

CHAPTER - IX

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CHAPTER - IX

CONCLUSION

9.1 BACKGROUND:

The ability to relate information on activities and resources to a spatial location and to monitor or predict changes over time is fundamental to modern society. International, national, regional and local governments use GI (Geographic Information) for a host of applications from defense and policing activities through regional planning, strategic studies for renewable energy resources, environmental management and risk avoidance through urban and rural policy decisions to day-to-day operational activities such as land registration, property taxation or routing of traffic. Businesses use GI together with other economic information to determine optimal delivery routes, pricing policies etc.

The undesirable side effects of urban transport have influenced most developed countries to move away from the “Build it and they will come,” infrastructure-incentive, capital intensive transport strategies, towards more balanced and sustainable transport solutions. Here Intelligent Transport Systems (ITS) comes into picture and it holds the promise of sustainability. Public transport organizations in India can make use of these kinds of ITS for better management.

An Intelligent Transport System utilizes advanced technologies, frequently Geographic Information Systems (GIS) to improve both the efficiency and

safety of transport system. Transportation service providers employ ITS to provide traveler information, lower costs, decrease travel times, and provide more convenient routes and schedules. ITS can also be used as a decision support system for making pricing policy decisions by varying various business parameters like cost, price and customer related parameters like travel time, seat location, travel distance etc.

Within the GIS field there is increasing interest in the use of GIS software to provide decision support. Many GIS based systems are described as being DSS (Decision Support System) on the basis that the GIS assist in the collection or organization of data used by the decision maker. However there is a lack of agreement on what exactly a DSS actually constitute. These differences of definition also reflect the differing needs of decision makers who use spatial information. For many of the current Spatial Decisions Support System (SDSS) applications, the main information requirement of the decision makers is for relatively structured spatial information. GIS techniques are beginning to have an impact on DSS applications. Keeping in mind the applications of GIS in transportation a literature review was done.

9.2 OUTCOME OF LITERATURE REVIEW:

GIS has been widely used in the field of development of SDSS for solving vehicle routing and scheduling problems. Route generation between OD (Origin-Destination) is an integral part of any GIS based transport application. Researchers have supported the use of Dijkstra algorithm for generating the shortest path between the origin and destination.

Secondly all researchers in their articles have identified that GIS offers huge potential for spatial analysis. Very few research articles have dealt with the problem of road congestion using GIS.

All research papers have considered GIS as a tool for achieving operational optimization.

Finally in almost all the research article we can see the usage of ESRI's Arc Info / Arc View/ ArcGIS as the most popular GIS tool for spatial analysis and hardly few have used MapInfo and MapBasic as tools for spatial analysis and for customization.

9.3 SCOPE FOR RESEARCH:

From the review we were able to identify some gap where research work is possible for instance:

All earlier research works have addressed the shortest route problem first and then have solved other issues. However there is hardly any mention of generating alternate routes between an origin and destination other than generating the shortest route. This is important to us as shortest route does not always translate into shorter travel time. This is true because the shortest route may be narrow in width, or it may have higher volume of traffic, or more number of traffic signals or more number of turns. Further generating alternative route to the best path is important because during , pre-trip planning, for example drivers often want to be provided with one path for their outbound trip and an alternative path for their return. Another example could be in case of users of in-vehicle guidance systems who often want to be provided with several alternative paths that they can be used to avoid particular facilities. Alternate paths allows a user to prefer a particular path because of light traffic, few boulevard stops, etc. or avert using a particular path because of frequent delays, high toll, etc.

Secondly transportation is not just 'x' and 'y' coordinates on a map but is a business. We are attempting to convert business variables like cost, profit and price based on customer preferences into geo-coordinates to make business

decisions. That is we are trying to make use of GIS for business decision-making and not just for operational efficiency.

Thus there is wide scope for research work, where in GIS can be used to display route network, the shortest route and the alternate routes between an origin and destination. In addition we also calculate route based pricing using MapInfo as backend and Microsoft Visual Basic as front end. Customer decides the route and its implications and therefore takes responsibility of its outcome. Logistics Company's job is to ensure the quality of service delivered at customer end and use differential pricing as a tool to improve capacity utilization and profit for the company.

9.4 OBJECTIVE:

The objective of the study "Business Graphics- A New Approach to Decision Making" is to develop a spatial decision support system for customer driven routings with differential pricing, which

1. Display alternatives to the best route / shortest route between a source and destination. Thus allowing the passenger to be aware of all the possible routes between a source and destination, which he can choose when he plans to travel.
2. Provides passengers to have prior information about the distance, time taken to travel, route selected.
3. Becomes a useful tool for managers to make business decisions based on the difficulty factor equation

4. To know the factors considered by different category of passenger when they travel by public transport.

With these inputs managers will be able to make better business decisions to serve customers better.

9.5 DATA COLLECTION:

To substantiate the necessity and usefulness of such as system a survey using a structured questionnaire is conducted. The data collected is collected in two phases. In phase I data is collected from 200 passengers to understand the factors that the passengers think are important when they plan to travel. In phase II data is collected from 200 passengers to understand the level of difficulty a passenger is willing to undergo while he is traveling and the price he is ready to pay for varying level of difficulty. Lower the difficulty experienced by the passenger higher would be the price charged and vice versa.

9.6 CONCLUSIONS:

The system was developed using MapInfo ver.7.8 as a backend tool and Microsoft Visual Basic ver.6 as the front end tool. This system provide the customer with information about the road network, alternative routes to the best route the travel distance and the travel time for various levels of speed. Travel speed is used as a proxy to traffic data. This spatial decision support system answers the first objective.

To identify the attributes that passengers would look at when he plans to travel, the data was run through SPSS ver10 for analysis. Some of the statistical tools used for analysis are

1. Factor analysis
2. Perceptual mapping
3. Student 't' test
4. Chi-square Test

9.6.1 Analysis:

- Passengers are interested in few attributes when they plan their travel, these few attributes have been categorized as
 - Core Customer Services,
 1. Senior citizen care, care taken by the bus personnel towards senior citizens.
 2. The bus service, which is the right scheduling of bus arrival and departure.
 3. Clean and Safe buses have an impact on the minds of the passengers when they choose a service provider.
 - E-Flexibility which includes,
 1. Internet Booking.
 2. Automated Information System
 - Pre Journey Value Added Services this includes,
 1. Pickup and Drop facility
 2. Alternate Route Facility

- Post Journey Value Added Services this includes
 1. Prior Information about the route network, travel time and travel distance helpful in planning the journey.
 - Value Added Services, which includes,
 1. Prepaid Auto facility.
 2. Different Tariffs (Route based tariffs).
- Different Passengers have different preference among the four factors. Students for example rate E-Flexibility as the most important factor.
 - Perceptual mapping using discriminate analysis also shows almost the same pattern, student passengers being influenced by attributes like Prior information about route network, travel time and travel distance, leads to better journey planning and Prepaid auto facility.
 - Self employed respondents are strongly influenced by the attributes like NWKRTC personnel being helpful to senior passengers and Internet Booking; however between the two attributes Internet Booking is not as important as being helpful to senior passengers.
 - Similarly when perceptual mapping was done on Female and Male respondents for the total sample it was found that the male female respondents have almost the same attitude towards all the attributes except for the attribute availability of alternate routes, the male respondents significantly perceive the availability of alternate routes as an important factor.
 - Internet Booking has been identified as one of the important factor in Factor analysis and in Perceptual mapping, but the strength of this attribute is low. When the same was tested by Chi-square test it was found that there is no association between Internet Booking and Passenger's attitude this could be because Passengers are still not comfortable with the concept of computers

and Internet the other reasons could be the connectivity factor and the third reason could be the use of credit card for payment of the tickets as credit card users are less in number.

- Automated Information Systems also has no impact on the Passenger's attitude probably because of the ignorance of computer usage, but there is tremendous scope for its usage as highlighted in the factor analysis and perceptual mapping.
- Passengers have shown interest in having graphical presentation of the route network, travel time and travel distance than compared to oral presentation.
- Passengers feel that having prior information about the route network, travel time and travel distance, shortest path is helpful in planning their journey.
- Passengers have no interest in route based pricing this could be because they could have presumed that route based pricing means higher price than the existing ones. Route based pricing need not necessarily mean higher tariffs. Different tariffs can be made use for example longer and slower routes can be charged slightly less than the fast route but implementation could be problem because pricing is done at the government level.
- Clean and safe buses are the most important factor a passenger looks into. Passengers do not mind if the transporter does not provide value added services like prepaid auto facility, or music in the bus or increase the number of pick and drop points, but clean and safe bus is a must.
- Public transport is not necessarily for the middle income group, middle income group people will also use private mode of transport.
- Age is an important factor when it comes to using of Internet Booking facility. Middle aged people and student respondents felt good about Internet Booking facility.

- SDSS has huge potential in transport management. It will help people plan their journey properly and reduce stress.

Analysis of data relating to difficulty factor and differential pricing resulted in:

- 17.5 percent, that is 34 respondents have strongly agreed to travel 5 kilometers more at 3 rupees less than the normal charges.
- 53 respondents, about 27.13 percent have agreed to travel 5 kilometers more at 3 rupees less than the normal charges.
- 87 respondents, about 44.87 percent show favorable response to travel longer distance at lesser price against the normal price.
- Only 25 respondents strongly agreed to travel by longer distance in case they are forced to travel by longer route
- 48 respondents agreed to travel by the longer route in case they are forced to travel by the longer route.
- Thus we can say about 73 respondents, 37.6 percent would definitely like to travel by the longer route by paying 3 rupees less than the normal charges.
- 87.6 percent of the respondents are ready to pay extra to travel by good roads
- 12.4 percent of the respondents feel bad roads are fine if it means paying less.
- 81.95 percent of the respondents are ready travel between 7 am to 9.30 am (before peak hour) if it means paying bit less than the normal charges.
- Amongst the respondents willing to travel between 7 am and 9.30am, 40.25 percent of them would like to travel by 9.00 am
- 11.85 percent of the respondents said they are ready to travel during peak hours even if it means paying slightly more than the normal charges.

- About 51.54 percent of the respondents would like to have good drivers even if it means paying more than the normal charges.
- 39.6 percent of the respondents are ready to pay more if the bus personnel are capable of handling emergency.
- Only 17 percent of the respondents said they are ready to pay more to get a seat in the middle portion of the bus.
- The difficulty equation for the total population are:

$$DF1 = 0.823 SD + 0.755 EH + 0.576 GR + 0.563 TT + 0.488 LD$$

$$DF2 = 0.795 AB + 0.771 BS + 0.665 SI$$

Equation 'DF1' can be termed as the difficulty factor equation for ordinary travelers who feel safe driver/safe driving is important and are ready to pay more for having a safe driver. The next important weightage is given to emergency handling capacity of the bus personnel in case of tyre burst, fights among passengers and so on. Passengers are ready to pay extra for good roads. Travel time is also important. Similarly equation DF2 can be called difficulty equation for luxury travelers who in addition to the basic requirements have said they are ready to pay extra for an air-conditioned bus. Size of the bus is also important for these passengers. Location of the seat in the bus is important for these passengers and they are ready to pay more for a seat in the centre than at the front or rear portion of the bus.

- Respondents are ready to travel by alternate routes hence they need to be given choice of the routes.
- Respondents travel early because less traffic, less congestions etc, passengers can be motivated to travel early by charging less compared to the charges during the peak hours.
- Various factors like travel distance, time of travel, good roads, size of the bus, seat location in the bus, bus driver's ability, air-conditioned bus and

emergency handling capacity can be used to calculate the difficulty factor equations.

- Using the difficulty factor equation we can calculate differential pricing for various combination of factor that the passenger

9.7 RECOMMENDATIONS:

- Transporters should make use of GIS for providing information about the road network, travel time and travel distance in graphical format as it is easy to understand.
- Public transporter should have one person who can operate the system and provides information to the passengers so that they can plan their travel.
- This type of system could be extended to truck operators, car owners who plan to travel by their cars.
- Internet booking of tickets will take more time to catch up with the passengers.
- Kiosks can be set up at various strategic locations to provide detailed information to the passengers.
- Managers can make better decisions if they are trained in using GIS based decision support systems.
- There is definitely scope for implementing differential pricing, based on the passenger's preferences.

Lastly we can say that this work is the first step and one part of mapping of all the activities of public transport, leading to better management leading to better customer service and increased profitability.

9.8 SCOPE FOR FUTURE RESEARCH:

- Since there is no mapped database, one could take up the task of developing a database which includes comprehensive information about,
 1. Utilities like banks, post offices, police stations, hotels, hospitals, schools, ATMs etc.
 2. Important building locations with name and address.
 3. Extending the system for a wider geographic area.
- Generating routes at the micro level like within the cities, from taluka headquarter to all the cities and villages within that taluka.
- Future studies can include few more parameters in calculating difficulty factor equation and analyze the findings for various segments of passengers based on their demographic profile.
- During the journey from a source to destination, passengers embark and disembark at different stops and in differing numbers. The data about passenger embarking and disembarking into the bus can be used to calculate real time profitability and can be represented in a graphical form. This is of tremendous use to transport companies to identify the stops where profitability is high.

The above mentioned four areas for future research are an extension of my present research work. Other general areas, which can be taken up for research work using GIS tool are:

- Integrating GPS with GIS for tracking and effective management of resources.
- Identifying accidents spots and patterns along the road network.
- Mapping of waste movement
- Using GIS for fleet management.
- Using GIS for managing movement of Iron ore in North Karnataka region.
- Using GIS for generating the buffers for identification of location for setting various utilities inside the impact area.