (RN)	NO
Need - Transportation Demand Management (Limited Access RN)	NO
Need - Transportation Demand Management (Non-Limited)	NO

PRODUCT AND PLATFORM | View specific types of needs within context



About ▾

Vision + Actions ▾

Needs + Priorities ▾

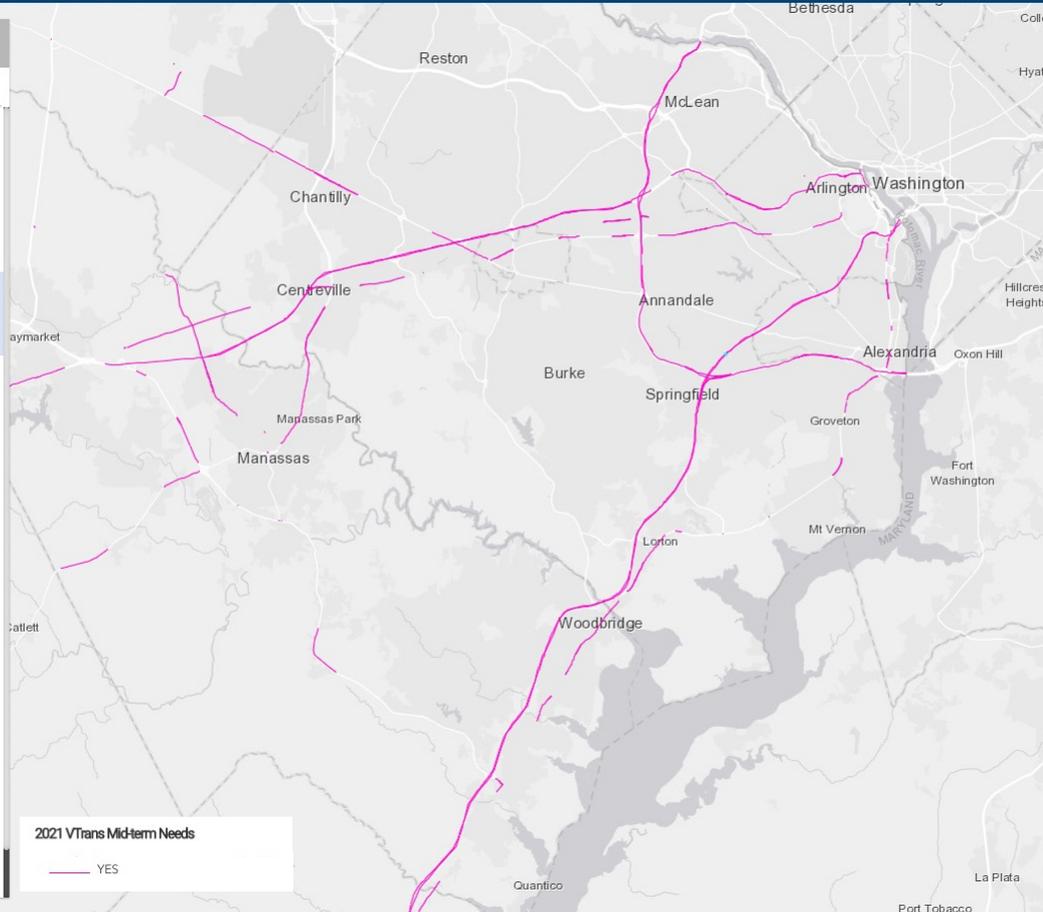
Long-Term Risk Register ▾

Intersect VTRANS ▾

Map Explorer | Data Explorer

Search + Download | View + Download | Comment

- VTrans Travel Markets >
- Committed Projects and Studies >
- VTrans Mid-Term Needs ▾
 - 2021 VTrans Mid-term Needs 📄 ↻ 📄 📄
 - Need - Congestion Mitigation (CoSS) ▾
 - Yes x ▾
 - 2019 VTrans Prioritized Mid-term Needs 📄 ↻ 📄 📄
 - 2019 VTrans Mid-Term Needs (Nodes) 📄 ↻ 📄 📄
 - 2019 VTrans Mid-Term Needs (Segments) 📄 ↻ 📄 📄
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Zoom to 1 of 59

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PRODUCT AND PLATFORM | View specific types of needs within context



About ▾

Vision + Actions ▾

Needs + Priorities ▾

Long-Term Risk Register ▾

Intersect VTRANS ▾

Map Explorer

Data Explorer

Search + Download **View + Download** Comment

VTrans Travel Markets >

Committed Projects and Studies >

VTrans Mid-Term Needs ▾

2021 VTrans Mid-term Needs

Need - Capacity Preservation (CoSS) ▾

Yes x ▾

2019 VTrans Prioritized Mid-term Needs

2019 VTrans Mid-Term Needs (Nodes)

2019 VTrans Mid-Term Needs (Segments)

Political Boundaries >

Roadways and Safety ▾

Roadway Characteristics

Travel Time Index (TTI)

Planning Time Index (PTI)

Level of Travel Time Reliability (LOTRR)

Crash Data

VTrans Flooding Risk Assessment

Multimodal Facilities >

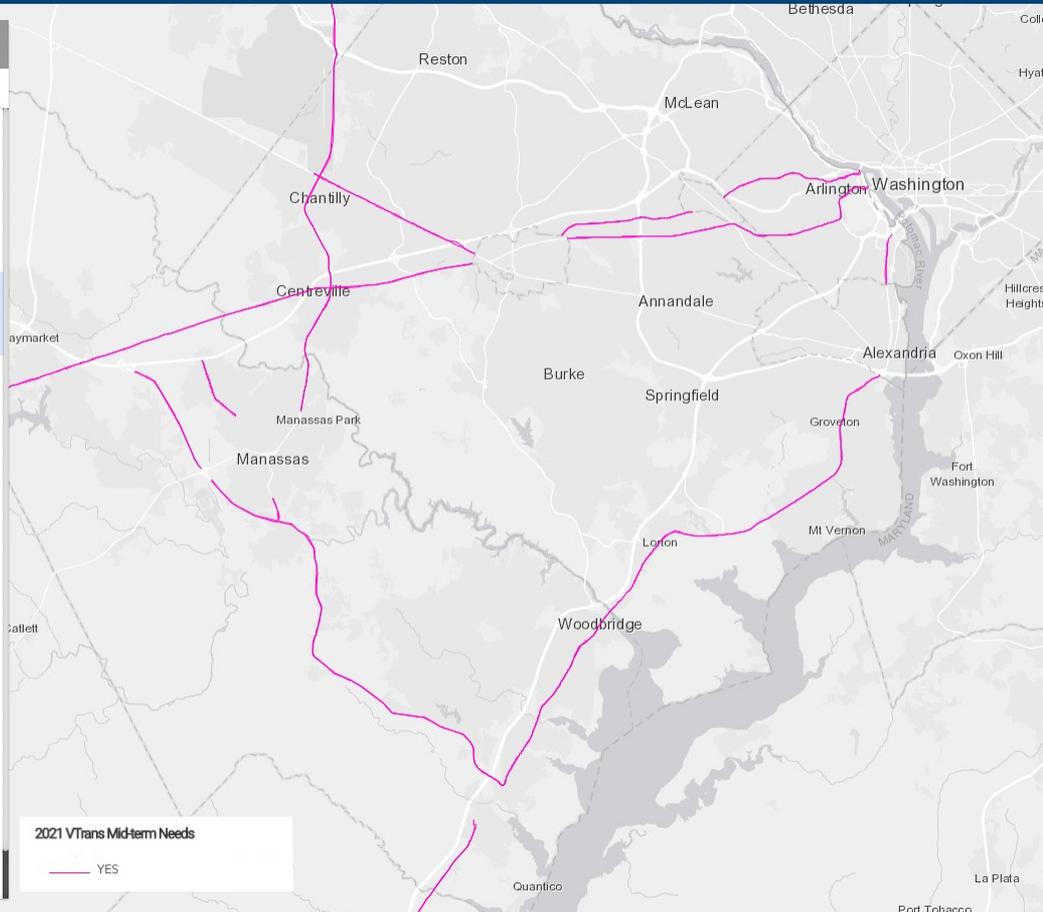
Intermodal Facilities >

Freight ▾

Freight Performance Measures

Critical Urban and Rural Freight Corridors

Warehouses and Distribution Centers



Zoom to 1 of 59

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PRODUCT AND PLATFORM | Provide functions to understand context

The screenshot displays the VTrans Map Explorer interface. The top navigation bar includes a home icon, 'About', 'Vision + Actions', 'Needs + Priorities', and 'Long-Term Risk Register'. The 'Intermodal VTRANS' logo is in the top right.

Map Explorer Panel (Left):

- Search + Download | **View + Download** | Comment
- VTrans Travel Markets
- Committed Projects and Studies
- VTrans Mid-Term Needs
 - 2021 VTrans Mid-term Needs
 - Need - Safety Improvement
 - Yes x
 - 2019 VTrans Prioritized Mid-term Needs
 - 2019 VTrans Mid-Term Needs (Nodes)
 - 2019 VTrans Mid-Term Needs (Segments)
- Political Boundaries
- Roadways and Safety
 - Roadway Characteristics
 - Travel Time Index (TTI)
 - Planning Time Index (PTI)
 - Level of Travel Time Reliability (LOTR)
 - Crash Data
 - Crash Severity: K.Fatal Injury x
- VTrans Flooding Risk Assessment
- Multimodal Facilities
- Intermodal Facilities

Map (Center): Shows a network of roads in the Washington, DC area. Red dots represent 'K. Fatal Injury' data points. A yellow polygon highlights a specific area in the Arlington/Washington region. A legend for '2021 VTrans Mid-Term Needs' shows 'Need - Safety Improvement' as a pink dashed line and 'YES' as a solid pink line.

Crash Data Legend:

- Crash Severity
- K. Fatal Injury

2021 VTrans Mid-Term Needs Legend:

- Need - Safety Improvement
- YES

Generate Statistics (BETA) Panel (Right):

- Layer: 2021 VTrans Mid-term Needs
- Field: Need - Safety Improvement
- To switch layers, click the icon next to the layer name. To switch fields, select a different field from the dropdown menu.
- SELECT AREA:** DRAW SHAPE | SELECT LOCATION
- DRAW SHAPE & SET BUFFER:** Polygon | 0 | FEET | MILES
- 4.58 square miles
- SELECT AGGREGATION:** Sum (Need - Safety Improvement)
- Directional Miles: 0 to 20
- Buttons: Reset, Run

PRODUCT AND PLATFORM | Statewide priorities that are easy to understand and visualize



About ▾

Vision + Actions ▾

Needs + Priorities ▾

Long-Term Risk Register ▾

Intermodal VTRANS ▾

Map Explorer

Data Explorer

Search + Download **View + Download** Comment

VTrans Travel Markets >

Committed Projects and Studies >

VTrans Mid-Term Needs ▾

2021 VTrans Mid-term Needs ⓘ ↻ ⬇️ 📄

2019 VTrans Prioritized Mid-term Needs ⓘ ↻ ⬇️ 📄

Statewide Priority ▾

Multiple x ▾

2019 VTrans Mid-Term Needs (Nodes) ⓘ ↻ ⬇️ 📄

2019 VTrans Mid-Term Needs (Segments) ⓘ ↻ ⬇️ 📄

Political Boundaries >

Roadways and Safety ▾

Roadway Characteristics ⓘ ↻ ⬇️ 📄

Travel Time Index (TTI) ⓘ ↻ ⬇️ 📄

Planning Time Index (PTI) ⓘ ↻ ⬇️ 📄

Level of Travel Time Reliability (LOTRR) ⓘ ↻ ⬇️ 📄

Crash Data ⓘ ↻ ⬇️ 📄

VTrans Flooding Risk Assessment ⓘ ↻ ⬇️ 📄

Multimodal Facilities >

Intermodal Facilities >

Freight ▾

Freight Performance Measures ⓘ ↻ ⬇️ 📄

Critical Urban and Rural Freight Corridors ⓘ ↻ ⬇️ 📄

Warehouses and Distribution Centers ⓘ ↻ ⬇️ 📄

2019 VTrans Prioritized Mid-term Needs

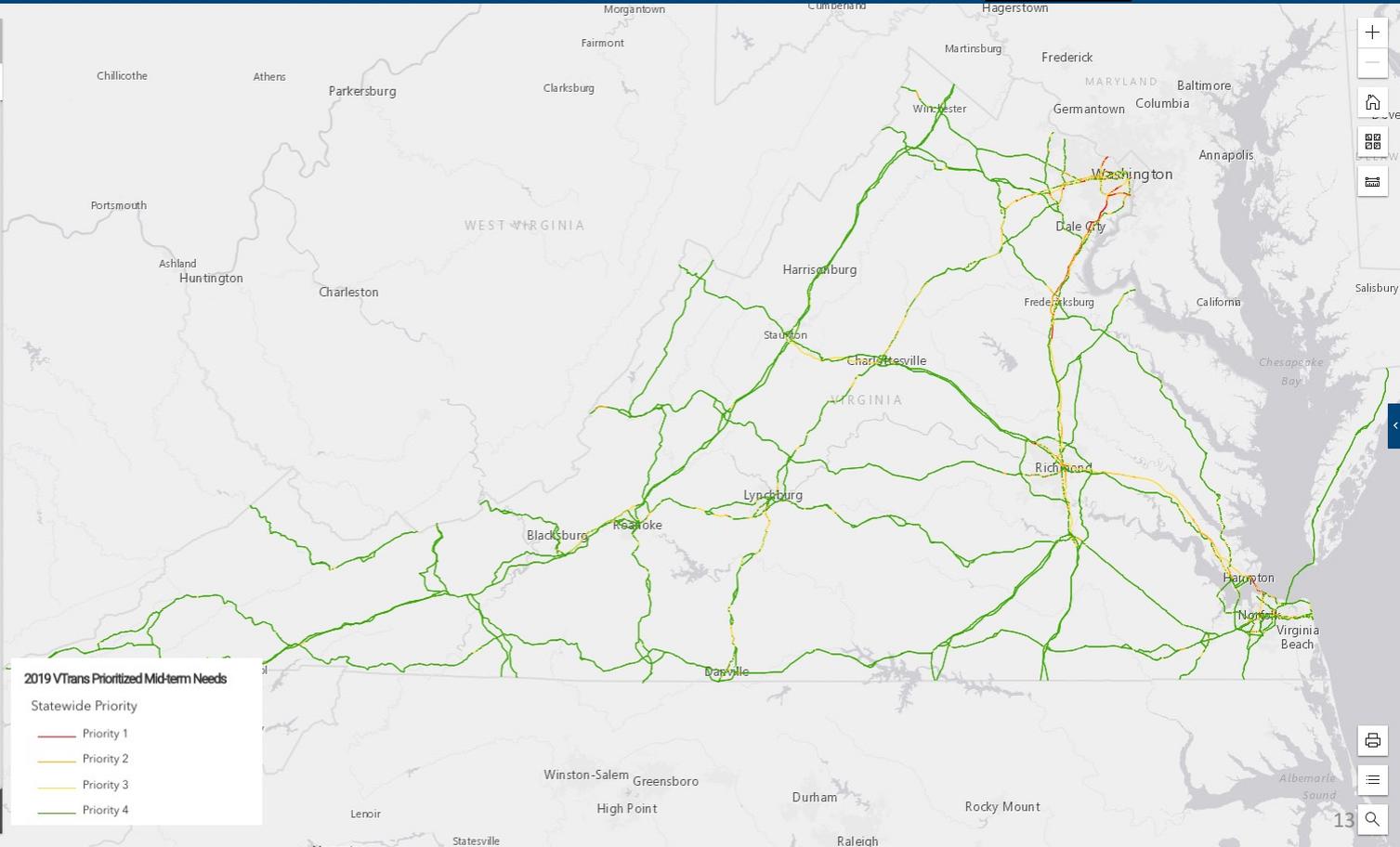
Statewide Priority

— Priority 1

— Priority 2

— Priority 3

— Priority 4



Map navigation controls including zoom in (+), zoom out (-), home, full screen, and search icons.

PRODUCT AND PLATFORM | Construction District priorities that are easy to understand and visualize



About ▾

Vision + Actions ▾

Needs + Priorities ▾

Long-Term Risk Register ▾

Intermodal VTRANS ▾

Map Explorer

Data Explorer

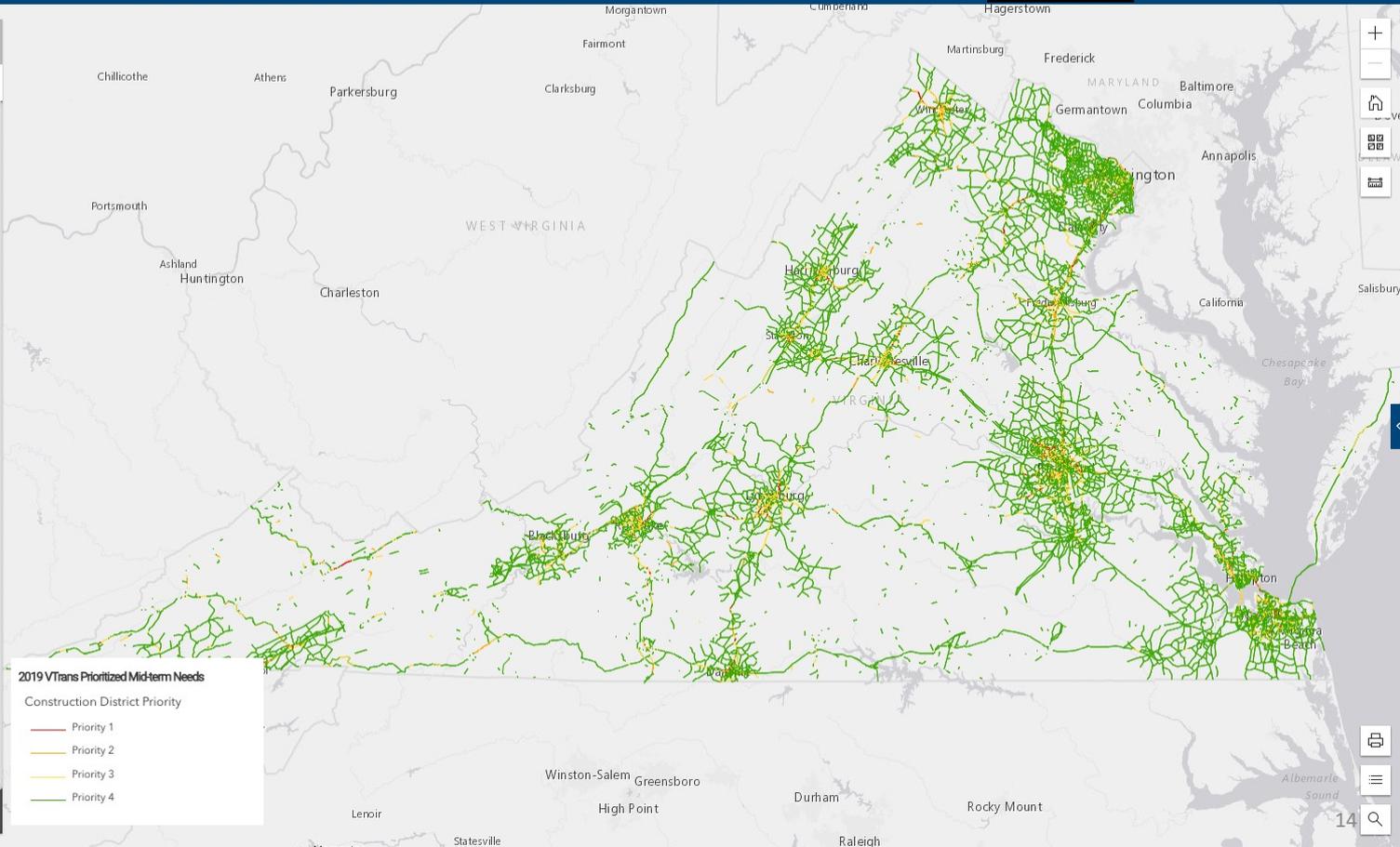
Search + Download View + Download Comment

- VTrans Travel Markets >
- Committed Projects and Studies >
- VTrans Mid-Term Needs ▾
 - 2021 VTrans Mid-term Needs
 - 2019 VTrans Prioritized Mid-term Needs
 - Construction District Priority ▾
 - Multiple x ▾
- 2019 VTrans Mid-Term Needs (Nodes)
- 2019 VTrans Mid-Term Needs (Segments)
- Political Boundaries >
- Roadways and Safety ▾
 - Roadway Characteristics
 - Travel Time Index (TTI)
 - Planning Time Index (PTI)
 - Level of Travel Time Reliability (LOTR)
 - Crash Data
 - VTrans Flooding Risk Assessment
- Multimodal Facilities >
- Intermodal Facilities >
- Freight ▾
 - Freight Performance Measures
 - Critical Urban and Rural Freight Corridors
 - Warehouses and Distribution Centers

2019 VTrans Prioritized Mid-term Needs

Construction District Priority

- Priority 1
- Priority 2
- Priority 3
- Priority 4



PRODUCT AND PLATFORM | Richness of dataset allows for program-specific usage

Intermodal VTRANS

[About](#) | [Vision + Actions](#) | [Needs + Priorities](#) | [Long-Term Risk Register](#)

Map Explorer
Data Explorer

Search + Download View + Download Comment

- VTrans Travel Markets >
- Committed Projects and Studies >
- VTrans Mid-Term Needs >
 - 2021 VTrans Mid-term Needs 🔍 ↻ 📄 📄
 - 2019 VTrans Prioritized Mid-term Needs 🔍 ↻ 📄 📄
- Need Priority - Capacity Preservation (CoSS) |
v
- Multiple x
v
- 2019 VTrans Mid-Term Needs (Nodes) 🔍 ↻ 📄 📄
- 2019 VTrans Mid-Term Needs (Segments) 🔍 ↻ 📄 📄
- Political Boundaries >
- Roadways and Safety >
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 - VTrans Flooding Risk Assessment 🔍 ↻ 📄 📄
- Multimodal Facilities >
- Intermodal Facilities >
- Freight >
 - Freight Performance Measures 🔍 ↻ 📄 📄
 - Critical Urban and Rural Freight Corridors 🔍 ↻ 📄 📄

2019 VTrans Prioritized Mid-term Needs

- Very High
- High
- Medium
- Low

Zoom to 2 of 11

2019 Prioritized Midterm Needs gdb - Mid Term Needs

Priorities: Washington to North Carolina Corridor

Need Segment ID	107034
Master Needs Segment ID	00000107034
Street Name	
Route Common Name	I-395S
Direction	Southbound
VDOT Construction District	Northern Virginia
Area Type	A
CoSS Name	Washington to North Carolina Corridor
Regional Network Name	Northern Virginia Region
Metropolitan Planning Organization	YES
Statewide Priority	Priority 1
Construction District Priority	Priority 1
Need Priority - Congestion Mitigation (CoSS)	Very High
Need Priority - Reliability (CoSS)	No Need
Need Priority - Rail On-time Performance (COSS)	Very High
Need Priority - Capacity Preservation (CoSS)	No Need
Need Priority - Transportation Demand Management (CoSS)	Low
Need Priority - Congestion Mitigation (RN)	High
Need Priority - Reliability (RN)	No Need
Need Priority - Capacity Preservation (RN)	No Need

15

PRODUCT AND PLATFORM I Perform queries to access + download more relevant information

Map Explorer | Data Explorer

Search + Download | View + Download | Comment

SEARCH AND DOWNLOAD
Search for particular attributes in a chosen location type (ex. County, MPO, PDC, etc) and download results.

+ Start Query

or

RETRIEVE AND DOWNLOAD
If you ran and saved a query in the past, enter your Query ID number in the form below and click 'Run' to re-run your saved query and download results.

Enter Query ID

Map Explorer | Data Explorer

Search + Download | View + Download | Comment

Select Location | Select Layers | Select Features

I want to query within...

A Specified Area (Optional)

The Whole State

Map Explorer | Data Explorer

Search + Download | View + Download | Comment

Select Location | Select Layers | Select Features

Select Location Type

Metropolitan Planning Organizations

There are 15 Metropolitan Planning Organizations locations to select from

- Bristol Metropolitan Planning Organization
- Central Virginia Metropolitan Planning Organization
- Charlottesville-Albemarle Metropolitan Planning Organization
- Danville Metropolitan Planning Organization
- Fredericksburg Area Metropolitan Planning Organization**
- Hampton Roads Transportation Planning Organization
- Harrisonburg-Rockingham Metropolitan Planning Organization
- Kingsport Transportation Planning Organization
- New River Valley Metropolitan Planning Organization
- Northern Virginia Portion of The Metropolitan Washington Council of Governments
- Richmond Transportation Planning Organization
- Roanoke Valley Transportation Planning Organization
- Staunton-Augusta-Waynesboro Metropolitan Planning Organization
- Tri-Cities Area Metropolitan Planning Organization
- Winchester-Frederick Metropolitan Planning Organization

Map Explorer | Data Explorer

Search + Download | View + Download | Comment

Select Location | Select Layers | Select Features

What layers do you want to include in your query (check up to **three** checkboxes below)

- VTrans Travel Markets
- Committed Projects and Studies
- VTrans Mid-Term Needs**
 - 2021 VTrans Mid-term Needs
 - 2019 VTrans Prioritized Mid-term Needs**
 - 2019 VTrans Mid-Term Needs (Nodes)
 - 2019 VTrans Mid-Term Needs (Segments)
- Political Boundaries
- Roadways and Safety
- Multimodal Facilities
- Intermodal Facilities
- Freight
- Other

Map Explorer | Data Explorer

Search + Download | View + Download | Comment

Select Location | Select Layers | Select Features

Search Criteria

Layer 2019 VTrans Prioritized M...

Criteria 1

Construction District Priority

Values

Priority 1 x Priority 2 x

AND OR

Criteria 2

Need Priority - Congestion Mitigatio...

Values

Very High x

Q Run

PRODUCT AND PLATFORM | Allow communication



About ▾

Vision + Actions ▾

Needs + Priorities ▾

Long-Term Risk Register ▾



< **Map Explorer** Data Explorer

Search + Download View + Download **Comment**

MAP WITH COMMENTS

Please leave a location-specific comment to help us improve VTrans.

12/07/2021 -
This corridor is always backed up



02/12/2021 -
Blue Ridge Parkway is not under the jurisdiction of VDOT, localities, or regional agencies; as such, needs for the Blue Ridge Parkway should not be shown.



02/12/2021 -
Blue Ridge Parkway is not under the jurisdiction of VDOT, localities, or regional agencies; as such, needs for the Blue Ridge Parkway should not be shown.



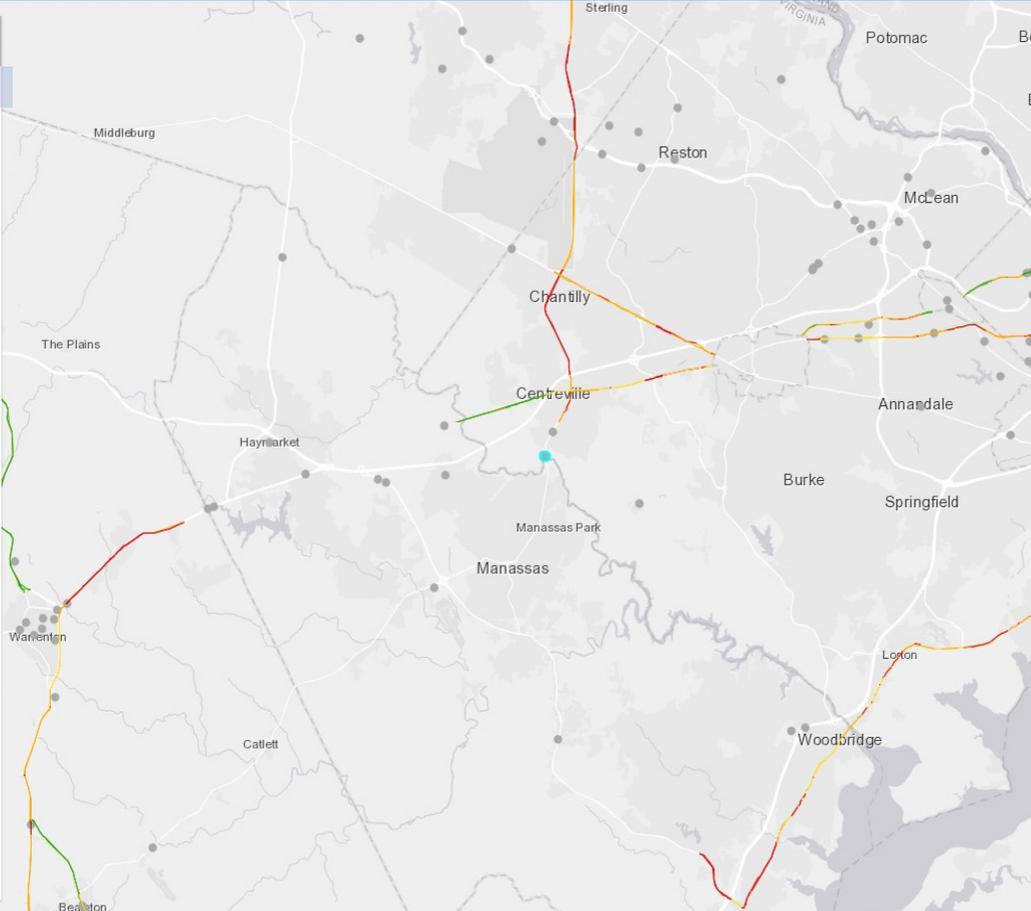
02/12/2021 -
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02/12/2021 -
Blue Ridge Parkway is not under the jurisdiction of VDOT, localities, or regional agencies; as such, needs for the Blue Ridge Parkway should not be shown.



1 2 3 4 5 ... 111



Zoom to LIKE (0) Zoom to

Comment

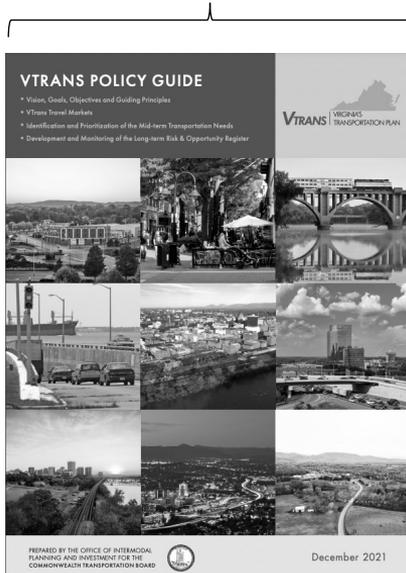
Date	9/5/2019
Category	Highway
Self Identification	
Comment	Network connectivity is a big issue around Routes 15 and 28 since they are the two ways in and out of Loudoun County and there are limited choices for commuters: CO
Response Date	
Response	

CONTEXT | Document methods to allow for review and replicability

POLICY GUIDE

For Policy Makers

Adopted by the Commonwealth Transportation Board

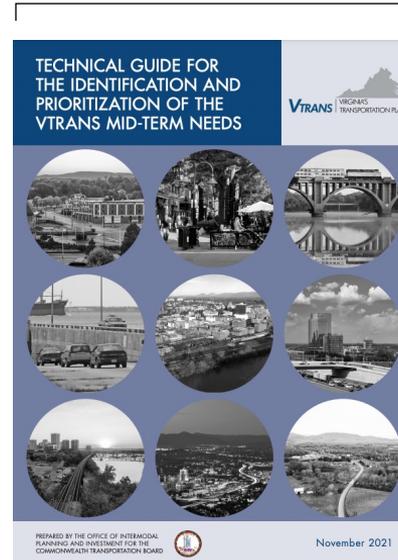


Includes policy-level details for all five policies

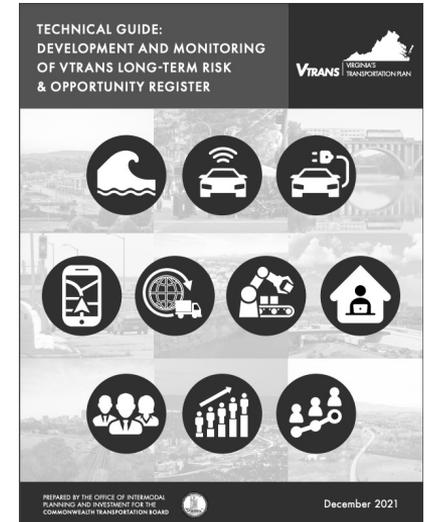
TECHNICAL GUIDES

For practitioners

Not adopted by the Commonwealth Transportation Board



Technical details for three policies



Technical details for one policy

FIVE TAKEAWAYS

- Key takeaways from our experience:

1. An ability to reimagine utilization of available data and tools by developing new methods and processes is a greater and more pressing need.
2. There is an abundance of “shiny objects”¹ - solutions that develop organically to address a genuine problem will be more helpful than those in search of a problem or start with “shiny objects”.
3. An ability to conceptualize and ensure tighter integration (a.k.a. vertical integration) between product/business strategy and the product delivery mechanism is essential.
4. Focus and clarity around the end user and end use is critical to achieve business objective(s).
5. A multi-disciplinary program team that develops a common vocabulary and deeper understanding of each member’s strengths, instead of a siloed approach centered around separate teams of “GIS professionals”, “planners”, “IT staff”, “programmers”, “data scientists”, etc., has a higher likelihood of generating process/product innovation.

CONTACT

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 - jitender.ramchandani@oipi.virginia.gov

Visit www.vtrans.org/interactvtrans/map-explorer for more details.

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