Application Of GIS In Highway Alignment With Soft Computing Tools

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Abstract - The vision of the Highway Alignment is to increase the capacity, connectivity, efficiency and safety of the Highways System so as to enable balanced socio-economic development of all sections of the people and all regions from Perundurai to Palani and to reduce the traffic and travelling of the state. It is to establish shortest path for road network time in the roads which provide a better and comfortable base for updating the traffic and other related information in road administration. It is to identify the short route for the vehicles traveling from Perundurai to Palani and to reduce the time travel for the vehicles with possible paths or routes or places for laying eco-friendly highway. To optimize the route for the vehicles traveling from Perundurai to Palani using GIS with Neural Network such as Analytic Hierarchy Process and Fuzzy Logic. From this we can find the suitable route for peoples to carry out without any traffic disturbances and protecting the environment. It also took advantages of GIS capabilities that offer the ability to overlay maps, merge them, and perform spatial analysis on various layers of information in either two or three dimensions.

Keywords - Highway Alignment, GIS With Soft Computing Tools.

1. Introduction

Tamil Nadu is the eleventh largest state in the country with a total area of 1,30,058 Sq. km. The density of the population in the State is 555persons/Sqkm. The vehicle population which was 27,325 in 1951 increased to 1,36,60,717 in 2011 registering an increase of 500 times. The density of road network in Tamil Nadu as on 2011 is 280 km per Lakh population and 156 km per 100 Sq.km areas and it is well above the all India average of 103 km. The road network increased by about 6.26 times (i.e.) from 32,307 km to 2,02,296 km since 1951 to 2011. Out of this, 62,017 km of roads is maintained by Central and State Highways Department.

Table 1. Categories Of Roads And Their Length

Category of road	Length (km)
National Highways (NH)	4,974
State Highways (SH)	10,764
Major District Roads (MDR)	11,247
Other District Roads (ODR)	35,032
Total	62,017

Table 2. Types Of Bridges And Their Numbers

Types of Bridges	Nos.
Major Bridges	1357
Minor Bridges	7936
Culverts	108915
Road Over Bridges at Railway level crossing (ROB)	197
Road Under Bridges at Railway level crossing (RUB)	59
Total	1,18,464

2. Highway Alignment Between Perundurai And Palani Corridor

A. *Categories of Roads*

National Highways are roads connecting different State capitals, Major Ports, large industrial areas and tourist centers. These roads have heavy traffic intensity. The total length of National Highways in Tamil Nadu is 4974 km of which 1500 km are maintained by National Highways wing of the 8 State Government and 3474 km are maintained by the National Highways Authority of India (NHAI). National Highways are being widened to two lane with paved shoulder/ four lane / six lane and strengthened using Central Funds or under PPP mode.

State Highways provide connectivity to District head quarters with National Highways and neighboring states. These stretches have heavy traffic intensity next only to National Highways. The total length of State Highways in Tamil Nadu is 10764 km. Roads classified as State Highways are required to follow standards such as, Minimum carriageway width of 7m (double lane), Right of Way minimum of 30m, All the culverts and bridges to have a minimum width of 12m etc.,

Major District Roads connect towns and municipal areas with District head quarters. These roads link to production and marketing centers and these centers in turn are connected with the National Highways and State Highways. In Tamil Nadu, the length of Major District Roads is 11,247 km. Roads classified as Major District Roads are required to follow standards such as, Minimum Carriageway width of 5.50m (intermediate lane), Right of way minimum of 30m, All the culverts and bridges to have a minimum width of 12m etc.,

Other District Roads connect villages and marketing centres with Taluk headquarters and other important roads nearby. These roads are important as they provide mobility for transport of agricultural produce from villages to nearby marketing centers. These roads are the backbone of the rural economy. The Other District Roads are maintained as Single Lane or Intermediate Lane based on the traffic intensity of the roads. Apart from this the Other District Roads connecting the sugarcane production centers with Sugar mills and in turn with nearby marketing centers are being improved and maintained under the category of ODR - Sugarcane roads. There is 35,032 km Other District Roads including Sugarcane roads. Roads classified as Other District Roads are required to follow standards such as, Minimum carriageway width of 3.75m (single lane), Right of Way minimum of 12m.

Road Capacity require catering to the rising demands of the traffic. In view of the exponential growth of the traffic due to industrialization and urbanization, the existing capacity of roads is planned to be increased as given below, Widening of

roads National Highways roads are widened and strengthened to the capacity of two lane with paved shoulders, four lane and six lane with the funds provided by the Government of India. Providing additional connectivity and upgrading roads.

Roads are being formed along new routes to connect important towns. Formation of Bypasses to avoid traffic congestion in major cities and towns, bypasses are being formed. ROBs / RUBs are being constructed at level crossings to avoid the traffic congestion and accidents and also to allow free flow of traffic. Construction of Bridges across un-bridged crossings and reconstruction of dilapidated and narrow bridges are undertaken to ensure uninterrupted traffic flow.

Road Quality and Efficiency of the Highways system are of paramount importance. The department will ensure provision of efficient pavement catering to the demands of the traffic, smoother riding surface for greater riding comfort, requiring less maintenance and better durability. Good riding conditions result in reduced journey time between the origin and destination. Less wear and tear of the automobile parts, less vehicular maintenance etc., due to the better road conditions ultimately result in greater economical benefits to the nation.

Road User Satisfaction, the benefits of better road construction are ultimately passed on to the Road User. The quality and efficiency of the road systems impinge on road user satisfaction. Feedback from the road users regarding the quality of the road and an effective system to incorporate such feedback would help optimal allocation of budgetary resources for road projects and evaluation of utility of such projects. Maintenance and improvements are taken up as and when feedback is obtained from the public representatives and road users. A web site is being maintained to share information about various projects under execution, their current status etc., with the road users.

Methodology Adopted In Selection of Works, usually guided by some of the parameters, Policy Guidelines, Representation from the Public Representatives, Renewal Cycle, Up gradation of Roads to Meet the Norms.

Vision of us is to provide road infrastructure for equitable socioeconomic development throughout the state. To ensure equity and balance, new road works are identified considering the density of road network per unit area and unit population and taken up in phased manner. [1]New Special Economic Zones and industrial corridors are established by the Government in the economically backward areas. To provide connectivity considering the heavily loaded vehicles plying in those industrial areas, specially designed roads are required to be provided.

Quality Control, for improvement and maintenance of roads and bridges huge amount should spent. In order to ensure quality of these works, a 3 tier quality control system is in vogue under Quality Assurance wing. Quality of the roads has been improved over the years. The road condition report based on the Roughness Index taken from Road Management System (RMS) reveals that the percentage of State Highways in damaged condition has decreased from 8% in the year 2010 to 6% in the year 2011. Improving Delivery Systems, is a Comprehensive Road and Traffic Planning. This is especially true of urban and peri-urban areas which are fast developing and where seamless blending of various transport options is required. It is planned to focus on this aspect in all future programmes especially in developing cities. Public Private Partnership (PPP), the Highways Department has usually restricted its activities to the available budget. Demands are many but only a few can be fulfilled every year. So infrastructure deficit continues and infrastructure development becomes a slow process. A paradigm shift is needed from this to an approach where needs of different users are considered and plans evolved in an integrated and holistic manner. This will ensure that infrastructure delivery is faster. It is obvious that for this paradigm shift resources need to be available and PPP is one method through which resource mobilization is possible as mentioned in the budget speech. The available resources can be leveraged through PPPs so that infrastructure development is faster.

Performance Based Maintenance Contract (PBMC), as announced in the budget speech PBMC is one method of ensuring accountability in the maintenance of roads. This has already been tried in some stretches on a pilot basis. Based on this new schemes will be taken up. Land Pooling has become increasingly difficult to compulsorily acquire land for widening roads as well as forming bypasses. Land owners are reluctant to part with their lands, which is leading to delays in project execution. [2]To ensure that they are co-opted as partners in the development process, it is proposed to try out the land pooling system as announced in the budget speech. Through this scheme, land is pooled and road grids can be neatly formed. This has proved very successful in some parts of the world and other states in India. The Highways Act is proposed to be modified giving effect to Land Pooling. Land Pooling technique will be utilized for development of infrastructure as well as economic development. This in turn enables for redistribution of the remaining plots back to the land owners to develop or to sell. This technique will avoid huge land acquisition cost and also beneficial to land owners though the land owner lose some land (undeveloped or under developed), gets back 70% - 80 % of developed land. To achieve the above, facilitation through TN Highways Act is being proposed.

Road Safety, in view of the increasing road traffic and congestion, safety of road users, especially pedestrians, cyclists and those travelling in smaller vehicles etc is paramount. Number of vehicles during 2002 – 2003 was 56,58,097 and it has increased to 1,48,61,695 in Dec. 2011. Number of fatalities per 10,000 vehicles during 2002 – 2003 was 17.56 and through Road Safety measures it has been reduced to 10.38 at present. The department has identified several critical junctions as black spots. Geometrical improvements have been made to reduce the accidents and to provide safe and comfortable driving for the users. In addition to the above, the department has proposed construction of bypasses and flyovers at the intersection of NH and SH which are identified as critical junctions. As envisaged in the Road Safety Policy, the reduction in fatalities per 10,000 Vehicles has been achieved. The World Bank Mission has appreciated the reduction in accidents as an impact of implementation of Road Safety Programme. However, statistics reveal 98% of the accidents are caused by human error. So, the Department will take special efforts to spread awareness among road users.

Road Accident Data Management System (RADMS), is a web enabled GIS based software developed for Tamil Nadu. With the assistance of the World Bank, this system is being implemented through Tamil Nadu Road Sector Project wing of the Highways Department in coordination with Police and Transport Departments. The objective of the system is to collect accident data, analyze the cause of accidents and to improve road safety measures.

Accident Data[3] is being collected by the three departments and uploaded in the system. This data is analyzed and interventions are implemented by the department concerned to improve Road Safety. Road Safety Awareness programme is being implemented through the Institute of Road Transport. This includes formulation of detailed action plan, creating awareness among the drivers of three/four wheeler, school students and general public about the road safety measures, find ways and means to avert collision with vehicles parked on the road side.

Road infrastructure is planned in consonance with the environmental conditions of the local area. It is proposed to use sustainable technology utilizing alternate materials for road infrastructure, thereby conserving the Ecology. The following eco-friendly measures are being adopted.

Plantation, [4]during the widening of roads cutting of trees located along the roads is inevitable. To compensate, for every tree cut several new saplings are planted. Taking an eco-friendly view and to reduce global warming, the department is implementing the plantation program along the boundary of the roads. During 2011-12, 67200 saplings have been planted and a target of 1 Lakh saplings has been set for 2012-13 by the Government.

Rain Water Harvesting is being implemented in all bridges, roads and Government buildings with either open or closed drainage facilities based on the site conditions. It is important to note that proper drainage of storm water away from the road helps to maintain the durability of the roads. Provision for construction of earthen drains is included in all the road works.

3. Study Area

Perundurai is a panchayat and taluk in Erode district in the Indian state of Tamil Nadu. It is located on National Highway 47, which bypasses the city of Erode from here, between Salem and Coimbatore. It is 20 kilometers from Erode, and exactly at 80 kilometers from both Coimbatore and Salem. Perundurai has developed as the industrial centre of Erode City with SIPCOT Industrial Estate and SEZ Complex. Perundurai is one of the major and fastest growing area in Erode, also it is well connected by the National Highway 47 (NH-47)and State high way whereas the other major towns in the Erode district is not connected by the National Highway. Perundurai SIPCOT established by the State Government of Tamil Nadu in July,2000,[1] Which is having a land of around 2000 Acres after that this town floating population gradually increasing, because lot of dyeing industries were re-located from Erode, Tirupur and Coimbatore to Perundurai.

SIPCOT has acquired another 1,600 acres (6.5 km2) of land by extending the existing area in 2007. This is due to large demand from the textile industry. Perundurai is located at 11.27°N 77.58°E. It has an average elevation of 292 meters (958 feet). It's Latitude (DMS) 11° 16' 0N Longitude (DMS) 77° 34' 60E. As of 2001 India census, Perundurai had a Population of 46,973. Males constitute 50% of the population and females 50%. Perundurai has an average literacy rate of 72%, higher than the national average of 59.5%: male literacy is 80%, and female literacy is 65%. In Perundurai, 9% of the population is under 6 years of age.

Kangeyam is a Municipality in Tirupur district in the Indian state of Tamil Nadu. Kangeyam was the capital of Kongu Nadu for many centuries. Kangeyam is situated in the heart of the Tirupur district. Kangeyam has a population of 38,862. Kangeyam is situated in the meeting point of NH 67, SH 37 and SH 205.Kangeyamis located at 11°00′19″N 77°33′43″E/11.0054°N coordinates 77°56′20°E Coordinates 11°00′19″N. 77°33′43″E/11°00′54°N 77°56′20°E. Access to all main cities of Tamil Nadu like Coimbatore, Tirupur, Tiruchy, Erode, Palani, Dharapuram, Tanjore, Karur, Dindigul, Madurai, Chennai, Ooty, Theni, Kodaikanal, etc. are available frequently.

Kangeyam comes under Tirupur District and Dharapuram revenue division.The town of Kangayam is well connected by NH 67,which runs between Mysore Viz. Gudalur, Ooty, Mettupalayam, Coimbatore and Nagapattinam Via Thiruchirapalli, Thanjavore. A major State Highway connecting Erode and Palani runs through Kangeyam. The highways through Kangeyam are NH67, SH37, SH81, SH96, SH172 and SH189.

Dharapuram is also known as Rajarajapuram and a municipality in the Tirupur district of the South Indian state of Tamil Nadu. Dharapuram is one of the Oldest Town in Tirupur District. It has a population of 78,137. Dharapuram is located at 10°44′N77°31′E / 10.73°N 77.52°E. It has an average elevation of 245 metres (803 feet). It is strategically located in the line of Palakkad pass from where it gets lot of wind for its numerous windmills.

Water scarcity is high here. One side of it is bordered by the Kodaikkanal mountain ranges. It stands on the banks of the holy Amaravathi River, a tributary of the Kaveri River. Dharapuram is the major junction point of Roadways connecting major cities Coimbatore-Madurai, Trichy-Cochin, Tirupur- Madurai, Palani - Salem (Via Erode), Coimbatore - Theni, Dindigul-Tiruppur and Karur -Pollachi, via road connects.

Every 5 minutes once buses available for Coimbatore, Tirupur, Erode, Palani and Madurai, midnight time every 15 minutes once buses available.78 km from Erode,34 km from Palani, 80 km from Coimbatore,48 km from Tirupur, 150 km from Trichy, 72 km from Karur, 243 km from Neyveli, 118 km from Madurai. Buses are available to all these cities 24 hours.

Palani is a city and a municipality in the Dindigul district of the South Indian state of Tamil Nadu, located about 100 km South-east of Coimbatore City and 60 km west of Dindigul. It is the location of the far-famed temple of the god Kartikeya, resorted to by more than 7 million devotees each year. It is situated at the South Indian Peninsula. Its coordinates are 10°27′01″N 77°30′38″E 10.45037°N77.510429°E Coordinates: 10°27′01″N77°30′38″E / 10.45037°N 77.510429°E. Palani had a population of 67,175. Males constitute 51% of the population and females 49%. A Roadway NH209 connects Palani to Coimbatore and Mysore. There are frequent buses to Dindigul, Coimbatore, Madurai, Erode, Tirupur, Pollachi, Karur, Trichy.

Many Omni buses are available to Chennai, Bangalore and Kodaikanal. Railways there was a meter gauge line between Coimbatore and Dindigul via Palani, which is presently under gauge conversion. After the gauge conversion a Coimbatore-Madurai Intercity Express and Coimbatore-Rameshwaram Express are expected to ply the route. Airways Palani is located equidistant from Coimbatore, Trichy and Madurai Airports.

Survey of India Toposheet No. 58E/11, 58E/12, 58F/9, 58F/11 & 58F/10 on 1:50,000. Planning of roads in plain area is somewhat different from hill areas. In hill areas alignment of roads has to be circuitous and is primarily governed by the

topography. In the plain area we should find the elevation and depression by the surveying. The elevation areas should be leveled by removing the upper surface of the earth and this soil can be used for the filling up the low lying areas.

Table 3. Details Of New Route Places

S.No	Loaction	Longitude	Latitude
1	Perundurai	77° 34' 60"	11° 16' 0"
2	Kangeyam	77°3343"	11°0019"
3	Dharapuram	77°52	10°44
4	Palani	77°3038"	10°2701"

The roads in our country in plain areas, they have been classified as National Highways, state Highways, Major District Roads and Other District Roads and Village Roads according to specification, traffic needs, and socio economic, administrative or strategic consideration. Some National Highways are point to point which will connect the state boundaries. State Highways will connect all the National Highways. Major District Roads will connect all the state Highways. Other District Roads and Village Roads will connect the major district Roads however from topographical considerations; these can be broadly being divided into arterial Roads and link roads. Arterial roads will include national/state highways and major district roads. Link roads take off from arterial roads to link villages/production areas in small/sub-valleys. These will comprise other district roads and village roads.

Width of the Road Land, Roadway, Carriageway and Shoulders, desirable widths of road land (right of way) for various categories of roads are given in Table 4.

Table 4. Desirable Widths Of Road Land (Right Of Way) For Various Categories Of Roads

	Highway Classification	Carriage Way Width (m)	Shoulder Width (m)	Road Way Width (m)
A	National Highway and State Highway 1. Single lane 2. Double lane	 3.75 7.00	 2.25 2.90	 6.25 8.8
B	Major district roads and Other district roads	3.75	2.50	4.75
C	Village Roads	3.09	2.50	4.00

Highway Alignment, "the position or the layout of the centre line of the highway on the ground is called alignment."In general alignment is of two types, Horizontal alignment, Vertical alignment .

The basic requirements of ideal alignment between two terminal stations are, Short - A straight line alignment would be the shortest, though there may be several practical considerations which would cause the deviation from the shortest path. Easy - The alignment should be such that it is easy to construct and maintain with minimum problems. Safe - The alignment should be safe enough for construction and maintenance from the view point of stability of natural hill slopes, embankments, cut slopes. Economical - The alignment is considered economical only if the local cost including the initial cost, maintenance cost.

Factors Controlling Alignment to be shortlisted, it would be straight between two terminals which are not always possible due to practical difficulties such as intermediate obstructions and topography. A shortest route may have very steep gradients and hence not easy for operations. Similarly, there will be construction and maintenance problems along the route which may be otherwise short and easy. Canals are often deviated from the shortest route in order to cater for intermediate places of importance or obligatory points. A highway which is economical in its initial construction cost need not be necessarily economically maintenance or operation cost. It may also happen that at the shortest and the easiest route may work to be the costliest of different alternatives from construction point of view. [5]Obligatory Points are control points governing the alignment the canal. These control points may be broadly divided into two categories, Points through which alignment is to pass, Points through which alignment should not pass. "Obligatory points through which alignment has to pass may cause alignment to often deviate from the shortest or easiest path".

Geometric Design factors gradient, radius of curvature governs the final alignment. As far as possible while aligning a canal the gradient should be gradually increasing. It may be necessary to make adjustments in horizontal alignment of canal keeping in view the minimum radius of curvature and the gradient. The alignment finalized based on the above factors should also be economical. In working out economics, the initial cost, operation cost, maintenance cost is taken into account. The initial construction cost could be minimized by avoiding embankments and deep cuttings and alignment is chosen in a manner to balance cutting and filling.

While aligning canal, special care should be taken to align along the side of the hill which is stable. A problem in doing this is that of the landslides. The cutting and filling to construct the canal on the hill side causes steepening of existing slopes and affect its stability.

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4. Soft Computing Tools

Fuzzy logic began with the 1965 proposal of fuzzy set theory by Lotfi Zadeh. Fuzzy logic has been applied to many fields, from control theory to artificial intelligence.

In mathematical logic, programming, philosophy and linguistics fuzzy concepts can be analyzed and defined more

accurately or comprehensively, by describing or modelling the concepts using the terms of fuzzy logic.

Techniques can be used such as, Specifying a range of conditions to which the concept applies (for example, in computer programming of a procedure). Classifying or categorizing all or most cases or uses to which the concept applies (taxonomy). Probing the assumptions on which a concept is based, or which are associated with its use (Critical thought). Identifying operational rules for the use of the concept, which cover all or most cases. Allocating different applications of the concept to different but related sets (e.g. using Boolean logic) Examining how probable it is that the concept applies, statistically or intuitively. Examining the distribution or distributional frequency of (possibly different) uses of the concept. Some other kind of measure or scale of the degree to which the concept applies. Specifying a series of logical operators (an inferential system or algorithm) which captures all or most cases to which the concept applies. Mapping or graphing the applications of the concept using some basic parameters Specifying a series of logical operators (an inferential system or algorithm) which captures all or most cases to which the concept applies. Mapping or graphing the applications of the concept using some basic parameters.

Applying a meta-language which includes fuzzy concepts in a more inclusive categorical system which is not fuzzy. Reducing or restating fuzzy concepts in terms which are simpler or similar, and which are not fuzzy or less fuzzy. Relating the fuzzy concept to other concepts which are not fuzzy or less fuzzy, or simply by replacing the fuzzy concept altogether with another, alternative concept which is not fuzzy yet "works exactly the same way".

Fuzzy Logic[7] offers several unique features that make it a particularly good choice for many control problems. It is inherently robust since it does not require precise, noise-free inputs and can be programmed to fail safely if a feedback sensor quits or is destroyed. The output control is a smooth control function despite a wide range of input variations. Since the FL controller processes user-defined rules governing the target control system, it can be modified and tweaked easily to improve or drastically alter system performance. New sensors can easily be incorporated into the system simply by generating appropriate governing rules.

FL is not limited to a few feedback inputs and one or two control outputs, nor is it necessary to measure or compute rate-of-change parameters in order for it to be implemented. Any sensor data that provides some indication of a system's actions and reactions is sufficient. This allows the sensors to be inexpensive and imprecise thus keeping the overall system cost and complexity low. Because of the rule-based operation, any reasonable number of inputs can be processed (1-8 or more) and numerous outputs (1-4 or more) generated, although defining the rule base quickly becomes complex if too many inputs and outputs are chosen for a single implementation since rules defining their interrelations must also be defined. It would be better to break the control system into smaller chunks and use several smaller FL controllers distributed on the system, each with more limited responsibilities. FL can control nonlinear systems that would be difficult or impossible to model mathematically. This opens doors for control systems that would normally be deemed unfeasible for automation.

Fuzzy concepts often play a role in the creative process of forming new concepts to understand something. Fuzzy concepts are often used to denote complex phenomena, or to describe something which is developing and changing, which might involve shedding some old meanings and acquiring new ones.

In politics, it can be highly important and problematic how exactly a conceptual distinction is drawn, or indeed whether a distinction is drawn at all; distinctions used in administration may be deliberately sharpened, or kept fuzzy, due to some political motive or power relationship. A politician may be deliberately vague about some things, and very clear and explicit about others. The "fuzzy area" can also refer simply to a residual number of cases which cannot be allocated to a known and identifiable group, class or set.

In translation work, fuzzy concepts are analyzed for the purpose of good translation. A concept in one language may not have quite the same meaning or significance in another language, or it may not be feasible to translate it literally, or at all. Some languages have concepts which do not exist in another language, raising the problem of how one would most easily render their meaning. In information services fuzzy concepts are frequently encountered because a customer or client asks a question about something which could be interpreted in many different ways, or, a document is transmitted of a type or meaning which cannot be easily allocated to a known type or category, or to a known procedure. It might take considerable inquiry to "place" the information, or establish in what framework it should be understood.

In the legal system, it is essential that rules are interpreted and applied in a standard way, so that the same cases and the same circumstances are treated equally. Otherwise one would be accused of arbitrariness, which would not serve the interests of justice. Consequently, lawmakers aim to devise definitions and categories which are sufficiently precise that they are not open to different interpretations. For this purpose, it is critically important to remove fuzziness, and differences of interpretation are typically resolved through a court ruling based on evidence. Alternatively, some other procedure is devised which permits the correct distinction to be discovered and made.

In theology an attempt is made to define more precisely the meaning of spiritual concepts, which refer to how human beings construct the meaning of human existence, and, often, the relationship people have with a supernatural world. Many spiritual concepts and beliefs are fuzzy, to the extent that, although abstract, they often have a highly personalized meaning, or involve personal interpretation of a type that is not easy to define in a cut-and-dried way.

In meteorology, where changes and effects of complex interactions in the atmosphere are studied, the weather reports often use fuzzy expressions indicating a broad trend, likelihood or level. The main reason is that the forecast can rarely be totally exact for any given location.

The analytic hierarchy process (AHP) is a structured technique for organizing and analyzing complex decisions. Based on mathematics and psychology, it was developed by Thomas L. Saaty in the 1970s and has been extensively studied and refined since then.

A hierarchy is a stratified system of ranking and organizing people, things, ideas, etc., where each element of the system, except for the top one, is subordinate to one or more other elements. Though the concept of hierarchy is easily grasped intuitively, it can also be described mathematically. Diagrams of hierarchies are often shaped roughly like

pyramids, but other than having a single element at the top, there is nothing necessarily pyramid-shaped about a hierarchy.

Uses of Analytic Hierarchy Process, Deciding how best to reduce the impact of global climate change (Fondazione Eni Enrico Mattei), Quantifying the overall quality of software systems (Microsoft Corporation), Selecting university faculty (Bloomsburg University of Pennsylvania), Deciding where to locate offshore manufacturing plants (University of Cambridge), Assessing risk in operating cross-country petroleum pipelines (American Society of Civil Engineers), Deciding how best to manage U.S. watersheds (U.S. Department of Agriculture).

The main advantage of the AHP is its ability to rank choices in the order of their effectiveness in meeting conflicting objectives. If the judgements made about the relative importance of, in this example, the objectives of expense, operability, reliability and flexibility, and those about the competing machines' ability to satisfy those objectives, have been made in good faith, then the AHP calculations lead inexorably to the logical consequence of those judgements. It is quite hard – but not impossible – to 'fiddle' the judgements to get some predetermined result. (In MOA, it is impossible to do that.) The further strength of the AHP is its ability to detect inconsistent judgments. The limitations of the AHP are that it only works because the matrices are all of the same mathematical form – known as a positive reciprocal matrix.

5. Conclusions

The main purpose of alignment is to collect the data which are required for route optimization and site selection for new route which prevents distance and duration but also free from collision with economical one. In the present work was carried out to collect data of new route alignment. Various details of route places are collected. By using collected data, GPS will be used to locate the places and the route optimization will be achieved by the help of Network Analysis. It will be used to find the new favorable routes by considering the land use map, soil permeability, and ground water level.

This alignment helps to collect data and will help to identify efficient route for development of the Sipcot Perundurai and surrounding Cities. The developed GIS model has demonstrated the potential of using GIS technology as a tool to assist in route location and highway alignment applications. It has been shown that using GIS in route location and highway alignment can be flexible and has the capability to expand easily and accommodate any additional required data layers, such as soil and geological features, to represent the real world, where the highway will be aligned. On the other hand, the model can take additional data and layers that come from the future plans of the study area.

Interface with Software (Softdesk) allows interaction with the capabilities of GIS model, because ArcView is very limited in design features. This allows for the design of horizontal and vertical alignments. This study proved to be a good analytical tool in conducting the impacts of suggested highway on the environment elements such as agricultural areas, biodiversity areas, forest areas, and on water resources. This will help in reducing the negative effects on these areas and resources.

The developed model showed high capabilities of dealing with 3D in two ways, determining the preliminary centerline and avoiding the topography with steep slopes using Profile Extractor Extension PE, Showing the designed highway in 3D and simulating a driving experience, thus giving a trial simulation of the highway before it is constructed and visual checking the sight distance.

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