

# GIS based material management and supplier selection in Thane city – A case study

Prashant V Thakare<sup>1</sup>  
Civil and Environmental Engineering Department  
Veermata Jijabai Technological Institute,

Dr Sumedh Y Mhaske<sup>2</sup>  
Civil and Environmental Engineering Department  
Veermata Jijabai Technological Institute,

**Abstract** — *Materials are the inputs to the construction activity. Materials forms the single largest component of the total cost of the facility. Material cost being in the range of 50% to 60% of the total cost of the project. Improper supplier selection usually faces problems in price of material, delivery, communication, quality, timely availability of materials, etc. and its bad effect on the cost of project, so need of ideal supplier is for avoiding these problems and also cost overrun. There are several method for supplier selection and it can be possible to select ideal suppliers by using of those methods but these several traditional methods fails to collect information of all the suppliers with all their material correctly, also it takes too much time to collect such information manually. For supplier selection purpose requirement of all data about supplier like personal detail, cost of materials, quantity, quality, delivery services, location, communication facility, discount, transportation facility, experience, etc. and collecting these information would be less or no time consuming using data base. Hence GIS is very effective tool for data base management, GIS should be used for storing and quantifying all data of all suppliers and using these data easily screen all suppliers in very short time. By using GIS GRAM++ software, digitise map of study area, roads and locate location of suppliers, Then it is very easy to find out suppliers location, all detail information of suppliers, ideal suppliers and shortest route between supplier and construction site by developing queries in very short time.*

**Keywords** — *Material management, supplier selection, GIS, GRAM++, Shortest path, GRAM Net*

## I. INTRODUCTION

Today, India is one of the fastest growing economy in the world. And the construction industry is an integral part of the growing economy. Material management plays an important role in construction industry and to select most ideal material in the required time, need of a best material supplier. And since because supply on demand is the backbone of material management, it becomes very important aspect in determination of success of any construction project [1].

### A. Materials management

Materials management is a process for planning, executing and controlling field and office activities in construction. The goal of materials management is to insure that construction materials are available at their point of use when needed. The materials management system attempts to insure that the right quality and quantity of materials are appropriately selected, purchased, delivered and handled on site in a timely manner and at a reasonable cost. Materials management is the system for planning and controlling all of the efforts necessary to ensure that the correct quality and quantity of materials are properly specified in a timely manner, are obtained at a reasonable cost and most importantly are available at the point of use when required. Thus Materials management is an important element in project management. Materials represent a major expense in construction, so minimizing procurement costs improves opportunities for reducing the overall project costs. Poor materials management can result in increased costs during construction. Efficient management of materials can result in substantial savings in project costs [1].

### B. Supplier selection

Supplier selection is substantial and forms the foundation for success or failure of construction projects. The significance of maintaining a strong relationship with suppliers to be competitive in today's construction environment. Quality and cost of material procurement are two attributes that are directly affected by the material supplier selection process. In order to maintain both of these attributes, supplier selection should be well defined, in a way that decreases project logistics and supply chain management costs. Therefore supplier selection criteria should be well defined. Supplier selection is a multi-criteria decision making problem which includes both qualitative and quantitative considerations. A trade-off between tangible and intangible criteria is important in selecting the best supplier [4].

### C. Critical success factors for supplier selection

- a) Quality of materials
- b) Quantity of materials
- c) Price of materials
- d) Availability of materials
- e) Delivery service
- f) Technical capability
- g) Financial strength

- h) Geographical Location
- i) Reputation
- j) Management and Organisation
- k) Other factors [6].

**D. Major steps of supplier selection**

- Step 1 - Identification of the need for a specific product
- Step 2 - Identify key sourcing requirements and criteria
- Step 3 - Determine sourcing strategy
- Step 4 - Identify potential supply sources
- Step 5 - Limit suppliers in selection pool
- Step 6 - Determine method for final selection
- Step 7 - Select suppliers and reach agreement [2].

**II. GEOGRAPHICAL INFORMATION SYSTEM (GIS)**

A Geographic information system is a computer based system capable of capturing, storing, and analysing and displaying geographically referenced information; that identified according to location. Practitioners also define a GIS as including the procedures, operating personal and spatial data that goes into system.

A GIS tool is used for mapping and analysing spatial data. GIS technology integrates common database operations such as query and statistical analysis with the unique visualization and geographic analysis benefits offered by maps [5].

**A. Component of GIS**



Fig. 1 Component of GIS [5]

**B. Working of GIS**

GIS stores information about the world as a collection of thematic layers that can be linked together by geography. This simple but extremely powerful and versatile concept has proven invaluable for solving many real world problems from modelling global atmospheric circulation, to predicting rural land use, and monitoring changes in rainforest ecosystems.

1. Geographic references
2. Input of data
3. Map making
4. Manipulation of data
5. File management
6. Query and Analysis
7. Visualization [5].

**III. CASE STUDY**

**A. Study Region – Thane City**

The city of Thane is one of Maharashtra’s major industrial town and the district headquarters. The National Decennial Census 2011 pegged the population of the city at 1,818,872. The geographical jurisdiction of the Thane city spreads over an area of 128.23 sq. km. The city falls on latitude 72°50'12" North with longitude 19°10'15" East.

**B. Data Acquisition**

Total 130 major construction materials suppliers are available in Thane city region. The scope of materials was restricted to only sand and cement, owing to its importance and availability. Collection of data included personal information of suppliers like name and address, details of materials like cost, brand, quarry source, available stock, lead time, discount, transportation, guarantee for safety, replacement, test certificates, etc. The Thane city map was obtained from Thane Municipal Corporation (TMC) office, Pachpakhadi, Thane. GRAM++ software collected from IIT Bombay.

**IV. APPLICATION OF GIS MODEL**

**A. Procedure for Database generation**

1. Geo-registering of Thane city map
  - Step 1: Create Thane city map file
  - Step 2: Open image file of Thane city map
  - Step 3: Add the tic marks to registered the map
  - Step 4: Calculate error
2. Create different Layers in Thane city map
  - a. External boundary layer of Thane city – Polygon Layer
  - b. Roads network and Railway line Layers of Thane city – Segment Layer
  - c. Supplier’s location Layer in Thane city – Point Layer
3. Digitization of all layers
4. Editing map
5. Polygon formation
6. Adding labels
7. Table creation of supplier’s location layer
8. Preparation of Data base of supplier’s data

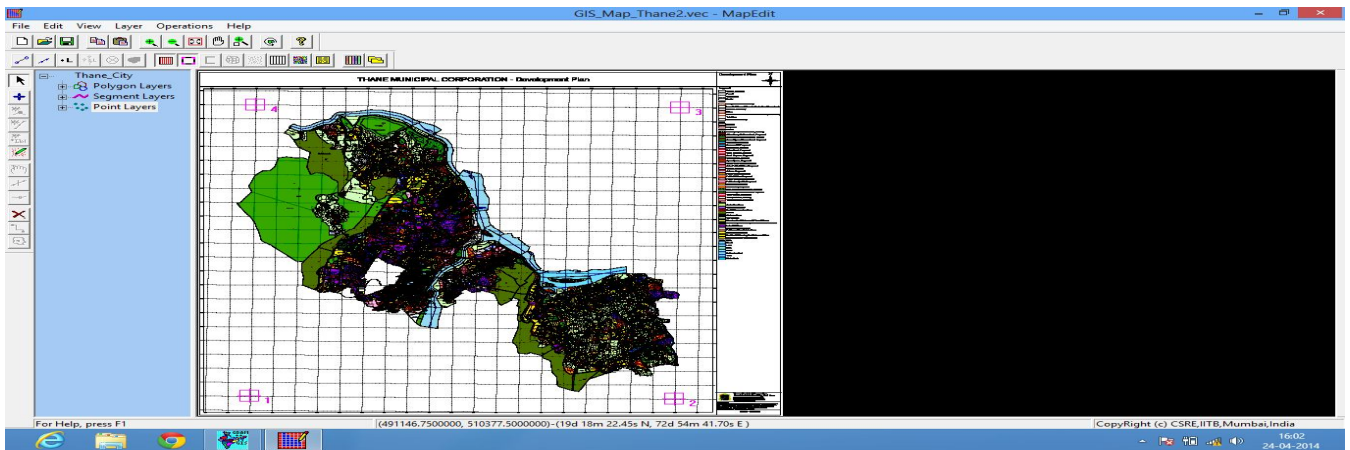


Fig. 2 Thane city opened in GRAM++ software and Geo-registered of Thane city map

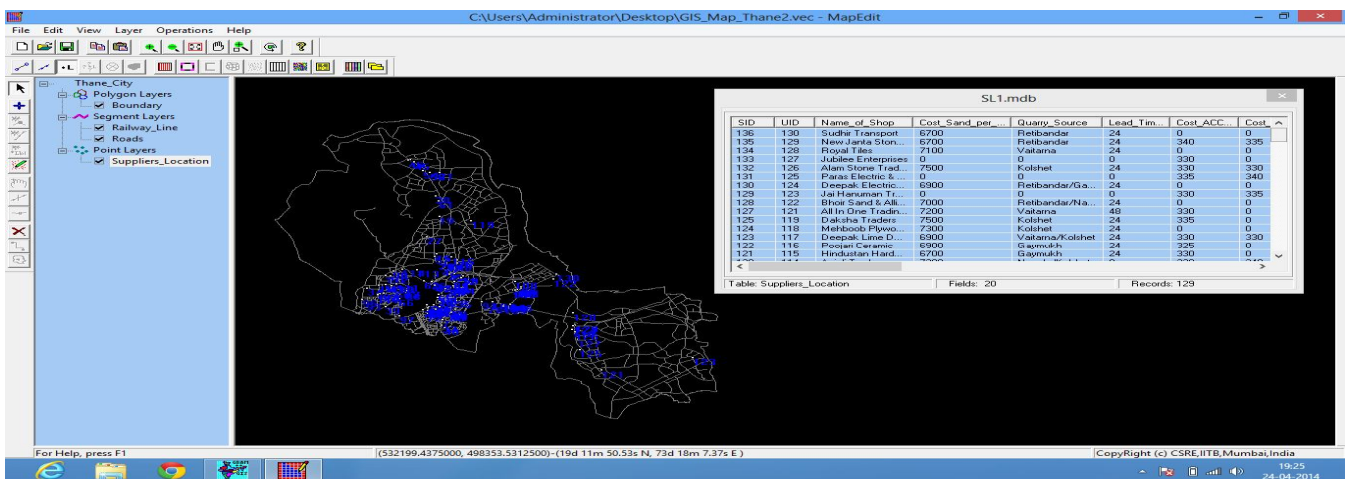


Fig. 3 Digitized map shows all layers and table creation of supplier location layer of supplier’s data.

**B. Generation of Queries**

The database file of Thane city map is used in vector GIS. The vector GIS contain vector query module, tin module, network module. Vector query module basically used for running query and find out best solution. Vector query is very important to Thane city map vector file. By run query find the more solution and that will more helpful for supplier selection process. By this query find out minimum cost of materials, available stock, lead time etc. in very few time. Also it is used to compare more suppliers and evaluate each suppliers.

Query No. 1

Find out lead time of cement is 15 hrs and Condition for this query is “Lead\_Time\_Cement = 15” and result of this query is 11 out of 129 suppliers having lead time 15 hrs. This query is very important because information of lead time play an important role in delivery of materials and supplier selection process. It is very important when emergency requirement of material And this query and data gives solution in very less time.

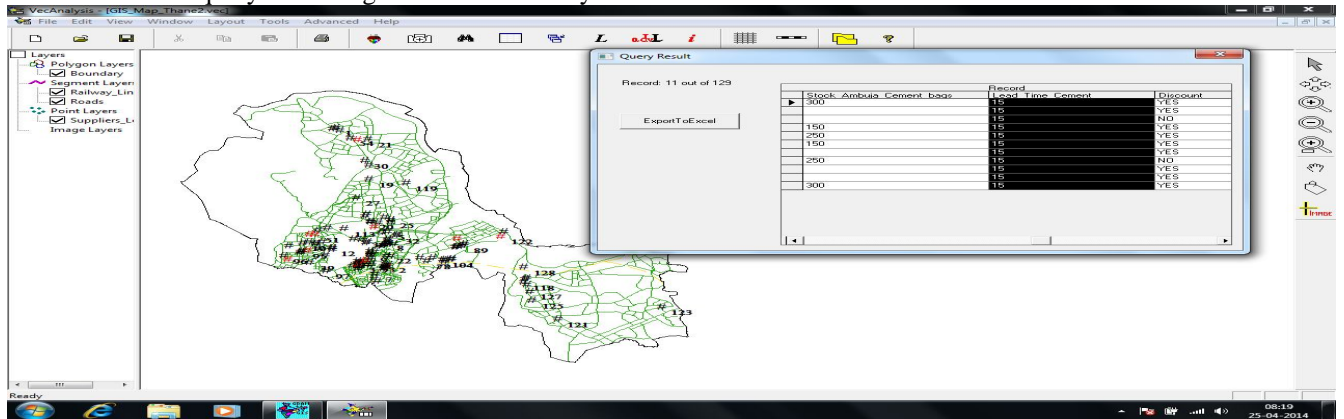


Fig. 4 Detail of Query no. 1

Query no.2

Find out multiple characters of suppliers in one click, use of multiple condition i.e. “Cost of sand < 7300 and lead time <= 24 and query source = Gaymukh and discount = Yes” and result of this query is 6 out of 129 suppliers coming under this condition. This query is important to finding out multiple characters of suppliers in one click. This query gives better idea for ideal supplier as per requirement.

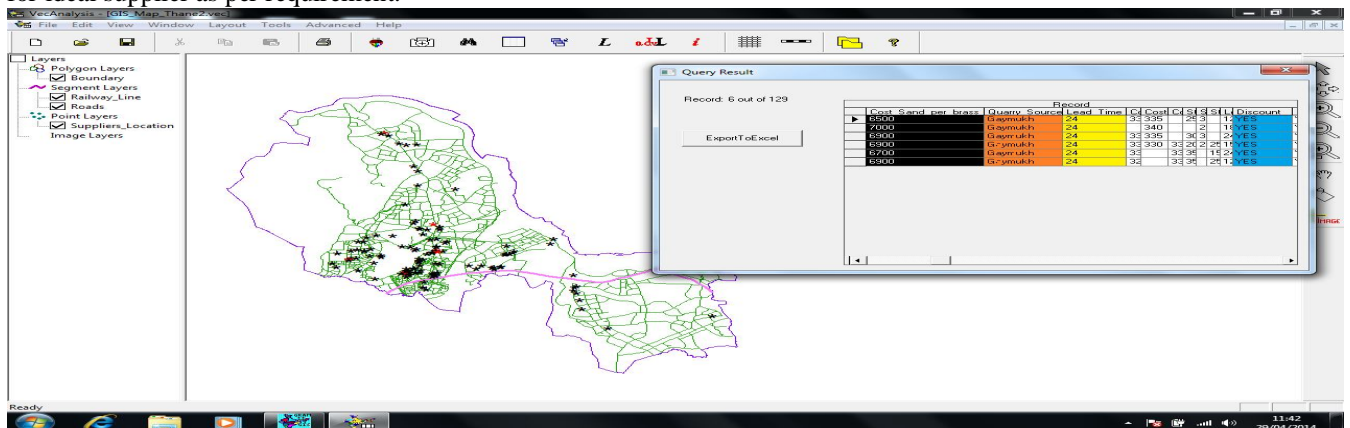


Fig. 5 Detail of Query no. 2

Query no. 3

Find out detail information of any one supplier in one click, for this condition of query is “Name of shop = Daksha Traders” and result of this query shows exactly that supplier with location and all detail information.

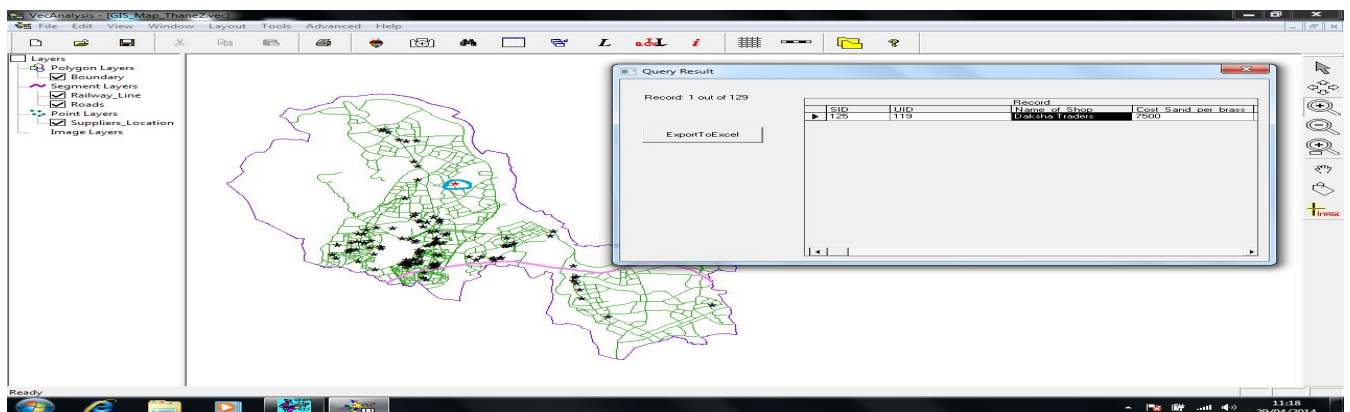


Fig. 6 Detail of Query no. 3



**C. GRAM Network**

GRAM Network is used for to find out shortest route between construction site and suppliers location and to find out nearest and best suppliers among more suppliers.

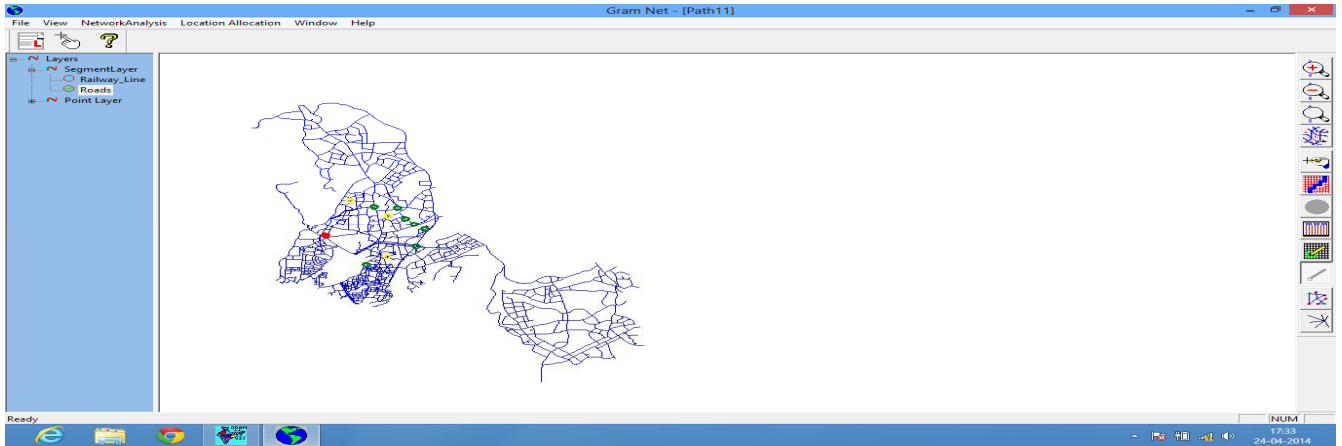


Fig. 7 Image shows finding best of three suppliers by using best supply node operation in GRAM Net.

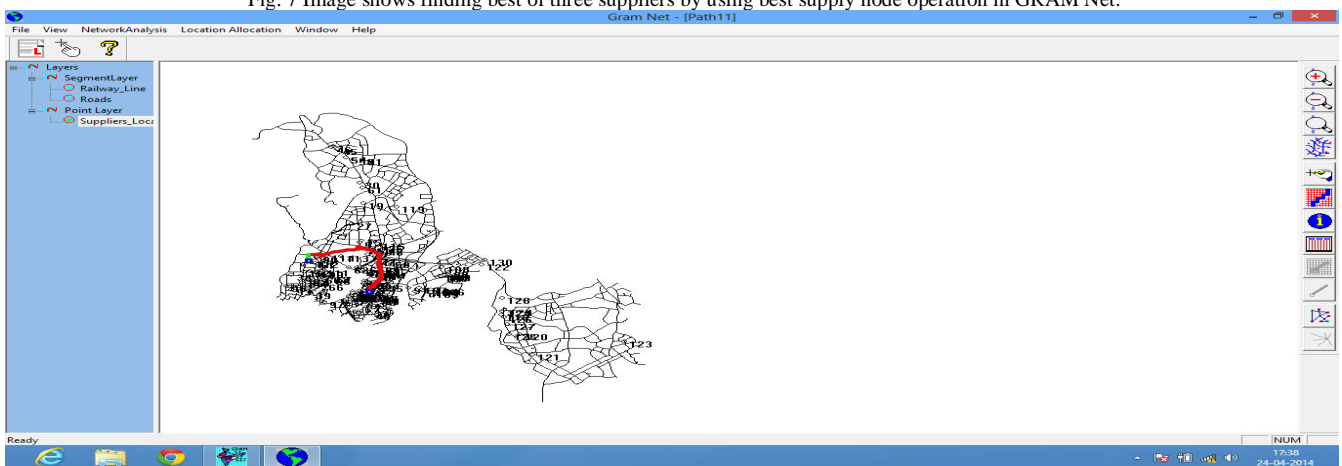


Fig. 8 Combine layers of roads layer and supplier’s location layer and find out shortest route between source and destination using shortest route operation

**V. RESULT**

1. The result of project is there are many method for evaluation and selection of suppliers but all method required all data of suppliers every time. Collection of all data is time consuming process compare to use stored data in GIS.
2. Vector queries gives very helpful and very useful result. Its shows and categorised suppliers data as per requirement and as per condition in very short time. So it helps to reduce the time of supplier selection process and also helps to select best supplier.
3. Gram Network gives best solution for select nearest best suppliers. It also help for finding shortest route between supplier’s location and construction site location.

**VI. CONCLUSION**

Excellent performance of material suppliers is most essential for the smooth obtaining of materials. Supplier evaluation and selection is a usual main issue. The multi-criteria signify both qualitative and quantitative characteristics. Construction company would be able to make the appropriate decision using a tool which is interactive, reliable and affordable. GIS tool is very effective to avoid those problems in very short time to create for supplier selection. And which is very helpful to integrate and categorised supplier’s data.

**ACKNOWLEDGMENT**

I would like to Thanks Thane Municipal Corporation (TMC) Pachpakhadi, Thane for providing Thane city map. I would like to thanks all suppliers for their support for providing data related to construction materials. Also I would like to thanks IIT Bombay for providing the software needed to carry out the study.

## REFERENCES

- [1] Prof. Chetna M. Vyas, K.V. Patel, 2008, "Construction Materials Management on Project Sites."
- [2] Don Amila Sajeevan Samarasinghe, John E Tookey, James Olabode Bamidele Rotimi, and Sivadas Thiruchelvam, 2012, "Supplier Selection in the Construction Material Purchasing Function."
- [3] Bayazit O., Karpak B. & Yagci A., 2006, "A purchasing decision: Selecting a supplier for a construction company." *Journal of Systems Science and Systems Engineering*, vol. 15, no. 2, pp. 217-231.
- [4] Mendoza A., 2007, "Effective methodologies for supplier selection and order quantity allocation." PhD thesis, The Pennsylvania State University, Pennsylvania.
- [5] Kang tsung Chang, 2006, "Introduction to Geographic Information Systems."
- [6] Yong L., Qi W., (2012) "Case study of optimal material supplier selection by the Value Engineering Theory" *Key Engineering Materials*, pp. 887-891.
- [7] Chen X., Zhou XF., Zhang Y., (2011) "Research on building engineering materials supplier selection based on ANP method" *Key Engineering Materials*, pp. 474-476.
- [8] Pi W., Low C., (2005) "Supplier evaluation and selection using Taguchi loss functions" *The International Journal of Advanced Manufacturing Technology*, vol. 26, no. 1-2, pp. 155-160.
- [9] Ho C., Nguyen P., (2007) "Supplier evaluation and selection criteria in the construction industry of Taiwan and Vietnam" *International journal of information and management sciences*, vol. 18, pp. 403-426.
- [10] Aretoulis G.N., Kalfakakou G.P., Striagka F.Z., 2009, "Construction material supplier selection under multiple criteria." *Operational Research*, vol. 10, no. 2, pp. 209-230.