Reengineering in Road Transport Systems Through GIS and GPS

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ABSTRACT

By way of GIS/GPS in the realm of transportation, a wide range of possible applications get underway, as diverse as the arena of transportation itself. This is presumably the largest potential for the future of GIS in transportation. GIS will no longer be a stand-alone product, but fully integrated with other information systems.

***Key words**:* Road Transport, GIS, GPS, Re-engineering, GIS-PMS database, Road Information Systems.

1. Introduction

Information and Communication Technology (ICT) and related services are the wealth generators for any nation. A Geographic Information System (GIS) can capture, store, analyze and manage data and related attributes which are spatially connected. Geographic Information System (GIS) and Global Positioning System (GPS) technologies can help in monitoring road transport activities through internet. Road transport, which is an important economic sector of the country, accounts for about 65% of the cargo movement in India at present. Cargo carried by roads increased from 6 Billion Tonnes Kilo Metres (BTKMS) in 1950-51 to 613 BTKMS in 2004-05. Similarly, passengers carried by roads increased from 23 BTKMS in 1950-51 to 3365.9 BTKMS in 2004-05. Average annual growth in road sector at around 10% is much higher than the present overall GDP growth of 6.4% in India. Roads Transport has a dominant share of 4.5% in GDP.[1] India has 72.7 million registered motor vehicles at the end of fiscal year 2003-04. Goods vehicles share is 5% of registered vehicle population as on 31.03.2004, registered cars were 272895, jeeps 87203, tractors 373373, goods vehicles 3748. Goods vehicles registered in 2004 stood at 3748 (in thousands) as compared to 82 (in thousands) in 1951. Number of buses increased from 34 thousands in 1951 to 768 thousands in 2004. Number of accidents per lakh population is also showing an increasing trend from 21.2 in 1970 to 22.8 in 1980, 33.8 in 1990, 38.1 in 2003 and further to 39.8 in 2004. With vast road sector of the country ranging from the Himalayas to Kanyakumari, J&K, Central India, North Eastern states, Bihar, Western States including the large coastal line, there is a need to strictly enforce the provisions of Motor Vehicles Act, which regulates the transportation in our country. From these figures, it is understandable that GIS can play a major role in controlling traffic and enabling safety of road transport. It is foreseeable that there is a challenging task to cover the National Highway System of the whole country.

2. Promise of GIS/GPS

Using GIS in the field of transportation provides abundant possible applications as vehicles are moving along a direction in space and GIS can provide important role in a specifically referenced context, considering the paths as a transportation network. There is a need to monitor and regulate the problems of traffic, overloading, road designing, improvement in highways, wayside amenities, road signage, etc. The

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benefit of GIS must reach all parts of the country through E-Governance. We have to embark on creating GIS infrastructure and developing competence in this sector. A web-based transportation information system can help transport users in many ways. NIRS, a programme launched by the Department of Space jointly with the State Remote Sensing Centers, is envisaged as a network of GIS based nodes connecting many districts from different States in the whole country. These nodes are the repositories of resource information in the spatial domain and are assigned to provide vital inputs to decision-making at the district, state and central levels. Data should be integrated and stored in the GIS - PMS database. GIS based Pavement Management System for selected National Highways can be very useful. Innovative solutions are possible in a GIS environment where a total integration approach is adopted. On the basis of a survey of employees of Department of Road Transport and Highways in India, experts and users, following recommendations have been made for including certain areas under the GIS / GPS monitoring system:-

- Better design of roads
- Analysis and identification of black spots and their removal
- Improvement of roads in accident prone stretches on National Highways
- Identifying the accident causing culverts and proper widening wherever necessary along with strengthening of shoulders with proper road markings
- Provision of bus bays for passengers
- Construction of over-bridges and by-passes on National Highways (NHs)
- Segregation measures for mixed traffic on the roads and visualizing traffic patterns
- Reconstruction/widening of narrow and weak bridges/culverts including over-bridges on NHs
- Improvement of deficient road geometric, which ensures adequate width and proper horizontal and vertical alignments
- Provision of good drainage system along the roads
- Parking lay byes along NHs and passing places on hill roads
- Construction of by-passes on NHs with access controlled facilities and the grade separated crossings
- Control on the access to NHs for safe, uninterrupted and efficient movement on long distances
- Preparing detailed project reports
- Monitoring traffic and safety
- Improved layout for the intersections
- Route planning and car navigation
- Engineering drawings and maps
- Segregation of local traffic in built-up stretches through provision of service roads
- Improved road signs with retro reflective sheeting and road markings
- Regulating better night visibility
- Provision of road over bridges at congested intersections and at the locations of railway level crossings
- Provision of underpasses for crossing of pedestrians and local traffic of two-wheelers, animal driven vehicles and cattle etc.
- Road side facilities for truck drivers
- Wayside amenities for long distance travellers
- Provision of Highway Traffic Management System with emergency call boxes, close circuit TVs, variable message signs, mobile communications, ambulance, crane and highway patrol
- Regulating overloading of vehicles
- Discouraging use of agricultural tractors for carrying of goods
- Use of interceptors/video cameras for traffic violation/rash driving
- Road Information Systems

The range of applications in the transport sector is quite large and many innovative ideas can be adopted taking into account the above suggestions received in the survey. The total integration approach within the GIS environment can be used to evolve an effective GIS based pavement management system for a selected highway network. The GIS-PMS application can be used to apply GIS to the task pavement management. This integration immensely benefits the different activities within the pavement maintenance management process. The way in which the data is captured and stored in the GIS-PMS database, enhances the availability of quality data. This also minimizes the time cost of data storage and retrieval in comparison to the manual process. Using GIS for analyzing data can be very helpful in 3D visualization of large scale infrastructure and engineering projects. Along with integration and development of GIS-PMS Database, the related activities should be re-engineered and re-structured.

GIS based road management and construction system will avoid duplication of efforts besides controlling leakage of resources. The above recommendation is summarized in the following illustration:

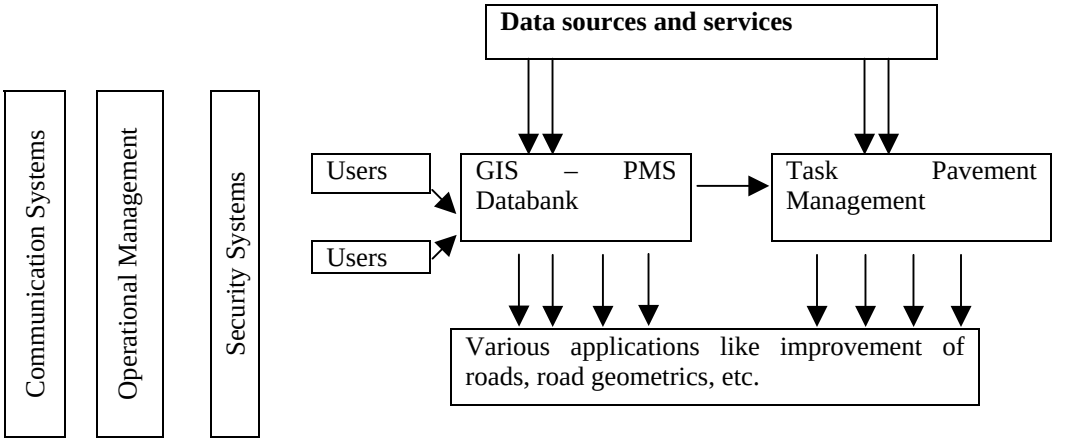

Figure 1: GIS based road management and construction system

3. Implementation framework

Using GIS planning and designing of roads can be simplified through Computer Aided Design (CAD). However, survey of 300 employees of Ministry of Shipping, Road Transport & Highways indicated that only 15% employees were confident on Computer Aided Design (CAD) and only 1% was confident in using GIS/GPS technologies. The survey further revealed that awareness, attitude, ability and affordability are the key factors for effective implementation of GIS / GPS technologies. Therefore, requisite knowledge and skills should be provided to the users of this technology.

In order to cover the whole country, a number of parallel strategic interventions would be necessary. The following figure shows a possible implementation structure for adopting GIS / GPS in Road Transport Sector.

The first step proposed for implementation of GIS / GPS is the preparatory phase. This should be followed with parallel activities like training, infrastructure development, legal framework and final adaptation of the strategy. High technology GIS infrastructure can be successful only when there is no disruption. An effective web interface software should be installed for interactive access to design, drawings, maps and data through internet. There should be a mechanism for automatic data collection and data utilization.

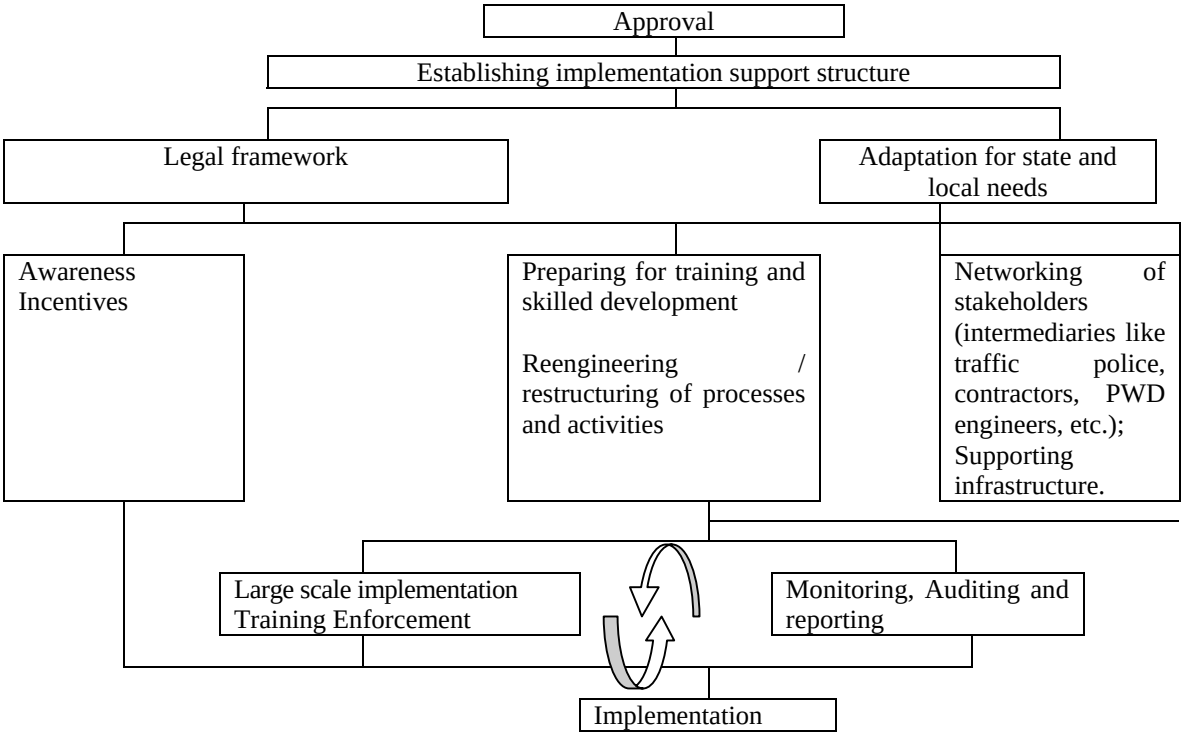

Figure 2: Mechanism for automatic data collection and data utilization

5. Concluding Remarks

GIS / GPS have immense possibilities in facilitating Electronic Governance. In a transport set up, it is a computer system competent to assimilate, save, edit, evaluate, share, and present geographically-referenced information. In a broadened generic sense, GIS is an innovative tool that can allow users to create interactive queries, analyze the spatial information, access and edit data, maps and offer instant results of all such functions. This paper has outlined the need for developing GIS based applications relating to transport sector. It presents the significance of understanding GIS / GPS and related applications relating to its functional requirements. It is also concluded that the capabilities for processing geo-spatial and related aspects need to be enhanced for winning better strategies.

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About the Author

Reena Sethi is M.Sc.; M.Ed.; MBA from Australia; Ph.D in Management from FMS, University of Delhi. Her area of research is E-Governance in Transport Sector of India. She has contributed research papers on E-Governance and related topics. Presently, she is working as Under Secretary in the Ministry of Shipping, Road Transport and Highways.