Integrating Freight Investment Into State Transportation Improvement Programs (STIP)

A Playbook for Practitioners

Prepared for:
Institute for Trade and Transportation Studies (ITTS)
Prepared by:
Metro Analytics

Authors:
Chandler Duncan
Prasanna Humagain
Tony Furst
Vincent Matheney

With

Metro Analtyics

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What the Playbook is About

This playbook is about how State Departments of Transportation (DOT) address freight investments in their Statewide Transportation Improvement Programs (STIP). Beyond the programming of National Highway Freight Funds, a state's STIP process can provide opportunities for states to prioritize freight projects in ways consistent with statewide freight performance indicators and integrate other state and discretionary grant opportunities into a states' overall funding and prioritization process. With the growing complexity of freight needs and funding sources, and the intrinsic integration of freight performance with other areas of performance (especially for highways), DOT's could benefit from consistent approaches to addressing freight projects in their STIP. This playbook is offered to guide staff in the ITTS member-state DOTs to potential issues, approaches and tools that are successful in states (both within and beyond the ITTS community) for integrating freight into the STIP process.

This playbook focuses on the freight component of Statewide Transportation Improvement Programs (STIPs) While the primary focus is on freight, references to 'STIP' throughout this document refer to the entire STIP process and framework, rather than specific freight related planning/programming such as Freight Improvement Plan (FIP), unless otherwise noted. This distinction is made to provide a clear understanding of where freight priorities fit within the comprehensive scope of each state's transportation improvement planning process.

Topics the Playbook Addresses

Outreach within the ITTS states and other states enable this playbook to address the most common challenges and opportunities for integration of freight into the STIP that were identified by ITTS member states. The observations and approaches are based on in-depth interviews with DOT staff from each of the ITTS member states and case studies from selected states outside of the ITTS. Key topics include practical challenges like (1) assessing the role that freight projects should play in a state's STIP process, (2) addressing the degree to which a state can benefit from considering non-highway freight assets and investments in the STIP process, (3) ways to evaluate investments in a STIP within the context of overall freight performance objectives, (4) opportunities to consider freight performance indicators in relation to STIP investments and (5) ways to utilize the STIP to have projects prepared and prioritized for discretionary grant or other funding opportunities if those funds should become available.

How to Use the Plays

The "Plays" in the playbook are offered as topical primers on key considerations for a state DOT when exploring each of these issues. The six plays are listed below and accessible through the below links to specific elements in the Playbook.

PLAY 1 | Take Stock of the STIP Process

Play 1: Take Stock of the STIP Process

To effectively integrate freight considerations into the Statewide Transportation Improvement Program (STIP), it is crucial to understand how the Department of Transportation (DOT) utilizes the STIP process. This includes identifying the state's programming objectives, the broader goals of the STIP, such as satisfying federal requirements or using it as an investment plan, as these factors will influence how freight issues are addressed and prioritized. A key step is assessing the STIP process by evaluating each states' expectations regarding freight performance, and the alignment of the STIP with the state's freight objectives. Play #1 relates strategies for conducting this assessment, guiding the state DOT through the evaluation of its own unique STIP process to appropriately integrate freight considerations.

Consider the role of STIP in statewide investment management

To get the greatest value from the STIP process, a state DOT can benefit from clearly defining its expectations of the STIP within the context of the state's overall investment strategy. It often occurs that states begin by simply meeting federal requirements, and thereby have a STIP that is less connected to freight performance objectives that they might like. Clearly establishing the role of the STIP at leadership levels is a starting point for re-assessing the role of the STIP in freight investments.

Mapping the Investment Footprint

Integrating Freight in the STIP begins with understanding what the state intends to accomplish with its outlays, and the role of specific programs in that strategy. Statewide plans can often serve as a starting point.

When considering the strategic role freight investments in the STIP play in a state's investment strategy, it is helpful to first map out a holistic view of all the states' transportation outlays at a very high level. One observation from the interviews and case studies across states undertaking in this playbook research is that state DOT's often have different groups or staff members responsible for meeting specific requirements of specific programs – but there is often not a clear operating picture of how those programs (and associated investments) are intended to work together to achieve the DOT's overall performance objectives. Until this investment "footprint' is well defined – in a readily comprehensible way, it is difficult to engage in critical examination of the role of the STIP in freight decisions.

Purpose Vs Process: One of the principal challenges in arriving at such an "investment map" is the fact that different offices or functional units in a DOT are often tied to specific programs. DOTs are often oriented towards considering "how" funds are programmed than "why". DOT managers are better able to indicate which ***modal office or business unit*** is responsible for different funds than the ***intended purposes*** the programs serve, and how funds across programs are leveraged to achieve outcomes. For this reason, it can be helpful simply to look at overall DOT outlays independently of the internal organizational responsibility – and focus on the types of outlays are made, and which are (1) included in, (2) influenced by. or (3) fully independent of the STIP. The use of Venn Diagrams or

summary matrices can be helpful in this process. If it does not already exist, a high-level investment map is essential for understanding and considering expectations of the STIP regarding freight.

Building on Statewide Plans: A definition of freight programs and performance areas are often defined in a statewide multimodal transportation plan, and when they are they can serve as a starting point for associating performance criteria with specific programs. **Figure 1** to the right, from the current *Arkansas Intermodal Long-Range Transportation Plan,* is representative of a matrix that organizes programs into different performance areas.

If there is not this type of association between programs and performance objectives in a DOT's statewide plan, making these associations can be a first step to taking stock of what the DOT expects from the STIP process.

Investment Program and Performance Areas	Criteria Description
Safety	This criterion is used to evaluate the LRITP investment level for funding projects and programs aimed at reducing fatal and serious injury crashes, reducing vulnerability (the magnitude of impact on the system due to events such as major traffic incidents, flooding, lane closures, bridge failures, and seismic activity), and improving system resiliency (the ability of the system to recover from these events). The measure is based on the percent of safety needs met.
Smart transportation	This criterion is used to evaluate the LRITP investment level's ability to invest in and expand the existing ITS. The measure is based on the percent of ITS needs met.
Maintenance	This criterion is used to evaluate for the state and the 10 Districts the LRITP 25-year investment level's ability to invest in highway maintenance that addresses pavement profiling and marking, facilities management, maintenance management, traffic services, communication and ITS maintenance, and bridge maintenance.
Infrastructure condition	This criterion is used to evaluate the LRITP investment level's ability to invest in existing highways and bridges to maintain and preserve the system.
Bridge	This criterion is used to evaluate the LRITP investment level's ability to invest in the existing bridges to maintain and preserve the system.
Pavement	This criterion is used to evaluate the LRITP investment level's ability to invest in the existing highways to maintain and preserve the system.
Congestion reduction, mobility, and system reliability	This criterion is used to evaluate the LRITP investment level's ability to invest in the multimodal transportation system to improve mobility, connectivity, accessibility, and reliability for movement of people and goods.
Capacity	This criterion is used to evaluate the LRITP investment level's ability to invest in the multimodal transportation system to improve system capacity and reduce travel delays.
Economic competitiveness	This criterion is used to evaluate the LRITP investment level's ability to improve intermodal transportation system connectivity, efficiency, and mobility to support existing industries and strengthen national and regional economic competitiveness.

Figure 1: Arkansas DOT LRTP Performance Areas by Program

In the figure to the right – a process of mapping out the STIP investment footprint would entail building out the table to identify specific programming mechanisms that create, or fund projects associated with each performance criterion, and how many are currently served by STIP projects, and which ones are not served by STIP projects. The template below (**Table 1**) serves as an example of how a DOT can organize this information:

Table 1: Suggested Template for pinpointing DOT programs and freight performance areas presently addressed fully or partly by STIP

Program or Performance Area	Specific DOT Programs that fund project outlays in this area	Freight Performance Areas Related or Affected	Fully within STIP, Partly within STIP, Independent of STIP
Safety	• *Program 1* • *Program 2 etc.*	*Truck Crashes* *Reliability etc.*	
Smart Transportation			
Maintenance etc.			

A table like **Table 1** can be prepared by DOT staff, or within the context of a statewide multi-modal or freight plan, or as a separate initiative. By using a table of the type above to take inventory of DOT

programs addressing freight performance areas in the plans – the DOT can arrive at a profile by which to summarize the degree to which resources and performance areas it currently pursues are within the context of its STIP and which are covered elsewhere. Presentation (and summary) of columns 2 and 3 in the above template can serve as a starting point for strategic discussions about how the DOT uses the STIP (or wishes to use the STIP) to support freight performance.

Meeting Federal Requirements Vs. Strategic Investment Rationale

With a high level of understanding of what the DOT covers within its existing STIP process in relation to system performance, the DOT is in a position to critically evaluate its expectations of the STIP process with respect to freight. This evaluation is largely an executive level discussion as it governs the degree to which the state can or should seek to make changes in how it utilizes the STIP to address its freight needs.

States may have different objectives for the STIP process based on legislative, political or administrative agreements and goals. In some states, the central purpose of the STIP is simply to meet federal requirements for highway funds. If compliance with federal requirements is the extent of the states' interest or need for the STIP, then a process sharply focused on meeting the Federal Highway Freight Fund criteria in a manner consistent with overall highway preservation, modernization and expansion requirements can be preferred.

By contrast, other states may seek to leverage the STIP to both (1) meet federal criteria for investments and (2) achieve the maximum value of strategic corridors or multi-modal investments by organizing STIP programs and criteria in a way that includes in the STIP prioritization projects or modes that are not explicitly required to be addressed, but that can achieve more value when addressed together.

There are states, like Indiana and Kentucky, that have dedicated port and waterway grant programs that are intentionally administered separately from the highway programs and where the other modal programs have their own committed funding streams, criteria and project selection processes which can be set in statute. Similar programs may exist for air cargo, rail and pipeline facilities that are intended to be programmed by their own criteria and are entirely outside of the STIP. However, those projects could be included in the STIP to reflect the role they play in freight investments that could be integrated or complemented by projects within the STIP.

Table 2 offers questions for DOT planners and leadership to consider when evaluating whether the current role of the STIP warrants further development or consideration:

Table 2: Leadership Discussion Guide for Exploring STIP Freight Objectives

Question	Relevance	Implications
Is the state interested in the STIP only to meet federal requirements, or to support other aspects of programming decisions?	*This discussion addresses whether the STIP can or should go beyond simply programming federal highway funds.*	*If the STIP is understood as purely an exercise in compliance, the focus should concentrate on making the most of Federal Freight Funds. (Valid for most states)*
Can the state readily answer stakeholders' questions about how it is investing in freight performance overall?	*This discussion considers whether the state has adequate transparency of programming decisions between STIP and other programs.*	*If greater transparency is desired, the focus should be on either integrating freight activities into the STIP or defining linkages between STIP and other freight programs to achieve performance targets. (See MnSHIP Example)*
Does the state have separate freight programs with legislative or statutory programming requirements to be independent of the STIP?	*This discussion identifies limits to which the STIP could or should inform freight investment decisions.*	*If significant off-STIP state programs are in place, there should be a focus on defining STIPs role in relation to these other programs vs. integrating into one process. (See INDOT Example)*
Does the state want the STIP to guide how investments change with revenue fluctuation between funding cycles?	*This discussion defines how flexible the STIP should be to be able to apply and prioritize new funds or defer/postpone projects that may affect freight performance.*	*If there is a desire to guide investments through fluctuating revenue levels, incorporating different funding sources/programs into the STIP, and including illustrative or un-funded projects for opportunistic investment.*
Does the state want the STIP to address non-highway modes?	*This discussion clarifies what the benefits of a multi-modal STIP are relative to simply a highway STIP.*	*If the state wants STIP to address non-highway modes, then focus should be on balancing mode-neutral to mode-specific criteria, and how inter-modal projects affect performance. (Click here for more details)*

Arriving at the DOT's freight STIP Profile

Upon completion of this discussion, the DOT can readily arrive at a profile for (1) the role the STIP can or should play in the states' overall investment strategy, (2) specific linkages between the STIP and other programs to develop in its freight programming strategy, (3) the role the STIP may play in guiding new freight funding (whether through discretionary grants or other sources) and (4) whether and to what degree other modal freight programs or investments belong in the STIP and if not how the STIP can inform (or be informed by) such programs.

Play 2: Map out the dimensions of the current STIP

When the state DOT has clarity regarding the role its STIP can and could play in its overall freight investment strategy (as considered above), the DOT can begin to critically evaluate the existing and desired features of its STIP for freight in relation to this objective.

"*Mapping the dimensions of the STIP*" involves examining the geographic and modal aspects of statewide freight investment, and the best way for the state to manage its unique freight investment and asset mix. Dimensions to consider in this process include (1) modal detail, (2) geographic organization and (3) programmatic structure. **Figure 2** offers a typology matrix based on different types of STIP organization throughout the country that a state can use to identify and consider the type of STIP organization and scope that would be appropriate given the state's objectives for the STIP. Using the matrix, the state can create a profile of (1) how its STIP is currently organized, and (2) how and whether a different role and scope for the STIP warrants consideration to achieve freight objectives based on the type of assessment introduced in **Table 2**. When completing the matrix, the DOT can populate the cells with specific programs it administers that are supportive of freight objectives, noting where STIP as a program currently fits alongside, circumscribing or complementing other freight related investments. The completion of a matrix of this type can then provide a basis for the state to re-assess its STIP process with respect to freight – and set specific objectives based on the examples and other resources in this playbook for enhancing the project where appropriate.

	Centralized	District or Region Based	Corridor Based	Tiered
Highway Only	*Cells Populated by Indicating which dimensions best characterize the STIP and other Freight Supportive Programs administered by the DOT*			
Semi Multi-Modal				
Fully Multi-Modal				

Figure 2: Typology Matrix for Mapping out Existing And Potential Role of STIP in Statewide Freight Outlays

The following considerations can inform scoping out the dimensions of the STIP with respect to freight investment.

Geography (Centralized vs local) – How freight investments are treated?

The choice between centralized and decentralized management significantly impacts how freight investments are handled. For instance, centralized programs might streamline decision-making and ensure consistency across the state, whereas decentralized approaches can tailor investments to regional needs and account for urban vs. rural distinctions. It can be the case that a state may have a singular waterborne commerce or air cargo facility which does much of its own programming but has unique demands on the state highway system or other programs that are not shared by different

regions or districts. For this reason, when defining the STIP in freight investment terms it is helpful to consider the following high-level characteristic:

Centralized: A centralized STIP defines freight programs and investments in a singular statewide process. In this type of process even if other programs are more regional or decentralized, specific modal offices may exist that program freight on a statewide basis because freight modes span across other geographic units and may be deemed to be of statewide importance. Missouri is an example with a highly centralized process regarding freight.

District or Region-Based: A district or region-based STIP will program freight investments by DOT region or district. In this type of arrangement, each designated DOT region will set its own priorities based on the understanding that the DOT district staff have with local public works, planning and economic development stakeholders, and resources are allocated often both by district and mode. Highway investments are some of the most common freight investments handled at the district or region level: (weigh stations, rest areas and other things often included in highway preservation or modernization performance areas). District or region-based STIP's are chosen because of the collaboration they can facilitate between DOT and freight stakeholders. The Minnesota ATP process is an example of a highly collaborative regional process for highway and intermodal freight programming in a state that otherwise utilizes a centralized process for rail, air cargo and waterway freight investments.

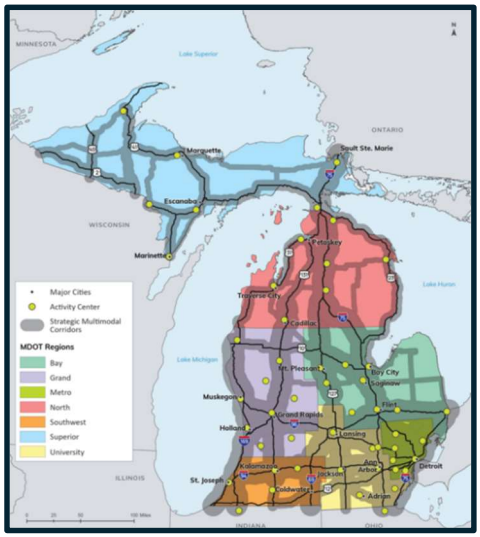


Figure 3: Corridor Organization of Michigan's 2045 Mobility Plan

Corridor-Based: Corridor based programming can occur in situations where freight investments are programmed in geographic areas defined as specific multi-modal corridors. While very few STIPs are organized by corridor, initiatives like Indiana's S*tatewide Corridor Management Initiative* (currently entering its second phase) and *Michigan's 2045 Mobility Plan* identify specific corridors with freight needs that inform the STIP and other freight programming processes.

Tiered: States may geographically organize their freight investments for the STIP into "Tiered" systems, in which existing assets and systems are given a status based on their role in statewide commerce. In these instances, specific tiers of facilities have overall investment levels set for freight based on statewide significance, and priorities in the STIP are guided by performance objectives within the context of these "tiers". **Figure 4** below from the North Carolina DOT "state of the inform a corridor-based approach in the current planning cycle system" report (within NCDOT's 2050

statewide plan) – documents how the multimodal investment network (MIN) as a system evaluation tool supports designation of investments by tier.

Planning Cycle	System Evaluation Tool	Core system	Number of corridors /modes served	Designations	Threshold metrics (examples)	Stakeholder involvement
2000-2004 (2025 Plan)	Multimodal Investment Network	Strategic Highway Corridors	55 / Highways	Activity centers and highway activity level criteria	Federal highway classification, Truck volumes, Annual Average Daily Traffic	Initially targeted at cross-state coordination; ultimately pushed to CTPs
2010-2012 (2040 Plan)	Multimodal Investment Network (basis for NCTN)	Strategic Transportation Corridors	25 / Highways, Air, Freight/passenger Rail, Bike/Ped, Aviation, Ports, Ferries, Public Transportation	Activity centers and service level of modal activity by tier	Highest use modal facilities based on activity and proximity	Corridor Steering Committee sets mobility and operational vision; coordinate with CTP and other sub-corridor studies

Source: NCDOT - Strategic Highways Corridors, 2040 Report

Figure 4: Multi Modal Investment Tier in NCDOT Planning and Programming Structure

Florida DOT's Strategic Intermodal System (SIS) is also a tier-based framework in which facilities can be designated based on their role in the transportation system, with STIP and other programming tied to the tier to which an asset or project belongs.

Working with MPO's

Metropolitan Planning Organizations MPO's can vary significantly in the degree to which they address freight in their TIP's. When re-assessing the role of a DOT STIP in freight programming it is essential to include MPO's to take stock of what role they do (or would like to) have in freight programming. In some cases, MPO's are not equipped to program freight improvements as they serve networks with reach far beyond the MPO boundary, however in other cases MPO's may take an active role when a major freight facility is closely tied to the commuting, delivery and other needs of an urban network.

Multimodality (Highway vs other modes)

When assessing the existing and desired multi-modality of a DOT STIP process for freight, at the highest level it is important to consider if the STIP is to be a highway-only program (as would be appropriate in a state that simply seeks to meet Federal Highway Fund requirements), a Semi Multi-Modal program (including some non-highway freight programs in the STIP while treating other separately), or a Fully Multi-Modal program.

Highway-Only Program: A highway- only program allows the STIP to be very focused and simple. This option can work well if the STIP objective is limited, and the state either (1) does not invest in non-highway freight modes or (2) has other programming processes either through DOT policy or state statute to guide freight rail, air cargo, waterway and pipeline investments. For instance, Arkansas

DOT is not the modal authority for ports, waterways, airports, or railroads and their STIP development process focuses only on highway freight needs, which often overlaps with other general highway needs. Similarly, DOTD (Louisiana) also does not include other modes in their STIP as there are programs for other modes responsible for funding the related projects such as the Port Priority Program.(See here for more details)

Semi-Multi-Modal Program: In a Semi Multi-Modal program, the STIP may have separate funding categories at the statewide level for its non-highway programs, but address only selected freight modal investments – and does not include all state investments in non-highway modes in the STIP. Missouri DOT is an example of a state that has specific programmatic totals for freight rail and waterway programs in its STIP but does not program these modes at the individual project level as it does its highway program.

Fully Multi-Modal: In a Fully Multi-Modal program, the STIP includes all of the freight modes, with its programming and investment criteria organized by mode-neutral areas with projects of different modes programmed together based on larger strategic objectives. Examples include efforts like the multi-modal programming of the Florida Strategic Intermodal System (SIS) and the North Carolina Strategic Transportation Investment (STI) legislation.

Assessing Programmatic Structure and Alignment

When a state understands its profile in terms of how it treats geographic and modal complexity in its STIP – (which cells in **Figure 2** it addresses, or seeks to address in the STIP), the state can begin to define relationships between programs, and between STIP and other business processes addressing freight.

For example, if a state has identified that it currently has a highway-only STIP organized into its DOT districts but has a separate rail freight facilities program at the statewide level (not currently programmed in the STIP), the state can identify a decision regarding whether it is appropriate to regionalize or align the statewide rail program with its districts. Such a change may be considered if the state seeks to facilitate the development of access facilities to inter-modal rail nodes, or grade crossing elimination or improvement projects on the highway system.

Considering Programmatic Allocations in the Current STIP: In this process it is important to consider the ways that STIP funds currently support different programs and how those programs may relate to the DOT's objectives for the STIP in supporting freight performance (as addressed in **Tables 1-1** and **1-2**). **Figure 5** demonstrates the allocations of the Georgia STIP by program (2024). The current STIP process in Georgia supports freight objectives within the context of wider objectives (for example the safety outlays can address a specific project aimed at truck-car collisions or enhancing truck reliability) – but the STIP does not explicitly require this to be the case or track this as a performance area. Assessing STIP outlays by program as shown in **Figure 5**, can however serve as a starting point for a DOT to define what it expects in terms of freight performance from its STIP investments.

Figure 5: Georgia DOT STIP Expenditures estimated from 2024-2027

Category	STIP (Averaged)	% of STIP Total	SSTP/SWTP (Yearly)	% of SSTP/SWTP Total
Bridge	$480	17%	$412	17%
Capacity	$927	33%	$948	39%
Maintenance	$391	15%	$350	15%
Safety	$116	4%	$320	13%
Traffic Ops	$266	10%	$371	15%
Total	$2,180	79%[6]	$2,401	100%
Expenditure numbers are by Year ($ millions)				
STIP expenditures are the total spending in each category from FY 2024 to 2027 divided by 4. SSTP expenditures are the yearly recommended spending level in the 2021 Statewide Strategic Transportation Plan.				

Tying STIP Allocations to Performance Areas: Minnesota provides a helpful example of how considering the structure of DOT programs can form the basis for specific freight investment decisions in the STIP. **Figure** 4 demonstrates the recommended/suggested allocation of programming outlays from the MnDOT freight plan, supported further by **Figure 7** from MnDOT's larger multi-modal transportation plan, organizing projected revenues into programs, and nests programs under performance areas. Structures of the type shown in **Figure 7** can be helpful for DOT's to assess what they expect from their STIP in terms of freight performance areas and the role of their specific programs.

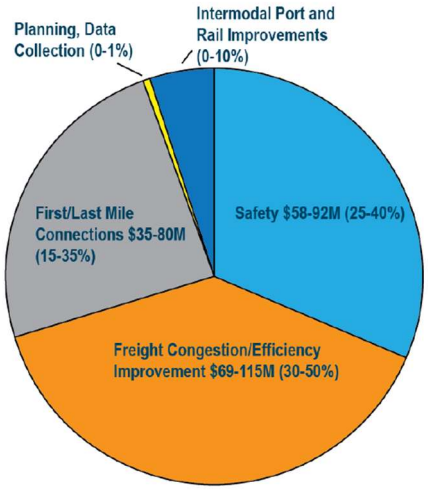


Figure 6: Investment Direction for the Minnesota Highway Freight Program

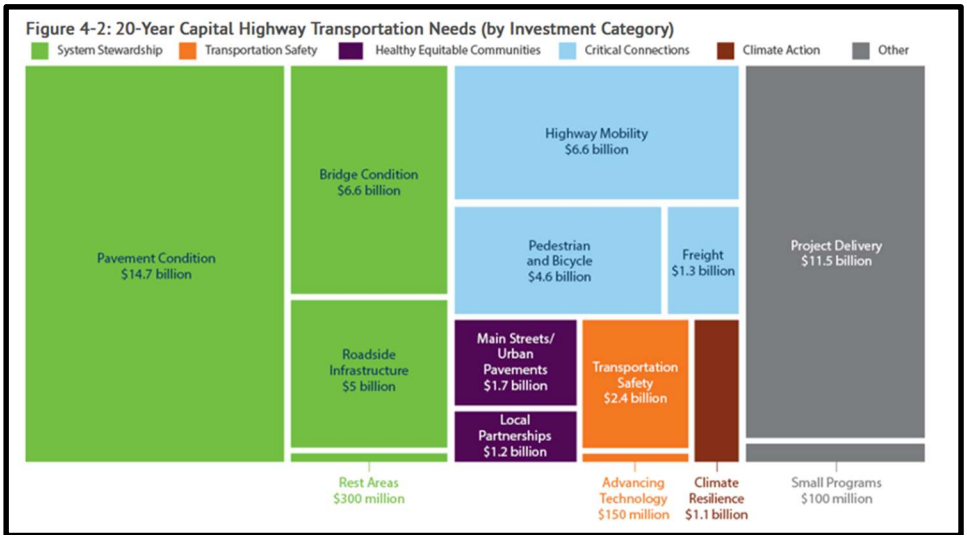


Figure 7: MnDOT 20-Year Capital Highway Transportation Needs (by Investment Category)

Takeaways: Mapping out STIP Dimensions

Based on the examples and suggested processes above, a state DOT can review its STIP process with respect to freight and come away with:

- ✓ **A clear objective for the role the STIP plays in its freight investment**
- ✓ **A basis for evaluating and updating the scope of the STIP in terms of modal programs and geographic allocations in the state consistent with freight performance objectives**
- ✓ **Workable frameworks for defining and relating how the programs included in and supported by the STIP can be expected to support investment in freight performance objectives.**

Play 3: Assessing the Role of Freight Stakeholders in the STIP

Needs and Models of Engagement: While statewide freight and multi-modal plans have very well - defined stakeholder engagement and outreach processes – there is not a consistent best practice for what role (if any) stakeholders have in addressing freight investments in the STIP. There are several models for effective engagement. One approach is the regional partnership model, such as Minnesota's Area Transportation Partnerships (ATPs), which bring together regional stakeholders to collaboratively prioritize and plan investments. Corridor management teams are another model, focusing on managing transportation investments within specific corridors, allowing targeted stakeholder input and decision-making. Freight Advisory Committees (FACs) are an essential mechanism, providing a platform for freight stakeholders to advise on transportation planning and policy, ensuring freight needs are considered. Many states have both regional programming bodies and Freight Advisory Committees. An important part of taking stock of the DOT STIP process with respect to freight is considering (1) which stakeholders need to be engaged to achieve the freight investment objectives of the STIP and (2) specific input or buy-in is needed to support the effectiveness of implementing the STIP as a freight investment resource.

MPO and RPO Processes: Collaboration between Metropolitan Planning Organizations (MPOs) and state DOTs plays a crucial role in aligning regional and statewide freight priorities. Effective MPO-DOT partnerships enhance the integration of freight considerations into broader transportation planning efforts, promoting coordinated investment strategies. These various engagement methods highlight different approaches to stakeholder involvement, each with its own benefits and challenges. Providing examples of states successfully implementing these strategies can help illustrate their effectiveness, offering practical guidance for adopting similar models. If MPO's or RPO's have specific committees focusing on freight performance, these committees can be a source of input and buy-in for the STIP implementation, especially when the MPO TIP has already followed an inclusive project development process.

STIP Engagement as Extension of LRTP or Freight Planning

By law, all states have a well-established process for public involvement, mainly due to the FHWA requirement to include a public involvement component in plans and programs. Below is an example that shows a well-structured public involvement process. A state can utilize the same type of engagement structure used for its long-range plans to obtain input and buy-in to the STIP. The advantages of this type of structure are that it builds on groups and discussions already addressed in the latest plan update and it shows follow-through to make investments consistent with the needs identified in the plan. However, some drawbacks are that the plans may not have stakeholder networks explicitly associated with freight and the details of a statewide programming process may be of little interest to the same actors with an interest in the broad strategies of a plan, hence stakeholders may become disengaged. Indiana DOT provides an example of a state DOT process that builds stakeholder engagement with the STIP out of the processes used in developing long-range plans.

INDIANA DOT STIP: Building from Planning to Programming:

Indiana's STIP development is guided by the 2022 Planning Public Involvement Plan (PPIP) and Planning Outreach Procedure (POP). To ensure that all plans have an appropriate level of outreach, the plans are classified into three tiers for public involvement purpose. These three tiers of plans include, but are not limited to:

- **Tier I:** Statewide Transportation Improvement Program (STIP), Long-Range Transportation Plan (LRTP)
- **Tier II:** Freight Mobility Plans, Transportation Asset Management Plan (TAMP), Corridor/Planning studies
- **Tier III:** Rail plans, Aviation plans, Highway safety investment plan (HSIP), INDOT Asset Preservation programs

INDOT's continuous public involvement in the STIP takes place in four different phases: (i) informing the public about the new STIP/update through various mediums, (ii) consult with internal planning partners as well as the public which occurs at the start of prior to finalizing the draft STIP, (iii) involve the public in STIP development through public and stakeholder meetings, which occurs during mid-point or at draft finalization stage, and (iv) collaborate with tribal governments, businesses, and stakeholders, freight advisory council, internal agencies, and partners, local governments which occur frequently from the start to the finalization of the draft. The figure below highlights the level of engagement involved with each tier of INDOT plans, and associated activities.

	Tier 1 Plans		Tier 2 Plans		Tier 3 Plans	
	New Plan/ Update	Plan Amendment *(minor changes)*	New Plan/ Update	Plan Amendment *(minor changes)*	New Plan/ Update	Plan Amendment *(minor changes)*
Inform						
Email Notifications to GovDelivery ListServ and Stakeholder/interested public contact list	✓	✓	✓	✓	✓	✓
Press Releases/Media Advertisement	✓					
Public Comment Summary Memo	✓	✓	✓	✓	✓	✓
Fact Sheets/Printed Material Available	✓	✓	✓			
Information on Website	✓	✓	✓	✓	✓	✓
Social Media Notification	✓	✓	✓	✓	✓	✓
Consult						
Internal/Planning Partner/Federal Review	✓		✓		✓	
Legal Public Notice	✓					
Public Comment Period	45 days	3[2]-7[3] days	30-60 days	7 days	7-30 days	7 days
Public Surveys			*optional*		*optional*	
Public Meetings/Open House			*optional*		*optional*	
Involve						
Public Events	✓					
Stakeholder Meetings	✓		✓		*optional*	
Collaborate						
Community Groups	✓					
MPO/RPO Meetings	✓		✓		✓	

The two-way communication between INDOT and the public results in proactive public involvement and informs INDOT on existing freight needs, and plans/prioritizes projects that meet such needs which also plan for future needs that are not met. It is to be noted that in urban areas with more than 50,000 residents, INDOT shares the responsibility to the MPOs to conduct public involvement programs on MPO long-range plans and the TIPs. For areas outside the MPOs, INDOT is responsible.

STIP as Inter-Governmental Collaboration

In states where there is a complex range of MPO's, port authorities, districts and other entities involved, the stakeholder engagement in the STIP is largely accomplished through a process of engaging the different organizations through district offices. The Florida DOT process is very explicit for engaging directly with Florida's counties (elected commissioners and their associated county level governments) to provide input for the STIP. Florida demonstrates how the key to success in a largely inter-governmental stakeholder process is a clear structure for which decisions engage with which stakeholder entities, and on what timetable. The Florida example demonstrates the importance of clearly enumerating the responsibilities of district offices, the transportation commission and the DOT central office. **Figure 8** below illustrates the Florida process.

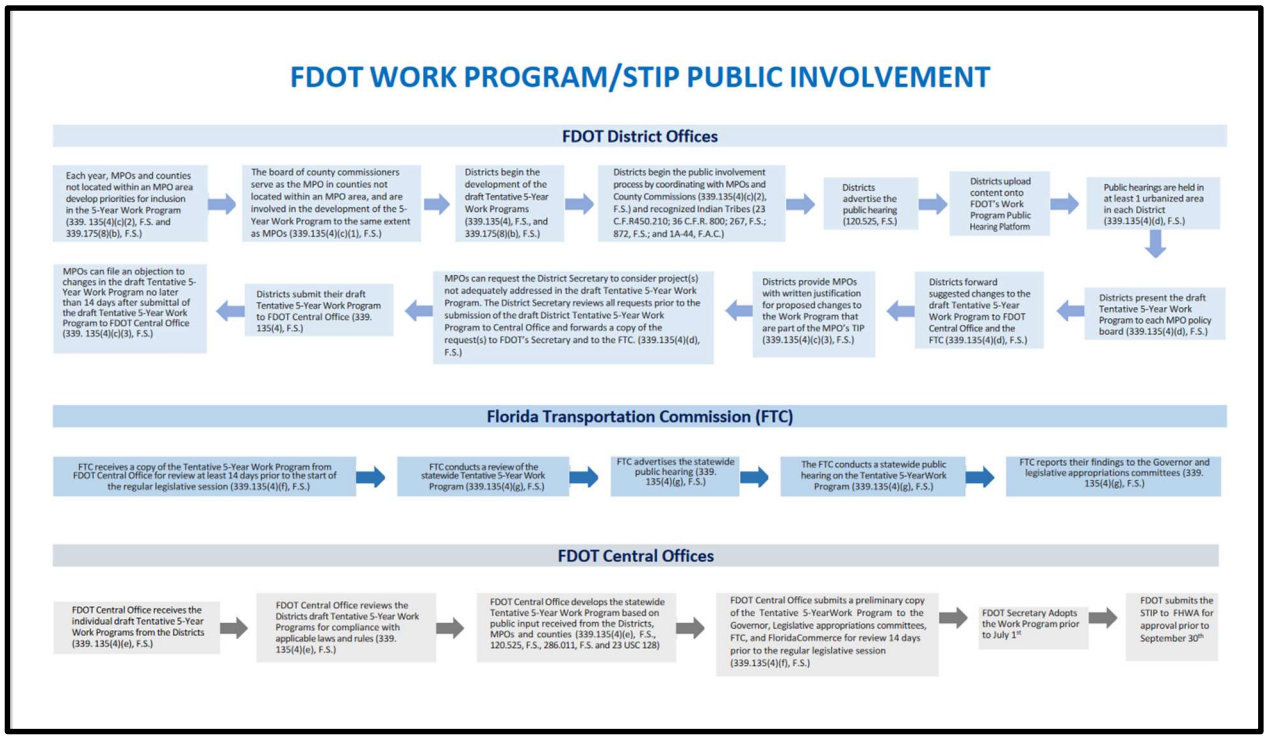


Figure 8: FDOT STIP Public Involvement

STIP-Specific Groups and Authorities

Another available model is for a DOT to establish collaborative state, local and regional bodies that make specific programming decisions in the STIP. In these cases, the decision-making bodies are designed to represent state DOT, county and local input, as well as input from port authorities and relevant economic development stakeholders in the region to determine specific categories of investment in the STIP.

STIP-Specific groups are appropriate for program areas where there is considerable variation between regions in terms of the rationale for investments and the type of perspectives needed. Minnesota's Area Transportation Partnerships (ATP) process is an example of how MnDOT districts involve local stakeholders to special groups that have the explicit purpose of programming highway

STIP improvements. Freight supportive elements such as weight stations, rest areas, grain elevators and other amenities can be nominated and programmed through Minnesota's ATP's – however it is notable that major new modal infrastructure is still programmed through MnDOT's centralized modal offices.

Area Transportation Partnerships/Districts

MnDOT created Area Transportation Partnerships (ATPs) to enhance public involvement and regional planning for the development of STIP. There are eight ATPs in Minnesota as shown in **Figure 9**. ATPs are partnerships of diverse transportation professionals and stakeholders that align regional priorities within their respective MnDOT District State Aid boundaries. The ATP solicits projects eligible for federal funding and reviews the proposed project lists, which are then compiled into the Area Transportation Improvement Program (ATIP). The ATIP is submitted to MnDOT's Office of Transportation System Management for inclusion in the State Transportation Improvement Program (STIP). The finalized STIP is sent to the Federal Highway Administration and Federal Transit Administration for approval, which is required before any federal projects can begin. ATPs review, comment on, and influence the draft STIP, ensuring coordinated regional investment of state and federal funds, and consult on any amendments, enhancing the overall development and alignment of the STIP. This structure allows freight needs to be identified from all jurisdictional levels, and freight needs that are observed by external stakeholders such as businesses and industries relevant to freight (manufacturing, trucking etc.)

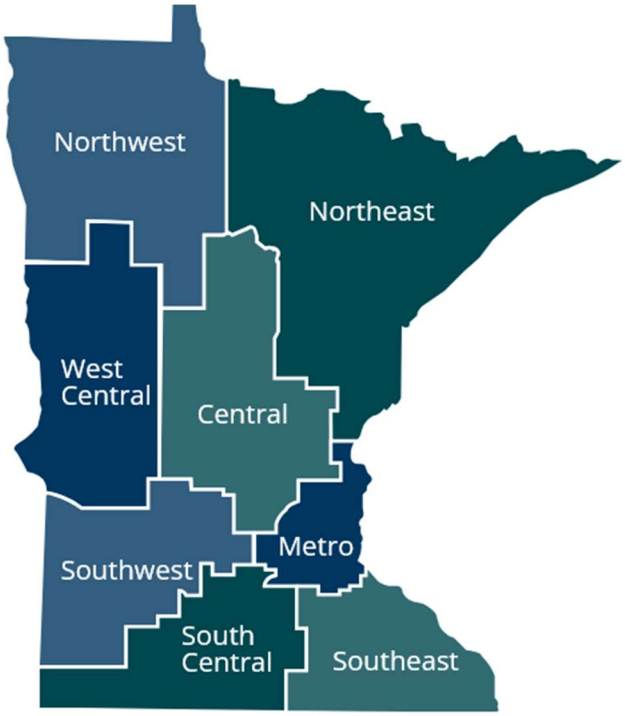


Figure 9: ATPs designated by MnDOT

Indiana has a similar structure, where projects are submitted by six INODT districts and selected through an agency-wide, statewide asset management process in coordination with MPOs, local public agencies, and transit coordinators.

Counties

The MarylandDOT Consolidated Transportation Plan (CTP) serves as a guide for developing TIPs and the STIP. The first step in the STIP development process involves counties submitting priority letters, which reflect their internal project rankings based on local needs and input. These letters request funding for various purposes, including freight, highway construction, transit improvements, and safety. Following the receipt of these priority letters, a draft CTP is created, which sets the stage for the Annual Fall Tour conducted by the Secretary of Transportation. Before the tour, MDOT meets with staff from each county and Baltimore City. During the tour, local elected officials, state legislators, and the public participate in meetings focused on discussing projects, revenue forecasts, and current needs. After the tour, MDOT reviews comments and concerns to finalize the CTP. Once approved by the legislature, the finalized CTP updates the projects in the seven MPO TIPs and the STIP.

MPO-DOT Partnerships

Metropolitan Planning Organizations (MPOs) and Departments of Transportation (DOTs) collaborate closely in freight planning and investments for the STIP. For all states included in the research, MPOs gather input from local stakeholders, including businesses and freight operators, to identify critical freight needs and prioritize projects that enhance the movement of goods. During and after the preparation of TIPs by MPOs, there is regular consultant with the DOTs, and after the final approval of an MPO TIP, they are directly referenced into the STIP. However, as mentioned above in states where there are larger jurisdictions, the needs of the MPOs along with other areas are coalesced together to form a larger form of STIP such as ATIP. In both cases, MPOs have a big role to play in identifying local needs and soliciting freight projects.

Role of Freight Advisory Committees

An increasing number of states have standing freight advisory committees (FAC's). These committees are often formed in the statewide freight planning process but can play a constructive role in programming. Freight Advisory Committees can involve both public and private-sector stakeholders who represent (1) owners and maintainers of freight infrastructure (DOT, port authorities and others), (2) carriers of freight modes and (3) shippers highly dependent on freight performance. While Freight Advisory committees are high-level, volunteer groups and cannot be expected to carry out STIP programming, they can (1) comment on the overall STIP process from a freight standpoint, (2) identify performance areas or needs that may be overlooked and (3) help the DOT identify linkages between freight performance and other program areas addressed by the STIP.

Takeaways: Engaging Stakeholders in the STIP

Based on the examples and suggested processes above, a state DOT can assess its process for engaging stakeholders in the STIP by addressing the following questions:

- ✓ **What are the freight assets that the state seeks to include or address in the STIP (either directly through programming or indirectly through roadway access projects)?**
- ✓ **What entities own or control these assets: Are they public port authorities, private entities, municipalities, counties or others?**
- ✓ **Are there existing models, task forces or groups (such as freight advisory committees) utilized in the statewide freight or multi-modal planning process that could readily support involvement with the STIP?**
- ✓ **Are there intuitive networks of freight corridors, ports, or intermodal networks identified in the state's plans that can provide a structure for identifying and engaging stakeholders in freight programming?**
- ✓ **Does the state have an interest in how freight-related projects are developed in the MPO and is there a process for coordinating statewide freight concerns with local priorities between the STIP and TIP processes?**

Set priorities for the process

Determine Appropriate Level of Effort to Invest:

An important consideration when taking stock of the STIP process is the amount of staff time, technology and attention is appropriate for the process. Factors to consider include:

- The DOT staffing and resource constraints
- The goals the DOT has for the STIP
- The number of full-time equivalents (FTE's) a STIP process may involve
- The cost of tools or data
- The elapsed time the state has to complete the STIP cycle.

Underinvestment vs. Overinvestment: While it is tempting to see a very modest and streamlined STIP process as efficient and practical, if the DOT investment in the STIP decision-making and engagement process is not aligned with the overall goals the DOT has for the program – the state may face long-term unintended costs. This could be especially true in situations where (1) freight markets or operating requirements are rapidly changing, creating a risk that project specifications and rationale are outdated by the time a project is delivered (imposing costs to revisit the project), (2) freight operators or owners of off-STIP freight facilities/assets make independent decisions outside of the STIP that could undermine the performance effectiveness of STIP projects, or (3) the

investment payoffs and rationale of STIP projects is highly dependent on other conditions outside of the STIP that must be carefully monitored and understood.

At the same time, if a state over-invests in the STIP process, it can become cumbersome, overly difficult to make changes and hamstring the DOT's responsiveness to changing investment needs within and between cycles. This is especially true in the area of freight, where (1) freight investments may account for a very small number of projects or investment dollars, (2) freight investments may be addressed by programs that the DOT has chosen for strategic reasons not to include in the STIP, and (3) the stakeholders with an interest in freight-related projects are few in number, and may work through other channels (such as legislative or board of transportation representation) on a case-by-case basis.

Naturally, states with larger investment programs, more assets to include in the STIP, more complex objectives and a wider range of investment in the STIP will allow for more investment in the STIP process itself than others. Factors to consider when assessing the annual investment, the DOT makes in the STIP (especially for freight) the below self-assessment can guide considerations of whether and when to consider revising the process.

STIP Freight Development Level of Effort Self-Assessment:

- *How many freight or freight-related projects are typically included in the STIP?*
- *How many dollars of freight-committed or freight-related funds (federal and state) are typically included in the STIP?*
    - *Consider the ratio of annual STIP freight process outlays/actual outlays to deliver the STIP*
- *Has the DOT experienced problems in scoping and delivery of freight-related projects that could have been addressed by a more rigorous process when forming the STIP? (Examples may include shifts in freight markets, expansion or scale-back of inter-modal facilities or industry locations with high freight volumes or changes in technologies affecting how freight carriers use the system)?*
    - *What has it cost the DOT to address/correct these issues downstream?*
- *Are district/region engineers or modal program heads reluctant to seek changes in the STIP even when conditions may warrant such changes due to the complexity or number of people/steps in the process?*

Prioritizing Features for the Freight STIP Process

With an understanding of efficient levels of investment in freight decisions for the STIP, the DOT can explore the aspects of its freight asset portfolio and performance objectives to drive priorities in selecting features of the STIP process.

Key considerations for prioritizing STIP features include evaluating the state's strategic modal facilities, the level of federal highway funding, and the extent of private sector involvement, such as engagement through Freight Advisory Committees. States should assess their transportation landscape, identifying whether they primarily focus on highways or have significant multi-modal freight needs. Based on these assessments, STIP processes can prioritize features such as multi-modality, data-driven freight sorting, and corridor prioritization, with considerations for urban and

rural contexts. The prioritization framework helps define which aspects of the STIP should be emphasized, ensuring that resource allocation aligns with state-specific transportation needs and funding realities.

Play 4: Consider Different Modal Programs

While exceeding the minimum STIP decision requirements of the national freight highway funding, incorporating diverse freight modes in the STIP may be important for a state DOT. Some of the benefits of incorporating diverse freight modes include (1) the ability to consider trade-offs between highway projects and other state-funded freight outlays which may compete for state or flexible funding sources, (2) the ability to explicitly address the payoffs and rationale for investing in highway facilities that depend on corresponding investment in a different freight mode when assigning priorities, and (3) the ability to provide a holistic accounting of all statewide transportation capital expenditures in a singular process or document.

Self-Assessment: Should the STIP Include Multi-Modal Freight?

Play #1 offers practical considerations for determining whether including multi-modal freight investments in the STIP is necessary or aligns with DOT investment decision-making objectives. Some practical questions to consider when deciding or re-evaluating whether and to what degree multi-modal freight belongs in the STIP include:

- ✓ **Is there sufficient non-highway freight funding consistently available to justify multiple/competing projects?**
  If there is rarely enough funding for any given cycle to apply objective criteria to competing rail, marine, air cargo or pipeline projects it may be more efficient and transparent to address them on a case-by-case basis outside of the STIP.

- ✓ **Are there enough assets (or proposed assets) on non-highway modes under state ownership or control to offer meaningful choices at the project programming level?**
  If there is significant funding available for non-highway modes, but all of the funding goes into one or two assets (such as a port or rail facility), the programming may best be handled within the management of that facility versus in the STIP.

- ✓ **Are there meaningful trade-offs or synergies between highway investments and corresponding investments on other modes, or do the systems perform independently of each other?**
  If there are consistent linkages between highway investments and corresponding investments in other freight modes (such as safety and capacity at ports, a significant number of rail crossings with high freight volumes or complex environments) considering these project-level linkages can support performance outcomes in the STIP.

Understand Why before Asking How

By working through the above questions, state DOT leadership can make a determination regarding the value and expectations of multi-modal investment criteria in the STIP. It is important in this process to recognize that multi-modal programming does not have intrinsic value for its own sake. The state's reasoning for making the STIP an investment process for multi-modal freight programming is a meaningful one, and the reasons for doing so can guide other decisions about program design, decision-making processes and expected investment outcomes. It can be helpful in

the front matter of the STIP document to address the reasons why specific freight modes are included in the STIP and not others, both to inform stakeholders and maintain a consistent rationale from one cycle to the next.

Identify and Define Modal Assets Appropriate for the STIP

When the DOT includes multi-modal freight in the STIP, the question of how freight programs are defined and organized becomes significant. In some cases, statewide freight programs are defined by statute. For example, in Missouri, the General Assembly appropriates funding for waterway programs from General Revenue and the State Transportation Fund. Projects are implemented when funds are appropriated through the legislative and gubernatorial budget processes. In Minnesota, the Minnesota Rail Service Improvement Program (MRSI) provides six programs with specific objectives – all covered in the STIP with the requirements of each program defining eligible assets (which in the case of MRSI include privately held rail freight assets). It is also possible that certain freight assets may be ineligible for the STIP. For example, in Kentucky the legislature establishes the Kentucky Riverport Improvement (KRI) grant program, which is administered through the Kentucky Transportation Cabinet. The KRI is not included in KYTC's STIP as riverport assets are specifically designated for programming under the separate KRI program, however, the KYTC STIP does include transit and aviation projects.

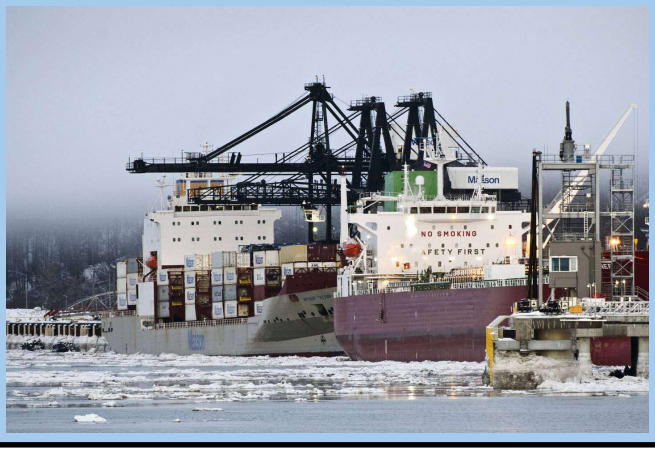
Self-Assessment – Identifying Multi-Modal Assets for the STIP

When addressing multiple freight modes in the STIP key considerations include:

- ✓ **STIP-Eligible Assets vs. Other Programming Requirements:** Identify any state legislation that may define specific modal freight assets or programs and whether they are required to have separate programming processes, or are eligible to be included in the STIP.

- ✓ **Distinguish TIP vs. STIP Eligibility:** Consider the location of freight assets. If all (or most) of the assets (even if serving the entire state) are in areas covered by Metropolitan Planning Organizations (MPO's), including them in the STIP instead of the MPO TIP could result in them being removed upon federal review.

Alaska 2024 STIP - Lesson Learned: In 2024 the Alaska DOT's STIP was initially rejected by the USDOT because it listed $68.7 Million of improvements for the Port of Alaska in the STIP which it was determined could only be covered through the Anchorage Metropolitan Area Transportation Solutions (MATS) MPO.



- ✓ **Which Modes to Include?** Evaluate whether all freight modes belong in the STIP or only some. For example, a state may have a singular port within a metropolitan area (addressed in the MPO process), but may have multiple rural rail assets throughout the state supported by state and federal funding and appropriate for programming in the STIP.

- ✓ **List Specific Assets by Mode and Program:** Enumerate the classifications and types of assets on each mode to be included in the STIP, and their associated state, federal or local funding sources – as well as eligible grant programs. (If statewide freight plans do not already include this inventory/classification it can be a helpful step to include them at the planning level).

Consider Mode-Neutral and Program-Specific Approaches

When a state DOT embraces a multi-modal approach to freight in its STIP, a vital consideration will be whether to program freight improvements in a "program specific" approach, or a "mode-neutral" approach.

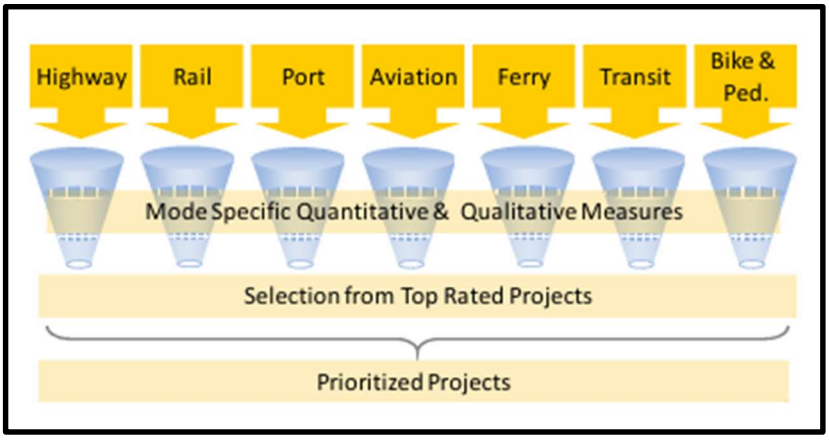


Figure 10: Example of Program-Specific Investment Structure

(Source: NCHRP 08(36) 112)

Program Specific Approach: In a program-specific approach, designated funding sources or levels are set by policy into designated "buckets" which are used to support projects of specific types. It is possible that a DOT may have a "freight" program or bucket in which it allocates all non-highway freight investments according to broad freight criteria – or it may have multiple buckets (such as a rail program, a waterways program, an air cargo program etc.).

Mode-Neutral Approach: By contrast a state can pursue a "mode-neutral" approach in which the state seeks to define its investment criteria in ways that allow projects on diverse freight modes to be compared against each other and against highway projects. Mode-neutral approaches preclude the state from using mode-specific criteria (such as VMT or congestion), but rather favor broader indicators (such as cost-benefit analysis, or scoring systems based on thresholds (such as 'improves capacity on a scale of 1-5' with capacity improvement threshold criteria defined for each mode but translated into a common score).

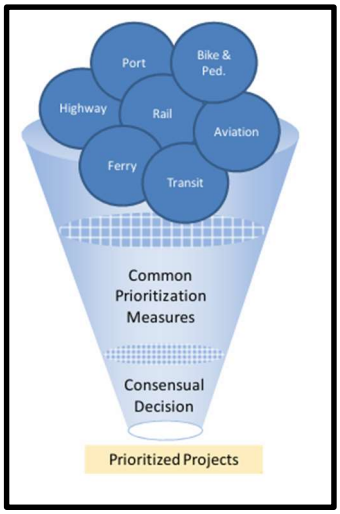


Figure 11: Example of Mode-Neutral Investment Structure

(Source: NCHRP 08(36) 112)

When to Apply Program-Specific Approaches

Most states that include non-highway freight investments in the STIP apply program-specific approaches. This approach to freight programming allows states the flexibility to lump freight projects into singular program categories, which can be practical if there is little funding, or if there are few projects within a mode. The approach also makes it easy and transparent for the DOT to demonstrate how resources for eligible modes are organized into modal programs, with consistent investment criteria applied to individual outlays within each program. Programmatic approaches to a multi-modal STIP can be helpful especially for states interested in:

- ✓ **Minimum Funding Level/Insured Coverage:** The state seeks to set aside or protect funding to ensure minimum coverage of specific modes. If minimum or balanced funding between freight modes is an objective, it is helpful for states to include programmatic investment strategies in statewide freight plans to assess the overall magnitude and distribution of needs between programs before arriving at the STIP.

- ✓ **Apples and Oranges:** The performance expectations of the freight modes are not applicable or comparable to those of highway projects (for example tons of cargo handled or international gateway status are as inapplicable to highway facilities as truck VMT or pavement condition are to ports).

- ✓ **Color of Money:** The STIP includes funds from programs or revenue specifically designated for specific modes. (For example, some states have statues prohibiting gas tax from being spent on non-highway modes). Color of money can also include federal formula funds, grants or special state programs that are required to be dedicated to ports, rail, air cargo or pipeline investments and include multiple projects.

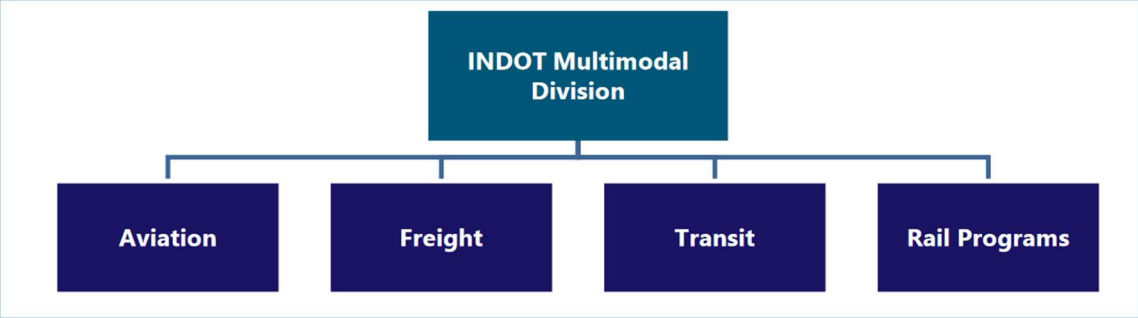
By contrast, program-specific approaches may be problematic in cases where:

- × **Trade-Offs Matter:** The state seeks to evaluate trade-offs between specific projects in different modes.

- × **Projects are Complex:** Projects are bundled in ways that include elements of multiple modes in the same project, thereby meeting multiple performance criteria with one investment.

× **Inter-Modal/Multi-Modalism is a Priority:** Funding programs are specifically designated with a strategic investment to improve inter-modal or multi-modal connections.

Indiana STIP – Focused Programming Approach: INDOT has separate project development programs and processes for multimodal projects that include aviation, freight, rail, and transit. The INDOT Multimodal Division oversees all the programming and planning for these modes.



- Freight projects that use NHFP funds are not part of the STIP, and they are directly programmed through the freight investment plan.
- Independent from freight, transit projects are included in the STIP with a separate TPIN number and can have more than one funding source supporting the projects (FTA or STBG).
- The INDOT Office of Aviation is responsible for administering the state funds using the statewide Airport Capital Improvement Program (CIO). State and federal (FAA) funding supports the projects. Air cargo investments are not included in the CIO.
- The Indiana State Rail Plan identifies all freight and passenger rail needs in the region and lists the projects for short-term investment and unfunded projects that are the priority for the next 20 years.

When to Apply Mode-Neutral Approaches

States seek to apply mode-neutral approaches when they consistently face situations where achieving performance objectives requires considering linkages between investments on complementary modes, the state policy environment requires showing best and highest use of public outlays (regardless of mode), and there are sufficient resources available with enough flexibility to make meaningful modal trade-offs possible. Mode neutral approaches are especially helpful for states interested in:

✓ **Multi-Modal Synergies:** Leveraging project-level investments to take advantage of modal synergies entails developing projects that intentionally add value by including multiple modal features. For example, investing in a highway interchange may triple the benefit of a port project by enhancing utilization and reliability of deliveries, whereas the highway project absent the port project may not even meet mode-specific investment criteria.

✓ **Return on Investment Accountability:** Elected and appointed leadership in a state may expect the DOT to demonstrate why one project is a higher public priority than another with

an "apples to apples" comparison. This type of comparison is not possible if the answer is simply "because this project is on a mode that has funding." In these cases, expressing programming rationale and outcomes in terms of mode-neutral scores (or even dollars) can provide the desired accountability for state dollars.

- ✓ **Strategic Objectives Supporting Modal Connections:** A statewide multi-modal or freight plan may have a specific performance objective associated with emphasizing projects to improve or enhance multi-modal connections. In these cases, both developing and prioritizing projects with intentional multi-modal features can tie project outlays to a wider objective of enhancing connection between modes.

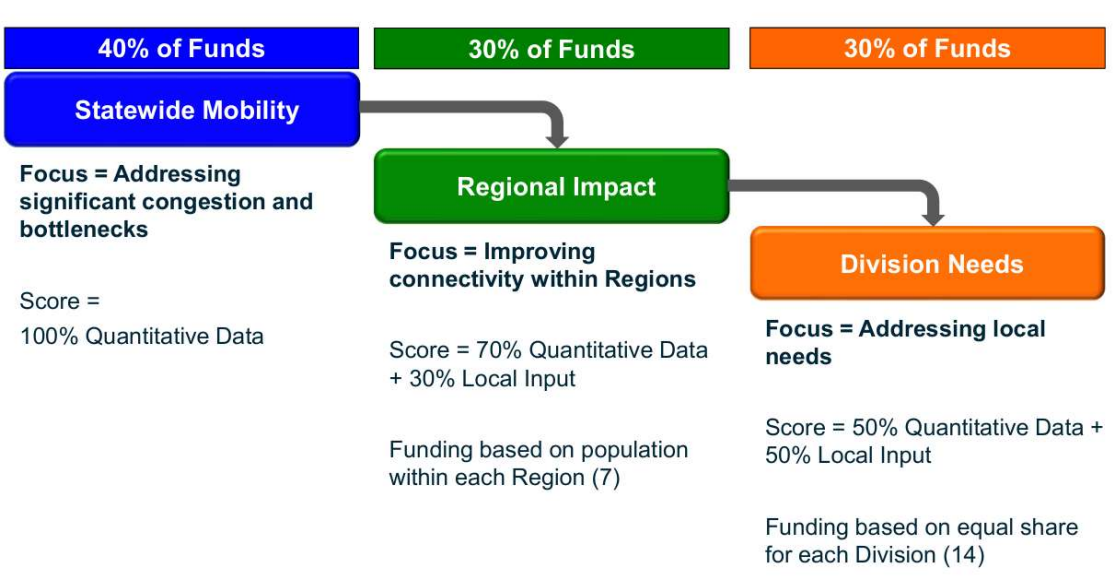
By contrast, mode neutral approaches may be problematic in cases where:

- × **Limited Program Size:** There are inadequate funds or identified project needs in non-highway modes to meaningfully assess them in relation to highway projects.
- × **Analytical Bandwidth:** The state lacks the data or staff capability to apply complex economic or multi-criteria analysis needed to arrive at and explain mode-neutral criteria.
- × **Policy or Legislative Constraints:** A significant amount of DOT funding is either designated for or precluded from a specific mode or group of modes.

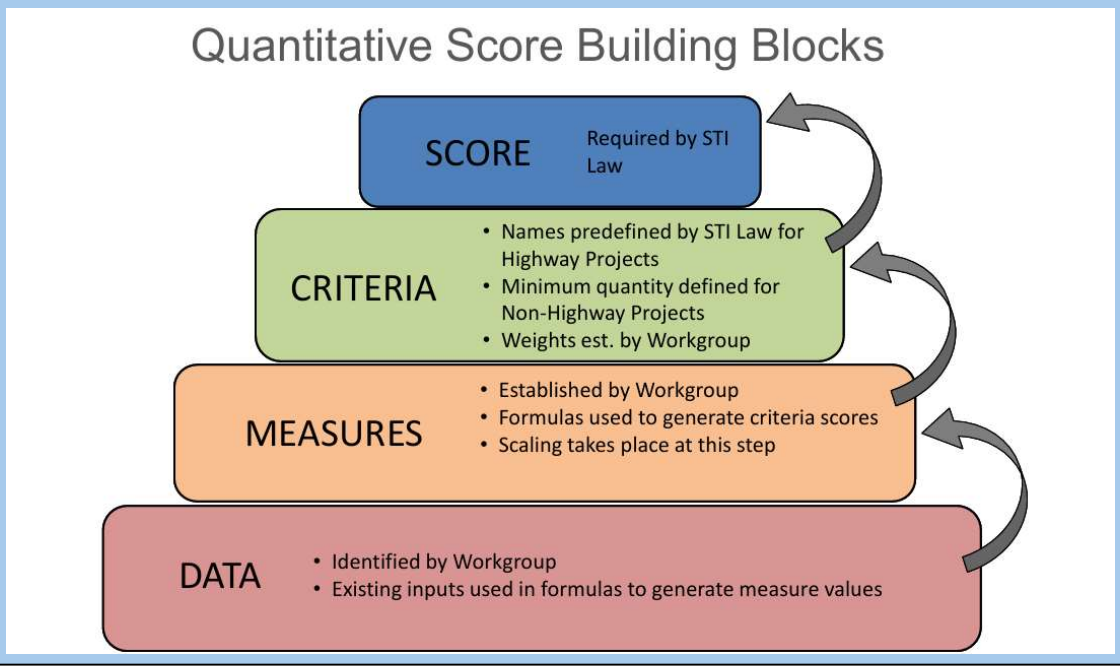
North Carolina Strategic Transportation Investments (STI): Mode Neutral Investment: In 2013 the North Carolina legislature adopted the Strategic Transportation Investments (STI) act. The act was explicit in its direction for the North Carolina Department of Transportation (NCDOT) to apply a systematic and data driven process based on multi-modal characteristics of projects.

North Carolina Strategic Transportation Investments Legislation (Continued):

The legislation led NCDOT to develop multi-modal investment and programming categories for projects achieving different strategic objectives including (1) Statewide Mobility, (2) Regional Connectivity, and (3) Local Needs. These categories include investments across all modes of transportation and allocate funding by strategic objective category instead of by mode.



Within the STI investment and programming framework, mode-specific data are provided to a statewide working group, which then assigns measures and criteria appropriate to each mode, assigning overall project scores which are then used to develop the multi-modal program. Hence while scoring is based on modal data and criteria – the scores themselves are comparable and are used to allocate resources on a mode-neutral basis among the three strategic areas shown above.



The North Carolina case is instructive as it clearly demonstrates key steps for arriving at a statewide mode-neutral programming rationale including:

- ✓ Identifying and assembling meaningful data to make quantifiable measures of need and existing performance available for projects on all modes in the program.
- ✓ Allowing each mode to have its own measures and criteria to earn "points."
- ✓ Involving a working group of individuals familiar with the infrastructure and the states' overall performance objectives to arrive at scores.
- ✓ Assigning scores to projects within the context of overall programming levels established around strategic outcomes.

It is also notable that NCDOT avoided certain pitfalls by:

- × Not assuming the same measures and criteria could apply to every mode of transportation.
- × Not allowing some modes to be based on quantitative data while others were purely subjective.
- × Not relying on "blind formulae" to make the programming decisions, but instead applying the judgment of expert working groups informed by data and measures.

Cross Asset Allocation in Freight Programming

What is Cross Asset Allocation? When engaging in multi-modal freight programming, whether in program-specific contexts or mode-neutral contexts - an important issue to consider is "Cross-Asset Allocation" of funding. Cross-asset allocation is broadly understood as the challenge of achieving overall statewide performance objectives such as "safety" or "mobility" (which tend to be mode neutral) by making investments in assets that contribute to those wider goals in very different ways with different costs.

Using a Cross-Asset Allocation Framework: Using a cross-asset allocation framework can help a DOT tie its methodology for programming multi-modal freight projects to the wider objectives of its statewide and multi-modal plans by beginning with the wider goals and objectives the plans serve, and "backing in" to a performance profile consistent with those goals. It can then assess the costs of meeting those goals and the most efficient project mix to cover those costs. The figure below illustrates the sequence of questions a DOT can confront in a cross-asset allocation strategy.

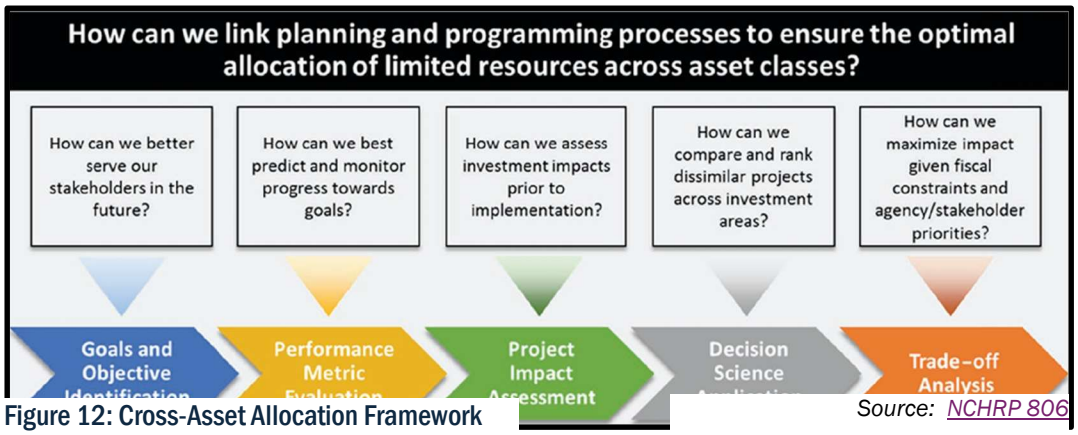


Figure 12: Cross-Asset Allocation Framework

Source: NCHRP 806

Top-Down Vs. Bottom-Up Approaches

Bottom-Up Approach: In many of the program-focused approaches described in the previous section, states may apply a "bottom up" approach to STIP development. In a "bottom up" approach, states will identify needs by individual program, allocate available revenues between programs to meet minimum needs, and prioritize the highest priority needs within each program.

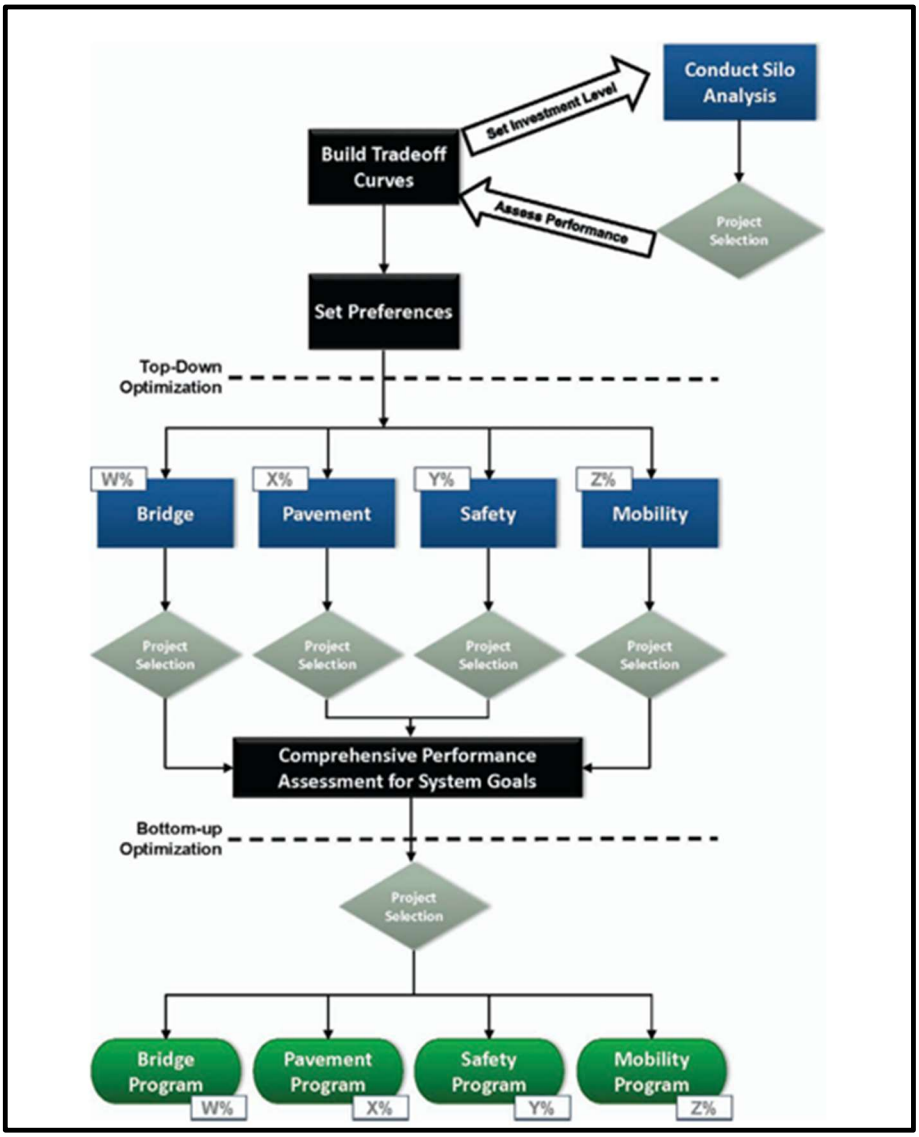


Figure 13: Example of Bottom-Up Approach
Source: NCHRP 806

This type of approach (shown in the bottom half of the figure to the right) understands the STIP primarily as a combination of program-level investments with program-level goals that are hoped to collectively achieve performance targets.

When it comes to freight, the bottom-up approach can be very limiting because (1) some freight investments may be in a class by themselves, creating a binary choice of whether to include or exclude a project, (2) the bottom-up approach overlooks the dependence that freight assets may have on other programs, and (3) there is not an intuitive connection between a freight investment and the larger performance goals of the DOT.

Top-Down Approach: By contrast, a top-down approach (shown in the upper half of the figure), establishes goals and preferences for the overall transportation system, and then estimates the investment levels each program may need to achieve these larger objectives, prioritizing investments against high-level strategic goals, and only assigning projects to programs after they have been prioritized. The top-down approach enables processes like the NCDOT process. The top-down process can also create a way to maintain functional program categories with their own distinct needs without isolating non-highway freight projects from the larger programs which have more funding and projects.

Projects Contribute to Multiple Common Objectives

Freight projects can play an especially important role in cross-asset allocation because freight can enable a single project to have profound implications across multiple performance areas. For example, enhancing the capacity (or changing the location) of a port, air cargo facility or major inter-modal freight rail facility can have more of an impact on inter-modal truck volumes, safety, emissions and demands on the highway system than any singular project in a highway program. **Figure 14** illustrates in conceptual terms how in a cross-asset allocation process, a program can be developed that is composed of projects which support multiple objectives.

Figure 14: Cross-Asset Allocation Process

Source: NCHRP 921

Practical Considerations for Understanding Freight Projects in Cross-Asset Allocation Terms

Some practical ways to incorporate cross-asset allocation principles when programming freight projects (either within or outside of a statewide overall cross-allocation strategy) include:

- ✓ **Designate Indicators in Planning Studies:** In planning studies for freight projects explicitly address and use the same measures that the DOT uses in other programs of the STIP (such as impacts on VMT, pavement and bridge condition, safety and other areas common to DOT programs)

- ✓ **Compare Relevant Indicators to Projects in Other Programs:** Consider ways to quantify the relative changes that a freight improvement can make (or relative needs the freight project represents) in these areas using comparable measures.

- ✓ **Apply Cross-Allocation Indicators in Case-by-Case Situations:** If the DOT has relatively few freight projects (addresses on a case-by-case basis) – contextualize the freight project or projects in terms of how its needs and expected outcomes compare in magnitude to the needs or outcomes per $ of investment of other programs or investment types.

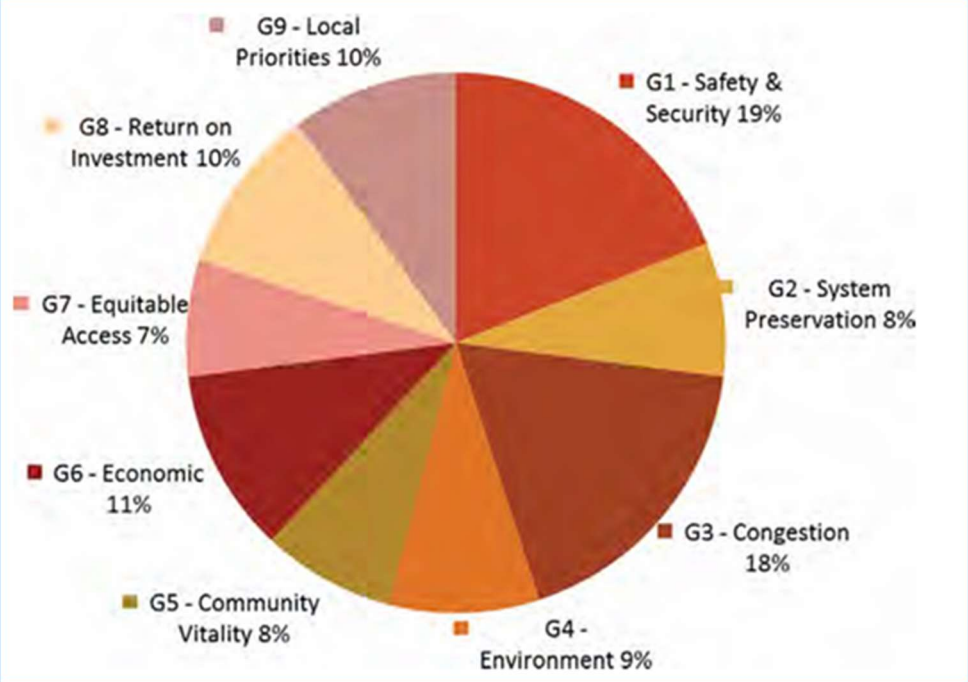
Cross Asset Allocation Tool

NCHRP 806 Makes an Interactive Cross-Asset Allocation Tool available to state DOT's. The tool can be applied to freight investments to contextualize them within the wider context of a STIP process.

Maryland DOT and the Maryland Open Transportation Decision Act: The Maryland Open Transportation Decision act of 2017 requires MDOT to develop a project-based scoring system to rank major capital transportation projects being considered for inclusion in the comprehensive transportation program. The law defines mode-neutral performance areas by which MDOT's investments must be programmed. Maryland DOT supports this law with a scoring model that evaluates projects across the nine goals and 23 measures using a combination of project data, modeling analysis, and qualitative questionnaires.

Floating Scores: In any given cycle, the range of scores may "float" in the sense that they are indexed such that the highest score of any project on any given measure is set to "1" and the lowest is set to "0" such that all projects on each of the 23 measures achieves a score indexed between 0 and 1. It is notable that this arrangement can allow the exact same project to have different scores in different cycles.

Measures Within Broader Goal Areas: With all of the scores normalized for each of the 23 areas the areas can then be grouped into nine groups and weighted according to the strategic importance of each goal area. It is notable that freight performance is not a goal area, but rather is included among measures in multiple areas. Goal area 3 (Congestion) includes measures of reliability and inter-modal connectivity supportive of freight projects and Goal Area 6 (Economic) has measures for movement of goods and services and support of local economic development strategies. The figure below shows how Maryland weighs all projects in its program against mode-neutral goal areas in its program, thereby implicitly including some freight projects.



Source: NCHRP 921

Play 5: Evaluation Process

When the state DOT recognizes a need to address freight investments in its STIP process (as explored in Play #1) and has an approach to addressing the unique value of its mix of modes (as explored in Play #4), the state can benefit from considering the unique challenge of evaluating freight projects. Like all projects, freight projects in the STIP are evaluated against statewide performance targets. Play #5 offers further consideration of how these targets as established in statewide freight plans in developing a STIP.

The evaluation of freight projects in a DOT programming context raises unique challenges:

- **Universally Accepted Criteria:** Freight does not have the "universally accepted" criteria for defining needs that are common to other investment areas. For example, bridges have sufficiency ratings, safety has crash rates, pavement has IRI and bottlenecks have VMT or Volume/Capacity ratios – there are not universally accepted measures common to freight across all states.

- **Freight criteria can be indistinguishable from other criteria:** In the absence of well-established criteria unique to freight – (and the fact that many states simply program federal freight highway funds in the STIP) – freight investment criteria can be indistinguishable from other criteria – including measures like VMT, or truck VMT, or crash rates – but offering little to identify and show the unique need or value of a freight project.

- **MPO's and DOT's may not apply consistent criteria:** Many MPO's have significantly more visibility on freight performance than is available to a DOT statewide. MPO's may have extensive passive data, models and studies of specific freight facilities in their area which they can use in their TIP's. However, the MPO's in a state may not evaluate freight in the same way or even have the same type of freight facilities.

- **Sufficient data are often not consistently available for freight criteria:** Freight criteria that are often shown in academic literature (such as freight fluidity measures) may rely on freight routing, origin/destination data, trip duration and incident recovery statistics not readily available to DOT's. While this information can be derived from "big data" sources, the investment of time and effort in the derivation process, and consistently defensible methods for doing so have yet to be established across states.

- **The benefits and impacts of freight investments are not localized to the state:** Because such a large percentage of freight traffic passes through most states – it can be difficult to establish the value of a freight investment to a state DOT. For example, if an intermodal rail facility accommodates cross docking and generates substantial concentrations of truck traffic in one state – it is entirely possible that investments by that DOT could be just subsidizing lower delivery cost for users in other states. This makes it difficult to evaluate freight investments in a statewide programming context.

This play will explore practical ways that DOT's can address these challenges when incorporating freight investments into their STIP.

Identify Consistent and Distinct Criteria for Freight

One of the greatest challenges of programming freight projects in the STIP can be determining what distinguishes a project as a "freight project" beyond the fact that it is being paid for with national freight highway funds or has trucks on it. The challenge is further exacerbated by the comparative lack of investment-qualifying performance data on the rail and water modes (or agreement among states or even within a state as to what such data should reveal). Evaluating a freight investment for STIP purposes entails the ability to consistently pinpoint and compare needs across projects (or in some cases between freight projects and other projects). Selecting investment criteria will depend significantly on the modes of transportation involved and sources of available data. The following are some considerations:

Evaluating Highway Freight Projects: While federal highway funds provide the criterion to demonstrate in the STIP that projects contribute to freight performance, often this criterion is satisfied simply by reporting the VMT of the facility, or the Heavy Commercial VMT. The incorporation of freight projects in the STIP can be considerably enhanced at the DOT level by developing composite metrics available to the DOT. Examples are as follows:

Table 3: Examples of Broad Measures Commonly Applied to Freight Highway Investments in STIPS

Broad Measures Commonly Applied to Freight Highway Investments in STIPs	Refinements made by some states that are available to all states
Overall VMT	• Heavy Commercial VMT • Heavy Commercial VMT in Peak Truck Season • Heavy Commercial VMT as a % of all VMT • % of Heavy Commercial VMT on congested links (if statewide models exist)
Overall Crashes	• Truck involved crashes per Heavy Commercial VMT • Fatal Truck Crash involvements per Heavy Commercial VMT
Composite Measures	• Annual Truck VMT on "poor" pavement condition • Number of Bridges close to trucks (due to bridge condition) by functional system
Non-Quantitative Measures	• Highway link has a strategic corridor destination • Highway link provides direct or indirect access to a major industrial site (defined in terms of level of output or employment) • Highway link completes a "missing link" in an interstate or NHS Connection

	• Highway link provides more direct access to a freight inter-modal facility.

Evaluating Rail and Waterway Projects: For rail and waterway projects, there is not a challenge of distinguishing freight from non-freight criteria since freight is generally already isolated on these modes. States are advised to consult the Army Corps of Engineers Waterborne Commerce Statistics Center (WCSC) to choose from widely available data for assessing port projects, and the Federal Rail Administration (FRA) and the American Association of Railroads (AAR) for data and available measures to support rail freight investments.

Widely available criteria that can be applied in evaluating rail and waterway projects include:

Table 4: Criterion Commonly Used by States

Type of Criterion	Examples Commonly Used by States
Size of Addressable Freight Market	Ports: Tonnage of Throughput Rail: Carloads, Carload + Inter Modal Tons
Condition State of Good Repair	Design exceptions per 100 miles of track (rail) Rail Operating Speeds (per AAR) Age of Locks, Delay Per Lock (waterway) Age of Ports & Time since last improvement
Safety Performance	Rail Crashes Crashes entering/egressing Port Property

To the degree that states can obtain and report metrics like the above examples for the freight projects considered in their STIP, the better able they will demonstrate the distinct value of their freight investments within the context of their overall program.

Address areas of Consistency/Inconsistency with MPO's

A consistent issue found in this research is the variation of project selection and evaluation across their jurisdictions in the prioritization and programming of freight projects. This issue typically arises because large MPOs/districts have established scoring criteria that have historically been effective for them. Large urban areas have unique freight needs that differ significantly from other regions in the state. These variations in the project selection process make it challenging for a central authority like a state to create a uniform project selection and programming process that works across all MPOs/districts. While MPOs are responsible for programming investments in their TIPS in ways that are appropriate for their areas – bringing freight into the STIP opens the DOT up to questions regarding why similar projects in different MPO areas may be viewed differently – and why in areas

outside of MPO's the DOT itself might view a freight project differently from one in a metropolitan area. The example below from Texas demonstrates how two MPOs in the same state can treat freight investments very differently.

Table 5: Examples of Divergent MPO TIP Freight Criteria within Texas

Example of Divergent MPO TIP Freight Criteria Within Texas	
Dallas-Fort Worth (North Central Texas Council of Governments) TIP 2023-2026	***El Paso MPO TIP 2023-2026***
How are Projects selected? • *Review unfunded projects in the Metropolitan Transportation Plan (MTP)* • *Projects get a Selection Score based on two components (system selection and technical selection)* • *System selection: Stand-alone project vs when a project is a part of larger system or phased implementation.* • *Technical selection score: Based on metrics such as congestion reduction, system reliability, safety, freight movement, and infrastructure condition among others.* • *Only Four Performance measures are considered: the highway safety improvement program, pavement and bridge condition, system performance/freight/CMAQ and transit asset management.*	***How are Projects selected?*** • *Evaluating projects that can achieve FAST National Performance Goals, identifying strategies in EPMPO's Congestion Management Process, and incorporating Regional Mobility Strategy efforts.* • *Eight goals with their performance measures are used (safety, maintenance, mobility etc.)*

Leveraging the Statewide Freight Planning Process:

The statewide freight planning process offers a unique opportunity to engage with MPO's throughout the state regarding how they address freight projects in their TIP's. While STIP level programming is not an explicit focus of the statewide planning process, it is an opportunity to seek a holistic rationale for how and why freight investments are viewed differently throughout the state. When a state includes (or seeks to include) consistent freight investment criteria in its STIP and has divergent evaluation criteria among its MPO's some questions to address in the statewide freight planning process may be:

<u>Freight Evaluation DOT/MPO Planning Questions:</u>

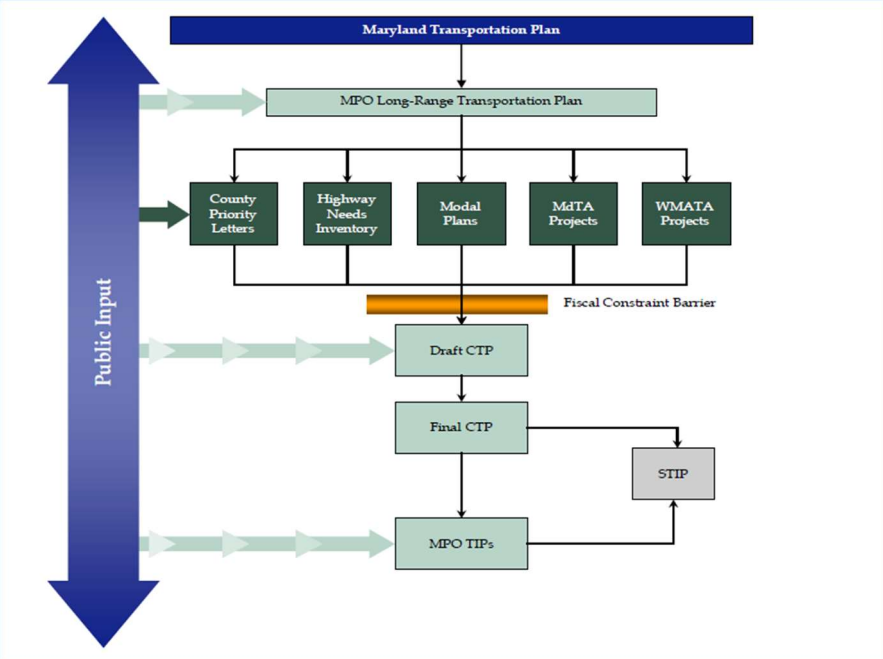
- ✓ **What aspects of the statewide freight portfolio are common across the state's MPO's?**

Are there encompassing or similar metrics used for the common measures that can be reconciled through future planning cycles?

- ✓ **What aspects of the statewide freight portfolio are divergent between the state's MPO's?** *Do these differences represent unique needs and performance areas for the state?*
- ✓ **What investment choices outside of the MPO's entail outlays for infrastructure similar to those made within/by MPO's?**
- ✓ ***Are there evaluation criteria for non-MPO state freight investments that encompass the divergent ones used by MPO's?***

Divergent freight investment evaluation criteria between MPO's within a state or between MPO's and other areas in a state are not intrinsically problematic. However, when all the investments are included in the STIP, it is helpful either at the level of statewide planning or in the STIP document itself to provide context for how the different criteria represent nuanced investment needs throughout the state.

Reaching Consistency – Maryland's Fall Tour and County Priority Letters: The STIP development process of MDOT is first informed by the MTP (Maryland Transportation Plan) and long-range transportation plan of each MPO. Throughout the STIP development process, there is regular interaction between MDOT, transportation business units, SHA (State Highway Association) Engineers, and county staff.



The STIP is used to implement Maryland's six-year capital investment program, MDOT's Consolidated Transportation Program (CTP). A key component of developing the CTP is the annual CTP/STIP fall tour, which is required by state law for the Secretary of Transportation to visit with and present to each of the State's County jurisdictions and the City of Baltimore, the annual draft CTP. Each county submits its list of projects based on local needs and local input to MDOT prior to the draft of the CTP, which is referred to as county priority letters. After county priority letters are received in the summer, a draft CTP is prepared, setting up the annual fall tour, where comments and concerns regarding the project list are documented and reviewed for the final CTP. Once the final CTP is approved by legislature, all projects are updated into the seven MPO TIPS and the STIP.

Explore Decision Support Resources and Technologies

Many state DOT's benefit from the use of special studies and decision support technologies when evaluating freight projects for inclusion in their STIP. These studies and technologies can significantly reduce the bandwidth required of agency staff to apply weights and performance criteria to a universe of potential projects and make it feasible to readily communicate how and why freight projects are treated as they are in the STIP. Examples of popular decision support technologies for evaluating and communicating freight projects in the STIP include business utilization/market studies, multi-criteria evaluation software and interactive dashboards.

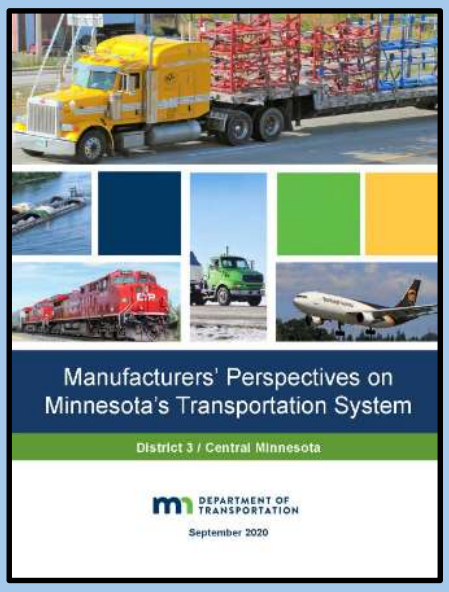
Freight User Surveys and Reporting Technologies

By surveying and interviewing a state's shippers, a DOT can acquire details about how and where freight projects add value to the program in ways not otherwise available. In addition to surveys and interviews with shippers, technology can enable observation of freight conditions and performance to reveal needs and potential payoffs of including freight projects in the STIP. The Minnesota Department of Transportation (MnDOT) utilizes these techniques as demonstrated in the below instructive examples.

MnDOT Making the Most of Freight Surveys and Data: MnDOT uses first-hand information about freight utilization to support its STIP programming, including both an innovative pavement condition rating based on digital inspection, and a Manufacturers Perspective initiative for giving shippers direct input to how MnDOT understands freight needs and performance.

Pavement Condition rating using Digital Inspection Vehicle: MnDOT collects pavement condition through Digital Inspection Vehicles which use three lasers mounted across the front bumper for collecting 3-dimensional images of the pavement structure, and they take a measurement approximately every 1/8 inch as the van travels at highway speed. The cameras capture the pavement distress, and right-of-way images, and help assess the overall condition of the shoulders. Using the data, a forecast for degradation of pavements and the rate of decay is estimated to identify projects and ensure that the STIP includes investments such that federal performance goals are met.

MnDOT Making the Most of Freight Surveys and Data (Continued):



Manufacturer's Perspective on Minnesota's Transportation System: MnDOT collects feedback from manufacturers on the transportation system which helps identify the challenges faced by manufacturers and other freight shippers in the region, enabling MnDOT to develop policies that address these issues. The goals of the Manufacturer's Perspective Study on Minnesota's Transportation System (2020)[1] are:

- Meet one-on-one with the manufacturers and leading industries in each district to understand their perspectives and priorities for the transportation system.
- Systematically collect and analyze customer information to inform practical, near-term planning and operations, policy development, and decision-making about investments.
- Build relationships among MnDOT, economic development professionals, manufacturers, and freight transporters to sustain both short-term and ongoing transportation system improvement.
- Support statewide continuous improvement and develop recommendations for enhancing transportation systems and practices to support freight movement.

The MnDOT examples demonstrate how taking data directly from the shipping and trucking operating environment can provide practical insight for both developing and validating the needs for projects to support freight trucking activity in the STIP.

Multi-Criteria and Prioritization Tools

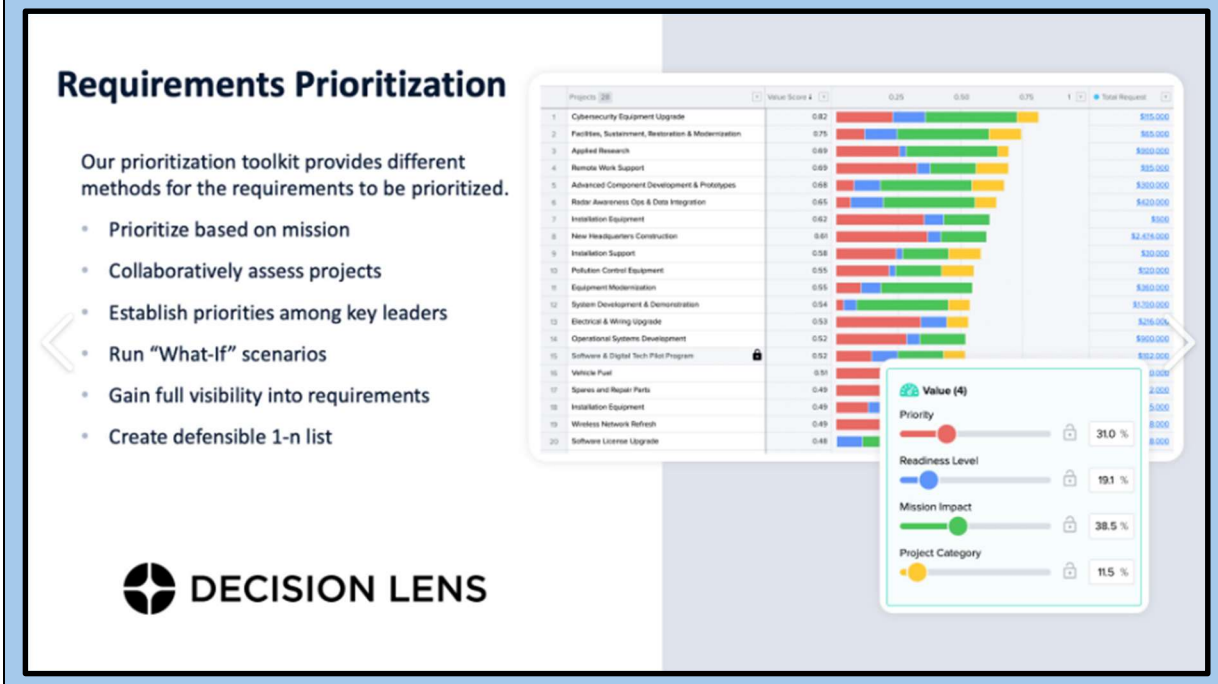
Increasingly states engage Multi-Criteria Analysis (MCA) to create weighted scores for projects in the STIP. As described in the discussion of mode-neutral program development in Play #4, MCA gives the DOT the opportunity to index continuous variables (like VMT or crash rates) with categorical measures (such as rating the strategic importance of a location on a 1-5 scale) into a consistent score. By normalizing criteria to be scaled in the same way, a DOT can weight different criteria to reflect the policy priorities of the DOT. When freight projects are considered in a STIP, multi-criteria methods provide an opportunity to scale freight needs and anticipated outcomes on levels appropriate for freight modes and facilities while still using the same performance areas as other programs. The Arkansas DOT experience with the Decision Lens process offers an instructive example of this type of decision technology.

Applying Multi-Criteria Tools in Arkansas:

The Arkansas Department of Transportation (ArDOT) develops its STIP in the following steps:

(1) Arkansas State Highway Needs and Capital Improvements Study
(2) Determination of the Funding Distribution by Category
(3) Decision Lens Software Ranking of Projects
(4) Project Selection Validation
(5) Final Project Selection

Once ArDOT completes the needs assessment and capital investment goals, the Highway Commission determines the investment plan for the STIP. Following the practice of performance-based planning and programming, since 2014 ArDOT's project prioritization includes a software program called *Decision Lens*. The *Decision Lens* technology-enabled process allows key decision makers to go through an iterative process of registering their weighted preferences regarding the importance of different indicators and applying them to the observed data on system conditions at the beginning of the programming cycle. Freight is explicitly defined as a category along with system reliability, congestion and air quality for consideration and weighting within the larger STIP context.



The Arkansas *Decision Lens* process addresses key program areas including bridge preservation, pavement preservation, capacity improvements for congestion relief, safety improvement and capital improvement by allowing participants to score different aspects of each type of investment and its role in the program. The *Decision Lens* process creates "data" regarding where departmental priorities lie, which can then inform the weighting of criteria in a multi-criteria scoring framework for the Arkansas STIP. The software provides an overall ranking for each

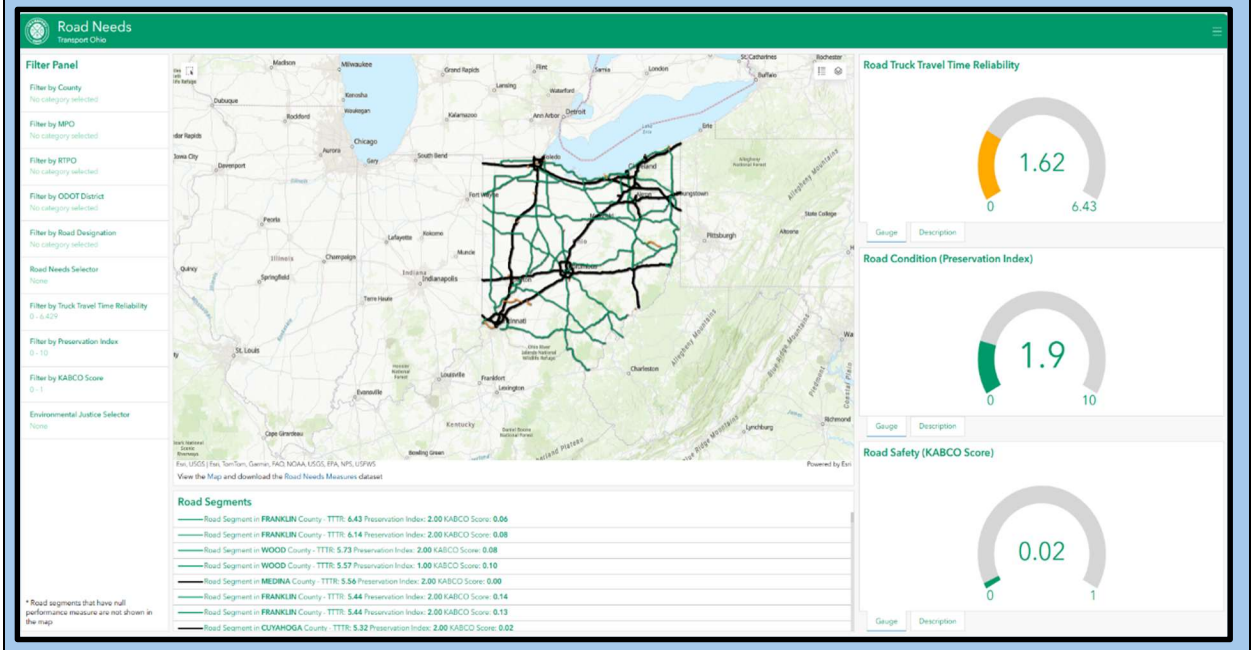
project by category and based on funding availability under each category, the top ranked projects are a potential candidate for selection.

Addressing Freight in Performance Dashboards

Performance dashboards are becoming increasingly popular with DOTs for placing performance needs, projects and priorities within the context of a "one-stop-shop" environment for exploring the location and nature of programmed projects and identified needs.

Applying Freight Performance Dashboards in Ohio:

The Ohio Department of Transportation (ODOT) uses freight dashboards in its freight statewide planning with sufficient resolution to carry over into programming for the STIP. While the statewide plan and the STIP are separate processes, ODOT has a dashboard that enables users to visualize on a map the specific location of freight projects, hot spots/needs, and where specific potential project locations stand relative to overall statewide performance. The dashboard allows users to see where needs are located and to select different maps of the system to view needs by program areas (such as pinpointing areas of high truck traffic with poor pavement condition, congested truck traffic, high truck crash locations, and areas of unmet need for truck parking. The Ohio Dashboard demonstrates how through visualization and spatial analysis of freight needs in the planning process – a practical understanding of how and where freight needs may be addressed in the STIP align with overall goals and objectives.



Play 6: Right-Sizing and Incorporating Uncertainty in the STIP

Funding uncertainty is an increasing challenge for state DOT's when considering freight investments in the STIP. With an increasing amount of transportation outlays associated with federal discretionary grants, it is possible that states will find they have additional money beyond what has been projected if an existing or new grant program covers a project. Furthermore, the cost escalation of the period 2021-2022 demonstrated the possibility that states could be able to cover less work than anticipated in any given STIP cycle. For these reasons, the flexibility of the STIP to have programming options for upside and downside scenarios, to become "future proof", is increasingly important. This play focuses on ways that state DOT's can build this flexibility into the STIP process to make the most of new opportunities and be prepared for unexpected shortfalls.

Include Illustrative Projects Beyond the Current Time Horizon

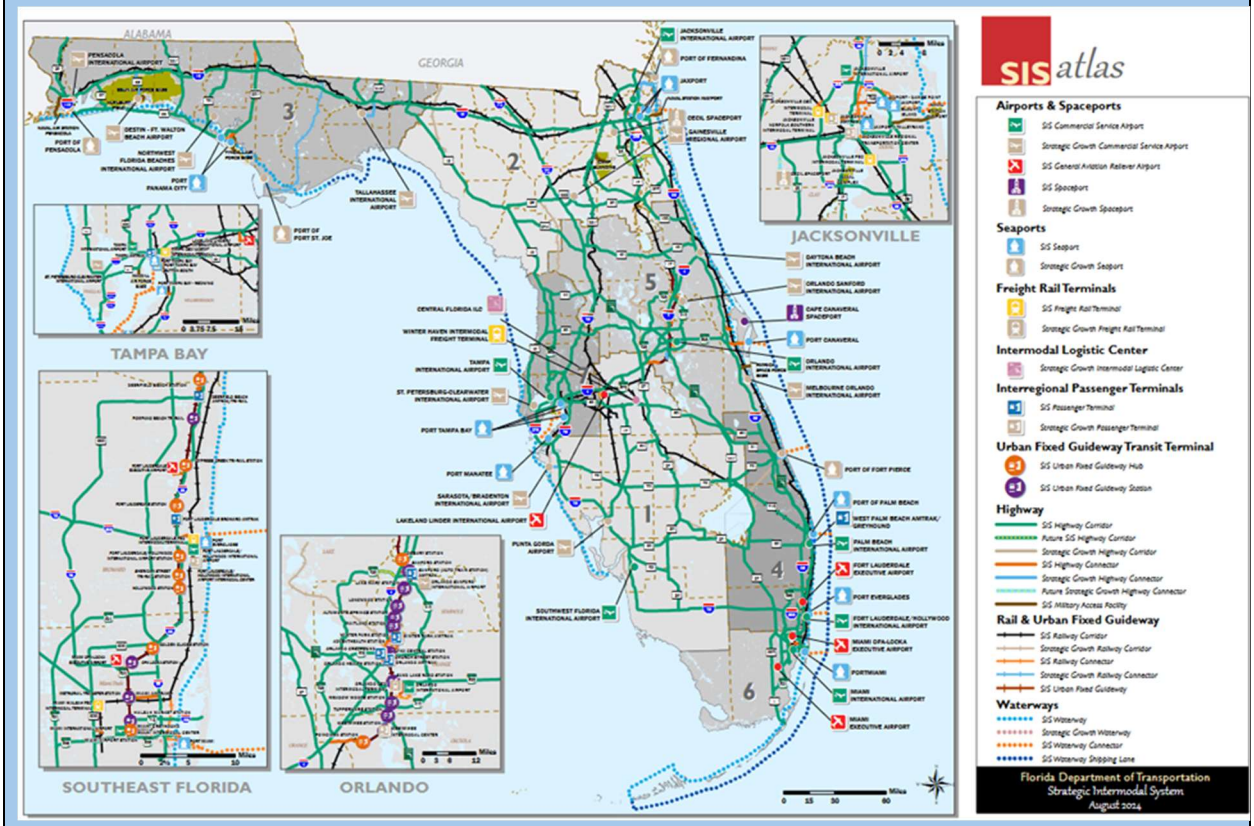
Strategic Approaches to Discretionary Grants:

To make the most of discretionary grants, some states have developed strategic systems for identifying unfunded projects in the STIP and prioritizing them for grant funding. This strategy involves a database that includes both the funded and unfunded projects, and applies criteria associated with each discretionary grant program to unfunded projects – such that when a federal grant opportunity is posted, the DOT already has a prioritized list of which projects best meet the criteria, has a match identified and is ready to integrate the project into the STIP. West Virginia and Ohio are examples of states that have these strategic and data-driven linkages between their STIP's unfunded projects and discretionary grant opportunities.

Include Near and Long-Term Projects

States can also prepare for potential new funding opportunities by including near and long-term projects in the STIP. States like Missouri, Florida and Minnesota include committed projects programmed to occur within the required STIP time horizon *and* envisioned long-term projects for 4-5 years beyond the current STIP. Including these un-funded/illustrative projects gives the DOT the advantages of (1) being able to more quickly develop the next STIP in each cycle, as there are already projects identified and ready to be brought in for each successive year, (2) having projects already identified if new funding sources should be available and (3) having a clear set of project development priorities for planning efforts to ensure projects are ready to deliver when they do enter the funded STIP.

Illustrative Future Projects in Florida: The Strategic Intermodal System (SIS) is Florida's top-priority network of transportation facilities essential to the state's economy. It was established in 2003 by the Governor and Legislature to direct limited transportation funding towards facilities that are key for regional, interstate, and international travel. The SIS facilities support multimodal passenger and freight movement and include highway and rail systems, airports, waterways and intermodal logistic centers. The SIS capacity projects are funded by the legislature and are listed in the FDOT Adopted Work Program, and subsequently in the STIP (projects that are in the adopted work program go into the STIP). The SIS funding cycle occurs through three stages (i) The first five-year plan are projects that are programmed for funding in 2-5 years (ii) The second five-year plan illustrates projects that are planned to be funded in the five years (6-10) beyond the current adopted work program (iii) The cost feasible plan illustrates projects on SIS that are considered financially feasible during last fifteen years.



Freight Programming Under Uncertainity

The Weakness of a STIP Based on Forecasts: Futureproofing a STIP involves attempting to address the uncertainty presented by factors not fully understood when scores are developed. Futureproofing (as described in NCHRP Web-Only 386) involves identifying and understanding the

most significant forces that could affect the program and determining how best to position projects that will perform under the broadest range of potential futures. When the time horizon for a return on decisions is short, forecasting works quite well. Forecasting is based on historical data and projects forward one potential future, often with tolerances or ranges around that future much in the way the potential path of a hurricane is shown **Figure 15** to the right.

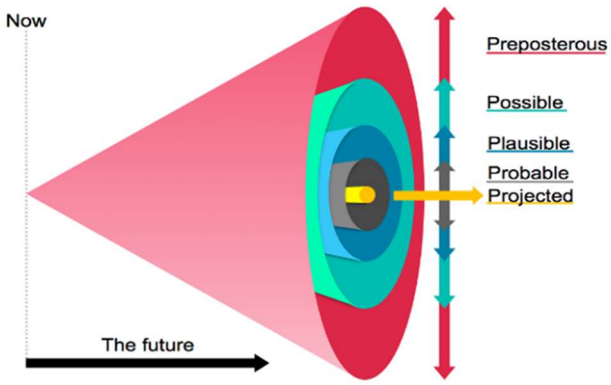


Figure 15: Forecasting Based Decisions

Time horizon for future outcomes: The farther out from the point at which the forecast is made the less reliable the outcome. Scenario planning enables a longer-term approach. It is based on identifying key driving forces that could affect a desired outcome and develops multiple possible futures shaped by those forces. It integrates into potential futures the external forces that can shape the destiny of that future. Decisions can then be made within the context of the potential future. It is a way of addressing uncertainty in long-term decisions. It is a way to try to futureproof a program.

The Value of Scenario Planning

Why Scenario Planning for the STIP?: While scenario planning is common in long range freight plans, the use of scenario planning in the STIP process is still in its infancy. However, there are ways that a consistent and intuitive scenario planning framework can support freight programming decisions in a STIP. This is especially true because freight projects often have higher costs requiring longer life-cycle benefits and higher vulnerability to technological and economic change than other projects in the STIP.

Drawing on the NCHRP Foresight Series: The NCHRP Report 750 Foresight Series: Strategic Issues Facing Transportation examined global and domestic long-range, strategic issues and their implications for state departments of transportation (DOTs)

The series covers goods movement, climate change, technologies, sustainability as an organizing principle, energy, socio-demographics, and preservation, maintenance, and renewal of highway infrastructure. Each report of the series seeks to look forward 30+ years. As a method to address the uncertainty of looking that far forward, scenario planning and variations on the scenario planning method were extensively employed. For example: The first volume in the series, Scenario Planning for Freight Transportation Infrastructure Investment, contains a section on the background of the

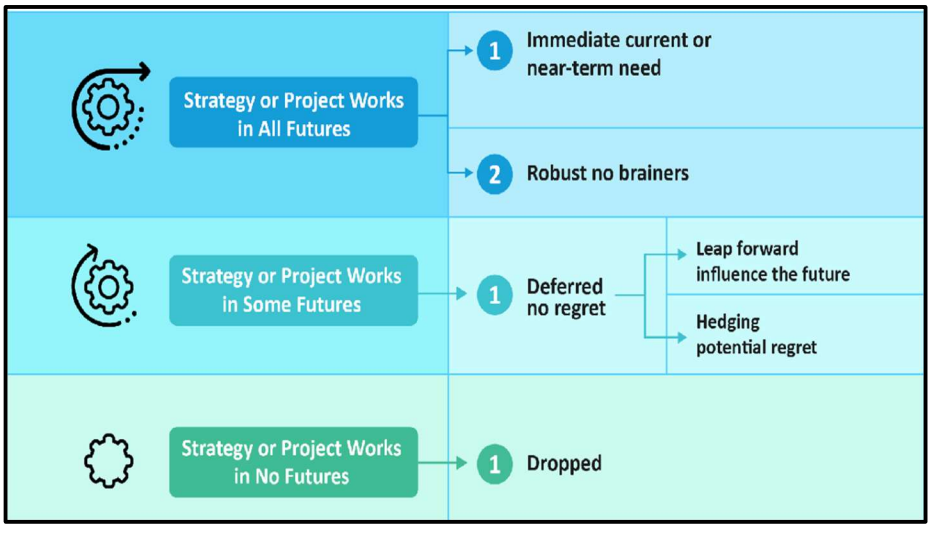
scenario planning methodology. In addition to multiple examples of scenario planning initiatives, it notes "Scenarios are methodically constructed stories about alternative futures in which today's decisions might play out."

Questioning Unspoken Assumptions: The series goes on to note that for scenario planning to be effective scenarios should "make the decision makers see the future in new ways and question their unspoken assumptions." and "we must open up our minds to multiple possibilities, rather than use mental constructs that are rooted in past experience and guided by personal beliefs and preferences." Later in the 4th volume, the series explores how a scenario planning effort can reveal the opportunity to pursue no or low-regrets options that bring near-term and future benefits.

Investing for an Unknown Future: The sixth volume, The Effects of Socio-Demographics on Future Travel Demand, considers socio demographic issues 30+ years into the future and how those issues can change the transportation needs, travel patterns, and expectations regarding the mobility of the U.S. population. The report finds that modeling and forecasting only go so far. The report notes that "transportation planners often are asked to predict socio-demographic trends that will affect future demand for transportation infrastructure. The greater the degree of uncertainty associated with these trends, the more problematic the resulting decisions will be." "With knowledge of the limitations of models to produce accurate long-range forecasts, the research team focuses on developing a tool (Impacts 2050) that would help transportation planners and decision makers apply a scenario approach for handling uncertainty." That tool utilizes scenario planning methodology as its underpinning..

Decision Making Within Scenario Planning

To attempt to futureproof freight investments in the STIP, decision-makers need to have as reasonable an understanding of what potential futures could evolve as possible. They then need to be able to evaluate decisions against those futures. Scenario planning expands the view of the potential futures and the potential environment within which the freight system will operate. Evaluating how potential projects or strategies would or could work within each future provides an opportunity for the decision-makers to prioritize projects or strategies that provide maximum utility across the broadest range of potential futures. The Figure 16 shows how scenario planning can reveal the opportunity to pursue no or low regrets options that bring near-term and future benefits. It also highlights that decision-makers need not be simply reactive to potential



Source: NCHRP 750 Series

futures; consideration should be given to priorities that can influence the future and how the investments could be used.

Build Economic and Technological Uncertainty into Prioritization

Two Dimensions of Freight Uncertainty: Economy and Technology

Economic Uncertainty: The rate of change in economic conditions and technology can greatly affect the intended performance outcomes of STIP priorities. Forecasting models are used to project freight volumes and associated capacity, and safety needs can shift rapidly with changes in trade or regulation. Examples like the emergence of the Amazon Prime e-commerce-driven air cargo market, the changes in routing from Post-Panamax vessels and shifts in agricultural commodity markets between Asia and Latin America are examples of changes not anticipated by STIP scores and which can affect intended outcomes.

Technology Uncertainty: Furthermore, changes in freight technology can greatly affect the needs and expected life-cycle payoffs of freight projects in the STIP. Developments such as accelerating autonomous and connected vehicle technologies across freight modes, increases in fuel efficiency, reduced safety costs (or obviating the need for some safety-based improvements), and demand management technologies for fleets are some examples of factors by which new technologies may obviate the need for some projects within a given STIP while rapidly creating new needs.

Over-Build and Under-Build Risk: Because these changes can occur faster than the DOT can deliver the projects in any given STIP cycle – these changes highlight the risk of both under-investment and over-investment in the STIP. Over-build risk places at risk the capital dollars in the present STIP cycle and increases the life-cycle costs of an asset that may be antiquated or obviated before generating its intended performance benefit. Under-build risk places risk on the larger economy as shippers and carriers face transportation deficiency costs for needs that the STIP did not anticipate. These risks (shown in the matrix below) leave DOT's with a need to reduce the amount of "gambling" associated with programming under uncertainty.

Scenarios	Modest Economic Growth	Aggressive Economic Growth
Modest Technology Growth	$ Benefits	$ Maximum Benefit for Infrastructure Investment
Aggressive Technology Growth	$ Minimum Benefit for Infrastructure Investment	$ Benefits

Figure 17: Risk Matrix

Source: NCHRP 917: Right-Sizing Transportation Investments

The Figure 17 illustrates how the actual "value" of a project will be the greatest if economic growth aggressively fulfills the need for the project and modest technology growth reduces the likelihood that the performance need for the project is satisfied in other ways. Likewise, it shows how the "value" of a project can be greatly diminished if economic demand shifts or does not materialize as expected and aggressive technology development solves the performance problem the project aims to solve.

Accounting for Over-Build and Under-Build Risk

NCHRP 917 offers a benefit-cost based methodology for addressing these risks by including 4 scenarios (corresponding with the cells of the above matrix) in the STIP. In this solution, the STIP will have 4 instances of its prioritization scores (represented in the example as net present value calculations), to allow the DOT to track economic and technology indicators and adjust priorities accordingly.

Overcoming Over-Build Risks: In many DOTs there has been a practice of building in a "stress test" to guard against deficiencies that may undermine the life-cycle effectiveness of a project. For example, engineers may double or triple the forecast heavy commercial traffic for a roadway segment when designing pavements, selecting materials or scoping projects "just in case" demand levels are higher than forecast. While this "stress testing" practice often can safeguard against costly re-builds or deficiencies for users, over time it has also led to over-built low-volume facilities with unsustainable life-cycle costs. The unsustainable life-cycle requirements of an extensive portfolio of low-volume facilities contributes to the perception of a "crumbling infrastructure" crisis and can crowd out future needs under limited funding.

The Right-Sizing Approach: A right-sizing approach to programming seeks to recognize both (1) the potential life-cycle cost to the agency of over-build and (2) the potential economic cost to users if under-build leaves a deficiency. By comparing the net cost of the project (to both the agency and the public) – it is possible to arrive at an "uncertainty cost" for a project. Knowing the uncertainty cost can enable the DOT to (1) pinpoint and protect the lowest-risk projects in the STIP in case of economic shortfall, (2) invest in projects with higher levels of risk when funds are available and (3) track economic and technological indicators through the program delivery process to make adjustments during the design and delivery process if shifts indicate a given scenario is more likely.

Example of Right-Sizing a Program: The table below demonstrates how traditional economic benefit and cost calculations of a STIP project set can reveal and help the DOT manage investment risk under different possible futures.

Project #	Cost	Max Public Benefit	Min Public Benefit	Max BCA	Min BCA	Max NPV	Min NPV	Net User Cost of Under-Build	Net Agency Sunk Cost of Over-Build	Highest Uncertainty Cost
1	$2.4	$4.4	$2.0	1.83	0.83	$2.00	($0.40)	$2.0	$0.4	UnderBuild ($2.0)
2	$1.6	$1.9	$1.2	1.19	0.75	$0.30	($0.40)	$0.3	$0.4	OverBuild ($.4)
3	$0.7	$1.2	$1.0	1.71	1.43	$0.50	$0.30	$0.5	None	None

Figure 18: Risk Investment Strategies Benefits and Cost Calculations

Source: NCHRP 917 Right Sizing Transportation Investments

In the example shown above, if an agency is prioritizing projects using a simple B/C ratio, "stress testing" for the most aggressive traffic & economic forecast available without presuming any change

in vehicle technology, Project 1 would be ranked first (BCA = 1.83), followed by Project 3 (1.71) and then Project 2 (1.19).

However, the department may have reason to expect more modest economic growth (either due to a long-term economic restructuring forecast by other state agencies, or because the state or region is reaching its development capacity), and there may be indications that the deployment of advanced vehicle technology is intensifying. In this case, Project 3 would be the top-ranked project (1.43) and neither of the other projects would even generate sufficient benefits to justify their costs.

Project 3 would also be the top ranked project if the agency were seeking to avoid a costly over-build and wanted to concentrate constrained funds only to those projects most likely to generate benefit regardless of how unknown technology or economic trends may develop.

The net present value analysis shown in the table is also helpful for understanding the relative magnitude of potential economic costs associated with either (1) over-building to an economic and technological future that does not materialize or (2) under-building and leaving a costly deficiency for system users. Using the net-present value equation, the "Net user cost of under build" shown in the table represents the present value of benefits that the project would generate for the public under rapid growth with modest technology progress minus the public cost of the project. In effect, if the project is not built – the column represents the anticipated maximum value of transportation performance benefit the public stands to lose resulting from the agency failing to do the project based on overly modest assumptions. In the same way, the next column, the "net agency sunk cost of over-build," represents money that the agency might waste if it were to build for a future that either does not materialize, or to solve problems that vehicle technology would greatly reduce or eliminate on its own. The final column simply reports which of these potential errors (over-build vs. under-build) represents the greatest cost, given the range of defined alternative scenarios.

The analysis shows that failing to build Project 1 would impose a greater cost than any other error that might be made due to uncertainty. The analysis also shows that the sunk cost of building Project 2 under overly aggressive market growth (and modest technology) assumptions would be a costlier error than failing to build the project at all. Overall, the final column further demonstrates that Project 3 is the "safest" project for avoiding any cost due to uncertainty (as it will generate benefits beyond its costs regardless). It should be noted that no single column in the table eliminates the uncertainty (the cost of failing to build Project 2 if needed is still four times the maximum benefit available from Project 3). Even without calculating costs as in the above example, agencies using multi-criteria prioritization approaches tied to growth in the size of the travel market (for any mode) and assumptions about crash rates, emissions and the value of time compromised by travel can sensitivity test multi-criteria scores much as B/C ratios are tested in the example