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A GIS Based Approach to Manage Spatial Distribution and Location of Financial Services: A Case Study of ATM Services

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Abstract

Location convenience is an important factor when customers select a financial institution. To stay competitive, banks usually attempt to increase convenience (be as close as possible to customers) by expanding their branch or ATM networks. Using GIS in the arena of finance can be very supportive and cost effective to facilitate location based decisions for financial institutions. For business expansion planning, banks need location-relevant data, and cost effective site analysis to select a new bank branch or ATM location confidently and reliably in a shorten-time cycle. When banks plan to open new branches, they need to consider the data such as the concentration of commercial areas, traffic patterns, workplaces or living places of customers whose demographics and purchase behavior match banks' target customer profiles. In this research, GIS-based approach has been developed to identify suitable location for an ATM network in Perspective of Bangladesh. The newly established banks those have not set up ATM network yet or have very small scale ATM services network can expand their banking services through acquiring partners from existing ATM network of other Banks and simultaneously can construct new ATMs in the most suitable unserved areas. This is how these banks can expand their ATM network more rapidly with a less establishment cost. Also banks, those have large ATM network with some unserved areas, can expand their existing network by reaching to the customers' convenience locations. The paper recommends that the analysis using GIS to find most suitable locations for ATM is better applicable for other cities and towns.

Introduction

Location convenience is an important factor when customers select a financial institution (Mylonakis, et al. 1998; Driscoll 1999). A customer may find a bank convenient, if it has a branch or an Automated Teller Machine (ATM) near his / her residence or workplace. To stay competitive, banks usually attempt to increase convenience (be as close as possible to customers) by expanding their bank and / or ATM networks. Basically, such expansions could be done in at least two ways (Birkin, et al. 2002): by building branches/ installing ATMs in new locations or by acquiring an existing (e.g. competitor, partner, etc.) network. The former option is likely to be expensive and time consuming, so many banks resort to acquiring or partnering already established ATM and / or branch networks (Farhan, 2007).

Geographic Information System (GIS) is widely used and very helpful tool for decision making. In particular, if it involves making a decision related to "location", it requires GIS. GIS makes locational analysis very easy. It makes the analysis simple and precise if the inputs are correct (Khan, 2013). Using GIS in the arena of finance can be very

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supportive and cost effective to facilitate location based decisions for financial institutions.

Objectives and Methodology

The main objective of this research is to determine the existing location of ATM services of all banks and find out the service area of ATMs using GIS analysis.

It is necessary to understand the concepts of GIS, Banking Services, ATM Service, and Location Analysis. Different text and document related to GIS and banking issue help to develop the idea of it. An elaborate literature survey was carried out to have a basic understanding on the relation between the uses of GIS technology and Banking service sector issue. This includes thesis papers, related books, seminar papers, articles, and journals as the important sources of literature review. A selected portion of Old Dhaka City Corporation (21 full wards and 1 partial ward) area has been selected to carry out this research.

A significant portion of greater DMDP area within the study area has already developed with significant number of ATM booths of different banks at different locations. In this research, an extensive GIS database of the selected area has been used to identify existing physical features pattern and land uses of the area. GIS database, which has been used in this research, was prepared by RAJUK under Detail Area Plan (DAP) for DMDP area (590 square miles). Identification of existing locations of all ATMs services can be done by using GPS and by using high regulation satellite image. In this research, satellite based image has used to identify the location of all ATMs within the study area due to lack of time and financial constrain. Questioner survey has been conducted to identify the most preferable service area of an ATM. For questionnaire survey, sample has been collected through random sampling method. And total 30 samples have been collected from ATM users within the study area to satisfy the central limit theorem (CLT). The collected data from questionnaire survey has been analyzed to explore most preferable service area of an ATM. Statistical software (SPSS and MS Excel) have been used to make quantitative analysis on collected data form questionnaire survey. Different Spatial data, like vector data and raster data have been analyzed through developing a GIS Model. Finally, some practical implications have been shown.

Application of GIS in Bank Industry

There have been so many ways to define GIS. An earlier definition of GIS is "a special case of information systems where the database consists of observations on spatially distributed features, activities, or events, which are definable in space as points, lines or areas. A GIS manipulates data about these points, lines, and areas to retrieve data for in particular queries and analyses" (Dueker, 1979). GIS provides acuminous insight of financial services business to know customers' purchasing habits and demands, so that it fixes on the target customers, the target market and the distribution of advertising resources, afterward provides customers with value-added products and services. Geographic models integrate with banking models can offer tangible benefits to the banking sector. Adding spatial locations to bank's customer database via geographical tools can obtain answers to compete effectively. Thus GIS is becoming a critical tool in today's banking environment (Fu, 2007). The importance of location cannot be ignored as argued:

"*You can be the best retailer in the world, but if you set up your shop in the wrong place, you will never do much business. If you operate from the wrong properties, you start with your hands tied behind your back?-you should always go where your customer is" By George Davies* (Davies, 1991).

GIS can help to understand how a potential new branch should be performed. Much information for bank seeking location are needed, for example land costs, building availability and suitability, construction costs, local and state taxes, local and state development incentives, availability and cost of energy, transportation costs to customers, the location and market areas of competitors, and the availability of other infrastructure such as telecommunications, sewer, and water, even the quality of life (Jafrullah, et al. 2003). Using GIS, this various information can be identified and integrated easily. In addition, this information can also be displayed in map formats to demonstrate that the sites meet specified criteria.

For providing an ATM machine to an area, banks need to think different spatial issues. For example, if establishing an ATM in a residential area, then the density of demography should be taken into account; or establishing an ATM in a commercial area, then the concentration of commercial land use should be considered. Also banks have to attach importance to concentration of debit/credit card holders of an area, route for taking money to the ATM etc. These all can be done with GIS without doubt.

According to Thulasi (2007), banks should take into account different spatial components to establish a new bank branch, for example

- Land value, or socio-economic condition to make a general idea of the area for establishing branch.
- The commercial land use of the area.
- Locations of the residential area and business area.
- The road network.

Banks can analyze the performance by using GIS. Spatial components can offer greater advantages for monitoring the branches performance. The spatial distribution of the customers can help bank to draw potential customer zones. GIS may help banks to monitor branches in defining a trade area around the branch, measuring the market potential within the trade area, and finding out the nearby competitors (Jafrullah, et al. 2003).

One of the major services in banking system is to provide loan service to the customers, especially in real estate loan. Banks have to take into account credit risks for making decision regarding if they provide real estate loan to the customers or not. Banks make sanction of loans by evaluating the value of the land, plot, or house. In doing this activity, banks have to analyze the property or plot like current land valuation, the size of the house and so on (Fu, 2007).

After providing a loan, it is better if bank can locate the account holders or loan takers in order to offer other services in the future. Bank is now spending a lot of money on this task (DelFin Analytics, 2005). GIS can make this job easily by profiling and finding customers. Banks need to produce a list of account holders or loan takers, and each in the list should have an address. Here GIS play a role for assigning a spatial identifier to each

account holder or loan takers record such as a postal code, address or census tract and so on, then account holders or loan takers can be identified in the map. Also GIS can help to calculate the distance and present the route from bank or branch to the client's address. This process is known as geo-coding. But for this, the database has to be updated regularly (Fu, 2007).

Experiences of Using GIS in Banks: Global Perspective

The usage of GIS in business areas has been increased in the western countries in recent years (Grimshaw, 1994 and Longley at el, 1995). Banks in Canada use GIS in many kinds of applications. They use GIS to select new branch sites, identify risks for closing a branch, perform targeted marketing campaigns, navigate customers toward their spatial locations, gain better understanding into markets served (Hugh, 2001).

According to Hugh (2001), in 1998, Canadian evaluates the country's largest banking institutions mergers by using GIS. His paper focuses on the ways that GIS based methodologies are applied in the merger evaluation process, particularly in defining market process and estimate market share. The research testifies how GIS can be used for helping a financial plan for competitions related to merger attempts. His research indicates that it is possible to use GIS to define markets through a combination of popular GIS and database software. For example, inspections of branch locations and municipality locations can be converted into a computer program executed in a couple a minutes (Hugh, 2001).

Panigrahi et al. (2003) reports on how to use GIS tools for simplifying the collection management system in banks and financial service organizations. Their paper proposes that an integrated GIS approach enables banks to locate current defaulters, identify the best location for collection boxes and ATMs in various zones, and identify potential defaulters from existing customers who have availed loans and so on. The steps in the methodologies followed in this report are:

- First prepare the city map and road map of the city,
- Then use GPS to locate ATM centers,
- Locate customers using Geo-coding which is a module developed by using Map Objects and VB, subsequently they classify defaulters based on types of credit cards, housing loans and personal loans and so on,

Finally, they analyze the defaulters to find the location of the defaulters and learn information from the defaulters, for instance, methods of collecting money to choose location of the ATM. In the analysis of the defaulters, for example the concentration areas of a particular type of customer can be identified using GIS easily. Also GIS can help to select different types of defaulters depending on the distance from an ATM.

Finally, they conclude GIS is "an effective tool in any discipline with relevance to space, it can be used to identify the location of ATM centers, location of customers, classification of defaulters, and so on" (Panigrahi, et al. 2003). The banks who don't want to lose money from payments of defaulters should have proper strategic planning and good operation managements that the collection management system follows through the latest technology like GIS for revolution of collection process (Panigrahi, et al. 2003).

Finding Suitable Locations for New ATMs

Location of the Study Area

A selected portion of Old Dhaka City Corporation area has been selected to carry out this research. A significant portion of greater DMDP area under the study area is developed with significant number of ATM booths of different banks. The selected wards of old Dhaka City Corporation are ward number 32, 36, 39,40 (Partial), 49, 50, 51, 52, 53, 54, 56, 57, 59, 61, 62, 63, 64, 67, 68, 69, 70 and 71 (Total 22 wards). Total size of the study area is about 10,002.10 square meters or about 100 square kilometer.

Spatial Data Collection

For building a GIS application system, there, first need to have a GIS based database system. This database system includes basic spatial database and integrated database of all kinds of bank network & services. To implement data collection processes, generally a bank should follow following digital survey methods:

- Physical feature survey to collect detail physical feature data like- structure,
- Land use survey to collect land use data of the study area,
- A topographic survey to collect land elevation data (if needed),

Along with digital survey, database can also be prepared from any secondary source, through:

- Scan of the had map document (Must have a spatial reference system for the data),
- Digitize of the map document & creating attribute data,
- GPS Survey to take ground control point (GCP) for making spatial correction.

In this research, spatial database have been collected from DAP (Detail Area Plan) project of RAJUK. Under this project, extensive and detail GIS database has been prepared for greater DMDP area including Dhaka City. Also spatial data for existing ATMs location of the study area have been processed[1] form satellite image. For having limitations in term of time and financial support, Google Earth's data has been used instead of doing GPS survey to collect location data of every ATM within the study area.

Spatial Sketch of the Study Area

The selected study area is the one of the compact and busiest portion of the Dhaka City. Total area of the study area is about 10002.10 square meters. The predominant pattern of land use within the study area is education and research use (about 25 % of total land use), and the second and third focus land use patter are Circulation Network (22.90 %) and Mixed use (19.56 %) constitutively. Land use pattern of the study area is shown in Figure 1.

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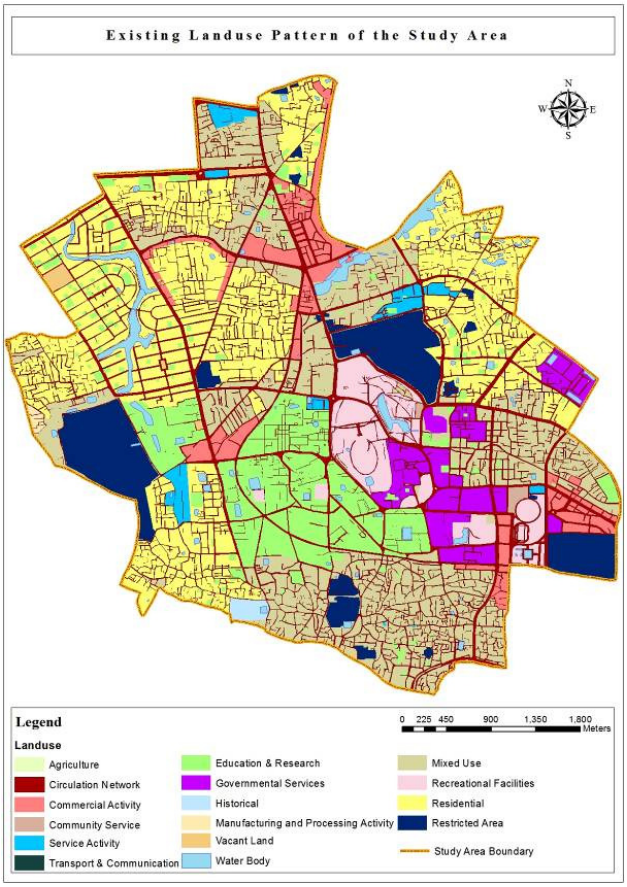
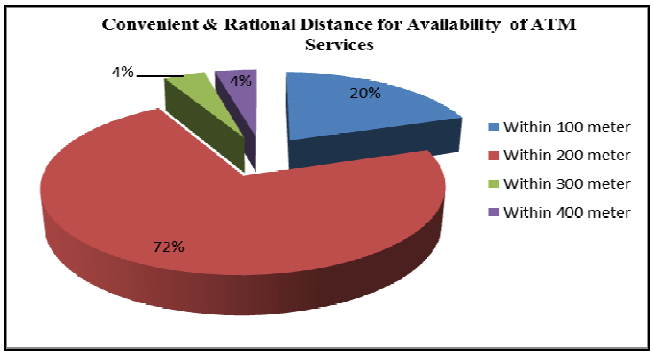
[1] *After collecting .kmz file from Google Earth, Data for all ATMs location has been converted to shapefile by using ArcGIS 10 software.*



Source: Developed by Author, 2014

Figure 1: Existing Land use Pattern of the Study Area



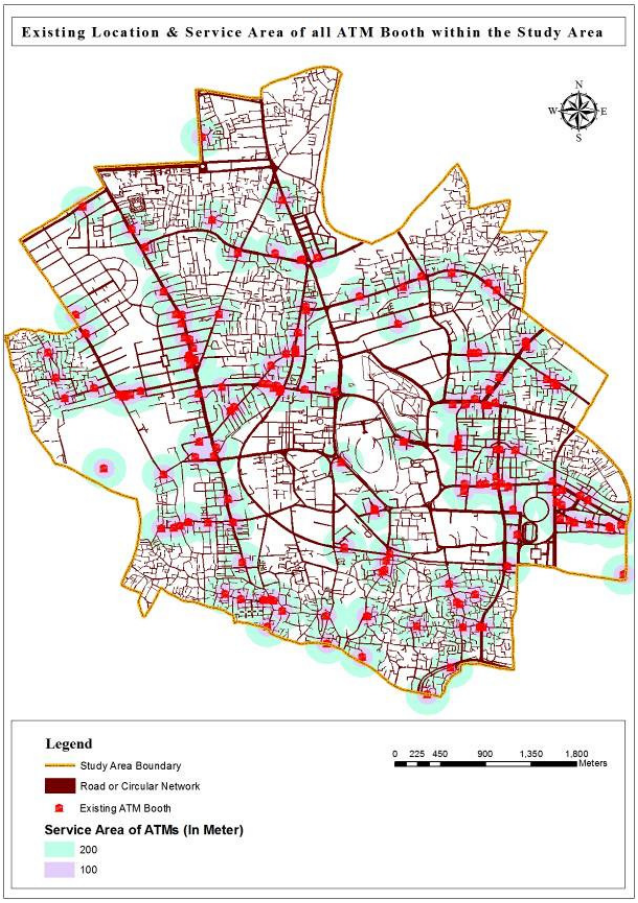
Sources: Field Survey, 2014

Figure 2: Convenient and Rational Distance for ATM Service.

Existing ATMs Location and Their Service Area within the Study Area

It has mentioned earlier that location data for all existing ATM has been collected through using satellite image available in Google Earth. There are a total of 176 ATM booths covering the study area. The highest numbers of ATM booth are under Dutch Bangla Bank Limited to ensure sound financial service and broad network connection. In term of ATM service providing strength, within the study area there are no other bank can develop as like as DBBL except BRAC Bank Limited.

After deriving data form satellite image in .kmz format, these data has been converted into point file (shape file) with detail attribute data for each and every ATM booth. To find the most preferable distance or the service area of ATM, a questionnaire survey was done among 30 respondents. Form the survey; it has been found that (see figure 12), the most preferable distance for the availability of an ATM booth is within 200 meter (72% of the respondents) form their existing standing. The second most preferred distance is 100 meter (20% of the respondents). Existing location and the service area (200 meter and 100 meter buffer) of all ATM are shown in Figure 3.

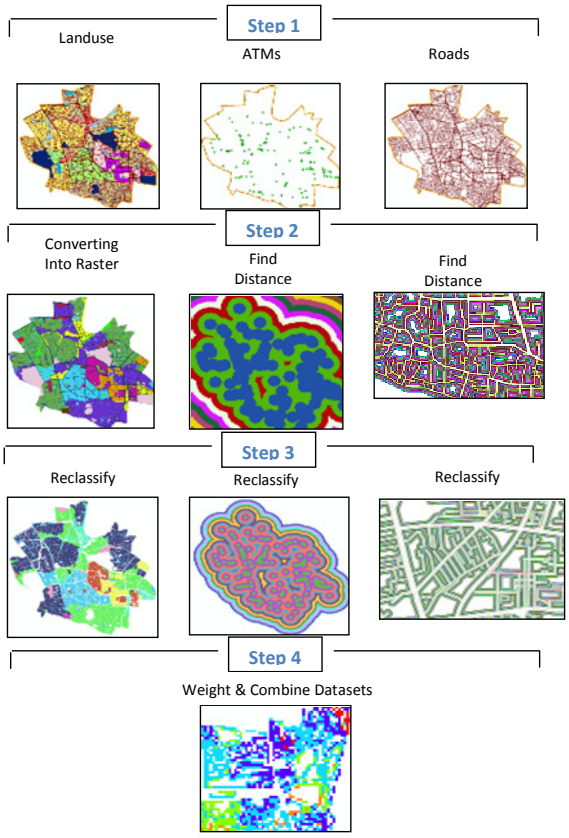


Source: Developed by Author, 2014

Figure 3: Existing Location and Service Area of all ATMs within the Study Area.

Finding New Location for ATM Services within the Study Area

The brief workflow of this GIS analysis is Step 1: Input Datasets, Step 2: Derive Datasets, Step 3: Reclassify Datasets and Step 4: Weight and Combine Datasets. The inputs in this datasets are Land use, Road Network and Existing ATMs. Then, there need to derive Land use in raster dataset, Distance to existing ATMs and distance to roads, then reclassify these derived datasets to a common scale 1-10. Finally, weight them according to a percentage influence and combine them to produce a map displaying suitable locations for new ATM. Figure 4 shows the GIS analysis process at a glance.



Source: Developed by Author, 2014

Figure 4: GIS Working Process to Find Suitable Locations for New ATM.

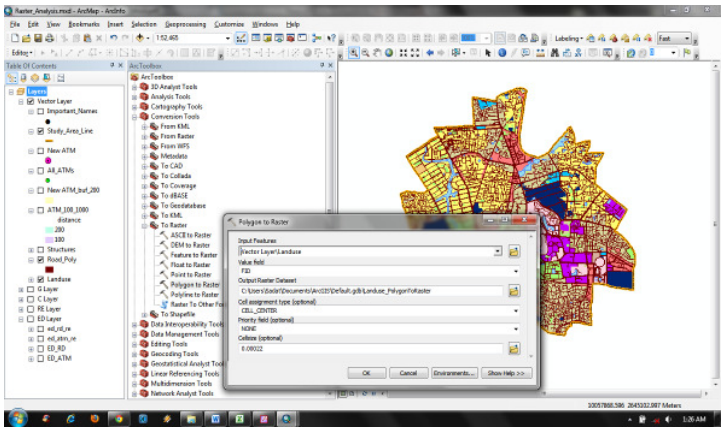
Deriving Dataset for Analysis

Deriving data from the input datasets is the next step in the suitability model. Here need to derive the following:

- Converting Land use Vector Data to Raster Data,
- Distance from Existing ATMs, and
- Distance form Road Network (3m. to 30m.).

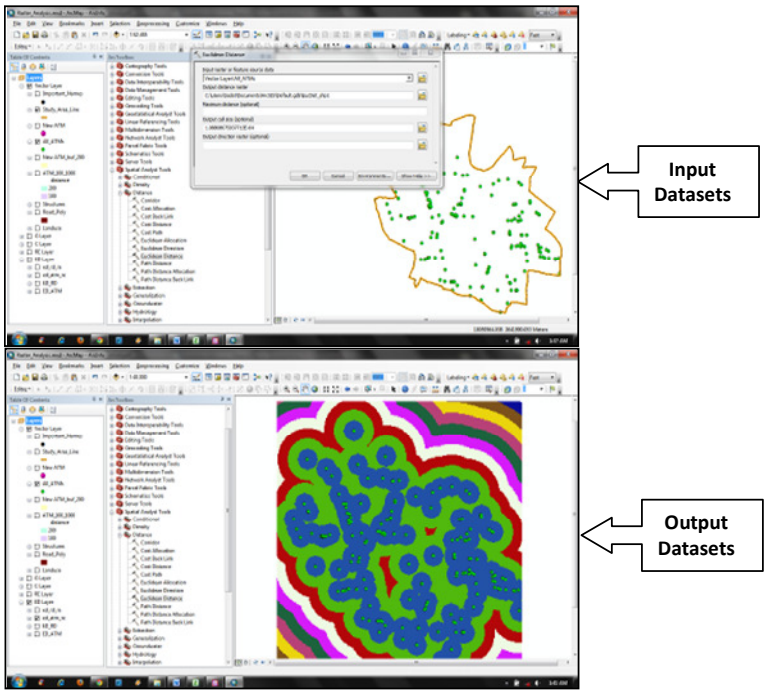
Converting Land Use Vector Data to Raster Data

As here, need to make operations with all raster datasets for the suitability analysis, first of all, land use database of the study area should be converted into raster format from vector format (polygon). By using Conversion Tool (Polygon to Raster) form Arc Toolbox of ArcGIS 10, the land use polygon has been converted to raster (Figure 5).



Source: Developed by Author, 2014

Figure 5: Polygon to Raster Conversion of Land use.

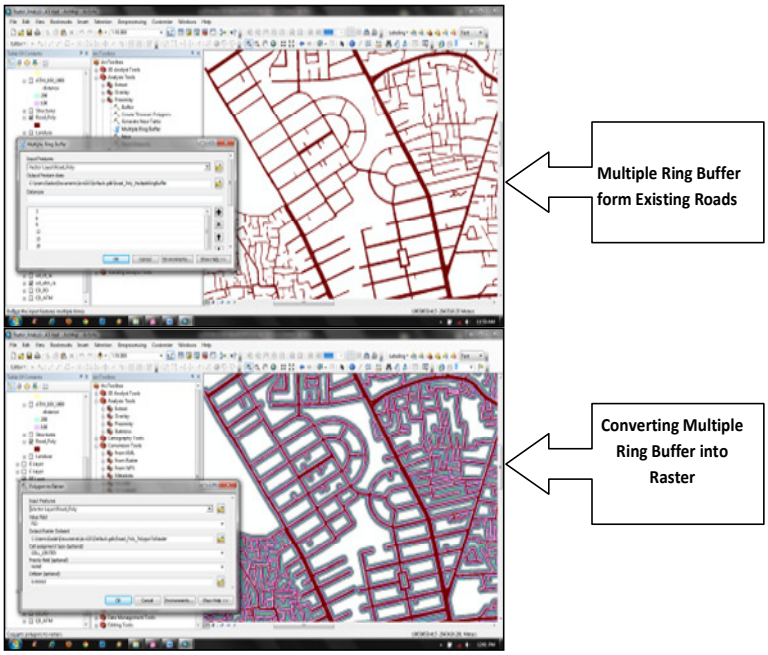


Source: Developed by Author, 2014

Figure 6: Deriving Distance Data from Existing ATMs.

Deriving Distance from Exiting ATMs

It is preferable to locate the new ATM away from existing ATMs. So, here need to derive a dataset of distance from existing ATMs. Spatial Analyst tool is an ideal tool for calculating Euclidean Distance form an input feature (Point data existing ATMs). Figure 7 is showing the input and output dataset for Euclidean Distance analysis of existing ATMS.



Source: Developed by Author, 2014

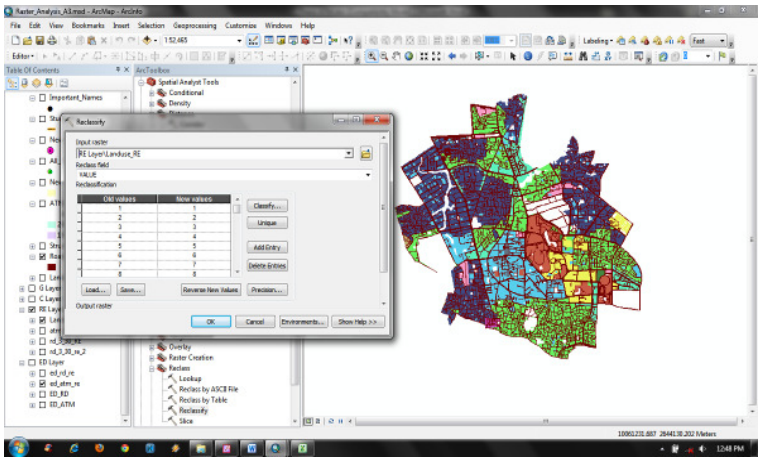
Figure 7: Multiple Ring Buffer Analysis and Converting into Raster.

Deriving Distance from Road Network

One of most suitable and preferable site for location ATM is site closeness to road access. In this regard, Land parcel (within 3-30 meter form road) is considered for locational model. By using Multiple Ring Buffer analysis tool for Arc GIS, the area within 3 meter to 30 meter form the road has been derived. And later on, the Multiple Ring Buffer (Ranging- 3 meter to 30 meter form the edge of road) is converted into raster format to derive desired data of distance (Figure 8).

Reclassification of Datasets

By Deriving dataset, here all required datasets are available to run further analysis for suitability model. The next step is to combine them to find out where the potential locations can be found. In order to combine the datasets, they must first be set to a common scale. That common scale will show how suitable a particular location (each cell) is for establishing a new ATM. Here need to reclassify each data set to a common scale, within the range 1-10.



Source: Developed by Author, 2014

Figure 8: Reclassification Analysis for Desired Data Using Arc GIS 10.

The reclassification parameters for land use, distance form ATMs and distance form roads has been shown in Table 1 and Figure 8. Analysis has been done by using the Spatial Analyst Tool of Arc GIS where the value has been classified according to unique value (for land use and road) and equal interval (for existing ATMs). In the Land use reclassification, the incompatible land uses (like water body, vacant land, circulation network and restricted use) are exclude form the analysis by giving "no data" value.

Table 1: Reclassification Parameter of Land use, Distance form ATMs and Distance form Roads.

Reclassification Parameter of Land use (Raster)										
Parameter	1	2	3	4	5	6	7	8	9	10
Land use	Historical Land use	Government	Education & Research	Recreational	Community Activity	Residential	Service Activity	Manufacturing & Processing	Mixed use	Commercial
Reclassification Parameter of Distance from Road										
Parameter	1	2	3	4	5	6	7	8	9	10
Distance form Road (In meter)	30 meter	27 meter	24 meter	21 meter	18 meter	15 meter	12 meter	9 meter	6 meter	3 meter
Reclassification Parameter of Distance from Existing ATM										
The Most Nearest Cell = 1, To The Most Long Distanced Cell = 10 (Ranging Parameter 1 -10)										

Source: Developed by Author, 2014

Weighting and Combining Datasets and Finding New Suitable Location

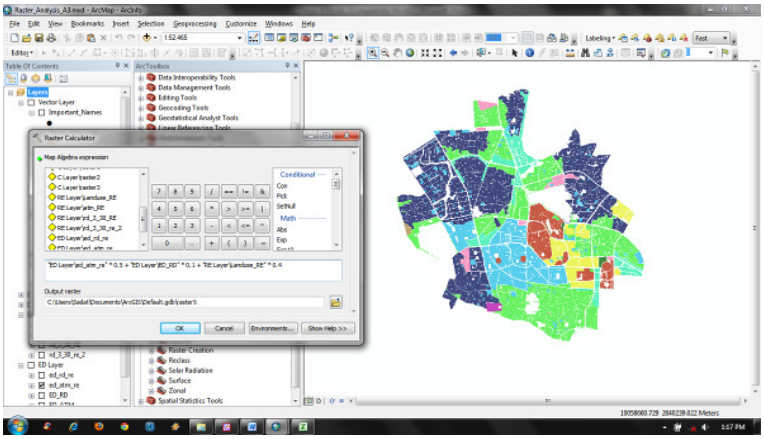
After applying a common scale to the datasets, where higher valued are given to those attributes that are considered more suitable within each datasets, now datasets are ready to combine to find the most suitable locations. This is most preferable to locate a new ATM away from the existing one. This is also noticeable that the need of financial transaction is mostly affected by the land use pattern of that area, as we have seen most financial service points and institutions are agglomerate within commercial area rather that others land uses like residential use. Also good accessibility is required for the convenience of customs of commercial and service organizations. Considering all these factors, the influence pattern is given to each layer (Table 2).

Table 2: Influence Pattern of Each Layer for Weighting and Combining.

Layer	**Influence Pattern***
Reclass of Distance ATMs	0.5 (50%)
Reclass of Distance Roads	0.1 (10 %)
Reclass of Land use	0.4 (40%)
Total	1 (100%)
**Each Percentage is Divided by 100 to nominalize the values*	

Source: Developed by Author, 2014

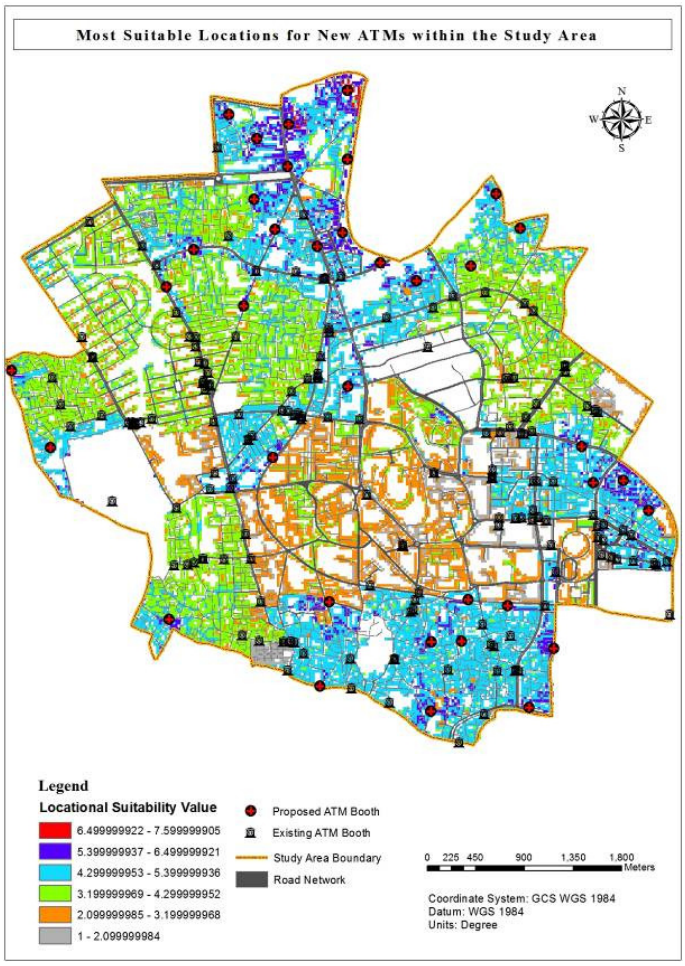
The weighting and combining analysis of spatial datasets are done with the Raster Calculator tools form Spatial Analyst (Figure 9). After doing analysis with Raster Calculator, it creates a new raster map having cell value of 1-8, where value 8 donates most preferable location to value 1 for least preferable location to establish new ATMs within the study Area.



Source: Developed by Author, 2014

Figure 9: Performing Weighting and Combining Analysis with Raster Calculator.

Figure 10 shows the suitable locations for new ATMs after running location model. By considering the most suitable location (Red Cell) and second most suitable location (Blue Cell), there still 36 new ATM Booths can be installed to cover the unserved area. The new locations for ATMs are proposed by considering structural density and use within the study area which is also shown in Figure 10.



Source: Developed by Author, 2014

Figure 10: Most Suitable Locations for New ATMs within the Study Area.

Implication of Location Suitability Analysis for ATM Services

Banks expand their ATM networks basically to keep existing customers or acquire new ones. Expanding an ATM network can be done essentially in two ways: building new locations (organic growth) or by partnering with a retailer. The first option is likely to be costly and can take a long time, so the latter may be a better option. Choosing the "right" partner is not an easy decision to make (Farhan, 2007). Form the findings of the suitability model, there are two important implications for ATM network development.

- For newly establish bank like Bangladesh Development Bank Ltd., Union Bank Ltd., NRB Commercial Bank Ltd., NRB Bank Ltd., Modhumoti Bank Ltd. and all other banks those have not establish ATM network yet or have very small scale ATM services, they can expand their banking services through acquiring partners from existing ATM network developed by other banks and simultaneously can construct new ATMs in the most suitable unserved area. By this way, these banks can expand their ATM network more rapidly with less establishment cost.
- Those banks, which have already large ATM network with some unserved area, can strengthening their existing network by reaching to the customer's convenience location. These type of analysis for finding most suitable locations for ATM is more applicable for other divisional towns, district towns or municipal towns, like Chittagong, Khulna, Rajshahi, Barisal ect.

Conclusion

GIS was instrumental throughout this research. As it is shown in this paper, GIS was used for presenting spatial data, processing spatial data (e.g. performing spatial queries and buffers to determine unserved areas), preparing the data for the spatial optimization model and finally showing the solutions of the optimization model on the map to assure that the model is applied properly, especially for display purposes (i.e. mapping).

For banks, who want to be successful in retail banking business in Bangladeshi competitive environment, it is crucial to make the rational distribution of bank branches or ATM networks according to different customers' attributes and demands. This type of suitability model also can be designed for all other urban areas of Bangladesh to disperse ATM services all over the country. A Strategic Plan can be prepared for all urban areas if possible for the whole country by giving priority in several phases (like 1st Phase ATM development, 2nd Phase Development) for constructing new ATMs. Besides finding location for ATMs, Also suitable locations for bank branch establishment or Mobile Banking Agent/ Point establishment can be found by developing GIS based model. This research has several limitations regarding time and data availability, but this type of modeling can give more realistic results, if we can incorporate density data and income data of any locality in raster format.

References

Birkin, M., Clarke, G. and Clarke, M. 2002. *Retail Intelligence and Network Planning*, England, John Wiley.

Davies, G. 1991. *What Next?*, Arrow, London.

DelFin Analytics 2005. *Look Up for Inspiration*, The Hindu Business Line, in http://www.thehindubusinessline.com/ew/2005/09/26/stories/2005092600220400.htm (accessed on March 10, 2014).

Driscoll, J. 1999. *Bank Wars: Episode 2. The Branches Strike Back*', Bank Marketing, Vol. 31 No. 12, pp. 22-30.

Dueker, K. J. 1979. *Land Resource Information Systems: A Review of Fifteen Years Experience*, GeoProcessing, Vol.1, pp. 105-128.

Farhan, B. 2007. *A GIS-Based Approach for Evaluating ATM Partnership Opportunities*, Palmleaf Ct. Columbus, Ohio, USA.

Fu, Y. 2007. *Managing Customer Services Using GIS in Banks: A Case in Chinese Competitive Environment,* Published Master's Thesis, ISRN: LITH-IDA-D20-07/003-SE, Department of Computer and Information Science, Institutionen för datavetenskap, Linköpings universitet, Sweden, in www.diva-portal.org/smash/get/diva2-23768/FULLTEXT01 (accessed on March 10, 2014).

Grimshaw, D. J. 1994. *Bringing Geographical Information Systems into Business*, Longman, Harlow.

Hamid, M. 1998. *Methods and Techniques of Social Research*, University Press Limited, Dhaka, Bangladesh.

Hanbali, N. A. 2003. *Building a Geospatial Database and GIS Data Model Integration for Banking: ATM Site Location*, Commission IV Joint Workshop: Data Integration and Digital Mapping Challenges in Geospatial Analysis, Integration and Visualization II, Germany.

Hugh, M. E. 2001. *GIS in Banking: Evaluation of Canadian Bank Mergers*, Canadian Journal of Regional Science, Vol. XXIV: 3, pp. 419-442.

Ian, H., Sarah, C. and Steve, C. 2002. *An Introduction to Geographical Information Systems, second edition*, Pearson Education, Harlow.

Jafrullah, M., Uppuluri, S., Rajogadhaye, N. and Reddy, V. S. 2003. *An Integrated Approach for Banking GIS,* in http://www.geospatialwortd.net/article/an-integrated-approach-for-banking-gis/ (accessed on 28 January, 2014).

Khan, M. B. 2013. *Banking GIS - A New Approach in Bangladesh*, Ezine Articles, in http://ezinearticles.com/?Banking-GIS---A-New-Approach-in-Bangladesh&id=332573 (accessed on 28 January, 2014).

Longley, P. and Clarke, G. (eds.) 1995. *GIS for Business and Service Planning*, GeoInformation International, Cambridge.

Miliotis, P., Dimopoulou, M. and Giannikos, I. 2002. *A Hierarchical Location Model for Locating Bank Branches in a Competitive Environment*, International transactions in operational research. Vol. 9, pp. 549-565.

Miller, F., W. Mangold, G. and Holmes, T. 2006. *Integrating Geographic Information Systems Applications into Business Courses Using Online Business Geographics Modules*, Journal of Education for Business, Heldref Publications.

Mylonakis, J., Malliaris, P. and Siomkos, G. 1998. *Marketing-Driven Factors Influencing Savers in the Hellenic Bank Market*, Journal of Applied Business Research, Vol. 14, No. 2, pp. 109-16.

Panigrahi, P.K., Sagar, P. Vijay, R. and Ronald, P. 2003. *GIS-Tool for Simplifying the Collection Management System in Banks and Financial Service Organizations,* Map Asia.

Pick, B. J. 2004. *Geographic Information Systems: A tutorial and introduction*, Communications of the Association for Information Systems, Vol. 14, pp. 307-331.

Sanabria, A. 2010. *Sector Model*, in http://www.lewishistoricalsociety.com/wiki/tiki-print_article.php?articleId=27 (accessed on 10 March, 2014).

Star, J. L. and Estes, J. E. 1990. Geographic Information Systems: Socioeconomic applications, Second edition, Routledge, London.

The Summits of Canada, (2014), *GIS*, in http://www.summitsofcanada.ca/canatrek/expedition/technology-GG-GIS.html (accessed on March 10, 2014).

Three Models of Urban Land Use, in http://www.uncc.edu/hscampbe/land use/bmodels/B-3mods.html (accessed on March 10, 2014).

Thulasi 2007. *Banking GIS - A New Approach in Bangladesh*, Information on Software Developer Tools Articles, in http://developertoolshub.blogspot.com/2007/01/banking-gis-newapproach-in-bangladesh.html (accessed on March 10, 2014).

Virrantaus, K., Markkula, K. J., Garmash, A., Terziyan, V., Veijalainen, J., Katanosov, A. and Tirri, H. 2002. *Developing GIS-Supported Location-Based Services*, in http://ieeexplore.ieee.org/iel5/7824/21513/00996708.pdf (accessed on March 10, 2014).

Wikipedia 2014. www.wikipedia.com, http://en.wikipedia.org/wiki/Realestate-economics (accessed on March 10, 2014).