Transportation planning is a technical and professional activity embedded in a constantly changing context local, regional, state, national and global politics. Laws passed by the U.S Congress and several states since 1990, had led to a mandatory, strategic and detailed approach to transportation planning, programming and operations. Among such laws is Transportation Equity Act for the 21st Century of 1998 (TEA-21) which obligated every metropolitan area in the United State, in cooperation with state transportation agencies, a Metropolitan Planning Organization (MPO) to coordinate plans, programs and project in order to receive federal funds for the transportation improvement in their region. Transportation planning has always been influenced by economic, social and environmental concerns but now it is even mandatory to systematically incorporate these parameters. Geographical Information System (GIS) has emerged as an effective and efficient technology which helps to capture, store, analyze, and display geographical information based on the location, descriptive attribute and the character of the event. When GIS are applied to transport field, this is more than just a sphere of application of their generic functionality (Thill, 2000). Given the importance that their different applications to this particular field have acquired, in the Anglo-Saxon world a specific term has been coined called GIS-T (GIS for transport), integrating modeling, handling and data analysis processes that are not included in conventional GIS. With the modeling software and the GIS package, planners are able to view a prediction of the future traffic demands in their jurisdiction (Shadewald, 2000). Transportation Planning has being conceptualized into four decision oriented stages and these are visioning, plan making, capital improvement programming and system monitoring. Visionary, programming and monitoring can each take advantage of a geographical perspective however the major goal for use of GIS in transportation planning is at the plan making stage (Nyerges, 2000). Plan making refers to the process of creating maps of future transportation needs (forecast map) given certain socioeconomic and land use characteristics driven by population trend over a 20 or 30-year time frame. Using, GIS for transportation data management, analysis and display at the plan making stage provides the transportation planners, policymakers, decision makers, citizen groups and the general public easier access to important geographical information relevant to the transportation planning process. In addition, some of those applications are being redeveloped as WebGIS or Internet GIS applications to foster public participation in the planning (Peng, 2001). According to Thill, (2000) Application of GIS to transport planning is an extensive field of development, facilitating long and mid-term decision-making among which are: Accessibility studies – This is the use of GIS in studies to calculate accessibility, aimed at improving network efficiency when planning transport infrastructure. GIS proved to be effective when used to prepare a transportation network and TAZs for an Idaho statewide traffic demand model (Khatib. Z; et el, 1998). Multi-modal Transport Analyses – GIS prototypes have been developed to design balanced networks for the transport demand, thus highlighting their capacity to offer a
realistic representation of multimodal traffic. The Wisconsin Department of Transportation developed a model known as Commodity Information Management System (CIMS). CIMS makes it possible to stimulate transportation scenarios based on the routes, type of transportation, vehicle characteristics, analysis of the scenarios and the generation of maps and reports.

**Integral Transport Planning** - This was the GIS-T/ISTEA project integrating 41 US states, the provincial transport departments of the District of Columbia in Canada and nine private companies. The project proposed the development of a GIS-T architecture that could be adapted for the planning and management of transport infrastructure including pavement and bridge management, safety and traffic congestion control, public transport management, intermodal management, traffic management and the control of atmospheric pollution. There has been a great deal of activity in GIS applications in transits operation and planning and the broad spread of application demonstrated the success of GIS (Sutton, 2005).

**Assessing the Environmental Impact of New Infrastructure or Policies** – With the use of GIS, geographic databases can be used to create virtual worlds (overlaying maps). Using virtual reality techniques, detailed analysis and evaluation can be made of the potential impact on the landscape that road infrastructure will have.

**Risk Planning and Management** – The application of GIS to route planning for heavy goods vehicles and vehicles transporting dangerous materials. University of Texas-El Paso designed an application for the Texas Department of Transport to automate the generation of routes for heavy goods vehicles, choosing the best route to be used. Likewise, based on GIS technology, an add-on tool was developed for New Jersey Department of Transportation and with this tool truck volume flow and percentage profiles on the state roadways and the predictive socio-economic data could be obtained (Boile, Golias, 2004).

In conclusion, the use of GIS in transportation planning has led to a turn-around of the conceptual ideas and a better yield of high quality results in comparison to the past but, nevertheless, there are still some challenges. One of the basic challenges is to translate the language of transportation issues, problems and analysis into a GIS language within an organizational (social) context (Nyerges, 2000).

**ANNOTATED BIBLIOGRAPHY**


This paper describes the development of a Geographic Information Systems (GIS)-based approach for estimating truck volumes and flows using classification counts and socio-economic data. Metropolitan planning organizations, transportation planners and researchers have attempted to address the issue of forecasting freight supply and demand to estimate future needs. However, the successful implementation of this type of analysis has been held back due to lack of appropriate freight transportation models, methodologies and data and the complexity of the freight transportation system. Based on current GIS technology, an add-on tool was developed for the New Jersey Department of Transportation. With the use of this tool, transportation planners could obtain truck volume flow and percentage profiles on state roadways and the predictive socio-economic data. The steps of the modeling approach can be summarized as follows; define roadway sections, develop the socio-economic data tables, estimate new or update current models, predict truck volumes on selected highway sections, and create truck volume and percentage profiles for each highway or selected section. The
main desktop tool for this application is ArcView and Matlab is used to create the statistical algorithms and export them into a format suitable for use with Visual Basic. VBA is used to create the GIS add-on feature interface and Microsoft Access is used to implement a relational data model.

Khatib, Zaher; Ou, Yanmei; Change, Karl (1998). GIS and Transportation Planning Proceedings Washington State Department of Transportation; Transportation Research Board

This paper discussed steps in using a GIS to prepare a transportation network and TAZs (Transportation Analysis Zones) for an Idaho statewide traffic demand model. The two main objectives of transportation planning are to simulate the current traffic volume and to forecast the future traffic volume on a transportation network. The writers selectively grouped traffic demand modeling into four tasks as follows: (1) defining traffic analysis zones (TAZs) based on land-use characteristics, (2) building the transportation network, (3) collecting traffic data for calibration, and (4) performing the four-step traffic demand modeling process of trip generation, trip distribution, mode choice, and trip assignment. Geographic Information Systems (GIS) is used to perform the first two tasks used to be time-consuming because paper maps and aerial photographs were the primary tools for constructing TAZs and the transportation network in the past. In this study for Latah County ARC/INFO was used to construct TAZs from TIGER files at different spatial scales and to build the transportation network from different data sources. Using AML programs, experiments were run to automatically assign TAZ centroids and centroid connectors, and to measure the effect of centroids and centroid connectors on traffic demand forecast. Overall, GIS proved to be an efficient and effective tool for the study but the writers pointed out that GIS cannot by itself improve the quality of input data, which is a critical factor in transportation planning.


The writer extensively covered all the application of GIS to the field of transportation planning by reviewing the literature. He explored three case studies describing GIS use in the central Puget Sound (Seattle metropolitan) region. The three case studies are at regional, county and city levels. One of the major problems encountered is that the plan making and programming (the two major work activities in planning) treat the concepts of transportation project differently. That is, the same projects are not described the same way across databases because the databases are developed under different mandates and by different units within transportation organizations. This problem then becomes increasingly apparent as organizations implement GIS application for transportation improvement programming.


Due to the spatial nature of most transportation data, transportation professionals found GIS to be a powerful tool to construct and analyze transportation networks, to conduct
impact assessment of transportation facilities, and to integrate transportation and land use planning. But GIS software is mostly proprietary. The use of GIS in transportation requires expensive GIS software and extensive user training. Therefore the use of GIS in transportation is somewhat limited to a small number of transportation professionals who have the resources and expertise to use it. Internet GIS is a new technology that is used to display and analyze spatial data on the Internet. It combines the advantages of both Internet and GIS. It offers the public a new means to access spatial information without owning expensive GIS software. Since most transportation data are spatial in nature, Internet GIS provides great potential as a powerful tool for transportation agencies and professionals to disseminate transportation information to the public via the Internet. It can also facilitate spatial data sharing within transportation agencies and between transportation department and other government agencies. The relative ease of sharing data will have a better impact on governmental agencies in general and transportation agencies in particular.


The writer emphasized how the ability to visualize data has grown immensely with functionality of Geographic Information Systems. He discussed the rapid increase in effectiveness and efficiency while using the proposed modeling software and GIS. With the modeling software and the GIS package, planners are able to view a prediction of the future traffic demands in their jurisdiction with the creation of a streamlined interfacing program. This packaged model also enable users to spend less time computing and more time assessing needs. The interface also provides analytical tools to assist the user in validation and assessment of the traffic model, all of which are executed in a GIS environment. Tools such as the shortest path through the network, time radius from a zone or node, traffic origins and destinations from a select link, and screenline validation have all been completely automated in the model. Through the use of pull-down menus and mouse clicks, activities that were previously time consuming events have become streamlined computer tasks, taking only a fraction of the original time. He later pointed out that with traditional modeling processes there is a large amount of data that needs to be accumulated before the traffic modeling process can begin. To begin with, a representation of the city needs to be created. This includes acquiring information on Traffic Analysis Zones (TAZs) and major streets in the network, along with frictional and external data for the network. The second step in the GIS modeling interface is to "load" traffic onto the newly created network through the use of traffic modeling software and finally, a select link. The greatest disadvantage of the automated process is that the user has less of an idea where to begin looking for errors because unlike the conventional modeling where users are required to prepared data before inputting, a user can point and click his/her way to unreliable information and since computers cannot produce good information from bad data, it is still the user’s ultimate responsibility to verify the result.

This article provides overview of current practice in Geographic Information Systems (GIS) applications in transit from a U.S. perspective. The evolution of GIS within transit agencies over the past decade was analyzed and trends in application areas as well as challenges were identified. The writer found out, that there is a great deal of activity in GIS applications in transit operations and planning, and that the broad spread of applications demonstrates the success of GIS as a core technology to transit practice. The article describes the three levels of implementation of GIS within transit organizations which are: project base application; departmental resource; and mainstream enterprise system. He provided the following examples to illustrate the trend toward more customer oriented applications: trip itinerary planning systems with web-GIS interfaces and automatic vehicle location/GIS systems that notify customers of bus arrival times.


Thill (2000) assembled 22 articles of a wide range of transportation research topics about transportation modeling and GIS. Six of these researched papers elucidate range of application of GIS in transportation planning. Application of GIS to transport planning is an extensive field of development, facilitating long and mid-term decision-making among which are; Accessibility Studies, Multi-modal Transport Analyses, Integral Transport Planning Assessing the Environmental Impact of New Infrastructure or Policies, Risk Planning and Pollution Control.