

# The Impact of using GIS on the Selection of ATM Sites and Their Effect on Profitability

Mahmoud Al-Zyood

**Abstract:** *This paper focuses on the factors that influence the locations of automated teller machines (ATMs) and their impact on profitability using Geographic Information System (GIS). ATM services represent relatively expensive operations for banks, who seek to meet consumer demands with optimum cost efficiency. The increasing availability of computer technologies to study and monitor user behaviors have opened many new areas for banks to streamline their operations, and one novel application is the use of GIS to determine the optimum location of ATMs to meet consumer demand and maintain market competitiveness related to strategic decisions. GIS can help banks to analyze competitors in order to maintain current market share and try to expand in the future for continuity and improve the quality of services provided. This paper undertakes a review of literature related to this topic, concluding that it is important to locate ATMs using the best strategies to achieve bank objectives in the short and long term, and that GIS can greatly assist in this by enabling banks to identify the optimum location for ATMs to meet consumer demand, achieving the strategic aim of maintaining and increasing market share and competition to attract and keep customers and increase profitability. Furthermore, it is recommended that future studies explore the incorporation of social media analytics in banking strategy relative to GIS and the placement of ATMs.*

**Keywords:** ATM, GIS, Profitability, Location

## I. INTRODUCTION

As banks globally seek to restructure their operations in line with the improved communications enabled by modern mobile internet technologies (e.g. online banking and the drift toward a cashless society), great efficiencies have been achieved in terms of streamlining traditional high street operations and empowering customers with modern payment solutions. However, automated teller machines (ATMs) remain an important physical interface between banks and customers, mainly in terms of enabling customers to withdraw cash, but also by enabling a range of other services such as paying utilities and checking balance etc. One of the most important strategies facing banks nowadays is to determine the location of ATMs to have the optimum efficiency from these relatively expensive operations, with impacts on competitive sales strategy, market share and profitability.

Location is often considered as one of the most important factors leading to the success of business ventures in general, and businesses fundamentally derive profits from a good location, from small local coffee shops to the multinational supply chain networks and distribution centers of international manufacturing and retail companies (Environmental Systems Research Institute [ESRI], 2006).

Banks must also pay great attention to the dimension of location, which in a largely homogenized service market can be a major differentiator in determining customer decisions.

The important question arises of the importance of ATM positioning for banks and the impact on profitability and effectiveness relative to the presence of competitors.

An increase in potential sales is possible with a good location, which can attract more customers (Pastor, 1994). Furthermore, in deciding on a financial institution, location convenience is vital factor for customers (Mylonakis et al., 1998; Driscoll, 1999), making ATM location a major facilitator of increased potential sales (Pastor, 1994). When choosing a location for a branch, each bank takes various factors into account, such as the level of income, branch functions, competition, land value, growth potential, and the number of neighboring financial institutions (Nelson, 1960; Chan-Seok et al., 1993). Various criteria need to be taken into account while deciding locations for ATMs, including the number of local businesses and residents, spending level, workforce and lifestyle habits, income levels, ATM purposes, competitor activities and the number and location of proximal ATMs (Quadrei and Habib, 2009).

Population characteristics and population expansion rates are traditional measures of potential demand for banking services (Soenen, 1974; Doyle et al., 1979; Min, 1989). More recent studies have noted the potential of geographic information systems (GIS) based solutions, and banks' deployment of branches and ATMs must include location-relevant data from fast and cost-effective site analysis to confidently and reliably plan strategy, particularly in relation to concentration of commercial areas, traffic patterns, workplaces or homes of customers whose demographics and purchase behavior match a bank's target customer profile (Jafrullah et al., 2003; Kim et al., 2004). Miliotis et al. (2002) found that GIS can successfully model geographical and other information according to the demand area, and discretize sub regions into square blocks. GIS is a unique geographic database that can greatly enhance problem-solving capabilities compared to using simple mapping tools or adding supplementary data to online mapping tools (Kuria et al., 2009).

It is important to locate ATMs using the best strategies to achieve the Bank's objectives in the short and long term, and through the use of GIS the optimum locations can be determined to ultimately promote the achievement of strategic goals, specifically increasing market share by attracting and keeping customers by optimized service provision with higher efficiency.

**Revised Version Manuscript Received on December 14, 2017**

**Dr. Mahmoud Al-Zyood**, Assistant Professor (Finance & Money)  
College of Business Rabigh (COB) King Abdulaziz University, KSA.  
E-mail: [amman2121@yahoo.com](mailto:amman2121@yahoo.com)

## II. LITERATURE REVIEW

Traditional geo-spatial considerations in bank strategy pertained to high centralization of population and commercial activities, with central business districts being the main areas in which ATMs and high street bank branches are located (Carol, 1960). Nelson (1960) identified specific important factors in deciding the feasibility of a location: population, income, branch function, competition, land value, and future development potential. The Huff Model added the non-static factors of traffic hours and the type of traded goods as contributing factors (Huff, 1963).

Customer and branch characteristics are the two fundamental factors in the location of bank services that affect profitability (Sung-Ryong, 1985). Studies have shown that the location of branches of competitor banks in close proximity to those of another institution have an important impact on performance (Clawson, 1974). Consequently, site selection must include situational analysis of the spatial factors and temporal changes, household characteristics, competition, site constraints, local access, parking, visibility and nearby attractions (Jones and Simmons, 1990). Comprehensive analyses must evaluate local demographics, traffic flow and accessibility, retail structure, site characteristics, and legal and cost factors (Ghosh and McLafferty, 1987), along with more consumer-oriented characteristics such as accessibility, ease of travel through roads networks, ease of use parking spaces, and nearness to shopping centers (Clawson, 1974; Avkiran, 1997). One long-term issue in site selection is that removal or redeployment of ATMs due to bad performance may be perceived by existing and potential customers as indicative of problems with the financial institution, causing reputational damage (e.g. negative public relations) (Adams, 1991). Similarly, many studies on bank efficiency include position issues in their models (Boufounou, 1995).

According to Morrall (1996), consumers increasingly demand the ability to conduct financial business at their convenience and at their preferred location. Also, when choosing a bank, personal banking customers tend to place more emphasis on their attitude toward a bank's services and images than business banking customers do (Kim and Nam, 1997). ATMs are a very important aspect of personal banking customer experience, and their locations and ease of use profoundly affect customer perceptions, attachment and brand loyalty (Wambugu, 2001).

Historically, many financial managers or researchers prefer to deal with site selection in an intuitive way, while others have attempted to provide appropriate methodologies (Clawson, 1974; Angelis et al., 1991). A number of studies on bank efficiency incorporate location factors in their models (Boufounou, 1995). There are many researchers and practitioners who gave models for finding the best site-location for competing facilities (e.g. Drezner, 1995; Plastria, 2001; Eiselt, 2002). Kim et al. (2004) found that the geographical characteristics of a location are very significant for customers. The parameters of measuring bank profitability can be divided into credits and deposits (Lee, 2006; Weon, Eui and SikAs, 2010). The time of travelling and distance are very important factors of how easily customers can reach a branch to obtain financial services

and it has been pointed out above that customer investment is subject to distance-decay effects. GIS combines information and mapping systems with analytical and modeling tools, allowing the acquisition, storage, analysis, and presentation of large volumes of geographic and attribute data as well as providing a sophisticated tool for data management; it essentially collates geographical and other information according to the demand area, discretizing sub-regions into square blocks (Miliotis et al., 2002). With regard to banks, according to Miliotis et al (2002), travel time and distance are important measures of how easily customers can reach a branch to obtain financial services and it has been pointed out above that customer patronage is subject to distance-decay effects. GIS is the most promising technology to analyze consumer habits and preferences relative to their geo-spatial location, as explained below:

"(GIS) is a computer-based tool for mapping and analyzing things that exist and events that happen on earth. GIS technology integrates common database operations such as query and statistical analysis with the unique visualization." (ESRI, 1998, cited in Dempsey, 2017)

"GIS is an integrated system of computer hardware, software, and trained personnel linking topographic, demographic, utility, facility, image and other resource data that is geographically referenced." (NASA, cited in Dempsey, 2017).

The core concerns of the banking sector are financial issues related to demographic factors that should be taken into consideration alongside GIS information, such as age, average annual family income, and occupation (Olsen and Lord, 1979; Frerichs, 1990). Financial institutions have increasingly discovered the unique capabilities of GIS as a tool to help them visualize market situations, analyze data, and build realistic models that predict how changes in strategy might affect their business (Harder, 1997, Wambugu, 2001), based on empirical studies of bank locations using GIS (e.g. Park and Lee, 1993; Lee and Kim, 1997). According to Jafrullah et al. (2003) GIS plays an important role in various functional areas of banking in achieving the various business objectives of banks, such as expansion of customer base, improvement in quality of services, increased customer satisfaction, consistent business growth, and increased profitability. As mentioned previously, many factors determine the appropriate location for ATMs or branches such as population density, income level, commercial sector, travelling and distance, current and potential competitors, all of which affect market share, bank efficiency and therefore bank profitability. For these reasons, banks seek to deploy the best and most modern ways to improve the services provided to their clients wherever they are. GIS can be used as a tool to analyze all factors affecting the choice of the appropriate services location to reach a large number of current and potential customers in the future, improve decision-making ability, customer base expansion, and quality of services, customer satisfaction, and ultimately long-term profitability.

### III. ANALYSIS (SOLUTION)

After reviewing the results of many studies using the use of GIS in the banking sector pertaining to the location of ATMs, numerous important factors have been identified from the perspectives of banks and customers. The most important studies are the following:

- Boufounou (1995) found that many studies on bank efficiency include position issues in their models.
- Wambugu, (2001) noted that GIS can be used as a tool to assist in answering questions about locations.
- Jafrullah et al. (2003) identified that GIS plays an important role in various functional areas of banking to achieve various banking business objectives.
- Lee (2006) assessed the branch networking efficiency related to ATM positioning by the size of credits and deposits.

In a highly competitive business environment, banks must minimize loss and maximize profitability while maintaining

the quality of services provided to existing and potential customers, and recognize new markets for their financial products and services. According to Weon, Eui and SikAs (2010), the parameters of bank profitability can be measured by credits and deposits. A number of studies on bank efficiency incorporate location factors in their models (Boufounou 1995). According to Clawson (1974) and Avkiran (1997), additional factors pertinent to bank branch profitability include logistical and technical accessibility, ease of use parking spaces, and nearness to shopping centers. Lee (1985) concluded that bank location affects the size of deposits and profitability.

GIS can help banks to analyze competitors in order to maintain current market share and try to expand in the future for continuity and increased profits, by interpreting data, making it serviceable to strategic planning (as shown in Figure 1).

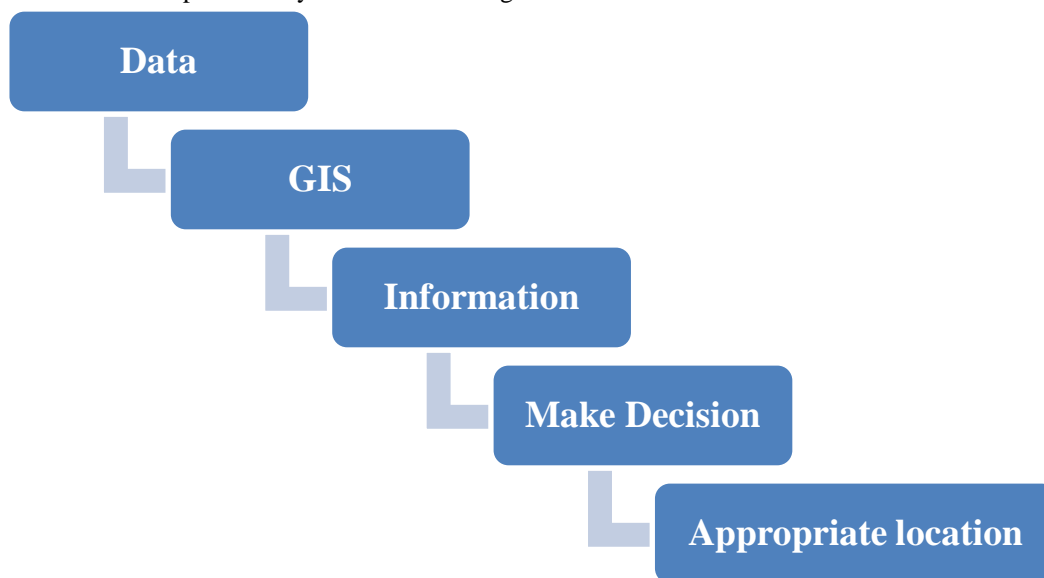


Figure 1: Process of Converting Data To Information using GIS

### IV. CONCLUSION

There is a universal consensus among empirical studies that banks can gain great commercial advantages from the use of modern information systems, enabling them to improve their competitive position by improving the quality of services provided to customers. One aspects of this is the potential use of GIS to make many strategic decisions, especially as the amount of information available to banks from GIS is vast, enabling the optimum deployment of ATMs. Future studies should focus on the impact of information from social media and link this to GIS.

### REFERENCES

1. Fernandes, L. (2007). The location intelligent enterprise: Enhancing business intelligence with location [online]. DM Insights on Location. Available at: <https://www.directionsmag.com/article/2629> [last accessed 26 Oct. 2017].
2. Ismail, W. M. (2001). Geographic information system, demographic spatial analysis and modeling. MSc thesis, School of Housing, Building and Planning, University Science Malaysia. Available at: <http://www.hbp.usm.my/thesis/HeritageGIS/thesis.htm> [last accessed 26 Oct. 2017].

3. Jafrullah, M., Uppuluri, S., Rajopadhaye, N., and Srinatha Reddy, V. (2003). An integrated approach for banking GIS. Business GIS, Map India Conference, March 2003.
4. Lee, H. Y. and Kim, E. M. (1997). The study of bank branch location through GIS techniques: The case of Kang Nam Gu, Seoul. Geographic Information System Association of Korea Publication, 5(1), Serial Number 8, 11-26.
5. Miliotis, P., Dimopoulou, M. and Giannikos, I. (2002). A hierarchical location model for locating bank branches in competitive environment. International Transactions in Operational Research, 9(5), 549-565.
6. Min, H. (1989). A model-based decision support system for locating banks. Information and Management, 17(4), 207-215.
7. Mylonakis, J., Malliaris, P. and Siomkos, G. (1998). Marketing-driven factors influencing savers in the Hellenic bank market. Journal of Applied Business Research, 14(2), 109-16.
8. Olsen, L. M. and Lord, J. D. (1979). Market area characteristics and branch bank performance. Journal of Bank Research, 10(2), 102-110.
9. Zhang, L. and Rushton, G. (2008). Optimizing the size and locations of facilities in competitive multi site service systems. Computers & Operations Research, 35(2), 327-338.
10. Butt, A. I., & Al-Ramadan, B. (2005). Usefulness of Geodemographics & GIS for Banking Sector in Pakistan. Term Paper. pdf.

## The Impact of using GIS on the Selection of ATM Sites and Their Effect on Profitability

11. Basar, A., Kabak, Ö., & Ilker Topcu, Y. (2017). A Decision Support Methodology for Locating Bank Branches: A Case Study in Turkey. *International Journal of Information Technology & Decision Making*, 16(01), 59-86.
12. Genevois, M. E., Celik, D., & Ulukan, H. Z. ATM Location Problem and Cash Management in ATM's. Murphy, R. E. (2017). *The central business district: a study in urban geography*. Routledge.
13. Endro, T., Taher, A., Zainul, A., & Nayati, U. H. (2017). The Influence of Business Location On Competitive Environment, Competitive Strategy, And Rural Banks Performance On The Example Of Bank Perkreditan Rakyat. *Russian Journal of Agricultural and Socio-Economic Sciences*, 65(5) (2017)
14. Paradi, J. C., & Zhu, H. (2013). A survey on bank branch efficiency and performance research with data envelopment analysis. *Omega*, 41(1), 61-79.
15. Paradi, J. C., & Zhu, H. (2013). A survey on bank branch efficiency and performance research with data envelopment analysis. *Omega*, 41(1), 61-79.
16. Farahani, R. Z., Rezapour, S., Drezner, T., & Fallah, S. (2014). Competitive supply chain network design: An overview of classifications, models, solution techniques and applications. *Omega*, 45, 92-118.
17. Sher, F. A. I. S. A. L., TARIQ, M., & JAN, F. A. (2015). Financial performance of banks in Pakistan: a comparative analysis of public and private sectors. *VFAST Transactions on Education and Social Sciences*, 6(2).
18. Franco Halpert, D. (2012). Assessment of the centre of gravity technique for the solution of the facility location problem (Bachelor's thesis, Universidad de La Sabana).