Usage of Geographical Information Systems in Travel sector – A Study based on Available Applications

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Abstract:
The role of Geographic Information System (GIS) in travel management is examined in this paper. In the international arena, role of GIS is immense in travel management. In the Indian scenario, GIS is not used in travel management extensively. Decision support systems based on GIS help in strategic decision making. Even though GIS is based on cartographic data, the underlying database can be tapped using appropriate tools for providing a total management solution in travel businesses, both governmental and private. The paper analyses the different GIS solutions in travel management used world over along with those in the Indian scenario. The importance of GIS in travel management is immense as evidenced in this study. With the advent of wireless devices and hi-speed internet access, cartographic data are available on the fly. The study gives suggestions based on the findings which will help travel management, especially in the Indian context.

Keywords: GIS, Travel Management, DSS, Tourism Administration, Travel Industry

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1.0 Introduction

Cartography is closely associated with travel ever since man ventured out from his homeland. Paper based maps have proved invaluable to travelers in discovering new lands. Many a time inaccuracy and its cumbersome handling leading to wear and tear have resulted in serious errors resulting in loss of human life and time. Information technology which is advancing by leaps and bounds is an integral part of modern day travel. Geographic Information systems (GIS) have revolutionised modern day travel leading to accuracy and savings in time and money. It can be said that it is now almost impossible for a traveler armed with GIS based technology to lose his way. Travel, by land or air relies on GIS to meet the demands of the traveler. With customer satisfaction being the key word, travel companies worldwide vie each other in keeping a customer happy. This paper examines the various applications available worldwide which used GIS in making travel a safe and satisfying experience to travelers.

2.0 An Insight into Geographic Information Systems

Human mind is tuned to analyzing information based on images. This holds the key to effective transfer of data from images (both digitized and non-digitized) from computers and mobile devices to human brain. Decisions such as finding shortest path, getting out from a traffic jam or finding the nearest hotel or railway station can be taken easily based on digitized cartographic information. GIS organizes data in such a manner which enables a person reading a map to select data necessary for a specific project or task. In addition to travel related data processing, a social analyst may be able to use the base map pertaining to a district and select datasets from the census bureau to add data layers to a map that shows residents’ education levels, age and employment details. With an ability to combine a variety of datasets in an infinite number of ways, GIS is a useful tool for nearly every field of knowledge ranging from travel to archeology.

A good GIS program is able to process geographic data from a variety of sources and integrate it into a map project. Many countries have an abundance of geographic data for analysis. Governments often make GIS datasets publicly available. Map file databases often come
included with GIS packages. Others can be obtained from both commercial vendors and government agencies. Some data is gathered in the field by global positioning units that attach a location coordinate (latitude and longitude) to a feature such as a pump station. GIS maps are interactive. On the computer screen, map users can scan a GIS map in any direction, zoom in or out, and change the nature of the information contained in the map. They can choose a layer such as roads, decide on how many roads to see and how roads should be depicted. Then they can select what other items they wish to view alongside these roads such as storm drains, gas lines, rare plants, or hospitals. Some GIS programs are designed to perform sophisticated calculations for tracking storms or predicting erosion patterns. GIS applications can be embedded into common activities such as verifying an address (Aeronautical GIS best practices, ESRI Press, 2013). Using GIS, stakeholders can get immediate feedback on the implications of their choices and reach consensus on outcomes quickly (Allen & Goers, 2002). GIS can be used to add value to spatial data (Heywood et al, 2010). GIS and map analysis developments began around the same time as related developments in computer cartography and spatial statistics began. These were promoted by the limitations of hard copy maps, problems with overlaying data sets and the increasing size and increasing number of datasets. (Tomlinson, 2005). GIS can be used for tourism planning. It is a long term process of readying a destination for tourists or improving the destination’s attractiveness to tourists (Fridgen, 1991)

3.0 Objectives of the study

- To analyse various applications available in travel sector worldwide
- To suggest measures to improve the effectiveness of GIS in Travel sector in Indian scenario

4.0 GIS for Air travel

4.1 Areas of application

In many countries, Military and civil aviation departments use GIS in the following ways:

- Aeronautical Information Systems (AIS) are used to create, analyse and reinvent critical data for distribution
Update charts automatically using AIS with the aim of reducing redundancy, latency and errors
Generate International Civil Aviation Organisation (ICAO) compliant charts for various purposes from the central data
Share data using Aeronautical Information Exchange Model (AIXM)
Generate aeronautical charts for route planning, in-flight navigation, and takeoff and landing

In order to improve quality, the international Civil Aviation Organization shifted from static tabular data to an interactive GIS portal. The advantages evidenced are

- The ICAO users could use global data from the GIS portal
- Co-ordination between state and international organizations increased
- The frequency of data updates increased
- Operations management received a boost

(Esri press, 2009)

The ESRI business partner ROK Technologies (Roktech) and has used web services in assisting its clients to delivery cartographic imagery on the fly. FltPlan.com, which is an online company and a client of Roktech serves the general and corporate aviation community. It uses a unique combination of ArcGIS Server tile processing and a relatively new type of cloud computing called Hardware as a Service (HaaS) to accommodate sudden influxes of visitor to its site. This proved to be trend setter in GIS applications related to aviation. The Romanian Civil Aeronautical Authority has used GIS based solutions to improve visual quality of data. The National Geospatial-Intelligence Agency launched a GIS based application with the following objectives and the results as given below

**Objectives**

To Provide aeronautical, nautical, and topographic maps, charts, and data to customers with immediate, on-demand access to relevant geospatial intelligence where and when they need it.

**Results**

Maritime charts are available the day after being cleared for release instead of the
traditional six to eight weeks.

Production time has dropped from hundreds of hours to less than one for some maps and charts.

Production time is determined based on the intended use of the product—saving person-hours and reducing expenses.

(Esri, 2008)

ESRI in 2009 helped ICAO improve data management and workflow for Air Navigation Planning using GIS. Aviation Authority Shifted from Static Data to an Interactive Platform for viewing, planning, and reporting using ArcGIS. The International Civil Aviation Organization (ICAO) is making air navigation safer through more timely access to accurate data. Using ArcGIS Server, a server-based GIS from ESRI, ICAO has created a web-based portal containing various global air navigation charts that can be viewed and accessed over the Internet. (ESRI Press, 2009)

The National Geospatial-Intelligence Agency used GIS to achieve the following objectives

- NGA moved from a product centric to a data centric organization.
- GIS changed the way flight information publications are produced and distributed.
- Geospatially enabled data enabled fusion with other data for additional analysis.

(ArcNews Online, 2007)

The Edmonton Airport in Canada has used GIS effectively in improving efficiency, communication and collaboration. It allows complex construction projects to be carried out intelligently. The Manchester Airport in the United Kingdom achieved Significant Growth by using a flexible GIS to ensure business sustainability.

**Highlights**

- ArcGIS saved the airport US$ 220,000 and 1,200 person-hours per year.
- GIS now touches on all aspects of running the airport.
ArcGIS integrates seamlessly into business models and evolves with the airport’s needs.

The Manchester Airport is using GIS to help plan sustained growth until 2030. Enterprise GIS was launched at Phoenix Sky Harbor International with the following highlights:

- The enterprise GIS is stored in Oracle Spatial and accessed through ArcGIS.
- The GIS includes business tools for managing the airport’s operations and growing number of assets.
- About 85 staff members, who are neither GIS specialists nor technicians, access the GIS weekly.

The airport’s enterprise GIS features an abundance of data, sophisticated technology, and reengineered business processes. The enterprise system has the following capabilities:

- Aerial photography and digital orthophotos of areas surrounding the airport operations area
- Aboveground features and underground utility data
- A Geodatabase design with 300 feature classes, from smoke detectors and passenger assistance monitors to noise contours and 3D roof prints
- Interior floor plan data and attribution for buildings in and around the airport, collected via floor plan surveys and CAD drawing conversions
- An intranet viewing portal based on ArcGIS Server technology
- Information availability that was integrated from the previously existing systems
- Ten servers in multiple clustered environments, which provide performance, reliability, and availability, including a redundant failover system at a remote location in case of system outages

(Spring 2010 issue of ArcNews Online)

4.2 Areas where GIS is applied for airport management

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ISSN: 2278-9111

The ICAO electronic Air Navigation Planning [eANP] GIS portal is a gateway combining a database and Internet-based GIS technology allowing authorized users to submit, store, update, manipulate, analyze, and chart global air navigation planning data from a centralized ICAO server.

Many airports use vertical navigation capability enabled by either the integration of barometric vertical data by the flight management computer or through the use of a satellite-based augmentation system (SBAS). In the case of SBAS procedures, the minima can be as low as 200 ft which is equivalent to that achieved using a precision Instrument Landing system (ILS) Category I.

Remote sensing can contribute in a number of ways in air traffic management. One significant application is addressing flight delays. Remote sensing can come to the rescue in such a situation. Stereo remote sensing can allow aircraft flight controllers to minimise such delays.

The use of Geographic Information System (GIS) and Global Positioning System (GPS) technologies in pavement management system (PMS) offers a number of benefits in view of the unique operational features of airports. Besides the usual advantages of a GIS-based system in creating, maintaining and displaying maps and pavement condition data in digital format, the system also provides a logical platform for PMS to interact with other facility management systems in the airport, such as the airfield lighting and underground cable system, and aircraft parking apron operation system. By means of GPS devices, the routine airfield distress survey can be conducted more efficiently with an enhanced and reliable location identification capability. The entire flow of field survey distress reporting, updating of records, and processing of maintenance and repair needs becomes a much more efficient paperless process. (Huang, et..al., 2004)
The role of Geographic Information System (GIS) technology in tourism analysis and site selection is well established. The tourism industry have widely adopted information technology (IT) to reduce costs, enhance operational efficiency, and most importantly to improve service quality and customer experience. Applications of Geographic Information System (GIS) that present travel patterns related data obtained from Petra city in Jordan have been examined in a study. The study shows that Geographic Information System (GIS) is increasingly becoming critical for the competitive operations of the tourism sites as well as hospitality organizations in Jordan. (Al Qeed et.al, 2010)

With Satellite imagery and a complete suite of GIS products, aviation users can provide all the functionality for creating and managing an Intelligent Aviation GIS for safety, quality assurance and reforms in the institutional and capacity building as a consensus for effective aviation reforms. (Adeoye, 2010)

5.0 GIS applications in Logistics

All over the world, geographic information system (GIS) solutions are helping transportation organizations better manage, analyze, and leverage their spatial data. These organizations are improving network planning, controlling costs, enhancing customer service, and expanding their business by using GIS technology to take strategic decisions.

5.1 Applications of GIS in Logistics

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ArcLogistics™ Navigator is a GPS-guided in-vehicle navigation solution that helps drivers stay on route and adhere to schedules. ArcLogistics Navigator is specifically designed for commercial trucking, fleet, and logistics applications and is tightly integrated with ArcLogistics.

5.2 Advantages of using ArcLogistics
Increase cost savings by ensuring drivers stay on route.

Adhering to routing restrictions set in ArcLogistics ensure safety.

Quickly reroute drivers to the original route in the event of missed turns.

www.esri.com/arclogistics

6.0 GIS for highway and roads management

A centralized information system based on ESRI GIS software provides transportation professionals with the IT framework for maintaining and deploying data and applications in every aspect of the transportation infrastructure life cycle as shown below.

**Planning:** Helps in identifying deficiencies and determine optimal solutions. **Design:** Integrates GIS with most design tools, including CAD, bringing greater analytic and cost-estimation capabilities to the infrastructure design process. **Survey:** Manages and stores GPS data and survey measurements more effectively. **Construction:** Integrates project and financial management software with GIS to better manage infrastructure projects. GIS can provide a single point of entry for all construction-related documents and files. **Operations:** Incorporates GIS into business processes to improve operational performance. **Maintenance:** Helps in managing disparate assets and integrates asset inventory with inspection history and work order management to maintain critical investments in a cost-effective manner.

(ESRI, 2010)

7.0 GIS Solutions for Ports and Maritime Transport

Visualization, Nautical Charting, Public Information, Shipping Channels Location, Restricted Area Awareness

www.esri.com/transportation

8.0 GIS Solutions for Railroads

GIS has been effectively deployed in support of a broad array of railway functions including
• Infrastructure management and maintenance planning - Bridges, tunnels, and track networks - Communications and signaling networks - Electric power distribution networks - Rail yards and other campus facilities • Real estate management - Valuation maps - Lease and tenant management • Rolling stock management - Locomotive health and well-being - Shipment and asset tracking • Safety and security - Incident tracking - Response management - Safety planning - Access management - Risk assessment • Design and construction - Environmental compliance - Capacity modeling - ROW acquisition • Supply chain analysis - Commodity flow history - Marketing analysis • Passenger information systems • Intermodal management

9.0 GIS in Indian Travel Scenario

Even though GIS is used extensively in various disciples in Indian context, its use in travel sector is a recent phenomenon. Road, rail, water and air travel are the major transport sector in India. Among these four modes of transport Rail and road travel are the most commonly used modes of transport which Indian railways being the backbone of Indian economy. Air travel, that too low cost flying is only catching up. The main reason for public preferring road and rail transport is largely due the low cost of travel and accessibility. Train travel is relatively cheaper of these two options. Water transport is also used though to a limited extend.

In travel sector in India, GIS is yet to find its place as an indispensible tool. In airports GIS in the lines issued of ESRI are used for air traffic control in major airports. Airports Authority of India (AAI) plays a major role in managing and controlling Indian aerospace and airports. Given the inherent spatial nature of the aeronautical data, geospatial technology can play an integral role in ensuring smooth and safe flight movements amidst growing traffic. Geospatial technology is one of the key enabling technologies being used in overall planning, deployment, delivery, maintenance, and management of the aviation infrastructure. It is changing the way the cockpit resource management and flight management are taking place in the modern aircraft fleet.

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ISSN: 2278-9111
Electronic flight bags are replacing paper charts and maps. Electronic route bulletins, aerodrome information, electronic aeronautical information publications, electronic terrain obstacle data are all the outcomes of geospatial technology.

Global navigation satellite system (GNSS), that provides accurate locations for cars, boats and aircrafts, has a lot of potential in air traffic management. The primary use of GNSS is for computing the aircraft position in order to navigate the aircraft. This is used in international scenario to a large extent and is main used in air traffic control in India.

In road transport almost all states in the country use GPS enabled devices in locating vehicles and to a limited extend for monitoring traffic. Major cities in the country use GIS based solutions based on GPS devices for policing and traffic management. Call taxi operators use GPS for locating their vehicles and tracking its route. Many state owned road transport corporations also use GPS enabled devices for vehicle tracking and fleet management. Logistics management also employs GIS for its routine checks and for tracking the shipments. Indian Railways is yet to implement GIS in a full-fledged manner. Water transport sector in India lacks a proper GIS system.

10.0 Findings

1. GIS is widely used in developed countries for Air traffic control and Airport management
2. Transport sector (rail, road and water) uses GIS enabled solutions to track and manage resources
3. Decisions support Systems (DSS) based on GIS has helped countries solve various issues associated with transport sector in developed countries
4. Remote sensing using GIS has helped service industry like tourism avert disasters and thereby ensure passenger safety.
5. Tourists use GIS to locate places and to find shortest paths using mobile and other hand held devices in additional to conventional internet based access to maps
6. Asian counties like India are yet o use the full potential of GIS for travel which is now limited to only GPS based information.
7. Even though few applications have been developed by a handful of states in India, a centralized GIS hub is yet to be implemented

11.0 Suggestions
1. Governments of developing countries should take steps to provide GIS based access to travel information online to general public
2. Private players should be integrated into the central GIS hub in India
3. All state owned websites related to tourism should be linked to a central hub using a GIS enable interface
4. Now mobile operators provide maps according to their specifications. A common map based application with more accuracy and details have to be provided by a public sector agency such as BSNL to all operators
5. All modes of transport (air, rail, road and water) should be given specific applications suitable to their needs which can be integrated to the central hub
6. Airport applications of GIS are minimal in India which can be upgraded to international standards specified by ESRI
7. Planning commission of India can use GIS to analyse problems faced by transport sector in India owing to traffic congestion, improper land use and planning, scheduling etc and use these finding to avoid such issues in future.
8. Above all GIS data being critical to the security of the nation may be given based only on security norms which should be constantly monitored.

12.0 Conclusion

International travel sector has used GIS to a large extend by throwing open transport sector to tourists and general public. A person visiting a developed country like Singapore will have no problem getting around on his own provided he has done his homework using internet well. This is largely due to judicious use of IT based on GIS and other travel solutions available over the net. The traveler is able to get what is seen on the website without compromising on time and money. Be it air, road, rail or water transport this is true in all countries which used GIS based solutions. The scenario in third world countries is very different as is the case with India. Even though India may not have the same money power as that of a developed country, the IT manpower is the immense. This can be tapped using Free and Open Software (FOSS) based solutions with GIS backup to address the need of the travel sector. Indian travel sector focuses
only on increasing revenues by increasing tourist receipts. The real problem faced by tourists and travelers in India is a hassle free public transport system. A GIS based solution which can handle the issues pointed out in the finding of this study focusing on the suggestions will help overcome this challenge to a large extent. During the long run, the travel sector in India will benefit immensely by adopting the GIS technologies adopted worldwide, that have been brought out by this study.

References


http://192.206.28.81/eganp/


http://www.esri.com/aeronautical

