Spider Maps: A Summary of Best Practices and Guide to Design and Implementation

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ABSTRACT

System transit maps are useful for getting riders from station to station, but give little direction as to the area within walking distance of stations. ĂIJSpider MapsĂİ are human scale maps that provide clear direction for riders leaving transit stations. Some transit agencies have implemented these simplified area maps at their stations, but there are no clear procedures for their creation. The purpose of this research is to provide guidance for transit agencies to create Spider Maps and increase rider understanding of areas surrounding stations. This will be accomplished by researching transit agencies that have produced Spider Maps and made them available in stations and online. These maps, as well as agency interviews, will help determine innovative methodologies used by transit agencies in creating Spider Maps. This, along with a comprehensive literature review on map design and attribute selection, will contribute to a guide of what attributes to include in these Spider Maps. Using MARTA in Atlanta as a case study, these attributes will be input into an ArcMap Model that will automatically generate Spider Maps for each MARTA station. In addition to paper maps, this process will yield an interactive web application for riders to view the MARTA Spider Maps before they get to a station. The final project will summarize findings and make recommendations for agencies who wish to pursue Spider Maps.

INTRODUCTION

System transit maps are important because they are useful in helping riders understand how to get from station to station and typically highlight train lines because of their dedicated right-of-way. However, system maps give little direction for the areas and destinations within walking distance of train stations and sometimes are too complicated to provide clear information about how to transfer to other modes. Riders may know which train station to alight at, but may be unsure where to go from there, whether they are walking or transferring to a bus. To fill in this gap between train stations and a rider's final destination, some agencies have installed Spider Maps at train stations and/or provided them online.

Spider Maps are maps that are specific to each train station. They show one train station in the center and all of the bus routes that begin at that particular station. The shape of many bus routes coming out of one origin somewhat resembles a spider, hence the name. Spider Maps have come to also include walking area maps displaying destinations surrounding that particular station as well as the bus routes. Installing Spider Maps at stations helps to orient riders so that know where they are and where everything is in relation to the station. Spider Maps provide clear direction for riders leaving train stations and orient riders to their surroundings as well as possible transit connections to other modes.

The three main goals of this project are:

1. Identify best practices in designing Spider Maps
2. Create a reproducible model that will automate creation of Spider Maps for transit agencies
3. Create a reproducible, interactive Spider Map web application that transit agencies can use as a base to work from

Using the Metropolitan Atlanta Regional Transit Authority (MARTA) in Atlanta as a case study, the team will use the developed procedure and produce Spider Maps for MARTA Transit Stations that are served by trains. Using recommendations from blogs by transit mapping experts, transit agencies, and relevant literature, this paper will go on to create both paper Spider Maps for all MARTA Transit Stations as well as a Spider Map web application. This process will yield maps and an application for MARTA as well as a guide that other agencies can use to produce effective Spider Maps.

SPIDER MAP DEFINITIONS AND BACKGROUND

To best understand Spider Maps, it is important to understand the terminology, discussions, and relevant research that have been performed. This section defines important terms used throughout this paper, summarizes discussions about Spider Maps that are happening in prominent transportation blogs, and the relevant research in map design.

Definitions

The important definitions to understand for this paper and the topic of Spider Maps are as follows: Spider Maps, schematic maps, geographic maps, frequency, and headway. These terms are important and will be used at length throughout this paper.

Spider Maps as mentioned before are maps that are centered on one particular station. The name comes from spider diagrams where there is one central idea and all sub-parts stem out from the center. Spider Maps as they relate to transit mapping have grown to include more than just the train station and connecting bus routes, but also walking area maps, as well as information about the bus schedules.

Schematic Maps simplify the lines on a map. They are typically used for transit maps and all lines representing various routes are limited to straight lines with angles of 90 or 45 degrees. A schematic display makes the maps more visually pleasing and easier for customers to read and follow. However, these maps can distort true distances between stations and locations because of the angle requirements.

Geographic Maps display streets and transit as they exist. There is no limit on which angles lines may meet at and the lines can have curvature if the route followed has any turns.

Frequency is how many buses per hour come to a certain stop or station. This is applicable to any form of transportation.

Headway is how much time is between each arrival of one particular route at one particular station. The headway and the frequency of a single route at a particular stop are the inverse of each other. Transit routes that come often have high frequencies and small headways.

These terms will be used throughout the paper as there are Spider Maps that are displayed geographically and schematically. Some maps also provide information on route headways and frequency.

Blogs Discussing Spider Maps

The three main transportation blogs that were consulted for this project were *Greater Greater Washington*, *The Global Urbanist*, and *Human Transit*. The blog *Greater Greater Washington* is a blog dedicated to the Greater Washington D.C. Area and is put together by activists and volunteers looking to improve the walkability and vitality of the region (*1*). The *Global Urbanist* is a blog created by alumni of the London School of Economics and Political Science about improving urban areas around the globe (*2*). Finally, *Human Transit* is a blog written and maintained by Jarrett Walker who is a professional transportation analyst. Posts in all of these blogs have references Spider Maps and debate how effective they are and whether transit agencies should use them.

Some of the Spider Maps that are most widely discussed in these blogs are the Spider Maps used by Transport for London at their train station and the one that the Washington Metropolitan Area Transit Authority (WMATA) has created for Dupont Circle bus connections.

While London is famous for its schematic Underground Map, it has also installed schematic Spider Maps at major transit nodes within its system. These maps are schematic and not to scale, as seen in Figure 1, but give an idea to transit riders of where they can get via buses from the transit nodes. In addition to London having historic schematic maps, Washington DC has recently implemented Spider Maps at certain locations within the WMATA system. Because of this, many transit bloggers discussed both the London Spider Maps as well as whether they benefit riders in the Washington DC area.

In the blog focused on Washington DC, *Greater Greater Washington*, Michael Perkins

breaks down the London Spider Maps and discusses the useful features specific to these maps including, local area walking map, schematic bus route map, and a timetable for each route. In addition to discussing only the maps, Perkins describes what he sees as challenges to implementation of schematic maps. These challenges include selecting which local bus stops to label as well as whether or not to include routes with low frequency and/or dynamic schedules (*1*). Buses have many more stops than trains, but typically only stop if requested. To label stops in a schematic map, popular ones would have to be selected based on attributes such as proximity to a popular destination, neighborhood, or some combination.

Another *Greater Greater Washington* blog written by a previous resident of London and entitled H Street Bus 'Spider Map' Can Demystify Bus Service addressed Spider Maps. In this post he discussed how the schematic Spider Maps helped him navigate complicated bus systems in London. To him, the buses around Dupont Circle were also confusing and the installation of the Spider Maps helped him navigate the area and possible transfers. Of a similar opinion that Spider Maps could be useful if altered, David Alpert posted in Greater Greater Washington and stated that integrating these maps into the system would be helpful if they added attractions and walking circles for fifteen minutes (*3*).

In the blog *The Global Urbanist*, Kerwin Datu argues that Spider Maps are not helpful because they do not give viewer a complete picture of the entire bus network. He states that they do not account for transferring from bus to bus, and they often cut off adjacent routes by not including bus routes within the walkable area. Datu also believes that destinations should be added to give users a better sense of location and route availability instead of only bus stops (*2*).

Finally Jarrett Walker in his blog *Human Transit* makes a case for frequency and that the maps should not give the impression that all bus routes are equal. There are a lot of posts in Walker's blog that reference mapping and information that is easy to use and understand. One of his problems with the London Spider Maps is that by being schematic and representing each route equally with thickness and line type, riders may assume the same level of service and/or frequency in all bus routes, or even that they are comparable to the frequent trains in London (*4*).

Walker also states that Spider Maps are useful in conjunction with system maps. They promote the one-seat bus rides from each train station, but neglect to show what connections can be made along these bus routes (*4*). To create effective Spider Maps, these comments will be taken into account.

METHODOLOGY

While some transit agencies have implemented these Spider Maps either at select or all train stations and/or online, there are no clear procedures for Spider Map design. All train stations are destinations for some riders, but riders have different needs when it comes to leaving the train station. Some riders need walking guidance to get around urban areas and reach popular attractions, such as a sporting arena, museum, and many others. Some train stations are at the end of the line riders need guidance to take buses further than they can take the train. Finally, there are train stations with no bus connections, but riders may need some walking direction.

Understanding what makes an effective Spider Map and how they can be implemented will be accomplished by researching transit agencies that have produced Spider Maps and

installed them in stations and made them available online. Analyzing Spider Maps from multiple agencies will help identify innovative methodologies used by transit agencies to create effective Spider Maps. Examining these Spider Maps will reveal different strategies to display information effectively, and also give an idea of information that is confusing and should not be included. Additionally, a comprehensive literature review on map design and related mapping research, will contribute to a guide of what information should be displayed on Spider Maps.

All of the findings from the blogs, review of relevant research, and examining existing Spider Maps will contribute to the creation of an ArcGIS model and web application that can be used by any agency to create both paper and online Spider Maps. This section outlines the relevant research that was used to create the various parts of the Spider Maps for MARTA, highlights effective ways that agencies have displayed information on Spider Maps, and details the creation of the paper Spider Maps and web application.

Relevant Research

There is very little scholarly research that has been performed specifically on Spider Maps. To create effective Spider Maps, research on general map design as well as walking area distance and map design was consulted.

Alasdair Cain, previously of the University of South Florida, has done extensive research on effective map design. He produced a guide entitled *Designing Printed Transit Information Materials*. Cain's document is a guidebook focused on the "design of hand-held, printed materials used to provide transit trip planning information for fixed bus services" (*5*). In *Designing Printed Transit Information Materials*, Cain addresses the discussion of schematic versus geographic maps. He says that both are acceptable displays of mapping information but that geographic displays are more flexible in what can be included beyond the map (*5*).

Another professional who addressed the effectiveness of schematic maps was Zhang Guo whose article Mind the Map discussed that while schematic representations of transit systems can effectively make maps easier to understand and more visually pleasing, there are some issues. Guo identifies multiple locations in the London Underground Map where train station locations are not appropriately placed and give off the indication that someone could easily walk between the two stations instead of riding the Tube to get there (*6*). While schematic maps are acceptable, it is important to provide some type of orientation for riders and adequately represent the travel time between stations. While the MARTA train map is not nearly as complicated as the London Underground, the entire MARTA system, including buses and trains, is extremely complicated.

Other important research is relevant to walking area maps. One study stated that the average distance that people were willing to walk to or from a light-rail station was 320 meters (approximately 0.2 miles) (*7*). This is important to create a walking area map for riders accessing their final destinations on foot. While this study was done for a light rail station, this can also be applied to heavy rail stations because both are permanent, unlike bus stops and buses that can easily be rerouted.

Another study performed in China provides a flowchart to decide which signs should be placed at which locations of a train station. While this study is directed at large, multi-level, train stations with multiple possible transfers, some of the recommendations can be

applied to Spider Maps. The Spider Maps tend to include a walking area map as well as the regional Spider Map. This paper written by Zhang, Chen, and Jiang stated that these types of information should be provided near the entry and on the top level of train stations (*8*).

Agencies with Spider Maps

The four most prominent transit agencies with Spider Maps in use are the Transport for London, the Massachusetts Bay Transportation Authority (MBTA), Los Angeles Metro, and Washington Metropolitan Area Transit Authority (WMATA).

Similar to its famous schematic London Underground Map, Transport for London has schematic Spider Maps installed in all of its train stations displaying bus connections from each particular station. The Liverpool Street Spider Map can be seen in Figure 1. The schematic design of the Spider Maps makes the maps visually appealing; however there are some potential issues for riders that are unfamiliar with the maps and the area. For users not familiar with the layout of the city and the various stops on the route, there are no points of reference or indication of where the stops actually are with regards to street names or locations, only the names of select bus routes. A helpful attribute is the area map around the station showing exactly where to connect to each bus, similar to the area map that MARTA has at its Five Points Transit Station to direct riders to bus routes that do not directly connect into the transit station.

Included in the map display is a chart of bus information included. This is called the "Route Finder" and is located on the right side of the map. The 'Route Finder' lists all of the routes available from that station as well as where to board the bus. Buses are divided into 'Day' and 'Night' buses, but there is no information about which hours are considered 'Day' or 'Night'.

In Boston, the MBTA has Spider Maps available at some train stations, with one example shown in Figure 2. The MBTA Spider Maps include two maps at different scales, a walking distance map and a regional map. The walking area map shows a street map of the area within a half-mile radius from the train station. Included in this map are the bus routes within the surrounding area as well as parks and bodies of water. However, there are few labels of specific locations and are limited to government buildings such as courthouses or schools.

The regional map shows the extents of each bus route that originates from the station. The regional map is geographic and shows the street map in grey and highlights the bus routes from the station in bold colors as well as other train stations in region. For each bus route from the station, there is a table that lists frequency for all service types, such as peak, day, night, and weekends. The headways in Figure 2 range from ten to forty minutes.

The existing Spider Map that the team found to be the most informative and useful map was the Dupont Circle Spider Maps created by WMATA Metro Bus in Washington DC, as seen in Figure 3. The Spider Map displayed a Dupont Circle includes a timetable with headway information, a bus stop location map, a walking area map, and a regional map showing all of the possible locations accessible by transit from Dupont Circle.

The headway timetable information allows the map to be more useful to train riders hoping to gain more accessibility by bus from this station. The headway information provides riders with their expected waiting time and comfort in knowing that if a connection is missed, it is clear how much time there is until the next bus arrives. When the headways are low

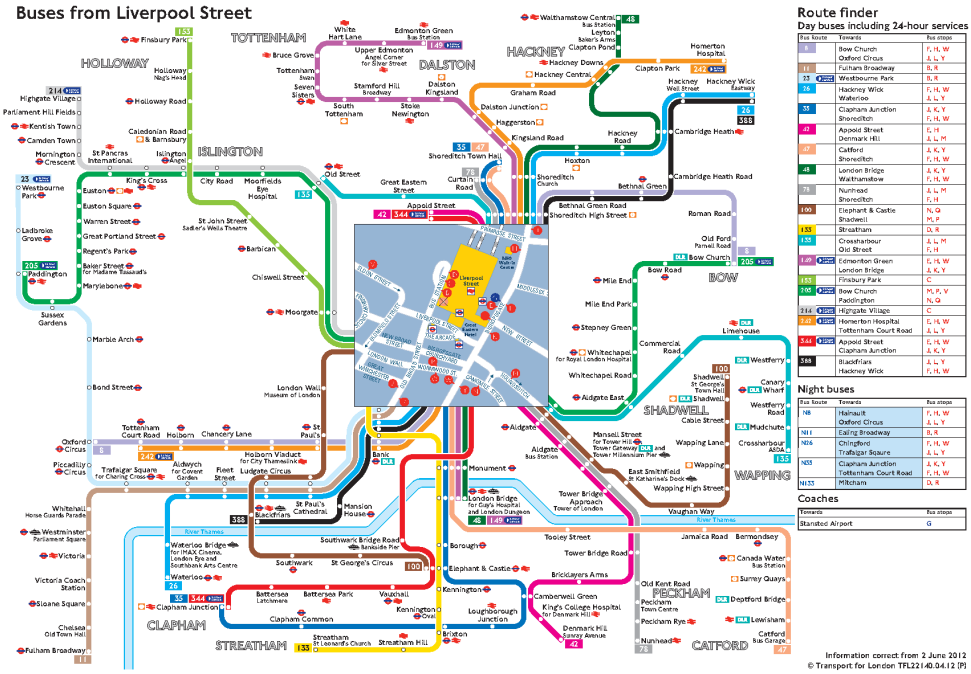


FIGURE 1 London Spider Map
Source: Transport for London, 2012

FIGURE 2 MBTA Spider Map
Source: MBTA, 2012

and the bus route is frequent, patrons do not need to check a schedule. This is imperative to include in maps if users are to have an accurate view of service availability.

The whole image contains a smaller map with a radius of 0.25 miles around the train station in the upper right hand corner of the display indicating where riders can catch each bus route, similar to the London Spider Maps. To the left of this smaller map is a walking area map that shows nearby attractions and connections to train stations nearby. One important critique is that it does not clearly point out where the Dupont Circle Station is in the map to assist the rider in understanding where he/she is standing.

The regional map on the other hand clearly shows Dupont Circle with a "You Are Here" bubble that directs viewers to their location. This geographic map is helpful because it includes roads for reference and clearly highlights bus routes stopping at Dupont Circle. Highlighting these bus routes connecting to the Dupont Circle train station makes it clear to riders which locations are accessible with a one seat ride. Displaying the bus routes on an actual street map provides riders with a better spatial perspective of their transportation options. Geographic features like lakes and interstates are shown as well, also adding to the clarity of the regional map.

Dupont Circle WMATA Metro Bus map also contains a "How to Use This Map" box in the corner which provides instructions for wayfinding and understanding the Spider Map. Contained in this box are instructions on how to read and interpret the maps and headway tables.

Los Angeles Metro has one schematic Spider Map that is displayed at Union Station, shown in Figure 4. This Spider Map has a schematic layout of the routes with interstates shown as reference to the location. The Los Angeles Metro Spider Map does not include a map of the surrounding walking distance, but does include a map of the station buildings and land where the various routes meet to make connections and transfers easily identifiable. There is no frequency or schedule data included in this map.

The inclusion of interstates as reference improves the ability for users to reference the locations of destinations when compared with the transit station. The regions that are noted on the map are very clearly labeled; adding to the ability of passengers to easily read and understand the relative areas accessible by the bus.

One thing that is different about the L.A. Metro Spider Map is the use of colors. Instead of having each route represented by a different color, each mode has its own color. The colors represent the type of bus service (local, express, rapid). The legend for bus type colors and bus route labels is located in the upper right corner of the map.

One useful feature of the Los Angeles Metro map is the use of the destination table at the bottom, which lists multiple destinations accessible from Union Station and shows which route to take to reach that particular destination. This wayfinding tool could be very helpful to riders without a trip planning tool who need to reach a specific destination.

Effective Spider Map Attributes

The map and website models created for this project are based on this research and the information that was most effectively displayed in the Spider Maps found in London, Boston, Washington D.C., and Los Angeles

The maps produced by this project will have a Regional Spider Map as well as a Walking Area Map associated with each MARTA station that connects with bus routes.

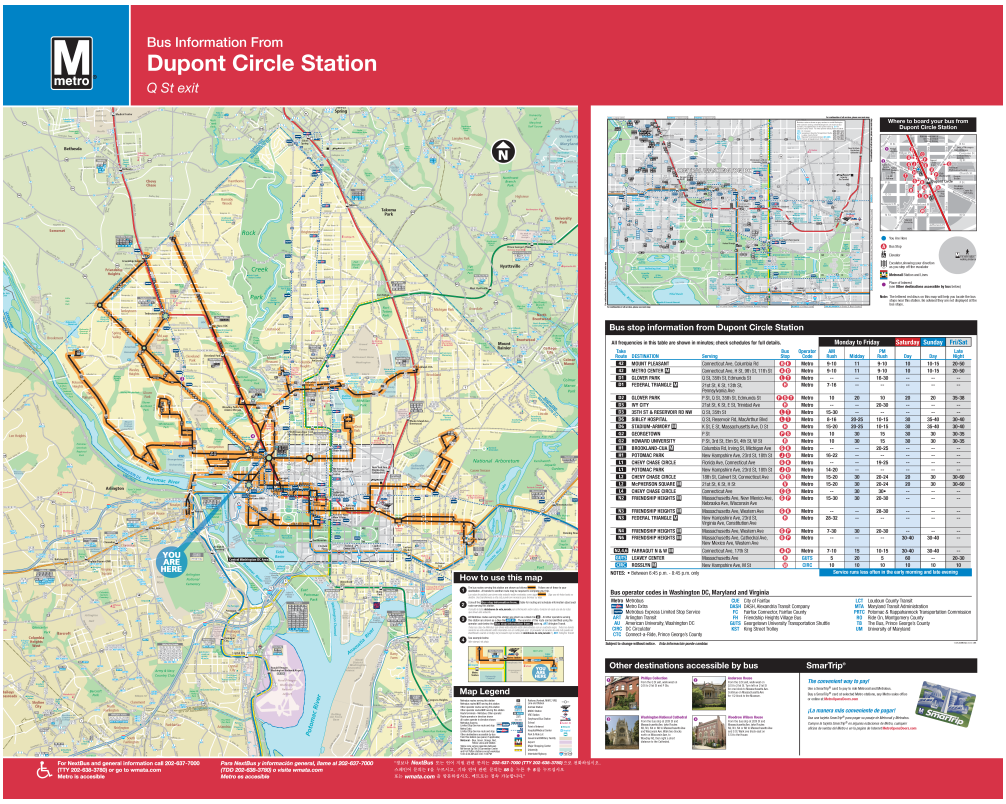


FIGURE 3 WMATA Spider Map
Source: WMATA, 2012

These two maps are important to have for two types of train riders; the ones connecting to bus routes and the ones leaving the train station for a final destination near the train station.

The walking area maps will be similar to the area map that is provided in the Five Points MARTA Transit Station to show where all connecting bus routes pick up passengers. In addition to these two maps at different scales will be bus route information. The regional Spider Maps will show all routes that come within the specified walkshed. This will direct connections from each train station and nearby bus connections, addressing the issues brought up by Datu in The Global Urbanist. The specifics of each of these maps and information to include will be based on a combination of the effective ways that London, Boston, Washington D.C., and Los Angeles have displayed route information.

For the MARTA maps, the team selected geographic displays over schematic representation of the routes for two reasons. The first is that the overall maps include a walking area map as well as the regional Spider Map. To show the walking area map schematically would be confusing, especially to riders new to the system, and it would be unnecessary to simplify. Showing two maps of the same bus routes at different scales but one geographically and one schematically could be confusing. Schematic maps are used to simplify complicated networks, but only showing a half mile radius around a station where the main idea is to correctly guide a rider to his/her final destination are less complicated and must be more precise.

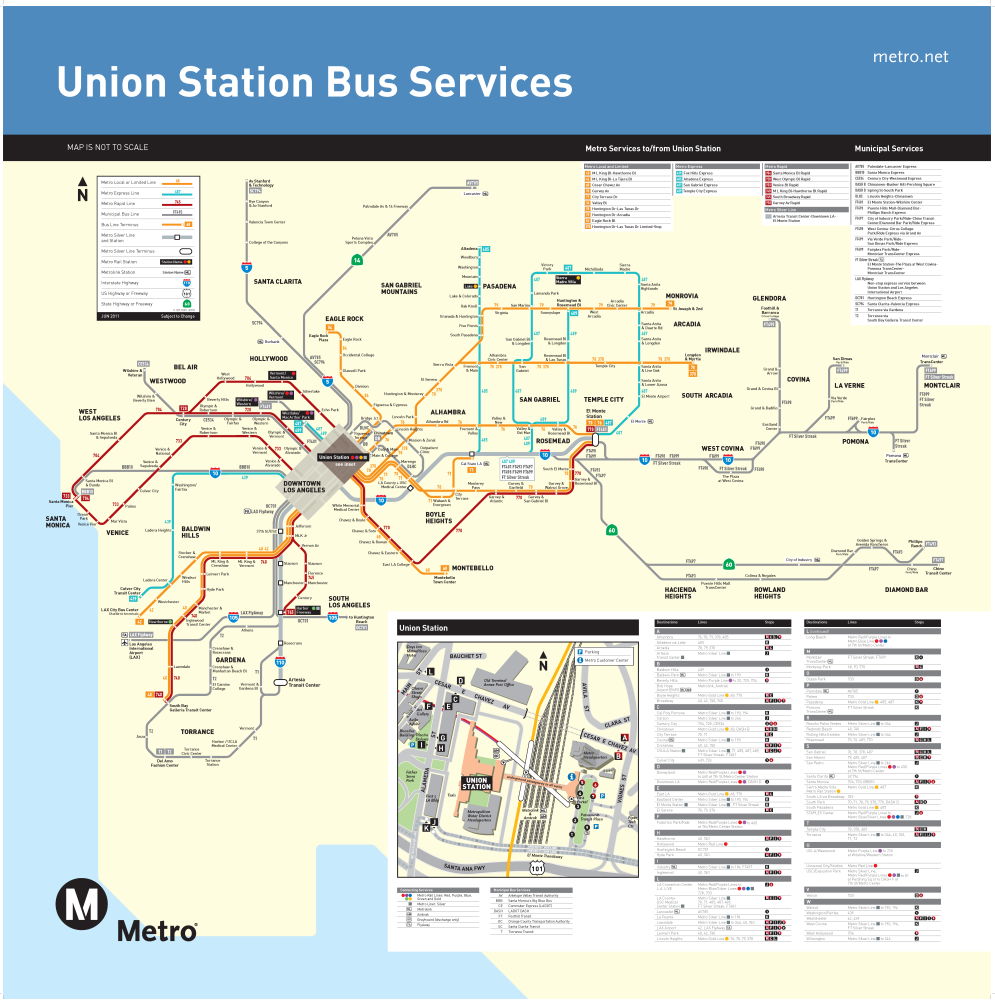


FIGURE 4 LA Metro Union Station Spider Map
Source: LA Metro, 2012

The second reason that geographic displays were selected was to give the bus rider a more precise understanding of which roads the bus routes would be traveling along and allow flexibility for MARTA to add more information to the maps. These local bus routes have stops almost every block so it is more important to understand the exact route instead of a general direction of travel.

As a reference for riders who leave the train station on foot, a walk shed will be included in the Walking Area map. The Boston walking area map shows a half mile radius, but walking time may be easier for pedestrians to judge. These walking area maps will display a fifteen minute walk shed based on the network. Some MARTA stations are near highways, freight rail lines, or other locations that are close but cannot be accessed on foot. Therefore, these walksheds will not be perfect circles around the stations, but based on the walkable network.

It is important to incorporate as many of these aspects as possible without making

the Spider Maps too busy or overwhelming. The two most important pieces of information was headway information and highlighting the bus routes with direct access to the train station centered in the map. Using these two pieces of information, riders could quickly understand all possible destinations and have a general idea of how long they will have to wait for their bus.

While some of these systems have more routes that provide service with headways of fifteen minutes or less than MARTA, they also have bus routes with headways up to 40 minutes displayed in their frequency table. Even though this is a large headway and not a desirable waiting time, it will provide riders with an estimate of when the next bus is arriving. For MARTA, this can be supplemented by full timetable scheduling information that is already provided at all stations where there are bus connections. If there is a headway greater than fifteen minutes, riders could consult the provided timetable, but if the headway is short, they can simply wait for the bus at the appropriate location.

MARTA bus headways, similar to other agencies, change during different service periods. For MARTA, these periods are 'Peak', 'Base', 'Night' 'Saturday' or 'Sunday/Holiday', so for each of those periods, the headway must be identified for users. This table will also include the hours that service begins and ends for each route so that riders can plan for a return trip if necessary.

Finally, one thing that stood out in the Dupont Circle Map by WMATA Metro Bus was the "How to use this information" box. The team found this useful for wayfinding and using these types of maps, so instructions will be provided for riders using these maps for the first time. All of these characteristics will be incorporated in the GIS model to create Spider Maps for MARTA.

GIS model creation

To create a process that would automate Spider Map creation for MARTA and would be easily reproducible by other agencies, the team used ArcGIS. Within this program, the team created an entire new toolbox which included four models and two python scripts. Together, this toolbox can automate the creation of the maps and the headway information for all MARTA Transit Stations with one model run. The steps in the new toolbox are as follows:

1. Define Walking Distance
2. Generate Walk Shed based on Road Network
3. Generate Bus Routes within Walk Distance to Rail Stations
4. Output Rail Stations
5. Output Layers
6. Output Maps

The first step was to define the area shows in the Walking Area map. This was done by using a straight line walking distance buffer for each MARTA Transit Station. This line will not be seen in the map, it simply defines what radius around the station is shown in the Walking Area Map. For the MARTA maps, the team used one quarter mile to cover the

distance that people would walk to transit (7). The inputs for this tool are the train station shapefile, the desired radius, and an output path. Steps one through four are designed to have the same interface as any standard ArcGIS tool.

The second step is generating the walkshed based on the road network for each station. The inputs for this step are the train station shapefile and the road network with travel time cost defined in minutes. Users can define the network walking distance for riders walking away from the station. In the example, fifteen minutes was used. As the extent of Spider Map was defined in step one, the walking distance defined in this step should be smaller than that so that the entire walkshed will be entirely contained in the Walking Area Map.

Once the walkshed is created, all bus routes that go through the walkshed are selected in step three by inputting the bus routes shapefile. This is important because there are some MARTA bus routes that come close to a station, but do not directly connect. For example, the 110 comes within a block of the Midtown MARTA Transit Station, but does not pull into the bus bays there. By including these bus routes as well, Datu's issue with connections to other buses can be addressed within the area surrounding the train station. The bus routes selected in this step will show up in the both Regional Spider Map and the Walking Area Map. Finally, at the end of this step, the program will output an attribute table of the selected bus for each station.

Step four outputs a new layer for each train station that includes only the bus routes selected for that particular train station and the calculated walkshed associated with it. The input for this step is a shapefile of the train stations. The layer created for each station is what is displayed in the Regional Spider Map

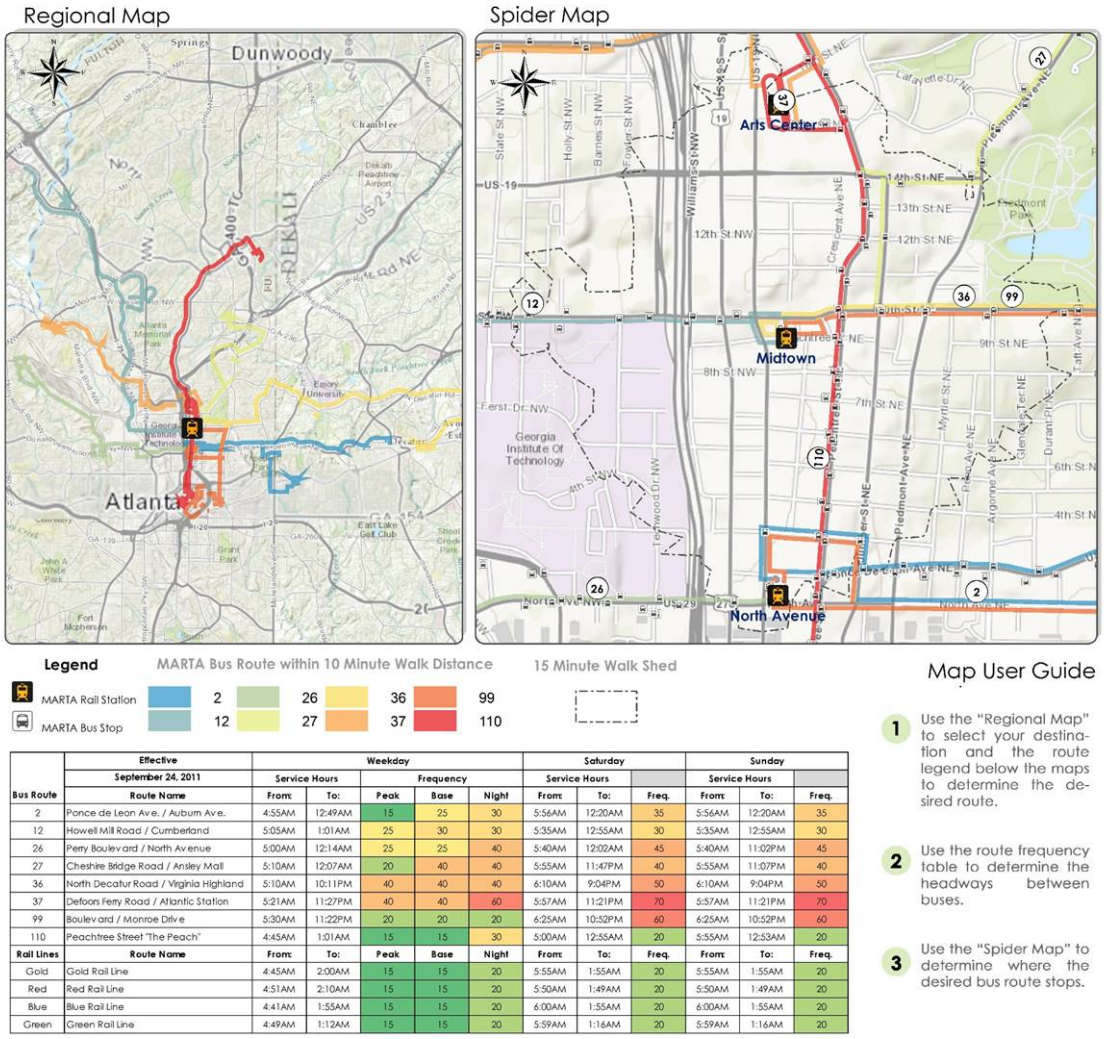
Steps five and six are python scripts and are available upon request. Step five inserts all of the previously generated layers into the template. This template includes the location and size of the Regional Spider Map, Walking Area Map, and instructions for reading and using the information provided. The only manual work required is inserting the table output in step three into the remaining space. Unfortunately, ESRI does not provide any python language that automates this process. But in the near future, when their "arcpy" language is further developed, this will have the capability to be automated. The final script creates one .pdf document where each page is a Spider Map for a particular MARTA Transit Station.

3.6 Web Application Creation

RESULTS AND MODEL OUTPUTS

Based on the discussion of existing maps and the information displays that the group found the most useful and effective, the Spider Map seen in Figure 5 was produced through the automated process using the ArcGIS model discussed in the previous section. Figure 5 shows the Midtown MARTA Transit Station as an example and incorporates the regional Spider Map, the Walking Area Map, as well as route headway information and directions on how to use the map. There is a fifteen-minute walkshed included in the Walking Area Map and there is the potential to add tourist attractions, government buildings, and other important destinations that surround each train station.

The scale of the Regional Spider Map is based on the furthest reaching bus route and the Walking Area Map is based on the fifteen-minute walkshed. The scales of the Walking Area Map will be the same for each MARTA Transit Station, but the walkshed will vary from station to station depending on the street network. Additionally, the background for



	Effective	Weekday					Saturday			Sunday		
	September 24, 2011	Service Hours		Frequency			Service Hours			Service Hours		
Bus Route	Route Name	From:	To:	Peak	Base	Night	From:	To:	Freq.	From:	To:	Freq.
2	Ponce de Leon Ave. / Auburn Ave.	4:55AM	12:49AM	15	25	30	5:56AM	12:20AM	35	5:56AM	12:20AM	35
12	Howell Mill Road / Cumberland	5:05AM	1:01AM	25	30	30	5:35AM	12:55AM	30	5:35AM	12:55AM	30
26	Perry Boulevard / North Avenue	5:00AM	12:14AM	25	25	40	5:40AM	12:02AM	45	5:40AM	11:02PM	45
27	Cheshire Bridge Road / Ansley Mall	5:10AM	12:07AM	20	40	40	5:55AM	11:47PM	40	5:55AM	11:07PM	40
36	North Decatur Road / Virginia Highland	5:10AM	10:11PM	40	40	40	6:10AM	9:04PM	50	6:10AM	9:04PM	50
37	Defoors Ferry Road / Atlantic Station	5:21AM	11:27PM	40	40	60	5:57AM	11:21PM	70	5:57AM	11:21PM	70
99	Boulevard / Monroe Drive	5:30AM	11:22PM	20	20	20	6:25AM	10:52PM	60	6:25AM	10:52PM	60
110	Peachtree Street "The Peach"	4:45AM	1:01AM	15	15	30	5:00AM	12:55AM	20	5:55AM	12:53AM	20
Rail Lines	Route Name	From:	To:	Peak	Base	Night	From:	To:	Freq.	From:	To:	Freq.
Gold	Gold Rail Line	4:45AM	2:00AM	15	15	20	5:55AM	1:55AM	20	5:55AM	1:55AM	20
Red	Red Rail Line	4:51AM	2:10AM	15	15	20	5:50AM	1:49AM	20	5:50AM	1:49AM	20
Blue	Blue Rail Line	4:41AM	1:55AM	15	15	20	6:00AM	1:55AM	20	6:00AM	1:55AM	20
Green	Green Rail Line	4:49AM	1:12AM	15	15	20	5:59AM	1:16AM	20	5:59AM	1:16AM	20

FIGURE 5 MARTA Midtown Transit Station Spider Map
Source: Zhang, 2013

these maps is the Open Street Maps and as a website will be automatically updated from Open Street Maps each time the model is rerun.

The bus routes included in these maps are the routes that fall within the fifteen-minute walkshed of the Midtown Station. One of the issues with using ArcGIS is that it does not automatically offset routes that overlap each other on various street segments.

The headway information and instructions on map use are also included to make wayfinding as easy as possible for riders about to leave the Midtown MARTA Transit Station.

A screenshot from the Spider Map webstie for the MARTA Midtown Transit Station can be seen in Figure 6 [1]. The same shapefiles included in the paper Spider Maps are included in the website as well as locations. Only the bus routes within the walk distance

[1] file:///C:/Users/mcarragher3/Dropbox/6642%20project/interactive_final.html

to the rail station were selected and displayed. The shapefile was uploaded to Google fusion table using SHAPE ESCAP website. The color and the width of the bus routes were defined based on the bus frequency information. The color is corresponding to the weekday peak hour bus frequency as shown in the frequency table. Additionally, the wider the route, the more frequent the route would show in the maps.

"Google Places" were added to the website, so that users can select a place of interest to display in the walk area map. The default places that will show are the bus stops around the rail station. However, users can select other types of locations such as lodgings, restaurants and schools. Once a type is selected, a list of the relevant places will be displayed. From there, users can click on the name of a place and an information window will pop up on the walk area map to help users to identify that particular place.

The same route search available on Google Maps is also available for users who know their specific destination information. Once users input an address the transit route between the current rail station and that destination will pop up. Transit is the default travel mode, but other travel modes are also available in case the rider is planning on walking or biking from the station to his/her final destination.

The bus routes are displayed geographically to match the printed ones. However, one of the limitations of Google fusion table visualization is that it is difficult to tell where multiple bus routes overlap and how many overlap in a given segment. To allow users to see exactly where each route is located, the team added an interactive function between the frequency table and the maps. By clicking on the desired route number in the frequency table, the corresponding bus route will be highlighted in the maps.

One of the biggest advantages of the website is that it needs very little maintenance. The background maps will automatically be updated by Google maps. The only data that requires attention is the bus routes and frequency information. If any of these data changes, the maps will need to be updated, which only requires updating the information in the Google fusion table.

CONCLUSIONS AND RECOMMENDATIONS

Spider Maps are very useful to train riders who do not know their way around their destination station or which buses they can connect to from one station. Based on the review of literature and Spider Maps that are currently posted, there are a few key pieces of information that should be clearly communicated to make the Spider Maps as effective as possible.

Regional Spider Map and Walking Area Maps should both be included. They are useful for different types of riders, those connecting to a bus and those walking to their final destination. By providing both maps, riders connecting or walking will be able to find their way and together, the rider is oriented on both a regional and local scale. Additionally, providing the Walking Area Map could also benefit riders connecting to buses if the bus connection is not directly at the train station, such as at the Five Points MARTA Transit Station.

Frequency and Headway are important to include. They give an estimation of waiting time and if a rider needs a specific departure time, they can consult a more detailed timetable. The team found that color-coding was an effective way to quickly display whether a bus route had a short or long headway. Regardless, riders can also use headway information

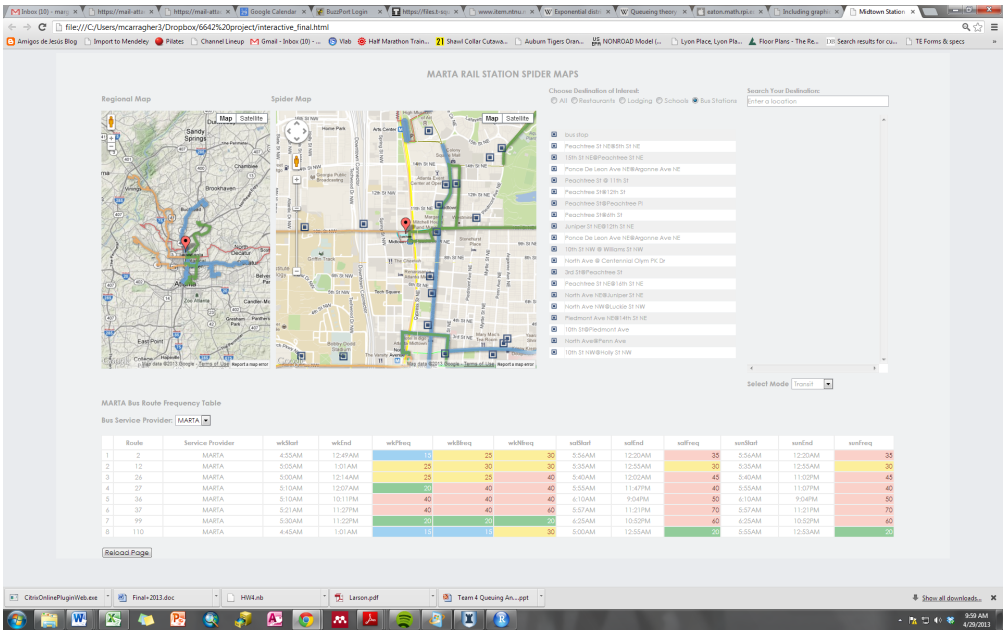


FIGURE 6 MARTA Midtown Transit Station Spider Map Website
Source: Zhang, 2013

to understand how flexible their return trip can be and whether it must be planned or they can walk out to the bus stop on their way back to the station if they have a round trip.

Instructions for reading the map are helpful and may give the riders a little more confidence than a normal map legend. For this project, the team created simple steps for riders to follow if they are unsure of the information provided and how to use this. However, only one other agency provided a guide like this, so it is a part of Spider Map design that is open subject area and could be considered for further research into creating helpful instructions and/or legends for these maps.

Points of Reference in the maps are additional features that can provide guidance and orient riders when they are about to exit the train station. These maps use Open Street Maps as the background layer, so some locations are labeled, such as Piedmont Park and the Georgia Institute of Technology. However, the models have the potential to add tourist attractions, government buildings, or any other destinations within the walking area. This will make walking to those destinations clear and could promote certain locations using the map.

Deciding which destination types should be included in the Walking Area Map is another area of research that could further Spider Map development. In some places, it may be obvious which locations to include, but in an urban area where destinations are concentrated, prioritizing what should be included would provide further guidance on the design and display of these maps.

The combination of the paper map and the web application are useful to riders not only because they can see the regional and local maps of their location, but to help make the overall trip experience better from planning to arrival. There are many riders who plan their

trips ahead of time and use station maps simply to guide them along what they know is the right path. Riders with access to the internet could access the online application and plan their trip before they leave the house, then use the Spider Maps at the station to confirm their trip and improve their confidence in taking transit.

These maps and web application were developed to further Spider Map design and implementation and are easily reproducible at MARTA and other interested transit agencies. They are simply another way to convey transit information easily and effectively to riders and highlight all of the possible destinations that some riders may not have been aware of before their implementation.

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APPENDIX

Included here are the models created for the ArcGIS toolbox and the interface that a user would see.

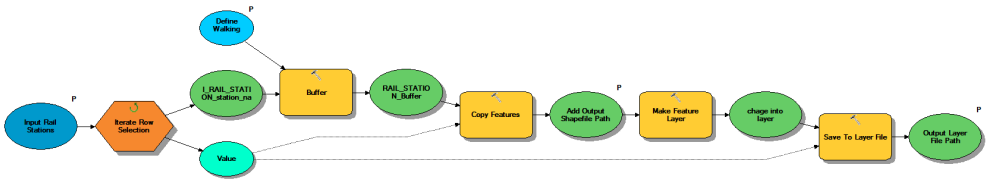

FIGURE 7 Step 1 ArcGIS Model

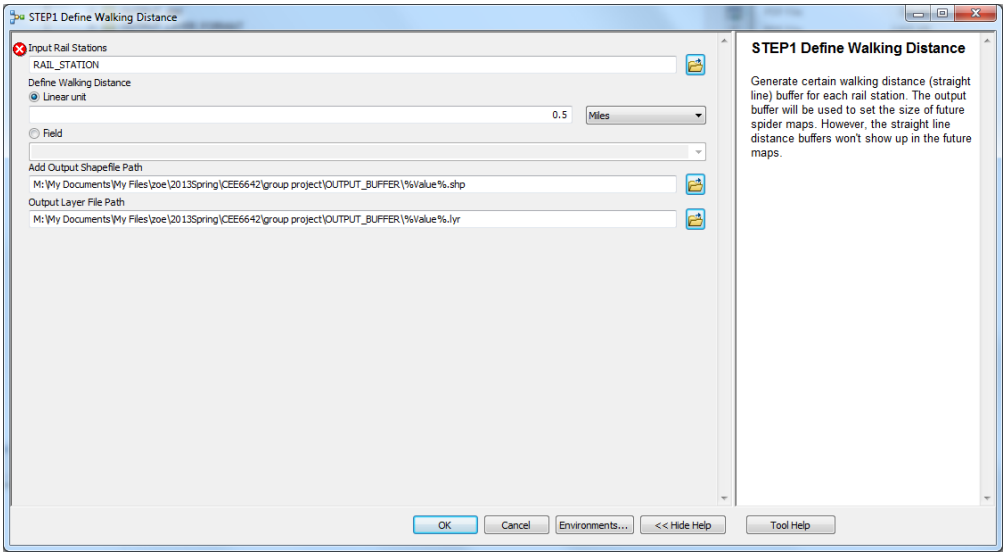

FIGURE 8 Step 1 User Interface

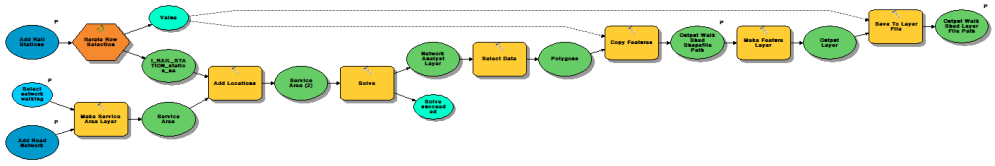

FIGURE 9 Step 2 ArcGIS Model

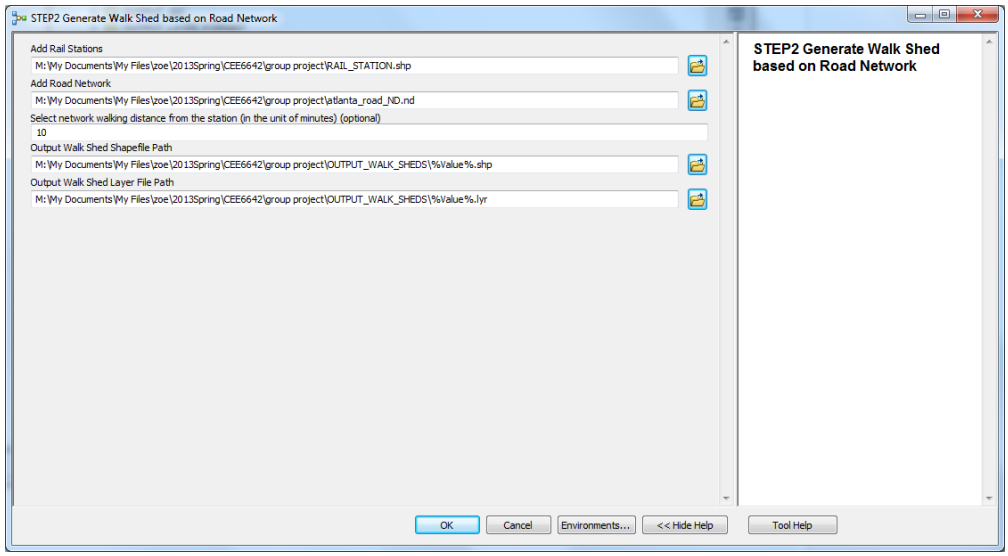

FIGURE 10 Step 2 User Interface

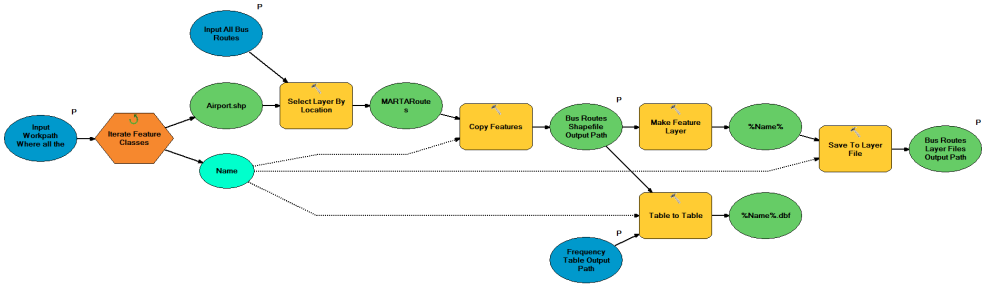

FIGURE 11 Step 3 ArcGIS Model

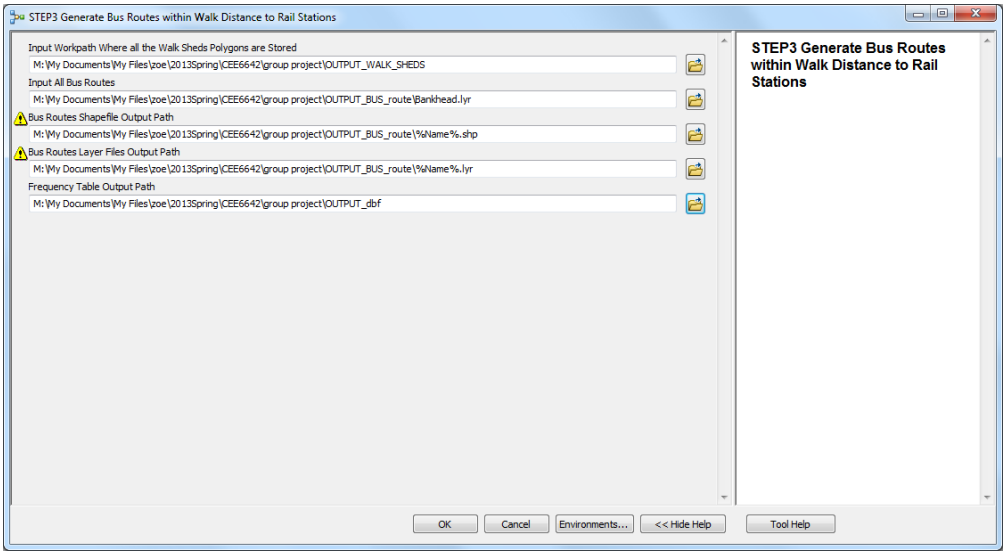

FIGURE 12 Step 3 User Interface

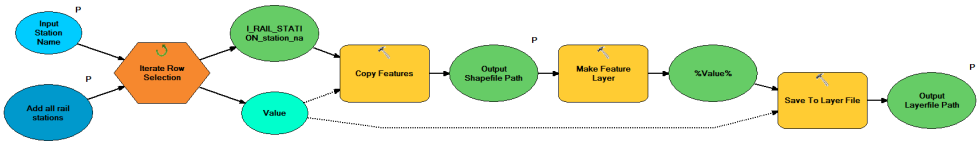

FIGURE 13 Step 4 ArcGIS Model

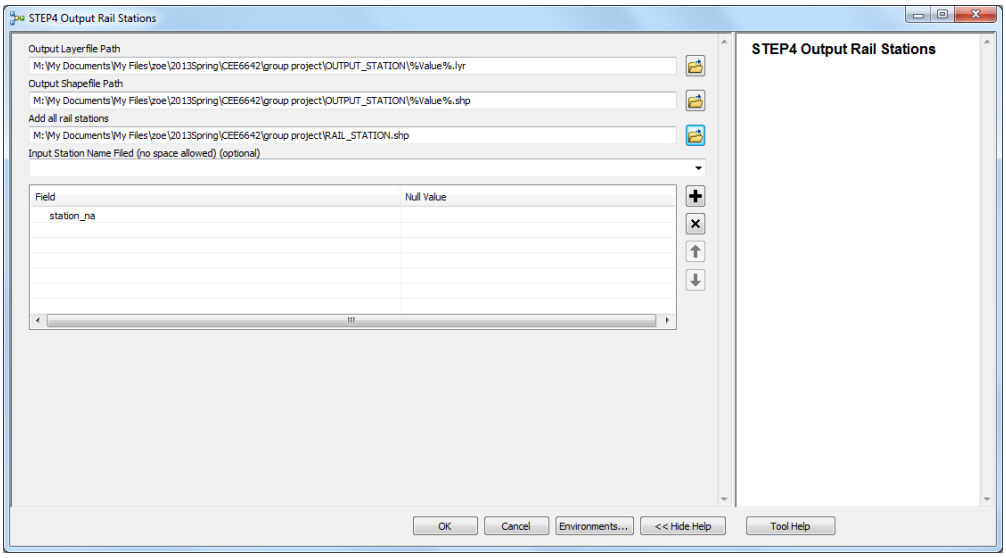

FIGURE 14 Step 4 User Interface