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AN OVERVIEW ON GEOGRAPHIC INFORMATION SYSTEM AND DECISION MAKING TO ENHANCE GIS IN DECISION MAKING FRAMEWORK

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Abstract-Geographic Information System (GIS) is a science basically deals with the geographical data. GIS is computer system that combines spatial database management, data manipulation, geo/statistical analysis and mapping of geo referenced spatial data. It has great functionality in data management, manipulation, and analysis of data, processing of input data and displaying output data. It is also used to retrieve, manipulate, and analyze data based on the user's request. But it is getting failed in case of decision making. GIS can assist better to decision makers in decision making phase but fail to identify how decision making process happens.
To make GIS most robust in decision making framework, there is need to understand the decision making process and its integrated functionality with GIS.
Decision making is the process that leads to a choice between a set of alternatives. Geographical decision-making means analyzing and interpreting geographical information that is related to the alternatives in question. To integrate decision making techniques with GIS, there are three methods are studied: Loose coupling, Tight coupling and interoperable.
Author has been decided to use this integrated approach of decision making and GIS to solve the spatial problems in case of land use planning and decision making.
Keywords- Geographic Information System (GIS), Decision making, Loose coupling, Tight coupling and interoperable.

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Introduction

Geographic Information System is a science deals with processing geographical data. It is act like information system design to work data referenced by geographic coordinates [1].
It is a combination of hardware, software and procedures designed to support the capture, management, manipulation, analysis, modeling and display of spatially referenced data for solving complex planning and management problems [2].
GIS is used to digitally convert analog to digital application and keep track not only of events, things or activities but also the point where these activities occur. It help to represent and analyze the geographic features present on the earth surface and the events including non-spatial attributes linked to the geography under study that are taking place on it [3].

GIS have a wide range of applications which include researcher's incorporation of map making process of traditional cartographers into GIS technology for the automated production of maps, resources management, scientific investigations, asset management, environmental impact assessment, urban planning, sales, marketing and logistic, etc [1].
GIS can store and retrieve data from the database based on the query done by user. The data retrieval and storage of geographic data into database and analysis of this data is done with help of functions which are defined by the users. Along with the user defined function, GIS has other function to manipulate and analyze geographic data that are scalar operation, overlay operations, connectivity operations, visualization of data etc [4].
GIS process input data which is present in the form of paper maps,

tables of attributes, photos etc while the digital data could be of electronic files of maps and associates attributes data, air photos and even satellite imagery. To get better result, this input data is converted into the format which is understandable by GIS. Once the data is converted then this data is need to be stored into the database for the future use. Whenever user request data for particular location, then that time GIS retrieves data from database present in the form of maps, charts, table of values or test in hard copy or soft copy. Maps that have been derived from the inputted data and the information produced are then to be printed or displayed as output of GIS.

Decision Making

Decision making is the process that leads to a choice between a set of alternatives. Geographical decision-making means analyzing and interpreting geographical information that is related to the alternatives in question. Decision making is often used in land suitability analysis, or site selection, as well as location allocation modeling (1)

The Decision Making Process

Decision making is a sequential process [4]:

- Defining the decision problem (objective)
- Determining the set of evaluation criteria to be used
- Weighting the criteria Generating alternatives
- Applying decision rules
- Recommending the best solution to the problem

Any decision-making process begins with the definition of the problem or the objective to be reached. Once the decision problem is defined, what follows is setting up a set of criteria that reflect all concerns of the problem and finding measures as to which the degree is achieved.[5]

Following figure illustrates the functionality of decision making process. [6]

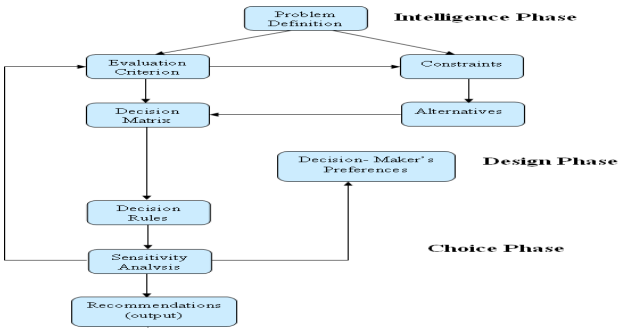

Fig.1-Decision making process

Criterion Evaluation: It is set of objectives that reflect all concerns relevant to the decision problem, and Measure for achieving those objectives. Criterion can be developed with help of decision maker's opinion, analytical studies etc. Criterion can be of two types: 1) constraints and factors.

Constraints: A constraint is a criterion that is absolute in its inclusion or exclusion of possible outcomes. This might be a boundary for a development area, slopes that are too steep or other attributes.

Factors: A factor is a criterion that influences the suitability of the decision, according to its value. Different factors might be assigned with different weighting to illustrate their individual importance.

Alternatives: It may represent different courses of action, different hypothesis, different land allocation, and so on.

Decision Rules: Decision rules is procedure by which criterions are combined to arrive at a particular evaluation and by which evaluations are compared and acted upon.

Sensitivity Analysis: It is the procedure to determine how the recommended course of action is affected by changes in the input of the analysis.

Failures of GIS

GIS has great functionality in data management, manipulation, analysis of data, processing of input data and displaying output data. GIS can retrieve, manipulate, analyze data based on the user's request, can assist better in decision making but fail to identify how. Even GIS can display output data as it is based on the user request. But it can not make any decision based on the real and practical situation because GIS has limited ability in decision making framework [6].

- There are some reasons why GIS has limited ability in decision making framework.
- Most time GIS is unable to compare and asses different scenarios of alternatives.
- Because of limited ability in decision support, GIS can not play vital role in choice phase of decision making process based on Simon's famous three phase framework of Intelligence, design and Decision.
- GIS can only provide the spatial information for the decision makers but can not provide any information about the potentials of the information for decision support.

As per the study of literature of the GIS, some authors considered GIS itself as a form of decision support system. However, GIS is computer system that combines spatial database management, geo/statistical analysis and mapping but not more than that. And hence after that some authors depicted current GIS do not offer sufficient decision support capabilities [4, 7-9].

Early development and commercial success of GIS were fuelled more by the need for efficient spatial inventory rather than decision support systems and as a result, few systems yet provide any explicit decision analysis tools [10].

Failure of the GIS strongly compels, use of decision making techniques in the decision making framework of the GIS. To make GIS more robust in decision making phase, there is need to integrate decision making techniques with GIS in a user friendly environment.

Integration of GIS and Decision Making Technique

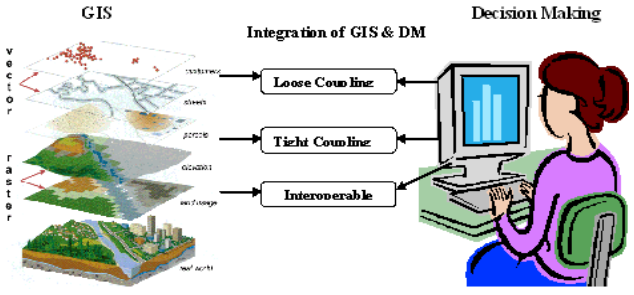

Fig 2-Integration of GIS and Decision making

Loose Coupling: Loose coupling strategy combines the capabilities of separate models for GIS functions and decision making techniques by transferring files. To work in GIS decision making model we have to switch between GIS software, database/ spreadsheet software, and decision making software very often. [11]

In loose coupling, integration of GIS and decision making tools is achieved through sharing data files written in ASCII or other standard file format using standard file transfer utilities [12].

GIS and Decision making tool runs independently, the user interface is kept independent on each tool, and therefore the need for additional software to provide common/overall interface platform does not exist.

In loose coupling, user needs to ensure an appropriate format for all input data files to avoid incompatibility. Because manual manipulation of the exchange files leads to errors in the output. [16, 17]. Some more examples of loose coupling have explained in the research articles. [9, 18, 16, 19].

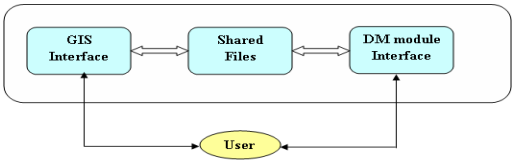

Fig. 3- Loose coupling

Tight Coupling: A tightly coupled strategy involves accessing decision making analysis routines from within GIS software [13]. In tight coupling, one system provides a user interface for viewing and controlling the entire application that may be built of several programs [13]. It allows the two components to run simultaneously and to share a common database; therefore, program control remains within the GIS when performing the decision making analysis.

In general, the tight coupling approach requires a high level of knowledge of the GIS in question and considerable programming skills. The user interface should support decision makers through all decision-making phases, and is the key to successful use of any decision support system [14]. It includes all I/O methods by which data are entered and results and information displayed by a MC-SDSS. It enables a dynamically interactive session in a real-time exchange of information between the user and the system [9]. Example of tight coupling has explained in the research articles. [15].

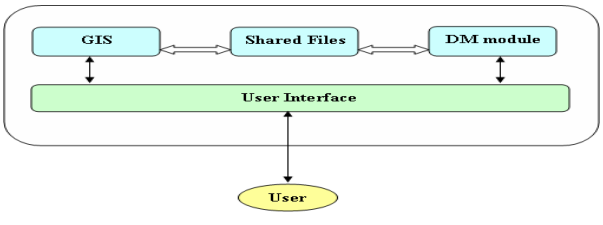

Fig. 4 -Tight coupling

Interoperable

Interoperable strategy involved GIS and decision making software components to directly cooperate or communicate despite of their differences in programming language, interface and execution platform.

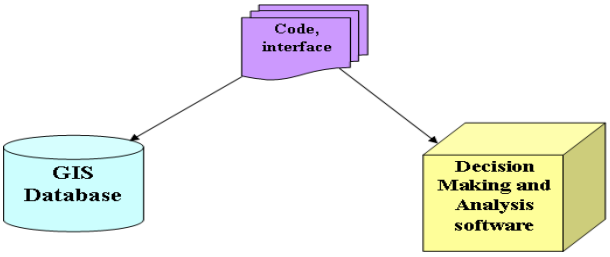

Fig.5 - Interoperable coupling

Conclusion

In this research, author has reviewed what Geographical Information system is and how it's work with geographical information. From the study it has been observed that GIS has good functionality in data input, output, data retrieve, manipulation and analysis but having less ability in decision making framework. GIS has also has the limited ability to compare and asses different scenarios of alternatives. Also in Simon's Decision making model, GIS can not play vital role in choice phase, it only play significant role in intelligence phase.

From the study of failure of GIS in decision making, it has been decided to study the integration of decision making techniques with GIS. To integrate decision making and GIS, three methods have been studied that are: loose coupling, tight coupling and interoperable.

From the study of integration of decision making and GIS, it has been decided to use these integrated techniques to solve the real world spatial problems in the framework of land use planning and decision making.

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