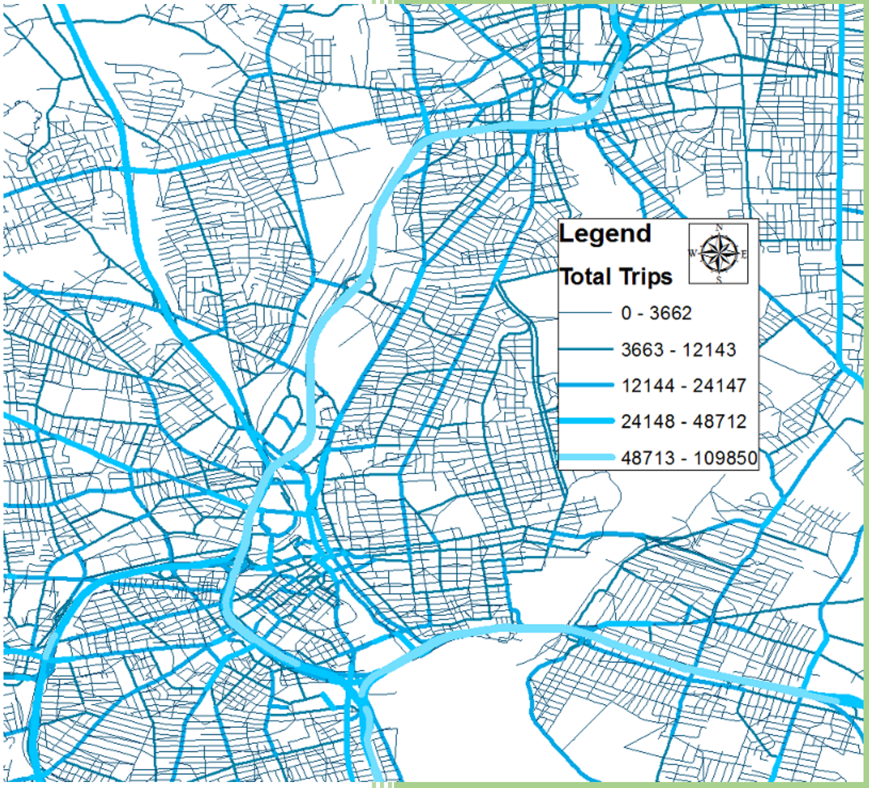
RISM Annual Report FY 2017-8



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Introduction

Greetings to all stakeholders of the Rhode Island Statewide Model (RISM), and thank you for your interest in the first Annual RISM Update Report. This report has two main goals. First, and in combination with the training program outlined in the RISM Model Maintenance Plan, this report aims to help you, our stakeholders, better understand what the model is and how to make use of it. The second goal is to provide a regular mechanism for tracking the work done on the model and the impact this work has on model performance. To achieve these goals, these annual reports will provide short narrative sections describing broadly what has changed about the model in the previous year ('What's New?' Page 2), before going into a little more detail on two or three of the most interesting changes ('Highlights 1' & '2', Pages 4 and 6). There will then be a section analyzing the model against the performance metrics established in the RISM Model Maintenance Plan ('Performance Review,' Page 6), and one discussing next steps envisioned for the next year of updates ('Next Steps', Page 9). The report will conclude with a data catalogue briefly describing the data available in the RISM for more advanced users ('Data Catalogue,' Page 10). Given the length of time elapsed since the start of this report and its publication, this first report is going to be longer than what is hoped will be usual going forward.

The RISM is a statistical tool that uses a geographic information system (GIS) and demographic forecasts to predict future travel behavior. This kind of tool is called a "Travel Demand Model (TDM)." The State of Rhode Island has had a TDM in one form or another since 1966, though the current iteration was developed starting in 2003. The model provides useful data about statewide travel patterns, which is important for things like long range planning and air quality monitoring. The model has many more potential uses in long range planning and even medium and short-range planning, but accuracy concerns have limited the use of the model for studies at a sub-state level. That said, the model can be adapted with the addition of data in a local area as part of a particular project, and as such has formed the basis of a number of project developments in the state.

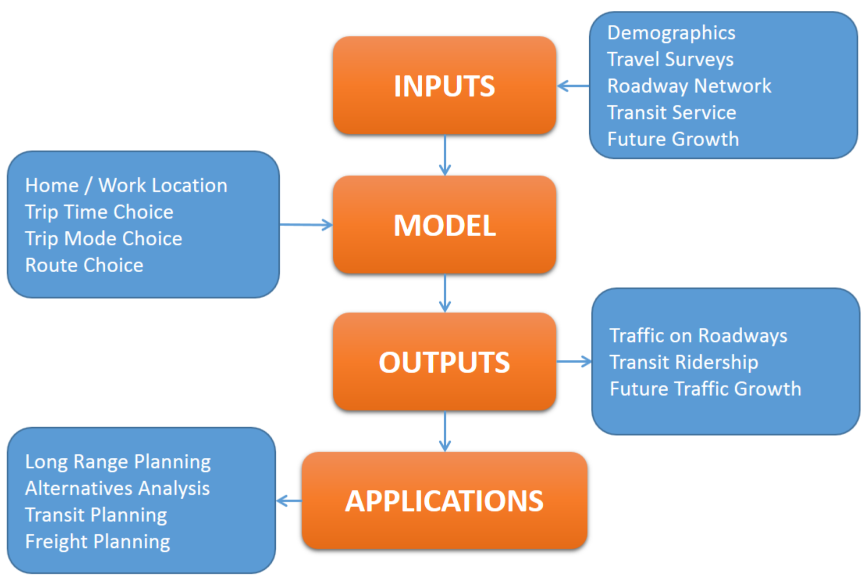


Figure 1: A rough outline of the modeling process

The "RISM Model Maintenance Plan: 2017-2027" was published in October 2017 in order to lay out steps to systematically improve the value of the model over the next five to ten years. Part of this process will include small investments to bring the model's internal architecture into line with industry standards. The plan also outlines the larger investments in data required to make the model the best it can possibly be. As the old saying goes, garbage in, garbage out.

The final need identified by the plan, however, relates to you, our stakeholders. While the model has problems, even in its current form it offers much more potential value than is currently being used, mostly due to a lack of visibility. It is hoped that by making the current model more accessible through training sessions and these annual reports, the RISM will be used to its full potential.

What's New?

The last two years have been an exciting time to work on the RISM. The state has contracted with a new vendor, AECOM, and has created the RISM Model Maintenance Plan to guide improvements. Staff have worked closely with AECOM to bring everyone up to speed on how the model operates and begin the scoped improvements. Four planned upgrades were completed in FY2018 and FY2019: The RIPTA Rider Survey, Transit Assignment (Highlight 2, page 6), the Truck Model, and a basket of smaller, Annual Updates. There was also a fifth, unplanned upgrade that ultimately required upgrading the model from TransCAD 6 to TransCAD 7.

RIPTA Rider Survey

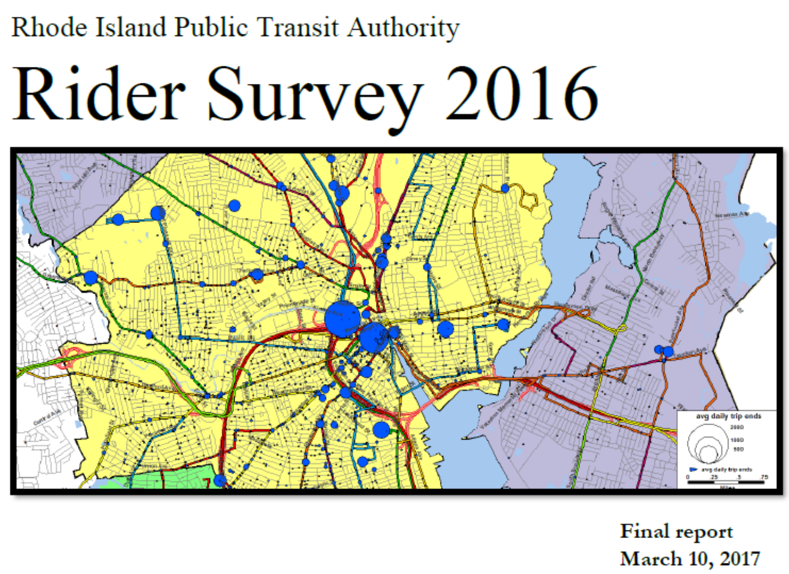


Figure 2: Survey completed by WARNER TRANSPORTATION CONSULTING, INC.

On March 10, 2017, Warner Transportation Consulting Inc. delivered the final report on the Rider Survey they conducted for RIPTA. This very granular survey work gathered data about those who use the RIPTA system, including where the riders came from, where they were going, how willing they were to transfer, as well as various demographic characteristics. The Division of Statewide Planning had collaborated with RIPTA in the development of the survey with an eye on incorporating it into the RISM, and so the raw survey data was also made available to AECOM after the delivery of the report.

AECOM used this data to calibrate the data being depicted in the local bus mode of the RISM. This calibration effort significantly improved the accuracy of the local bus modes within the model, something that is expected to increase once the results of a similar RIDOT survey of train travelers is included.

Truck Model

In the past, the model combined all automobile and truck traffic together. This was not ideal, given that different factors produce truck and car traffic, but in the past it was never a serious enough concern to warrant remediation. As federal regulations and state priorities have changed, however, this became an increasingly important area to understand. With the help of funding from Commerce RI, the DSP was finally able to engage in the work of setting up a truck model to examine this very important part of the Rhode Island transportation system.

Annual Updates

A key part of the RISM Model Maintenance Plan is the planned implementation of a “basket” of annual updates. This covers any number of small efforts that can be conducted under the annual maintenance budget of the contract with AECOM and which will fulfil the goals of continually improving model accuracy and accessibility. Most annual updates going forward will undoubtedly consist of minor updates to the input data sets as appropriate to keeping the data “fresh,” but it is also hoped that small modifications to the system architecture will provide cumulative benefits over time. This year two such changes have occurred, one in terms of the way T.F. Green Airport is depicted, and the other in the way the RISM produces output data in the user interface (Highlight 1, page 4).

Data Updates

The most common kind of annual update going forward is undoubtedly going to consist of minor updates to the input data sets as appropriate to keeping the data “fresh.” While this might not seem glamorous, several aspects of the effort this year are likely to have exciting ramifications for years to come. First, AECOM has provided a software tool that will automatically bring two shapefiles of differing origin together. While manual quality control is still advisable, this process drastically cuts down on the manual effort required to bring geographic data into the model, which will allow the model to expand its role as a data warehouse. One of the first data sets this was used on was the new Model Inventory of Roadway Elements (MIRE) data set developed by RIDOT in response to a FHWA mandate. This data set contains over 200 attributes describing elements of the built roadway environment from lane width to the existence of sidewalks. While this data has been used initially to update model road speeds, the future potential of this data is immense.

Figure 3: Speed Limits are a key component of the MIRE data set for the RISM

T.F. Green Airport Model

Airports present a challenge to any TDM. TDMs base their forecasts on an understanding of where people live, work, and, depending on the model, where they shop, go to school, and recreate. While people do work at airports, many more people travel to and from an airport than actually are employed at the airport itself. As is often the case with TDMs, truly elaborate models can be created to represent these behaviors, but this level of effort was clearly inappropriate in the case of Rhode Island. It was recognized that efforts needed to be made to better represent T.F. Green, but staff at the state and at AECOM were confident that this

Figure 4: T. F. Green is a hub for a large amount of travel that cannot be easily classified in the RISM

could be done with information easily available.

Staff worked with the Rhode Island Airport Corporation to get an understanding of the current travel rates at T.F. Green, the current levels of on-site employment, and how much of that travel to and from the airport happened by automobile, bus, and train. Preexisting airport master plans were used to forecast these rates into the model's future years. Staff also received data from RIDOT and RIPTA as to the current boardings and alightings at the stops and stations associated with the airport. This data was used to produce a small model addition which adds a set amount of travel demand at the airport in each forecast year.

Highlight 1: User Interface

There was a significant overhaul of the Graphical User Interface (GUI) of the RISM. To understand the importance of this change, one must keep in mind that the RISM consists of around 1,300 individual files organized and accessed via proprietary coding in the TransCAD environment.

A GUI allows for a more user-friendly modeling interaction by automating and combining steps involved with executing a process. Almost all computer programs in use today utilize some form of GUI. A GUI was developed for RISM in 2006, and it provided a lot of important functionality. This GUI allowed the user to run model scenarios relatively easily, and provided some data views to allow the user to review the results of each modeling step. On the other hand, the original GUI lacked some key functionality required for the easy delivery of data to stakeholders.

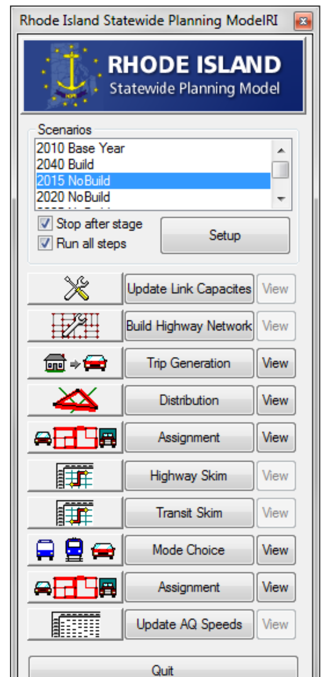
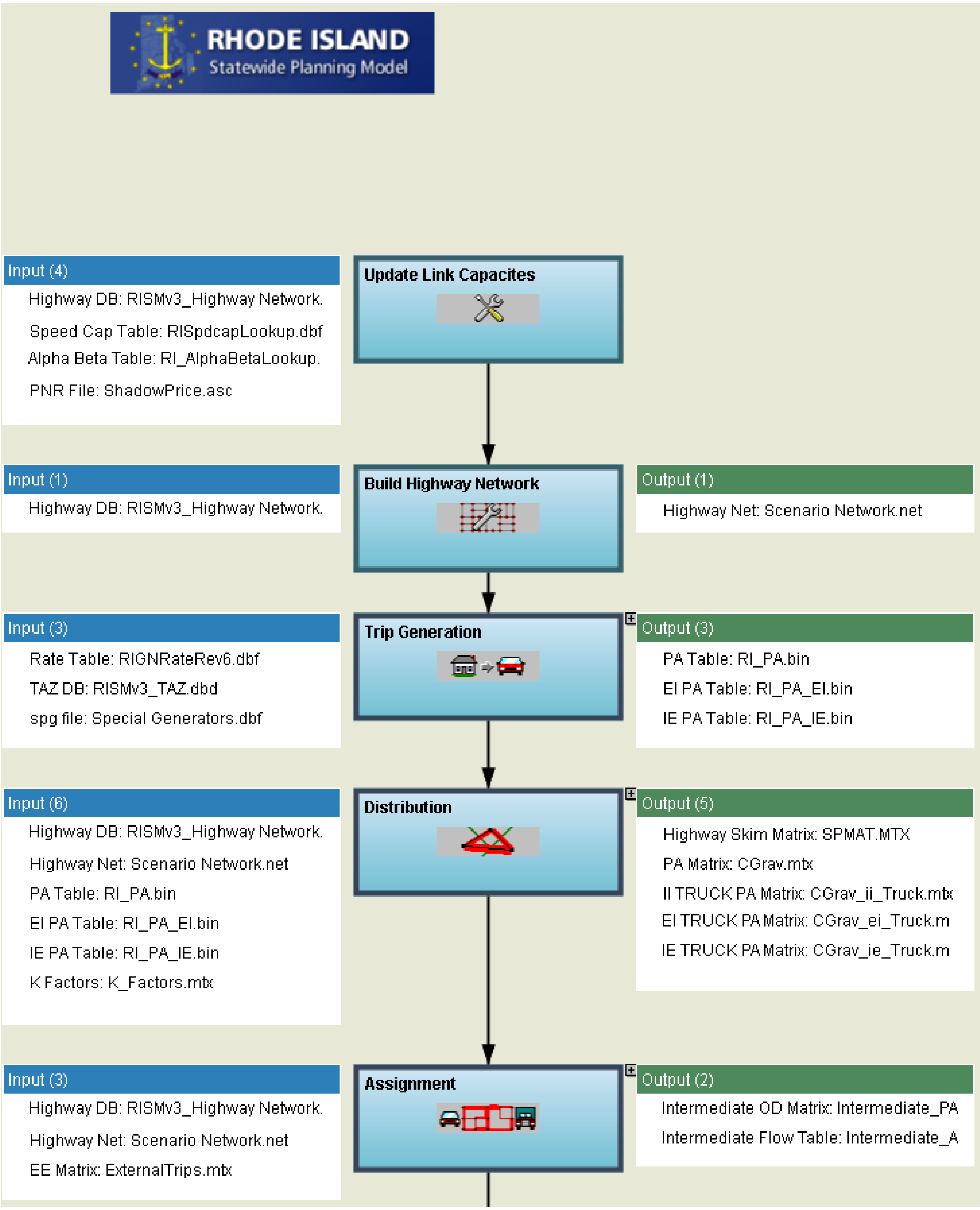


Figure 5: The original RISM GUI is above, the new one is on page 6. This dashboard style layout makes clear where each modeling step belongs in the modeling process, and what inputs and outputs are involved. Most of this data can be accessed directly from the interface rather than requiring the use of additional pop up screens.

The original GUI was not supported in the latest iteration of TransCAD. When Caliper updated from TransCAD 6 to TransCAD 7, they instituted changes to make it easier for users to develop GUI interfaces in a dashboard style environment. In the process of doing this, TransCAD ceased providing technical support for some key types of coding in TransCAD 6. When errors developed here, it forced DSP to undertake a lengthy and complex migration from the old GUI to the new, dashboard-based GUI.

The end result has been a much more user-friendly model interface, containing a set of utilities that will allow the model to easily produce aggregated matrices showing all travel for the entire state, reports of VMT and other factors by the state and various subareas, summaries of transit ridership, graphics displaying average trip lengths, and a validation report that automatically tests model accuracy against observational data sets. There are also tools to make scenario testing easier and responding to simple data requests much more straightforward in the future, resulting in an easier delivery of data to stakeholders.



Highlight 2: Transit Assignment

While the RISM has included a local bus mode since 2006, and a train mode since 2016, the modeling done was limited to steps necessary to determine the mode choices being made by travelers. The updated model now includes transit assignment, which allows greater granularity in the way the model represents transit trips. In this case, such granularity allows the model to be made more accurate, since staff are permitted more ways to “check in” on how realistic the model assumptions are during the calibration process.

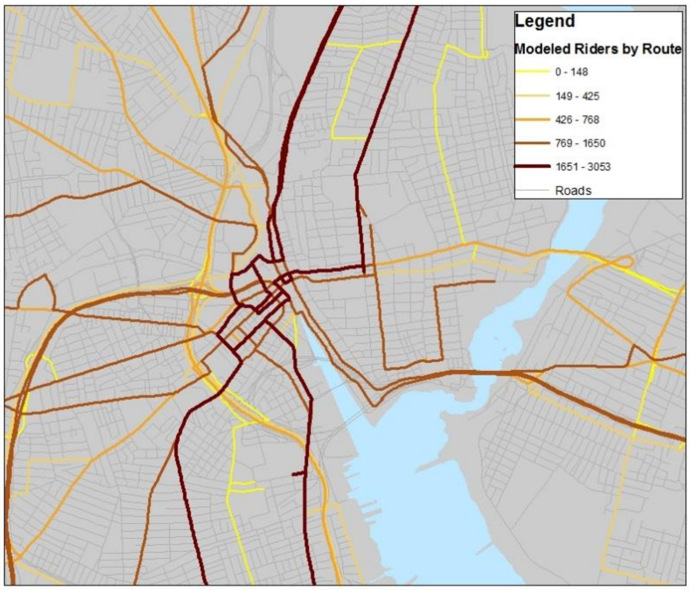


Figure 6: Transit routes with their assigned riders. Note that in this image the ridership is assigned to the entire route, though this is not the case in the RISM.

This situation has obvious implications for the value of modeling in transit planning, in terms of the ability of planners to study the volume of trips forecasted on specific routes, but more important in the short term are the implications for the accuracy of the model as a whole. Transit trips represent less than 2% of the trips made in the model, but that does not make representing them unimportant.

While the accuracy of the model does not yet permit the use of transit assignment outputs in route planning without some off-model work, the implementation of this update is just one of many planned steps that will significantly improve the ability of the model to represent transit over the coming years. Given the lack of realistic opportunities for expansion of the state’s road network, this effort will be vital for guiding transportation decisions in the coming years.

Performance Review

Reviewing and reporting on model performance is a key purpose of this report. In the future, this section will be important in tracking the effectiveness of the measures being taken as part of the Model Maintenance Plan. Model results and staff performance will be compared to the goals listed in the plan over time, using the performance metrics listed in the plan where possible. This will allow staff to determine if the measures being employed are moving things in the right direction. The current conditions can be seen in the tables on pages 7 and 8. The tables are broken into four sections, and there will be a brief, high level discussion elaborating on the significance of each section as needed.

In the process of creating this report and updating the RISM it was found that some of the metrics chosen in the Model Maintenance Plan were impractical or were superseded by more standard nationally agreed metrics. There are also some validation measures that will be added in future reports, but which are not ready for presentation at this time. This report’s entry will consist mainly of setting baseline conditions which will be valuable to those seeking to understand the work being done on the RISM.

Section 1 is intended to track how useful the model has been to stakeholders. Stakeholder satisfaction and the need for local data will be gauged over the course of this next year as a part of the training and outreach process. The other measures contained here must be understood as a major work in progress. In the past, staff have reported on data requests made by persons outside the state government as part of their federal reporting requirements. This was done to draw a line between routine office activities and genuine data requests. Unfortunately, it was stakeholders within the state government who often had the most serious concerns about timely data delivery and data usability. The baseline data represents an attempt by staff to backfill data requests from stakeholders into existing performance reports. As new processes are established, there will likely be some instability in these measures for the first few years.

Program Measures	Baseline	Goal
1. Ability of model to satisfy needs of stakeholders		
Stakeholder model satisfaction	TBD	TBD
Percentage of data requests handled by DSP Staff	93.33%	75.0%
Off model analysis performed by staff or stakeholder	100.00%	50.0%
Average stakeholder wait time	10	<180 days
Model accuracy sufficiency for stakeholders without addition of local data	N/A	50.0%
2. Model Calibration RMSE Score:		
NHS Roads	33.1%	10.0%
Interstate	20.6%	7.0%
Freeway or Expressway	37.3%	7.0%
Other Principal Arterials	41.3%	10.0%
Transit System		25.0%
Rail		7.0%
Rapid Bus Lines		10.0%
Local Bus Lines		25.0%
Screen-Line	41.0%	25.0%
*Current screen-lines are legacy lines and will be	TBD	TBD
updated in future reports.	TBD	TBD
Regions		
State	61.8%	25.0%
Sub-Regions 25% RSME (Defined by screen-lines)	TBD/TBD	TBD/TBD
Municipalities 25% RSME	0/39	20/39

Program Measures	Baseline	Goal
3. Longitudinal Model Accuracy (Measured in 2020)		
NHS Roads	N/A	10.0%
Interstate	N/A	7.0%
Freeway or Expressway	N/A	7.0%
Other Principal Arterials	N/A	10.0%
Transit Routes	N/A	25.0%
Industry standard of %RSME met in:		
State	N/A	25%
Municipalities	N/A	20/39
4. Maintenance Plan Goals		
Number of completed upgrades during contract period	4	10
Number of data products shared.	0	TBD
Number of core user training sessions held before 2020	0	1
Number of trained core users in state government	1	5
Stakeholder training sessions held per year	0	3
Model Data Requests	15	TBD
Number of Plan Actions completed by 2020	9	TBD
Number of Plan Deliverables completed	8	TBD

Section 2 shows a standard series of accuracy benchmarks used by modeling agencies across the country. Root Mean Square Error (RSME) is a standard way of measuring how much data produced by a statistical model differs from data produced by an observation. For many decades this measurement was used as a stand-in for model accuracy, and these measurements remain a useful rule of thumb to quickly check how well a model is performing.

That said, many in the industry are moving away from the use of these standard RSME scores as the *only* description of model accuracy. The problem is that the RSME only shows how well two data sets match, not how well the data matches reality. If there are flaws in the observational data, a very good RSME score will just move the model further from actual conditions. This is not an entirely academic discussion in the case of Rhode Island. The RISM is calibrated against road count data reported to FHWA by RIDOT. While this data is the best available, many at RIDOT have noted that the road count data reflected in this data set is not collected for this purpose, but as part of routine project planning. As a result, the data set may be inconsistent in its accuracy. RIDOT and DSP are aware of this issue and have been working for several years to resolve it with improved traffic counting procedures and the purchase of cell phone probe data sets from national vendors. These improvements are not available at the current time but may be in place for the next annual report. While this will be a big step up for model accuracy, it may throw off the model's RSME scores and undermine the value of the model baseline in the current document.

A final note about next steps in Section 2. When the model was created in 2003, the state was divided up into several sub-regions. These regions have no real world or political basis and were created simply to assist in the process of validation and calibration. Specifically, model outputs internal to the regions are validated, and then travel from region to region is analyzed for reasonability and accuracy. For the purposes of the RISM, the process of analyzing trips across the borders between regions is called screen-line analysis. This is standard practice in model validation, but it has been noted by staff that the regions are 16 years old and do not necessarily reflect the most logical or useful divisions of the state. While validation using the legacy screen lines and regions are presented here, an update to these borders is planned to take place before the next annual report.

Section 3 contains longitudinal measures. Longitudinal measures show how well the RISM has done in predicting conditions that were once in the future, but which can now be observed. For example, the first forecast period in the model is 2020. At time of writing it is 2019. In one year, staff will be able to examine how the current predictions for 2020 stood up to what actually happened.

Given that forecasting future conditions is one of the core functions of a travel demand model, this kind of analysis is extremely useful for determining how genuinely accurate the model has been. FHWA and other national bodies have embraced this kind of longitudinal validation as a core component of the process of validation, as such a measurement not only shows how well the model replicates a single data set, but also shows how well the model replicates changing conditions over time.

Of course, given that this report contains only baseline conditions, it is not possible to conduct a longitudinal analysis at this time. As a result, this part of the table is not filled in, but it will be a key part of the analysis for the next annual report.

Section 4 is intended to show how well the model maintenance plan has been implemented. A number of goal areas in this section remain TBD, as staffing changes have made it unclear what level of effort is going to be desirable or possible going forward. It should be possible to clarify this information over the course of the next year.

As a whole, the progress shown in the table is positive when compared to the situation depicted in the Model Maintenance Plan. When that document was written, finding validation results was difficult and model RSME scores were so bad that the author of the original model documentation chose not to include them in Technical Paper 166. While the model does not currently meet industry standards for accuracy, major steps have already been taken to improve the situation, and major investments are planned in the coming years that will drive major improvements.

Next Steps

The key next steps will be the implementation of the training program outlined in the RISM Model Maintenance Plan. An introductory training with FHWA has already been scheduled for May, 2019, and the core user training will be scheduled upon the publication of this report. These training and outreach efforts will help stakeholders understand and engage with the possibilities and the challenges of the RISM, and will help the state find value and solutions.

As these efforts reach completion, it will be time to begin work on the tasks highlighted in the FY 2019 UPWP. This next year promises to significantly shore up the data foundations upon which the RISM is built, with the projected purchase of a new cell phone probe data set and funding for the calibration of the model to a RIDOT passenger survey. When combined with the existing RIPTA passenger survey, this data should help resolve one of the key lingering problems with the transit component of the RISM: how often do transit riders transfer, and what modes do they transfer to? Combining these three data sets with the existing HPMS traffic counts is likely to be a challenge that will take up the first half of the financial year, but one that is expected to be very rewarding.

The second half of FY 2019 is going to involve the implementation of a bus speed model in conjunction with the annual update. The bus speed model will use GPS data from RIDOT busses to help calibrate the travel time of riders on the RIPTA system in the model. This obviously has a big impact on the choices made by riders in the real world, and improving the accuracy of the model in this area is a key goal of DSP now that the GPS data is readily available. In the process, staff hope that they will have time to take a second look at the road speed tables, which perform a similar function for the auto mode and which staff feel may need some serious revision.

While scoping is still in process the annual update will once again consist of a series of small tweaks to model operations to improve accuracy and usability. A major revision to the model screen-lines was mentioned earlier in this report and will probably constitute the largest change. Changes to the way functional classification is depicted in the model will help the model match up to state needs, as will an effort to bring the way RIPTA routes are numbered into line with the internal numbering system used by RIPTA. Staff are also interested in reviewing the model's walk to transit data, calibrating volume-delay functions, calibrating speed tables, calibrating park and ride catchment areas, adding an aggregated transit OD matrix utility, and instituting a speed feedback model. Which of these small updates is implemented will depend on the amount of resources available

The last two years have been full of intense efforts to improve the RISM. The progress made in this time would not have been possible without the support of DSP leadership and the enthusiastic cooperation provided by our stakeholders. Despite some setbacks, significant progress has been made and staff are eager to begin another year of the same.

Data Catalogue

When understood at the most basic level, the RISM consists of more than 1,300 interrelated tables, matrices, map files, and a very small amount of code that defines how the described data is organized. Describing, or even listing, each table would require a large amount of effort while delivering only confusion to the stakeholders. At the same time, the data included in the model is potentially useful, often in unexpected ways, an inability to understand what the model includes has often, in the past, undermined the ability of staff and stakeholders alike to make full use of this resource.

Therefore, staff have made the effort to compile the following catalogue of data elements in the model, along with some description of them. Data have been conceptually collapsed for this purpose, though in practice many of these data elements are separate tables or matrices. By contrast, many of the geographic files contain so much data that it was important to break them out in order to make clear their full value. It is hoped that this exercise will allow stakeholders and staff more clarity as to the potential of the data included in the RISM.

Geographic Files

The geographic files representing the state's transportation system and land use contain a huge amount of data beyond the raw line work. This data is important in the work done by the model, and contains a large amount of potential beyond the scope of uses directly related to the RISM. Much of this data was created elsewhere, and in some cases is better accessed from the data originators, but in many cases the post-processing done in bringing the data into the RISM, as well as the potential for further processing in the TransCAD environment, makes the use of the data from the model a useful prospect.

Highway and Transit Network

File Name: RISMv4_Highway Network [Multiple Scenarios]

This geographic file contains the entire transportation system for the state of Rhode Island, as well as the road networks for the municipalities in Massachusetts and Connecticut immediately surrounding it. Given the importance of ferry service in reaching Block Island and Prudence Island, ferry links to these locations are coded into the model as special roads with a 25 mph free flow speed. There is a different copy of the geographic file for each model year based on the current network, but with major funded projects represented in the network in future years. The network contains a fair amount of data relating to internal model functions, which will be omitted in this description. However, some discussion of the included input and output data will likely be valuable to the reader seeking to make full use of the model.

Much of the input data used by the model is held in the highway network file itself. It is determined if each link is one way or two way, and the appropriate directionality is assigned. Each link is assigned a federal functional classification code, based on the work done by the DSP in 2013. Based on work done by RIDOT, each link is assigned a terrain code, a walk access code, it is determined whether the road is divided, the number of lanes, and the area. The length is calculated as a basic function of the coding of the link into a GIS environment. During the model run, the free flow speed and travel time, congested speed and travel time, link capacity, and final volume (by direction) are calculated and assigned to each link.

Transit Network

File Name: RISMv4_Route System [Multiple Scenarios]

The links representing the transit system are hard coded into the highway layer. Most transit links, representing the RIPTA system, utilize public roadways. Some are commuter rail links, and are given attributes to prevent their use in modeling the highway system. During the modeling process travel times over these links are assigned. Each link within reasonable access to a transit stop has also been analyzed as to whether it can be used for walking, something which helps determine the ability of trips to access transit.

A relationship was established between the geographic links in the highway layer and a separate file in TransCAD called a “Route System,” which contains detailed information about the transit routes. This includes peak, non-peak, weekend, and nighttime headways, direction, minimum and maximum wait times for passengers, and bus travel times. It should be noted that the numbering system used for the routes represented in the model differ from those represented in public schedules. This was necessary in order to represent the different variations in schedule on each line. For example, the difference between regular and express service, or the tendency for busses on the same line to have slightly different destinations. For data querying purposes, there is an attribute in the file to allow routes to be collapsed back to their public number.

It was discovered recently that RIPTA has a similar system for internal purposes, but as they were developed separately the two classification schemes are not the same. It is considered preferable that the model conform to data structures used by state agencies, and so staff are seeking to find resources

TAZ Network

File Name: RISMv4_TAZ

To simplify calculations, and to allow detail where needed, most travel demand models utilize Traffic Analysis Zones (TAZs). These are geographies created by the modeler to contain the demographic detail needed for modeling. In the case of the RISM, the TAZs are based on US Census Block Groups in Rhode Island and the surrounding municipalities. In places where less detail is needed, the block groups are combined into larger TAZs. The model also contains so called "external stations," represented in the TAZ layer by triangles disconnected from the rest of the layer geographies. These stations are required to represent travel going to and coming from places well outside of Rhode Island along major roadways. Boston is an example of an external station in the RISM. If such stations were not created in the model, the model would not properly represent travel on these major roadways leaving the state. All told, the TAZ Network contains 1,844 TAZs and external stations. Unlike with the Highway and Transit Network, there is only one TAZ network for all model runs.

Given the purpose of the TAZs, they contain a large amount of useful demographic data as model inputs. This includes population, households, retail employment, non-retail employment, total employment, and the number of vehicles expected to be contained in each TAZ in 2010, 2015, 2020, 2025, 2030, 2035, and 2040. Each TAZ also contains a unique ID, a municipal, county, and state name to allow geoprocessing.

Modeling Files

The RIMS contains a number of files used for modeling that may be of interest to stakeholders. These include:

Speed Capacity Table

File Name: RISpdCapLookup.dbf
RI_AlphaBetaLookup.dbf

The Speed Capacity Table is based on national standards and defines free flow speeds in a link based on the link's terrain, area, access, posted speed, and whether or not it is divided. This is supplemented by the Alpha Beta table that defines posted speed based on functional classification. Given the major differences in posted speeds amongst roads of the same classification in Rhode Island, it may be desirable to add more detail to this table in the future.

Trip Generation

File Name: RIGINRateRev6.dbf
Speacial Generators.dbf

Trip generation is generally passed on population and employment data from the TAZ layer, but with the institution of the truck model an added layer of detail was necessary. Some truck trips, such as those involved with delivering packages to homes or making small shipments to retail businesses, can be calculated statistically based on population or employment in an area. Other, such as those related to auto shipments at Quonset Point, are unique and must be taken into account separately. The generation rates used for these special generators was based on the data from the DSP's Freight Plan, along with data taken from public company web sites and rough estimates about things like how many barrels of oil can go on a single tanker truck. As the DSP refines its freight planning data, these assumptions will be revisited. In the future, a full freight model including the rail mode will be implemented.

External-External Matrix

File Name: ExternalTrips.mtx

This matrix determines the amount of travel expected between the external stations within the RISM. Conceptually similar matrices exist for External to Internal trips, but these are actually modeled based on demographic data in a way that External to External trips are not.

Skim Matrices

File Name:	SPMAT10withDist.mtx	[Free flow, auto, multiple scenarios]
	SPCong10withDist.mtx	[Congested, auto, multiple scenarios]
	SkimOffPeakDriveLB.mtx	[Free flow, auto => local bus, multiple scenarios]
	SkimPeakDriveLB.mtx	[Congested, auto => local bus, multiple scenarios]
	SkimOffPeakWalkLB.mtx	[Free flow, walk => local bus, multiple scenarios]
	SkimPeakWalkLB.mtx	[Congested, walk => local bus, multiple scenarios]

These matrices contain the model skims for free flow and congested conditions. In layman's terms, the model takes a quick look at the expected travel time between each TAZ based on the underlying capacities of the network and then with the network loaded to capacity with trips. Because the model does not have a time of day component, this latter category of data is as close as this model comes to representing peak period conditions, but it is probably not a reliable guide. Instituting a Time of Day model would resolve this issue.

Model Outputs

The RISM conceptually produces two key outputs: the number of trips moving from each origin TAZ to each destination TAZ, and then an assignment file determining how those trips move through the transportation network. This data is produced very granularly, and is stored as such in order to allow easier geoprocessing. This section will discuss the granular files available, as well as the prepared reports available.

Origins and Destinations

One of the key products of a travel demand model is data representing the origins and destinations of trips. To arrive at this data, the model uses demographic data to represent where people start and where they might want to go, and puts this data into a matrix. The matrix has a list of TAZs on each side, and each cell represents trips between two TAZs. As the model works this data goes through two forms: a Production and Attraction Matrix (PA Matrix) and an Origin and Destination Matrix (OD Matrix). The PA Matrix is created earlier in the process, and represents each movement from one TAZ and to another. Since each such movement must result in a return movement, it is generally more useful to call the entire journey, from one TAZ to another and then back, one trip. So the model will eventually divide the PA Matrix by two, with the result being an OD Matrix. Due to the different stages at which data is produced, however, some key data is only available in PA Matrices.

PA Matrices

File Name:	TotalTripsAfterTranPA10.mtx	[Auto, contains three trip purposes, multiple scenarios]
	tr_pa.mtx	[All transit, contains 6 peak modes and 6 off-peak modes, multiple scenarios]
	MC_HBNW_Totals.mtx	[Home based non-work, contains 7 modes, multiple scenarios]
	MC_HBW_Totals.mtx	[Home based work, contains 7 modes, multiple scenarios]
	MC_NHB_Totals.mtx	[Non-home based, contains 7 modes, multiple scenarios]
	CGrav_[ii, ei, or ie]_Truck.mtx	[Internal to Internal, External to Internal, or Internal to External truck trips. Four weight classes, multiple scenarios. Information is added to Auto Pas above in later modeling steps.]

PA Matrices are calculated twice during the modeling process. The ones produced later in the process, during the mode choice stage, are more useful. As part of this process, the productions and attractions are calculated separately for each trip type, and they are assigned to each mode. A matrix is then compiled representing just the auto mode by trip type. This set of matrices is created as part of the modeling process for other purposes, but it also represents the one time in the modeling process where origin and destination type data is properly created, balanced, and differentiated by trip purpose and mode, making this the best place to go to understand many kinds of travel behaviors.

File Name:	Trips by TAZ – Productions.txt	['…Attractions.txt' and '…Productions and Attractions.txt' also available. Multiple scenarios.]
	Trips by Municipality – Productions.txt	['…Attractions.txt' and '…Productions and Attractions.txt' also available. Multiple scenarios.]
	Trips by County – Productions.txt	['…Attractions.txt' and '…Productions and Attractions.txt' also available. Multiple scenarios.]
	Trips by State – Productions.txt	['…Attractions.txt' and '…Productions and Attractions.txt' also available. Multiple scenarios.]

Important as the PA Matrices are, it was found to be very inconvenient to have to add them together to do any kind of analysis. As part of the ongoing effort to make the model more user friendly, the recent upgrades have compiled the data into several reports to allow easier analysis.

OD Matrices

File Name:	TotalTripsAfterTranODwEE10.mtx	[Auto, contains three trip purposes, external trips, and summary matrix. Multiple scenarios]

Four Step models, like the RISM, do not represent travel the way most people experience it on a day to day basis. Most of us will, on an average day, do something like leave home to go to work, but on the way drop our child off at school, and get breakfast at a drive through before getting to work. Once at work we may go out for lunch before returning to work. After work we may go pick up our child, then go to the grocery store before getting home. From the point of view of the model, this day of traveling consisted of six trips: one to and from the school, one to and from the doughnut shop, one to and from work, one to and from lunch, and one to and from the grocery store. While a nearly unrecognizable way to represent travel for a human being, from a broad, statistical perspective this way of representing travel has been found to be broadly equivalent to more intuitive models, which given the same amount of data.

Transit trips are not currently being summarized into a single OD matrix, though staff will look into adding such a utility into future model updates.

Utilities

The Utility functions of the RISM are a new way to quickly analyze model data.

Travel Behavior Output Summaries

File Name: [scenario year].txt [Multiple Scenarios]

This report depicts Vehicle Miles Traveled, Vehicle Hours Traveled, Vehicle Hours Delay, Person Miles Traveled, Person Miles Traveled by car, Person Hours Traveled by car, Person Hours Delay by car, Average trip length, average trip time, and average trip speed. This data is broken out by the functional classification of the roads over which the travel happened, by municipality, by urban or rural area, and by state. Vehicle Miles Traveled is a standard depiction of automobile travel, and is generally targeted for reduction by most government agencies in the United States due to the negative externalities of auto travel. This presents some difficulties, however, as agencies do not want to restrict travel, just travel by single occupant automobiles. Person Miles Travel was developed as a better way to depict travel, since it focuses on the number of people moved through a transportation system rather than the number of cars.

Ridership Summary

File Name: RIDERS_BY_ROUTE_[year].dbf [Multiple Scenarios]

This file summarizes ridership by route, access mode (walk or drive), and peak period. Information is depicted by route and by town. Also provides information about each rout’s mode, peak headway, and off-peak headway.

Operation Statistics

File Name:

This report allows the user to examine the modeled statistics describing each transit line. This includes length, peak and off-peak headways, the modeled annual average daily run time, the number of peak and off-peak stops, the peak and off-peak Travel Time, and the peak and off-peak load.

Compare Highway Networks

File Name: Highway_Comparison_Report.html

This utility allows the user to compare any two highway networks, which is useful in showing the differences between project scenarios.

Compare Transit Networks

File Name: Transit_Comparison_Report.prn

This utility allows the user to compare any two transit networks, which is useful in showing the differences between project scenarios.

Person Trip Length Distribution

File Name: N/A [Multiple scenarios]

This utility generates three charts, which the user can choose to save or not, showing the number of

Validation Summary

File Name: Validation_Summary_[year] [Multiple scenarios]

This utility generated a validation report showing accuracy to the observation data set by functional classification, screen line, corridor, municipality, area type, and road volume level. Staff is working to include transit validation statistics as well.