LYNX is using TBEST (Transit Boarding Estimation and Simulation Tool) to Model and Estimate Ridership for the Major TDP (Transportation Development Plan) Update in 2012

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Abstract

TBEST is a custom modeling software used to model various scenarios for short term transit planning and developed using the ArcGIS software platform. The modeling tool uses population and employment projections for the area of transit service to estimate stop level ridership for new transit routes. This process involves spatial analysis of the demographic characteristics for the area surrounding each transit stop and ArcGIS is a native platform for this type of analysis. TBEST was initially developed for ArcGIS 9.x, however, has been updated to use ArcGIS 10. With the implementation of TBEST in 2010, as a distributed system for transit service planning, the number of the ArcGIS users within the planning department has increased as well. The modeling system tools and databases are completely supported by LYNX' GIS staff in house. The available in-house expertise allowed the organization to run all of the modeling tasks for the 10 year transit development plan, and supported a more efficient and less expensive work-flow when compared to outsourcing the same tasks.

Introduction

The Central Florida Regional Transportation Authority (LYNX) provides transit services for Orange, Seminole, and Osceola counties in the Central Florida/Orlando area. The service area comprises 2,538 square miles and serves a population of just under 2.2 million. The tri-county agency was created in 1931, but the current organizational structure was put in place in 1992. LYNX has a bus fleet of 238 vehicles. Necessary operational funding is a complex combination of company revenue and funds provided by local, state, and federal governments. This funding schema requires a great deal of organization and planning. LYNX has implemented and expanded on the applications of GIS data and tools since 1999, and in 2010, the organization had put in place the infrastructure for implementation and maintenance of a GIS based transit modeling tool (TBEST). TBEST allows LYNX to justify funding for new routes and the need to edit routes to better serve the community.

In 2010, LYNX implemented the Transit Boarding Estimation and Simulation Tool (TBEST) for planning purposes. TBEST is a transit demand modeling and analysis software developed by Florida Department of Transportation Public Transit office (FDOT). This software is a comprehensive transit network modeling, management, and analysis tool with a focus on short to mid-term transit planning. Some objectives with the development of the TBEST were to be sensitive to service adjustments, be user friendly and cost effective, be scalable (be able to work on networks with 15 bus stops to 80,000 bus stops), have modest data requirements, and have a standard modeling methodology to be used by any agency for ridership estimation.

From a state wide standpoint, TBEST provides a standardized transit modeling tool for agencies to develop and submit the required ridership estimation portion of the Transit Development Plan (TDP). TBEST reduces the burden on FDOT for evaluating a variety of ridership estimation methodologies used by different transit agencies for their TDP documents. TBEST also reduces the burden on agencies to prepare and conduct more expensive and complex modeling efforts. It serves a dual purpose of being an enterprise tool for service and a strategic planning. In short, TBEST allows a standardized method, approved by FDOT, for transit agencies to estimate and report on ridership projections.

The implementation process for TBEST is relatively inexpensive because it uses readily available resources with minimal configuration time. It utilizes industry standard GIS and relational database software, so it's likely that agencies already have these components in place and will only need to install the TBEST software. TBEST fills the industry gap for short term ridership estimation. It provides scenario based modeling with scenario comparison tools. It takes advantage of the new GTFS (General Transit Feed Specification) feed and has an integrated GTFS network import tool and full network editor. TBEST includes tools to analyze land use and socio-economic markets, network accessibility, and model results. TBEST is easy for GIS and technical staff with experience in database, GIS, and modeling to learn. The tool also has a quick and painless implementation process.

TBEST approaches modeling from a scenario stand point. Each agency develops a base year model, which is calibrated to observed ridership. This base year should be a recent past year that has observed ridership for each fixed route. Using this base year, future year models can be developed as new scenarios. New scenarios can be based off of the base year, or based off another existing scenario. The network can then be edited and service modifications can be implemented with each scenario. There is also an option to adjust socio-economic data at the system level, area level, or individual stop level. This functionality allows for great control and manipulation of the existing and projected transit networks for obtaining ridership estimation results. TBEST's ridership estimation is stop level based. The model is direct demand and micro-level model which does not rely on mode choice and is not interactive with auto travel…strictly transit. The stops are uniquely defined by route and direction. Stop estimations can be aggregated to give route, segment, corridor, sub area, or system level ridership estimates. TBEST is designed to be used for 0-10 year forecasting. TBEST also utilizes a time of day based analysis. The network is broken into various times of day, including weekday AM peak, weekday PM peak, weekday off peak, weekday night, Saturday, and Sunday. TBEST recognizes that agencies may have varied route-level service configurations for each time period (headways, start/end times, etc.) and as such, routes can be digitized as multiple patterns represent the service structure occurring throughout the day.

The Transit Development Plan (TDP) is a plan that analyzes existing service and performance, outlines missions and goals for the transit agency, and must be consistent with community plans (road construction, new developments, etc.). The TDP requires projected service needs as well as projected ridership for each year within the plan. It also takes into account the cost of implementation and operations and the projected revenues for each year. The TDP is, however, financially unconstrained, meaning that the plans do not need to have expected funding sources listed. Essentially, the TDP is an implementation plan for the next 10 years of future service for a transit agency.

At LYNX, TBEST is setup to be maintained by a power user and to be used at large by the Service Planning staff. The power user maintains and updates the base year network, and adds in any and all operational changes being implemented by the agency. Service Planning can then take this network and create various scenarios to see how potential plans will affect ridership either at the stop, area, or system level. These estimates can then be used to determine whether or not specific changes or specific scenarios would be beneficial to the agencies and its customers.

Implementation of TBEST at LYNX

The implementation at LYNX, being a pilot and testing agency for TBEST, was fairly lengthy. This was purposefully done so that LYNX and FDOT would have adequate time to test and work out any bugs in the software. Such implementation process would not be typical for most agencies. Generally speaking, the implementation can take a few days or a number of weeks depending on the size of the agency and the number of staff hours that are able to be given to the that activity. LYNX is a medium sized agency that ended up with approximately 90 route patterns and 8000 stops within the TBEST model..

The basic TBEST implementation procedure that FDOT has published and distributed was developed during the implementation project at LYNX. The process began by creating an implementation plan. This plan focused on getting TBEST up and running within the agency which later included software distribution to Service Planning staff. The implementation began with the TBEST power user maintaining and updating the software, base network, and keeping the model and validation up to date. The initial network went through a number of iterations to get the system in order. LYNX has a complicated system with various modes of transit. Some of these were excluded from the model because they could not be accurately modeled by this particular software. Namely, these were the LYNX NeighborLinks. These are not fixed or deviated route services, but rather on demand services that operate within a defined area. Only the LYNX fixed route services were modeled.

Once the base network was established, LYNX calibrated and validated the model. This was done by entering observed ridership from the bid period that LYNX defined as the base year. In the implementation process, this was the December 2010 network. This base year can be updated to any bid period by obtaining the observed ridership for that bid period. Once the model was calibrated, it was run through the validation process within TBEST. This ensured that the model was running properly and project the ridership numbers that the agency would expect based on what was observed. Once this initial base year calibration was completed, the projected ridership numbers TBEST reported were very accurate when compared to observed ridership.

Upon completion of the validation process, TBEST was installed on the Service Planning staff members computers. Working closely with IT, a location on the network drives was setup so that the TBEST power user could post the TDS (TBEST distributable system) file for download by the Service Planning staff. Service Planning could then manipulate the system and run the model on proposed routes, stops, or areas of interest.

The TBEST power user also retains the responsibility to update the network with each bid period. Every 4 months, LYNX staff updates the network to better serve the community. These updates include route and stop additions and removals, routing changes, headway changes, start and stop time changes, etc. The updates are initially done in TRAPEZE FX scheduling system. From TRAPEZE, a GTFS export is

created. Using the GTFS import tool within TBEST, the power user can seamlessly import these files into TBEST to update the network. Once the import is complete, model validation can be performed to get a ridership estimate of that bid period. Once the bid period is completed, observed ridership can be obtained, and compared against the TBEST model. The model can also be calibrated to this observed data and the base year would be updated. It is then the responsibility of the power user to distribute this new, updated network to the Service Planning staff.

The TBEST implementation process concluded with a one day training seminar on the modeling software which included all users from Service and Strategic Planning departments. The training took place at a local FDOT computer lab, and was conducted by the TBEST development team. LYNX Planning has since used TBEST for analysis of fixed route alignments and estimation of the transit impact, from a redevelopment stand point, of certain areas in close proximity to existing fixed transit routes. The most extensive use of TBEST has been for the TDP major update that LYNX was required to complete this year.

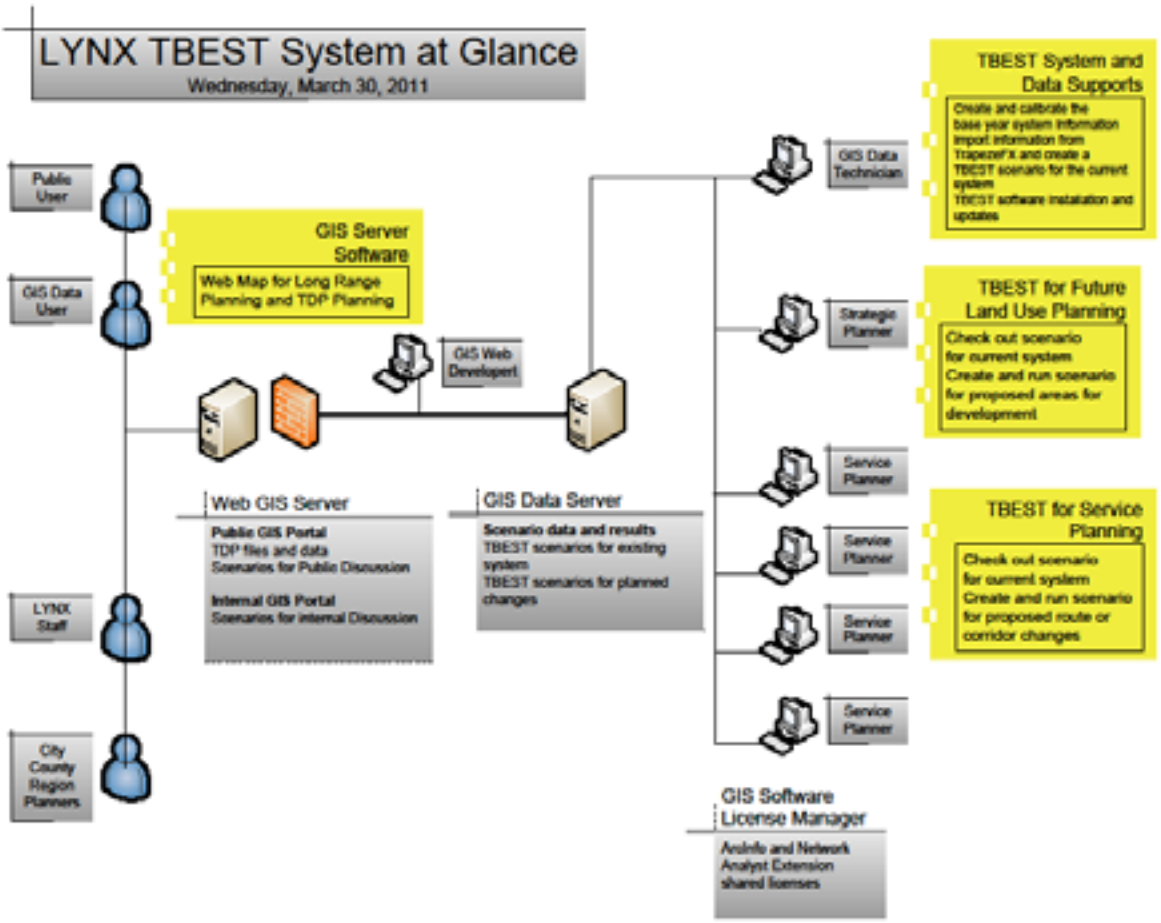

Image 1.1
The LYNX TBEST implementation and organization schema

TBEST and the Transit Development Plan (TDP)

TBEST had a critical role in this update process, as FDOT requires the utilization of transit ridership modeling for the Plan. Since TBEST is sponsored by FDOT for this purpose, LYNX was able to use TBEST as its ridership forecasting software for the TDP.

The main goal for this TDP was to modify the existing LYNX network to better match with LYNX' Long Range Plan for a corridor based system. The Long Range Plan identifies 22 main corridors that connect the East Central Florida region. The main changes to the network in the TDP are based on the idea to provide premium service (a service level between express routes and fixed routes) along these corridors, and have standard fixed routes, feeder service to these corridors at main intersection hubs. These main service hubs would also comprise the few stops along these corridors.

The process for the TDP began with Service Planning. The Service Planning staff created scenarios for each year of the TDP (2013-2022). These scenarios included routing changes, route and stop additions and removals, general service changes, headway changes, start and stop time changes, and various other changes that can be made within the TBEST environment. Many of these changes were done on paper, some were digitized in ArcMAP. As each year was completed, the data was forwarded on to the TBEST power user for input into TBEST.

TBEST input consisted of digitizing new routes and routing changes in TBEST (very similar process to digitizing in ArcMAP), manually inputting new stops, removing stops and routes for each year, and making the necessary attribute changes on specific routes. Since each year was built on the previous year, the changes had to be made year by year. LYNX used December of 2011 as the base year for the models, because this was the most current data when the process began. A new network was created within TBEST for 2013, using December 2011 as a base. The changes for 2013 were made for this year and saved. Once saved, the model was run and validated. The output of the model was forwarded to Service Planning to ensure that the ridership numbers made sense. This process was continued for the rest of the years, using the previous year as a base each time.

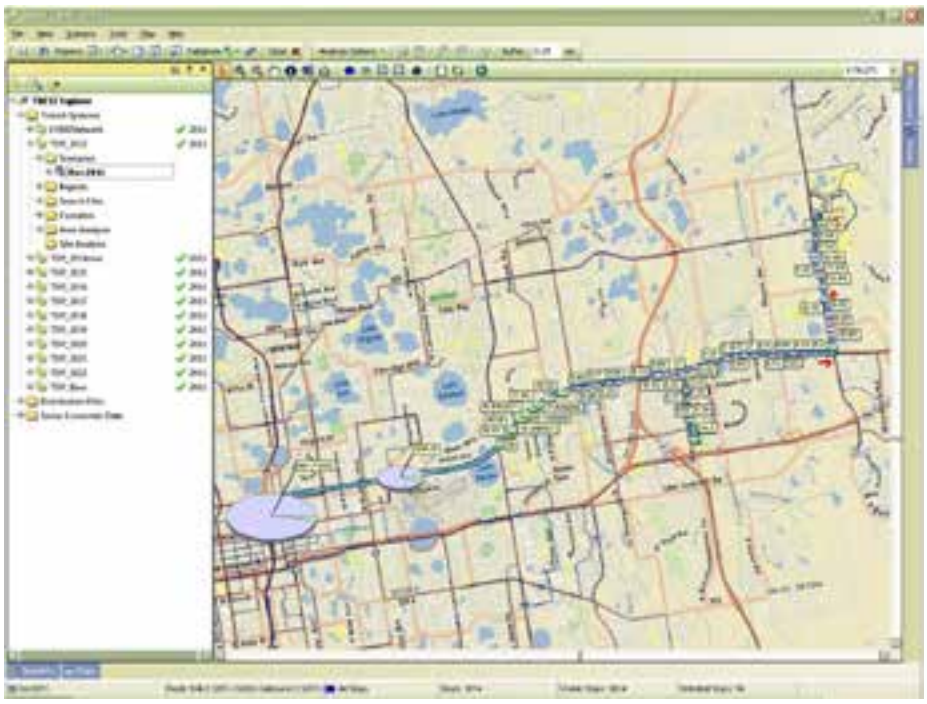

Image 1.2
Image of mapped report results based on ridership at the stop level.

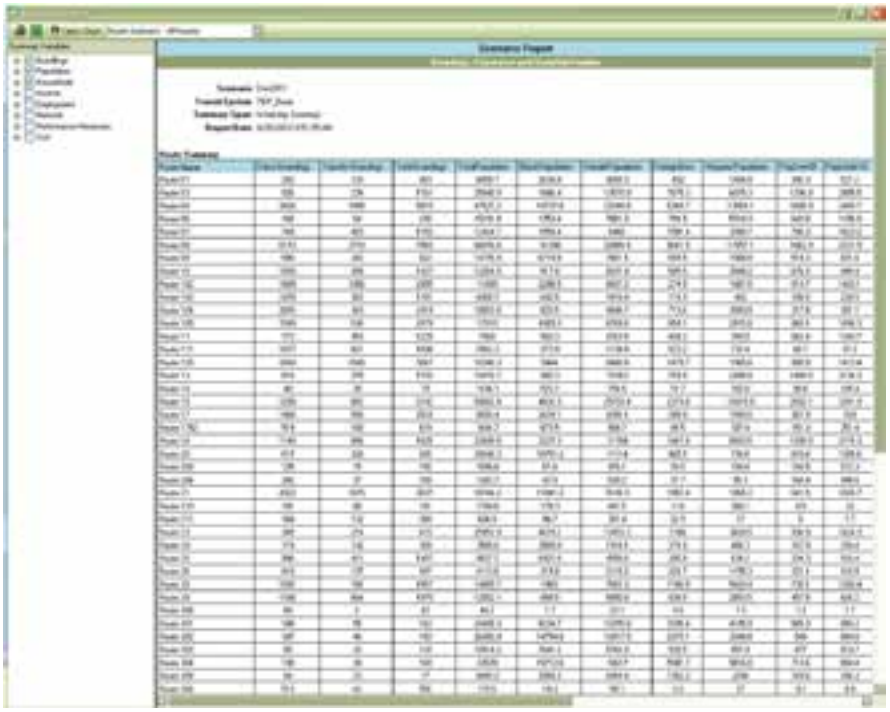

Image 1.3
Example of a TBEST report created by the TBEST Report Summary Tool.

Lessons Learned

LYNX came across some issues while using the TBEST tools for TDP. Some new routes had no precedent to base ridership off of because no route was previously in the area, or because new routes were completely replacing old routes, leaving a gap in the ridership data. This posed challenges to have ridership numbers fall within reasonable limits. Ridership on existing routes that covered areas of new routes were adjusted to observed ridership for a small amount of time in 2012. For new routes with no precedent in those areas, ridership was left alone.

LYNX was also unable to model non fixed route services within TBEST. TBEST is not designed and thus could not accurately model them. LYNX contracted out to have these service modeled in other ways.

Service Planning made various changes to years that were initially thought to be complete as the process moved along. This posed issues with going back and having to update these changes to the early years, then having to re apply the changes for the next year. Since each year built off of the previous, it is imperative that the first year be completed before the second years changes can be implemented within TBEST. LYNX will adjust its process for the next TDP in order to prevent similar issues.

Future of TBEST

The future of TBEST consists of expanding the modeling and analysis capabilities by introducing the parcel-based land use data into the software. The TBEST ridership forecasting model will be improved by calculating trips at the parcel level by utilizing land use designations and ITE-trip generation rates. Future versions of TBEST will also contain market and network accessibility analysis functionality to assist service planners in gauging potential market demand and evaluating Title VI considerations. Finally, TBEST will be equipped to generate a standardized TDP report which fulfills FDOT requirements for ridership estimation.

Conclusion

From implementation to use in the TDP, TBEST has proved to be a very useful tool in reporting and planning. LYNX has utilized this tool for TDP reporting, generating ideas for routes in service planning, figuring out what will and will not be effective route changes, and use as a future planning tool. LYNX has worked diligently to ensure that the TBEST model accurate reflects the conditions of the Central Florida region, and has successfully attained that goal. Based on the experience at LYNX, CUTR and Florida DOT have adopted and published a guidebook for “TBEST IMPLEMENTATION PROCEDURES FOR STRATEGIC AND SERVICE PLANNING”

http://tbest.org/wp-content/uploads/2012/01/TBESTImplementationSOP_Final-1-19-2012.pdf